2020

Consultancy Services to Conduct a Social Impact Assessment (SIA) for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements

Appendices – February 2020

KAIRI CONSULTANTS LTD.

An integrated approach to development.

Consultancy Services to Conduct a Social Impact Assessment (SIA) for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements

Appendices

Submitted to:

Secretary, Tenders Committee

National Infrastructure Development Company Limited

The Atrium, Don Miguel Road Extension, San Juan

Trinidad and Tobago

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1 APPENDIX A – STAKEHOLDER ENGAGEMENT PLAN

Consultancy Services to Conduct a Social Impact Assessment (SIA) for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements

October, 2019

CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS PROJECT

STAKEHOLDER ENGAGEMENT PLAN

June 18, 2019

1.1 INTRODUCTION

The proposed Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements Project (herein referred to as the Project) will be located at the intersection between the Diego Martin Main Road and Western Main Road, Powder Magazine, Saint James. The Project is expected to improve access to and connectivity with Port of Spain and the Western Peninsula through to the valley of Diego Martin and Chaguaramas. The improvements would also improve safety for pedestrians and vehicles, especially in the area of the intersection; enhance drainage by addressing deficiencies to the hydraulic capacity and structural condition of the drainage structures within the project area; reduce travel time and traffic congestion and improve road network efficiency.

The Project would involve the preparation of detailed engineering design and construction of:

- A four-lane main overpass over the Diego Martin Highway (providing a new access to Powder Magazine and Victoria Keyes compounds);
- A connector road through Cocorite Farms (that would serve as the main access to the proposed Diego Martin Regional Corporation Administrative Complex and Westpark recreational facilities);
- An access ramp from the Cocorite Farms connector road to the northbound Diego Martin Highway;
- Pedestrian facilities/sidewalks; and
- Associated drainage works, inclusive of the construction of new culverts and the replacement of culverts.

The Project would also widen/re-lane the Western Main Road and Diego Martin Highway from the intersection of Diego Martin Highway to Columbus Circle, Westmoorings. The proposed works would occur within the area that is bounded by:

- The East: Powder Magazine Road;
- The West: The eastern end of the Diego Martin River Bridge on the Western Main Road (the distance between east-west is approximately 5.4 kilometres);
- The North: In the vicinity of Victoria Gardens; and
- The South: Southern boundary of the existing Western Main Road (the distance between north-south is approximately 1.5 kilometres).

1.1.1 SUMMARY OF PREVIOUS STAKEHOLDER ENGAGEMENT ACTIVITIES

The current round of stakeholder engagement for the Project is a continuation of a consultation process started in 2015. To date, the MOWT/NIDCO has conducted two rounds of stakeholder consultations for the purpose of obtaining a Certificate of Environmental Clearance (Application Number CEC5500/12018), during the feasibility and project planning stages. Between March and May in 2015, a series of consultations were held in the form of individual, community group and special interest discussions. The purpose of these consultations was to discuss the views and concerns of stakeholders as part of a feasibility study on the construction of a vehicular overpass at the gateway of the highway network to Diego Martin and Chaguaramas. The results of the discussions highlighted the critical social issues that should be taken into consideration in the preliminary design and location of the overpass.

During the project planning stage, two meetings were held with communities and stakeholders in late 2018 (Meeting 1 on October 23, 2018 and Meeting 2 on November 7, 2018). Participants were provided with information on the proposed project (its objectives, location and activities), along with the information on the anticipated environmental impacts and corresponding mitigation measures. The aim of these meetings was to present and obtain feedback on the preliminary design of the proposed project proposals, allow for meaningful public participation in decision making and ensure all project impacts were adequately addressed.[1] Issues raised by participants at the consultation mainly focussed on the:

- Effect of overpass on local/ surrounding infrastructure: inadequate drainage systems and incidence of flooding, utility relocation, traffic, land encroachment and changes in real estate value;
- Effect of construction and operation of the overpass on human health: respiratory illness and associated medical costs;
- Effect of overpass construction on environment: rivers, air and noise pollution, wildlife;
- Effect of overpass construction and operation on community life: crime;
- Effect of overpass on vulnerable populations: persons with disabilities (impede their movement) and children (safety concerns due to increase of vehicular traffic and the lack of availability of recreation space for children);
- Transparency, integrity and community participation: data integrity, communication with community, consultation with community in making decisions and incomplete or insufficient measures and plans.

Two consultations were organised and held for the social impact assessment; the first was held on July 4, 2019 and the second on September 26, 2019. The issues raised at these meetings were similar. The main issues raised included:

- Effect of overpass on local/surrounding infrastructure – particularly with regard to inadequate existing drainage systems and flooding.
- Change of land use from green space to build development.
- Community health – concerns about air quality and noise level given the close proximity of Victoria Keyes and Powder Magazine Phase 2 to the Diego Martin Highway.
- Public safety concerns particularly for children and persons with disabilities – use of planned vehicular overpass and existing walkovers.
- Stakeholder engagement concerns – non-show of key public agencies; transparency concerns (first consultation).

1.2 REGULATORY FRAMEWORK GUIDING STAKEHOLDER ENGAGEMENT

Within an environmental legislative context, an environmental decision-maker is inevitably responsible for taking into account the public interest (Jeffery, 2002). The public is the most affected segment by the consequences of environmental decisions, and as such should be able to effectively influence the outcome of environmental decisions (Bran, 1996).

[1] NIDCO, 2018. Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements - Public Consultation Report for Certificate of Environmental Clearance (CEC 5500/2018).

NIDCO is committed to planning and implementing the Project and engaging stakeholders in accordance with Trinidad and Tobago's legislative requirements; to adhering to applicable international principles and standards guiding stakeholder engagement; and to ensuring that the Ministry of Works and Transport's and NIDCO's own environmental and social sustainability principles are met.

1.2.1 ENVIRONMENTAL MANAGEMENT ACT (ACT NUMBER 3 OF 2000.)

The social impact assessment (SIA) stakeholder engagement process is in adherence to the country's regulatory framework for meeting environmental requirements for certain development activities. The Environmental Management Authority (EMA) is Trinidad and Tobago's main national government agency responsible for regulating environmental impacts (including socio-economic impacts). The work of the Authority centres on the application of the Environmental Management Act (Act Number 3 of 2000.). According to the Act, one of the environmental requirements of a person (the applicant) planning and implementing development projects is to *apply for and obtain a Certificate of Environmental Clearance* for a range of development activities *(section 62(f))*. Once clearance is obtained the Applicant is expected to *comply with the conditions and mitigation measures in any such certificate (section 62(g)); and comply with all other procedures, standards, programmes and requirements in such a manner as may be prescribed by rule or regulation (section 62(l))*.

The Act empowers the EMA to monitor the environmental performance of the activity (project) *to ensure compliance with any conditions in the CEC, and to confirm that the performance of the activity is consistent with: (a) the description provided in the application for a Certificate; and (b) the information provided in any environmental impact assessment* (section 37).

The Certificate of Environmental Clearance (Designated Activities) Order (Legal Notice No. 103 of 2001) identifies and defines the 44 designated activities that require CECs. Included in those are activities that establish infrastructure for land transportation *(Activity 33) which are defined as*:

(a) *The establishment (inclusive of associated works) of a road of more than 1 kilometre in length.*
(b) *The extensive/expansion (inclusive of associated works) of a road by more than 1 kilometre or by 35 percent or more of its length or width.*

In considering an application, the EMA may ask the applicant for additional information including an environmental impact assessment (EIA) (section 35(4)). Built into this statutory requirement is the need for public participation when an environmental impact assessment is to be prepared. The EIA must be subject to public comment in accordance with section 28 before any Certificate is issued by the EMA (section 35(5)). Section 28 gives instructions on the publication of notices for public comments on the proposed project; the establishment of administration records on the project and EIA; and the responsibility of the applicant and the EMA in receiving public comments. The 2001 Certificate of Environmental Clearance Rules (Legal Notice No. 104 of 2001) also make provisions for stakeholder engagement through receiving comments on the draft TOR (Rule 5); and public access to CEC information, including the EIA in the National Register of Certificates of Environmental Clearance (Rule 9), and public view of the Certificate (Rule 7(2)). The responsibility of the applicant regarding stakeholder engagement is further elaborated in the TOR issued by the EMA in accordance with the Act.

1.2.2 INTERNATIONAL FINANCE CORPORATION (IFC) PERFORMANCE STANDARDS ON ENVIRONMENTAL AND SOCIAL SUSTAINABILITY[2]

Stakeholder engagement for the duration of the project would be guided by the IFC Performance Standards on Environmental and Social Sustainability which provide guidance on how to identify and manage environmental and social risks and impacts. They establish the standards that developers should meet throughout the life of a project. The Standards are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, through stakeholder engagement and disclosure obligations of the proponent in relation to project-level activities.

Performance Standard 1 advocates for a *dynamic and continuous stakeholder engagement process initiated and supported by management, and involves engagement between the client, its workers, local communities directly affected by the project (the Affected Communities) and, where appropriate, other stakeholders.*[3] The Standard supports an ongoing stakeholder engagement process that has the following elements and provide guidelines on each:

1- Stakeholder analysis and planning;
2- Disclosure and dissemination of information;
3- Consultation and participation;
4- Grievance mechanism; and
5- Ongoing reporting to affected communities.

The Standard notes that the nature, frequency, and level of effort of stakeholder engagement may vary considerably and will be commensurate with the project's risks and adverse impacts, and the project's phase of development.

1.3 OBJECTIVES OF THE SOCIAL ENGAGEMENT PLAN

Stakeholder engagement aims to build and maintain an open and constructive relationship with the affected communities and other stakeholders in order to facilitate and effectively manage the environmental and social effects and risks of the Project. The SEP will therefore promote and provide means for adequate engagement with affected communities and other relevant stakeholders throughout the project cycle on issues that could potentially affect them and ensure that the relevant environmental and social information is disclosed and disseminated, as required.

Stakeholder engagement provides the opportunity for the MOWT/NIDCO to:

- To maintain a dialogue with the affected stakeholders on the proposed project, its impacts and the proposed mitigation measures;
- To establish a forum where stakeholders' feedback and concerns can be obtained and effectively addressed; and

[2] International Finance Corporation, 2012. "IFC Performance Standards on Environmental and Social Sustainability." Washington DC: World Bank. Available [online], https://www.ifc.org/wps/wcm/connect/c8f524004a73daeca09afdf998895a12/IFC_Performance_Standards.pdf?MOD=AJPERES

[3] Other stakeholders are those not directly affected by the Project but that have an interest in it. These could include national and local authorities, neighboring projects, and/or nongovernmental organisations.

- Ensure that grievances from affected communities and external communications from other stakeholders are responded to and managed appropriately in a timely manner.

These objectives ensure that the affected stakeholders are centre stage of a transparent engagement process.

1.4 PRINCIPLES OF STAKEHOLDER ENGAGEMENT

This Stakeholder Engagement Plan (SEP) is meant to manage and facilitate the engagement of stakeholders during the social impact assessment (SIA) process and project implementation. The outcomes of implementing the SEP plan during the SIA and feedback from stakeholders during the stakeholder engagement process would shape the recommendations for continued stakeholder engagement that would be included as part of the Social Management Plan. A stakeholder engagement process will be implemented in accordance with the United Nations Evaluation Group (UNEG) principles for stakeholder engagement (Figure 1):

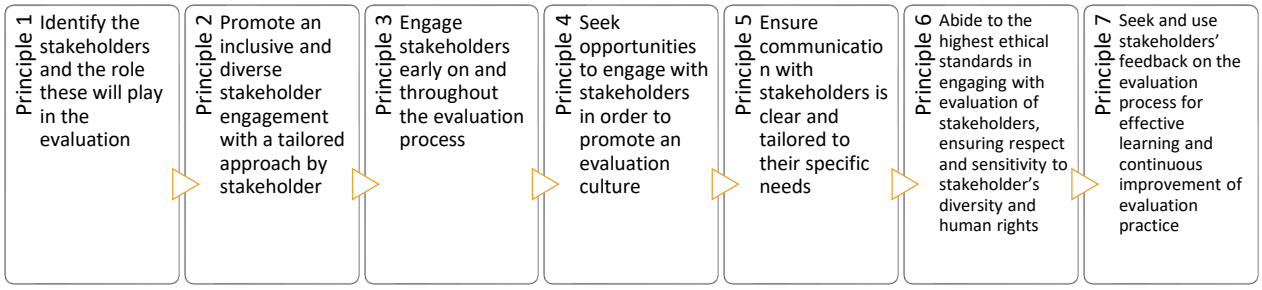

Figure 1: The seven principles of stakeholder engagement, UNEG, 2017

The process for the Project ensures that:

- **Relevant stakeholders** are included in the process including vulnerable persons and groups such as women, the differently abled, the poor and vulnerable;
- Information shared with stakeholders would be **relevant, transparent, meaningful, and culturally appropriate**, in a format and language that is understandable, and found at location(s) that are **easily accessible**;
- **Adequate assistance be provided to those who face barriers** of language, literacy, awareness, cost, or fear of reprisal;
- Stakeholders are **treated with respect at all times and their rights as human are observed**;
- Stakeholder's inputs into the project are **actively sought** and taken on board as part of the SIA process during implementation and for future engagement processes;
- Any procedures used to engage and redress the grievances of stakeholders are widely perceived as **transparent and fair**, especially in terms of access to information and opportunities for meaningful participation in final decisions; and
- The outcomes of the SIA and the grievance redress mechanism (proposals and recommendations) are **consistent with national and international standards**.

1.5 STAKEHOLDER IDENTIFICATION AND ANALYSIS

Stakeholders can be defined as persons or groups who are affected, directly or indirectly, by the project as well as those who may have an interest in the project and/or the ability to influence its outcome, either positively or negatively. The following are MOWT/NIDCO external stakeholder categories for the Project:

1. Locally affected communities or individuals and their formal or informal representative residential associations and local civil society organisations;
2. Sensitive human receptors – schools, health facilities (hospitals), nurseries and early childhood care and education facilities, care facilities for older persons, etc.;
3. Local persons seeking employment;
4. **Transport owners, drivers and operators – Diego Martin Highway and Western Main Road**
5. Local businesses and private sector agencies;
6. Diego Martin Regional Corporation;
7. Local politicians (Local Government Councillors, Members of Parliament and Representatives of the Opposition);
8. The media;
9. **Diego Martin Municipality residents;**
10. Contractors and sub-contractors on the Project;
11. Regulatory agencies (the EMA);
12. Other collaborating agencies (Government, NGOs); and
13. The general public.

The stakeholders are mapped (see Table 1) based on the following factors:

- **Their level of Interest** – How much a stakeholder is concerned about the outcomes of the Project. Are they beneficiaries or will there be negative effects?
- **Their level of Influence** – The degree in which a stakeholder can make or break the Project. For example, through funding, protests, etc.

Table 1: Stakeholders based on level of interest and influence

	Level of Interest	
Level of influence	**High Influence, Low Interest** **Stakeholders that are highly influential, but they do not have a lot of interest in the Project, nor are they actively engaged in it.** i Regulatory agencies ii Contractors and sub-contractors **Action: To be consulted; to be satisfied**	**High Influence, High Interest** Stakeholders have a lot of influence and a strong interest in the outcomes of the Project (Key stakeholders). i Affected communities or individuals, residents' associations, spokespersons ii Local persons seeking employment iii Sensitive human receptors iv Local civil society organisations v Local businesses and private sector agencies vi **Transport owners, drivers and operators** vii Local politicians viii Project site landowners ix The media **Action: To be build relationships and engage regularly in decision making to gain and retain support**
	Low Influence, Low Interest **Stakeholders are on the periphery of the Project. They are neither interested nor have much influence, but this may change with time.** 1) **The general public** **Action: Their involvement to be monitored in the Project; to be kept informed about it.**	**Low Influence, High Interest** **Stakeholders have a strong interest in the Project but very little power to influence it.** i **Municipality of Diego Martin's residents** ii **Diego Martin Highway, Diego Martin Main Road and Western Main Road users (travellers and passengers)** iii Collaborating agencies **Action: To be consulted and kept informed to ensure continued support.**

The full list of stakeholders to be directly or indirectly affected by the Project by their level of interest and influence is provided as Appendix 1.

1.6 PROPOSED STAKEHOLDER CONSULTATION PLAN

The following provides the proposed actions to be conducted as part of stakeholder consultation plan (see stakeholder consultation plan below).

Matrix 1: Stakeholder consultation plan

Stakeholder category	Expected or potential project impact / interest	Level of interest and influence	Characteristics	Engagement plan / events (Update post events, with details)
Affected communities or individuals, residents' associations, spokespersons	Disruption; displacement of community services and infrastructure; traffic congestion and delays; noise and dust during construction; altered transport and travel patterns, etc.	High Influence/ High Interest	▽ 38 communities, 13 residential areas including high- and low-rise housing units; single-family detached units and town houses ▽ 8 residents' associations ▽ 5 community councils ▽ Community facilities and services including1 police station; 1 fire station; 1 community centre; 2 disaster shelters (closest to project site)	**Pre-construction** **<u>Public meetings and community discussions for the SIA</u>** A first public meeting was conducted to provide information on the Project, the SIA approach and methodology, the SEP and GRM, and environmental impacts and risks, and to obtain stakeholder feedback and comments. Focus group interviews with affected communities, human receptors, local businesses and representative agencies (as required) to obtain socio-economic information and feedback on the Project. A second public meeting was held to provide information on the Project, the SIA approach and methodology, social impacts and risks, and mitigation measures; and to obtain stakeholder feedback. **Information disclosure**: **Public Meeting (PM)1:** A short notice (flyer) and a long notice of the public meeting. Both included the date, time and venue of the meeting, and a general statement about the Project. A copy of the long notice to be displayed at the DMRC for a stipulated two-week period. A copy of the flyer to be displayed at popular strategic location places
Local persons seeking employment	Employment opportunities; Employee recruitment biases; perception of employee recruitment and selection system; Occupational safety and health concerns, Labour relations	High Influence/ High Interest	▽ These will include unemployed persons in the neighbouring communities and the Diego Martin Valley and Chaguaramas Peninsula seeking work with project contractors and subcontractors.	
Sensitive human receptors	Disruption, increased noise, dust and exposure to health risks during overpass construction and maintenance	High Influence/ High Interest	▽ 2 hospitals ▽ 1 health care ▽ 2 primary schools ▽ 3 secondary schools ▽ Cocorite community centre (disaster shelter)	
Local civil society organisations	Disruption; increased complaint about the	High Influence/ High Interest	▽ 3 civil society organisations	

Stakeholder category	Expected or potential project impact / interest	Level of interest and influence	Characteristics	Engagement plan / events (Update post events, with details)
	Project and construction activities from membership			such as groceries, gas stations, pharmacies, etc. Takeaway copies of the flyer also made available at these highlighted locations. Invitation letters and copies of the long notice of public meeting emailed to residents' associations and other relevant stakeholders; Newspaper notice of the meeting were published in 2 daily newspapers. PowerPoint Presentation was developed and presented at the public meeting to provide information on the Project, the SIA, SEP/GRM, **PM2**: Same approach to information disclosure to be taken. But instead of preparing a long notice of public meeting, a reader-friendly summary of the main potential social impacts, mitigation measures and monitoring activities was prepared. Copies of this summary were sent to residents' association and other stakeholders; made available at the DMRC and at the public meeting. A second PowerPoint Presentation was developed and presented at the public meeting on the Project, the SIA approach and methodology and results of the impact assessment, mitigation measures and proposals for monitoring project implementation and maintenance, including proposed GRM for project implementation. **SIA Report** was made available for viewing at the Diego Martin Regional Corporation (DMRC) located at 17-18 Diego Martin Main Road,
Local businesses and private sector agencies	Disruption, traffic congestion and delays, noise and dust during project construction, etc.	High Influence/ High Interest	▽ Mainly commercial businesses including 2 shopping malls; 2 gas stations; retail stores; 2 gas stations; an insurance service provider; pharmacies; fitness centres; beauty care; ▽ Trinidad and Tobago Chamber of Industry and Commerce	
Transport owners, drivers and operators	Disruption, traffic congestion and delays, loss in revenue	High Influence/ High Interest	▽ 2 taxi drivers' association ▽ 1 maxi taxi association	
Local politicians	Increased complaint and dissatisfaction about the Project and construction activities from constituents	High Influence/ High Interest	▽ 4 Members of Parliament ▽ 10 Councillors ▽ Local representatives of the Opposition Party ▽ Representatives of minor Political Parties	
The media	Increased complaint and dissatisfaction about the Project and construction activities from the public	High Influence/ High Interest	▽ 3 daily newspapers ▽ 1 online local newsfeed	

Stakeholder category	Expected or potential project impact / interest	Level of interest and influence	Characteristics	Engagement plan / events (Update post events, with details)
				Diego Martin for a period of 30 days, from Wednesday 5th February 2020 to Friday 6th March 2020.Letters were sent to stakeholders who were consulted during the SIA to inform them about the 30-day review period and of the availability of the SIA report at the DMRC. An email address was provided on the letters to receive public comments. **<u>Detailed Planning & Construction Phases</u>** Development and implementation of project Communication Strategy. Address the concerns and if feasible) include inputs of stakeholders in the detailed project design. Continued and regular dialogue with the affected communities (at 30% completed detailed design stage and quarterly thereafter). Implementation of the Grievance Redress Plan – Receive and address grievances and request for information from stakeholder through the Grievance Redress Mechanism.
The regulatory agencies – the EMA	Make a decision on granting a CEC for the Project based on additional information submitted to the EMA.	High influence/ Low interest		**Public Meetings** Two public meetings were conducted to provide information on the Project, the SIA approach and methodology, the SEP and GRM, environmental impacts and risks, the results of the SIA, and to obtain stakeholder feedback and comments. **Information disclosure**:

Stakeholder category	Expected or potential project impact / interest	Level of interest and influence	Characteristics	Engagement plan / events (Update post events, with details)
				Submit questions to the Ministry of Works/NIDCO/EMA. SIA report was submitted to the EMA.
Contractors and subcontractors	Contracts and employment opportunities during construction and operation (infrastructure maintenance)	High Influence/ Low Interest	Contractors, sub-contractors and their workers attached to the Project during construction and maintenance phases	Discussions with firms (NIDCO's responsibility); bidding procedures; inclusion of environmental and social requirements in contract agreements.
Municipality of Diego Martin residents	Possible disruption, traffic congestion and delays, etc. during construction.	Low Influence/ High Interest	▽ 78,594 persons living in the 38 communities of the Diego Martin Valley and Chaguaramas Peninsula	Two public meetings was conducted to provide information on the Project, the SIA approach and methodology, the SEP and GRM, environmental impacts and risks, the results of the SIA, and to obtain stakeholder feedback and comments. **Information disclosure**: Notices of the public meetings were prepared for distribution. Both notices included the dates, times and venues of the meetings, and a general statement about the Project. Copies of the notices along with takeaway flyer (PM1) and a summary document of SIA results (PM2) were displayed at the DMRC for the stipulated periods. Copies of the flyers were displayed and copies for distribution were placed at strategic locations near the project area (as noted above). Newspaper notices of the meetings were published in 2 daily newspapers. **SIA Report** was made available for viewing at the Diego Martin Regional Corporation (DMRC) located at 17-18 Diego Martin Main Road,

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Diego Martin Highway and Western Main Road users (travellers and passengers)	Pre and during construction: Possible disruption, traffic congestion and delays, etc. during construction. Post construction: Improved road network; shorter travel times; better access to home, work & services such as shopping, health. education and medical facilities (particularly for users long Diego Martin Highway)	Low Influence/ High Interest	▽ Residents commuting out of the municipality of Diego Martin who travel outside of Diego Martin and the Chaguaramas Peninsula for work ▽ Individuals from outside of the Municipality commuting in for work, education and leisure	**Public meetings** Two public meetings were conducted to provide information on the Project, the SIA approach and methodology, the SEP and GRM, environmental impacts and risks, the results of the SIA, and to obtain stakeholder feedback and comments. **Information disclosure**: Notices of the public meetings were prepared for distribution. Both notices included the dates, times and venues of the meetings, and a general statement about the Project. Copies of the notices along with takeaway flyer (PM1) and a summary document of SIA results (PM2) were displayed at the DMRC for the stipulated periods. Copies of the flyers were displayed and copies for distribution will be placed at strategic locations near project area (as noted above). Newspaper notices of the meetings were published in 2 daily newspapers. **SIA Report** was made available for viewing at the Diego Martin Regional Corporation (DMRC) located at 17-18 Diego Martin Main Road,

Stakeholder category	Expected or potential project impact / interest	Level of interest and influence	Characteristics	Engagement plan / events (Update post events, with details)
				Diego Martin for a period of 30 days, from Wednesday 5th February 2020 to Friday 6th March 2020.Letters were sent to stakeholders who were consulted during the SIA to inform them about the 30-day review period and of the availability of the SIA report at the DMRC. An email address was provided on the letters to receive public comments.
The general public	To be determined	Low Influence/ Low Interest	National population (2018): 1,359,193 persons Trinidad population (2018): 1.3 million	**Public meetings** Two public meetings were conducted to provide information on the Project, the SIA approach and methodology, the SEP and GRM, environmental impacts and risks, the results of the SIA, and to obtain stakeholder feedback and comments. **Information disclosure**: Notices of the public meetings were prepared for distribution. Both notices included the dates, times and venues of the meetings, and a general statement about the Project. Copies of the notices along with takeaway flyer (PM1) and a summary document of SIA results (PM2) were displayed at the DMRC for the stipulated periods. Copies of the flyers were displayed and copies for distribution will be placed at strategic locations near project area (as noted above). Newspaper notices of the meetings were published in 2 daily newspapers. **SIA Report** was made available for viewing at the Diego Martin Regional Corporation (DMRC) located at 17-18 Diego Martin Main Road,

Stakeholder category	Expected or potential project impact / interest	Level of interest and influence	Characteristics	Engagement plan / events (Update post events, with details)
				Diego Martin for a period of 30 days, from Wednesday 5th February 2020 to Friday 6th March 2020.Letters were sent to stakeholders who were consulted during the SIA to inform them about the 30-day review period and of the availability of the SIA report at the DMRC. An email address was provided on the letters to receive public comments.

1.7 PROPOSED GRIEVANCE REDRESS PLAN

A grievance can be defined as "a real or imagined cause for complaint." The grievance redress or system (GRM) provides an effective process to receive and respond to grievances of affected/concerned stakeholders in an effective and timely manner, and to track the resolution of grievances so that results can be analysed. Such a mechanism forms part of the SEP because it helps to improve stakeholder engagement and ensure continued dialogue with stakeholders affected or concerned about the planning and implementation of the Project. In addition, having an effective GRM also helps to enhance accountability and improve project outcome. The grievance redress plan (GRP), which provides a roadmap for implementation of the GRM, and the GRM user guide are provided in Annex 1. The GRM is a proactive approach to capture and provide satisfactory responses to grievances as early as possible:

1.7.1 GRIEVANCE PREVENTION

Grievance prevention will be a crucial element of the SEP to reduce the chance of minor concerns escalating into unmanageable grievances. Apart from the establishment of the GRM, other measures will be implemented as much as possible to prevent smaller issues from becoming full-blown grievances:

- Work with impacted communities to identify and resolve minor incidents arising from project implementation that could adversely affect stakeholders and delay project advancement.
- Affected stakeholders should be furnished with relevant information in a timely manner to avoid issues that may arise because of the lack of or delayed information sharing on a proposed project and its activities.
- Adapt public consultations to the characteristics of the affected population (including the age, gender, education level and concerns). Meetings will be conducted to ensure facilitators and presenters at consultations are oriented before the events and debriefed to improve future events.
- Sensitise and build capacity of project staff and the facilitators of the public consultation. It is important that the public not made to feel that they are being "talked at." The avenues for dialogue must remain open and the views of the public respectfully and objectively acknowledged.
- Provide periodic reporting to affected communities on the GRM and the Project.

1.7.1.1 APPENDIX 1: STAKEHOLDERS CATEGORISED BY LEVEL OF INFLUENCE AND INTEREST

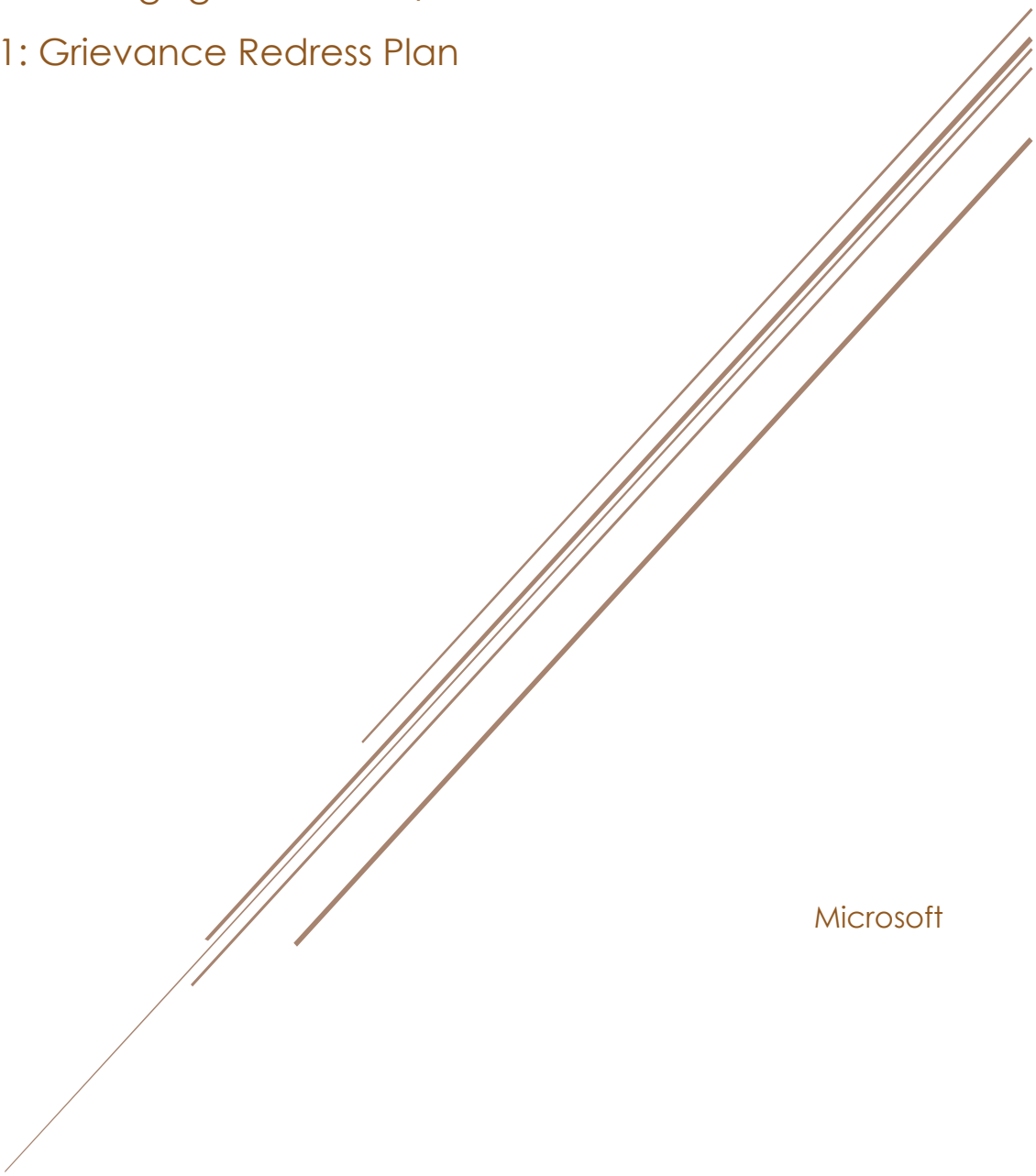
High Influence/Low Interest	
i. Regulatory agencies	1. Environmental Management Authority
ii. Contractors and sub-contractors	
High Influence/High Interest	
i Affected communities or individuals, residents' associations and/or spokespersons	2. Acton Court 3. Bayside Towers Limited 4. Goodwood Gardens Resident Association 5. Goodwood Park Residents Association 6. Hillcrest Drive/Petit Valley 7. Chaconia Crescent 8. New Dimension Four Roads Community Group 9. North Westmoorings Residents Association 10. Powder Magazine Phase 1 Committee 11. Powder Magazine Phase 2 Management Committee 12. Regents Garden Limited 13. Regents Tower 14. Ridgewood Towers Four Roads 15. South Diego Martin Community Council 16. The Glen at Alyce Glen Limited 17. Victoria Gardens Residents Association 18. Victoria Keyes 19. Victoria Villas 20. Westmoorings Gardens Limited 21. Westmoorings South East Limited 22. Cocorite Community Council <u>Other Diego Martin Communities</u> 23. Belle Vue/Debe/Dondonald Hill Community Council 24. Four Roads Community Council
ii Local persons seeking employment	
iii Sensitive human receptors	25. Westshore Medical Private Hospital 26. Community Hospital of Seventh-day Adventists 27. Four Roads Government Primary School 28. The International School of Port of Spain
iv Local civil society organisations	29. Association for Developmental Education 30. Simeon and Environs Women's Group 31. LIFE Centre - Learning Is for Everyone 32. Aster Foundation of Trinidad and Tobago
v Local businesses and private sector agencies	33. Massy Stores- Alyce Glen 34. Massy Stores- Four Roads 35. Massy Stores- Glencoe 36. Massy Stores- Westmoorings 37. Starlite Shopping Plaza 38. The Falls at West Mall 39. Trinidad and Tobago Chamber of Industry and Commerce 40. Peake's Gas Station 41. Four Roads NP Quik Shoppe and Service Center 42. Four Roads Gas Station

vi **Transport owners, drivers and operators (along the Diego Martin Highway and Western Main Road)**	43. Diego Martin/Petit Valley Taxi Drivers' Association 44. North West Regional Taxi Association 45. Public Transportation Service Corporation 46. Route 1 Maxi Taxi Drivers Association
vii Local politicians	47. Member of Parliament- Diego Martin West 48. Member of Parliament- Diego Martin Central 49. Member of Parliament- Diego Martin North 50. Member of Parliament- Port of Spain 51. Port of Spain City Corporation 52. Diego Martin Regional Corporation (DMRC), Glencoe/ Goodwood/ La Puerta 53. DMRC, St Lucien/ Cameron 54. DMRC, Chaguaramas /Pt. Cumana 55. DMRC, Covigne/ Rich Plain 56. DMRC, Petit Valley/ Cocorite 57. DMRC, Bagatelle/ Blue Basin 58. DMRC, Morne Coco/ Alyce Glen
viii The media	59. Daily Express 60. Looptt.com 61. Trinidad and Tobago Guardian 62. Trinidad and Tobago Newsday
Low Influence/Low Interest	
i. The general public	
Low Influence/High Interest	
i. **Municipality of Diego Martin's residents**	
ii. **Diego Martin Highway and Western Main Road users (travellers and passengers)**	
iii. Collaborating agencies	63. Diego Martin Regional Corporation (DMRC) 64. Port-of-Spain City Corporation (POSCC) 65. Housing Development Corporation (HDC) 66. Ministry of National Security, Trinidad and Tobago Fire Service (TTFS) – Four Roads Fire Station 67. Ministry of National Security, Trinidad and Tobago Police Service (TTPS) – Four Roads Police Station 68. Town and Country Planning Division (TCPD) 69. Trinidad and Tobago Electricity Commission (T&TEC) 70. Water and Sewerage Authority (WASA), Water Resources Agency (WRA) 71. National Gas Corporation 72. Telecommunications Communications – FLOW

Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements (CEC5500/2018)

Stakeholder Engagement Plan/

Annex 1: Grievance Redress Plan



Microsoft

Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements (CEC5500/2018)

Stakeholder Engagement Plan/

Annex 1: Grievance Redress Plan

October, 2019

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GRIEVANCE REDRESS PLAN

1. INTRODUCTION

The Grievance Redress Plan (GRP) is a critical component of the Stakeholder Engagement Plan. This Plan is in response to the Terms of Reference (TOR) issued by the Environmental Management Authority (EMA) to conduct a Social Impact Assessment (SIA) of the *Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements* (the Project) for the purpose of obtaining a Certificate of Environmental Clearance (CEC5500/2018). The implementation of the GRP is an important part of mitigating any adverse environmental and social risk likely to occur as a result of project activities or programmes. The Plan provides a roadmap for the implementation of a project grievance redress mechanism or system (GRM) which will address project related-complaints. The TOR therefore stipulates that affected individuals and groups in this project must have access to a *transparent, fair, and equitable mechanism that can act with a degree of independence from the proposed project*.[4]

An effective GRM represents a move towards greater stakeholder engagement and accountability which can ultimately lead to better project outcomes.

In accordance with the terms of reference issued by the EMA for the Social Impact Assessment and the EMA's response for the clarifications on the contents of the Project Grievance Redress Plan, mechanism and procedures must be established and operational throughout the project's life cycle and incorporate the following features:

- An understandable, accessible and culturally appropriate grievance process.
- Appropriately scaled to address project and stakeholder needs.
- A clear and public process for handling grievances.
- Support for transparent decision making.

2. DESCRIPTION OF THE WORKS

Design and construction of a vehicular overpass in the vicinity of Powder Magazine and related road improvements within the approximate boundaries of:

- East: in the vicinity of Powder Magazine Road
- West: the eastern end of the Diego Martin River Bridge on Western Main Road
- North: in the vicinity of Victoria Gardens
- South: southern boundary of the existing Western Main Road

The scope of the Project includes:

- Detailed engineering design of the roads, vehicular overpass and drainage structures, complete with appurtenances and fixtures based on a reference design which takes into account the inputs and concerns of project stakeholders.
- Construction of Works including warranty during the prescribed Defects Notification Period.

[4] *See Section 6.9 (Grievance Redress Plan) Terms of Reference for the Social Impact Assessment in respect of the Application for a Certificate of Environmental Clearance by Ministry of Works and Transport for the Construction of the Diego Martin Overpass and Ancillary Works on 17 Hectares of Land Located along the Diego Martin Highway, Diego Martin. Application Reference: CEC550012018.*

3. OVERVIEW OF THE GRIEVANCE REDRESS MECHANISM

As an important stakeholder engagement tool, a GRM provides *a consultative process* whereby affected stakeholders (individuals, organisations, communities, employees, and others) may raise concerns, dissatisfactions and grievances, whether actual or perceived, to seek timely resolution.

For this Project, grievances can be categorised mainly as complaints, concerns, or dissatisfactions.

It should be noted that requests for general information and answers to general questions on the Project will not be considered as or dealt with as a grievance but will be noted separately and addressed as part of NIDCO's Community Relations function.

Additionally, responses to grievances will be confined to concerns and complaints within the scope of this project.

The goal of the GRP is to channel grievances into a standardised, acceptable, institutionalised mechanism (the GRM) for resolving social and environmental problems and concerns deriving from implementation of the *Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements* Project. The implementation of the full GRM will commence from the design stage.

The Mechanism does not provide access to judicial or administrative remedies such as mediation or arbitration.

4. THE PRINCIPLES OF THE GRIEVANCE REDRESS MECHANISM

The principles governing the establishment and operation of the GRM are in keeping with the principles laid out in the proposed project through the Stakeholder Engagement Plan and the SIA Terms of reference (TOR). The following general principles will guide the design and operation of the GRM.

Accessibility:	The GRM will provide adequate, easy and equal access to all affected individuals and groups seeking resolution to issues arising from the proposed project. Information about its existence and functioning will be made readily available to all stakeholders. This means that the mechanism will be well-known and easily understood by users and potential users. There will be no cost associated with its use.
Credibility:	The GRM will provide well-established procedures to ensure that grievances are handled in a transparent and fair manner. Stakeholders will be kept abreast of the progress of their matters throughout the resolution process.
Fairness:	The procedures from complaint to resolution will be clear and unbiased, providing stakeholders with access to information and opportunities for meaningful participation in addressing their grievances.
Transparency:	The procedures and outcomes for handling individual grievances will be transparent, in an effort to satisfactorily address the public interest concerns. Additionally, the mechanism also allows for confidentiality and anonymity for aggrieved parties.
Predictability:	The mechanism will offer a clear and systematic process with stipulated reasonable time frames for each stage that will deliver workable results.
Capability:	The GRM will be adequately resourced with the necessary technical, human and financial resources to effectively deliver on the commitments of the facility.

5. EXPECTED USERS OF THE PROJECT GRIEVANCE REDRESS MECHANISM

The National Infrastructure Development Company Limited (NIDCO) recognises that its project outcomes and mandates cannot be accomplished in isolation of its various publics. Therefore, NIDCO places significant value on engaging its key stakeholders and the general public.

The SEP identifies a number of stakeholders as important to the proposed project (see section 1.5 of the SEP). It is anticipated that individuals and groups with complaints about the social and environmental performance of the Project will be the ones who will most likely utilise the facility. They will include affected/concerned individuals, groups and communities and businesses.

6. PROMOTING THE PROJECT GRIEVANCE REDRESS MECHANISM

The GRM will be well publicised on the Ministry of Works and Transport's (MOWT) and NIDCO's websites and Facebook pages, and at stakeholder consultation meetings.

7. ADMINISTERING THE PROJECT GRIEVANCE REDRESS PLAN

A Community Relations Officer (CRO) has been tasked with the responsibility for ensuring that project complaints are resolved in collaboration with a Project Management Officer (PMO) and other key personnel. The CRO will be located at NIDCO's Head Office, The Atrium, Don Miguel Road Extension, San Juan between the hours of 8:00am and 4:00pm.

8. STEPS OF THE GRIEVANCE REDRESS MECHANISM

The process consists of six steps:

1- Receive complaint;
2- Review and officially acknowledge complaint;
3- Assess and assign responsibility;
4- Investigate complaint;
5- Resolve and officially respond; and
6- Implement, monitor and close-out.

Figure 1 gives the steps in the Project GRM for addressing complaints. It should be noted that depending on the nature of the complaint, it may be possible to address some complaints and close off the redress process during its early stages.

Depending on the complexity of the complaint, the aim of the GRM will be to resolve all complaints within sixty (60) working days of receiving the complaint.

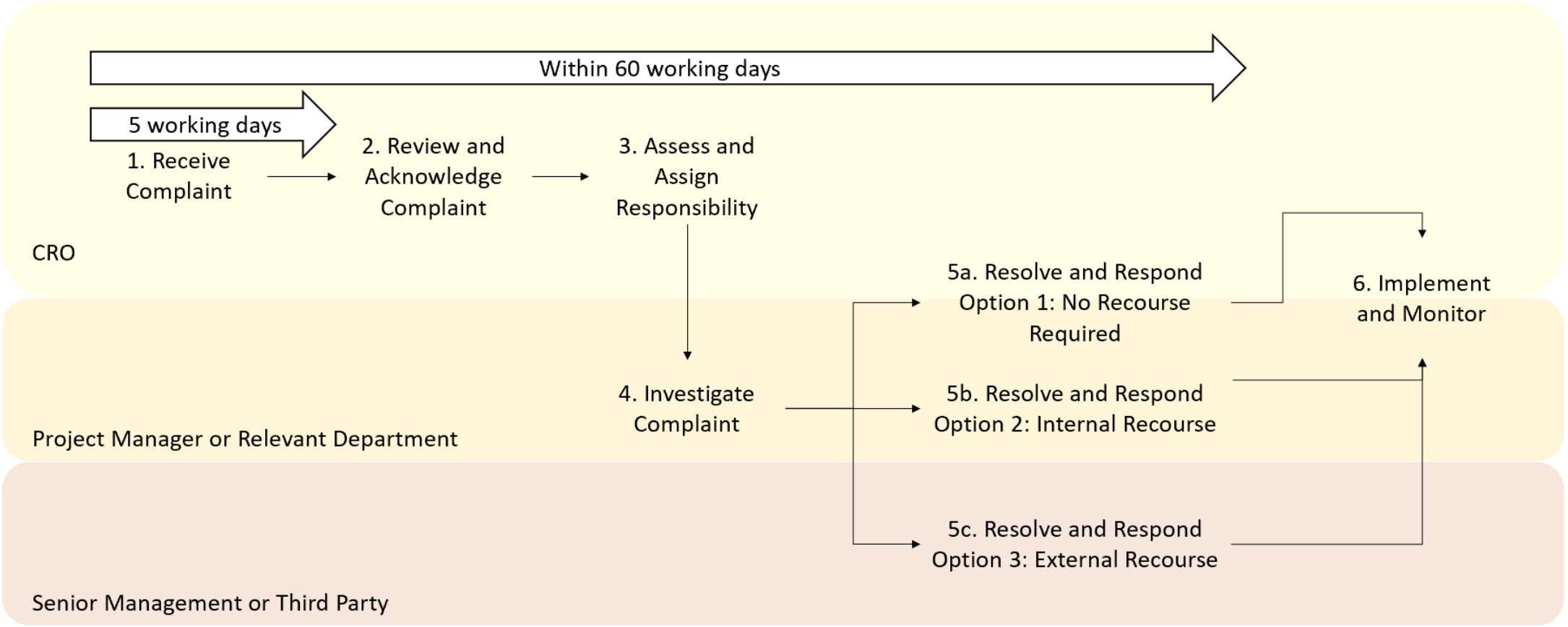

Figure 2.1: Steps and Organisational Level in the Grievance Redress Process

2.1.1.1 STEP 1: RECEIVE COMPLAINT

Complaints may be submitted through the channels provided in the figure below:



Figure 2.2: Available Project GRM Channels for Receiving Stakeholder Complaints

In submitting a grievance, the complainant will need to supply adequate information for the complaint to be registered. As part of this initial step, a grievance form provided must be completed by the complainant.

The standard grievance registration form will gather information on:

- the complainant (name and contact information);
- the nature of the grievance (when and where the project activity or incident(s) occurred) and its impact; and
- suggestions for resolving the grievance.

The sample grievance registration form (see Attachment A) will be made available on the NIDCO and MOWT websites and Facebook pages. The complainant will have the option of submitting a complaint anonymously or alternatively, providing their name and telephone contact.

The complainant will be given a receipt to verify that their complaint form has been received and within five (5) working days, an acknowledgement letter will be issued to advise that the complaint is being investigated.

Once a grievance is received, confidentiality will be maintained, and grievance details will be provided only to those directly involved in the investigation.

2.1.1.2 STEP 2: REVIEW AND ACKNOWLEDGE COMPLAINT

All complaints will be inputted into an electronic grievance management information system operated by NIDCO. The complaints entered into the electronic database will be updated frequently. Proper record keeping of grievances in the database will include:

i. A reference number;
ii. Name of the complainant (if the complaint is not anonymous); and
iii. Complainant contact information.
iv. Date and time of submission of the complaint;
v. Preferred mode of communication;
vi. Type of complaint (environmental, health and safety; worker relations, etc.);
vii. Date and time of the grievance occurred;

viii. Complaint details
ix. Complainant's suggestion on how the complaint should be resolved.
x. Investigative details (approach and methods)
xi. Results of investigation – cause; effect, reach and resolution options;
xii. Description of response/follow up action;
xiii. Target vs actual completion date;
xiv. Closing date of the claim;
xv. Action taken on the claim, i.e. resolved, dropped or under investigation by external body; and
xvi. Evaluation of process and outcomes.

The complaint will be categorised on the basis of the type of complaint as follows:

1. Complaints that fall within the scope of the Project GRM.
    - Level 1: Complaints which will not require investigation (bringing emerging issues and concerns to the attention of the CRO and these will include project-related queries, comments and request for information); or
    - Level 2: Complaints which will require investigation.
2. Complaints falling outside the scope of the Project GRM which will not be addressed by this GRM.

Once the complaint falls within category 1, Level 2, the complaint will be officially acknowledged within five (5) working days along with the following:

i. The reference number for the grievance case;
ii. An overview of the steps involved in the grievance redress process; and
iii. The contact information of the CRO.

In cases where the grievance falls outside of the scope of the GRM, this will be communicated to the complainant in the acknowledgement letter, and a recommendation can be made by the CRO on the relevant agency to address the grievance.

2.1.1.3 *STEP 3: ASSESS AND ASSIGN RESPONSIBILITY*

Once logged and acknowledged, the nature of the grievance will be assessed by the CRO. Project-related complaints will now be priority rated based on type and severity. This will also determine the department assigned to investigate and resolve the specific case. The CRO will determine the relevant department to be involved in conducting and managing the investigation after the conduct of a rapid assessment.

Within twenty-four (24) to forty-eight (48) hours of officially acknowledging the grievance, the complaint will be classified and prioritised by its level of severity (low, medium, high).

- **Level 1 priority (low)**: Grievances that cause minor inconvenience, discomfort and aggravation. This could include complaints:

    i Construction noise;
    ii Construction dust,
    iii Water pollution;
    iv Minor service disruption;
    v Vibrations from equipment use;
    vi Increased traffic congestion; and
    vii Flooding that falls within the scope of the Project.

Priority 1 grievances may not need to go beyond this step and can potentially be 'closed-out' or satisfactorily addressed after an initial assessment by the CRO. It is important to keep the complaint on file in the event that the level of priority of this type of complaint increases. .

- **Level 2 priority (medium)**: Grievances that cause inconvenience, adverse livelihood effects or low-level safety risks to the complainant or any other individual, group or community. These include:

    i. Temporary loss of access to a facility or establishment;
    ii. Damage to equipment used for livelihood activities; and
    iii. Increased risk for trips or falls on level ground.

- **Level 3 priority (high)**: Grievances that pose an immediate risk to the health and safety and well-being of the complainant, other individuals, group or community such as

    i. Health concerns arising from project action;
    ii. Major service disruption;
    iii. Damage to person/property caused by construction activities; i.e. negligence, not adhering to OSHA Health and Safety Standards;
    iv. Reports of health and safety conditions that pose an imminent danger;
    v. Illegal activities; and
    vi. Damage to critical public infrastructure.

All grievances will be submitted to the CRO through the channels outlined in Figure 2.

The CRO will then assign the grievance to the Project Manager for this specific project or the relevant department for investigation.

Precaution will be taken to expedite all grievances as quickly as possible without compromising the investigation. This is to ensure that a delayed response does not itself become a grievance. In cases where a grievance falls outside the scope of the Project GRP, for example, grievances unrelated to the Project or where the complaint will be referred to the appropriate agency for handling. This will be communicated to the Complainant in an updated acknowledgement and no further action will be taken.

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2.1.1.4 STEP 4: INVESTIGATE THE COMPLAINT

The investigating team will aim to complete the investigation of a complaint within 30-60 working days of the start of the investigation, depending on the complexity of the complaint. The CRO will notify the complainant of the estimated time to completion of the investigation.

The CRO will bring the grievance case to the attention of senior management for escalation if the investigation timeline has not been kept. It should be noted that in the case where a Policy Decision must be taken on a specific matter, NIDCO will acknowledge the grievance; however, the timeframe for the response will vary dependent on the finalisation of the policy decision.

Throughout the investigation process, the case will be updated in the grievance management database and the complainant will be kept informed on progress. If a response cannot be provided within an agreed period, an updated time frame will be estimated and communicated to the complainant.

2.1.1.5 STEP 5: RESOLVE AND OFFICIALLY RESPOND

Option 1: No Recourse Required by Complainant

Once the investigation is complete, the CRO will officially write the complainant on the solution. The complainant will be given five (5) working days to officially notify the CRO in writing whether they have accepted or rejected the preferred response. Once the solution is accepted by the Complainant, the solution will be implemented.

If the solution is rejected outright by the complainant, the next stage of resolution will be implemented.

Option 2: Internal Recourse Only

Once the investigation is complete, the CRO will officially write the complainant on the solution. The complainant will be given five (5) working days to officially notify the CRO in writing whether they have accepted or rejected the preferred response.

Once the solution is rejected by the complainant, the CRO will provide an opportunity for the complainant to seek recourse. The complainant will be invited to meet with representatives from NIDCO, MOWT and any other relevant agencies to resolve the complainant. At least one representative attending the meeting will have some degree of independence from the project.

The CRO will officially write the complainant on the solution. The complainant will be given five (5) working days to officially notify the CRO in writing whether they have accepted or rejected the preferred response. If the outcome of the internal recourse is rejected outright by the complainant, the final stage of resolution will be implemented.

Option 3: External Recourse

Should the Complainant be dissatisfied with the solution provided after seeking internal recourse, they will then become entitled to lodge a complaint to the Office of the Ombudsman or to raise the matter before the Environmental Management Authority.

2.1.1.6 STEP 6: IMPLEMENT, MONITOR AND CLOSE-OUT

Once a resolution has been agreed or a decision made, the final stage will be to implement the decision, monitor outcomes and close out the grievance. Follow-up may also be needed to address problems that develop during implementation of the response. Adjustments may be necessary to ensure that the root causes of complaints are addressed, and outcomes are consistent with the spirit of the original agreement with the complainant. Experience from the follow-up can also be used to further refine the grievance handling process or to inform future responses to similar grievances. The CRO is responsible for daily implementation of the Project GRP and for coordinating and overseeing the Project GRM with the support of Project and NIDCO staff.

9. MANAGEMENT FRAMEWORK FOR THE PROJECT GRIEVANCE REDRESS MECHANISM

A GRM is a business process and therefore it requires resources, clarity on roles and responsibilities, and systems to track and assess performance. It needs a management framework with an enabling policy/standard, standard operating procedures, qualified personnel with defined roles and responsibilities, appropriate resources and an assurance process. Equally important are management, commitment, and a company culture that is supportive of addressing complaints.

The GRM has several significant roles and decision-making points. Table 1 shows the areas of responsibilities with options for appropriate lead personnel.

Table 2.1: Lines of responsibility

Who is responsible for …	**Personnel Responsible (Options)**
Serving as the custodian for the project GRM?	Senior management
Accepting a complaint or grievance?	CRO
Capturing and recording the complaint in a centralised database?	CRO
Providing the initial receipt (proof of submission)?	CRO
Providing the acknowledgement letter?	CRO
Conducting the initial screening?	CRO
Assigning the case to the Project Manager or a particular department?	CRO
Assigning an investigator in the department?	Head of the Assigned Department
Leading the investigation?	Project Manager or assigned Officer from the concerned Department
Keeping the complainant informed during the investigation process?	CRO
Escalating a case internally if investigation timelines are not kept?	Head of the Assigned Department
Ensuring the investigation is completed within the designated time frame?	Head of the Assigned Department (reminders from the CRO)
Proposing the company response?	The investigator with the complainant
Agreeing on the company response?	CRO (for easy cases)

Who is responsible for …	Personnel Responsible (Options)
	Project Manager or Head of Relevant Department
Discussing the company response with the complainant?	CRO
Triggering a recourse/appeal mechanism?	The complainant
Closing a complaint if the complainant cannot be found?	The CRO along with the NIDCO Legal Department
Representing a case that is escalated to court?	NIDCO Legal Department
Paying compensation costs (if applicable)?	Outside the scope of the Project GRM

10. MONITORING AND EVALUATION OF THE GRIEVANCE REDRESS MECHANISM

Monitoring the performance of the GRM is critical to its success. The following provides a number of suggested key performance indicators (KPIs) that help measure the performance of a mechanism and usage patterns:

- Number of new and closed cases;
- Percentage of cases that were not acknowledged within the specified time frame
- Trends in grievances by type;
- Trends in grievances (study area versus external areas);
- Trends in grievances per department;
- Trends in grievances per contractor and subcontractor;
- Average resolution time;
- Proportion of true versus false claims;
- Number/percentage of company decisions that are being challenged;
- The number of stakeholders who came back after 15 days of resolution monitoring period stating they are not satisfied with the resolution;
- Trends in repeat grievances associated with the same department; and
- Trends in non-conformance of company departments with the time frame for investigation.

ATTACHMENT 1: GRIEVANCE SUBMISSION FORM

GRIEVANCE SUBMISSION FORM			
Instruction: Please read the form carefully and fill the spaces provided below with the relevant information pertaining to your complaint. Please ensure that your email address and contact number are clear and easy to read.			
Submission Date:			
Reference No:			
Complainant Information			
Complaint submitted on behalf of:	❑ **Self**	❑ **Other Individual** **Name of Individual:** _____	❑ **An Organization** **Name of Organization:** _____
Full Name: Note: you can remain anonymous if you prefer or request not to disclose your identity to the third parties without your consent	**First Name:** **Surname:** ❑ **I wish to raise my grievance anonymously** ❑ **I request not to disclose my identity without my consent**		
Contact Information: Please mark how you wish to be contacted (mail, telephone, e-mail).	❑ **By Mail: Please provide mailing address** _____ _____ _____ ❑ **By Telephone:** _____**Alternative:** _____ ❑ **By E-mail:** _____		
Description of Grievance			
Date and time of incident:	❑ **One-time incident** **Date:** _____ **Time:** _____ ❑ **Happened more than once** **How many times?** _____ **Date and time of last occurrence:** _____ ❑ **On-going** (currently experiencing problem)		
Description of Incident:	**Who was affected?** (Number of people, communities, organizations affected): _____ **Where did it happen?** (Location): _____ **What happened?** _____ _____ _____ _____ **What is the effect of the incident?** (Impact on people and/or environment): _____ _____ _____ _____		
Supporting evidence:	Include names of witnesses, photographs, reports, etc.		
What would you like to see happen to resolve the problem?			
Signature:			

CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS PROJECT

GRIEVANCE REDRESS MECHANISM USER GUIDE

This user guide provides persons and groups adversely affected by the (proposed) Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements Project with information on how to access and use the project Grievance Redress Mechanism (GRM). It provides a facility for stakeholders to have their complaints and concerns addressed in a transparent, fair and equitable manner. The GRM will operate throughout the planning, design and construction stages of the proposed project.

What is a grievance?

A grievance is a statement (either verbal or written) that an impact or effect arising from a project activity is either unsatisfactory or unacceptable to a complainant or action that has adversely affected the rights, health and/or well-being of individuals, groups or communities.

What is the Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements Project Grievance Redress Mechanism?

The Grievance Redress Mechanism provides affected stakeholders with a process by which their complaints and grievances can be raised and promptly addressed. The Mechanism allows for receipt of complaints/grievances, facilitation of investigation, addressing of the complaints and information on the status of redress.

Who can report and seek redress?

Individuals, communities, groups, businesses, institutions and other stakeholders affected by the Project.

How can I file a complaint?

Complaints and grievances may be reported verbally or in writing using the Grievance Reporting Form (found on the NIDCO website) which must be completed. During this project planning stage, complaints/grievances can be submitted by:

- Email (To be announced)
- Telephone (To be announced)
- Letter addressed to the Project
- Meeting with the Project Community Relations Officer

What information will I need to provide?

In each instance, the petitioner will have to provide:

1- Grievance submission date
2- Name and contact information of complainant (optional)
3- Date and time of incident (if applicable)
4- Description of the complaint/grievance
5- Number of persons affected
6- Attachment of additional information (evidence) to support claim (e.g. photos, documents)
7- Possible solution to the complaint/grievance.

What happens once my complaint/grievance is submitted?

Each grievance submitted will be become part of the grievance records. Each will be assigned a reference number, type of complaint, and grievance redress status. After receiving the complaint/ grievance, NIDCO will provide a written acknowledgement within 5 working days of receipt of submission. In cases where the complaint is incomplete, insufficient evidence is provided or the complaint is found to be unrelated to the project, the complaint will be acknowledged, and the petitioner notified of the inadequate nature of their complaint.

For completed claims, investigations will be conducted and resolution of the complaint sought. Further information may be sought during this period.

The timeframe for resolution of complaints/grievances will depend of the urgency and severity of the grievance. All claims will be resolved within 60 business days of claim submission. However, urgent claims will be resolved in considerably less time (e.g. in cases posing immediate safety risk).

Once a resolution is determined, this will be communicated to petitioner in writing and also orally (as required). If the petitioner believes their claim is unsatisfactorily addressed, the decisions can be appealed.

Should the petitioner consider that the grievance was not addressed in a satisfactory manner there will be further redress options, including lodging an appeal to the Ombudsman or the EMA .

3 APPENDIX C - STAKEHOLDERS ENGAGED

Table 3.1: Stakeholders Engaged

Date	Stakeholder	Duration
July 16th, 2019	Trinidad and Tobago Chamber of Industry and Commerce	8:00 AM – 9:30 AM
July 17th, 2019	Four Roads Government Primary School	1:00 PM – 2:00 PM
July 17th, 2019	Westshore Medical Private Hospital	10:00 AM – 12:00 PM
July 18th, 2019	Guardian Group Limited	
July 19th, 2019	Diego Martin Regional Corporation	10:30 AM – 12:00 PM
July 19th, 2019	Ministry of Rural Development and Local Government	1:00 PM – 2:00 PM
July 29th, 2019	Victoria Gardens Resident Association	5:30 PM – 7:00 PM
July 29th, 2019	Victoria Keyes Highway Committee and Powder Magazine Phase 2	12:00 PM – 2:00 PM
July 31st, 2019	Chaconia Crescent Residents Association	5:30 PM – 6:30 PM
August 2nd, 2019	Four Roads Residents Association	5:30 PM – 6:30 PM
September 5th 2019	SuperPharm Limited	8:00 AM – 9:00 AM
September 10th 2019	International School of Port of Spain	-E-mail
September 16th, 2019	Route 1 Maxi Taxi Association	9:00 AM – 10:00 AM

4 APPENDIX D - SUMMARY OF DISCUSSIONS

Table 4.1: Issues Raised in Public Consultation and Focus Group Discussions

Issue	Stakeholder Engagement	Public Consultation
The project adding to the existing drainage challenges including: - Inadequate capacity of the mouth of Diego Martin river to accommodate the additional flow (not being dredged) resulting from the overpass. - Flooding issues at the West Park site in the event of heavy rainfall events - Drainage problem is compounded by raw sewage observed in manholes in Victoria Gardens. - Adequacy of the existing drainage pond. - Location of new drainage infrastructure on the West Park site. - Narrow and clogged drains in Four Roads community.	4	8
Alternative solutions to vehicular overpass - Re-opening of bow tie (4) including the suggestion to re-open the bow tie and use concrete blocks to prevent persons from going left unto the Western Main Road until after the highway has a split after the Western Main Road. - coastal causeway, - a coastal railway, - having a water taxi from Port-of Spain with stops at West Mall, Pt. Cumana, Carenage, and Chaguaramas. - Building a ramp at the intersection of the western main road and Columbus boulevard to allow for seamless traffic - Removal of traffic light at Columbus boulevard	4	6
Concerns about moving the congestion (solving the problem at one point (the vehicular overpass, but the challenge remains elsewhere in the municipality - particularly along the Western Peninsula) : there is need for up-to-data data on noise, air including presence of particulates, at different times of the year.	7	3
Limited communication of information regarding stakeholder consultations in all areas of communication (print media, website, social media etc.) particularly for past consultations	1	6
Lack of representation of government stakeholders at the public meeting (HDC, DMRC) and other concerns about the lack of collaboration among government bodies and provision of false/no information	1	5
Disagreement of use of West Park green space for built development	2	4
Transparency issues regarding the CEC approval process for the Diego Martin Regional Corporation Complex to be located at the West Park site, including concerns about a lack of public meetings before giving CEC approval	1	4
Concerns about land acquisition (of public lands and residential areas) to construct the overpass: pile-driving with heavy equipment can cause damage to property	0	3

Issue	Stakeholder Engagement	Public Consultation
Concerns about adverse health impacts during and after the construction of the overpass (used the extension of the Diego Martin Highway (in the vicinity of Powder Magazine as an example)	2	2
Concerns about how stakeholder's comments are used in modifying the conceptual design (the need to go beyond just stating by stakeholders what is said in the stakeholder consultation report to actually showing how and why each question or comment will be or will not be on board. This will be the revised project design and project planning)	2	2
The need to address environmental impacts/risks including the call for conducting a full EIA	2	2
Transparency concerns on the MOWT as the arbitrator of the grievance redress process (the entity receiving and handling complaints)	0	1
Lack of entrance to get to Victoria Keyes from Port of Spain heading west	0	1
Concerns about the effects of planned construction works on buildings (e.g. Powder Magazine Building A) that were affected by past earthquakes	1	1
Accessibility to West Mall		1
Use of outdated baseline data	1	1
Change in property cost/value: misrepresentation by developers (HDC) in respect of the use of land between Victoria Keyes and Powder Magazine, which was to be kept as an open green space, thereby adding to the attractiveness of the residences.	1	1
Mitigation measures for key issues raised	1	1
Mechanism for recharging of WASA well field (located on West Park Site) – noted that WASA no longer use these wells because of saltwater intrusion	0	1
Concerns about the stage when design solutions are provided (conceptual design versus final design – participant indicated that it should be final design stage when more detailed proposals are known	0	1
Need for barriers and candle sticks - Feeder road to highway, Victoria Villas	1	1
Road ownership – expressed confusion about the DMRC owning the roads off of the highway versus MOWT owning the main highway	0	1
Danger posed to pedestrians living in Powder Magazine I – residents have to cross 3 lanes of highway to get across the road.	0	1
Required setbacks do not appear to be adhered to given the conceptual design presented	1	0

4.1 TRINIDAD AND TOBAGO CHAMBER OF INDUSTRY AND COMMERCE

Date: July 16th, 2019

Location: Trinidad and Tobago Chamber of Industry and Commerce

Duration: 8:00 AM – 9:30 AM

4.1.1 PERSONS IN ATTENDANCE

Name	Designation	Agency
Gabriel Faria	Chief Executive Officer	Trinidad And Tobago Chamber of Industry and Commerce
Michelle Pierre	Personal Assistant to the Chief Executive Officer	Trinidad And Tobago Chamber of Industry and Commerce
Lauren Maynard	Events Manager	Trinidad And Tobago Chamber of Industry and Commerce

4.1.2 CONCERNS RAISED

1. **Increasing Traffic at the Columbus Boulevard Intersection**
    a. Participants expressed the view that the light at the intersection of Western Main Road and Columbus Boulevard is already overburdened. It is a major point of congestion, especially during peak shopping times. In their view, the proposed design would only add additional traffic to an already overburdened intersection. Coming from the west into the falls at West Mall would become a little more complicated post completion. They maintained that the prevailing traffic challenges at the intersection should be treated with first, before adding infrastructure which will contribute to further traffic flows to the bottleneck.
    b. Consequently, participants proposed that the proposed intersection should have additional lanes, particularly on the west bound side of the western main road, to allow for further improvements in the flow of traffic. If additional lanes could not be added, they suggested that the existing lanes should at the very least be widened. Given the prevailing traffic at that intersection, participants also suggested the removal of the traffic lights altogether
2. **Benefits versus costs for the residents of the Municipality of Diego Martin**
    a. Participants believed firmly that the proposed vehicular overpass would benefit the residents of the Diego Martin Valley but not the residents living along the western main road.
    b. They believe that the proposed overpass is a very costly solution, and that the benefits did not outweigh the costs to the residents of the municipality as a whole.

Highlights:

Main questions asked about the project:

1. Given the recent improvements to the Diego Martin main road and highway, what is the motivation for designing and constructing this proposed vehicular overpass?
2. Is this project meant to increase the attractiveness of the units which remain unsold at Victoria Keyes?
3. When will construction start?
4. When will the construction take place?
5. When is the projected completion date of the proposed vehicular overpass?
6. Is this an election present?
7. How do the projected traffic flows after the completion of the proposed vehicular overpass compare to the prevailing traffic flows?

Important features which must be considered in the design of the Diego Martin Vehicular Overpass:

1. Widening of the west bound lane/ addition of a west bound lane at the proposed intersection at Columbus Boulevard
2. Removal of traffic lights at Columbus boulevard

4.2 WESTSHORE MEDICAL PRIVATE HOSPITAL

Date: July 17th, 2019

Location: Westshore Medical Private Hospital

Duration: 10:00 AM – 12:00 PM

4.2.1 PERSONS IN ATTENDANCE

Name	Designation	Agency
Umesh Rampersad	Chief Executive Officer	WestShore Medical Private Hospital
David Josa	Medical Director	WestShore Medical Private Hospital
Joanne Achille-Zamore	Operations	WestShore Medical Private Hospital
Nadine Hosein-Ali	Chief Financial Officer	WestShore Medical Private Hospital

4.2.2 CONCERNS RAISED

1. **The potential closure of the bowtie connecting the west bound lane of western main road to the eastbound lane of western main road**
    a. The bowtie is a main thoroughfare for the employees and patients of WestShore Medical Private Hospital. Participants maintained that this bowtie must remain open and should not be closed as part of the construction of the Diego Martin Overpass and Ancillary Works. In the event of an emergency, the Bowtie allows the ambulance ready access to the Community Hospital, the St. James Medical Complex and the Port-of-Spain General Hospital.
2. **Benefits versus costs**
    a. The proposed Diego Martin Overpass seems to benefit the residents of Victoria Keyes and Powder Magazine far more than the residents of the rest of the Diego Martin Valley.
    b. Westshore Medical maintained that it may be more beneficial to direct resources towards addressing the prevalent drainage issues among those communities rather than constructing a vehicular overpass.
    c. Westshore Medical also recommended the creation of additional entry and exit points from the Diego Martin Valley. They believe that additional roadways which would enhance access to Port of Spain and Tucker Valley would alleviate traffic problems far more than the proposed vehicular overpass
3. **Gridlock and congestion on the western main road**
    a. Westshore Medical indicated that the proposed vehicular overpass does not deal with other major shortcomings of the prevailing road infrastructure. Participants highlighted the fact that every time there is an accident or a troubled vehicle, a bottle neck immediately develops causing gridlock well into the Diego Martin Valley and along the western parts of the Western Main Road. They maintained that this was a far more pressing issue to address then vehicular access to Victoria Keyes and Powder Magazine.
    b. Westshore Medical recommended that given the frequency with which accidents occur that a tow truck should be permanently stationed at the segment of the western main

road between Powder Magazine and Mucurapo Road in order to rapidly move troubled vehicles from the western main road and to prevent the rapid resultant gridlock that is typically observed.

4. **Moving the traffic problem to the nearest traffic intersections**
    a. Participants agreed that the vehicular overpass will not only add additional traffic to the already overwhelmed traffic at Columbus Boulevard, but also to increase the volume of traffic at the traffic lights at Westmoorings Boulevard and the intersection at Morne Coco Road and the Diego Martin Main Road.
5. **General Recommendations**
    a. Create a reliable mass transportation system. The absence of such a system has made vehicle ownership almost a necessity.
    b. Create policies to reduce the importation of old vehicles
    c. Create policies to make new vehicles more affordable to lower income groups
6. **Gang warfare in Powder Magazine and Cocorite**
    a. Participants identified crime and gang warfare in Cocorite and Powder Magazine as posing risks to road users along the contiguous segment of the Western Main Road. They highlighted a recent incident where a passer-by was hit by a stray bullet while commuting on the Western Main Road and asked how the potential project will address the challenges posed by proximity to such occurrences.

Highlights:

Main questions asked about the project:

1. Will the overpass also benefit the patrons of the Diego Martin Regional Corporation, or will it solely benefit the residents of Victoria Keyes and Powder Magazine?
2. Should additional main exit and entry points to the Diego Martin Valley not be considered?
3. Will the bowtie be closed as part of the proposed construction and ancillary works?

Important features which must be considered in the design of the Diego Martin Vehicular Overpass:

1. The Bowtie connecting the west bound lane of western main road to the eastbound lane of western main road should remain open. Given the land area available, Westshore Medical maintained that it should be expanded to improve the safety of re-entry to the east bound lane of the western main road.
2. A tow truck should be permanently stationed at the segment of the western main road between Powder Magazine and Mucurapo Road to rapidly move troubled vehicles from the western main road and to prevent the rapid resultant gridlock that is usually witnessed
3. Given the prevailing traffic in the vicinity of the traffic light at Columbus Boulevard, the suggestion was made to appropriate lands from SuperPharm and the International School to allow for additional lanes to be paved to ensure the smooth movement of traffic.
4. The extension of the Diego Martin Main Road to Victoria Villas to enhance local access
5. Link Road from Mucurapo Road to Audrey Jeffers Highway should remain two way at all times of the day

4.3 GUARDIAN GROUP LIMITED

Date: July 18th, 2019

Location: Guardian Group Limited

Duration:

4.3.1 PERSONS IN ATTENDANCE

Name	Designation	Agency
Jade Camps	Senior Project Manager	Guardian Group Limited
Raul Mohammed	C.O.O.	Guardian Group Limited

4.3.2 CONCERNS RAISED

1. **Roundabout versus traffic lights at Columbus Boulevard**
    a. Members enquired about the viability of a round about as opposed to a traffic light at the Columbus Boulevard intersection.
2. **Cumulative Impacts**
    a. Representatives didn't believe the cumulative impacts of the proposed construction would be severe. They thought that traffic might build up during peak times, but they did not anticipate that traffic would be very severe.
3. **Impacts of Dust and Noise**
    a. Representatives maintained that during construction appropriate measures should be implemented to mitigate the impact of dust and noise on members of the population.

Highlights:

Main questions asked about the project:

1. How does the overpass flow into the existing roads?
2. Can a roundabout be added instead of a traffic light?

Important features which must be considered in the design of the Diego Martin Vehicular Overpass:

1. Inclusion of a roundabout at the Columbus Boulevard intersection

4.4 DIEGO MARTIN REGIONAL CORPORATION

Date: July 19th, 2019

Location: Diego Martin Regional Corporation

Duration: 10:30 AM – 12:00 PM

4.4.1 PERSONS IN ATTENDANCE

Name	Designation	Agency
Marcia Marslin	Councillor	Diego Martin Regional Corporation
Dr. Anthony Chang-Kit	PMHO	Diego Martin Regional Corporation
Verne Edwards	Public Health Officer	Diego Martin Regional Corporation
Joel Alexander	ROI	Diego Martin Regional Corporation
Natali George	Public Health Officer	Diego Martin Regional Corporation
Cherrie Hercules	Ag. ROI	Diego Martin Regional Corporation
Charlene Pran-Smith	Ag. ROI	Diego Martin Regional Corporation
Anthony Smith	Financial Officer	Diego Martin Regional Corporation
Jameel Ali	C/S	Diego Martin Regional Corporation
Hassana Alimaya	Accounts Officer	Diego Martin Regional Corporation
Brinsley Rodriguez	Accountant 1	Diego Martin Regional Corporation
Cyril Mejias	Road Officer 1	Diego Martin Regional Corporation
Purell Bennet	Public Health Officer	Diego Martin Regional Corporation
Lydia Rivers	Ag. Inspector Municipal Police	Diego Martin Regional Corporation
Patrice Cain	Chief Executive Officer	Diego Martin Regional Corporation

4.4.2 CONCERNS RAISED

1. **Regional Coordinating Committee and the proposed Highway Development**
    a. Members of the Regional Corporation highlighted the non-attendance of members of the highway division of the Ministry of Works. Due to the central role played by the Regional Corporation in local economic development, questions regarding the proposed vehicular overpass in addition to the then ongoing pedestrian overpass continually come to the members of the Regional Corporation. However, they have not been apprised of any of the details about these projects, and attribute this directly to the non-attendance of representatives from the Highway Division in the monthly regional coordinating committee meetings. They expressed disappointment at this continued lack of collaboration among key stakeholders in the greater interests of the burgesses of the municipality of Diego Martin.
2. **Grievance Redress Process and Focal Point**
    a. Since complaints about these types of projects typically come directly to the Regional Corporation as opposed to the Ministries responsible, members of the Diego Martin Regional Corporation advocated for a clear and well-designed Grievance Redress

Mechanism with clearly defined focal points to address questions posed and grievances raised.

3. **Approach to infrastructural development**
    - **a.** Members expressed the view that the approach to infrastructural development in the Municipality appears to be on a very ad hoc basis. Members believe that these types of projects should form one part of an overarching national and regional spatial development plan. They believe the vehicular overpass should be accompanied by major infrastructural work along the western main road
    - **b.** Members put forward several complementary recommendations for traffic alleviation in the municipality including a coastal causeway, a coastal railway, and having a water taxi from Port-of Spain with stops at West Mall, Pt. Cumana, Carenage, and Chaguaramas.
4. **Air and noise pollution**
    - a. Members believe that air and noise pollution should be addressed since increased traffic would bring additional pollution into the area.
    - b. Members advocated for import restrictions on diesel vehicles and inventive systems for the importation of hybrid and electrical vehicles.
5. **Moving the bottle neck**
    - a. Members believe that proposed design would only move the traffic from the intersection at Columbus Boulevard westward to the intersection at West Moorings Boulevard.
    - b. Members anticipated that taxi drivers and maxi drivers would use the overpass to avoid prevalent bottlenecks in the area, as opposed to using it for the additional movements allowed to the east, west, north and south.

Highlights:

Main questions asked about the project:

1. Are there any forthcoming plans for road development and improvement for the entire western peninsula?
2. What mitigation strategies are place for the existing traffic and dust?
3. Are there any proposals for the development of a causeway along the coast of the Gulf of Paria?
4. Are there plans for the purchase/lease of a Water Taxi for the coastal communities along the western peninsula?

Important features which must be considered in the design of the Diego Martin Vehicular Overpass:

1. Impact of air and noise pollution as a result of the increased volume of traffic to the Municipality

4.5 MINISTRY OF RURAL DEVELOPMENT AND LOCAL GOVERNMENT

Date: July 19th, 2019

Location: Kent House, Maraval

Duration: 1:00 PM – 2:00 PM

4.5.1 PERSONS IN ATTENDANCE

Name	Designation	Agency
Jameel Chadee Ameeral	Ag. Deputy Permanent Secretary	Ministry of Rural Development and Local Government
Hinni Maraj	Engineer	Ministry of Rural Development and Local Government

4.5.2 CONCERNS RAISED

1. **Structure of the Proposed Diego Martin Regional Corporation Complex**
    - **a.** Previous designs for the proposed overpass created challenges for the plans for the Diego Martin Administrative Complex. The prior design had two loops which prospectively would have divided the land earmarked for the proposed administrative complex. They were concerned about the land. They had gone and gotten approval to transfer the land, and then they heard that a loop was going in the middle. So, they were very concerned. Then a couple months later, they went back to the original design.
2. **The Regional Coordinating Committee**
    - a. Kairi Consultants sought clarify on the concerns expressed by the Diego Martin Regional Corporation regarding the non-attendance of members of the regional coordinating committee. Participants explained that the MUNICIPAL CORPORATIONS ACT outlines the persons that form part of the committee. They explained that the law mandates who is supposed to attend and admitted that it was an issue that was currently being treated with by the Joint Select Committee of Parliament. In every Municipality there shall be established a Co-ordinating Committee with responsibility for ensuring efficiency in the management of operations and co-ordinating the delivery of services
        - i. Mayor of the Council
        - ii. the head of the district or regional operations of the Water and Sewerage Authority;
        - iii. the head of the district or regional operations of the Trinidad and Tobago Electricity Commission;
        - iv. the District or Regional Officer responsible for main roads in the area;
        - v. the District or Regional Officer responsible for drainage and irrigation in the area;
        - vi. the Medical Officer of Health;
        - vii. the Chief Executive Officer;
        - viii. a secretary to the Co-ordinating Committee appointed by the Council;

ix. such other officers of Central or Local Government and other persons as the Minister may upon the request of a Council appoint.

x. The Mayor shall be Chairman of the Co-ordinating Committee.

b. However, they explained that for a variety of reasons, those who have been mandated by law to attend the meetings do not. In many regional corporations, many council members attend the meetings. And, as a result, the focus of the committee meeting becomes far more micro level than macro level for the municipality. For these reasons, these heads of institutions typically send persons in their stead, undermining the functionality of the committee. They acknowledged that, as the process for local government reform advances, this committee will likely receive more attention given the amount of power and authority that will be devolved to this committee.

4.6 VICTORIA GARDENS RESIDENT ASSOCIATION

Date: July 29th, 2019

Location: Victoria Gardens Park

Duration: 5:30 PM – 7:00 PM

4.6.1 PERSONS IN ATTENDANCE

Name	Designation	Agency
Stuart Franco	President	Victoria Garden Residents Association
Trevor Martin	Committee Member	Victoria Garden Residents Association
Ryan Prudent	Committee Member	Victoria Garden Residents Association
Shannon Maingot	Secretary	Victoria Garden Residents Association

4.6.2 CONCERNS RAISED

1. **Drainage Infrastructure in and around Victoria Gardens**
    a. The current drainage infrastructure was built in the 1960s to accommodate the then prevailing and projected drainage needs. At that time, there was negligible development in the immediate vicinity of Victoria Gardens. Chaconia Crescent, Powder Magazine and Victoria Keyes were all not in existence. The current infrastructure cannot accommodate the volume of water now coming through the community.
    b. **Drain Through Victoria Gardens**
        i. Water coming from the western side of the Diego Martin Valley (particularly from the communities comprising Four Roads) pass through Victoria Gardens via two conduits which cross the Diego Martin Main Road and the Diego Martin Highway just north and south of the entrance of Victoria Gardens respectively. The water is then forced into a drain bordering the northern wall of Victoria Villas and running directly through the centre of Victoria gardens. During periods of persistent rainfall, Victoria Gardens rapidly becomes flooded, forcing residents to navigate flood waters of 2 feet or more.
    c. **Drain South of Victoria Gardens**
        i. The drain to the south of Victoria Gardens is inadequate for the prevailing run off in the area. Residents expressed concerns about whether a properly designed concrete drain was going to be built between Victoria Gardens and the land directly south of it. Since the land south of Victoria Gardens is significantly higher than Victoria Gardens (residents estimated a minimum elevation of 3 metres), the residents are concerned that the additional runoff from the West Park Savannah and the proposed Diego Martin Regional Corporation building will not be adequately accommodated by the existing drainage infrastructure, which itself largely follows thee natural contours of the land.
    d. Dredging of the Diego Martin River

i. A part of the drainage challenges for the community stems from the Diego Martin River. Residents requested that the river be dredged more frequently to deal with the above average rain fall which has become the new normal for the municipality.

2. **Relocation of the Diego Martin Regional Corporation**
    - **a.** Residents indicated that initial plans for the land south of Victoria Gardens had the Diego Martin Regional Corporation Building in the south eastern quadrant. However, the current conceptual design has earmarked the north eastern quadrant of the land for the Diego Martin Regional Corporations. Residents enquired about the reason for the relocation of the proposed building, since the suggested site will likely contribute to greater levels of runoff into an already inadequate drain running south of Victoria Gardens.
    - **b.** The residents of Victoria Gardens also indicated that there was a great degree of ambiguity regarding the characteristics of the proposed complex. Due to this ambiguity, the residents felt ill equipped to fully express their concerns about the proposed design.
    - **c.** The residents firmly believe that the Diego Martin Regional Corporation complex should be located elsewhere. Residents believe the complex will only add more concerns to an already concerning situation and maintain that the proposed location simply cannot work.
3. **Diego Martin Highway, Diego Martin Main Road and the Entrance to Victoria Gardens**
    a. Residents have significant concerns about the roads linked to the entrance to Victoria Gardens. Since the Diego Martin Main Road connects to the Diego Martin Highway in the vicinity of Victoria Gardens, drivers entering the Diego Martin Main Road often reach to Victoria Gardens at highway speeds as opposed to the speed limit for the main road. As a result, the entrance to Victoria Gardens is quite dangerous for residents. The Victoria Gardens Residents Association requested that candle sticks be placed near the entrance to force drivers to make the decision to enter the Diego Martin Main Road cautiously, instead of giving drivers the space to make the decision to enter the main road at the last minute at speeds which are unsafe for drivers and pedestrians alike.
4. **Elevation of West Park Savannah and the land earmarked for the Diego Martin Regional Corporation vis-à-vis Victoria Gardens South**
5. **The benefits versus the costs of constructing the vehicular overpass**
    - **a.** Residents do not believe the benefits of the overpass outweigh the costs. Residents maintain that the overpass will simply move the traffic to the nearest traffic lights at Morne Coco Road.
6. **Lack of a Holistic Development Plan**
    a. There is a concern about the lack of a holistic development plan for the western peninsula in existence. Residents indicated that the lack of communication about such a plan has resulted in confusion for the burgesses of the Diego Martin region.

Highlights:

Main questions asked about the project:

1. Will comprehensive drainage infrastructure form part of the final design for the Powder Magazine Vehicular Overpass?
    a. Will well designed drainage infrastructure be developed between Victoria Gardens South and West Park Savannah to mitigate the increased runoff from these developments and the forthcoming Vehicular Overpass?
    b. Will the proposed drainage infrastructure improve upon the drains currently passing through the centre of Victoria Gardens?
2. What are the characteristics of the proposed Diego Martin Regional Corporation Building?
3. Why was the Diego Martin Regional Corporation relocated from the south eastern quadrant of the area south of Victoria Gardens to the north eastern quadrant? (That is to say, why is the Diego Martin Regional Corporation now going to be located north of the overpass as opposed to south of the overpass?)
4. What is now going to be located in the south eastern quadrant of the land south of Victoria Gardens?
5. Will a holistic infrastructural development plan be developed for the western peninsula of Trinidad and Tobago?

Important features which must be considered in the design of the Diego Martin Vehicular Overpass:

1. Comprehensive Drainage Infrastructure
    a. Through Victoria Gardens
    b. South of Victoria Gardens

4.7 VICTORIA KEYES HIGHWAY COMMITTEE AND POWDER MAGAZINE PHASE 2

Date: July 29th, 2019

Location: Victoria Keyes Conference Room, Tower 1

Duration: 12:00 PM – 2:00 PM

4.7.1 PERSONS IN ATTENDANCE

Name	Designation	Agency
Vishesh Ramnarine	Resident	Victoria Keyes Highway Committee
Roger Alcantara	Resident	Victoria Keyes Highway Committee
Ingrid Henriques	Resident	Victoria Keyes Highway Committee
Nadia Henriques	Resident	Victoria Keyes Highway Committee
Lester Walker	Resident	Victoria Keyes Highway Committee
Ashley Ross	Resident	Victoria Keyes Highway Committee
Dieve Ross	Resident	Victoria Keyes Highway Committee
Patricia Picou	Representative	Powder Magazine Homeowners Association
Andrew Matthews	Representative	Powder Magazine Homeowners Association
Patrick Billy	Representative	Powder Magazine Homeowners Association

4.7.2 CONCERNS RAISED

1. **Interactions between NIDCO and Victoria Keyes Highway Committee**
    a. The VKHC indicated that NIDCO has been written specifically on their concerns and that NIDCO has heard their concerns on at least three prior occasions. Residents expressed disappointment in the progress made thus far in addressing the concerns communicated to NIDCO. The VKHC thought it strange that in spite EMAs detailed particularization of what they expect from NIDCO that they have not seen concrete responses to those concerns.
    b. The VKHC indicated that they have seen nothing in terms of a proper design put forward to the residents of Victoria Keyes and Powder Magazine, only a conceptual design.
    c. Initial interactions between residents and NIDCO suggested that the purpose was for traffic mitigation. The last consultation suggested it would also be utilized for the provision of access to the Regional Corporation and a newly constructed First Citizens Bank. The VKHC was surprised not to see very specific responses to the suggestions made to the EMA. The VKHC is still interested in opening up meaningful conversation and dialogue to arrive at a final design that is in the best interest of all the residents of the Diego Martin region.
2. **Only one of many concerns put forward has been addressed**
    a. The conceptual design only took on board one of the concerns raised by the VKHC, which was losing the front of Victoria Keyes. one concern was addressed, but everything else that was documented in the Terms of Reference was not addressed in the revised design.

in the last consultation, the VKRA expressed curiosity regarding the status of all the other concerns? What about all the things that EMA requires the Ministry of Works to do?

3. **Impact on Health**
    a. Emissions due to proximity of the Diego Martin Overpass to Victoria Keyes and Powder Magazine Phase 2
        i. Their research [5] says that you have to have a clearance of at least 300-500 metres from a highway System in order to protect yourself from the particulate matter.
    b. Manholes in Powder Magazine
        i. During heavy rainfall sewage comes out at the front entrance.
    c. Respiratory Problems
        i. Residents believe the particulates emitted post construction by vehicles will be harmful to the health of residents of Victoria Keyes and Powder Magazine. They maintain that the project is disproportionately skewed towards costs. The costs far outweigh the perceived benefits and there will be financial and human collateral cost. They anticipate a cumulative impact on the public health system due to respiratory issues. They also fear for the health impact of particulate emissions on Pregnant Women, Children and the Elderly.
4. **Green Spaces**
    a. The VKHC indicated that the space was earmarked for an ECO park along with West Park, but the current proposals have gone against that. Given the incorporation of the Diego Martin Regional Corporation and a branch of the First Citizens Bank, they believe that it will really be a quasi-green space, not really a full green space. They indicated that they want the initially proposed Eco Park to be the green space for this community and environ. When Victoria Keyes residents purchased their units, they were told there was going to be a n Eco Park between the two communities. The committee believes this was material misrepresentation. The residents would not have purchased the properties had they known the green park would not eventually have been constructed.
5. **Mitigation Plan**
    a. The mitigation plan presented in October was inadequate. Their legal counsel highlighted the fact that there has been no scientific measurement of key data since Victoria Keyes had been constructed. The data that was used is no longer valid.
    b. They consider the data used to be null and void.
6. **Impact on the Valuation of the properties**
    a. The residents believe unequivocally that the construction of the overpass between Victoria Keyes and Powder Magazine will reduce the valuation of the properties.
7. **Privacy**
    a. Given the expected elevation, residents of Victoria Keyes and Powder Magazine expect their privacy to be invaded.
8. **Crime**
    a. Having been such open road infrastructure in an area with limited road infrastructure now exposes us to crime. The public will now have an easy ingress and egress

[5] Quick and Dirty Tips. 2018. How Close is Too Close to Live by the Highway? - https://www.quickanddirtytips.com/education/science/how-close-is-too-close-to-live-by-the-highway

Highlights:

Main questions asked about the project:

1. What is the real purpose of the Vehicular Overpass?
2. Is the overpass meant to alleviate traffic or to provide enhanced access to the Diego Martin Regional Corporation and First Citizens Bank?
3. What are the specifics of the proposed design?
    a. How are the residents of Victoria Keyes and Powder Magazine meant respond to respond to/ mitigate against a conceptual design?
    b. What are the setback distances?
    c. What is the elevation?
    d. What is the height of the overpass?
    e. What is the angle of ascent to the overpass and descent?
    f. Where does it stand alongside the front of Tower 1?
    g. What are the proposals for drainage?
        i. What is the width?
        ii. What is the depth?
    h. How many lanes will there be?
    i. Where is the current and projected data for things like noise, vibration, particulates emitted and runoff?
    j. What is the minimum acceptable distance for a residential building and a highway?
4. The conceptual design only addressed one of the concerns raised by the VKHC, what is the status of all the other concerns raised?
5. How are they going to protect themselves from the anticipated increases in crime?

Important features which must be considered in the design of the Diego Martin Vehicular Overpass:

4.8 CHACONIA CRESCENT RESIDENTS ASSOCIATION

Date: July 31st, 2019

Location: Chaconia Crescent

Duration: 5:30 PM – 6:30 PM

4.8.1 PERSONS IN ATTENDANCE

Name	Designation	Agency
Gabriel Reece	Facility Manager	GPR Developments Limited
Richard Andrews	Facility Manager	GPR Developments Limited
Karen Quashie Rivaux	Assistant Treasurer	Chaconia Crescent Residents Association
Derron Mark	Trustee	Chaconia Crescent Residents Association
Carlene Solomon	Trustee	Chaconia Crescent Residents Association
Nigel Wint	President	Chaconia Crescent Residents Association

4.8.2 CONCERNS RAISED

1. **Social impact during the construction stage**
    a. Residents lamented the prospects of dust and noise and hoped that contractors would do their due diligence.
2. **Alleviating the traffic versus moving the bottle neck**
    a. Residents acknowledged that traffic during peak hours is heavy on the Diego Martin Highway. They acknowledged the fact that many new major housing developments such as Victoria Keyes and West Hills are still not at capacity. As such, the residents indicated that when these developments did reach capacity, traffic would worsen for all residents of the Diego Martin Valley and environs.
    b. The residents believed that while the proposed design would directly improve vehicular access to the residents of Powder Magazine, Victoria Keyes, Victoria Gardens and West Moorings, it would indirectly improve the flow of traffic into the Diego Martin Valley at large. If it could alleviate traffic, even a little, without adversely affecting resident populations, then they thought it would be good.
3. **Additional considerations for infrastructure in the Diego Martin Regional Corporation**
    a. Residents acknowledged that the proposed overpass would alleviate some of the traffic but not eradicate all of the well-known points of congestion. Residents suggested broader infrastructural development in the form of a coastal causeway to Chaguaramas and a road connecting the Diego Martin Valley to Tucker Valley through Covigne would be useful options to consider helping alleviate the prevalent traffic woes in the Western Peninsula.
    b. Furthermore, residents suggested that additional infrastructure should be developed to provide additional direct access to Port-of-Spain.
    c. The residents also acknowledged that the prevailing and projected traffic challenges can be partly attributed to the lack of a mass transit systems. They believed that a properly

designed train system could incentivize residents to move away from their heavy reliance on vehicles for transportation.

Highlights:

Main questions asked about the project:

1. Will the proposed design effectively treat with the prevalent traffic in the area of interest or just solely move the traffic further into Diego Martin, into Chaguaramas, or to Cocorite?
2. Is the existing road infrastructure insufficient?
3. Will the project be completed if political administrations change during its construction?

Important features which must be considered in the design of the Diego Martin Vehicular Overpass:

1. Enhanced access to Chaguaramas via a coastal causeway in addition to a road connecting Tucker Valley through Covigne

4.9 FOUR ROADS VILLAGE COUNCIL

Date: August 2nd, 2019

Location: Four Roads Government Primary

Duration: 5:30 PM – 6:30 PM

4.9.1 PERSONS IN ATTENDANCE

Name	Designation	Agency
Kerry Williams	Resident	Four Roads Community

4.9.2 CONCERNS RAISED

1. **Encroachment on the shoulder of the south bound lane of the Diego Martin highway.**
    a. There is insufficient space for the flow of traffic if the shoulder is taken to accommodate the lane required for the Vehicular overpass
    b. There will be no space for emergency vehicles to pass for roughly 1 km along the south bound lane of the Diego Martin highway. Currently, emergency vehicles utilize this shoulder lane during peak hour traffic.
2. **Benefits versus Costs for PMVO**
    a. The residents believe that the benefits of the project do not outweigh the costs.
    b. Access already exists to Carenage from the existing roadways (Morne Coco Road and Mucurapo Road). The residents have grown accustomed to it.
    c. They believe that improvement of the existing infrastructure is better alternative.
    d. They have advocated for sensible change.
    e. They anticipate that the proposed design will create further traffic in the morning.
3. **The overpass fails to address prevailing weaknesses in the road infrastructure**
    a. Accidents or dysfunctional vehicles on the stretch of the western main road the vicinity of Cocorite (or even on the St. James overpass) often cause gridlock in the Diego Martin Valley and the rest of Western Main road.
    b. Depending on the type of accident, this substantially protracts the commute towards Port-of-Spain.
    c. The residents anticipate that the design will add additional congestion to this.
4. **Traffic Light by Four Roads**
    a. A major bottleneck exists at the traffic lights between the NP Gas Station and the Diego Martin Highway.
    b. There is too short a distance to navigate to go back to the highway.
    c. Due to the traffic going to and from the gas station, it further exacerbates the problem. Residents believe that access to the gas station from Morne coco road should be closed, and that the northern lane of the road should only be used exclusively as an exit lane.
    d. The residents lamented the closure of the bowtie in the vicinity of Acton Court.
5. **Moving the bottle neck**

a. The proposed design moves the traffic from the traffic lights at Columbus boulevard to the traffic lights in west moorings.
b. Residents anticipated that taxi drivers and maxi drivers would use the overpass to avoid prevalent bottlenecks in the area, as opposed to using it for the additional movements allowed to the east, west, north and south.

6. **Large Vehicles**
    a. The large vehicles might find it difficult to navigate the area. The square footage at the light might not be enough for them to navigate. IT would add more cost to what is currently existing and working. That is a major concern with keeping the loop there (by the highway existing) and the proposed one by Victoria villas. The existing exit into Diego martin doesn't warrant an additional exit. They weren't sure how high It was going to go. The gradient for that to come up, that height clearance has to be there. That bridge might not be feasible to do so. Large vehicles may not be able to use the overpass.
7. **Cumulative Impacts**
    a. The walkover under construction is currently an issue
    b. The traffic light by four roads needs to be reconsidered. The amount of traffic coming there is too large for the lights. When cars stop by the gas station, and someone is crossing a lane, it blocks off the possibility for entering the north bound part of the highway. Residents suggested that the area should be graded to allow the additional movement into the Diego martin highway, minus the cost.
8. **Drainage**
    a. Residents acknowledged that the drainage in the area hasn't been updated for 60-70 years. Residents acknowledged that infrastructure through Victoria Gardens was there since there was a train track to Wilson road.
    b. The quick runoff has increased due to suburban development with old infrastructure (slip drains). The infrastructure needs to be improved to accommodate for the volume of water coming from four roads and going into Victoria gardens.
        i. The cavity on four roads side (which has a spring) enters the Diego martin river. It comes down from the hill in four roads. From union road, the water goes down and enters the river by four roads government primary school.
        ii. Everything south of that goes down to Victoria gardens via drainage under the highway. The small cylinders crossing the highway cannot accommodate it.
        iii. When they did the drainage upgrades (for the runoff coming from the highway), it was a 16X12 cavity with a catch pit. It serves the purpose of a catch pit, which doesn't account for when there is debris in it. When water gets into there, it can't be serviced. This is similar to the ones on the left and right sides of the highway, which would be the small lanes.
        iv. There are several 90 degree turns, which has affected properties in the area.
        v. The existing drain has never changed, it's a half cylinder drain which is totally inadequate. 4R did a walk through with the drainage division for the area. So, they know when problems arise, when and where.
    c. Regional corporation is responsible for everything off the highway. The grey line between here MOWT and RC responsibilities shift, drainage data used was old data.

i. On exiting Diego martin, those with responsibility for cleaning the highways pile up the debris on the sides of the road, as opposed to transporting it away from the area.
ii. Drainage was supposed to be increased, and they were supposed to get permission from residents (property owners) for the expansion, but they didn't get it.
iii. Correcting the drainage problems may require permission to run infrastructure under existing properties.

Highlights:

Main questions asked about the project:

1. Will the shoulder be taken to accommodate the lane required for the Vehicular overpass?
    a. If so, what provisions will there be for emergency vehicles on the Diego Martin highway?
2. Do the benefits of the project outweigh the costs?
3. What will be done to address the traffic situation at the four roads intersection?

Important features which must be considered in the design of the Diego Martin Vehicular Overpass:

1. The inclusion of comprehensive drainage infrastructure to treat with the additional runoff generated by the development
2. Design to accommodate large vehicles

4.10 SUPERPHARM LIMITED

Date: September 5th, 2019

Location: #3 Chootoo Rd., Aranguez South, San Juan.

Duration: 8:00 AM – 9:00 AM

4.10.1 PERSONS IN ATTENDANCE

Name	Designation	Agency
Reagan Brooker	Manager - Development and Facilities	SuperPharm Limited
Glenn Maharaj	CEO	SuperPharm Limited

4.10.2 CONCERNS RAISED

1. **SuperPharm welcomes the proposed improvement**
    a. SuperPharm sees the overpass enhancing access to all parts of the Diego Martin Region, and particularly improving the convenience for residents of Powder Magazine, Victoria Keyes and Four Roads.
    b. SuperPharm only sees positives coming out of the overpass and they have no issues whatsoever with the proposed design, particularly because the proposed design does not require land acquisition from the company.
2. **Traffic lights versus a round about**
    a. SuperPharm did not consider a roundabout to be the most efficient type of intersection for the location due to the volume of traffic and the high frequency of accidents associated with using roundabouts nationwide.
    b. If a roundabout is to be considered, they acknowledged that land would have to be acquired. However, due to their drive through service, it would not be possible for SuperPharm to allow any acquisition of their land for the project.
    c. SuperPharm proposed that in the event a roundabout was considered, that land be acquired from any of the other three quadrants at the intersection.
3. **Traffic Management during construction**

Highlights:

Main questions asked about the project:

1. Would the Western Main road in the vicinity of Columbus Boulevard be widened?
2. How would the construction phase nearest to SuperPharm inconvenience the business and its customers?
3. What would happen during the construction phase at the Columbus Boulevard intersection?
4. How long will the phase of construction nearest to SuperPharm last?
5. How will the flow of traffic to SuperPharm be affected during construction?

Important features which must be considered in the design of the Diego Martin Vehicular Overpass:

1. SuperPharm welcomed the road improvements but suggested the inclusion of a ramp at the Columbus boulevard intersection to allow for east and westbound traffic to flow smoothly without disruption, and for the traffic coming from the proposed vehicular overpass

4.11 INTERNATIONAL SCHOOL OF PORT OF SPAIN

Date: September 10th, 2019

Location: Email

Duration: N/A

4.11.1 PERSONS IN ATTENDANCE

Name	Designation	Agency
Aykean Matthews	Facilities Operations Director	International School of Port of Spain
Anthony Ralph	Head of Security	International School of Port of Spain
Michael Charles	Assistant Head of Security	International School of Port of Spain

4.11.2 CONCERNS RAISED

1. **Safe Unhindered access to Columbus circle during construction**
    a. Members of faculty and staff walk and ride to and from the international school, it would be critical to safeguard these individuals during and post-construction.
2. **Health and Safety (Air Pollution and Dust)**
    a. Given the proximity of the school, ISPS enquired about the mitigation measures which would be put in place to mitigate the effects of the dust which would accompany
3. **Traffic Congestion**
    a. The ISPS underscored the importance of having traffic management plans in place for phases of construction occurring near to Columbus boulevard
    b. The ISPS indicated that if there will be some traffic management system in place during key hours in the morning and afternoon, it should take consideration of school opening hours - drop off is from 6.45am to 7.45am and pick from 1.30pm to 3.30pm.
4. **Grievance Redressal**
    a. The ISPS would like to ensure proper communication throughout the project life cycle in particular, a person to contact to address concerns that may arise

Highlights:

Main questions asked about the project:

1. What is the proposed project timeline to start and complete?
2. What is the nature of the grievance redressal mechanism?
3. Who should the ISPS contact to address concerns that may arise?
4. What mitigation methods would be put in place for dust and overall health and safety given the proximity of the project to the ISPS?

Important features which must be considered in the design of the Diego Martin Vehicular Overpass:

4.12 ROUTE 1 MAXI TAXI ASSOCIATION

Date: September 16th, 2019

Location: South Quay, Port of Spain

Duration: 9:00 AM – 10:00 AM

4.12.1 PERSONS IN ATTENDANCE

Name	Designation	Agency
Elias Dick	PRO	Route 1 Maxi Taxi Association
Everet Archibald	Secretary	Route 1 Maxi Taxi Association
Herman T Soobhanath	Trustee	Route 1 Maxi Taxi Association
Eon Hewitt	Chairman	Route 1 Maxi Taxi Association
Everton Young	Trustee	Route 1 Maxi Taxi Association

4.12.2 CONCERNS RAISED

5. **The Bowtie**
    a. The association had concerns about the fact that they planned to close the bowtie near Westshore Medical Complex.
    b. The association reminded us that in that situation, the closure of the bowtie directly affected the residents of Cocorite and the Taxis that serviced the residents in the community. At the time, the closure meant that the taxis would have to either go to West Mall or to Four Roads in order to return to Cocorite. Due to the volume of traffic, it added substantially to the commute from Port of Spain to Cocorite. The distance that they have to commute, while it's not a far distance, for them it was a far distance. This commute was particularly problematic during peak times in the morning and evening.
6. **Volume of Traffic**
    a. What are the volumes of traffic going into and out of Diego Martin now?
    b. To what extent will the proposed overpass drastically change the volume of traffic currently using the roads into and out of Diego Martin?
    c. What volume of traffic uses the existing roadways for the additional movements which the overpass will allow (e.g. Diego Martin to Carenage, Carenage to Diego Martin, Port of Spain to Powder Magazine/Victoria Keyes, Port of Spain to Carenage)
7. **Overburdening the traffic light at Columbus boulevard**
    a. On an evening, the traffic going onto Columbus boulevard backs up onto the highway. Adding more traffic to a traffic light that is already burdened is likely to create more congestion in the area. If the vehicles from Powder Magazine, Victoria Keyes and Diego Martin go to the traffic light, then the timing of the lights would have to change to allow the additional volume of traffic, lengthening the time at the traffic light for people coming in all directions.
    b. The Association estimated that for every 20 seconds put on a traffic light, it backs up traffic for about a minute due to the stopping and take off time.

c. The association does not believe that having the traffic light remain will alleviate the traffic situation, they believe it will only worsen congestion at the traffic light intersection. While having a filter lane for those coming from Carenage is good, they think the fact that those coming from Port-of-Spain will still have to stop at the traffic light, that this would nullify the total impact on congestion.
d. If this traffic light remains, it will create more problems

8. Impact on the taxi drivers who ply the Prince Street to Cocorite Route

a. The proposed closure of the bowtie would have a material impact on the time and cost to ply the Cocorite taxi route.

9. Benefits versus the cost

a. Given the small number of commuters that would benefit from the proposed overpass, the association did not see the overpass as being good value for money. They see the overpass benefiting the residents of PM and VK directly, but not materially alleviating the volume of traffic moving through the other roads.

10. Proposed Drainage

a. They would have liked to know that the existing drainage system was working even before the construction started. The overpass will contribute materially to the runoff in the area. The existing drainage system is inadequate to deal with the volumes of water already in existence, and the association expressed reservations about any proposed work that would worsen an already troubling drainage situation
b. They believe the West Park Savannah and the Diego Martin Regional Complex will add further run off, and they are not certain that the proposed drainage system would
c. The association attributed the prevailing flooding problems to the rapid pace of suburban development.
d. The more roads that are paved in an area, the more houses and roofs that are constructed in an area, the more run off that will ultimately be generated. The association saw the overpass as being analogous to a large roof, channelling larger volumes of runoff to specific areas.

11. The connector road to Diego martin

a. The proposed connector road has the potential to become dangerous if the appropriate traffic enforcement systems are not put in place.
b. Given the short distance between the proposed connector road and the place where drivers must decide to go onto the Diego Martin Main Road or Highway, it is likely that drivers that attempt to go straight onto the highway will either get into accidents or cause accidents for other motorists.
c. The association believes that there should be some traffic management system to prevent drivers who use the connector road from entering the Diego martin highway directly, but rather via the turnoff at Wilson Road

Highlights:

Main questions asked about the project:

1. Would the bowtie in the vicinity of Westshore Medical be closed?
    a. If So, what are the estimated times for those who would now be forced to use alternative routes to get onto western main road?
        i. E.g. turning off by massy stores west mall and coming around
        ii. Stopping at the traffic light and taking the new roundabout at the proposed overpass
        iii. Going into Diego Martin and turning back at four roads
2. What changes, if any, would there be to the rules of the roads that are already in existence?
3. Would the proposed overpass materially decrease congestion in the area? If so, but how much?
4. What volume of traffic currently utilises the proposed overpass?
5. What is the volume of traffic anticipated to use the proposed overpass once completed?
6. How many people currently account for the movements that the overpass will allow?
    a. POS to VK/PM
    b. DM to CHG
    c. CHG to DM
7. Can the proposed drainage infrastructure deal with current and projected runoff for the area?
8. Are there cheaper alternatives to the proposed overpass that can have the same desired impact and take account of projected vehicle ownership in the Diego Martin valley?
9. Could a roundabout replace the traffic light at Columbus Boulevard?

Important features which must be considered in the design of the Diego Martin Vehicular Overpass:

1. Remove the traffic lights at Columbus boulevard
2. Some type of traffic enforcement system to ensure that motorists who use the new connector road to Diego martin are forced to go onto the Diego martin main road, since the distance between the connector road and the intersection of the Diego martin main road/ highway separate, is not short enough for someone to safely go onto the highway from that connector road

4.13 COMMUNITY HOSPITAL OF SEVENTH-DAY ADVENTISTS

Date: September 25th, 2019

Location: Community Hospital of Seventh-day Adventists

Duration: 11:00 AM – 12:00 PM

4.13.1 PERSONS IN ATTENDANCE

Name	Designation	Agency
Dr. Richard Spann	Secretary – Board of Management	Community Hospital of Seventh-day Adventists

4.13.2 CONCERNS RAISED

1. **Bowtie closure**
    a. Community Hospital of Seventh-day Adventists is in favour of closure of the Bowtie. The institution does not see the additional time required to use the proposed overpass as being a negative thing. *"An extra 5 minutes to save your life"*
    b. While the number of fatalities in the vicinity of the bow tie might not be very high, the Community hospital urged us to consider the number of near misses. Patients who use the bowtie to come to the Community Hospital consistently comment on the dangerousness of the bowtie. Many patients tell him when they come to the hospital saying *"Doc' I almost just got killed."*
    c. Because of the short distance between the bowtie and the Community Hospital, many times people going to the Community Hospital miss the turnoff when attempting to cross the three lanes required to get to the northern side of the main road.
    d. The closure would not adversely affect patients in ambulances and emergency situations since patients in the ambulance are stable, and the time that could be saved by driving recklessly is not worth it. In considering other jurisdictions, Rd. Spann highlighted that in the United Kingdom ambulances are only allowed to speed in certain circumstances – and its referred to as blue lighting -
    e. The overpass will have to be introduced with a lot of public education
2. **Impact on residents west of Columbus Boulevard/The traffic light at Columbus boulevard**
    a. Adding additional traffic to the intersection will necessitate an increase in the time spent waiting for every motorist at the intersection. As a result, during peak hours, those leaving and entering Chaguaramas will have to face longer wait times at the intersection. This could possibly be mitigated if the western main road is widened.
3. **Widening western main road by Cocorite**
    a. Public Transportation (maxis and taxis) pose a challenge to the smooth flow of traffic along the Cocorite segment of the western main road. Drivers do not use the lay by and hundreds of members of the community use public transportation daily. They lay by can only accommodate so many people
    b. Maxis come and block the lanes on the morning
    c. Because of that taxi stop, traffic is terrible as well
    d. That could and should be addressed at the same time

e. If they make that change, he thinks the people in Chaguaramas will not complain
f. Police must persistently be present

4. Air Quality

a. The traffic is bad enough to cause health challenges
b. Those coming from petit valley and Diego martin, they are in traffic for 45 minutes to get from where the traffic starts in Diego martin
c. One the lane split into 4, the impact on speed is dramatic
d. The challenge on Wrightson road is the traffic at Colville street and French street
e. People in Diego martin sit and inhale particulates for long periods of time
f. Because of the layout of Diego martin, it is difficult to envisage additional lanes
g. The risk is ever present, so we are exposed to carbon monoxide and many of the less publicised poisons
h. There are lung specialists in the country have noted the increased frequency of cases of sensitive populations with respiratory challenges
    i. Young children (asthmatic kids) who spend a lot of time in these air polluted areas have their asthma worsen and end up coming to the hospital more frequently

5. Mass Transit

a. The government said we can't afford it, but we need it. There is no way you can build enough roads in Trinidad to solve the traffic problems
b. Car ownership is a sign of affluence
    . A young person who just goes into the workplace can get a loan instantly to buy a new car with ease. Historically, people would use public transportation for years before they got one
    i. Foreign used cars make it even easier
    ii. The mindset is to wake up and use your own personal vehicle than get public transportation
    iii. Even if we get a mass transit system, it will be difficult to persuade the population to move away from the convenience afforded by vehicle ownership.
    iv. There are hundreds of thousands of cars on the nation's roads, and now parking has become an issue in areas like Port of Spain
    v. "Development gone awry "
c. <u>Prospect of a Rapid Rail</u>
    . Is it easier to have a car and sit in traffic, or would it be more convenient to use a train to get there in 15 minutes?
    i. In the UK, people get to London on mornings from 200 miles away using trains.
    ii. The time spent travelling is used productively, it is a big difference when compared to using vehicles
d. <u>Water Taxi</u>
    i. He wondered if people would take it up
    ii. It is very well patronised
    iii. It is proof that a there are people who would use a rapid rail system
    iv. Why not privatize the rapid rail system? They would make the money
    v. It shouldn't be that the government invests money into a rapid rail, and then subsidising it in the way they do CAL, and PTSC. Let the private sector do it so that it can be done privately.
e. Toll roads in Jamaica

i. The Chinese built it and they charged tolls for it. The road allows you to use a fast-direct route for a fee. The Chinese did it, why not let them come here and do the same for us.

f. There's a price of development. If we are strapped for cash, it shouldn't prevent us from developing. We need to just find creative ways to do it.

6. Signage

. Non-locals would not be familiar with the alternative routs

a. It would be important to have the traffic light at west mall and how to use the roundabout to come back

b. Many patients at the hospital come from outside the area

c. When they reach, they are often confused

d. For people who are unfamiliar, they often end up in Carenage

7. Health Tourism

a. They don't run the hospital to make money

b. They cover costs

c. They've tried to collaborate

d. But their business model is profit making

e. For profit versus not for profit.

f. They are trying to get their international partners (hundreds of SDA hospitals) to raise the standard of health care offered in Trinidad. E.g. organ transplantation

g. If those things that can't be done now in Trinidad, they can be done here. And that can be niche health tourism

h. It's not that they don't want to, they just have challenges in meeting their requirements - equipment wise.

Highlights:

Main questions asked about the project:

1. Would the proposed overpass and ancillary works include the widening of the Western Main Road?

Important features which must be considered in the design of the Diego Martin Vehicular Overpass:

1. The overpass will have to be introduced with a lot of public education
2. Signage for the proposed overpass
    a. Signage must be comprehensive and clear to allow motorists to be aware of how to use the proposed overpass to get to the community hospital
3. Creation of a designated area off the main road for the collection of passengers from the community

5 APPENDIX E– PUBLIC CONSULTATIONS

5.1 ADVERTISEMENT

5.1.1 PROJECT SUMMARIES LODGED AT REGIONAL CORPORATIONS

5.1.1.1 PUBLIC CONSULTATION 1 (1ST NOTICE)

Notice of Public Meeting

The Government of the Republic of Trinidad and Tobago, through the Ministry of Works and Transport (MOWT) and National Infrastructure Development Company Ltd (NIDCO) will hold a Public Meeting regarding the proposed Construction of a Vehicular Overpass and Related Improvement Works linking the Diego Martin Valley and the Chaguaramas peninsular.

The meeting will be held on **Tuesday June 18, 2019**, at **the Four Roads Government Primary School, Union Road, Diego Martin**. The meeting will be held in a 'townhall' format from **6:00 p.m. to 8:00 p.m**. The purpose of the Public Meeting is to present to the public and receive comments on the proposed project based on an amended design. This meeting is being conducted as part of the Social Impact Assessment of the proposed project. Information would be shared on the process to be used by affected individuals, groups and communities to submit grievances to the MOWT and NIDCO and to seek redress when they believe an adverse impact has arisen from the proposed project activities.

The proposed project would involve preparation of detailed engineering design and construction of:

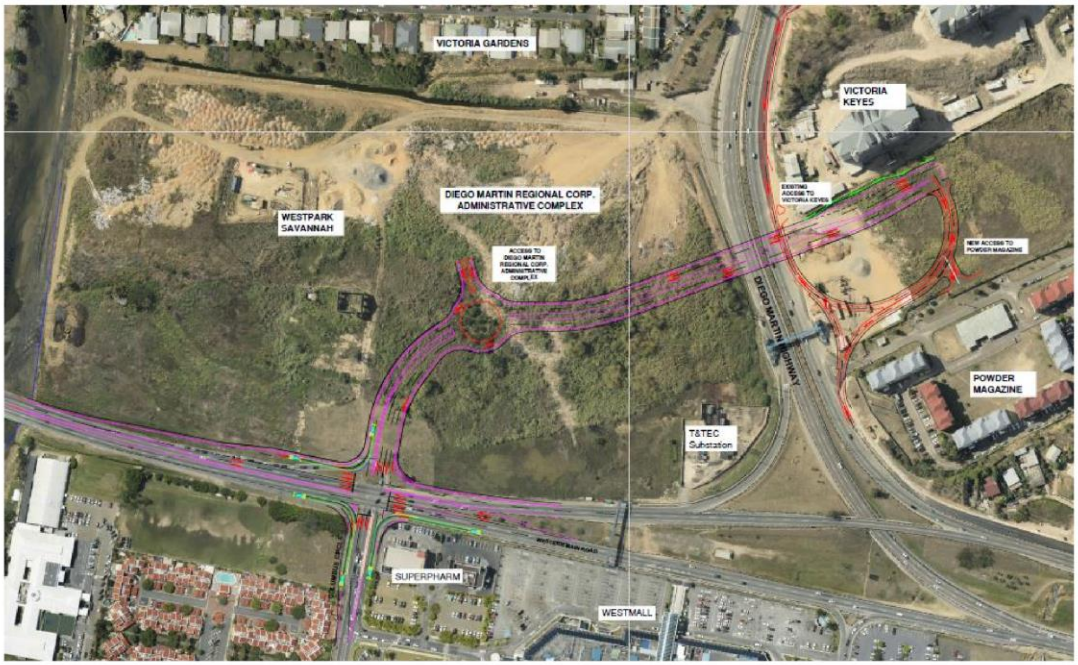
- A four-lane main overpass over Diego Martin Highway (providing a new access to Powder Magazine compound);
- A connector road on the western side of the Diego Martin Highway (that would serve as the main access to the proposed Diego Martin Regional Corporation Administrative Complex and Westpark recreational facilities);
- A connector road on the eastern side of the Diego Martin Highway (that would serve as the new main access to Powder Magazine Phase 2 and egress to both Powder Magazine Phase 2 and Victoria Keyes);
- An access ramp from the western connector road to the northbound Diego Martin Highway;
- Pedestrian facilities/sidewalks; and
- Associated drainage works, inclusive of the construction of new culverts and the replacement of existing culverts.

The proposed project would also widen/re-lane Western Main Road at the intersection of Western Main Road and Columbus Boulevard. The approximate project boundaries are as follows:

- In the East: Powder Magazine Road
- In the West: The eastern end of the Diego Martin River Bridge
- In the North: In the vicinity of Victoria Gardens

- In the South: The southern boundary of the existing Western Main Road

The current preliminary design takes into account concerns of Cabinet and comments and concerns of neighbouring residents and businesses received during the two public meetings held in October and November, 2018.



The purpose of the proposed project is to improved network efficiency, cut travel time and enhance road and pedestrian safety. The project would also improve accessibility to and connectivity with Diego Martin, the Western Peninsula and Port-of-Spain, and neighbouring residential developments, shopping and commercial facilities and institutions.

This Public Meeting is in response to an application made to the Environmental Management Authority (EMA) for a Certificate of Environmental Clearance (CEC 5500/2018) for the Construction of the Vehicular Overpass and Related Improvement Works. The EMA has requested that the MOWT hold at least two public meetings.

An integral part of the CEC process is effective consultation with members of the public and other stakeholders. All interested members of the public are invited to the meeting

with a special call issued to neighbouring communities, including their residents, businesses, institutions, and other stakeholders.

A formal presentation would be made and maps showing the proposed project's location and conceptual engineering design would be available for viewing at the Public Meeting. The Grievance Redress Plan (GRP) will be presented; whereby nearby communities, project employees and others may bring attention to grievances and seek redress from the MOWT and NIDCO for adverse impacts arising from the implementation of project activities.

Written comments from the public regarding this proposed project are welcomed and can be submitted.

FOR MORE INFORMATION OR SUBMISSION OF COMMENTS, PLEASE CONTACT:

MOWT COMMUNICATIONS UNIT
Level 4, Main Administration Building
Ministry of Works and Transport
Cor. Richmond and London Streets, Port-of-Spain
communications@mowt.gov.tt

OR

NIDCO CORPORATE COMMUNICATIONS UNIT
The Atrium
Don Miguel Road Extension
San Juan
communications@nidco.co.tt

5.1.1.2 PUBLIC CONSULTATION 1 (2ND NOTICE DUE TO POSTPONEMENT)

Notice of Public Meeting

The Government of the Republic of Trinidad and Tobago, through the Ministry of Works and Transport (MOWT) and National Infrastructure Development Company Ltd (NIDCO) will hold a Public Meeting regarding the proposed construction of a Vehicular Overpass and Related Improvement Works linking the Diego Martin Valley and the Chaguaramas peninsular.

NIDCO wishes to advise the public that the first public consultation for this project, previously scheduled for Tuesday 18th June 2019, has been rescheduled. This is required to facilitate additional data collection.

The **rescheduled meeting** will be held on **Thursday July 4, 2019**, at **the Four Roads Government Primary School, Union Road, Diego Martin**. The meeting will be held in a 'townhall' format from **6:00 p.m. to 8:00 p.m**. The purpose of the Public Meeting is to present to the public and receive comments on the proposed project based on an amended design. This meeting is being conducted as part of the Social Impact Assessment of the proposed project. Information would be shared on the process to be used by affected individuals, groups and communities to submit grievances to the MOWT and NIDCO and to seek redress when they believe an adverse impact has arisen from the proposed project activities.

The proposed project would involve preparation of detailed engineering design and construction of:

- A four-lane main overpass over Diego Martin Highway (providing a new access to Powder Magazine compound);
- A connector road on the western side of the Diego Martin Highway (that would serve as the main access to the proposed Diego Martin Regional Corporation Administrative Complex and Westpark recreational facilities);
- A connector road on the eastern side of the Diego Martin Highway (that would serve as the new main access to Powder Magazine Phase 2 and egress to both Powder Magazine Phase 2 and Victoria Keys);
- An access ramp from the western connector road to the northbound Diego Martin Highway;
- Pedestrian facilities/sidewalks; and
- Associated drainage works, inclusive of the construction of new culverts and the replacement of existing culverts.

The proposed project would also widen/re-lane Western Main Road at the intersection of Western Main Road and Columbus Boulevard. The approximate project boundaries are as follows:

- In the East: Powder Magazine Road
- In the West: The eastern end of the Diego Martin River Bridge on Western Main Road
- In the North: In the vicinity of Victoria Gardens
- In the South: The southern boundary of the existing Western Main Road,

The current preliminary design takes into account concerns of Cabinet and comments and concerns of neighbouring residents and businesses received during the two public meetings held in October and November, 2018.


VICTORIA VILLAS ACCESS
DIEGO MARTIN HWY NB LANES
DIEGO MARTIN HWY SB LANES
ROAD A
VICTORIA KEYES
MOT ACCESS
DIEGO MARTIN REGIONAL CORP. ADMINISTRATIVE COMPLEX
WESTPARK SAVANNAH
EXISTING ACCESS TO VICTORIA KEYES
ACCESS TO DIEGO MARTIN REGIONAL CORP. ADMINISTRATIVE COMPLEX
NEW ACCESS TO POWDER MAGAZINE
CONNECTOR RD
ROAD D
POWDER MAGAZINE
T&TEC Substation
ROAD B
WESTERN MAIN ROAD WB LANES
COLUMBUS BLVD
WESTERN MAIN ROAD EB LANE
SUPERPHARM
WESTMALL

The purpose of the proposed project is to improved network efficiency, cut travel time and enhance road and pedestrian safety. The project would also improve accessibility to and connectivity with Diego Martin, the Western Peninsula and Port-of-Spain, and neighbouring residential developments, shopping and commercial facilities and institutions.

This Public Meeting is in response to an application made to the Environmental Management Authority (EMA) for a Certificate of Environmental Clearance (CEC 5500/2018) for the construction of the Vehicular Overpass and Related Improvement Works. The EMA has requested that the MOWT hold at least two public meetings.

An integral part of the CEC process is effective consultation with members of the public and other stakeholders. All interested members of the public are invited to the meeting with a special call issued to neighbouring communities, including their residents, businesses, institutions, and other stakeholders.

A formal presentation will be made and maps showing the proposed project's location and conceptual engineering design will be available for viewing at the Public Meeting. The Grievance Redress Plan (GRP) will be presented whereby nearby communities, project employees and others may bring attention to grievances and seek redress from the MOWT and NIDCO for adverse impacts arising from the implementation of project activities.

Written comments from the public regarding this proposed project are welcomed and can be submitted.

FOR MORE INFORMATION OR SUBMISSION OF COMMENTS, PLEASE CONTACT:

MOWT COMMUNICATIONS UNIT
Level 4, Main Administration Building
Ministry of Works and Transport
Cor. Richmond and London Streets, Port-of-Spain
communications@mowt.gov.tt

OR

NIDCO CORPORATE COMMUNICATIONS UNIT
The Atrium
Don Miguel Road Extension
San Juan
communications@nidco.co.tt

5.1.1.3 PUBLIC CONSULTATION 2

Notice of Public Meeting

The Government of the Republic of Trinidad and Tobago, through the Ministry of Works and Transport (MOWT) and the National Infrastructure Development Company Ltd (NIDCO) will hold a second public consultation regarding the proposed Construction of a Vehicular Overpass in the vicinity of Powder Magazine and Related Improvement Works linking the Diego Martin Valley and the Western peninsular.

The meeting will be held on **Thursday 26 September 2019**, at **the Four Roads Government Primary School, Union Road, Diego Martin** in a 'townhall' format from **6:00 p.m. to 8:00 p.m.** The purpose of this second public consultation is to **present the findings of the Social Impact Assessment**, to clearly outline how potential impacts will be mitigated and to show how the public's initial concerns were incorporated into the project design. Additionally, this meeting will **provide a detailed outline of the final Grievance Redress Process** and how affected individuals, groups and communities could submit grievances to seek redress where adverse impacts are experienced as a result of proposed project activities.

The proposed Construction of a Vehicular Overpass in the vicinity of Powder Magazine and Related Improvement Works involves the detailed design and construction of the following (Figure 1):

- **A four-lane main overpass over Diego Martin Highway** (providing a new access road to the Powder Magazine compound);
- **A connector road on the western side of the Diego Martin Highway** (that would serve as the main access to the proposed Diego Martin Regional Corporation Administrative Complex and First Citizens Bank);
- **A connector road on the eastern side of the Diego Martin Highway** (that would serve as the new main access to Powder Magazine Phase 2 and egress from both Powder Magazine Phase 2 and Victoria Keyes residential compounds);
- **An access ramp from the western connector road** to the northbound Diego Martin Highway;
- **Pedestrian facilities/sidewalks**; and
- **Associated drainage works**, inclusive of the construction of new culverts, the replacement of existing culverts and cleaning of existing drains.

The proposed project would also widen/re-lane Western Main Road at the intersection of Western Main Road and Columbus Boulevard. The approximate project boundaries are as follows:

- **In the East:** Powder Magazine Road
- **In the West:** The eastern end of the Diego Martin River Bridge
- **In the North:** In the vicinity of Victoria Gardens
- **In the South:** The southern boundary of the existing Western Main Road



Figure 1: Conceptual Design of the Construction of a Vehicular Overpass in the vicinity of Powder Magazine and Related Improvement Works Project

The purpose of the project is fourfold:

1. Improve the transportation network in order to accommodate future growth and development in the Western Peninsula;
2. Improve the connectivity for the commuters from the Diego Martin Valley heading into the Western Peninsula;
3. Provide access to new and proposed developments in the vicinity of the intersection of the Diego Martin Highway and the Western Main Road; and
4. Improve road safety and network efficiency by eliminating unsafe turning movements and circuitous movements.

This Social Impact Assessment is in response to an application made to the Environmental Management Authority (EMA) for a Certificate of Environmental Clearance (CEC 5500/2018) for the Construction of a Vehicular Overpass in the vicinity of Powder Magazine and Related Improvement Works. An integral part of the CEC process is effective consultation with members of the public and other stakeholders. A formal presentation would be made highlighting the issues emerging from the Social Impact Assessment, the proposed mitigation measures and the Social Management Plan. The Grievance Redress Plan (GRP) will also be presented whereby affected stakeholders may lodge grievances and seek redress from the MOWT and NIDCO for adverse impacts arising from the implementation of project activities (Figure 2).

All interested members of the public are invited to the meeting with a special call issued to neighbouring communities, including residents, businesses, institutions, and other stakeholders.

Written comments from the public regarding this proposed project are welcomed and can be submitted.

FOR MORE INFORMATION OR SUBMISSION OF COMMENTS, PLEASE CONTACT:

MOWT COMMUNICATIONS UNIT
Level 4, Main Administration Building
Ministry of Works and Transport
Cor. Richmond and London Streets, Port-of-Spain
communications@mowt.gov.tt

OR

NIDCO CORPORATE COMMUNICATIONS UNIT
The Atrium
Don Miguel Road Extension
San Juan
communications@nidco.co.tt

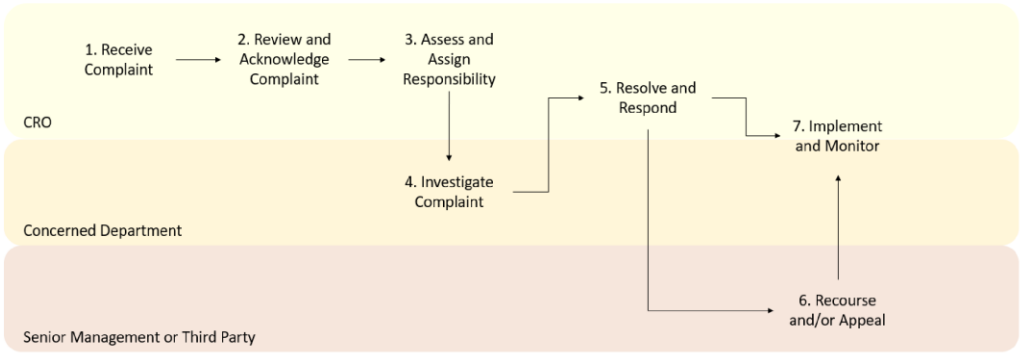
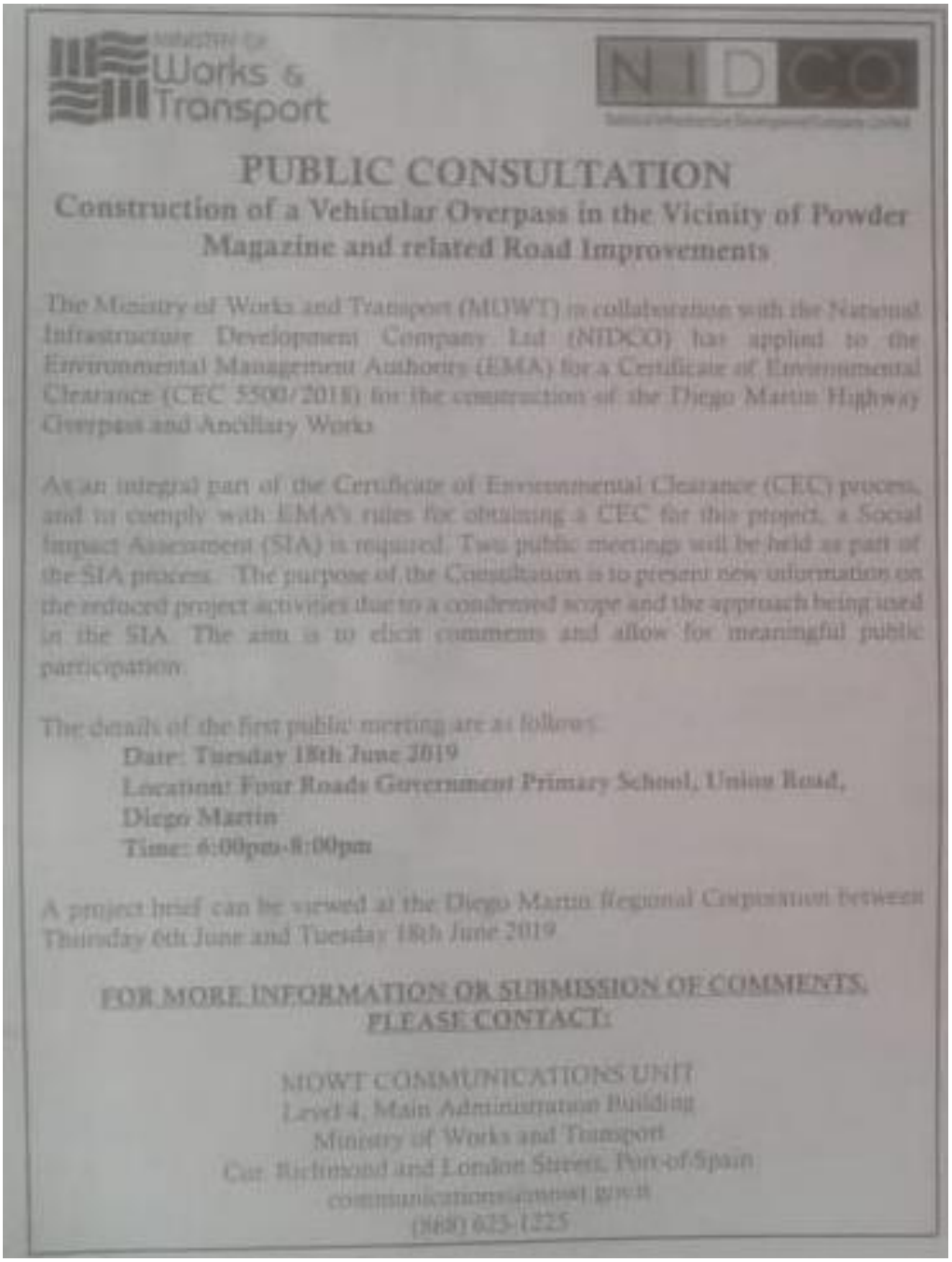


Figure 2: Steps and Organizational Level in the Grievance Redress Process

5.1.2 NEWSPAPER ADVERTISEMENTS

5.1.2.1 PUBLIC CONSULTATION 1 (1ST ADVERTISEMENT)

The first advert that was published on Friday 7th June 2019 in the Newsday. However, it was not published in the Guardian due to the postponement of the public consultation.



Ministry of Works & Transport

NIDCO

PUBLIC CONSULTATION

Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and related Road Improvements

The Ministry of Works and Transport (MOWT) in collaboration with the National Infrastructure Development Company Ltd (NIDCO) has applied to the Environmental Management Authority (EMA) for a Certificate of Environmental Clearance (CEC 5500/2018) for the construction of the Diego Martin Highway Overpass and Ancillary Works

As an integral part of the Certificate of Environmental Clearance (CEC) process, and to comply with EMA's rules for obtaining a CEC for this project, a Social Impact Assessment (SIA) is required. Two public meetings will be held as part of the SIA process. The purpose of the Consultation is to present new information on the enforced project activities due to a condensed scope and the approach being used in the SIA. The aim is to elicit comments and allow for meaningful public participation.

The details of the first public meeting are as follows:

Date: Tuesday 18th June 2019
Location: Four Roads Government Primary School, Union Road, Diego Martin
Time: 6:00pm-8:00pm

A project brief can be viewed at the Diego Martin Regional Corporation between Thursday 6th June and Tuesday 18th June 2019

FOR MORE INFORMATION OR SUBMISSION OF COMMENTS, PLEASE CONTACT:

MOWT COMMUNICATIONS UNIT
Level 4, Main Administration Building
Ministry of Works and Transport
Cor. Richmond and London Streets, Port-of-Spain
communications@mowt.gov.tt
(868) 625-1225

5.1.2.2 PUBLIC CONSULTATION 1 (2ND ADVERTISEMENT DUE TO POSTPONEMENT)

Due to the postponement of the public consultation, the revised advertisement published on Thursday 27th June in the Guardian and Monday 1st July in the Newsday.

MINISTRY OF Works & Transport

NIDCO
National Infrastructure Development Company Limited

RESCHEDULING OF PUBLIC CONSULTATION

Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and related Road Improvements

The Ministry of Works and Transport (MOWT) in collaboration with the National Infrastructure Development Company Ltd (NIDCO) has applied to the Environmental Management Authority (EMA) for a Certificate of Environmental Clearance (CEC 5500/2018) for the Construction of a Vehicular Overpass in the vicinity of Powder Magazine and Related Road Improvements Project.

As an integral part of the Certificate of Environmental Clearance (CEC) process, and to comply with EMA's rules for obtaining a CEC for this project, a Social Impact Assessment (SIA) is required. Two public meetings will be held as part of the SIA process. The purpose of the Consultation is to present new information on the reduced project activities due to a condensed scope and the approach being used in the SIA. The aim is to elicit comments and allow for meaningful public participation.

NIDCO wishes to advise the public that the first public consultation for this project, scheduled for Tuesday 18th June 2019 has been **rescheduled.**

The **new details** for the first public meeting for the SIA are as follows:

Date: Thursday 4th July 2019
Location: Four Roads Government Primary School, Union Road, Diego Martin
Time: 6:00pm-8:00pm

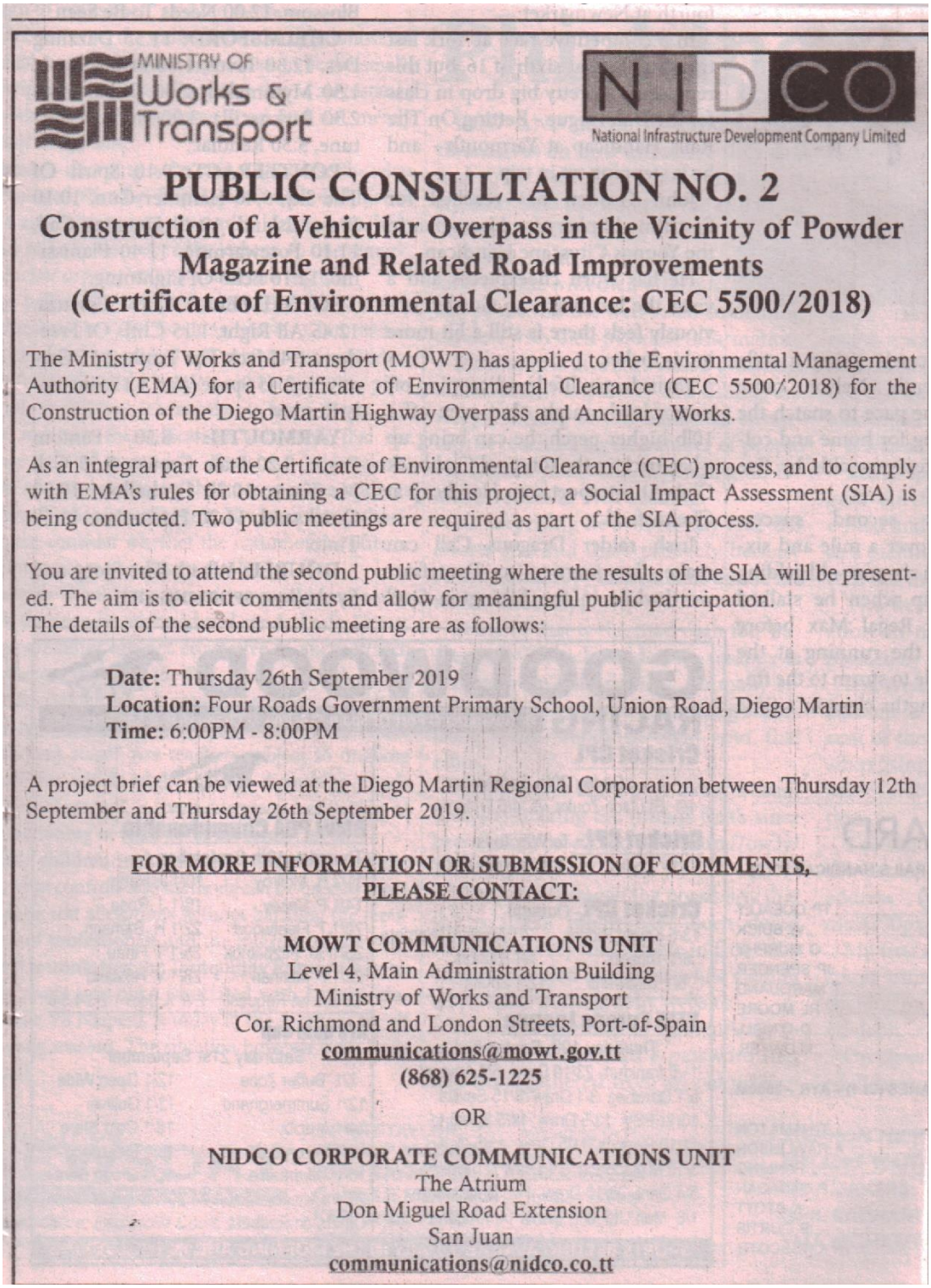
An updated project brief can be viewed at the Diego Martin Regional Corporation between Tuesday 18th June 2019 and Thursday 4th July 2019.

FOR MORE INFORMATION OR SUBMISSION OF COMMENTS, PLEASE CONTACT:

MOWT COMMUNICATIONS UNIT
Level 4, Main Administration Building
Ministry of Works and Transport
Cor. Richmond and London Streets, Port-of-Spain
communications@mowt.gov.tt
(868) 625-1225

5.1.2.3 PUBLIC CONSULTATION 2

5.1.2.3.1 TRINIDAD NEWSDAY - THURSDAY 19TH SEPTEMBER 2019



MINISTRY OF Works & Transport

NIDCO
National Infrastructure Development Company Limited

PUBLIC CONSULTATION NO. 2

Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements (Certificate of Environmental Clearance: CEC 5500/2018)

The Ministry of Works and Transport (MOWT) has applied to the Environmental Management Authority (EMA) for a Certificate of Environmental Clearance (CEC 5500/2018) for the Construction of the Diego Martin Highway Overpass and Ancillary Works.

As an integral part of the Certificate of Environmental Clearance (CEC) process, and to comply with EMA's rules for obtaining a CEC for this project, a Social Impact Assessment (SIA) is being conducted. Two public meetings are required as part of the SIA process.

You are invited to attend the second public meeting where the results of the SIA will be presented. The aim is to elicit comments and allow for meaningful public participation.
The details of the second public meeting are as follows:

Date: Thursday 26th September 2019
Location: Four Roads Government Primary School, Union Road, Diego Martin
Time: 6:00PM - 8:00PM

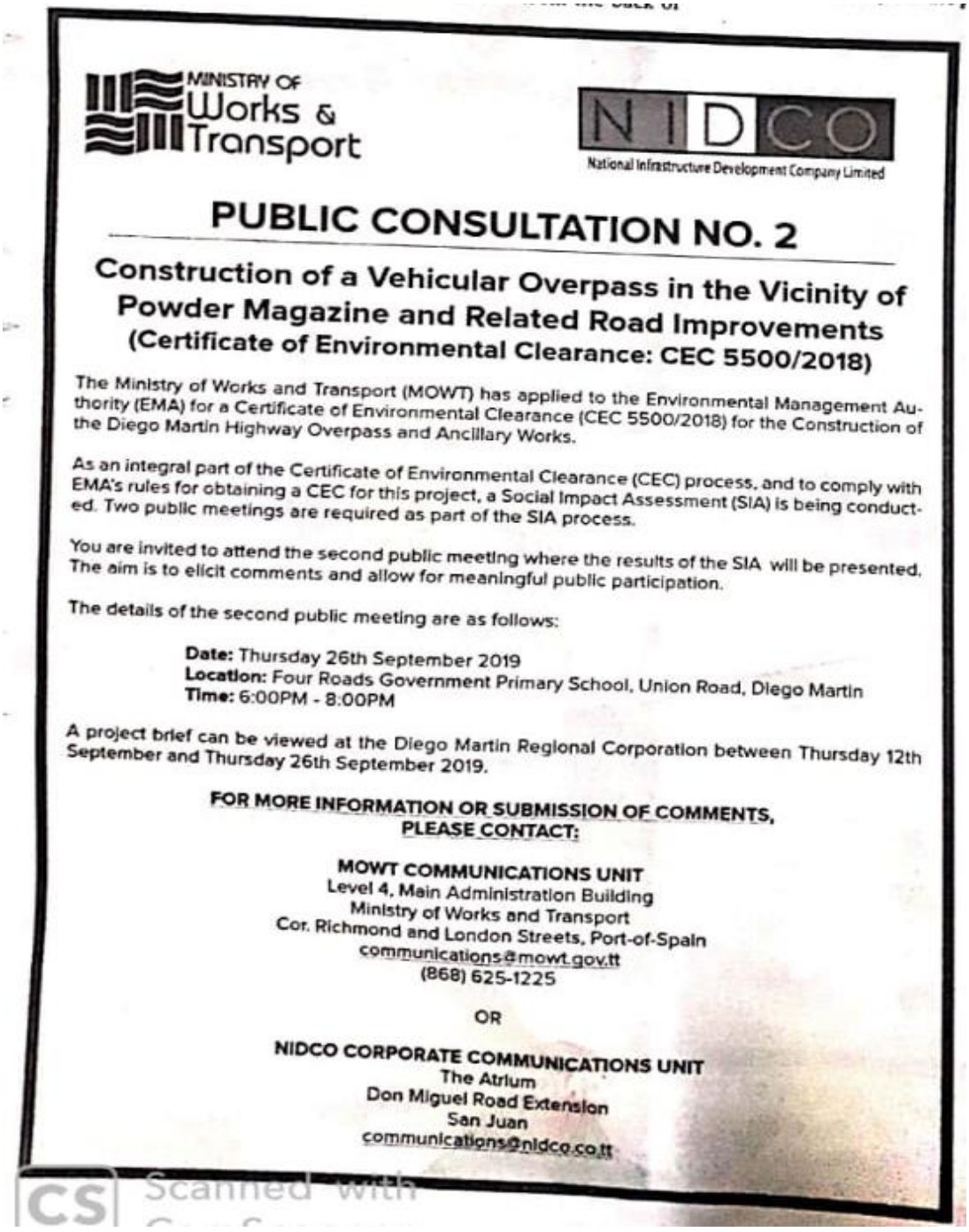
A project brief can be viewed at the Diego Martin Regional Corporation between Thursday 12th September and Thursday 26th September 2019.

FOR MORE INFORMATION OR SUBMISSION OF COMMENTS, PLEASE CONTACT:

MOWT COMMUNICATIONS UNIT
Level 4, Main Administration Building
Ministry of Works and Transport
Cor. Richmond and London Streets, Port-of-Spain
communications@mowt.gov.tt
(868) 625-1225

OR

NIDCO CORPORATE COMMUNICATIONS UNIT
The Atrium
Don Miguel Road Extension
San Juan
communications@nidco.co.tt



MINISTRY OF Works & Transport

NIDCO
National Infrastructure Development Company Limited

PUBLIC CONSULTATION NO. 2

Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements (Certificate of Environmental Clearance: CEC 5500/2018)

The Ministry of Works and Transport (MOWT) has applied to the Environmental Management Authority (EMA) for a Certificate of Environmental Clearance (CEC 5500/2018) for the Construction of the Diego Martin Highway Overpass and Ancillary Works.

As an integral part of the Certificate of Environmental Clearance (CEC) process, and to comply with EMA's rules for obtaining a CEC for this project, a Social Impact Assessment (SIA) is being conducted. Two public meetings are required as part of the SIA process.

You are invited to attend the second public meeting where the results of the SIA will be presented. The aim is to elicit comments and allow for meaningful public participation.

The details of the second public meeting are as follows:

Date: Thursday 26th September 2019
Location: Four Roads Government Primary School, Union Road, Diego Martin
Time: 6:00PM - 8:00PM

A project brief can be viewed at the Diego Martin Regional Corporation between Thursday 12th September and Thursday 26th September 2019.

FOR MORE INFORMATION OR SUBMISSION OF COMMENTS, PLEASE CONTACT:

MOWT COMMUNICATIONS UNIT
Level 4, Main Administration Building
Ministry of Works and Transport
Cor. Richmond and London Streets, Port-of-Spain
communications@mowt.gov.tt
(868) 625-1225

OR

NIDCO CORPORATE COMMUNICATIONS UNIT
The Atrium
Don Miguel Road Extension
San Juan
communications@nidco.co.tt

CS Scanned with

5.1.3 FLYERS

5.1.3.1 PUBLIC CONSULTATION 1 (1ST FLYER)

Hard copies of flyers disseminated at the following locations on Tuesday 24th September 2019

First Round- Distribution

- Peakes Gas Station
- Westshore medical
- Westmall
- Massy Westmoorings
- The Towers
- Spanish Court - Westmoorings
- International school of Port of Spain
- La Rivera- Westmoorings
- The Chamber of Commerce
- Massy- Glencoe
- Kappa Drugs- Glencoe
- Diego Martin Regional Corp
- La Puerta Govt Primary School
- Four Roads Government Primary School
- St. Finbars
- St. Anthony's
- Victoria Villas
- Victoria Gardens
- Gas Station -Starlite
- Massy- Four Roads
- Starlite shopping
- Massy- Alyce Glen
- Maple leaf international
- Powder Magazine Phase 2 community centre
- Victoria Keyes-
- D&S minimart powder magazine
- Phase 1 Powder Magazine
- WestBees Supermarket
- Keron Seebaran- Councillor Diamond Vale

Public Consultation

Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and related Road Improvements

The Government of the Republic of Trinidad and Tobago, through the Ministry of Works and Transport (MOWT) and National Infrastructure Development Company Ltd (NIDCO) will hold a Public Meeting regarding the proposed construction of a Vehicular Overpass and Related Improvement Works linking the Diego Martin Valley and the Chaguaramas peninsular.

This Public Meeting is in response to an application made to the Environmental Management Authority (EMA) for a Certificate of Environmental Clearance (CEC 5500/2018) for the construction of the Vehicular Overpass and Related Improvement Works. The EMA has requested that the MOWT conduct a Social Impact Assessment and hold two public meetings.

Date: Tuesday 18th June 2019

Time: 6pm-8pm

Venue: Four Roads Gov't Primary School, Union Road Diego Martin

On the evening we will be:

- asking for ***your comments*** regarding the proposed design

- ***sharing information on*** the Social Impact Assessment



CONTACT for more information MOWT COMMUNICATIONS UNIT at 625-1225
Document lodged at Diego Martin Regional Corporation for PUBLIC REVIEW

MINISTRY OF Works & Transport

NIDCO
National Infrastructure Development Company Limited

5.1.3.2 PUBLIC CONSULTATION 1 (2ND FLYER DUE TO POSTPONEMENT)

Hard copies of flyers disseminated at the following locations on Tuesday 24th September 2019

- Victoria Gardens
- Victoria Villas
- Powder Magazine 1
- Powder Magazine 2
- Massy
- Four Roads
- Westmoorings
- Alyce Glen
- Glencoe
- Four Roads Gas Station
- Starlite Gas Station
- West Mall
- Starlite Shopping Mall
- Four Roads Government School
- St. Anthony's College
- International School of Port of Spain

NEW DATE ALERT!

Public Consultation

Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and related Road Improvements

The Government of the Republic of Trinidad and Tobago, through the Ministry of Works and Transport (MOWT) and National Infrastructure Development Company Ltd (NIDCO) will hold a Public Consultation Meeting regarding the proposed construction of a Vehicular Overpass in the vicinity of Powder Magazine and Related Improvement Works linking the Diego Martin Valley and the Western Peninsular.

This Public Consultation Meeting is in response to an application made to the Environmental Management Authority (EMA) for a Certificate of Environmental Clearance (CEC 5500/2018) for the construction of a Vehicular Overpass in the vicinity of Powder Magazine and Related Improvement Works. The EMA has requested that the MOWT conduct a Social Impact Assessment and hold two public meetings.

Date: Thursday 4th July 2019

Time: 6pm-8pm

Venue: Four Roads Gov't Primary School, Union Road Diego Martin

At the meeting, we will be:

- **sharing information** on the Social Impact Assessment

- asking for **your comments** on the project



CONTACT for more information MOWT COMMUNICATIONS UNIT at 625-1225

Document lodged at Diego Martin Regional Corporation for PUBLIC REVIEW

MINISTRY OF Works & Transport

NIDCO
National Infrastructure Development Company Limited

5.1.3.3 PUBLIC CONSULTATION 2 – SEPTEMBER 26TH, 2019

Digital flyers sent to participants of first public consultation and stakeholder engagement process. Hard copies of flyers disseminated at the following locations on Tuesday 24th September 2019

- The Towers
- Trinidad and Tobago Chamber of Commerce
- Spanish Court
- International School of Port of Spain
- La Fontaine
- La Riviera
- Massy Stores Glencoe
- Massy Stores Starlite
- Chaconia Crescent
- Victoria Gardens
- West Bees Supermarket
- Massy Stores Alyce Glen
- Four Roads Intersection
- Four Roads Government Primary
- Victoria Keyes
- Powder Magazine 1 and 2
- Community Hospital of Seventh-day Adventists
- Peakes Gas Station
- Bayside Towers
- Westshore Medical

Public Consultation

ROUND 2

Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and related Road Improvements

The Government of the Republic of Trinidad and Tobago, through the Ministry of Works and Transport (MOWT) and National Infrastructure Development Company Ltd (NIDCO) will hold a Public Meeting regarding the proposed construction of a Vehicular Overpass and Related Improvement Works linking the Diego Martin Valley and the Chaguaramas peninsular.

This Public Meeting is in response to an application made to the Environmental Management Authority (EMA) for a Certificate of Environmental Clearance (CEC 5500/2018) for the construction of the Vehicular Overpass and Related Improvement Works. The EMA has requested that the MOWT conduct a Social Impact Assessment and hold two public meetings.

Date: Thursday 26 September 2019

Time: 6pm-8pm

Venue: Four Roads Gov't Primary School, Union Road Diego Martin

On the evening we will be:

- ***Sharing information on*** the Social Impact Assessment and proposed mitigation measures



CONTACT for more information MOWT COMMUNICATIONS UNIT at 625-1225

Document lodged at Diego Martin Regional Corporation for PUBLIC REVIEW

MINISTRY OF Works & Transport

NIDCO
National Infrastructure Development Company Limited

5.2 LETTERS

5.2.1 PUBLIC CONSULTATION 1 (1ST DRAFT LETTER)

KAIRI LETTER HEAD

2019 July 01

<NAME>
<POSITION>
<ORGANISATION>
<ADDRESS>

Dear <INSERT NAME>

Re: Invitation to Public Meeting – Social Impact Assessment for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements Project

The Ministry of Works and Transport (MOWT) through the National Infrastructure Development Company Ltd (NIDCO) has embarked on a project to improve the intersection of the Diego Martin Highway and the Western Main Road for improved access, safety, mobility, and connectivity.

MOWT has applied to the Environmental Management Authority (EMA) for a Certificate of Environmental Clearance (CEC 5500/2018) for the construction of a Vehicular Overpass in the vicinity of Powder Magazine and Related Improvement Works. As an integral part of the CEC process, MOWT through NIDCO is required to conduct a Social Impact Assessment (SIA). The EMA has requested that the MOWT hold two additional public consultation meetings with neighbouring communities, including residents, businesses, institutions and other stakeholders.

As a key stakeholder, this letter serves to invite you to the first public meeting to be held on **Thursday July 4, 2019** at the **Four Roads Government Primary School, Union Road, Diego Martin**. The meeting, which will be conducted in a 'townhall' format, is being held from **6:00 p.m. to 8:00 p.m**. The purpose of the Public Meeting is to present to the public and receive comments on the:

- Proposed Vehicular Overpass project;
- Approach being taken to undertake a Social Impact Assessment for the project;
- Grievance redress process to be used by affected individuals, groups and communities.

A presentation would be made and maps showing the proposed project's location and conceptual design would be made available for public viewing. The Grievance Redress Plan (GRP) will be presented; whereby nearby communities, project employees and others may bring attention to grievances and seek redress from the MOWT and or NIDCO for adverse impacts arising from the implementation of project activities.

You may contact MOWT's Civil Engineer, Mrs. Rose Marie Maraj-Wright at 625-3723 or rmaraj-wright@mowt.gov.tt OR NIDCO's Project Engineer, Mrs. Lynn Marie Cameron at 674-8042 ext. 370 or LCameron@nidco.co.tt for any further information or clarification on the project. If you wish to confirm your attendance, please contact Kairi Consultants Ltd at 663 2677/1442.

Regards,

.....
Kairi Consultant Representative

Social Impact Assessment for the Construction of a Vehicular Overpass in the vicinity of Powder Magazine and related Road Improvements

Stakeholder listing for issuing Invitation Letters for the 1st Public Meeting on Thursday 4th July,2019

Governmental	**Residences and Community Based**
Members of Parliament -Diego Martin West	Victoria Keyes
Members of Parliament -Diego Martin Central	Victoria Gardens Residents Association
Members of Parliament -Diego Martin North	Victoria Villas
Members of Parliament -Port of Spain	Powder Magazine Phase 1 Committee
Minister of Works and Transport	Powder Magazine Phase 2 Management
Director of Drainage	Regents Garden Limited
Port of Spain City Corporation	Regents Towers
Diego Martin Regional Corporation	Ridgewood Towers Four Roads
Town and Country Planning Division (TCPD)	Bayside Towers
Environmental Management Authority (EMA)	North West Moorings Homeowners Association
Housing Development Corporation	Acton Court
Ministry of National Security, Trinidad and Tobago Fire Services Division (TTFS)/Four	Hillcrest Drive/Petit Valley
Ministry of National Security, Trinidad and Tobago Police Service (TTPS)/Four Roads	Four Roads Community Council
Ministry of Public Utilities	New Dimension Four Roads Community Group
Trinidad and Tobago Electricity Commission (T&TEC)	Powder Magazine Phase 2 Management
Public Transport Service Corporation (PTSC)	Cocorite Community Council
Telecommunications Services of Trinidad and Tobago	South Diego Martin Community Council
The National Gas Company of Trinidad and Tobago	Belle Vue/Debe/ Dundonald Hill Community
	Westmoorings Gardens Limited
Businesses	
Trinidad and Tobago Chamber of Commerce	**Sensitive Human Receptors (Schools &**
The Falls at West Mall	Four Roads Government Primary
Starlite Shopping Plaza	The International School of Port of Spain
Guardian Life- Westmoorings	Community Hospital of Seventh-day Adventists
Massy- Westmoorings	West Shore Medical Private Hospital
Massy- Four Roads	
SupherPharm- Westmoorings	**Non- Governmental Organization**
	Diego Martin/ Petit Valley Taxi Driver's
	Route 1 Maxi Taxi Association

5.2.2 PUBLIC CONSULTATION 1 (2ND DRAFT LETTER DUE TO POSTPONEMENT)

KAIRI LETTER HEAD

September 19, 2019

<NAME>
<POSITION>
<ORGANISATION>
<ADDRESS>

Dear <INSERT NAME>,

Re: Invitation to Second Public Meeting – Social Impact Assessment for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements Project

The Ministry of Works and Transport (MOWT) through the National Infrastructure Development Company Ltd (NIDCO) has embarked on a project to improve the intersection of the Diego Martin Highway and the Western Main Road for improved access, safety, mobility, and connectivity.

MOWT has applied to the Environmental Management Authority (EMA) for a Certificate of Environmental Clearance (CEC 5500/2018) for the Construction of a Vehicular Overpass in the vicinity of Powder Magazine and Related Improvement Works. As an integral part of the CEC process, a Social Impact Assessment (SIA) must be conducted. The EMA has requested that the MOWT hold two additional public consultation meetings with neighbouring communities, including residents, businesses, institutions and other stakeholders.

As a key stakeholder, this letter serves to invite you to the second public meeting to be held on **Thursday September 26, 2019** at the **Four Roads Government Primary School, Union Road, Diego Martin**. The meeting, which will be conducted in a 'townhall' format, is being held from **6:00 p.m. to 8:00 p.m**. The purpose of the Public Meeting is to present to the public and receive comments on the:

- the findings of the Social Impact Assessment and proposed mitigation measures; and
- the extent to which your initial concerns were incorporated into the project design.

A presentation would be made, which would include maps showing the proposed project's location and the conceptual design. The Grievance Redress Process will be presented; whereby affected stakeholders (individuals, organisations, communities, and others) may raise concerns and complaints about the project and seek timely resolution.

5.2.3 PUBLIC CONSULTATION 2

KAIRI LETTER HEAD

You may contact the MOWT's Communications Unit at 625-1225 or communications@mowt.gov.tt OR NIDCO's Corporate Communications Unit at communications@nidco.co.tt for more information. If you wish to confirm your attendance, please contact Kairi Consultants Ltd at 663 2677/1442.

Regards,

.....
Kairi Consultants Representative

Social Impact Assessment for the Construction of a Vehicular Overpass in the vicinity of Powder Magazine and related Road Improvements

Stakeholder listing for issuing Invitation Letters for the 1st Public Meeting on September 19th 2019

Governmental	**Residences and Community Based**
Members of Parliament -Diego Martin West	Victoria Keyes
Members of Parliament -Diego Martin Central	Victoria Gardens Residents Association
Members of Parliament -Diego Martin North	Victoria Villas
Members of Parliament -Port of Spain	Powder Magazine Phase 1 Committee
Minister of Works and Transport	Powder Magazine Phase 2 Management
Director of Drainage	Regents Garden Limited
Port of Spain City Corporation	Regents Towers
Diego Martin Regional Corporation	Ridgewood Towers Four Roads
Town and Country Planning Division (TCPD)	Bayside Towers
Environmental Management Authority (EMA)	North West Moorings Homeowners Association
Housing Development Corporation	Acton Court
Ministry of National Security, Trinidad and Tobago Fire Services Division (TTFS)/Four	Hillcrest Drive/Petit Valley
Ministry of National Security, Trinidad and Tobago Police Service (TTPS)/Four Roads	Four Roads Community Council
Ministry of Public Utilities	New Dimension Four Roads Community Group
Trinidad and Tobago Electricity Commission (T&TEC)	Powder Magazine Phase 2 Management
Public Transport Service Corporation (PTSC)	Cocorite Community Council
Telecommunications Services of Trinidad and Tobago	South Diego Martin Community Council
The National Gas Company of Trinidad and Tobago	Belle Vue/Debe/ Dundonald Hill Community
	Westmoorings Gardens Limited
Businesses	
Trinidad and Tobago Chamber of Commerce	**Sensitive Human Receptors (Schools &**
The Falls at West Mall	Four Roads Government Primary
Starlite Shopping Plaza	The International School of Port of Spain
Guardian Life- Westmoorings	Community Hospital of Seventh-day Adventists
Massy- Westmoorings	West Shore Medical Private Hospital
Massy- Four Roads	
SupherPharm- Westmoorings	**Non- Governmental Organization**
	Diego Martin/ Petit Valley Taxi Driver's
	Route 1 Maxi Taxi Association

5.3 AGENDA

5.3.1 PUBLIC CONSULTATION 1 – JULY 4TH, 2019

Stakeholder Consultation Meeting

Construction of a Vehicular Overpass in the vicinity of Powder Magazine and Related Road Improvements Project
July 4th 2019
Four Roads Government Primary School, Diego Martin
6pm-8pm

SIA Public Consultation Programme

National Anthem

Welcome and Prelude
Dr. Ralph Henry, Kairi Consultants Limited
Welcome and Protocol
House Announcements & Safety Briefing
Introduction of Head Table
Programme Briefing

Presentation 1: Revised Conceptual Design and Project Information
Ms. Andrea Abel, Trintoplan Consultants Limited

Presentation 2: Social Impact Assessment (CEC 5500/2018)
Dr. Ralph Henry, Kairi Consultants Limited

Questions / Comments

Closing Exercises

Vote of Thanks

5.3.2 PUBLIC CONSULTATION 2 – SEPTEMBER 26TH, 2019

5.4 HANDOUTS

5.4.1 PUBLIC CONSULTATION 1 – JULY 4TH, 2019

GRIEVANCE REDRESS MECHANISM (GRM) – USER GUIDE

Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements

What is the GRM?

The GRM is the tool that persons affected by the project can use to seek assistance for their complaints or grievances.

Who can use the GRM?

Individuals, communities, groups, businesses, institutions and other stakeholders affected by the project.

STEPS FOR FILING A COMPLAINT & PROCESS

1. **Report complaint either verbally or in writing by calling the number provided or sending an email to the address provided to the Community Relations Officer (CRO).**

2. **Provide the following details:**
   - ✓ Date of your grievance submission
   - ✓ Your name (optional)
   - ✓ Date and time of the incident
   - ✓ Description of the complaint/grievance
   - ✓ Number of persons affected
   - ✓ Contact information (email, phone number or address)
   - ✓ Additional documents (evidence, photos etc)

3. **A receipt will be provided to you.**

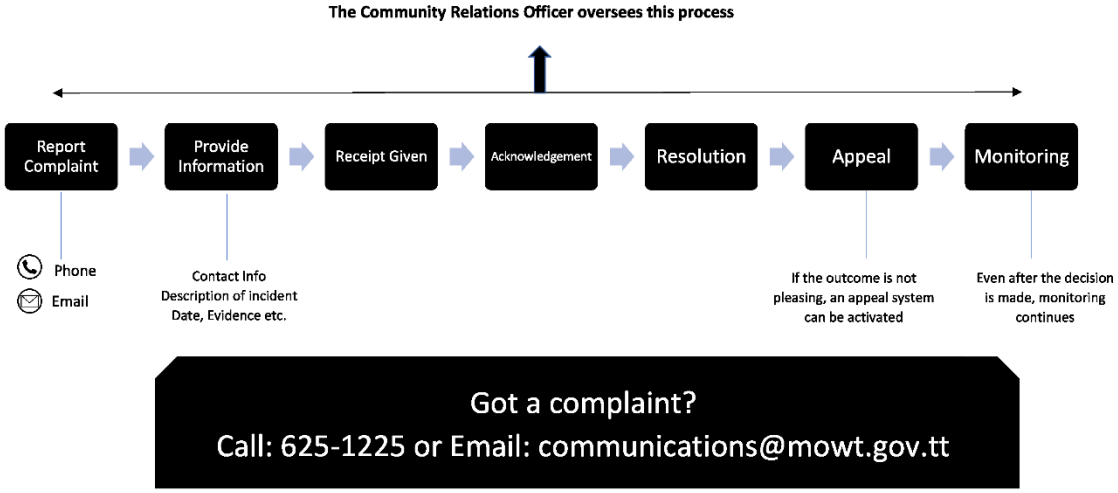
4. **The Ministry of Works & Transport (MOWT) will provide written acknowledgement within 10 working days of the receipt of your submission.**

5. **All claims will be resolved within 45 business days of the claim submission** (urgent cases will be resolved in less time).

6. **If you are not pleased with the resolution, there is an appeal process that can be activated.**

7. **Once a decision has been made, monitoring and follow up will be done to ensure resolution of the complaint.**

STEPS FOR FILING A COMPLAINT & PROCESS



5.4.2 PUBLIC CONSULTATION 2 – SEPTEMBER 26TH, 2019

5.5 ATTENDANCE REGISTERS FOR PUBLIC CONSULTATIONS

5.5.1 PUBLIC CONSULTATION 1 – JULY 4TH, 2019

STAKEHOLDER CONSULTATION MEETING

THE CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

July 4th 2019

Four Roads Government Primary School

6pm-8pm

Attendance Sheet

NO.	Name	Organization	Phone No.	Email	Signature
1.	Jeffrey Smith	—	771-5822	jsmith@flowtrinidad.net	Jeffrey Smith.
2.	Nanita Lyman	NIDCO	7383981	nlyman@nidco.co.tt	N Lyman.
3.	Aloma Lashley	NIDCO	466-1202	alashley@nidco.co.tt	
4.	Courtenay Legendre	TTEC Dist North	689 6236	clegendre@ttec.co.tt	
5.	Kerry Williams	Four Roads Community	765-8434	KERRY WILLIAMS.BIZ@gmail.co	
6.	Rene & Diana de La Bastide		633-9032	landi@epus.co.tt	
7.	Nadia Mahabir	EMA		nmahabir@ema.co.tt	N M
8.	Ingrid Henriques	Victoria Keyes	680-5716	ingrid20th@gmail.com	I Henriques
9.	Nadia Henriques	VK	687-8747	shakkira23@hotmail.com	
10.	GREGORY PANTIN		389-6812	gregory.pantin@gmail.com	
11.	LESTER L. WALKER	Victoria Keyes	687-8679	lesterlwe@hotmail.com	
12.	CATHERINE KUMAR	V. K.	788-5875	rukminikumar51@gmail.com	
13.	VASHTI JITMAN	VK	761-6193	v_jitman@hotmail.com	V Jitman

STAKEHOLDER CONSULTATION MEETING

THE CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

July 4th 2019

Four Roads Government Primary School

6pm-8pm

Attendance Sheet

NO.	Name	Organization	Phone No.	Email	Signature
14.	TRACEY OLIVEIRA-HARRIS	EMA	2264EMA	toliveira-harris@ema.co.tt	TraceyOliveira-Harris.
15.	SHERONNE de ROCHE	EMA	2264EM	sderoche@ema.co.tt	Sheronne de Roche
16.	Brent Augustus	Resident			
17.	ROGER ALCANTARA				
18.	PATRICIA PIGOU	Resident	3857872	cherypics84@gmail.com	P. Pigou
19.	RUDY RAMBALLY	MOWT	7856334	rrambally@mowt.gov.tt	
20.	Garth Elliott	Resident	628-1518	—	Garth Elliott
21.	LYNETTE MOHAMMED	Resident	678-4907	—	L. Mohammed
22.	BRIAN MOHAMMED			—	B.Y. Mohammed
23	YOHANCE NICHOLAS	RESIDENT	632-4170	ynicholas88@gmail.com	
24.	ROBERT DATE	RESIDENT	633-6353		Date.
25.	Zaahir Ali	Resident	481-7015	—	Zaahir
26.	R Phillips	Nidco	782-4213	rphillips@nidco.co.tt	R Phillips.
27.	M. MAHON	C-LIFE	750 5631	madienne.melon@gmail.com	

STAKEHOLDER CONSULTATION MEETING

THE CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

July 4th 2019

Four Roads Government Primary School

6pm-8pm

Attendance Sheet

NO.	Name	Organization	Phone No.	Email	Signature
28.	KRISHNA SADIK	Personal Assistant to the PM	—	—	
29.	EVERTON YOUNG	ROUTE 1 MAXI TAXI ASSOCIATION	716-5896	evertonyoung716@hotmail.com	Everton Young
30.	FRANCIS SYLVESTER	Resident	683-9016	dlegend1984@gmail.com	
31.	Robert Lee	Resident	—	—	
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STAKEHOLDER CONSULTATION MEETING

THE CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

July 4th 2019

Four Roads Government Primary School

6pm-8pm

Attendance Sheet

NO.	Name	Organization	Phone No.	Email	Signature
1.	TENNILE NOEL	MOWT	732-5149	tnoel@mowt.gov.tt	T.Noel
2.	ANDREA ABEL	TRINTOPLAN	680-1981	andrea.abel@trintoplan.com	aabel
3.	JO-REANE PASCALL	TK Jackie Consultancy	715-3525	joreane_pascall@hotmail.com	Pascall.
4.	PATRICK WHITE	RETIRED (EX QRC)	632-9939	patroviv@flowtrinidad.net	(Retired)
5.	ANN ROBERTA WHITE	RETIRED			Roberta White
6.	VIVIENNE WHITE	IMMORTELLE CENTRE			V.White
7.	Lyan Cameron	NIDCO			
8.	TREVOR MARTIN	VICTORIA GARDENS	685-3429	trevorlmartin@gmail.com	
9.	DONNA FERRAZ	VICTORIA KEYES			
10.	REAGAN BROOKER	SUPERPHARM	756-3484	rbrooker@superpharm.tt.com	
11.	ANDRE MATTHEWS	Ridge Mag 2	678-6563		
12.	ALICIA LAURENT-WING			alaurentwing@ema.co.tt	A Laurent-Wing
13.	NICHOLAS LOCHAN	Petit Valley Football	731-0914	nlochan@hotmail.com	Nfoch

STAKEHOLDER CONSULTATION MEETING

THE CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

July 4th 2019

Four Roads Government Primary School

6pm-8pm

Attendance Sheet

NO.	Name	Organization	Phone No.	Email	Signature
14.	Paul I. Cole	Community Hospital	299-1611	parriscol@hotmail.com	
15.	SHELDON MAHADEO	COMMUNITY HOSPITAL	776-4371	sheldon_tt@yahoo.com	Sheldon Mahadeo.
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STAKEHOLDER CONSULTATION MEETING

THE CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

July 4th 2019

Four Roads Government Primary School

6pm-8pm

Attendance Sheet

NO.	Name	Organization	Phone No.	Email	Signature
1.	PHILYSTRA NOEL.	Min. Works & Transport.	713-2018.		
2.	N. MOHAMMED	NIDCO		nmohammed@nidco.co.tt	[signature]
3.	GAIL BRITTO	Resident - Powder Magazine	6854622.	~~gailbritto~~ [illegible]	[signature]
4.	CHANTAL SWEENEY	FKJackie Consultancy	703-9962	chantalsweeney@gmail.com	[signature]
5.	KEN CRICHLOW	NIDCO	297-5303	kcrichlow@nidco.co.tt	[signature]
6.	Winston Aqui	Area resident	782 3465	aquiwinston@gmail.com	[signature]
7.	ANDREW BOWLES	Resident four Rds	741 3982	andrewchesslone@hotmail.com	[signature]
8.	VISHESH RAMNARINE	VK RESIDENT	342 6124	visheshr@hotmail.com	[signature]
9.	Frederick Deare	Kaini Consultants	663 2677	fmdeare@gmail.com	[signature]
10.	SELENA MOHAMMED	Resident	710-8153	selenamohammed13@hotmail	[signature]
11.	RYAN PRUDENT	"			
12.	Alice Prudent	"			
13.	[illegible]	Resident	684 7897	alscape@gmail.com	

STAKEHOLDER CONSULTATION MEETING

THE CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

July 4th 2019

Four Roads Government Primary School

6pm-8pm

Attendance Sheet

NO.	Name	Organization	Phone No.	Email	Signature
14.	NAZEERAH ALI				
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STAKEHOLDER CONSULTATION MEETING

THE CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

July 4th 2019

Four Roads Government Primary School

6pm-8pm

Attendance Sheet

NO.	Name	Organization	Phone No.	Email	Signature
1.	CYRIL D. BERKELEY	P/MAGAZINE PH2.			[signature]
2.	ANDREW DALGLIESH		384 6125	DAGGERSTT@GMAIL.COM	[signature]
3.	Reg Potter	Retired	694 1160	rjpotter@opus.co.tt	[signature]
4.	JOANNE ACHILLE-ZAMORE	WEST SHORE MEDICAL	360-8506	operations@westshorett.com	[signature]
5.	Eric Emmanuel	Resident	637 6352	eemmanuel@hotmail.com	[signature]
6.	Lincoln Jitman	"	720 9575	linc_jitman@hotmail.com	[signature]
7.	Kevin Mahoney	CNC3	781-4442		[signature]
8.	Dieuer Ashley Ross.	Resident VK.	620-6063	ross@crism.com.	Dieuer Ross.
9.	Stephen Boyne	Resident		stephen.boyne123@gmail.com	[signature]
10.	Patrick Billy	Powder Mag	490-3755	patrickbilly318@gmail.com	[signature]
11.	Coreen KIRTON	Wilson Rd F/Kds	778-7427	coreenkirton@gmail.com	[signature]
12.	RICARDO RAMDIN	Resident	473-7089	ranaldor119@gmail.com	[signature]
13.	STUART FRANCO	UGRA	684 6672	Kristy.ann.franco@gmail	[signature]

STAKEHOLDER CONSULTATION MEETING

THE CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

July 4th 2019

Four Roads Government Primary School

6pm-8pm

Attendance Sheet

NO.	Name	Organization	Phone No.	Email	Signature
14.	Jaliyah Phillips	Resident	474 9676	jaliyahphillips01@gmail.com	
15.	[illegible]	Resident	751-6784	kernigould@yahoo.com	
16.	Kenneth Weeks	Resident	754-8768	—	Kenneth Weeks
17.	JAHD REID	RESIDENT	334·7701		
18.	Faine Richards	GUARDIAN MEDIA	389-6106	fainerichardstt@gmail.com	
19.	Elias Dick	Route one MAXI Taxi Assoc	4677711	Route(1)MaxiTaxi@gmail.com	Elias Dick
20.	SANDRA CAMPBELL	RESIDENT	6816805	sandra.campbell16@gmail.com	
21.	JEROME THOMAS	RESIDENT	620-3324	ojerome@gmail.com	
22.	Cheryl-Ann Simmons	Resident	463 7426	cherylannsimmons@yahoo.com	
23	Jayden St. Hill	—	—		
24.	Ralph Henry	Kairi Consultants	663-2677		
25.	Kareina Mohammed.	"	"		K. Mohammed.
26.					
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5.5.2 PUBLIC CONSULTATION 2 – SEPTEMBER 26TH, 2019

STAKEHOLDER CONSULTATION MEETING

THE CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

September 26th 2019

Four Roads Government Primary School

6pm-8pm

Attendance Sheet

NO.	Name (BLOCK)	Organization / Area of Residence	Phone No.	Email	Signature
1.	VISHESH RAMNARINE	VICTORIA KEYES	342 6124	vishesh_r@hotmail.com	
2.	ROSE MARIE MARAJ-WRIGHT.	MOWT	728-0045	rmaraj-wright@mowt.gov.tt.	
3.	'AWO MATTHEWS	Goodwood Gdns.	684-0774	awolgaboy@gmail.com	
4.	LESTER L. WALKER	VICTORIA KEYES	687-8679	lesterlw@hotmail.com	
5.	Isabel Wing				
6.	STEPHANIE LEWIS	U. KEYES			
7.	SHERONNE de ROCHE'	EMA	226-4EMA	sderoche@ema.co.tt	S. de Roche'
8.	Fredericka [illegible]	KAURI	663 2677	fmdeare@gmail.com	
9.	TRACEY OLIVEIRA-HARRIS	EMA	226-4EMA	toliveraharris@ema.co.tt	Tracey Oliveira-Harris.
10.	KERRY WILLIAMS	FOUR ROADS D/M.	765-8434	KERRY WILLIAMS7.812@ymail.	
11.	Jozef Walker	Four Roads	701-3007		
12.					
13.					

STAKEHOLDER CONSULTATION MEETING

THE CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

September 26th 2019

Four Roads Government Primary School

6pm-8pm

Attendance Sheet

NO.	Name (BLOCK)	Organization / Area of Residence	Phone No.	Email	Signature
1.	LIESL CHARLES	HOC	465-0329	lies1001@yahoo.com	[signature]
2.	Adam Raffoul	resident westmoorings	741-9343	adamraffoul@hotmail.com	adam Raffoul
3.	Jan & Sandra Landreth Smith	Resident	620-4715	svlandrethsmith@gmail.com	[signature]
4.	Winston Aqui	Resident	632 1166	aquiwinston@gmail.com	[signature]
5.	ALICIA LAURENT-WING		226-4362	alaurentwing@ema.co.tt	A. Laurent-Wing
6.	Gertrude Pompey	Four Roads	751-7515		G. Pompey
7.	SANDRA CAMPBELL	FOUR ROS	681-6805	sandra.campbell16@gmail.com	[signature]
8.	RUDY RAMBALLY	MOWT	785-6334	rrambally@mowt.gov.tt	[signature]
9.	Elias L Dick	Route (1) Maxi Taxi Association	4677711		[signature]
10.	Hinni Maraj	MRDLG	622-1921	marajh@gov.tt	[signature]
11.	ASHLEY ROSE	UK	620 6663		[signature]
12.	ANDRE MATTHEWS.	MAG & MARTA	393-4639		[signature]
13.	EVERTON YOUNG	ROUTE (1) MAXI TAXI ASSOCIATION	716-5896	evertonyoung716@hotmail.com	Everton Young

STAKEHOLDER CONSULTATION MEETING

THE CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

September 26th 2019

Four Roads Government Primary School

6pm-8pm

Attendance Sheet

NO.	Name (BLOCK)	Organization / Area of Residence	Phone No.	Email	Signature
14.	YOHANCE NICHOLAS	KAIRI	723-0325	yohance.nicholas@gmail.com	[signature]
15.	SYMON de NOBRIGA	Councillor - NORTH COCO ALYCE GLEN	684-3094	symondenobriga@yahoo.com	[signature]
16.					
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STAKEHOLDER CONSULTATION MEETING

THE CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

September 26th 2019

Four Roads Government Primary School

6pm-8pm

Attendance Sheet

NO.	Name	Organization / Area of Residence	Phone No.	Email	Signature
1.	NADIA HENRIQUES	VK	687-8747		
2.	GREGORY PANTON		389-6812		
3.	LYNN CAMERON.		3.		
4.	Riane Rosales.	FK Jackie	753 3036		
5.	National College	FK JACKIE	701-1934		
6.	ANDRIA ABEL	TRINITOPIAN	680-3902		
7.	RYAN PRUDENT	VG			
8.	KRISTINA GRAINGER.	Benjamin 37.	389-5619.		
9.	JOANNE ACHILLE-ZAMORE	COAST SHORE MEDICAL	360-85096	operations@coastshoremed.com	
10.	NIGEL WINT	CCRA	796-5221	nigel.Wint@gmail.com	
11.	MARCIA TINTO	EMA	226-4EMA	Marcia	mtinto@ema.co.tt
12.	SEAN MENDONCA	TATEC	689-4686	Smendonca@tatec.co.tt	
13.	DONNA FERRAZ	VK		ferraz.donnam@gmail.com	

STAKEHOLDER CONSULTATION MEETING

THE CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

September 26th 2019

Four Roads Government Primary School

6pm-8pm

Attendance Sheet

NO.	Name (BLOCK)	Organization / Area of Residence	Phone No.	Email	Signature
14.	A Lewis	V.K.			[signature]
15.	C. Kirton	Wilson Rd			C. Kirton
16.	SELENA MOHAMMED	Diego Martin	710-8153	selena.mohammed1@my.uwi.edu	S. Mohammed
17.	JEROME THOMAS	VICTORIA KEYES	6203324	ojerome@gmail.com	[signature]
18.	Rodger Lee	OK	—	—	[signature]
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STAKEHOLDER CONSULTATION MEETING

THE CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

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Attendance Sheet

NO.	Name	Organization / Area of Residence	Phone No.	Email	Signature
1.	TENNILLE NOEL	MINISTRY OF WORKS & TRANSPORT	732-5179	tnoel@mowt.gov.tt	T. NOEL
2.	PHILYSTRA NOEL.		652-9475/713-208		P. Noel.
3.	N. MOHID	NIDCO			
4.	MARCIA MARSHAN	DMRC / COUNCILLOR	684-2768	mmarslin@hotmail.com	
5.	CYRIL-D. BERKELEY.	POWDER MAG: PHASE II			Berkeley.
6.	Jeffrey Smith	–	771-5822	jsmith@flowtrinidad.net	
7.	TREVOR MARTIN	UGRA	685-3429	trevorlmartin@gmail.com	
8.	Monique Walker	Benjamin St	681 2383	mooons5@gmail.com	
9.	RAMANAND RAMSARAN	MOWT	767-4401		
10.	CHATRAM SOOKLAL	MOWT	727 4910	csooklal@mowt.gov.tt	
11.	AMANDA MENDONKA	TTTEC	486-0787	amendonca@tttec.co.tt	
12.	MICHAEL CHARLES	ISPS	465 7402	mcharles@isps.edu.tt	
13.	ROGER ALCANTARA	Diego Martin			

5.6 TRANSCRIPTS OF PUBLIC CONSULTATIONS

5.6.1 PUBLIC CONSULTATION 1 – JULY 4TH, 2019



Public Consultation

Re: Construction of a Vehicular Overpass in the vicinity of Powder Magazine and Related Road Improvements Project

Thursday 4th July, 2019

Four Roads Government Primary School

Diego Martin

TRANSCRIPT

Prepared by
FKJackie Consultancy
fkjackieconsultancy@gmail.com
719-5094

The Consultation began at 6:20pm with the playing of the national anthem, followed by the safety briefing done by Ms Karina St Hill.

Opening Remarks

Dr. Ralph Henry – Kairi Consultants Limited

My name is Ralph Henry I am from Kairi Consultants and I am your moderator for this evening. At head table with me on the extreme left is Ms. Andrea Abel of Trintoplan Consultants and to her right Ms. Tennile Noel of the Ministry of Works and Transport. On her right is Mr. Navin Ramsingh who is the Director of Highways, and on his right is Mr. Crichlow, Programme Manager at NIDCO and on his right is Dr. Fredericka Deare colleague at Kairi Consultants. We have a pretty extensive agenda that will start with presentations and we have to ensure that they are kept as short as possible because the objective of the evening proceedings is to ensure that you have your say, and we are here to document all that you have to say about this project which is as you see a social impact assessment of the construction of a vehicular overpass in the vicinity of Powder Magazine and related roads improvement project. It's quite a mouthful and I am sure we will have quite a lot of mouthing this evening about this project.

I will move quickly, to the presentation by Ms. Abel who is as I said from Trintoplan Consultants and they have been responsible for the initial concept, elaborating the concept and she will be explaining in 20 minutes what it's all about and where it has reached at this point in time.

Presentation 1: Revised Conceptual Design and Project Information

Ms. Andrea Abel – Trintoplan Consultants Limited

Good afternoon everyone and welcome to this public consultation. I am about to do a technical presentation and the social will follow. What I am doing this evening is presenting the technical alternatives. So you have been already introduced to the members of the head table so I will not bother to go through this any further. As I introduce myself I indicated that this presentation is of a technical nature. The slide you are looking at gives a summary of the presentation which would be given today. I will touch on the location; give some information as to the purpose of the project. In the overview, background information will be given on the genesis of the project and I will also give some historical back ground on activity which have lead us to where we are today in this public consultation. I will describe the consequences of taking no action with respect to this intersection and I will walk through some of the various alternatives which have been considered. Later I'll give some information on the conceptual designs undertaken from 2018 and then I will talk about the project status as it is now, revised conceptual designs which were done is 2019 and I will also give an indicative project schedule.

Project location: I am sure that the location of this project is familiar to everyone present.

Purpose of the project: the purpose is four-fold. The first is to improve the transportation network in order to accommodate future growth and development in the western peninsular. (2) to improve the connectivity for commuters who are in the Diego Martin valley and heading into the western peninsular.

(3) to provide access to new and proposed developments in the vicinity of the intersection of the Diego Martin highway and the Western Main road intersection.

(4) to improve the road safety network and the network efficiency by eliminating on safe turning movements and also circuitous movements. For example, I know if anyone of you is from Victoria Keys if you want to head back into Diego Martin Valley you have to go all the way to the fish market and turn around. So we would like to eliminate some of those movements.

To give an overview the original Diego Martin highway was constructed the 1960's when the population in the Diego Martin Valley was significantly lower than it is now. In addition, there was also a much lower percentage of vehicle ownership and at the time the intersection was constructed the arrangements was adequate given the existing situation. However, by the 1990's it became apparent that the arrangements were inadequate. The construction of an overpass at this location was first approved by cabinet in 2003 and again in 2013. Arising from this in 2015 the Ministry of Works through NIDCO engaged a consultant to undertake a feasibility study, with the aim of eliminating conflicts and improving the safety in the Diego Martin Highway, Western Main road intersection. During that feasibility study, some public consultations were held with individual stakeholders and various community groups to address concerns. And those concerns were taken into account when the consultant went forward into the detail design, conceptual designs which were done in 2018. The feasibility study limits are identified as follows: it encompasses the Western Main road between Westland Avenue on the west and the intersection of the Audrey Jeffers highway by the Cocorite fish market. The northern limit is the Morne Coco road from the intersession in Diego Martin highway through Four Roads across West End Avenue. Western limit is West End Avenue and then the eastern limit is an amalgam of the Diego Martin highway from Powder Magazine north to the Four Roads Junction. Also we take into account the east bound lane of the Western Main road between, the Diego Martin highway and the fish market.

So the objectives of the feasibility study were to improve the road network in the Cocorite section of the Western Main road intercepting the Diego Martin highway, and they were as follows:

1. Provide improved road network in the subject area;

2. Provide the road user and pedestrians with affordable, safe and efficient connectivity, with the least impact on the environment and the stakeholders;
3. Solving a problem of no direct connection between the south bound Diego Martin highway traffic intending to go west into the Chaguaramas peninsular;
4. There were inefficient traffic signal operations and unsafe traffic operations throughout;
5. There were multiple access points from driveways and intersecting streets along the Diego Martin highway and Western Main road corridor;
6. There was no west bound through movement at Morne Coco road and Diego Martin highway intersection;
7. There has been flooding along the southern end of the Diego Martin highway that's also been taken into account;
8. There is a lack of safe and convenient facilities for pedestrian movement;
9. The whatever is done has to make sure that the future development can accommodate future traffic growth;

So just to look at the existing traffic arrangements so we see a Google earth image, so the movements which if someone is coming out of the Diego Martin Valley and heading south bound to east bound it's the pretty straight forward, you just merge into the Western Main road. If you are going from west bound to north bound it's also fairly straight forward. There are two turning lanes, on the Western Main road which split and head off into Diego Martin Valley. If you are heading east bound and you want to go north bound you will be able to go on a ramp which will take you from the Western Main road heading north. If you are going south bound to west bound you have quite a challenge because you have to take the intersection of the Morne Coco road, head along Morne Coco road, then down West End Avenue, and then to the Western Main road. The challenge with this particular route is that you are passing our local roads, there is a lot of traffic growth and therefore especially during the peak hours morning and afternoon it's very slow going through that location. If you are heading to the east and want to turn around and head west, you can use a "jug handle" which is just north of West Mall. And if you are coming from Port of Spain and you want to head back to the east, say you are coming from town and you want to go to the community hospital, there is a small bowtie which you can take.

So in any feasibility study one of the things you look at if what if I do nothing and the traffic numbers are up there for you all to see. Based on the existing traffic volumes and for feasibility study a 25 year horizon was used. Traffic was projected from 2015 when the study was done through to 2040. And if you look at the number in 2020, the expected vehicle registrations in Trinidad would have increased to 845,000. By 2030 to 1,080,000 and by 2025 1,200,000, so you are approaching saturation, with respect to vehicle ownership. The reality of it is that at this point in time there is already difficulty in this intersection. So with continued growth of

population and also of vehicle ownership, it is going to get worst. Therefore, something has to be done with this intersection to improve the level of service.

In the feasibility study, several alternatives were looked at:

- Alternative 1: I am not too sure how well you could see this, but I just want to point out to you there is a ramp which would have been proposed, which would have passed above the east bound lanes of the Western Main road, passing over the north bound lane on the Diego Martin highway, which will make this ramp two levels tall, which is quite expensive. So for the people in the back I will just point to it. Well I guess I am having some technical difficulties so you will not be able to see it but, it would have been a two level ramp.
- The second alternative is considering a roundabout but the problem with that is that the traffic volumes were just too large for the roundabout to work efficiently.
- The third alternative is using an at-grade intersection. At-grade means that nothing is passing over anything else, everything is at the same level, so you have traffic lights and so on and that was developed with a connector road.
- The forth design alternative was using the connector road and a tight diamond interchange and it was found to provide an acceptable level of service.
- The fifth alternative which will call 4A, is a diamond interchange with frontage road system. Would you like me to use the pointer to show you the various options? Okay so I'll go back to the first one. The first one is a south bound to west bound directional ramp which I'll point out.

Male participant: (*inaudible due to not using the microphone*)

Ms. Abel: Okay unfortunately, I do not have a larger image in the presentation but I am sure if someone would like some further details we will be willing to assist you after the presentation.

As indicated the second alternative was a roundabout. I know we all know what a roundabout looks like. The challenge is when you have too many vehicles on a roundabout it does not move. So that's alternative number two.

Alternative three is the at-grade intersection, so I'll just point out the connector road which goes from across the highway.

Male participant: (*inaudible*)

Ms. Abel: And in that scenario everything will be at-grade, so you will have a traffic light, there would be a traffic light on the Diego Martin highway at the start of the highway, which is not ideal.

Female participant: (*inaudible*)

Ms. Abel: Excuse me. Certainly. Right okay so the connector road which would be at-grade would pass across the Diego Martin highway but there are some challenges in this location because, we would need traffic lights which are not ideal in a situation of high traffic volumes.

Male participant: (*inaudible*)

Ms. Abel: Okay in number one there is a ramp similar to what, okay the intersection at Grand Bazaar has a multilevel, a high level ramp, so it would have been similar to that, where a ramp would have come off the south bound Diego Martin highway and it would go over the existing bridge here and it would go, come into the Western Main road.

Female participant: (*inaudible*)

Ms. Abel: Yes, in number three you are coming across, but it is a much smaller structure. A shorter structure and small structure. So in this instance the structure will start about there and it would come all the way across here. In number three the structure will just be, but in three it's actually no structure. It's in four that there's a structure.

Female 2: (*inaudible*)

Ms. Abel: Yes, that would have been the intention but this alternative. May I move on to the next slide?

A few persons interjected without using the microphone.

Ms. Abel: I am being told that the transcriptionist would not be able to hear the questions from the audience because it is not going through a mic. At the end we'll need to get the questions.

Male participant: Do you have another mic we could use?

Ms. Abel: The questions would be taken after. Okay if you could provide a mic. It would have to be brief keeping in mind the fact that we have a time schedule this afternoon. Okay so I will just continue. Right so coming into the alternatives, alternative number four it's similar to number three but we have a tight diamond interchange. Alternative number four

Female participant: What is a diamond interchange?

Ms. Abel: A diamond interchange relates to the shape of the interchange, it has four corners, like a diamond. So it has on ramp off ramp on both sides. Okay so number four is a tight diamond interchange. Number five is similar but there is an overpass with the connector road going across the Diego Martin highway, it's also a tight interchange. There is also some fronted road options. And alternative 4B it's also a diamond interchange but with a back access road further in the back which would have required more right of way.

So I just want to quickly walk through what this the feasibility study, the conceptual designs came up with. For people who are heading from east bound direction heading to the north you would go, take a traffic signalizing intersection, and turn on a connector road and then head into the Diego Martin valley. For traffic which is west bound coming from Port of Spain and wanting to return to the east, take the Western Main road to the intersection at Columbus Boulevard, head north on the connector road, over the overpass and onto the connecter loop road, onto a frontage road, which would eventually end at Lady Hochoy Circular which would be the access to the Western Main Road and what the frontage road did was it picked up a lot of the local traffic. For traffic going from south bound to west bound, so you are coming out of Diego Martin and want to head west, you would have come up the ramp in the interchange and then you would turn to the right and along the connector road to the traffic lights at the Western Main Road.

If you are heading east and you want to return west, you would have turned on the connector road and gone to the end of Victoria Keys where there is a roundabout and then turn around back over the bridge and to the intersection and then through the traffic lights and then onto the Western Main road.

The challenges with this design were the budget and it's understood that the cost of implementing this project would have been beyond the budget of the employer. So in addition to that, the construction of the ramp from the south bound lane to the connector road and the associated works would have interfered with the existing entrance to Victoria Keys and would have required relocation of the entrance to Victoria Keys. And then in addition to the cost of implementation of designs, there was also the cost of land requisitions for the frontage road, so this design was going no further.

In 2019, a decision was made to reduce the project's scope due to budgetary constraints but still to address the general concerns of the affected residents and businesses. In May 2019, NIDCO engaged Trintoplan consultants to review the WSP conceptual design from 2018 and to present another option with a reduced scope, while still improving the connectivity from the Diego Martin Valley into the western peninsular. The new option also provides less disruption to the neighbouring residents during the operational phase. In doing the design Trintoplan took into account the existing conditions:

So in the top photograph is a view of the Victoria Keys housing development. It's a fairly large development with three (3) towers, a parking garage. The second photograph in the back ground shows the Power Magazine development, they also had to be considered and in the fore ground of that picture there is a pedestrian walkover which we need to maintain. And the third photograph is another one showing the entrance to the Victoria Keys housing development. So in doing the redesign Trintoplan looked at the elements that needed to be

adjusted or removed from the original scope of works. We also noted the traffic movements which had to be accommodated and we took in to account the proposed developments at Cocorite farms as well.

So the elements which were removed or adjusted from the WSP design is that we took out the frontage road it was truncated and we also shifted the vehicular overpass southward, so that it would not affect the entrance for Victoria Keys. And the traffic movements had to be accommodated from west bound to east bound movement, so if you were coming from Port of Spain and head back to the community hospital you could still do that. From the south bound to west bound which doesn't exist right now in a simple manner, we also looked at that. And then also for a new movement which is people heading south bound and wanting to turn back and head north.

The design took into account the proposed development in Cocorite farms because there are plans to build a new office for the Diego Martin Regional Corporation, as well as a First Citizens Bank branch. And also, there are plans to develop the West Park savannah. And in doing our designs we tried as much as possible to take into account the existing entrances.

Some elements of the WSP designs were used however the frontage road was eliminated and the many retaining walls which was one of the costly aspects of that design were removed. And the primary intention was for us to get the missing turning movements addressed and also to provide access to some of the other developments which are proposed, such as the Regional Corporation offices and the proposed West Park savannah. So in the next few slides I will look at the key components: -

Component #1

Is a fully signalize the intersection of the connector road with the Western main road.

Component #2

Is the eastern part of the connector road is shown and it also shows a new access which would be provided to the Powder Magazine development, because where the loop road is going to be built, would interfere with the existing entrance to the Powder Magazine development. And we are also using this opportunity to provide another alternative access to the Victoria Keys development, even though the existing entrance is going to be maintained.

Component #3

It's the overpass and also there is a north bound ramp, and just to give you a little bit of information the overpass: - it's going to have two spans: one is 17.5 meters approximately which would be going over the north bound lanes of the Diego martin highway, and another

span of 21.9 meters which will be going over the south bound lanes of the Diego Martin highway. There'll be a paired in the medium of the Diego Martin highway. So the traffic movements if you are coming from Port of Spain and you want to go to Powder Magazine or if you want to go to; you know just to turn around, the alternative is here. If you are heading east bound and you want to go north bound, then you would go onto the connector road through the roundabout and up to the Diego Martin Highway. If you are heading east bound and you want to turn around and head west, you turn on the connector road through the roundabout, back to the intersection and head west. If you are going south bound and you want to head to the west, you go under the overpass structure, onto the loop road, over the bridge, onto the connector road to the traffic lights and then head west.

So to summarize the redesign; the redesign caters for the south bound to west bound movement, which is the critical one for us to see. It also caters for people who are heading west and want to return to the east. It includes movements for Victoria Keys and Powder Magazine heading north. So you could actually go across the connector road through the roundabout and then head to the north and it also provides access for the proposed developments in the Diego Martin Regional Corporation offices and the West Park savannah through that with that roundabout.

One of the things which was taken into account in the conceptual design is the challenge that there currently exist with drainage in the area. So there is space for doing another detention pond with a bigger capacity within the loop, to reduce the likelihood of flooding which happens on the Diego Martin highway from time to time. There is also a lower social impact with there would be no land acquisition anticipated at this time. The existing entrance for Victoria Keys would be maintained and that there should be a lower level of disruption to daily traffic, because the only thing that is being built is just the bridge works, whereas again, in the previous design there were a number of retaining walls and so on, which would have impacted on the development.

So I will give you a brief over view of the status at this time. What I need to highlight for you is what has been shown is a conceptual design and this has formed the basis for a design bill tender. So similar to the previous one which has been modified. So in May 2019 the tenders for the original design which had been issued in June 2018 were cancelled. A new tender process was started, with the revised, reduced Trintoplan's design and tenders closed in July 2018 in about 2 weeks. It's expected that the evaluation would be completed in order for there to be an award in around mid-October and the design and construction period is 24 months.

I'll just mention briefly something about the social impact but, Kairi will deal with that in greater detail, when they come to the podium. Following the previous public consultation held in October, November 2018 the EMA requested a social impact assessment to be a part of the

requirements of the CEC application. In May 2019 NIDCO engaged Kairi to undertake this assessment. As part of the social impact assessment process the EMA has requested that 2 public meetings be held in order to effectively determine and communicate the social impacts of the projects to the affected public and to indicate the proper channels for the residents and or the businesses to submit any grievances and suggestions they may have on the project.

The schedule which I am putting up is an indicative schedule because it depends to a large extent on the contractor and so the first page of this schedule shows the initial activities in 2019 to mid-2020. It is anticipated that the social impact assessment would be completed in August 2019. The procurement process for the design builder is on the way, so the evaluations and so on should take place in August 2019. Critically is the CEC process, and it is anticipated that once all the requirements can be met it is possible to get the CEC by September. Once the CEC has been received it is expected that an award will be made to the design build contractor in October, so he can commence the design aspects of his contract. So that the construction is expected to start by early 2020.

Katherine Kumar: Quick question, I don't understand, you say something closes in July?

Ms. Abel: The tender for the design build contract.

Katherine Kumar: So this happens before the social impact assessment is completed?

Ms. Abel: Yes

Katherine Kumar: That seems to be a conflict. So if social impact assessment shows up something, do you go back and tender again?

Ms. Abel: Okay no. What is presented is a conceptual design; the outcome of the public consultation process would be communicated to the successful bidder, who would not be brought on board until October, when a contract is awarded. So the outcome of the social impact assessment would form part of the contractor's detailed design. What is presented here is a conceptual design because with the design build process the contractor needs to know what is the design intent and therefore he can tender on that. But the final designs are within the remit of the design build contractor.

Okay so going back to the schedule, for construction this is what our best guess because again it comes back to how a contractor programmes his work. It's expected that between June. Sorry maybe I should go back to the previous slide. Construction is expected to start in about February 2020 and it would include construction of western and eastern connector roads and ramp. Going into 2020 it's expected that between June to September there may be construction of new drainage culverts and improvement to the existing drainage infrastructure.

In October 2020 through to January 2021 it's expected that there be widening and upgrading of Columbus Boulevard and the intersection with the Western Main road. Between February to May 2021, we expect that the construction of the overpass bridge, with the completion of the bridge deck and the roadway safety features would be done. Between June and August 2021 should be the construction of the final connector road loop and final paving. So it's expected that constructed would be completed by September 2021. At this time, I would like to hand you over to Kairi who are going to do their presentation.

Presentation 2: Social Impact Assessment (CEC) 5500/2018

Dr. Ralph Henry: Kairi Consultants Limited

Thank you very much Ms. Abel I just want to point out at the very beginning that the project is still being conceptualized, so it's not cast in stone. No stones have been cast yet. We are still evolving and an important component in this exercise is the acquisition of the CEC on the part of the Ministry of Works, which is indeed the parent in this whole exercise, through NIDCO and that only happens after all of the public comments have been assessed, examined and the design adjusted to take account of the public consultation of which we are in today engaged. I will try to keep mine as short as possible because we, I know already there are a number of questions that have already come.

Well as I indicated in the very beginning the Ministry of Works is the sponsor, its agent is NIDCO and we Kairi we are mandated to document all that you say. In this public consultation, as well as in the other consultations and focus group meetings that we would be having with members of the public. The process follows a set regime and I am going to very quickly tell you what we are going to do this evening. We are going to give you an overview of the social impact process. This is indeed a stakeholder engagement where we anticipate the impacts, positive and negative, the risks that would be encountered and it's all good of you in getting stakeholder feedback as we document the concerns that you may have.

The role of the various entities Ministry of Works is the applicant, NIDCO is an agent of the applicant, we have been hired by NIDCO but we are arm's length, so that your views, your views are transmitted through us and we make sure that we document everything that you say.

Participant (male): Are you independent of the government?

Dr. Ralph Henry: Yes, we are independent of the government.

Participant (male): You are a private organization?

Dr. Ralph Henry: Yes, yes.

Participant (male): Registered in Trinidad and Tobago?

Dr. Ralph Henry: Yes, registered in Trinidad and Tobago, operating in Trinidad, the Caribbean and elsewhere. As Mrs. Abel indicated it's a conceptual design that is evolving and the next step is the securing of the CEC and that can only be secured when we would have documented all that you have said and the sponsors, along with NIDCO and the other consultants, would have taken account to mitigate risks to treat with challenges and to ensure that with the minimum of disruption, with the minimum of hurt, that this project could be implemented. I should just say very quickly that whatever we do there are costs. So if we did nothing there are costs and the costs are indeed in the snarling of traffic that you see, where people may spend 2 / 3 on the road, travelling just 2 / 3 hours. So it's meant to alleviate that but of course there are costs involved in so doing.

There were a number of presentation that we done even before the attempt, the initiative was taken to arrive at a Certificate of Environmental Clearance and some of you would be aware of public meetings that were held in previous years and my understanding is that this idea of an upgrade of the traffic system, dates back actually into the 1990s. So it is not a function of whoever is the government in power. It means that various administrations have been looking at this, this problem and attempting to find a mechanism of solving the traffic problem in an area that has grown; that has spiralled in terms of population. There has been massive increase in the population in this area and we document this in our assessment. There was a public meeting held in October of last year, followed by another one in November and I think those meetings were held here actually and here we are again today. But this time it deals with the SIA and that is critical to the powers at be, acquiring the Certificate of Environmental Clearance.

The purpose this evening is to communicate to you as clearly as possible the proposed project and Ms. Abel has already done that. The project component; its location etc.; alternatives that exist and you have I think has already excited a number of questions which will hopefully be answered. But I should warn that there be no definitive answers except maybe in a few areas, in the discussions that the various other people at the head table may be able to provide this evening.

The main objective of the SIA is to identify qualitatively and quantitatively the type and extent of impacts on the human environment and to examine the potential socio, cultural impacts of the project on the wider community. Every project has relevance to the wider public, the public of Trinidad and Tobago and to the extent that the Ministry of Works is engaged in this project is concerned to improve the infrastructure, of the road infrastructure for the country. But in this particular case its initiative is going to impact on a public, the public of Diego Martin which consists of residence of people who engage in businesses in the community; people who

transit through the area etc. So it's that immediate public that is being consulted in this exercise.

I have already indicated who are the main facilitators in this SIA process, but I think what is important is for you to note the key stakeholders and they are enumerated there, the key stakeholders the residents; the civil society; local businesses; sensitive human receptors like hospitals, schools, churches; the government agencies that operate in the area; of course there are politicians etc. And we attempt in this exercise is not only to hold a discussion like this a public consultation but also to meet some of these groups. There are about 17 focus group meetings that we anticipate over the next month or so, as we document the concerns of people in their various capacities.

At the end of the day one expects that the Social Impact Assessment include a socio, cultural and economic baseline study and we are well advanced in that, in that we have documented the growth of population in the area and for the demand for, the transport demands of the area as a result of the expansion in population of the area. We will be identifying, monitoring and intervention strategy when once the design is finally agreed on. How do we monitor the implementation and the post implementation of the project?

What sort of mitigation strategies that must be put in place to reduce the risk, to reduce the difficulties that may be experienced by people as the project is implemented? And as you know, as we deal with some of the cumulated effects not only for this project but as this project is in a sense integrated with other previous interventions in the transport system. At the end of the day we expect that there be a; the stakeholder engagement would lead us to a Grievance Redress Management system, which is something a little bit new to us but is now mandated by the EMA. We have to show that not only are your questions being addressed now, but questions that you may have subsequently, to the extent that there may be grievances, that there is a procedure to treat with these grievances in a transparent and a coherent way.

As indicated we had done the socio-demographic baseline study. We are attempting to get a clear understanding of the likely benefits, positive and benefits of the proposals, that have been elaborated by Mrs. Abel and we would want to highlight the changes that may occur before the project is implemented in light of previous and also future activities that may be reasonably anticipated to have a combined effect, with regards along with this project. So we are taking the entire picture into account, what has happened in recent times and you know that there has been some substantial development of the capacity, the road capacity in this area, new highway etc. etc. But there are also other things that need to be done and how in making this new intervention, we hopefully do not compound problems or errors that might have been committed. I don't what to say errors, but challenges that might have been created in the past

and how in going forward, we in a sense correct or adjust the design to accommodate the demands of the situation.

That leads us really to the mitigation strategy in which aims to come up with realistic and feasible measures that employ the best technologies not entailing excessive costs. Mrs. Abel talked about made the point a while ago about costs, some solutions are absolutely too costly and therefore we have to live within our budgetary limitations and therefore have to make adjustments. The best practical solutions that are possible within costs; within the resources that are available but most importantly there must be the best practicable environmental options, because all projects have environmental impact and those impacts include the social impact and we have to mitigate or remedy such impacts to acceptable levels. And this all will be integrated into an overall management plan and that management plan is designed to, to specifically come up with measures that describe how existing adverse impacts if any, would be handled to prevent accumulated effect, with respect to the intended project.

There is the monitoring and intervention strategy and that requires the proponents to introduce an institutionalized measure, mechanisms such that we are constantly monitoring the impact and there maybe need as time goes by to have other interventions that will mitigate, problems, challenges that might not have been properly addressed in the very beginning.

Male Participant: (*inaudible*)

Dr. Ralph Henry: It is and I will explain; we will get a chance to develop this further, alright as we come to question time. It is part of it. The mitigation, yes, yes it is very much so. It is going to be institutionalized, there are some as I said, some of these things are new. The CEC you know every major project now requires a CEC, including projects implemented by the government and the firm that and you know we have had experiences with roads that have been built and you know, NGOs and other groups have got together and they have been able to force the state to change its design etc. in keeping, in recognition of the concerns of residents and people, the public. So that this is now the new reality and the monitoring and the grievance procedures etc. as well, part of the institutional mechanisms have to be put in place.

So we are into the stakeholder engagement in which we are engaged today and what we expect is that we would get feedback from the intended stakeholders, I enumerated the list earlier on. Today we are dealing with the public but the public is composed of various groups and we are also going to meet people in their various groups. To ensure that people understand the project and its various impacts on them and the social, cultural and physical environment and to have their views and concerns raised and addressed. Everyone would be given the opportunity for a fair hearing and I know we might be running late but we want to

ensure that nobody leaves here this evening without having, if there is a burning concern, without having the opportunity to express it and for us also to document it.

So all comments, questions from the meeting and other stakeholder fora shall be documented and submitted as a stakeholder engagement report. So subject to our editing any bad language we would be documenting everything that you say. The information gathered shall be the representative of the views and concerns of stakeholders and a stakeholder engagement report will be prepared capturing stakeholders' concerns raised during the consultation process. And the consultation process as I said before includes this, as well as, the other focus group meetings that we would be holding with taxi drivers; residents in particular areas; resident associations; the business groups etc. all this is going to be documented. At the end of the day hopefully we will arrive at your major concern; a grievance regress process which is transparent, fair and equitable and can act with a certain degree of independence from the project.

You know, when a project is identified by the government there is interest. We have been hired to ensure that your interest is represented in the process. So that there is a little bit of contending forces at work, that you say certain things, the government says certain things etc. etc.; the engineers try to accommodate both and hopefully they will do so successfully. But you know there is a grievance process that ensures that those who might be hard done by the process have a way of ensuring that their concerns are addressed. And to the extent possible there is, I won't say compensation, I am not in a position to say that but at least that is addressed.

The feature of that grievance process is that it has to be a clear public process for handling grievances. It must be understandable accessible; culturally appropriate; appropriately scaled to address projects and stakeholder needs and it must allow for good record keeping and protocols to facilitate the grievance, effective grievance management and that means that people who do not use the internet and do not use Facebook, they have a voice we have to make sure that their voices are heard as well. So we must have mechanisms in place, so that all and sundry have an opportunity to share their concerns and those concerns to be addressed.

Continuing on the grievance procedure, the grievance process and the steps of filing a complaint is elaborated there. Right down to reporting the complaint; providing information in receipt of, a receipt is given, you had a complaint and its documented that you made a complaint and you have a receipt acknowledging that your complaint has been registered; there is an attempt to resolve it, some resolution and if you are not satisfied there is going to be an appeal process, the exact elements of which are still being worked out. But there is going to be an appeal process. At the end of the day they will be monitoring to what extent the grievance has been addressed, through the grievance monitoring process. And with that in

mind or I didn't want to blank anything out. Yes, has to be very transparent, there is going to be a contact person and for the moment it's going to be the Corporate Communications Unit in the Ministry of the Director of Highways Office, with a telephone number and an email address. And this is what has been provided to us because we ask those questions and we have asked questions about the appeal process and we understand that is being also addressed. Sorry.

Male Participant: The applicant is taking our data? Ministry of Works and Transport they are the ones who you all will be giving the data to directly? The grievance?

Dr. Ralph Henry: Yes.

Male Participant: That's not very transparent.

Dr. Ralph Henry: Yes, we will talk about that after. Right now very quickly and some of this would have come up in previous discussions that were held, in the one in October, October, November? Yes, and may be even before and we just want to list some of these impacts/risks, that were raised during past consultations. So it means we are suggesting to you that if you have such concerns they have been raised before and Mrs. Abel and others have to take them into account alright. So we don't get heated, too heated if it continues to be a burning concern to you. Just note that it has been raised before.

The existing drainage and flood conditions; waste water treatment; the waste water treatment plant; the traffic management during construction – it always creates humbug, alright how is that being dealt with; encroachment of the overpass on vacant open lot near Victoria Keys and Powder Magazine Phase 2; land acquisition; change in real estate value because of the presence of the overpass. These things have been raised before and I think Ms. Abel already indicated that some of the, some of these concerns have already been addressed and in the new conceptual design, they have attempted to correct for that. Alright so it's on going. The issue of human health, you know respiratory illnesses and associated medical costs due to the dust; water ways; air and noise pollution; increased access to neighbouring communities in which may increase incidents of crime, people are concerned that people could – other people who have criminal intent might be now better able to get into certain communities and so on. These are concerns that have been raised before. The issue of the mobility of persons with disabilities and I could just recognize that in planning this consultation, we were not as effective as we might have been in accommodating my past Spanish teacher, who spent a lot of time trying to get access and he did make it and he is at the back of the room. Yes, taught me Spanish some years ago, many years ago.

So as I said the past consultation dealt with a number of these concerns, raised these concerns. Reduction in land area allocation – related to recreation and green spaces etc. and a concern about transparency and the project – sharing of project information with neighbouring

communities. And I hear that the procedure that we have already outlined might not quite meet certain peoples' criteria of transparency etc. if we are requiring concerns to be reported to the Ministry of Works but we will deal with that. We hear you and we will document that.

There is the matter of drainage and flooding and wastewater treatment plant and the traffic management during construction. These were raised before and again they are being addressed in proposed mitigation measures some of which are already identified; the noise and vibration as well and the proposed project has been, you know there are mitigation measures that are to be provided, at the next public meeting, you know it was raised and it's going to be addressed and dust emission during construction and you know again has been raised before and is being addressed in the design of the project.

Ms. Abel made mention of the land acquisition, it's no longer an issue and so some people who might have been concerned, can rest comfortably that there hopefully their land values will not be impacted because there is no intention to acquire any private property to, I hope I am not going beyond my remit. But I take it Ms. Abel that as of now there is no intention to acquire anybody's land.

The other lists that have been identified include the environment and the water ways; the increase in crime in the neighbouring communities; access to new green spaces and the sharing of project information. All these have been raised before so I hope that in the discussions that we have over the next at least forty-five (45) minutes or maybe an hour, that we will get your feedback with respect to other areas that might not have been addressed before. And based on the presentation that Mrs. Abel has made this afternoon which as I said has not been – is not cast in stone. Yohance in the back is showing me something, he is telling me to shut-up. So I think at this stage I will do so and invite your comments and questions.

We want you to be even briefer than I had been because there are lots of people and I am sure that there are still lots of concerns that people have and we will have open forum. Use the microphone, you give your name and the area from which you come or the agency from which you come or the group from which you come. That will be helpful alright so that yes. So we have a gentleman at the back. Keep the questions and comments as short as possible. So the gentleman yes yeah alright. Please, thank you.

Feedback Session

Mr. Stuart Daglish: Good evening everybody ladies and gentlemen. My name is Stuart Daglish I live in Victoria Gardens. First of all, an observation the majority of the people that I know here

were blissfully unaware of the previous 2 public meetings (*applause*). So your mechanism of informing people is sadly lacking.

Secondly the secret society about this whole project and I am talking about West Park Savannah, I am talking about the Diego Martin Regional Corporation and I am talking about the flyover, there is absolutely nothing on anybody's website as to what it is intending or what is happening, even though we see work being undertaken already. My suggestion number 2 is we live in an information age all of that should be made public before meetings like this to help so people are better informed.

One very brief suggestion with regards the design, there is nothing in the design that allows you coming from Port of Spain heading west and going into Victoria Keys. No, no, no you have going into Powder Magazine not Victoria Keys. So the Victoria Keys as I see it has to go to Four Roads and come back down.

Okay, before closing ladies and gentlemen I want to refer this question to the gentleman from NIDCO. We have been unaware of any public meetings to do with West Park Savannah or to do with the Diego Martin Regional Corporation and I would like to know if we are going to have public meetings before the buildings are built because we were unaware of them. Are there going to have public meetings?

Dr. Ralph Henry: Before Mr. Ramsingh answers let me just say, that we were contracted about a month or two ago so we have not been members, if you feel that there is a secret society and I don't think there is.

Mr. Stuart Daglish: No, no is just I have been lobbying for West Park Savannah over 12 years.

Dr. Ralph Henry: Right, right yes.

Mr. Stuart Daglish: Okay. West Park Savannah is half the size that it was originally intended too. Right, it's thirty something acres they have it down to about 15 acres. The Diego Martin Regional Corporation a year ago, paid for the design of a building; paid for the engineering of a building; went out to tender. That building was going to be in the south east corner, in other words, diagonally opposite the mall, adjacent to the T&TEC compound. All of a sudden that tender is withdrawn; we now have a new building on the north east corner but yet, that entire land on the south east corner is being cut off by the highway and we are just seeing that 7 acres of Park land has just disappeared and we don't know why and I think the population needs to know because the lord not making very much green land. Right, that's the last chance we have for a sporting and a recreational facility in the West. Thank you very much ladies and gentlemen. (*applause*)

Dr. Ralph Henry: I think Mr. Ramsingh is going to say something.

Mr. Ramsingh: Okay I could talk about the public meeting for the interchange – the Diego Martin interchange. Whenever we have public consultations I think we had the same amount of people, most of these people are repeats. Right? We do put it in the newspapers and we do come and circulate flyers right, to most of the communities. So we have to apologize that maybe you didn't see it, maybe you were not in the country and we had two consultations right at this location. So it is difficult for everybody to know because I guess in speaking to someone here and I asked him how I didn't see him in the last consultation and he said he was out of the country. Right so it may be unfortunate at that point in time you may not have been informed of it.

In terms of the Park right, in terms of the Park we don't have from the Ministry of Works perspective we don't have much information about the Part but what I could tell you, is one of the advantage of the interchange that we are building is to make the Park readily available to you the Diego Martin residents right. You could leave home, you could drive safely down the Diego Martin highway and go and enjoy the benefit of the Park. I have been to the park; I mean it doesn't fall under Ministry of Works but the car park is completed; they have already the grass in place. So a lot of work has been done in the Park. Right and this project that we are discussing here today will just make that accessible to you.

As I said before in the previous consultation people asked about the environment and all that and we are here, we came and we presented to you how we tried to minimize the amount of footprint that the interchange will take. Right, that's what we did with our optimized design.

Dr. Ralph Henry: Right I think this gentleman has a question.

Mr. Ryan Prudent: Hi goodnight Ryan Prudent from Victoria Gardens South as well. Based on the gentleman's points I would just quickly. You already said it this composes of a number of projects right, and you just said you can only talk much about the overpass right now. But it's about 4 different projects on the same plot of land, the hectareage. It's West Park; it's the Regional Duplex; it's the bank; it's the this; it's the that.

I am only living there a year and a half now almost 2 years; I saw no public consultation about West Park. West Park is a good idea a park you welcome it. You spoke about the greenery and the pitch being paved okay, that's not all that makes the projects. I don't know if you all are aware but that whole acreage of land is higher than the surroundings. Right! So the border between that West Park project is a little ravine that is about 7 feet wide, undeveloped by the

way, its natural, it's filled and dirty right now for more than almost well I am there a year and a half let's say almost 2 years.

On the next side of that bank which is on the opposite side of the West Park it's quite lower, so we are looking up at the park. That's a big concern for Victoria Gardens South. The livelihood and the properties because if any hurricane we get, or any serous water people can die there because of these projects put together. What it looks like, we haven't spoken about the drainage as yet, the proposed mitigation measures but we would like to see where is the main channel going to go. Apparently it looks like that little narrow ravine right, may be it. I am hoping not.

But guess what, just a second, this is not about shooting down the West Park but people didn't get a fair chance to speak about it and you said everything needs a CEC to go ahead. In fact, we saw that, the tender and they are going to be awarded prior to the CEC being approved, which is actually the opposite way around. It should be CEC approved and then they tender awarded but fair enough. All of those CECs for all of those other projects have been awarded, I don't know if everybody here knows that. But the CEC for the Regional Complex awarded, approved. Right! The CEC for West Park approved. These things are in 2019, this here I do not know what planet we are on. But where is the public consultation?

Anyway s0 the major concern here right now is okay we have KAIRI here, claiming to be an independent party. However, the grievance plan, the people collecting the data are the applicants which is the Ministry of Works and Transport. How could that ever be transparent? That's a joke (*applause*). That is a joke (*applause*). That's why I have this little paper here I couldn't wait to say it. But it's not about just bringing things down, it's about. I mean it's not a bunch of dummies you're talking to here. At the end of the day there are a lot of different projects on this same plot of land and everything, things that were missed before guess what? You'll, we, need to tie it into this, because this project is the major one on the same plot of land. Thank you (*applause*).

Mr. Ramsingh: If I may, I mean you may have missed it in the presentation by our consultant but drainage is one of the most important components of this project. Right. We tried to explain to you all that what is; we have to get a CEC. First of all, we cannot go into detail design. We have identified the problems through meetings like this. People tell us about flooding, we put that down into our information, in our project brief and we ensure that the consultant takes it into consideration and do a proper design for it. Rest assured that little ravine that you see there will not exist because we have to put proper drainage in the area and that is part of the mandate.

Now last time we presented we did give you all an idea of what it would look like but remember you have to understand, we are in the consultation stage. We heard the issue about drainage, we took it into consideration and we wrote it into our terms of reference.

The other issue that you have.

Mr. Ryan Prudent: You know what's happening right now as we speak in Victoria Gardens we can all go after here if you all would like to. There is a manhole that water and sewerage, raw sewerage is coming up as we speak. Do you know why? Because the same little ravine that is not cleaned and all the debris from the land that was cleared for all of these projects have been dumped into the Diego Martin highway, I mean river. Which you clearly should be aware. They've been moving this around on like a quarterly basis, like I have 20/20 eyesight right, so I have been seeing this. That debris is blocking the drains in Victoria Gardens' drainage, main drainage systems going out to the sea, to the delta and to the sea. Its blocking everything and everything is backing up now. I did a report to the Councillor about this, right about a month ago. I mean what is going on? And this project isn't even started as yet and you are saying that drainage is a great concern?

Mr. Ramsingh: No. What I am saying is the concern that you have will be addressed in this project. That's what I am telling you. Try to understand that. No you have an existing situation there now, that we will make arrangements and make a visit with you and maybe you can show us where the areas are and we will deal with it. So I will definitely take your number after and we will come out and deal with it. But just remember the drainage in that area will be addressed by the construction of the interchange because it was indicated to everyone here.

No, no. How a design build contract is done we will identify that you must have all the drainage issues that are there. We will hire a drainage expert once the contract is on board and we will hire what you call a drainage engineer. And he will come and he will do a full drainage design in the area and doing that drainage design, he will cater for all the external flows, all the internal flows. You would have heard the engineer spoke about something called a detention basin. All those are components of a drainage design. It will be designed and we had indicated to the people last time, it would be presented to you all, so you all will be aware of what we are going to do.

Whenever we come and we build interchanges the first phase one of the objectives is to we improve the area. We improve the drainage; we improve the connectivity; we improve the way people get across the highway. That's why we are here you know. We are here to make your live easier that's why we are doing projects like this. Right and that's why we are into forum like this. That we listen to you all and we make sure we incorporate it into the design. Right.

The other thing that you spoke about. I can't remember, you have an issue with the Ministry of Works receiving the complaint. The moderator indicated that we heard that, we understand it, we would document it and we will address it because that's why we are here. Right.

Mr. Robert Dade: Good evening, welcome to the head table and ladies and gentlemen. My name is Robert Dade from West Moorings. You mentioned about the drainage, my problem is Diego Martin River, that has not been dredged for years. If we are having drainage going into the Diego Martin River that is not being properly cleared, we are going to have a serious flooding problem, in many of our residential areas around here. So please take into consideration dredging the Diego Martin River.

Dr. Ralph Henry: Dr. Deare wanted to make a comment before this gentleman across here.

Dr. Fredericka Deare: I just wanted to make a comment with regard to the redress mechanism. The grievance redress mechanism is still in draft. It's just a concept. Based on what you say tonight we will incorporate it, as well as the other meetings that we are supposed to have, other discussions. For this stage the EMA though require that we do start the mechanism. So just for this stage that is why the Ministry has been listed. Alright, so maybe tonight you might say okay you need somebody to look at the consultants who are doing the stakeholder engagement and you find the Ministry may not be the person. We will take that into account and try to address it immediately so to speak okay. But I just want to assure you that this is not their address and contact. It's not the final one; it is just for this part of the project. This SIA.

Dr. Ralph Henry: This gentleman here please.

Mr. David Burkley: The name is David Burkley – Powder Magazine, Phase 2. Transportation network to the Western Peninsular, this project is supposed to assist in that. So I want to go to the western peninsular. So I get to by West Mall very quickly because of your overpass. What happens to me now? I am in a set of traffic going down, how does it assist me? It's a fanciful project (*applause*). How does it assist me to get to the Western Peninsular? This massive fanciful project. How does it? Tell me.

No way. No land acquisition you say? You are acquiring land where you are putting your loop, is lands that is under the auspices of the Port of Spain Regional Corporation. Look how long Powder Magazine people there. Every successive government see how beneficial it is to have recreation for the kids. We have people children who come in there at 5, they're now 35. Never get an opportunity to play there.

The housing people - the HDC told us that area there would be for you and incoming community. What are you doing with that? You are putting a big loop now and putting concrete (*applause*). So what about we? For 30 years while that project was going on Victoria Keys we suffered here for 30 years. Look I have a young lady here who is sick. My wife passed away as a consequence of the dust and the banging, badang badang, from 4 o'clock in the morning. She passed away, she developed a tumour and she used to say, "Oh God David I can't take it no more, God I can't take it no more." I say, "Girl what we go do?" We have any representative of HDC here? That wicked state enterprise. You don't think you should be here because the residents under torture, your residents are under siege, you don't think you should be here, as a landlord to represent us (*applause*)? We done pay you for the apartments. We are owners too you know. We pay for the apartment. Allyuh does treat us as we are renters and indispensable, disposable, we are disposable. This project is the icing on the cake.

The other point I want to deal with is I want to know how close are these works because I am interested in Powder Magazine Phase 2 in general but in Building A in particular, which is nearer to the road. The earthquake done shake up that building already. So we want to know if your project is going to bring it down. Thank you. (*applause*)

Dr. Ralph Henry: I wondered if Ms. Abel any comment from you?

Mr. Ramsingh: Let me just add something. Within the Ministry of Works right, we have a number of projects all over the country. The objective of the project is to alleviate traffic congestion. So I presented to you what are the projects we have in Diego Martin. The traffic heading west down the Western Main Road, I another area that we know that we have to deal with it. Right. No, no, no we deal with things parallel. We are doing this project; we have another project that is in the design stage; we have a number of options to widen that road. We were looking at a 4 lane divided highway but that was detrimental to the properties as you are heading west. We are now looking at other options, right and that is a project right now in the Ministry of Works. Right so don't say that when you build this project you won't be able to go west. The Ministry has projects to deal with that traffic congestion.

The other thing about the park, is what our project does, right now, is that you will get access, proper access across the highway into the West Park development to that park. Right, because we are ensuring that there is proper pedestrian and safe access to take you across the highway. Right and apart from which if you look at when we had put up the design, the foot print of the road, it's just a small section of the open space. You still have a lot of greenery there right, that could allow you guys to make Play Park and whatever. It is there you could see it there in that section.

Dr. Ralph Henry: Yes comments.

Mr. Stuart Daglish: Sorry, Stuart Daglish again for Victoria Gardens. As I said, now that you have the map up there. The point that I would like to make; and this is why I am harping on the issue that we have to have a public meeting with Diego Martin Regional Corporation and NIDCO about the park and the Diego Martin Regional Corporation Headquarters. If you have a look at the map, the South East corner was where the Diego Martin Regional Corporation was originally going ok. The tender was withdrawn, after having paid engineers to do the design, and a brand-new design was done where it is now going to the North East Corner. Now if you look at the size of the North East Corner, the North East corner fits into the South East Corner 1 ½ times. Which leads me to the question: which one of the boys getting that land opposite the mall? (*Laughter from audience*) No, but no no, I'm sorry, but this is how we are forced to think in Trinidad and Tobago based on historical fact. And I didn't mention the 1% and what have you. But it leads us to believe that somebody is doing something because that land is earmarked for somebody and we need to know why. I agree with the flyover. I would like to be constructive with the flyover. I think, I think it's needed. I agree right, but we need more public consultations especially to do with the park and especially to do with the Diego Martin Regional Corporation. The point that I said that there is nothing available. I have written the Diego Martin Regional Corporation at least 10 times. I have emailed them. I have put it on their website asking for copies of the plans. Right… I have not had a reply. For the benefit of everybody here, some of them know the information. Under Mayor Louis Lee Sing, which is almost 12 years ago; a private sector grouping of Architects, Engineers, Planners and Businessmen; offered to build the park for free and to maintain the park for free. Nothing happened. All of a sudden, we hear now, we have a white building in the corner that costs $6million; I don't mean to be negative because we don't know. We don't know. We have not been called to a meeting and say this is what we are doing, and we have not had the opportunity. I would love to see more park. I would love to see the Diego Martin Regional Corporation go in that area that's cut off because it have almost nothing you can do with that other than give it to somebody.

(A*pplause and laughter from the audience*)

Mr. Ramsingh: What I will do. What we will do at the next consultation because that open area there is the site for the, what we call our detention basin right. When we do projects now, you have to create a detention pond that you store the water before you put it into the Diego Martin River.

(*Mumbling from the audience*)

Mr. Ramsingh: No, but when we present the journey design you will see what we have planned for in that area.

Mr. Stuart Daglish: How much you need, tell me how much you need; with the Diego Martin Regional Corporation tender done out already. So, before the next public meeting they are going to be turning sod and the land gone. Right. The land gone.

Dr. Henry: Let me say we are due to have another public meeting that we would endeavour to ensure that these questions are indeed answered if possible.

Mr. Gregory Pantin: Thank you. Good evening everyone. Gregory Pantin, Attorney at Law. Miss Abel, maybe you might be able to assist because I want to be clear on the pictorial chart which is being shown at the moment, and some of the written language in the project description. But as it relates to the north bound, I suppose it's a connector road. When you exit east bound from the overpass and you go into the loop and that turns north bound, I see a pink line that's moving north bound. Know what I am speaking about? The pink line that is going north. That is from the eastern side of what would be the south bound lane of the Diego Martin Highway. (***audience****: that is not going north*) That is going north (**audience:** *right hand side going south bound*) Well alright, yes, the existing south bound lane of the Diego Martin Highway, the pink line is north bound (**audience:** *no south bound)* Well that is the question I am trying to clarify - yeah thanks - from the written description of the project – yes that line- is that part of the project and that local road that is being built; that would be to the western boundary of Victoria Keys? If you keep going up, that is what? One direction? North bound, south bound? Lane? (**Ms Abel:** *that's a lane south bound)* That's a lane southbound.

Ms. Abel It exits unto the loop and you can go unto the connector road over the Diego Martin highway. So, the ramp is going under the bridge at this point. The access which Mr. Daglish asked about to Victoria Keys comes off here and goes to Victoria keys. If you are in Victoria Keys and you want to go north, you come into, unto the ramp, you go around the roundabout and you go north. (**audience:** *the existing entrance remains)* Right, the existing (**audience***: you go off unto that road and they would make the same road?)* Right, if you are coming from the north you can get directly into Victoria Keys as you do now. If you are in Victoria Keys and you want to the north it is as I described a while ago. The access to Powder Magazine, we will be creating a new access to Powder Magazine, new vehicular access in this vicinity.

Mr. Gregory Pantin: Okay thank you. (**audience:** *How do you return to Victoria Keys from Port-of-Spain.)*

Ms. Abel: From Port-of-Spain to Victoria Keys you go along the Western Main Road, you go the intersection over the, you go along the Connector Road over the bridge down the ramp and exit here into Victoria Keys.

Mr. Elias Dick: Good evening everyone Elias Dick, Public Relations Officer Route 1 Maxi Taxi Association. I am here with my executive brothers here and my concern; I'm also a resident of the area I live just three houses from the school. First time I really realise that they have a consultation here. I would like to thank the Kairi for the invitation to our Association and Route 1 as the first invitation we got so I would like to say thank you very much. I am more on the positive side of things and I do hope you consulted with the Maxi taxi, you consulted with the Maxi, but the Cocorite Taxi Driver's Association. I heard you said the taxi drivers, this Association. Because a couple of years ago and that is going to affect us and affect the travelling public, the Ministry of Works bought some slab block of concrete and the present Commissioner who was then Ministry of Security had to come get heavy Equipment and remove it. Because my problem is it has an impact, these things, when we don't consult, and we don't deal with these things properly it impacts the travelling public and the poor people I am concerned about have to feel it by their pocket. Because when the taxi drivers go up the poor people feel it and I'm concerned about that and that is why in our area the Maxi taxi fraternity in Diego Martin, fares remain at $3. If you live in the Valley it remains $3 doesn't matter which part of Diego Martin, you come out from. We look at the people and I'm begging you Kairi, Doctor please consult with us relevant bodies so that we wouldn't have that problem that we had some years ago that actually became violent. We know what is happening in our society we can do with less of that, we can do with less of that problem. So please consult properly with the bodies so that they are aware of what is happening, the residents and the people in the area is aware. I just came up from home and as I was walking a resident asked me - I don't know anything about this- I say well I just got an invitation as the PRO of Maxi Taxi Association. Probably as a resident they probably might not have known about it. But please, you could please address those issues. I would be happy. I'm happy for the development but all the other aspects of it must be taken care of. Thank you. (*applause)*

Mr. Ricardo Ramdin: My name is Ricardo Ramdin. I just want to identify two things; first of all that this project supposed to improve the flow of traffic but I cannot see anything like that when you have to leave to go to work in the morning how it improves, this is, this what you put up here how it improves leaving Diego Martin, Carenage and improve the flow when you passing. (*applause)*

In fact, this traffic light here at Columbus, my estimate and I'm sure your modeling result could show better, would make me take 5 minutes longer to leave my house to reach in town in addition to the normal traffic I reach. Alright. And you are saying that you are doing projects in parallel. Why weren't these presented here today? (*inaudible)* You said that -alright. The other point I want to make very quickly- So in dealing with this project we want to reiterate your footprint on the green environment. The West Park, as Mr. Daglish indicated, was stated that residents would get it for something similar to what The Queens Park Savannah is like. I know you would think of putting a road through Queens Park Savannah, but I have objected against that on several occasions in a fee committee. Right, and today I don't agree with this because part of the problem here is that in previous years this was used as a Well Field by WASA. The system had several wells which operated in terms of production from the Diego Martin gravels. What happened is that it was backfilled to a certain extent and the wells had gone, I think they gone out of abandon because of some problems WASA had (**audience:** *they over pumped it and it went brackish)* right, so they went brackish. So, what happens here is that this, as part of what you call a discharge recharge system, right? This could be the discharge here. So, in your design it should consider some mechanism to recharge it with natural rainfall. But in apart from that, the whole Diego Martin Valley is being developed and the more we develop is the more we pave. Paving means increased run off and reduced ground water recharge. More than 90% of the water in this area is from ground water. That's why we didn't really feel an impact because of the drought this year in this part of the area. So, you have to deal with the ground water sustainability recharge issues and plus, I don't know, you can't put a road in the middle of it. Because where somebody kicks a ball, and a 10year old boy runs across the road; that's not going to be a slow road, that's going to be a 60km/m road. How could you do that? That's my comments. (*applause)*

Dr Henry: Just remember all your comments are being documented.

Mr. Garth Elliot: Good night everyone my name is Garth Elliot. I've been hearing about The Keys and Powder Magazine 2, but I am not hearing anything about Powder Magazine 1 at all and we have to be crossing 3 highways to get across the road. I don't know if that is in the plan or it's going to be worked out pretty soon, alright. But remember that Powder Magazine 1 exists. Thank you very much.

Ms. Roberta Wright: Good evening, my name is Roberta Wright; I live just around the corner, Franklyn Road. I'm sorry to be coming so late with this suggestion. But I was not aware of the two previous meetings. Looking at the various suggestions which have been looked at and

discarded for one reason or another I had looked or would like to put forward yet again another which would eventually not require an overpass at all. I think the Ministry may have had overpasses on the brain; I think all you need to do is re-open the bow tie but whereas before the bow tie was rightly cutoff because it was just too dangerous to try and get from the east bound Western Main Road bow tie, across 4 lanes of westbound Western Main road, to try to get to West Mall. I mean that was a hideous thing to have to do and even before the bow tie was cutoff, I've gone down to St. James and back again, when I wasn't trying to get to West Mall through the bow tie. What we need to do is re-open the bow tie but put concrete blocks along as you come out of the bow tie, so that you are prevented from going left unto the Western Main Road until after the highway has split off from the Western Main Road. So that you are now free to get onto the highway and you would then; and I have driven over this area daily, I reckon you would then have time to get across the two lanes of the north bound unto the west side of the north bound, and then you can get unto Victoria Villas and that whole Western Park Area without actually needing an overpass. And from there you can get your roundabout and your big Columbus etc. The only thing, I admit this would not do, is give short cut from Port of Spain to Victoria Keys. You will still have to go through Four Roads (**audience:** *that's fine. We could live with that. That's a very good point. Applause)*

Dr. Henry: I am sure that some of these technical solutions have been addressed, but maybe in light of the comments they need to be looked at again. Yes, sorry, there is somebody behind. Well sorry Miss.

Ms. Nadia Henriquez: Can you ask if it has been looked at?

Dr Deare: You need to say your name. I hope you don't mind.

Ms. Nadia Henriquez: Not a problem. Has this alternative proposed been looked at because I did not see it in the slides you put up?

Dr. Henry: Yes. Ms Abel.

Ms Abel: Our remit started in May 2019. In terms of whether it has been looked at by us, no, but in the feasibility study which was done by others it was looked at. The challenge was that the weaving length was too short, so it was dangerous.

Ms. Catherine Cobalt: Catherine Cobalt Victoria Keys. My concern is really one more of procedure and it comes straight to the point that was just raised. We had two consultations before you put up a whole list of stakeholder's consultations you are going to have. From in my world where I lived before, coming out of all of that, a report would be done of all the various

comments that were raised by various persons and what was the final decisions. Considered not feasible because of budgetary constraints, environmental issues considered to play a very positive included in the new design etc., etc. So that we would know for sure that we have spent hours here going through these consultations and what is coming out of it. Are our concerns really being addressed? And then because it is a public consultation, there is no reason why this can't be on the website or something that we could go back and look and just as her comment we see that was discussed before and it was thrown out because whatever you said was too short. Alright, so I think we need…and that's the kind of transparency we need in things like this. And I mean especially in this situation where we really have a moving target. Because today is Kairi, or tomorrow is somebody else or yesterday was somebody else. Trintoplan come on the scene now. I mean we moving from…since what we said….is about more than 15 years ago or so this thing has been going on. Who is keeping the cumulative input of all of this and all the discussions? I really don't care that a contractor has changed, or consultant has changed in the same project. Somebody must be the master of this, and it has to be The Ministry of Works. It's your project. So, I don't know, I don't know if something like that is in place. Maybe I am assuming it is not but I would certainly like to hear.

Dr. Henry: I would depend on my colleague Dr. Deare to elaborate on this point but my understanding is that the SIA documentation that comes out of it is going to be put on the record of the EMA. It is a requirement, so that's how our independence, in a sense, is guaranteed whatever you say is put…

Ms. Catherine Cobalt: But that is the documentation. I'm going beyond the documentation. I'm going to the point where every comment that was raised or every proposal was put forward, what was the outcome of that and if not accepted, why? Not just documenting the presentation.

Mr. Ramsingh: The last time we came we presented what we call the 2018 design right, and we listened to you guys. I could tell you, you spoke about the entrance to Victoria Gardens. You spoke about the detention pond. You spoke about sewer system. You spoke about how close it is to your building, right. Those are the comment that came from you guys, right. So, we went back to the drawing table because that's why we are here. You will see today in the design, that we have your existing entrance to Victoria Keys remains. You still will be going in and out of Victoria Keys. The only advantage you have now is that when you come out, you have easy access to all directions. Andrea would have spoken about the fact that we have shifted the entire bridge from the south, which is further away from Victoria Keys right. You all were very passionate about some sewer line right. So, if we not interfering with your entrance and all your detention basins and so forth, there is minimal impact to you in Victoria Keys right. We shifted the bridge away right, reduced the Diamond Interchange. Notice, it is just a simple design. And

all that came about because of the consultation. So, when we hear and we listened to you guys, we go to the drawing table and I keep telling you guys because it's a concept. If you all understand what a concept is, that is a concept. We now hire consultants and we write what you call a terms of reference right. And in that terms of reference, we clearly define what it is we want that we heard of you guys. I heard about the drainage. I could tell you that is there in the design. We heard about the fact that you want to ensure that there is enough greenery so that you could refresh the aquifer. If you look at it, look at the amount of greenery, look at it. From that distance to the river, there is a lot of greenery there. Now what we are doing here, there is this huge area of land there that has always existed right. If the land is not accessible to you the people to enjoy the benefits of it, this is of no use you know right. You all must be able to access that park comfortably, safely right. And that is the reason we are here. That is why we are building this bridge. That's why we trying to have connectivity between both sides so that you all could enjoy the park. And this, as we all said, this development is way before my time. I inherited it. We look in the Ministry of Works, that's why we spike about 1990, you know, right. Since 1990, but what I could tell you are engineering plans are dynamic right. We come, we listen to you guys, we make changes and again we listen to you all again and we will go back and some of the changes may be physical. Some of the changes may be specified in our contract, right. And if one thinks I could get from you all is that you must understand; it's a concept. We don't have all the answers. We are here to hear all the problems you have, and we are here to make sure that when we finish the project that we could solve most of your problems, right. That's why we are here.

Mr. Crichlow: Let me just add something here on behalf of NIDCO, and it's really to let you all know a few things. It's important that you know this and really, we want to listen to you, and believe it or not we are on your side. We are! However, we are a special purpose company and we are hired by the Ministry of Works to do something. When they say go, we go, basically. So, I want to direct you to the timelines that we gave you earlier tonight where we are saying; we will have a Social Impact Assessment in August and so on. And in August we are looking to procure a Design Build Contractor. This is the intention at this point in time right. This could change. So, you have until somewhere the mid to end of august with the consultations that we have to affect. The conceptual design and I'm not going to say that that is when it stops. We will have a conceptual design that will go out to tender for a Design Build Consultant, right. Now all that means is that somewhere in October we are hoping to hire that person or that group. Now within the RFP of those documents there is a further 120 days that we hold, we ask the consultant to hold. We have that time to further do some; probably more consultations with you, to change and tweak the design. However, what you need to know, is that come August, end of August, we will have a conceptual design. The basic main frame of it, if we are going the way we are going the way we are going now, that is going to be, well, more or less what it is. You will get to still tweak certain aspects of it, so there is still a lot of time to affect the design

and make changes and have our consultation and work through Kairi and so on. I just want you to know that so that you don't get all tisik and start getting too worried. But the Government is not going to necessarily wait forever. And we have got to reach the point where we come to decisions.

Male participant: No but the SIA has to be completed and approved by the EMA before anything in the ideal world...

Mr. Crichlow: And that's right in fact we have that there, the CEC is going to be complete. (***male participant****: most important thing here is Kairi*)

Dr Henry: Yes and we are happy to be important.

Mr. Vishesh Ramnarine: Good night everyone, my name is Vishesh Ramnarine from Victoria Keys. Let me start off by holding the whole panel on the assurance that there will be no land acquisition firstly. And secondly, I am holding the panel to the fact that all of our prior concerns which would have been expressed in the last rounds of consultations through the Victoria Keys resident's attorney - Hamel-Smith, as that would in fact form part of your mandate, right. Secondly, now in all the project alternatives, I didn't see enough conversation on the no action alternative. Victoria Keys and Powder Magazine Phase 2 are very comfortable with the existing roadways to get to West Park or wherever else we have to get, right. So, let me make that point. We want to see more information on the no action alternative. Next of all, as part of the Kairi Consultants Limited project, we need you guys to do current basic line data. Not the 2015 data that was mentioned before. We want 2019 baseline data and projected data into the future in the areas of noise, particulate water runoff and all the different criteria that would affect our quality of life. Kairi wasn't here at the last consultation but there was a young lady who had a toddler and she lives in Chaconia and when the Diego Martin Highway was done, her toddler developed asthma. So, what you talking about here is not concrete and sewer and water flow, we talking about the quality of life for Victoria Keys, in particular Tower 1, Powder Magazine Phase 2 and also Victoria Gardens. Now what you guys don't know, or maybe you know, Powder Magazine Phase 2, Victoria Keys, Victoria Gardens, Victoria Villas, we very much aligned on this issue. Don't think that we are thinking with a separate head. It's one community thinking the same way and at our last meeting, in preparation for this consultation, we realized that both Powder Magazine Phase2 as well as Victoria Gardens, when there are heavy downpours, they have storm water and sewage coming up through the manholes. So, what we would be lobbying for is not only a Social Impact Assessment, which I think is a bit understated considering the problems and the scale of this project. But we want an Environmental Impact Assessment. We have reached that stage with this project (*applause*). And last of all, whilst HDC

may not be here and whilst you guys might have to take the licks for this at the end of the day. When I went to purchase in Victoria Keys as well as others who had the same experience, the agents of Housing Development Corporation, misrepresented that vacant lot of land and said it was going to be an Eco Park. And up to today it's in the promotional materials for Victoria Keys. Because it still has about 35% of the units to sell. So, beyond the cost of this monstrosity should that fall-in overpass go in front Tower 1. And I do appreciate the adjustments made to not acquire lands that was affecting our boundary as well as possibly Powder Magazine Phase 2 but I think it was only our boundary was going to be impacted. The cost of this project is not only going to be this monstrosity. Should we lose a dollar in property value there will be a lawsuit because we believed the lie of that Eco Park and we invested in Victoria Keys. And should we have a loss in property value there is another tranche coming. Alright. Thank you (*applause)*

Mr. Kerry Williams: Good afternoon ladies and gentlemen, panel – My name is Kerry Williams I represent the Forest Committee and let me apologize to my neighbours who did not get the invitation; what happened is we got the information and the date was changed and we did not get enough time to circulate. We did communicate with Kairi and they would have an email to prove that we tried to get it to all the communities that would be affected. That being said; Mr Ramsingh good afternoon again - so let's add some history to this, Mr Ramsingh is no stranger to this project, he was part of the highway development project as well where we echoed the concerns about the drainage and how it impacts Victoria Gardens. The Consultants have changed but the message remains the same – we spoke about flooding which we advised from the Four Roads side of things how it would impact our Victoria Gardens, Victoria Keys and everyone else. I am hearing that you all have now projected a pond area but the veins that go to that pond still remain uncleaned, they are the wrong size for the volume of water based on your consultation. There is a grey line between Diego Martin Regional Corporation and MOW where Regional Corporation for the benefit owns the roads off of the highway and the MOW – and keep me honest here Mr Ramsingh - owns the main highway. So some of the things we are raising should actually be involved with the Regional Corporation who is absent again. We actually asked that question in the last two meetings and requested that the next time we come to this forum that they be invited. Is there anyone from the Regional Corporation present tonight? Again we are disappointed that – they were invited? Well from the communication coming from the Corporation no one had knowledge of it hence the reason our Councillor for the area is absent as well. So I don't know where the communication gap is; it may have been us in transition. So that is the part on drainage. We echoed previously that we welcome change and we are not in the mindset that we don't welcome change; we know it's a developing environment and the population is increasing yes but we need to be realistic. We echoed from the last meeting and I'll say it again, coming out of Diego Martin in the morning which I don't

think anybody on the panel has the pleasure of, would understand that the delay comes from lack of use of the layaway. We know it's a behavioural problem, we also know that if you at least start with the policing which we also requested that the Four Roads Police Station be had here so that they too could partner with us in ensuring that the flow of traffic out of Diego Martin would be efficient – that has not been addressed. We are hearing about this plan, we are not closed to the plan, we just need for you all to do it with integrity and it's not feeling that way coming from the beginning. We consult about the highway, we gave you all feedback, we still have a 12 x 12 manhole going into an 8 inch pipe to go to Victoria Gardens. We echoed that what is happening to Victoria Gardens is not new and we know that the challenge was MOW with Regional Corporation and that conversation that seems to be so difficult to be had to actually come to one common understanding to positively impact the lives of the people that live in all the areas. We are asking again; we are passing on to Kairi now who is the new Consultant; the previous Consultant would have had the data, we are clear on the environmental piece, we are clear on what consultation is, we are very clear on what the concept is; what we want you all to hear is not that we are pushing back but we are trying to work with you and if you just give us a minute and hear what we have to say and respect that what we are saying is just for opposition of a design but it is the people that actually live in these communities and how it betters them and these are the people here. I am not just speaking on myself – Victoria Gardens, Victoria Keys, Powder Magazine all those areas Four Roads sorry I leave out my area – we've been echoing that MOW speak with Regional Corporation , sort out the drainage issue that's nothing new. The gentleman highlighted the dredging of the river, you're going to set up a pond to send to a river that has not been dredged in over 20 years or so and we have barge sitting there – yea we don't have budget that includes the fact that the Diego Martin River is in need of repair which we all know. We need to start communicating within the groups, it is impossible for me to understand or compute that MOW knows that there is a grey line between Regional Corporation and Ministry of Works and you all cannot clear that up as an entity that supports the people of Trinidad and Tobago – that is unacceptable and if we continue to go this way we cannot get progress. We need to stop taping this stick in the box consultation and do something real. A gentleman lost his wife, we are not saying that it might be the only fault of the development but somebody else lost a life. The walkover – several people have lost lives and we need to understand at the rate we are going if we don't listen to the people who actually live here we are not going to solve anything. That's my contribution thank you.

Dr. Henry: Let me assure you that the Regional Corporation was invited, as well as the Police.

(*Inaudible comment*)

Mr. Ramsingh: We would have another consultation coming up ...

Mr. Kerry Williams: Mr Ramsingh you and I have been to all of these consultations and since you've been sitting in that chair and we have not seen the Police, we have not seen a proper representation of the Regional Corporation and these are all government bodies. I cannot accept and I don't think anyone here wants to accept that government bodies within a region or Corporation cannot come together and say let's appoint people to come and listen to the needs of the people that they support – that is unacceptable. And let me give you the response to that – the response is MOW I control this shop I don't concern Regional Corporation, Regional Corporation is another body I don't have hands here to make anybody come.

Dr. Henry: Alright let me also say that notwithstanding that they are not here – the Regional Corporation – they are listed as one of the entities that we will engage in this discussion so we are going to see them as well.

(*Mumbling from crowd*)

Mr. Crichlow: I just want to interject here for a quick one. As NIDCO, I can tell you that Kairi is our Consultant and I want to confirm right now that we are prepared to ensure that Kairi picks up on all those people and co-operations that you want in this consultation and I want to commit that they will be here the next time. However, my good friend here said something that I thought was a little unfair to us – I heard what you said and I know where he is going but it is a little unfair because Navin took quite a bit of time to show that in the previous consultations it affected the design; we changed it to the point where no more acquisitions etc, there were changes made and I believe Kairi put up on the screen too all the areas that they dealt with on the last occasions. So I want you to feel a little more confident that we are really looking at what you have to say and taking it into account.

Mr. Kerry Williams: Again good day sir. I've been part of this project from the actual highway extension and when I say part of it - listening, giving feedback and sharing – what has changed besides the shifting of the footprint and I think an access road being removed that's it. We have seen the recommendations so all the recommendations that 1, 2, 3, 4, a, b, c, those were null and void, we didn't need to see that. It was actually painful looking at it again because we have seen that. We know that those are the recommendations that didn't' work – this; nothing has changed – nothing besides the road sorry and shifting south to not impact.

Dr. Henry: I hear you.

Ms. Donna Feraz: Goodnight, Donna Feraz, Victoria Keys. I have just one really simple question; the last I heard that piece of land was in court. I think it was the Port of Spain City Corporation was trying to regain ownership of it. Can anybody say what is the latest with that because we

are spending a lot of money to have consultations and I don't even know if the land will be available.

Mr. Stuart Daglish: For your information the Port of Spain City Corporation was in court with WASA, the Port of Spain City Corporation won the case... or you are talking about the swimming pool. I do apologize I thought you were talking about the S Park, okay. You know Chair since I have the mic I would just like to venture an opinion – a number of things are being said about no acquisition. I am looking at it from something totally different; we were promised from Louis Lee Singh down to Mr Valentine to a number of people that that entire area was going to be a green space. I am seeing that that green space has gone from 35 odd acres to approximately 15 or 16 acres to me that is land acquisition and as a tax payer that is actually my land so that is why I'm so passionate about it right. Okay, you may not have to pay any money but there has been land acquisition.

Mr. Ramsingh: She didn't get an answer. I guess we are going too far ahead – in a project cycle first of all we have a concept which is what we have, we have consultation, we get information from you all, we refine the concept, we get the approval so we have a project. Once we have a project we always at this stage try to minimize acquisition and when we say minimize acquisition we try not to touch houses where somebody living right because that has a lot of trauma and so forth involved with it. So when we reach that stage in the project we go to what we call the lawyers and the land surveyors, we do what you call a cadastral survey, we do what you call a title search and we find out who owns the land and if the land is in dispute the law has a way in which we could use compulsory acquisition right. We go to Cabinet, we serve the owner a Section 3, we serve them a 4 and ultimately a 5 but if the title of the land is under dispute now as this project proceeds the title will not be under dispute because we will use the compulsory acquisition part of the law in order to allow the project to proceed.

Ms. Donna Feraz: So is that where you are at now? So what you are saying is that it is still in court. That was my specific question whether the matter has been resolved because I didn't ask you all but I asked elsewhere up to about February and I don't think that it had been resolved.

Mr. Ramsingh: I personally don't know but the by the next consultation I would try to find out what's the status of the land. But as I said we don't deal with that at this stage in the project.

Ms. Donna Feraz: Okay then thank you.

Mr. Ramsingh: I wonder if, Brent; if we build this road here would the property value surrounding increase or decrease?

Mr. Brent Augustus: You are asking me a question that I'm about to address. I live up in Crystal Stream but I am a Diego Martin resident and what happens here affects way up in Patna, up in the North Coast, it affects Glencoe, Carenage everything about this affects the entire Diego Martin Valley family down to the Chaguaramas. This design you talk about a detention pond, you talk about lack of culvert, there is so much more to this, my fear is that this 36 acres of green space when I moved into Diego Martin that was supposed to be that design lends itself to tremendous congestion and further development and I want to tell my Diego Martin residential family that you all need to start lobbying Town and Country Planning that any space in front Victoria Keys, any space where Diego Martin Regional Corporation wants to put their office - why it is not back down south I have no idea maybe there is alternative reasons – but we need to start lobbying Town and Country for that to be green space and green space only. (*applause*) Navin I am picturing where that south of that loop in the 36 acres, that 7 or 8 acres next to T&TEC, if they think Victoria Keys big, that will be just as big; it's just a matter of time. The way it's designed we are going to get built development. From Victoria Keys to the eastern space Mr Berkley I feel sorry for you but the fact of the matter is you are not in control of it; you are going to find yourself having to do exactly this again because somebody coming to take that piece of land to do another development – probably HDC and if the seat becomes marginal, worse. Navin, as regards property values this doesn't really affect; it affects the people retaining the land in the loop, those are the people that are going to benefit, not us as tax payers. The people who retain the bottom are going to work a deal with the developer. Regional Corporation must be here to explain to us why they are taking 7 prime acres north of that road work and not the southern part, it makes absolutely no sense. Now you said about a detention pond but as Mr Prudence says that detention pond area next to T&TEC is the lowest part of that entire area, I don't know how you taking water uphill into a ravine at the end of which we crossing the highway unless we going by Paragon and making some culvert that is about 10 feet wide but that whole design concept, folks start lobbying your Councillor, start lobbying Town and Country Planning, it is coming. If we don't object vehemently it is built space that should be 36 acres of green space for the Diego Martin family. (*applause*)

Mr. Ramsingh: Brent, when we do the drainage engineering, once we complete the engineering and the design anything is possible. A piece of land can be low today and ultimately we have to keep the water there when there is high intensity rainfall and we must discharge the water into the ravine basically so that is an engineering solution that once we reach that point it will be solved.

Mr. Brent Augustus: Yes but I can't understand how you're going to have a 7 acre wide pond; the land south there is about 7 acres so we can have the pond and Diego Martin Regional Corporation, FCB can have the biggest branch they want downstairs, there is no need for them

to go north, we can accommodate everything in that little loop south and please folks, green space, lobby your Councillor, lobby Town and Country - you have to start now.

Ms. Cheryl Ann Simmons: Diego Martin resident so I don't live in any of these areas but like the previous speaker I have to say that it will affect everybody in Diego Martin. So just a question, Ministry of Works indicated well NIDCO indicated that this is a design build project but yet Ministry of Works said that you will design the detention pond or you will hire a Consultant to design the detention pond. I'm kind of confused; is it that the design builder will be the person designing the whole thing including the detention pond? Or is it that you all are directly hiring somebody to design the ...

Mr. Ramsingh: The design builder will hire people with design competence to deal with the structures and the drainage

Ms. Cheryl Ann Simmons: And Ministry of Works would then approve whatever the design would be?

Mr. Ramsingh: Yes it has to be approved by the drainage division, by the Local Government, everybody in the process.

Ms. Cheryl Ann Simmons: Okay that clears that up because in my mind I was kind of getting confused. Now that area between Victoria Keys and Victoria Gardens that you said that nobody seems to know what's happening with respect to ownership; it seems to me that if you go out to Tender and you engage a Contractor and you still don't know about ownership even if you talk about compulsory acquisition – it takes time. So you; you see my tax I work hard you know, my taxpaying dollars. So if I were the Contractor the first thing I would be doing when I give you my implementation plan is I would put that part as early as possible knowing very well that you would not be able to solve that acquisition problem and then it would become a variation and my poor taxpaying dollars would have to pay the extra money. So I'm just saying should you not clear up that issue before you go out to Tender and before you engage a design builder to start; should that issue not be cleared up?

Mr. Ramsingh: Okay one thing, we do acquisition all over right; one of the most difficult thing in acquisition is if there is residential people who live in the area and they are affected we like to give those people at least a year or 2 year notice because they have to relocate. When we have to do acquisition in open space; in what you call green space, then it makes it simple for us because we don't have to relocate somebody, we use the law and the law allows us we serve a 3, we wait 3 months, we serve a 4 and upon serving the 4, we enter and do construction and that's how we do it all over when you have an open space of land. When we have somebody

living on it it's different right so it really is just a matter of getting the title, completing the cadastral survey, getting the title done, going to Cabinet and asking Cabinet to approve a Section 3, 4 and 5. Once the 3 is served we have to wait 3 months and after 3 months we serve a 4 and we enter for construction purposed. That's how we've been doing all the interchanges as we go throughout Trinidad.

Ms. Cheryl Ann Simmons: 3 months but then you said you have to go to Cabinet, that takes some time to write up and go.

Mr. Ramsingh: Well it's not the first acquisition that the Ministry of Works is doing.

Ms. Cheryl Ann Simmons: No I'm not saying it is but with you engaging a Contractor now or whenever...

Mr. Ramsingh: No if you look at the implementation plan right, as engineers we have to plan, we have to plan the project from the consultation stage to the conceptual design stage, we have to plan, we must have a plan. If you notice the plan that was put up it talks about the consultation that we are doing today, it talks about the EIA approval and then it talks about the award of a contract you know. If you all didn't notice that's how it was.

Ms. Cheryl Ann Simmons: October; the award of contract was October.

Mr. Ramsingh: Yes but remember something, we have to plan, we have to put a plan forward but the key thing about the plan is that you will see there is the consultation, there is the CEC that will be granted and then there will be the award of contract before we start work and that was clearly shown in our schedule.

Ms. Patricia Picou: Good night I am from Powder Magazine Phase II. I would like to address the person who is representing NIDCO. We heard that NIDCO was doing some measurement in Powder Magazine and when asked they said that there was going to be a tunnel running between Powder Magazine towards Phase I. We would like to know if there is any truth to that fact.

Mr. Crichlow: I have not personally heard of that project or tunnel in Powder Magazine. I will certainly check on it, maybe I missed something.

Ms. Patricia Picou: Well they represented your company sir and they were doing measurements.

Mr. Crichlow: Maybe for something else but anyway we will check on it and let you know

Ms. Patricia Picou: Thank you.

Ms. Joanne Ashell Z'amore: I live in Diego Martin but tonight I am here representing West Shore Medical. You all made a brief mention of the bow tie because this project is supposed to go up to Fisheries; my question is; is that bow tie, the one remaining bow tie is it going to be closed off? And how are ambulances to access Port of Spain because we have 2 hospitals in Cocorite, 2 schools in Cocorite and there is no emergency access at present; it's very dangerous.

Ms. Abel: Okay speaking about West Shore; to get back into Port of Spain they would go to the traffic light. They would go along the western main road through the intersection that's the route. That should be about 1 minute drive (*laughter*). Alternatively, they could go through the roundabout and back out (*it wouldn't be a minute*) It depends on the traffic.

Mr. Ramsingh: We have to remember it's an ambulance and when an Ambulance is on the road by law we have to give way whether there is traffic or not. An ambulance doesn't stop for traffic.

Ms. Joanne Ashell Z'amore: So excuse just to confirm you all are going to be closing the bow tie; yes?

Mr. Ramsingh: Ultimately, I don't know if you all are aware right of the amount of accidents and incidents that has happened at that bow tie. I don't know if you all aware of it right but every 2 weeks we have to go and adjust the concrete barrier which means that it's dangerous. It's one of the most dangerous things that you have in the west. So one of the advantages of this project, is that we are trying to make that situation safe and trying to minimize the out of way travel for the people of that area. We are ultimately trying to make it safer for you all. So that's why in this solution, you come to the traffic light and you make a 'U' and you proceed; it's just about less than a kilometre away and as I said we give way for an ambulance.

Ms. Joanne Ashell Z'amore: Alright, but Trinidad culture we don't give way for ambulances and we would only appreciate that when it's our relative inside the ambulance

Mr. Ramsingh: Really? I disagree with that eh… I drive the highway everyday and when an ambulance comes the traffic parts. Everybody on the highway parts and allows the ambulance to proceed.

Ms. Joanne Ashell Z'amore: Okay then you are a good citizen. Secondly, the point I would like to add – excuse - is; we have the 2 hospitals yes, I know at West Shore we have made several requests for lights, for a lay-by into the hospital, we have accidents all the time coming into our wall because of people speeding past the walkover and with no recourse whatsoever. So now

with this additional delay I hope we are included in the focus groups that you all are going to be having in the future.

Dr Henry: I want to assure you, I think we got that you represent a particular group and we will ensure that we do visit with you.

Mr. Vishesh Ramnarine: I just have one more question; in addition to this project here the amount of money that is going to be spent on this project - it's a lot. From what we get so far this conception seems to be, or we are being told you are trying to get something to be the most economical – this overpass. From the designs shown so far I disagree that this is the most economical one; that's one. And the main solution that this is solving what it appears to be is from getting from the Diego Martin highway to the Western highway, full stop an area of 100 acres full stop. It's not adding any more value to the western peninsula, it's not helping traffic in and out of Diego Martin (*applause*), and it's not helping traffic to Chaguaramas and back okay.

Mr. Ramsingh: Again I have to explain to you within the Ministry of Works; I don't know if you are aware but in the previous consultations when we did...

Mr.Vishesh Ramnarine: Do you agree with what I just said...

Mr. Ramsingh: No what you have to remember is you must not take a project in isolation because if you think about the project we did by Grand Bazaar; that was built over a 7 or 8 year period. Every year we did something and it provided relief for motorists...

Mr. Vishesh Ramnarine: Yes but we can use a different approach here and then spend monies in other areas that we all work simultaneously; widen the roads going down Chaguaramas, widen some roads heading out, widen some roads headed in; not dump all the money in one little spot to cross a bridge...

Mr. Ramsingh: Again I told you that the Ministry of Works have a number of projects, we have projects all over the country...

Mr. Vishesh Ramnarine: Well we are not being informed so this is why we are speaking.

Mr. Ramsingh: Alright well we have a project when we come for the next consultation I will let you be aware of what are the plans we have...

Mr. Vishesh Ramnarine: Yes; this does not seem justifiable enough at this point. If it has no value for the wider picture...

Mr. Ramsingh: I will try to present to you the wider picture alright.

Mr. Vishesh Ramnarine: As it stands it is not justified; it's not.

Dr. Henry: Alright I think we have Mr Ramsingh pleading with us that he will be providing additional information at the next meeting.

Ms. Nadia Henriquez: Victoria Keys; I just had a couple of concerns coming out of some of the comments that were made and generally what transpired over the evening so I just wanted to highlight them. I was really hoping when I looked at the alternatives as the other gentleman said, we've seen some of them before and they are clearly not feasible. So I would have hoped coming out of the EMA's request that you would have looked and put up more feasible and newer alternatives for examination by the public and be clearer as to why they cannot work viz-a-viz this still very large, very costly complicated alternative. So I would ask again that before we have the next consultation and as part of the focus groups that be properly examined including options like the bow tie because what I am hearing from Trintoplan is that they have not even looked at the option of properly and safely reopening the smaller bow tie option which obviously will be much cheaper. So I would ask them as part of this exercise as mandated by the EMA to relook at alternatives that would be cheaper and simpler and have a minimal impact to the community of Diego Martin; that's the first point. (*applause*) I have 2 other quick points.

Coming out of the last 2 consultations, we would have gone into detail as you noted about our concerns and about the lack of mitigation plan and so on. I have noted that a comment was made in passing earlier that you all have taken note of our concerns and addressed them in the presentation; I just want to point out that the presentation was again noting the clear buckets of noise, dust, crime etc, impact during construction; the mitigation plan still has no details, that was a concern from the last 2 consultations, months have passed and there still is not further explanation to the community of Diego Martin as to what these mitigation measures would entail. So again we are being told further down the road in consultations and focus groups - who knows how they would be documented this is going to be explained to us. So I would like to again ask as part of the consultation process; it's fine if you discuss it in the focus groups but it needs to be documented and explained to the community in detail for each bucket of concern what both pre, during and post construction would be employed by NIDCO as mitigation measures and long-term mitigation measures after this 4 lane, elevated overpass is constructed in between 2 residential communities and in the vicinity of several more.

One further point very quickly; we come back to the same issue which is that from the last consultation we had really emphasized that this conceptual design lends to uncertainty. It

lends to uncertainty because you are meant to come up with a mitigation and grievance plan and monitoring plan as mandated by the EMA without having a design set in stone. So how are you meant to mitigate against same in a fulsome fashion. So what I again implore you to do is come up with a more concretized design prior to this whole application for the CEC process. To me this simply appears to be putting the cart before the horse and it seems to also be very dangerous because if the designs changes significantly how are we meant to ensure that you properly mitigate against new risks arising from your changed design. Thank you.

Mr. Trevor Martin: Good afternoon, Trevor Martin from Victoria Gardens. I just have a question with regard to the actual roads and then to make a suggestion or an appeal with regard to the entrance in and out of Victoria Gardens. The first question with regard to the road is on the most northern side of the highway after the roundabout there appears to be a feeder road going unto the Diego Martin highway is that correct? (*Yes*) Okay I'm just sort of wondering what is the purpose of that because traffic further down by the roundabout could actually come down to the lights on the western main road, the major intersection there by Superpharm and come back up around the existing feeder road unto the Diego Martin highway. That way it will give traffic more time to filter for those who want to continue down the highway further into Diego Martin to cross the lanes rather than trying to squeeze further down when you at the last minute deciding whether you want to go on the main road or Diego Martin highway. So that's a question I just want to know what that road is for. So it may be something you want to look at; is it really necessary.

The other aspect that I wanted to bring up and we brought it up with the Ministry of Works the time that the highway for the Diego Martin Victoria Gardens was developed; that for people coming out of Victoria Gardens the little triangle at the entrance there needs to be protected because people come down the feeder which is the feeder to go into Victoria Gardens, they continue to drive straight past and then try to squeeze in just before the gas station. This afternoon when I was coming here, a 'PH' taxi driver was flying down that road and nearly cleans me up; (*an illegal 'P' taxi*) they are not illegal anymore because the government approves that they operate on the road – but that's a different point. So what I've asked is could you put is jersey barriers they call it or candle sticks or something to stop people being able to drive on that little piece so that they have to go across unto the road.

The other issue is if you can also put jersey barriers or the same candlesticks a little bit further on towards Victoria Villas because what happens is a lot of people wait till the last minute to change from the highway to the main road and I know it's supposed to be a lower speed but people are flying down there and by the time you try to come out of Victoria Gardens they are flying at you and you will get cleaned up there. There have been a number of accidents of

people coming out of Victoria Gardens or crossing to go into Victoria Gardens because people have waited to the last minute to change to go unto the main road. Again if candlesticks were there forcing them to make that decision closer up to Victoria Villas we would not have that problem.

Mr. Ramsingh: What I would ask is at the end of the proceedings please come and talk to my engineer Rudy here; give him your name and whatever and we will come and have a look at it alright.

Mr. Trevor Martin: Sure, not a problem. And another thing is if there were jersey barriers going further up; well I'll talk to him. When you are coming up at night to turn into Victoria Gardens from Starlite the lights from the cars are blinding you and at least the jersey barriers will cut that lights but I'll talk to you afterwards. Thank you.

Closing Remarks

Dr. Ralph Henry

Well at 9:05pm I would like to bring the proceedings to a close. I want to thank everyone for a very vigorous discussion that we have had here this evening. A number of issues were raised; issues some of which were raised before but which you feel have not been properly addressed in the design or concept that has been put before you this evening. I want to assure you that all your comments have been documented and we've had a fool proof system in place so that the recording; you see the microphones are being passed around etc and it's being recorded and you see there are also people doing the verbatim record of the proceedings as well as my colleague in the back having our own recorders. So we have a fool proof method so to speak of ensuring everything is documented and we will be processing all of this information and surely it would be part of the report that is going to be in the SIA. Let me assure you though that our remit is very specific and it requires us to identify and assess; qualitatively and quantitatively the type and extent of impacts to the human environment arising from the proposed project. So that we are not really into an Environmental Impact Assessment as such although he SIA is a component of it; so we are simply here to provide the SIA component and that's why we are having this public consultation and we will be having the focus group meetings with a number of institutions and agencies (**Male participant**: *the SIA includes a lot of environmental stuff*). We take it on board the impact of the physical infrastructure on the environment and how people react or are likely to be impacted by this physical intervention so to speak. So it's more on the human; the social, the socio-demographic issues are going to be addressed. (**Male participant**: *I read in the CEC; the SIA yes it's based more on social which is 60% but the rest 40% is result of the environment on people*) On people yes so we have to look at how it impacts on

people. When it's being built, while it's being built and that why let me very quickly add that this is regulation that is evolving so that actually we have been required to develop aspects of the grievance procedure which might not have already been there or if it were there before it was not being observed in the kind of way that it is now expected. So you can see that we in a sense; you are the guinea pigs; it's the first time. So at the end of the day the public is consulted; the public with a big 'P' and also the public with a small 'p' that we are going to be talking to at the various organizations and entities that are resident in the area in one way or another.

So again, let me thank you on behalf of the Ministry of Works, NIDCO, Ms. Abel of Trintoplan and of course Kairi; they have come with us, we are the ones facing the music but they have danced as well in hearing your complaints and concerns and my colleague Fredericka Deare assures me that we are required to have another public consultation within the next 4 to 6 weeks so if even you don't see anything in the press lookout and you can call our office; we put our phone number in the documentation to find out when is the public consultation and it would extend that you meet us in the focus group meetings. We would be informing you when that second public consultation will be held. (**Male participant**: *Not before a rainy public holiday again*) Well we are not in a position to predict. Let me assure you that we sent out notices to 17 such entities. So thanks very much and we have surely benefited from your intervention this evening. Thank you. There are some refreshments to the back to give you some sustenance.

5.6.2 PUBLIC CONSULTATION 2 – SEPTEMBER 26TH, 2019



Public Consultation

Re: Construction of a Vehicular Overpass in the vicinity of Powder Magazine and Related Road Improvements Project

Thursday 26th September, 2019

Four Roads Government Primary School

Diego Martin

TRANSCRIPT

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overview of what has been done in previous years consultations and then I also want to address all the specific concerns raised in those earlier meetings.

So the contents of my presentation tonight are as follows; I will give a brief description of the project process to date. I will also give the context of the project which includes identification of the rationale for the project. Next I will give an overview of some of the previous consultations which took place in 2018 and 2019. I will give a description of the conceptual design and then from that point forward I will address specific questions which were raised in earlier consultations. These include questions as to why we have arrived at this stage with this design and not some other design. Also several questions have been raised about the drainage which is a challenge in this area. I will spend some time going into the conceptual drainage design and the storm water management plan. I will also address some of the questions which have arisen regarding some of the safety issues related to the design and its alternatives and I will also address some specific questions which were raised on construction issues.

You have to excuse me; I have jumped over some of the slides. Okay, so the project process, this slide outlines the process of the project. This project started with a feasibility study and it will ultimately end with the construction of the work and between the start and the end there are a number of stages. At the feasibility stage there were a number of consultations with key stakeholders such as the Regional Corporations, Community Groups, businesses directly impacted by the works, for example, the Community Hospital and West Shore Medical. After the conceptual design was prepared, an application was made for a Certificate of Environmental Clearance which is the C.E.C and the C.E.C process includes consultations, public consultations contrasting…and just to say a little bit about the consultations. Some contrasting questions and comments have been raised in previous meetings about the sequencing of the design about the public consultation process. On the one hand, you have comments raised where you have been told that it is preferable if the public saw the final designs so that they could understand what is going on but on the other hand we have had comments where by the public has said that they would like to be involved in the process, so we have to balance both. But the point that I am really making here is that the public consultation process is somewhat iterative and it allows the public to have some input in the design process.

On this project so far there have been 3 meetings and in this 4th meeting we are going to use the opportunity to give some feedback on some of the questions which you have asked and once the public consultation process is completed then one of the outcomes would be the Social Impact Assessment Report and thereafter NIDCO will procure a design build contractor. They're already in that process and once a contractor is on board, he will then take the conceptual designs to detailed designs and once those detailed designs and once those detail designs are approved by NIDCO, then the construction will proceed.

So, the project context…the location. Will I am sure you'll are quite familiar with where the project is located, to the south is the Western Main Road and West Mall. To the east are housing developments of Victoria Keys and Powder Magazine and to the north is Victoria Gardens and to the west is the Diego Martin river and the land through which the connector road passes, which also known as Cocorite Farms is currently undergoing some development. On the West is the West Park Savannah which is under construction and also proposed is the Diego Martin Regional Corporation Administrative Complex. The locations of these proposed developments are shown on the slide, so immediately adjacent to the Diego Martin River is the West Park Savannah and to the east of that in the north east quadrant is the proposed Diego Martin Regional Corporation Administrative Complex which will also have an FCB bank, the works for that are due to commence shortly. The West Park Savannah is nearing completion.

Project overview

The original Diego Martin highway was constructed in the 1960's when the population of the valley was significantly lower than it is now. In addition, there was a much lower percentage of vehicular ownership. At that time when the intersection was constructed the arrangements were quite adequate to deal with the level of traffic at the time. However, by the 1990's it became apparent that the arrangements were inadequate. The construction of an overpass at this location was first approved by Cabinet in 2003 and again in 2013. Arising from that in 2015, the Ministry of Works and Transport through NIDCO engaged a consultant, W.S.P Limited to undertake a feasibility study with the aim of eliminating conflicts and improving the safety of the Diego Martin Highway and the Western Main Road intersection. During this study, there was some public consultation with individual stakeholders and community groups to discuss concerns and these concerns were taken into account in coming up with the alternatives for the conceptual designs. The conceptual designs were completed in 2017 and they have been further revisions to the conceptual designs in 2019.

The existing arrangements are shown on the slide. So as you all would be aware if you are going from south from…coming out of the Diego Martin valley and heading south and going east is quite seamless, all the lanes of the Diego Martin Highway merge unto the Western Main Road. If you are going north…if you are going west and headed north from the Diego Martin valley, also fairly seamless as 2 lanes split off from the Western Main Road and head north into the Diego Martin valley. If you are going east bound to north bound, you take an off ramp from the Western Main Road to the Diego Martin Highway. For traffic heading south bound and intending to head to the west, you need to turn on Morne Coco Road at Four Roads and then head west and then south unto Westland Avenue. For traffic heading east and wanting to return to the west if you take a U-turn, you take a jug handle at Columbus Circle and then you turn back west and if you miss this turn, you can go up to Four Roads and make a loop around. For traffic coming from Port of Spain and wanting to head back into Cocorite, then you take the bow tie which is the part still being kept open.

Context: Traffic Volumes

The level of vehicular ownership in Trinidad has exploded. The volumes have increased very dramatically over the last few years and if you use the projections based on a rate of growth of 1.75% you can see that by 2020, you would have 845,000 vehicles on the road, by 2030 - 1, 080,000 and by 2030 - 1,285,000. So there is significant growth in the traffic and based on the traffic projections, Diego Martin is no different to what is going on in Trinidad. The traffic volumes are such that the alternative for leaving this intersection as it, is just not considered to be advisable.

So in the early 1990's the Ministry of Works and Transport indicated that this intersection does not have enough capacity and the alternative route from the south, those coming from the valley going from south bound to west bound the motion is circulators and it's also on local roads contributing to congestion on the Morne Coco Road and West Avenue particularly during the peak hours and with the expected growth of traffic that road will approach saturation by 2020.

An overview of the Consultations taken in 2018

There were 2 consultations that took place, one took place on October 23rd and the other took place on November 17th 2018. In those consultations the results of the feasibility study were presented, also the 2018 version of the conceptual design which was the outcome of the feasibility study was also presented. The process of procurement, i.e. the design BILCON model was also presented to the public and the conceptual design coming out of that feasibility study is presented on the next slide.

This design which was undertaken by W.S.P included an overpass over the Diego Martin Highway and a series of frontage roads starting on the Diego Martin Highway south bound lanes and ending in Cocorite at in Lady Hochoy Circular road. It also included a connector road from the Western Main Road passing over the overpass structure and ending at Victoria Keys and there are a series of ramps between the two highways. This conceptual design was taken to tender, however there was a review of the concept arising from concerns particularly of budget and also into account some of the outcomes of the public consultations, so because of that the design was simplified and the simplified design was presented in the next public consultation, July 4th 2019 which is shown on the next slide.

Now as indicated in 2019, NIDCO engaged Trintoplan to review W.S.P's conceptual design and to present another option which had a reduced scope of works while still improving the connectivity from Diego Martin into the western peninsula and the new option had certain considerations.

The first thing is the overpass was shifted to the south and this is coming out of the consultations, it was shifted to the south so it would have less of an impact on the Victoria Keys development so the entrance to the Victoria Keys could be maintained and this also increased the setback for the construction from Victoria Keys and the frontage road was also eliminated so there was no need for property acquisition. The required traffic movement were considered and the new movement which doesn't exist now from south bound to west bound and south bound to north bound and west bound to east bound i.e. people coming from Port of Spain and wishing to go into Powder Magazine; those were also considered. And another thing that was ensured is the current pedestrian walkover Powder Magazine was also maintained. In addition to that, a round-a-bout was also included to provide access to the new development in Cocorite farms. So this is the new design in which some of W.S.P's designs were used and as indicated the frontage roads were eliminated and the primary focus of this design was to get all the missing turning movements addressed as well as to provide access to the other developments.

So in this slide I will show some of the movements, so if you are coming from Port of Spain and you want to get into Powder Magazine or Victoria Keys this now allows for you to get in, you take the connector road, go through the round-a-bout and you head over the overpass you could get to Victoria Keys and into Powder Magazine. If you are going from Port of Spain and you want to head back to Port of Spain, in other words you make a U-turn; you go through the round-a-bout and head back. If you are coming from the west and you want to head north into Diego Martin, you go unto the connector road and go through the round-a-bout and on a ramp and get on to the Diego Martin Highway. If you are coming from the east and you want to make a U-turn to head back west, you go unto the connector road unto the round-a-bout and get back to the Western Main Road and head west. If you are coming from the Diego Martin valley and you want to go to the western peninsula, you come off on an off ramp unto the connector loop over the overpass through the connector road around the round-a-bout, the traffic lights at the intersection of the Western Main Road and Columbus Boulevard and you head west.

So some of the key components in this design is that there would be a fully signalized intersection at the Columbus Boulevard intersection with the connector road. The connector road will be a dual carriage way with 2 lanes in each direction, plus there is a left turn lane on the south bound of the intersection with Columbus Boulevard. On the Western Main Road there is a dual carriage way that exists now and in the west bound direction there would be 2 right turn lanes at the intersection with the connector road. The connector road will have a round-a-bout to provide access to the West Park Savannah and to the Diego Martin Regional Admin Complex. On the eastern side there will be a connector road, so there will be a ramp off the Diego Martin Highway south bound which would connect to the eastern connector loop. This joins the connector road and it crosses the highway and an overpass structure and the loop

road will have an entrance into the Victoria Keys and to Powder Magazine. So that's at that location.

Key Component 3

There is a 4 lane overpass structure over the Diego Martin Highway and the north bound ramp on to the connector road. This bridge….and some key components of the bridge, it will be a 4 lane double span bridge over the Diego Martin Highway. One span is approximately 17.5 meters and the other one is approximately 21.7 meters. The bridge will be supported on auger piles.

So at this stage I'd like to go into some of the specific questions which have been raised in previous consultations and these are broadly in 4 categories:

1. Was consideration made for maintaining the existing arrangements in other words, such as doing nothing or re-opening the bow ties?
2. There were concerns raised about the drainage
3. Some of the residents raised specific concerns about the effects of construction on their surrounding properties
4. There were some safety concerns regarding the designs

So the question of maintaining the status quo is why not leave the highway as it is and the reality is that the traffic volumes have been increasing and the most problematic movement is for persons coming out of the Diego Martin valley wanting to head west. Those persons currently use Morne Coco Road and Western Avenue.

The capacity of Morne Coco Road is being stretched to capacity during the peak hours, now if you take one lane of a freeway it can take approximately 1500 vehicles per hour but Morne Coco Road and Western Avenue are local roads with entrances and intersections so you have to factor down the capacity too because of that and the true capacity for a local road like that is about 800 vehicles an hour and we are at that at that number of vehicles right now in 2019/2020. So at this stage during this peak hours that section of the road is at capacity and the traffic is only going to increase. So that means if there is any further increase in traffic at peak hour, you will just sit there.

A question was also raised about the re-opening of the bow tie, one section of which was closed in 2014. So this slide shows the geometry of the bow tie. So if you are making a U-turn on the Western Main Road, you go through here. The problem with the bow tie is the danger it poses and the risks for accidents. The merging traffic…the traffic from the bow tie comes off the right lane which is at highest speed goes into this off lane and one of the problems is that traffic going unto the bow tie will slow down so it creates a problem for the person who is behind. You then come to the intersection with the east bound lane so you are at a stop and you are

meeting traffic in the right lane which is going at the highest speed. If you are taking the bow tie and you want to go to any of the roads in the north you have to weave through 3 lanes of traffic so it creates a lot of possibilities for conflicts and it's actually quite dangerous. So we went to the Western Division of the Police and asked them for information on accidents and unfortunately the police don't keep full statistics, they only keep statistics on fatalities but what is interesting is that between 2012 and 2017, 8 fatalities were recorded in this general vicinity because the request was could you give us accident statistics in the vicinity of the bow tie in Cocorite and there were 8 fatalities in a 5 year period. These are actual data, the dates of the accidents and one fatality is one too many. So I guess the statistics really speak for themselves, the bow tie is somewhat of a dangerous….it's a dangerous design for the road, particularly now as the traffic volumes have increased.

The next thing I would like to get into is issues related to the drainage. In the feasibility study several areas of flooding were identified and these are shown on the slide so and I would also want to acknowledge that members of the public in the last consultation spoke about flooding in Victoria Gardens and the Ministry of Works went and met with the residents and they identified the specific areas which flood and these are shown on the slide.

So the main drainage features are the Diego Martin River, there is also a very large drain…a large earthen drain in the north of Cocorite Farms that runs in an east west direction. There are a series of culverts which cross the road at various occasions. There are about 5 of them which bring water from other catchments from other areas but they all end up in this area and there is also a lot of run off which takes place from Victoria Keys and it comes through a culvert in this general vicinity.

As indicated, the water which is coming into this area comes from catchments some of them which are a significant distance away. So this is a photograph of the section of the Diego Martin Valley which contributes water into the area. So there are 5 catchments, there is the Union Road catchment which is this rather large one which is 105 hectors but this one doesn't bring water into the area of the intersection. There is a culvert which takes water directly into a drain which is adjacent to Morne Coco Road. There is also the Cuthbert Circular catchment which water from that ends up from that in this general vicinity. There is the Wilson Road catchment which is 7.6 hectors that also brings water into this vicinity. There is the Mary Street catchment which is 4.9 hectors. There is Dangerous Corner which is 2.1 hectors and there is Victoria Keys which is 10.3 hectors.

So the water from the catchments which were previously identified do find a way into the vicinity of the site, from the Cuthbert Circular it crosses the highway in a culvert at this location. From Wilson Road it crosses here and there is also a smaller culvert on the Diego Martin Main

Road, from Mary Street it crosses in a culvert in at this location. There is also a culvert at Dangerous Corner and there is a culvert at Victoria Keys.

So in consideration of the drainage design, all these catchments were taken into account. Now the first 4 catchments, i.e. Cuthbert Circular, Wilson Road, Mary Street and Dangerous Corner, all of those catchments when they cross the road come into a drain that runs through Victoria Gardens. The drain in Victoria Gardens does not have the capacity to take all of this water and that leads to localised flooding. So what is proposed is a new channel which will take water from, which will intercept the drainage on that side and will take water from this location down to the large earthen drain in Cocorite Farms which has the capacity to handle those flows.

Now the storm water management design…a storm water management plan has been developed and will form part of the submissions to the EMA. The designs take into account a 1 in 50 year return period as the design storm and it takes into account…in addition to that, the potential for additional developments. If there is more built development therefore a quicker run off that's taken into account and it also takes into account the effects of climate change such as higher intensity rainfall and sea level rise and the outcome of the storm water management plan with those designs are 2 detention ponds are needed. Detention Pond #1 with a capacity of 14,000 cubic meters and detention 2 with a capacity of 3,500 cubic meters and this is the location of Detention Pond #1 which would be on the main earthen drain running across from the section of Cocorite Farms and Detention Pond #2 would be in the loop of the intersection.

The basis on which the detention pond works is that you look at the predevelopment flow, so what is it now and you work out the post development flow, how much it will be when there is full build out, climate change, 50 year storm and so on and for the period of time the storm is going to last. You have to be able to store that amount of water and then once the storm is over the water is then released into the drainage channel downstream at the same rate at which the original drainage channel will be working. So there is a controlled structure on the downstream end of the detention pond which allows the water to run off slowly at the same rate as the predevelopment flow and what this does is ensures that there is no flooding downstream.

In terms of the flooding, the flooding on the Western Main Road which is just on the south side of the Cocorite Farms is due to the absence of any drains in the south of Cocorite Farms and new designs will involve cut off drains on the side of the Cocorite Farms and these will be integrated into the drainage system for the West Park Savannah which have a detention pond in the south western quadrant. In addition to that the drainage for Diego Martin Admin Complex will be routed to the north.

Questions were asked about the maintenance of water ways. At the drainage division there is a programme in which the major water courses are identified and dredging works is identified annually based on inspections and also on previous occurrences and are schedule is determined at the start of each year. For the information of the public, the section of the Diego Martin which were desilted in 2019 are as follows:

- Between Western Main Road Upstream to the bridge at Morne Coco Road
- Upstream at Crystal Stream to the bridge at Sierra Leone Road
- Upstream of Sierra Leone Road to the bridge at Wendy Fitzwilliam Boulevard
- Downstream of the bridge at the Diego Martin Main Road to Mason Street

Currently, construction is also ongoing between Sierra Leone Road and Emery Street.

So I will move into some of the construction issues that were raised in the last meeting. Questions have arisen with regard to the vibration from the piling. The specification which has been given to the design builder is in the tender for the use of auger piles and not for driven piles. With driven piles these are pre constructed, pre stress, pre cast piles which are hammered into the ground and could be between 300 – 600 diameters and so on and when they are driven by a pile hammer which is a big piece of equipment and there is a lot of noise and there is a lot of vibration. With auger piles it's a completely different system, holes are drilled into the ground to the required diameter of the pile and then the reinforcement is placed on the hole and the concrete is pumped into the hole. So there is no issue of vibrations at all, so the nuisance and the noise of the vibrations do not arise with auger piles.

Another resident had raised concerns about the effects of construction possibly doing structural damage to their property. Well, with the elimination of the pile driving that is one factor that can be removed but another thing which is good construction practice and I have no reason to believe anything would be different in this job would be prior to construction a pre-construction assessment is made of the surrounding properties to identify the condition which includes taking a photographic record so that we can identify cracks and any other defects that may be present in the building beforehand and at the end of construction another inspection is done. Now this is all done, it has to be done with the consent and permissions of the homeowners because we can't just allow any random person to come into your home so the assessment is done, you get to sign off on the photographs and on the report to show that this is the actual condition beforehand and at the end of construction if there is a difference, a claim can be made against the contractors insurance.

Some issues were also raised with regards to safety and 3 issues were raised. One resident enquired about the existing position of the walkover and that pedestrians would have to cross multiple lanes of traffic to get into the Powder Magazine development. There was also a

question about a potential point of conflict between traffic taking the exit ramp to get into Victoria Villas and the new ramp which would come from the connector road. And the third safety issue was an increase in the travel time from ambulances from West Shore which would no longer have use of the bow tie.

So with regards to the pedestrian crossings, pedestrians coming over the walkover, this shows what is proposed in that area. So 3 separate pedestrian crossings are proposed and in each case none of these pedestrian crossings will cross more than one lane of traffic. So there is one here, one here and one here. So you come off the walkover and this is a concrete paved median. You will not have to cross more than one lane of traffic at a time so those are 3 pedestrian crossings proposed.

Another person raised a question of conflict where the ramp from the connector road comes unto the Diego Martin Highway and from my impression at the last consultation meeting I believe the resident was speaking of a conflict lower down by the Victoria Gardens entrance but this ramp will come into…there will be stop lines with traffic coming from Diego Martin Highway on this off ramp to get to Victoria Villas will have the right of way. Traffic coming on the ramp will have a stop sign so they will then stop and then safely merge and then from this point to get back unto the Diego Martin Highway is 100 meters which is adequate time to get up to speed and to be able to merge safely. There is however a need to repaint some of the lines and replace the candlesticks near the Victoria Gardens entrance. That's something that the Ministry of Works Traffic Management Branch may need to look at.

The travel time concern which was raised by the hospital, the increased distance from the bow tie to the new route which will take you around the round-a-bout is approximately 1,200 meters. If you use an average speed of 40 km per hour, maybe convert this to the number of meters per second…11.11 meters per second and you divide the distance by the speed gives you 180 seconds or 1.8 minutes additional time and the average speed of an ambulance may be higher but that's the calculation that has been done. Now while I recognise that anytime that is lost in responding to a medical emergency may be a cause for concern. You also have to factor in the safety risk and the risk of accidents in the bow tie.

So at this point, I will….that's the end of my presentation. I will like to hand over to Kairi who will take you through the social impact assessment aspects of the project and all questions to my presentation as well as Kairi's can be taken at the end, thank you.

Presentation 2: Social Impact Assessment (CEC) 5500/2018

Dr. Ralph Henry: Kairi Consultants Limited

Thank you very much Ms. Abel and as she indicated, all questions would be handled at the end. I'll move straight into our presentation by Kairi and we were required to conduct the social impact assessment. Of course any physical development impacts on people, the people who, the ones who call for changes in the physical infrastructure but in the end it will impact on certain groups of people in different ways. The requirement of this contract is that we document the social impact of the overpass and identify ways in which negatives could be avoided or mitigated and what are the positives that will arise from the intervention.

The social impact assessment is a process and we outline here how we went about it. We had to define the study area, identify the study area, describe the socio cultural characteristics of the study area, analyse the potential impacts, come up with mitigation strategy and management plan and at the end of the day, how one would have monitoring and intervention strategies in place to deal with problems as they arise.

The stakeholder process has taken us….we have arrived on the 26th of September with this public meeting. You would recall there was a public meeting on the…a public consultation on the 4th of July but prior to these two consultations some of you would have been involved in public meetings in October of last year and November of last year when some elaboration was done of the overpass and the idea an overpass and you'll see from Ms. Abel presentation that some of the recommendations that came with that, those two earlier public meetings have been the basis for the work that she has done and that has supported the two presentations that we have had this year.

Now, we are supposed to provide communities and other stakeholders with information and that information is about the study area, the social and cultural characteristics of the area, the key concerns and this is the critical issue here - the key concerns that come out of focus group discussions and the public consultations that was held on the 4th of July. So, we came, we listened, we documented all that people had to say and of course those public meetings where people did have concerns but we sought to meet with people in smaller groups and interview them and get some sense of their particular interests, issues etc. and document those and put all of this together in analysing the potential impacts which we would be outlined here and in coming up with the mitigation strategy and management plan and the monitoring and intervention strategy.

So these are the issues that we attempt to treat with the type and extent of the impacts on the human environment arising from the proposed project and to examine both positive and negative impacts of the project on the wider community, those in the immediate local area as well as in the wider community.

The Study Area

Well Ms. Abel pointed to the overall, the localised the area but our brief requires us to look at this as a local area but as well… and the impacts here… but as well the general impacts across the entire area of the Diego Martin Valley.

The Regional Impacts

So we talked people who are within 1 km of the facility, but also with people who are in the wider area of the Diego Martin Valley as well as some people who are the Community Hospital for example, West Shore they are outside more than 1km from the area but they are impacted as well as people across at the intersection at Columbus Boulevard. You've seen all of this before in Ms. Abel's presentation.

Right!! Now…some information, we looked at information, we collected information from the 2000 census and the 2011 census and what you notice there is that the population in 2000, Trinidad and Tobago increased but the population of Diego Martin seemed to have declined from 103,000 to 102,000 and one might say well a decline in the population in Diego Martin may be we might have less vehicles but notice what we have in red here, the number of households has increased from 29,000 in 2000 to 32,000 plus in 2011 and it tells you that is 2011 and the trend that we identified then based on other information that we were able to secure which suggest to us that, that trend continued of smaller households but more households and therefore more people quite likely with vehicles. And if you look around you would see that some of these households would be middle income and high-income individuals who would all have vehicles. So whether they are in Victoria Keys or in Powder Magazine #2 which might not have been there, I don't know, it might have been there in 2011 and Chaconia Crescent and West Hills all these are substantial developments as well as a number of smaller developments that have come into the area where they have small families, yess…but household of middle income and high income and of course you've also attracted households that have set themselves up in informal settlements so that the population might not have increased but the number of households has.

The density / population characteristics

Again I want us to keep in mind the issue of households. The density, you know, plenty of households here. The density decreases, but just think of the road serving all of these households and there are already 2 roads that come out of Diego Martin into this highway and you start seeing what the picture is likely to be with regard to vehicles. Now in terms of the structure of the population you would notice that like everywhere else in this country we are seeing the aging of the population. There are fewer children being born to support later on a much larger group so that we have an egg-shape in our population. The pyramid is becoming egg-shaped but it's even more egg-shaped in 2011 and there are a lot more elderly people so

there is a change taking place in the population. Elderly people, some of them are retired but with high enough incomes they have a car. And you also have the inflows of younger households with children etc. so it means that maybe the number of babies and children might have increased a bit but it still doesn't change the egg shape of the structure in the population. An important characteristic that we note…alright so we have put to one side the idea of population increase, Diego Martin has not had a population increase as a population in the national population, but it has had an increase in the number of households. This is a very attractive area to socially mobile households. In respect of education we see in terms of tertiary and post-secondary, almost a quarter of the working population has higher education, alright! Just keep that in mind.

In respect of labour force participation the national labour force participation is represented in this blue curve but in respect of Diego Martin you see it's higher than the national average. You have a higher than national average in respect of the educational curve. The stock of people with higher education is higher than the national average and in respect of participation of labour force you have a higher level of participation in Diego Martin than you had in the national population. So it means that you have many more people in Diego Martin who would be working, going out to work than in the national population, alright! And we have some other data there; wage workers, own account workers etc. but another important characteristic that you should take account of is that the public sector accounts for about 30% of the people who are working and living in Diego Martin. They are living in Diego Martin and they are employed in the public sector but look at this, again we see professional and technical. Diego Martin is in blue, it's higher than the national average, in respect of information and communication they are higher in skills. Again they're much higher than the national average. Administrative and support services, again slightly higher but most importantly, scientific and technical and information and communication and technology etc. Diego Martin has a higher representation than the rest of the national population.

This is employment patterns in business establishments and of course it's business establishments in Diego Martin, almost a quarter of the people working are working in very small establishments and only perhaps in the industrial estate you'd find people working in organisations where there are more than 50 or so people working in an establishment.

Land use in the Diego Martin recreational space that is identified in the…you know because it's a social impact assessment so we have to identify how the land is being used in various areas for sport, for education, for community facilities etc. Alright, I think we might have dropped a slide but there is a slide in which we show you the public sector is absolutely small, maybe about 5% of business establishments in the Diego Martin area. So if 32% of the work force in Diego Martin is in the public sector and less than 5% of the work establishments are public

sector, that might really be regional corporations and I don't know, something else…2 other things. It means that most of the people working in the public sector are actually going out of Diego Martin to work. So it tells you about the trips out of the area.

Now we did look at the 2011 census again as a baseline and we saw there that more than half of the households had at least one vehicle for private use and actually something of the order of 70-75% of households in 2011 had a vehicle for private use. Yeah, that's 2011, more households have moved in so that the estimate of 800,000 vehicles in Trinidad and Tobago for private use, that Diego Martin will have a very high percentage, more of a higher percentage than the national average in respect of automobile ownership. And many of those people are coming through here to go to work, either going west or going east.

We note the figure mentioned by Ms. Abel of 2013, we're getting up to about 1.2 million automobiles but the Minister of Works mentioned recently that Trinidad and Tobago already has over 1 million vehicles for private use. So it seems that we have already gone past that million mark and there is a figure suggested somewhere of an average of about 25,000 new registrations per year at the present time. Many of those would be people in the Diego Martin area. So it means in effect then that if even one did nothing, if even one did nothing there is already a problem of plenty of vehicles moving in and out of Diego Martin on a daily basis.

Now we conducted focus group meetings with a number of organisation and groups, we talked to the resident associations; the Chaconia Residents Association, Victoria Keys, Victoria Gardens, Powder Magazine #2 is there. It's there we met with them, they came with the Victoria Keys Residents Association, maybe in the typing it was not included but we met with them as well and we also spoke with other stakeholders, the West Shore Medical Facility, the Community Hospital, the route taxis association, SuperPharm etc. so that we attempted to get people's views of this overpass in addition to what might have said or might not have said. You know, they might have come to the meeting as public consultation but didn't make their views known but they had in small group meetings an environment in which people could come and say what they thought of the overpass. There is only one agency where we had to depend on them to submit their concerns in writing and that's after plenty of pleading and begging for them to meet with us. These are the dates on which we met with various groups. Yes, there is Powder Magazine; we met with them on the 31st July.

Yes, now what are the issues people came up with? Well Ms. Abel mentioned of the drainage issue and that has been addressed, at least you know some attempt has been made to look at seriously at the drainage issue and when we went to Victoria Gardens people talked about the raw sewage…they fill the man holes, inadequacy of the drainage ponds etc. etc. so that we saw some of the problems ourselves and clearly we were there to document what we saw. People came up with proposals as to what should be done. There is a suggestions that the bow tie

should be reopened, there should be a coastal course way, there should be a coastal railway or we should have the water taxis move from Port of Spain and make stops at West Mall and Cumana, Carenage and Chaguaramas and relieve the traffic that comes out of the Carenage area. There is a suggestion that maybe in moving the traffic and reducing the congestion that we have in this local area. We might simply be shifting the problem to the intersection on Western Main Road and Columbus Boulevard and maybe there might be need for a ramp because at the end of the day there might be need to remove the traffic light at Columbus Boulevard. All these are some of the issues that have been raised and Ms. Abel actually has been looking in to some of these recommendations. Meetings were held with various agencies and attempts were made to at the problems that have been identified with the public meetings etc. so work has been ongoing as we speak in the intervening period.

Alright, concerns about the adverse health impacts from the construction of the overpass. Now we looked at this issue because it's a concern in particular to the people of Victoria Keys and also of Powder Magazine. Now we are being assured that it's a very small sliver of land that is going to be used in the building of the overpass so that a fair amount of the green space is still going to be retained.

On the matter of the health impact, now we have to see whatever health impact that might arise from the building of but as well in particularly from the presence of a course overpass particularly in this area as planned. We have to see that against what is already a problem of congestion of lots of vehicles standing and burning gasoline and emitting fumes in a congested…in a particular area where the overpass is supposed to relieve the congestion. So in effect actually if you remove the congestion, in removing the congestions some people is going to be affected because you now have the fumes maybe disbursed but passing through coming into the neighbourhood throughout the day and night as against one where at certain times of the day they are going to have the fumes outside their windows or doors etc. alright! So it's a problem because we have a huge number of vehicles that are going into the valley on an evening and coming out of the valley on a morning and we attempted to look at the problem and see what exists in other parts of the world and how this overpass…the issues, the problems it may create having regard to other areas in other parts of the world, maybe tropical areas where you have huge numbers of vehicles being in one location. And based on the data that we have seen that was collected 4 years ago which is perhaps even more recently than the census data. A study done 4 years ago showed that the air quality was not at a level that would have impacted health, of course air quality always impacts health but it was not at a level where one could identify it as extreme or even moderate. It was well within what one might regard as the acceptable limits, well within what one might regard as the acceptable limits.

In other parts of the world, you look at places like Kuala Lumpur, you look at Miami where there are many more vehicles and they are still showing more recent data, you can go check it online and see that because there is a world air pollution index that is calculated and generated on a daily basis so you can see what happens in other parts of the world and it's clearly not one where we are in the extreme zone or even what one might call the zone of…the yellow zone.

As Ms. Abel indicated, she attempted to address some of the other stakeholder concerns and at every area one is attempting to ensure that people's concerns are being addressed including the matter of grievance redress process which I will explain in a little bit. Now we have analysed the impacts and come up with some mitigating measures because we are required to give a clear understanding of the likely benefits as well as the negative impacts of the proposal and to highlight changes that need to occur before the project commences in light of previous and ongoing future activities that can reasonably be identified this moment.

We attempted to follow the terms of reference and to look within the immediate vicinity within 1km of the overpass. What are the impacts? So we have localised impacts, we have regional impacts and we have national impacts and we look at things in the short term type preparation, the construction etc. occurring within a very short time period. Medium term; 2 years or more or 3 years or more and long term, extending beyond the construction phase. We look at the intensity, the intensity in terms of impacting on people, whether it is a small impact, a minor impact, a medium or major impact. Major impact being where there is serious impairment and functioning of the social groups, specific eco systems, services or resources and the changes that may result in or may come with significant disturbance to large numbers of people and some of the interventions may not be reversible. So we looked at a number of areas, employment of labour and of course in this kind of construction there isn't going to be much expansion in labour in this project although there might be on the other project that is going to be undertaken which is the building of the complex.

On the issue of congestion, we have been comforted with the thought that the people who are going to be working at…and the trucks that are going to the regional complex to deliver material etc. will be entering the site from a different point to those that would be engaged in delivering and working with the overpass, so that the intensity would be minor in terms of the impacted in that sense. The matter of congestion down at to Columbus Boulevard is minor, is short term, is localised and is kind of indirect and we have a sort of low rating for that but in respect of the labour you see for that is minor, medium term over more than 1 year into 2 years but it is localised and it is direct.

The closure of the bow tie, it is going to impact on a substantial number of people, its long term, it's going to impact the region actually. It is very direct but we give a moderate rating in so far as once people recognise that it has to be done, well it has to be done. While we heard

from one group of people that the bow tie is absolutely necessary, I think in West Shore Hospital, people at another hospital said "well you know something, it's dangerous." People coming to this hospital feel as they are risking their lives to come to the Community Hospital in using the bow tie because as Ms. Abel said they have to cross 3 lanes of traffic. I had the experience of doing it 2 days ago and I think I am well-seasoned and practiced driver but it was quite a challenge.

The matter of the taxi drivers, there seemed to be mixed views among them and I know there is a representative here but there is mixed views among them about how they will treat with this disruption because on one hand they see the bow tie as necessary to service some of their passengers but on the other hand they also recognise that while they are more skilled than the other people who use the road, they do encounter accidents and they are always trying to get away from having an accident.

On the matter of crime, some people feel it will increase the possibility of crime in the area because the bandits will be able to travel more quickly in and out of the area but unfortunately for them, the emergency services too will be able to move more quickly to arrive and take care of them maybe even before they leave.

Air pollution, I made mention of the issue before that it is half a dozen of one and six of the other. Whichever way you turn you are trapped, the real solution to this problem really comes from as a country adopting a different mode of mobility. But we have a society where motor cars have moved from being positional goods to being wage goods; you want to get a salary and a wage that would guarantee that you can have a vehicle. That is almost the natural law of labour in this place, alright! So the issue of air pollution and noise pollution have been addressed. Noise pollution during construction, Ms. Abel made mention of the fact that there is not going to be any pile driving and there are other requirements that will be imposed on the contractor which already apply in these contracts. They are not supposed to allow for vehicles to be overly noisy etc. etc. So these are things already in place in the contracts that are awarded to contractors who work for the state.

The matter of drainage, again it has been addressed. It is a major problem and we have been assured that the area is the subject of an overall drainage plan. There is a larger scale drainage plan that has to be done and I think in her presentation again that was pointed out.

The air pollution post construction, how one goes about doing it, of course it has to be and I have a sense of the EMA and I think a representative is here but I have a sense that we are moving very quickly to be like other countries and to report routinely what is the air quality on a daily basis in different parts of the country but there are some data that the EMA collects to air quality and I suspect that one would have to look at it in terms of how they make it location

specific and what we can get the country to do to deal with emissions. We have not been in the habit of pulling drivers off the road if we see…I cannot remember seeing any, in all the years I am driving seeing anybody hauled off the road for their emissions to be checked or for having excessive emissions but I suppose we are gradually getting there. So we have the ratings of all the negatives, alright and there are attempts to mitigate their impacts, the design and the final construction that will be undertaken.

(Inaudible due to non-usage of mic)

I wanted to answer the questions at the end but just to tell you that we have been…there are design attempts to reduce and keep the minimum amount of green space that is being utilised and there will be measures taken to ensure that even if some of the green space is going to be utilised that you introduce shrubbery and other arrangements to control pollution and improve or at least mitigate the pollution in terms of air quality etc.

Mitigation strategy and management plan and since I have already been into it and the requirement is that one should proposed realistic and feasible measures by employing the best available technologies not entailing excessive costs and the best practical environmental options to avoid or mitigate remedies to such impacts of acceptable levels. So the mitigation measures are being addressed in the form of a management plan and we just identified some of the measures because we are expected to identify the negative impacts at each phase of the project and indicate what specific measures can be taken to manage those negatives at each stage and to describe how existing adverse impacts if any would be handled to prevent cumulative effect with respect to the intended project, that's the terms of reference.

Employment of labour, well there is a requirement that as far as possible the contractor would be required to employ local labour. In respect of congestion at Columbus Boulevard, there is supposed to be a traffic management plan for various phases of the project taking place at Columbus Boulevard and Ms. Abel pointed to some of this. The closure of the bow tie, we have no other recourse we think but to close it but one has to have public education to get the…people must know the route so you would have signage to help people to understand the route to get from Port of Spain to Cocorite and the Community Hospital and motorists and pedestrians and people at large must be educated. And we can see that since the closure of part of the bow tie and other road works that have gone on in this country that people have come around to recognising that to get to some places that you might not be able to go directly across to a particular location, you now have to do a little bit of turning and not turning but what the French call a *"cour tu yay",* you have to go around to get to a particular. So it's becoming increasingly part of our motoring culture that you do have an overpass, that you do have an…you're going to San Fernando and you want to get to get to Grand Bazaar. You might

have to go up to a round-a-bout and come back down etc. So I think that our motoring culture is in a sense changing and with education etc. it will also happen in this part of the country.

Increased congestion in other areas, we have to monitor the population of traffic growth an early warning for measures that would require the Ministry of Works to see where they might need to increase the capacity and see where corrective measures for a possible congestion either at Four Roads and or at Columbus Boulevard. Some people have argued that in reducing the congestion this area what is happening is that you are moving it to Columbus Boulevard but the point about it is that you have congestion and if you did nothing I think you realise that you just have to do something until such time as you move a new culture in transport. The perceived increase in crime, we have adequate street lighting would be necessary for the proposed overpass and add barriers to prevent people from going over the overpass in terms of risks of accidents etc. and it is recommended that there be increased police patrols in the area and what you see on the line there and in italics is our Kairi saying, "well maybe if there is people of the area that want to introduce or to encourage the state to introduce CCTV with infrared capabilities, it means that you are passed better protected from crime etc." I think increasingly we will be moving in that direction, maybe all our roads and highways will be served with cameras not only to catch people that might be speeding but also to catch them if they are speeding away from a crime.

On the issue of air pollution during construction, there are already in place arrangements to how stock piles are treated onsite. How you ensure that fine aggregates are not allowed to be exposed to the wind and the contractor will be required to clear only the area needed for construction, leaving the vegetation and other areas in tact as far as practical and pave or vegetate all clear areas as early as is practical, so that this would be a requirement on the contractor. Again, these are requirements already in place in contracts and you know the tires of the trucks have to be washed. The dust control has to be put in place, the contractor has to adhere very diligently to these requirements and clearly all transport vehicles have to be covered when they are moving materials off site or bringing materials to site, they have to come in with covers. Ms. Abel talked about the noise and the augered piles and again these are all other arrangements that can be put in place or are being required to be put in place to ensure that there is as little noise pollution as possible. Building construction always generates some amount of noise but you know we want to keep it as low as possible so that you don't have any major disruption to normal living on the path of residents and likewise on the conduct of businesses, schools and hospitals. We want to have the minimum of disruption.

The drainage issue has already been mentioned and they design the drainage systems to accommodate the increased run off, with the Regional Corporation being responsible for certain drains and keeping them clear and the Ministry of Works being responsible for the

major interventions as for example the dredging of the river and keeping all the major drains clear to receive the water. So the continuous dredging of the river, you see that there and it will now be a requirement of the Ministry of Works, it's not a matter of if there is silt but rather there be quarterly. They have to put that in their budget that there will be a quarterly examination of the river mouth to ensure that it is clear.

On the matter of air and noise we have that requirements which will be able to put provision and measure for shrubbery and trees to muffle noise and absorb particulates in the atmosphere and setbacks would be maintained to new inhabitable buildings.

Monitoring plan

Now this project is taking place in the midst of the construction of another major project which is the construction of the Diego Martin Regional Complex which of course will result in the employment of labour from the municipality. We know that there is going to be a disruption of taxi services and we have to therefore come up with arrangements to monitor the impacts and there are a number of complaints that have to be resolved with relating the cumulative impacts of the fact that you have 2 large projects in operation at the same time and NIDCO fortunately is responsible for both so at least there is that level of coordination. They know that there is a project on the overpass and there is a project on over on the other side so that the silos that might have existed are hopefully a thing of the past in the sense that NIDCO has a responsibility for both and will therefore know that it has to call the….from time to time not only the regional corporation and the Ministry of Local Government but the contractors together to make sure there are not negatives of the one on the other etc. and if there are how do you resolve them?

The issue of feedback from taxi drivers and Maxi Taxi Associations there is something that will come up and we think that the Regional Corporation would have a responsibility to see how you would deal with laybys and other arrangement for taxi drivers to ply their trade without creating…you see the disruption as far as possible. So that might mean the regional corporations sitting with the associations to find where you have maybe temporary laybys etc. to satisfy the travelling public.

The monitoring, Ms. Abel made mention of the fatality data and accidents and of course this will have to be monitored with the closure of the bow tie. In respect of crime, there is the matter of neighbourhood groups becoming watch groups in monitoring and looking at problems of perception of crime related to the project and ensuring that initiatives and interventions are being put in place to control this and with respect to air pollution there would be sensitive receptors to be put in place around dwellings and during construction mode to monitor potential air pollution. This is noise pollution during construction; again this is sensitive receptors to be placed around dwellings to establish if the noise level is above what one would

regard as acceptable. We have to monitor any incidence of onsite flooding and then there is post construction and most critically onsite air quality and noise quality complaints from the public received and treated in the overall monitoring arrangement.

Now the grievance regress plan, this is a requirement of the EMA and we worked very closely with NIDCO in coming up with an arrangement which we think is acceptable as far as the promoter is concerned that they are putting something in place such that the grievances come up it means that people can have…there is an ear and not just a listening ear but an ear that is prepared to act, in respect of treating with each grievance that might come up during the construction and even post construction. At the end of the day we did take on board a comment that was made at the public consultation and that is that at the end of the day if the Ministry and NIDCO put in place a grievance procedure that the people who are aggrieved do not want ever to feel that there isn't something above the Ministry and NIDCO because it would be a case of Ceasar to Ceasar and we think that that is a reasonable concern but we think that what exists can already handle a grievance that might not be treated…and I don't think there is any reason it may not be treated well by the Ministry of Works based on the proceedings that are going to be put in place but at the end of the day people may still feel aggrieved and want to get to higher authority and they think that authority in my analysis would reside with either the EMA itself or the Ombudsman and clearly other countries when we looked at other countries, we can see that the regulator retains that right to decide whether the grievance might be handled by the Ministry or the entity. Remember big projects are not only big projects by the Government, big projects might be undertaken entirely by the private sector so there must be something somewhere where people feel that their grievance can be heard and discharged. So we have in place and the Ministry seem to be putting in place an engagement process and to where the mitigation of this is environmental and social risk can be handled and it includes the public consultation because one wants to foster stakeholder engagement and accountability from the very beginning and we therefore have to ensure that we have a consultative process where concerns are raised or real or conceived complaints related to the project come up that a grievance redress procedure starts when construction work begins and where the grievance procedure has not provide access to administrative judicial remedies there is still room for mediation and arbitration.

So the main the main objective is to ensure that there is transparency, there is fairness; there is equitable process that acts with some degree of independence from the project. So the grievance procedure within the Ministry does allow for some degree of independence of the person who is being appointed or the people who are being appointed to hear the grievance, they will be empowered to handle the grievance, to exercise an understandable and accessible and cultured grievance process and it means that at the end of the day with good record keeping and protocols to facilitate effective grievance management it means that people can

have a sense that not only are there grievances being heard but it being acted upon by the various agencies that might be involved.

So this is how it goes, the complaint would be received and reviewed officially, documented so that record keeping will be there and at the end of the day what is intended is that one will resolve all complaints within a matter of 45-60 working days depending on the complexity of the complaint. At no point in time should it go beyond that. We have the grievance process outlined in steps; the receiving of the complaint, the reviewing, identifying who is responsible to investigate it, so you have a Complaints Redress Officer, the Project Management Officer and a CM Management or third party at the end of the day would sign off on whether or not the grievance is being effectively addressed.

Grievances can be reported in different ways; emailed or meeting with the Project or Complaints Officer or a letter addressed to the Project Officer. A grievance redress form must contain the name of the complainant, the nature of the grievance and suggestions for resolving it. It will be entered on an electronic database which means that we have record of it and it would be categorised as to whether it falls within the scope of the project or whether it falls outside the scope of the project but in any event, all complaints must be officially acknowledged within 5 working days. The complaint would be priority weighted the officer will pass the complaint to the relevant department for the rapid assessment of the grievance and acknowledgement of course within 24-48 hours. The investigation will identify how…it has to be conducted within the shortest possible time and if there is need for additional time of course that has to be determined and identified and maybe reasons why it might take such time do with a complaint because some complaints require substantial and vetting and maybe the engagement of many stakeholders outside of the Ministry of Works itself. There is option 1; once the investigation is complete the officer will officially write the complainant about the solution. If there is internal recourse i.e. there is need for examination and there is opportunity for the complainant to seek recourse with representatives of any other agency, it can still be handled within the complaints structure that is set up within the Ministry. At the end of the day there may still be need for external recourse, hopefully with the kind of response that one will get in this new structure it might never come to that but in the few instances where it does it means again where we put in italics the citizens who want to be arm's length of the sponsor, there may be need for the aggrieved party to appeal to a higher authority for the satisfaction of the complaint. So that at the end of the day even without having to go to an external party, one can come to an agreed solution and monitor and close off on the complaint.

End of presentation and we now take questions and comments on both presentations

Feedback Session

Kerry Williams, Four Roads Community: Good afternoon ladies and gentlemen, my name is Kerry Williams from the Four Roads Community, no stranger to the panel. Good afternoon all, Dr. Henry. I've been coming to these meetings from day 1 so I have a lot of information as well as facts and somewhat fiction to this story. Dr. Henry I'd like to say thanks for the census that Diego Martin people has some of the brighter and most technical people on the island. That being said we hope that the Ministry of Works will hear and listen to some of the concerns and recommendations made. I have seen in this presentation some things that have changed which Ms. Abel, thank you for some of the changes in regard to the drainage, what I didn't see in your presentation was, the specification on the recommended drainage so while we appreciate that you all took into consideration what is happening to our neighbouring communities in Victoria Gardens and so on, you did not or, I didn't grasp dimensions of what is going to be the new drainage plan and if you can elaborate on that we will appreciate, so we can really understand that what you are putting in place is adequate for the volume of water coming into that area.

The information provided in terms of drainage goes back to the Diego Martin River but the part that is causing the most havoc on the communities which is Victoria Gardens and environs has not been addressed. So we have seen the work being done higher up on the stream of the Diego Martin River but the dredging at the mouth of the river which is the most critical path that's where all the water goes to, has not been addressed. The water levels and I'm sure the members from Victoria Gardens could tell you they cannot remember the last time they have seen the bottom of that river and we know there is a bottom and it is a lot deeper than what is there presently. And that would arrest the drainage, the backing up of water into Victoria Gardens because it would be an easier flow out. That's one!

So if we could go back to the jug handle, if I could get the slide back up, with regards to what we calling the bow-tie. Yeah….so the jug handle that we identified and we agreed that the navigation across the jug handle in the three lanes is dangerous and has caused the loss of lives and many accidents. Our recommendation would be, since you have blocked off one of the jug handles already would be to extend it because the challenge is the jug handles is too short if you lengthen it you will get vehicles to properly align themselves with the flow of traffic which would allow better filtering into the oncoming lanes. That's one recommendation.

If you can pull up the slide with the proposed… sorry! … I want to call it an insane junction but I would not be disrespectful. Sorry… so if you can pull up the image of the junction please, right… the present flow of traffic with the number that you all have recorded indicate that the volume of traffic exiting Diego Martin in its peak hours which is between 7:00 - 8:30 that is where we have the most congestion. This would help. For people living in the Diego Martin area, who

commutes this everyday would tell you that nobody leaves Diego Martin and goes back into Carenage on any of those passes.

(A*pplause from the audience*)

Fact… the volume that you all observe going into the Morne Coco Road is people avoiding the traffic light congestion after the highway works and still coming back to the bottleneck at this point here which is where the real problem is. As was correctly highlighted, the objective is to remove congestion and we would like to work with you all to remove the congestion because that is the end goal. However, what is being forecast and proposed here will not aid in that. What will aid and we are willing to work with you again is proper management of the lay ways exiting Diego Martin, if we have the proper policing of the layways that will remove the congestion coming out of Diego Martin. Diego Martin is limited and we understand that because of how the acreage is laid out, but if we have those areas properly utilised by the taxi association…, the general driving public it will relieve the congestion coming out of Diego Martin without putting any of these things in place, that is one! So if we partner with the police get that done, congestion out of Diego Martin, no problem!

The proposed areas where you all want to put traffic lights and Mr. Ramsingh please correct me, is there any immediate change into your traffic light system outside of your timer programmed system that is running now? No? No! … Sorry…

(*Mr Ramsingh talks in the background which is inaudible due to none usage of mic)*

Right… so we have all lived in Trinidad and Tobago and seen the major reason for traffic congestion by traffic lights being the timer is not necessarily efficient in managing the traffic. So that will only as we said before, shift the traffic congestion into the places that you are proposing traffic lights. That will not work. Y'all are proposing a plan that is going to destroy the fabric of mental health of the commuting public in Diego Martin. There is no other way to entertain it, as I said I am willing, we are willing to work with you all and communicate what will work, but y'all please, the evidence is there we have technical education to back what we are saying, listen please.

With regards to what you all are proposing when we come down if we remove the layaway or if we use the layaway, sorry…, it will help the alignment with the jug handle which you all are calling the bowtie, if we lengthen that and allow vehicles to get into proper alignment filtering into the three lanes easier and less hazardous to the driving public. An area that wasn't highlighted but is going to be impacted by this design is the Four Roads Junction which presently is a nightmare to navigate for the mere reason that we depending on traffic lights, one and it's not because of the distance of the junction to the highway, getting back to the highway from that junction is too short a distance for cars to navigate into a queue of lanes.

Our recommendation from the last meeting exists where if you all entertain opening back the exit by the big tree, it will allow motorists other options to exit the main road on to the highway and remove that congestion. So therefore, people coming into the Four Roads Junction between the gas station and the fire station don't need to fight or jostle to get into there because they can easily progress a little lower down and filter on to the highway. Simple solution, I think we have touched on all your pieces, thank you.

What I'd like to tell the committee, the panel here today is that we have heard a lot of things around how we progress. One thing we keep hearing but I don't think we have a lot of people doing is the consensus report called the "CRP" where we could report our grievances. I have not seen an email address for the Ombudsman or anything… I am hearing the tools of communicating but I haven't see anything that would enable us to do that but let's all please represent your community and committees to make that contribution because that is the only thing that would be documented to reflect our position. I've been coming this meeting for the fourth time presently and at present there are some changes and I do commend them on some of the between the last one and this one. The prior ones there were not many changes or any at all but we need to start having our voices heard and documented and if you all could get your necessary committees to submit the information there, that's where it will start. Making these verbal contributions, I have learnt and observed that it falls on deaf ears and is not recorded outside of Dr. Henry's team report, so please go the website and do the necessaries. Thank you.

(A*pplause from the audience*)

Trevor Martin, Victoria Gardens: Yeah good afternoon everyone, thanks for the updates and some the changes proposed. I am Trevor Martin from Victoria Gardens and I specifically brought up 2 of the points which were addressed. However I still have a little concern and confusion with regards to why is traffic coming from the West to go North having to go through a round-a-bout in that complex rather than continue as it presently exist on to a feeder that's already built on there and feeds straight on, there is no reason to abandon that and reduce the amount and reduce the amount of traffic going around that round-a- bout. I am also, and I would like to approach the screen if possible. Yeah there is another issue which I brought up the last time this connector road here… I believe this is the entrance to Victoria Gardens, Victoria Villas between here and here you say is 100 meters ok… you are asking a vehicle to stop here, to wait for traffic to clear, to get on to the highway, either the Diego Martin Main Road or the highway…

(Inaudible due to none usage of mic by Ms. Abel)

Trevor Martin, Victoria Gardens: yes… but you are coming out of here to get on to the highway, correct?

(Inaudible due to none usage of mic by Ms. Abel)

Trevor Martin, Victoria Gardens: I am trying to find out whether you are still trying to get the traffic to go on to the highway or only on to the Diego Martin Main Road.

Ms. Abel, Trintoplan Consultants: No it's … that point is Victoria Villas, Victoria Gardens is higher up

Trevor Martin, Victoria Gardens: OK, the distance to get on to the Diego Martin Highway

Ms. Abel, Trintoplan Consultants: Yes

Trevor Martin, Victoria Gardens: You have to pass, just pass Victoria Villas

Ms. Abel, Trintoplan Consultants: You pass Victoria Villas entrance and you filter on to the highway where Victoria Villas enters the highway.

Trevor Martin, Victoria Gardens: You say that is about 100 meters in distance

Ms. Abel, Trintoplan Consultants: It's 100 meters from here to where it gets on to the highway

Trevor Martin, Victoria Gardens: There is no vehicle I know that can accelerate in 4 seconds to get from a stand still position to there with vehicles moving down there at 80km.

Ms. Abel, Trintoplan Consultants: The vehicles at this point are not getting on to the highway, they are in the lay-by Victoria Villas. Victoria Gardens is up here. This is Victoria Villas there is already an entrance into the highway at this point.

Trevor Martin, Victoria Gardens: Yes, there is and you are saying from here to there is 100 meters

Ms. Abel, Trintoplan Consultants: Yes, it is.

Trevor Martin, Victoria Gardens: What I am trying to bring to your attention is that I cannot see a vehicle that has stopped here, to be able to accelerate fast enough to get into the traffic

Ms. Abel, Trintoplan Consultants: Ok, at this point, you are not getting, you are going through the lay-by from Victoria Villas, this is the exit to Victoria Villas from this point you get on to the Diego Martin Highway, as for the people from Victoria Villas get on to the highway now.

Trevor Martin, Victoria Gardens: Can I make a suggestion? one of the Ministry Works personnel who is with me presently, about six weeks ago, and we stood up here looking at the traffic going down and the amount of near misses within about 10,15 minutes while standing up there looking at the traffic was phenomenal. People just cannot and that is vehicles coming from here trying to get on the highway. It's not possible. You're filtering into traffic that's coming down at 80km, the road is marked 80km,

(Person from the audience shouts more than 80km)

Trevor Martin, Victoria Gardens: the registered thing is 80 they are probably doing 100

(Person from the audience correct, we know that)

Trevor Martin, Victoria Gardens: so that's why I cannot understand why this is here, bring the traffic around here, and you have more distance in which to filter.

Ms. Abel, Trintoplan Consultants: This is not going to be closed off, it's select this, so you have 2 options

Trevor Martin, Victoria Gardens: Oh!! Well it's not being… my … I thought it had appeared because it was taken off

Ms. Abel, Trintoplan Consultants: No it's not taken off, they have 2 options

Trevor Martin, Victoria Gardens: Ok, alright… fair enough… but still you, know from here you can very easily come back here and go through. Anyhow… somebody will have to clean up the mess on the highway.

David Berkley, Powder Magazine: The name is David Berkley and I am from Powder Magazine Phase 2. I am still not sure what your objective is. I've heard your stated objective, but I don't know if your stated objective and your real objective is one in the same. There seems to be some other agenda in this entire project. Your stated objective which was stated in I think the 2nd consultation was to alleviate traffic going into the Western Peninsula. I am paraphrasing one of the presenters who stated that as the objective. I conceptualise that to mean people going into Carenage and beyond, beyond Pt. Cumana because that is what we regularly refer to as the Western Peninsula. I am saying that all this even if it works properly would not meet that stated objective of alleviating traffic going into the Western Peninsula.

(Applause from the audience)

I heard one of the presenters this afternoon made reference to it in another way. She said going into the Western Peninsula if the traffic remains as is, we will just sit there. Well HELLO!! We will still just sit there from the time we pass the yacht club. We will still just sit there. I am

suggesting to you as long as you don't fix that local road and what was a major road when I was a youth is now, is now a local road. And in my youth, there are some backroads that can accommodate more traffic in a healthier way, if that is the term, than that road going into Carenage. You have to fix that! You must fix that to make this even necessary. This would not be necessary if the road going into the Western Peninsula if we still have that bottleneck there. So, I am saying all this would not meet your objective of making traffic easier going into the Western Peninsula. And the point was made, how have you done any study as to how many people coming out of the Diego Martin Valley, Petite Valley, Diego Martin and environs go into the Carenage area or go West, How Many? I don't think you have done that study and I think if you did it you would find that it would be less than 10% of the people who come out of Diego Martin go into the Peninsula. *(Someone from the audience shouts, "That's what it is based on.")*

So, if this is based on that, then you must have some other objective. And the national community, because of projects, pie in the sky projects that really were based on corruption in the past would start thinking that this is another project intended to be corrupt. This is the view that would permutated the ground, with projects like these that seems not to meet the stated objective and this particular project is not meeting its stated objective. And with respect…I must touch on this, I must touch on this, the relationship between the contractors and the parameters under which they would be allowed to work or should work. This is a Ministry of Works project but we had an experience with the HDC when they were building Victoria Keys and that experience was a terrible one. The contractors flout every so-called requirement that was put in place for them to conduct themselves. They flout everyone, and what was the position of the HDC, the position was a hand-off position and gave the contractors full reign to disrespect the residence of Powder Magazine Phase 2 and many times I in particular with the noise pollution. All you seeing there, I am seeing a lot of them low, low, low everything is low, low, low but I think it is high, high, high. High, high, high not low, low, low. High, high, high!

So when the HDC representative was introduced as one of the representatives here tonight I didn't see that person stand up and take a bow. I didn't see that person put up a hand and say that I am and probably he/she knows why because the HDC is one of the most delinquent state enterprises in Trinidad and Tobago right now and I am sorry that you call the name of the Ombudsman because the Ombudsman have the HDC listed as one of the most delinquent state enterprises where complaints coming to him about them and never, never, never addressed and that only signifies to me that the Ombudsman has no teeth. So I want to close with that and tell you that you're not meeting your stated objective and that the HDC must say something, not only about this but about our deeds when we have finished paid you refuse to give you or deeds when we have paid. We at Powder Magazine paid you so many years ago and refuse to issue our deeds. Don't deal with that tonight, don't tell we anything about that

tonight but I just want to remind you that that is something we will be coming at you with, probably with legal representation, thank you!

(Applause from the audience)

Vishesh Ramnarine, Victoria Keys: Good night everyone! My name is Vishesh Ramnarine from Victoria Keys. Kairi, I don't know what to say, before we punish the panel members and Ministry of Works and NIDCO, you would add to that list now right! Ammm…what I would suggest first of all, before you finalise the report because you had told us that it would now be on public record, I suggest that you should really relook some of your analysis. It seems to be based on a lot of qualitative factors, a lot of feelings, a lot of sentiments, a lot of outdated data and really before you finalise the report you need to have current data, right. Now I will limit my comments to the immediate area of Victoria Keys, Powder Magazine Phase 2, Victoria Gardens and Victoria Villas. Now in that area, we have been looking out for some kind of instrumentation to document current baseline data. Whether that be traffic flow, water runoff, sewer capacity, noise, air emissions in particular PM…2.5 in PM10. We really heard nothing elaborated on; we were looking forward to seeing that movement to get that data because it is upon that data that you then really project forward as to what this monstrosity is going to do these neighbouring communities. We did not see that!

I would like to highlight your attention to the document that EMA wrote to the Ministry of Works dated December 27th 2018, and in Appendix 1 the EMA basically gave you the terms of reference for this social impact assessment and in there while they did mention qualitative factors they also spoke to quantitative analysis and the social impact assessment as it currently stands is missing that. And in particular, you need to look at section 3.1.1 which speaks to some very clear areas that where we wrote to EMA and EMA would have considered both our comments at the first 2 consultations and our written documentation from our attorneys and they would have had in my view done the terms of reference for the social impact assessment and we are holding you to meeting this Appendix 1, this terms of reference. And what I want to also say is when we get your report, when it's in the public domain we are going to sit down and cross reference every terms of reference requirement against your report and where there are deficiencies we would be highlighting that. So rather than us go down that road and then place EMA in a funny position where they may be feeling pressured to approving the CEC but they cannot because we are looking at you all very closely, and y'all know this. This is not a surprise; we're doing this since October last year. So rather than put yourself in that embarrassing situation, it is better if you look at your terms of reference and do your social impact assessment against that. Unless you have current baseline data your analysis is flawed *(inaudible chatter in the background due to none usage of mic)* and let's not go down that road. We can't be looking at data from 2011 and we're in 2019, one went back to 2009. What we

want to see is data from 2019 for the baseline, right. Now another point that we note and we're watching very closely is that when the Ministry of Works made their application to EMA for a Certificate of Environmental Clearance, they actually provided outdated data, so clearly if they provided outdated baseline data then by logic the baseline data has some merit, otherwise why would you have included it in the first place.

So I know EMA is here, I wouldn't even start on HDC with their lies but in terms of EMA, our commitment to Kairi, Ministry of Works, NIDCO and EMA is that we are going to be looking at this report very closely and where there are any deficiencies, through our attorneys we would be taking the necessary steps and rather than have a CEC approved and then we file an injunction and this whole monstrosity of a project "string up" in the environmental commission, let's do this thing the right way. As we said to you guys when Powder Magazine Phase 2 and Victoria Gardens met you guys, we are willing to work with you. We do not trust the Government authorities; this presentation has eroded the trust even further. So I think it is an opportunity for us to step back and do the social impact assessment in a logical, methodical way based upon current data and let's move this thing forward together. We are not against infrastructure development but it has to be done in a responsible way and to date I don't think that the Government has demonstrated responsible infrastructure development.

So let us work together for this project to be the first one, that Ministry of Works and NIDCO gets this right and it's on you guys to get this right too, because we are not standing down, we have not been from day one and we don't intend to. We will go the full length that we need to on this matter to make sure that we get it right, thank you!

(Applause from the audience)

Dr. Ralph Henry, Kairi Consultants Limited: Just one point about the use of 2019 data, outside of a census or survey which have not been required in terms of getting the population etc. what we have had do, we hired a demographer to use…and that's what demographers do, they use census data and they do projections based on information on births and deaths etc. so that is what we have done. So it's not presented here but it's part of our report so we do attempt to bring whatever data that might be in the public domain and available to us. We try to bring that information based on the estimates of the experts in the area up to the present, that's one.

The second point that I need to make is that we have not been involved in this project. Sorry…we only became involved in this project in July of this year. So we have not been around since 2018.

Vishesh Ramnarine, Victoria Keys: So just one closing point, so I understand what you are saying about the data analysis but certain things we are particularly concerned about which is the particulate matter. I don't know if what you have is really still relevant because that

baseline data has to be taken in that plot where Victoria Keys is now at right and like some of the mitigating measures saying like shrubbery and trees would absorb particulate matter, you really need to do the research properly. You can go on our Facebook page, Diego Martin Concerned Residents, where we did the research and you need much more than the shrubbery and the trees right. So all I'm saying is we need to work together for you'll to get this right and until you get it right we will always be there raising a flag.

Adam Raffoul, Westmoorings: Good afternoon, Adam Gaffoul from Westmoorings. My first question has to be was any traffic studies done on the potentially widening the Diego Martin Highway because to my understanding that is the main cause of the major traffic right. People going into Diego Martin and people leaving Diego Martin, so that's my first question.

The second point is I note what you'll are trying to do. I understand you are trying to make the area more connected; you're trying to make an area for the Diego Martin residents to go to the west. I could see that we are now going to have the West Park Savannah and the Diego Martin Regional Corporation, so there needs to be more connectivity. My concern is for the residents of Victoria Keys and Powder Magazine, what would a flyover adjacent to their buildings do to the sound, to noise pollution do to the air quality and my suggestion would be a park in that area to the east of that and try and put as much trees as possible to try to block the noise traffic to try to block the air pollution for the ward between Columbus Circle to the flyover itself. Let's try and have large medians, you know with palm trees in the centre. You should have some nice sidewalks where you have fruit trees or poui trees or or…we need to green the area. I understand what you are trying to do but we also have to try and make it look nice and also try to cover the concerns of the residents which is you're building a big flyover in the middle of a residential community and I understand of course with more and more people are moving to Diego Martin or we're getting more households and there is need…. I can understand the thinking of there will be more traffic and if we don't do anything now we're going to end up with far more traffic in the next 10, 15, 20 years and that's what traffic studies are meant to do right, to plan for the future, not just to do something but I think we need to try and work with the residents to try to address the concerns to try to stop and prevent any side effects which is which is more air pollution which is more noise pollution.

My question is I don't know if you can explain to us, what is going to happen to east of the flyover? So we have the West Park Savannah, we are being told that there is a Diego Martin Regional Corporation building, what's happening to the east or the south of that flyover? I don't know if NIDCO knows or if that's going to be open land until the Government figures out what they're going to do with it? Anybody could speak on that? Okay, nobody knows, okay! And then one last question for the Victoria Gardens residents, are they going to be sold the land

which is north of the new road which was built by CALCO? So that's my final question. Okay, thank you!

(Slight applause by the audience)

Dr. Ralph Henry, Kairi Consultants Limited: We will take 2 more questions and then we will have some more responses. Yes please…

Jan Landreth Smith: I believe this project was supposed to be started to be implemented in 2003 is what it was in but that was what was up. We're almost in….16 years later and this is the stage it has reached. Unfortunately what I am very concerned about it is not…it is about the delay of a project like this because a lot of people look at this in isolation that this is the one structure or project to solve all of Diego Martin's problems and I hope not. I assume they have traffic measures going west that are outside of this scope of work and also going east. The main problem with the traffic going from ideally from Diego Martin going east is when you get the fork under the flyover going in St. James and you have a bit of a bottleneck, so I assume that may be some future project where you all will have to widen and create bigger capacities. So unfortunately from my limited knowledge, most people seem that this is the end all and be all of dealing with the traffic.

On a technical matter that I have, I notice that…I am not sure if it's Ms. Abel , Mr. Williams or I am bad with names so you have to forgive me, the social guy. The flooding going through Victoria Gardens , it was stated that the drainage capacity presently is limited and that is why it floods there. I believe where the pedestrian walk way is presently, they had some grades to culverts done there recently but it's still flooding, so I assume that is the reason for putting the retention ponds on either side for the capacities. Is it possible, because who knows about climate control, because they have all the experts are here now on climate control that we don't know what the rain intensities would increase to and I would suggest that you try to make the drains as big as possible to either minimise the size of the retention pond or not to have retention ponds. I appreciate that if you get really high intensity rain over a period from about a storm; that may be challenging but try to make the drain the capacity of the drains as large as possible; so in the final designs just to do a double check on that.

My last concern is just at this intersection, I will call it the SuperPharm intersection because that's where SuperPharm, KFC. I noticed that it is proposed to make some turns in either coming from west going north, coming from east going south. I would suggest that, that capacity may be limited in the very near future and you may need to look at some sort of overpass in that area sooner than later because the capacity there with the movement especially ummm…because right now you don't really have much turning therefore, you have an easier flow. Once you start to have flows going at right angles to the traffic, I think the traffic

it may cause congestion to increase very quickly and you know I think I would like to suggest that you all for the audience and Diego Martin to give them at least some sort of synopsis of the other plans that the Ministry and or NIDCO may have for mitigating the traffic because this is not to eliminate the traffic totally. This is I would like to believe one of many projects and I think if you all could identify the other projects that are planned it may, it wouldn't eradicate all because everyone complains but it may minimise concerns of some of the residents within the area. That's it.

(Applause by the audience)

Dr. Ralph Henry, Kairi Consultants Limited: we will take this group and then have some answers and then we will a have another round.

Ryan Prudent, Victoria Gardens: Hi goodnight, Ryan Prudent, Victoria Gardens. Can you just put the slide up with the proposed drainage? I would like to know if….first of all thanks Kairi for meeting with us and a lot of this…no it's before this, that's the catchment ponds *(back and forth in trying to find the correct slide to reference.)*

Well clearly you listened to us with the drainage issue and we see that you're trying to kill two birds with one stone here. You spoke about the ravine in the back and this is in the back of north of Cocorite Farms, in the blue right! That is to the south of Victoria Gardens. So you're saying that that ravine can more than handle the projected water that you plan to pass down there, correct? *(Ms. Abel, Trintoplan Consultants inaudible due to none usage of mic)* I do not know if you have been to that site and you're in a position to say that, ummm I think that there is…we think that there is potential for that to happen but as it stands right now, the language that you're saying that with such confidence that it could more than handle it seems mis…it doesn't seem right. That ravine is merely 6ft wide for the most. It's a natural ravine, not one bit of concrete was laid.

Now the length of it from east to west because its mouth is to the Diego Martin river right, the projected design of this and the actual implementation of this projection, is this going to be done at the same time as both projects, the Diego Martin Regional Complex and the overpass? Is it going to be done before those projects? When is it projected to be done? *(Inaudible person due to none usage of mic)* Because you have to remember that that little ravine right now is now is taking water from Four Roads here, right as well as the newly finished Wet Park because its north boundaries exit into that little narrow ravine. The vegetation which has been removed from that Cocorite Farms parcel of land from is also adding run off. The DMRC which is soon to begin is going to add more run off. We are talking about interim time here, which leads to my question, could you answer that?

Ms. Abel, Trintoplan Consultants: Okay, the storm water management plan speaks to improving and cleaning out that ravine from start…from east to west. It also speaks of implementing a new drain to pick up water which is now currently going through Victoria Gardens so there is work which is planned to be done on this ravine in terms of improving the capacity.

Ryan Prudent, Victoria Gardens: No I asked…now I understand that

Ms. Abel, Trintoplan Consultants: Yes

Ryan Prudent, Victoria Gardens: But I asked…

Ms. Abel, Trintoplan Consultants: It is going to be done as part of the project for the interchange

Ryan Prudent, Victoria Gardens: Will it be done concurrently or before the project starts? There is a reason why I am asking that because we don't know when actually these projects will start or when they will actually end and it needs to count for either…it's a variable. We are not sure and it has to account for both types.

Ms. Abel, Trintoplan Consultants: Okay, I am not in a position to say when the Diego Martin Regional Admin Complex is going to start…

Ryan Prudent, Victoria Gardens: Let me give you an example, suppose *(inaudible due to none usage of mic)* and I will answer whoever just asked that…if we need it now? Yes, we need it now, that's what he said. Suppose…2020 is going to come, not suppose this project starts, adds more runoff, more debris, more of everything. Not this project, times 2 we keep forgetting that, 2 concurrent projects and nothing is done to that ravine except it being cleaned which it needs to right now, okay. How are we going to be sure that that interim cleaning can handle that situation? So typically what should have been done here and we're not going to cry over spilt milk but usually the infrastructure has to be developed prior to the projected projects, alright so that it can handle those types of situations. That did not happen; the cart was put before the horse in this situation. So we are very happy that we are seeing it factored in, don't get me wrong this is great news but there are still concerns based upon the questions that I am bringing up. It's very fair, you may not have the answers right now but you need to get that back to us.

Ms. Abel, Trintoplan Consultants: Okay, one of the things I mentioned it may be…I didn't get it across clearly enough is that the design is done for taking into account future conditions, future development in other words, more areas of land being under concrete or pavement as well as we taking into account climate change and sea level rise, so we're looking at the future as best

as we can predict it at this point in time. It is normal in construction for the contractor to put the drainage works into place first,

Ryan Prudent, Victoria Gardens: Correct!

Ms. Abel, Trintoplan Consultants: …so that during his temporary situation in other words during construction his site does not flood. So it is anticipated that the contractor would be doing the drainage works as an early item, however we are not the contractors. It would have to be something which the contractor would factor in to his work programme once he is on board.

Ryan Prudent, Victoria Gardens: Okay, now with that in mind we would expect that there would have drainage for different…*(inaudible person due to none usage of mic*)….thanks a lot brother, who is responsible for this design? The contractor, solely? For the drainage design…this projection?

Ms. Abel, Trintoplan Consultants: No, there are various levels of responsibility and there are various responsibilities at different times. This at this stage is a conceptual design. It's going to go

Ryan Prudent, Victoria Gardens: I am talking about the design in making, after this subsequent…

Ms. Abel, Trintoplan Consultants: After this …

Ryan Prudent, Victoria Gardens: Because they're going to use this, right? They're going to use this as a concept.

Ms. Abel, Trintoplan Consultants: It will be used as a concept.

Ryan Prudent, Victoria Gardens: Who is they?

Ms. Abel, Trintoplan Consultants: The contractor is going to have a design team who will take this conceptual design to final design stage. It then has to get approval from the Drainage Division from the Ministry of Works who is the regulatory body for approving drainage designs.

Ryan Prudent, Victoria Gardens: Are there any planned consultations based on that with the surrounding in communities?

Ms. Abel, Trintoplan Consultants: That's a question I cannot answer.

Ryan Prudent, Victoria Gardens: Okay, ummm the gentleman before brought up the specifications that this will be based on. Is it that we will have to rely solely on the good faith of

the contractors to have this designed fulfilled today and tomorrow? The capacities of water…because we know nothing, we don't have a clue what this…I mean like I said before this is a natural ravine that is about 5ft wide. Now I don't know if you have ever been on the site, I am asking you again?

Ms. Abel, Trintoplan Consultants: I have been on the site.

Ryan Prudent, Victoria Gardens: Okay. Are you aware of the road that the Diego Martin Regional Corporation has put down bank with the natural ravine. This road takes you to the Diego Martin River; it's to be used for the local corporation to clean the river. Are you aware of that road they just put down?

Ms. Abel, Trintoplan Consultants: How recently was the road put down?

Ryan Prudent, Victoria Gardens: Within a month and a half now.

Ms. Abel, Trintoplan Consultants: No, I have not been to the site within the last month

Ryan Prudent, Victoria Gardens: Alright, okay I understand, so along here there is a road that has been put down yes and the road…and you spoke about clearances, proper clearances. There is no proper clearance here because that road the actual clearance…the set back from that road. The road banks with the ravine by the way, clearance is 1.5ft from the road, bank and if you go down, the natural ravine…dirt. No concrete is in that ravine and the ravine is also 5-6ft. We're planning for all of this water, they're going to stop water from passing through Victoria Gardens, that's perfect but that's actually great because we all know that it is overwhelmed from the other side and I am saying this is a good idea in the back here because you have something to work with, more importantly you have an exit from a source to the mouth of the Diego Martin River. This is overwhelmed as it is right now, that little ravine with the rains that we had 3 days or 4 days ago the water…and this gentleman asked if this reserve at the back of people's houses here in Victoria Gardens are going to be sold to them because we have been maintaining that for the past 2 decades if you all didn't know. That water came up to half way of that land as it is now with that little ravine. If that rain kept up for one more day, it would have caused havoc. So now we have an eye opener of how much this little ravine can actually handle and with the climate changes, because the data that we have that Kairi has used has already expressed to be outdated by almost a decade, alright! Yes you can use analysis and you can get the different types of analysis by the way, analytics, okay! But today we live in a world that is data driven and the quicker you can get up to date data is the more accurate you can be and it sets you apart from the competition. So I am just giving you a hint here that we cannot work with old data. The climate changes every year, you see it on the news. So the rain from this year is more than likely going to be worse next year. I am not throwing this at you eh ma'am, I am painting a picture because out of this whole thing here, what is the most

important thing here is the environment and there is not an EIA done here as yet…and Environmental Impact Assessment. So this is why we have to stress now in little pockets on environmental, you realise most of our complaints here are on environmental alright!

So we need, we need to get some more information. It is paramount and I think every single shareholder will agree that we need to get more information on environmental factors that are affecting the communities around here, whether it be noise, air, more importantly water, because lemme tell yuh, we know well too well in Trinidad now, yuh cya stop water and look at the amount of houses where that water is supposed to pass. That actually needs to be developed into a huge…another person said it before, this gentleman here, as wide as can be, yes! That actually has…I am an engineer, well not in this area but we use the same metrics, somewhat right! That actually has to be developed into a wide drain…reinforce concrete, how could you have a road bordering that ravine and no reinforcement alongside that bank as it stands. Do you know what is happening with that road they just put down here from the Diego Martin Regional Corporation? Guess what? The road is starting to collapse right now, do you know why? Because of the rain we had earlier this week *(Person in the background saying that's a brand new road)*…and that's a brand new road that they put down 1.5 months now and the road is set back 1.5ft from the ravine, the natural ravine. Do you also know ma'am, you've been on the site, that the farm, great farm…that this parcel of land is 6-7ft higher than the other side of the ravine's bank where these houses are? Think of what I am saying here. So it's not a bad idea in utilising here to get the water out, notwithstanding everything else that is required, you mentioned by the corporations that they would be held accountable for maintenance, right but we need to get some more information on that, how can we get that information?

Dr. Ralph Henry, Kairi Consultants Limited: This last person here.

Mr. Navin Ramsingh, Chief Technical Officer, Ministry of Works: Let me just answer him, this is our 3rd consultation right so the assumption that we make, we present, we get comments, we come back again. So again I told you this is the concept, we came here, we heard all your concern. One of your concerns was the flooding, we came and we gave you an idea of some of the things we're going to consider. We told you all that it is a design build contract so in a design build contract you have the professional designers, so we will get the drainage engineers; we will get the hydraulic engineers. They will have a specific design criteria; it's not by "vaps", they have a code by which they work with. The engineer here was telling us that when we consider drainage, we will highlight the problem for them and the consultant; the design engineer will look at it.

Ryan Prudent, Victoria Gardens: You're talking about the contractor here?

Mr. Navin Ramsingh, Chief Technical Officer, Ministry of Works: No, I was telling you in this type of contract which is a design build contract, you have 2 entities right! You have the professional designers who are the ones that do the designs, the contractor will employee a designer. That designer has specifications by which they must work with right. So you are talking about the environment, we heard the flooding in Victoria Keys or Victoria Gardens, that is your concern. So that is the concern we will put forward to the designer, so when the designer come in play they will compute the size of that drain based on the run off and based on the data, the updated data that they use. They do not use old data, they use the most updated data that they have, right! And we will…the only thing that I am gathering here from you is that when the designer completes the drainage for the design at that point in time we will present it to you and all the answers we will have for you but at this point in time we just want you to know that we appreciate your concern and I think we have a very good grasp of your concern. You are concerned about the size of the drain; you are concerned about the size of the detention basin. Notice we didn't put those things there, we are just saying that there will have a detention basin, we will just draw it. Once the designs are completed, the size of it will be there. Whether it's going to be lined, whether it's going to be earthen, all that will be determined at that point in time, right! So the whole configuration of it will change once we have the design and generally I would tell you we do what we call a 30% design initially and then we go to an 80% and then 100% because we don't want to do a 100%, then have to change it. So at the 30% point we will do a consultation and show you guys exactly what the design will look at.

Ryan Prudent, Victoria Gardens: Well I want to thank you very much for explaining that because you just actually answered all the questions that I had asked, those concerns. I know it's primarily having the opportunity to see when you reach maybe like 50%.

Mr. Navin Ramsingh, Chief Technical Officer, Ministry of Works: No, 30. We do it at 30 because sometimes 50 is too late. Yea 30, 60, 90 then we do 100.

Ryan Prudent, Victoria Gardens: Well let's say 60 right, because right now it's 0.

Mr. Navin Ramsingh, Chief Technical Officer, Ministry of Works: We just want you to know that we appreciate your concern.

Ryan Prudent, Victoria Gardens: Likewise

Mr. Navin Ramsingh, Chief Technical Officer, Ministry of Works: And that is what will be put to the designers

Ryan Prudent, Victoria Gardens: Likewise, I am just saying that if we could be abrisk of the design of the drain and how it's developing.

Mr. Navin Ramsingh, Chief Technical Officer, Ministry of Works: And what we are saying is that we would put that as part of the project. As the project roll off we will come and do a presentation at the 30% stage.

Ryan Prudent, Victoria Gardens: That sounds fantastic!

Mr. Navin Ramsingh, Chief Technical Officer, Ministry of Works: Because let me tell you something, the Ministry of Works, right we develop projects to solve your problems you know! Really, because we know the problems, we know the problems in Diego Martin, we know the problems of flooding, we know the problem with traffic congestion and we are here to solve the problem in this community. So I just want to digress again to a question Mr. Landreth Smith had asked right. In our earlier presentation that was done we told you guys in our first study that was done by MMM Group, we looked at the whole Diego Martin area, inclusive by WSB, inclusive of the Western Main Road, right. The entire area was looked at right and they had extensive consultation with everybody. At the end of that they came up with solutions to solve the traffic congestion, we need to provide solutions incrementally right. We're not going to start a mega project because a project like this involves acquisition; it involves buying people's properties and thing.

So we decided it is better to have incremental solutions for you all so you can see things are happening and you could benefit from it from that perspective. The final design was presented in one of my earlier presentations, all the projects that they identify, they talk about Four Roads, they talk about improvements on the Western Main Road because one of the biggest conflict area is when you have Diego Martin traffic coming out and meeting Western Main Road traffic, that conflict point there is where you get a lot of traffic, so we have to widen Western Main Road. The existing bridge that goes to the Four Shore, they say that bridge is too narrow, you have to widen that bridge in the future, right!

So the entire project was presented to you guys earlier, right to let you know that the objective of the project wasn't just traffic congestion, it was connectivity and then we have other benefits in traffic reduction, environmental issues…the reduction in emissions and so forth, alright! And of course safety, one of the things we do…safety for pedestrians and safety for motorists. So that's why a big part of this project is, how do you get across from Victoria Keys across to the other side? How do you get from Westmoorings to that area? So, all those things were specified in the objectives.

Ryan Prudent, Victoria Gardens: And thanks a lot for that. I am sure you understand, before I go I am sure you understand. I am sure everyone here understands based on what I had asked and what it is I explained why it is I will be concerned, right. As of to date, right now there is so much vision to use that little ravine for so much water volume and right now the little ravine is

dirty, it's clogged. So you know, put things in that perspective. Again, thank you for your factoring in this, let's work with you all like Vishesh said but we need to get back to this at some point so that we are comforted that you all are doing the right thing, okay!

Mr. Navin Ramsingh, Chief Technical Officer, Ministry of Works: And you have our assurance at the 30% stage, we will be presenting to you all because we are here to solve the problems of the people in Diego Martin and environments, the whole project is about that.

Dr. Ralph Henry, Kairi Consultants Limited: This gentleman here.

Roger Alcantara, Victoria Keys: Good evening everyone, stakeholders, panel, Dr. Henry. My name is Roger Alcantara and I am a resident at Victoria Keys. Now whilst I appreciate a lot of the mitigating measures that you all have exposed tonight Dr. Henry, as well as in the previous consultation where it speaks to not touching the front of Victoria Keys and all the other things that you exposed tonight as I said, we appreciate that, it's not lost on us right. But I am afraid that the loop that is flanked by the 2 communities, Victoria Keys and Powder Magazine 2, I am afraid that the loop continues to be a massive deal breaker for the 2 communities and I'll tell you why.

I have in my hand here some articles that speak to the carcinogenicity, big word! It just means cancer causing of fuel, of diesel fuel in particular. The World Health Organisation, I'm not going to read it of course, all of it but I will read out some of it for you, some excerpts from it. The World Health Organisation says that, well first of all this article is entitled "Diesel Engine Exhaust Carcinogenic." So that is very telling in and of itself; it says here that the working group found that the exhaust is a cause lung cancer and also noted a positive association with an increased risk of bladder cancer, right. So that's very telling. I have here an article from the University of Toronto, Kerolyn Shairsingh is a Trinidadian, she is a scientist and she did as far as I am concerned, the first and only study of traffic related pollution in Trinidad and Tobago. This study is actually dated as November 2018 which is very, very recent and it reads, a new University of Toronto measures significant concentrations of traffic related air pollution near major roadways in Trinidad reaching levels comparable to highways in Toronto and Detroit, imagine that! This very small dot of an island. The team focused primarily on the airborne pollutant, black carbon also known as soot which has negative health outcomes including lung conditions and cancer. Their findings were recently published in the Journal, Science of the Total Environment. So this is not a Mickey Mouse thing that I am reading here, this was published in a journal, a scientific journal called the Science of the Total Environment, this is germane to Trinidad and Tobago.

I have here another article from the American Cancer Society, "Diesel Exhaust and Cancer". The title alone is very telling. I have another one here, "Living near A Highway is Terrible for Your

Health". You're getting the picture right. I have another one here "They Say What Is a Safe Distance to Live or Work Near A Highway?" They say the high toxicity zone is near 300 – 500ft, I am not making this stuff up eh! This is facts, we are all entitled to our own opinions but we are not entitled to facts. This is factual data that I am presenting to you. We have the World Health Organisation again, "How Air Pollution is Destroying Our Health?" This is what it says, the very air we breathe is growing dangerously polluted 9/10 people not breathe polluted air and it kills 7 million people every year. So ladies and gentlemen we are not just talking about morbidity and quality of life, we are now talking about mortality of people and what I am saying is that this proposal in its current incarnation, in light of all this factual data, you all are now electing to take the highway, the fringes of which we live, these communities. You all are now electing to take that and bring it into our laps, bring it into our front yard, the clear and present danger of traffic pollution and put it squarely in our laps in our front yard. Now that is insanity to me, I am going to assume that you all weren't aware of all that I have said. I am going to assume that I am now bringing this to your conscientiousness.

I am humbly submitting to you that in light of this information, you cannot in good conscience continue with this project in its current incarnation. *(Applause from the audience)*. You all cannot do this to people. This is not just about our quality of lives, this is about mortality now; this is about your length of life. Now it's not going to show up naturally in the first year, second year or third year but this thing is going to be here forever. This is going to be death by 1000 cuts, it is going to manifest itself eventually in the health and the lives of the communities that are flanked by this loop. And mind you, this is a four lane highway with an elevation. The elevation is as if the pollution wasn't dangerous enough on a ground level, you have an elevation now to get…Mmmm!!!! Moree, more diesel, mmmmm going up inside in the towers. Craziness!! And I am simply saying in its present incarnation, this is unacceptable in light of this factual data that you all can research yourselves. I didn't make this up you know and there is more, I can go on and on and on, I didn't make this up. This is not airy fairy stuff and so all I am simply saying to you ladies and gentlemen is that we are not going to accept this in its present incarnation. I want to make the point abundantly clear that we are not anti-national infrastructural development, we are not! You can tell we are not foolish people, we are not backward thinking people. You can tell this, we are not "nowarians". We understand what you are trying to do. What we are simply saying is that the price of this ostensible progress is too high, because you are now looking at human collateral in the mix here, morbidity and mortality risks is at stake and that you cannot turn a blind eye to. It will be unconscionable for you to do so, alright! Thank you very much.

(Applause from the audience)

Mr. Navin Ramsingh, Chief Technical Officer, Ministry of Works: One thing I want to add to you is that umm, the information you provided is well known and if you look at developments, now if you look at developments the car is being made more efficient. The world is going towards hybrid cars, transportation is important because we need to move people and goods. That's why in Trinidad you're getting hybrid cars. You will also learn that in Europe they have stopped manufacturing diesel cars, right they have stopped. So pretty soon in the next 5-6 years, you wouldn't have diesel vehicles right because I again these studies. All these studies are around and internationally decisions are being made to eliminate those things because of morbidity as you put it and because of the need to protect the human lives.

Now what we're doing here and last time we tried to explain it right and we said imagine the Western Main Road, you already live close to the highway so imagine the Diego Martin Highway is congested in the morning, you have thousands of cars parked up in congestion putting the exhaust fumes in the air. Just think of it, park up every morning and every evening, they are there parked up and what do we do as a Ministry of Works? We want to reduce that and how do we reduce it? Reduce the congestion, ensure that the cars pass through that area in a shorter space of time and that by itself now reduces the amount of pollution you are exposed to and that's what we are trying to achieve here. We didn't say that we're going to achieve it in 1 year or 2 years but that is ultimately the plan, to ensure that the amount of pollution you breathe there is reduced substantially, right! So we are doing our part in the short term and the international bodies have a plan for us in the long term. I think diesel vehicles in the next 5 years may not exist, the next 5-7 years, right because they already stop manufacturing it. You can go into the internet and you will see that information is there. *(Person from the audience says cars, not trucks).* Diesel…trucks too, when they say they're stopping diesel vehicles they are stopping diesel.

Dr. Ralph Henry, Kairi Consultants Limited: Any other comments?

Male Participant: The Victoria Keys **w**here that loop you was just talking about, the 4th floor is right there you know. Could you imagine people who living there with cars passing whole day? ….Wait wait, I ain't finish. Another thing too, I was reading what you all put up there. You said from 8-4 is your timeframe for working.

Dr. Ralph Henry, Kairi Consultants Limited: Recommended

Victoria Keys: Recommended. I am 100% certain, they can't be done. They can't work from 8-4 because you start work at 8 which is in fact 9. You have to shut down at 4 o'clock that means they shut down at 3 o'clock. You getting 6 hours a day, you could never. They will work to the night and people living there, "ah sorry fuh dem, ah sorry fuh dem". Now if you say 8-4, can we protest and shut down the place at 4 o'clock in the evening if they continue? I would like to

know because if I am living there and I hear noise outside my house 6 o'clock in the evening, 7 o'clock, 8 o'clock, I am going to get crazy, so long as you all have it there from 8-4, I agree with it but as long as you start to extend it, you have a problem. You all can't answer it, can you answer from surety from 8-4? Can anybody surety give me that answer?

Female Participant: I just have 2 quick questions regarding Victoria Keys. I am seeing here, it looks like almost 50% of the land, can you tell me 2 things? I want to know if you have an idea of the elevation of the loop, the highest elevation point and I also want to find out the percentage of the land that you would be taking in front of there based on what I am seeing in the conceptual design? Because I know this project is going to go forward and as persons would have stated before, no one is against infrastructure development, so you must include the stakeholders' feedback. That's extremely important because the whole purpose of this is to alleviate traffic and connectivity or what have you, right. So it's just those 2 things I want to find out.

Male Participant: When you all going to do this project here what are the byways you're going to make to keep traffic flowing? You all have any idea, all the traffic you all are talking about will be running there?

Mr. Steve Garibsingh, Vice President Engineering, NIDCO: The contractor will have to develop a divergent plan.

Male Participant: I want you all to tell me

Mr. Steve Garibsingh, Vice President Engineering, NIDCO: We don't know at this point.

Male Participant: When are we??

Mr. Steve Garibsingh, Vice President Engineering, NIDCO: When the contract is awarded and the plan is developed and agreed and signed off with the Ministry of Works and Transport then we can present the plan to the public.

Male Participant: So don't care what happens, you all are going ahead with the project, whether we like it or not, is that what you are trying to tell me? What you said there was you have to wait for the contractor to give you the design to start the job.

Mr. Steve Garibsingh, Vice President Engineering, NIDCO: I cannot tell you that we are going to go ahead come what may, we have to have approvals to proceed. This group, the NIDCO and so on, we are not a law unto ourselves. We have to get approvals, for example right now we are in the process of procuring a contractor but we cannot award a contract. We have to go back to Cabinet of Trinidad and Tobago and say this is the project, these are the concerns of the citizens; do we wish to proceed? If they say yes, then we can proceed and if they say no, then

we don't proceed. So I can't tell you that we are going to go ahead no matter what. It is not within my mandate to do so.

Male Participant: But you just answered the question, if they say yes you go ahead, that's what you just told me.

Dr. Ralph Henry, Kairi Consultants Limited: Ms. Able you needed to answer a question?

Male Participant: If they say yes you go ahead, no matter what we say.

Dr. Ralph Henry, Kairi Consultants Limited: I don't think that it's that bad

Male Participant: I've seen it done a million times.

Dr. Ralph Henry, Kairi Consultants Limited: Ms. Able the issue of percentage of land

Ms. Abel, Trintoplan Consultants: I am not answering the percentage of land area. They asked a question of height difference. Right, the highest point of the overpass will be 8 meters above existing ground.

Female Participant: You're unable to clarify

Ms. Abel, Trintoplan Consultants: I cannot clarify the percentage.

Dr. Ralph Henry, Kairi Consultants Limited: Any other comments, concerns? Alright, Mr. Ramsingh any closing comments you want to make.

Mr. Navin Ramsingh, Chief Technical Officer, Ministry of Works: Just to close, I want to indicate to you all that we at the Ministry of Works, our main objective is to try to alleviate traffic congestion and try to make sure lives of you guys are better. That's why we are here, wherever I go to implement in Trinidad, we implemented the interchange, few peoples are affected. People are affected because we are building in communities and your concern is no different to the concerns to the people of Grand Bazaar, it is no different to the concern that the people have at Curepe Interchange and I am sure it is not going to be any different from any project where we implement, right.

So the whole purpose of this consultation is to listen to you guys concern and to try to make sure at the early stage of the project that we could incorporate it into the project for a successful project, alright. And I hope, I hope, this is the 3rd consultation and we made changes. Remember we had a frontage road taking a part of Victoria Keys, we took it out. You talked about acquisition; we took it out, right. So we are working with you all to try to get a successful project and we will do as professionals. We will carry out our duty with due diligence. We have hired a consultant, we were advised to hire an independent consultant to address your

concerns. We hired the consultant, the consultant will come and provide his professional information to you guys right, and that's what they did. We always welcome; you indicated to us previously that you will look at the submission, we welcome that and I am sure the consultant welcomes that. In a presentation we can't provide you with all the information but the information is there in the volumes of reports that we get from the consultant, alright. And they are professionals in that field, I don't know anything about social impact, so I will sit here and I will learn right, so likewise. We have hired a professional, I think we have done our due diligence to show you guys that we will listen to you all and we will implement it in the project. And what we learned from this consultation is that a number of people will benefit, some negatively, some positively but Victoria…the people across the road, they will get a solution to this flooding problem. The people in greater Diego Martin, they will get some relief in traffic congestion in terms of the connectivity, you guys when you go Carenage you will get some relief. In terms of pedestrian traffic, you will get some relief for pedestrians, so generally we try to satisfy most of the people, we never seek to satisfy all, alright, thanks!

Ryan Prudent, Victoria Gardens: Mr. Ramsingh could you tell us….*inaudible due to none usage of mic.* Kairi, what are the contacts for the GRP…We have no contact information as it is now with respect to grievance….but moving forward how are you supposed to hear us? What is the contact? What is the email addresses….

Mr. Navin Ramsingh, Chief Technical Officer, Ministry of Works: Well I guess Kairi…

Ryan Prudent, Victoria Gardens: How are we supposed to contact KAIRI, email addresses? What are the websites, the numbers?

Dr. Ralph Henry, Kairi Consultants Limited: In respect of Kairi, let me just…everybody has received mail from us and that's our mailing address and there is also a phone number identified but we are just in a sense a bird of passage in this project because we are there to complete an exercise and the recommendation is there that there will be a permanent structure set up within the Ministry of works.

Ryan Prudent, Victoria Gardens: Is it set up already?

Dr. Ralph Henry, Kairi Consultants Limited: It is one of the recommendations that we made.

Ryan Prudent, Victoria Gardens: Okay, so it that it has to be given or a

Dr. Ralph Henry, Kairi Consultants Limited: That is our understanding, that you will be given that information

Ryan Prudent, Victoria Gardens: We will hold you to that and we will await that contact

Dr. Ralph Henry, Kairi Consultants Limited: Based on the discussions and agreements that we have had with NIDCO and the Ministry of Works; that will be set up.

Ryan Prudent, Victoria Gardens: Alright, thanks

Adam Raffoul, Westmoorings: Can you advise what happens to east of the interchange or what not?

Dr. Ralph Henry, Kairi Consultants Limited: I don't know but I am sure that information will be provided.

Adam Raffoul, Westmoorings: Okay, because it will be important for the residents to know who owns that land and who owns the land south of the round-a-bout because the residents have been kind of pushing for green space prevent too much traffic congestion.

Closing Remarks

Dr. Ralph Henry

Before I close, let me just make one comment and that is in conducting our work we have brought all the information that is currently available to us in assessing the complaints, in assessing the concerns that people have had and we are aware that the work that is being done elsewhere on the impact of traffic generally on people's health and that information is well known across the world. And if you go on the website you see that the World…there is an agency that collects information across the world on air pollution and one of the major contributors to air pollution of course is the motor vehicles that we have in our midst. That's part of the culture of the 20th into the 21st century. So that most of the studies that you see, you have localised studies but you have general studies that show how traffic and being in traffic contributes to ill health, morbidity and also to mortality. And our last interview was actually with a medical practitioner, and he was complaining actually about what we are doing to ourselves because of our….cars are in dear to us and we see morbidity, one person travelling in a vehicle all locked up, air conditioned yes but where is the air coming from? It's all coming from these exhaust fumes that we are breathing indirectly in our vehicles, so that the problem is more serious actually than we might care to admit and the solution is passed more fundamental than we might want to admit.

I want to end by thanking you for your contributions and I supposed you recognise that our role is to hear those concerns and try in what we recommend to make sure that we address those concerns and we continue to do that in the rest of work we'll be doing in respect of this particular contract. So again, thank you very much.

5.7 PRESENTATIONS

5.7.1 PUBLIC CONSULTATION 1 – JULY 4TH, 2019

Public Consultation

Social Impact Assessment of the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements

Certificate of Environmental Clearance: CEC5500/2018

MINISTRY OF Works & Transport

NIDCO
National Infrastructure Development Company Limited

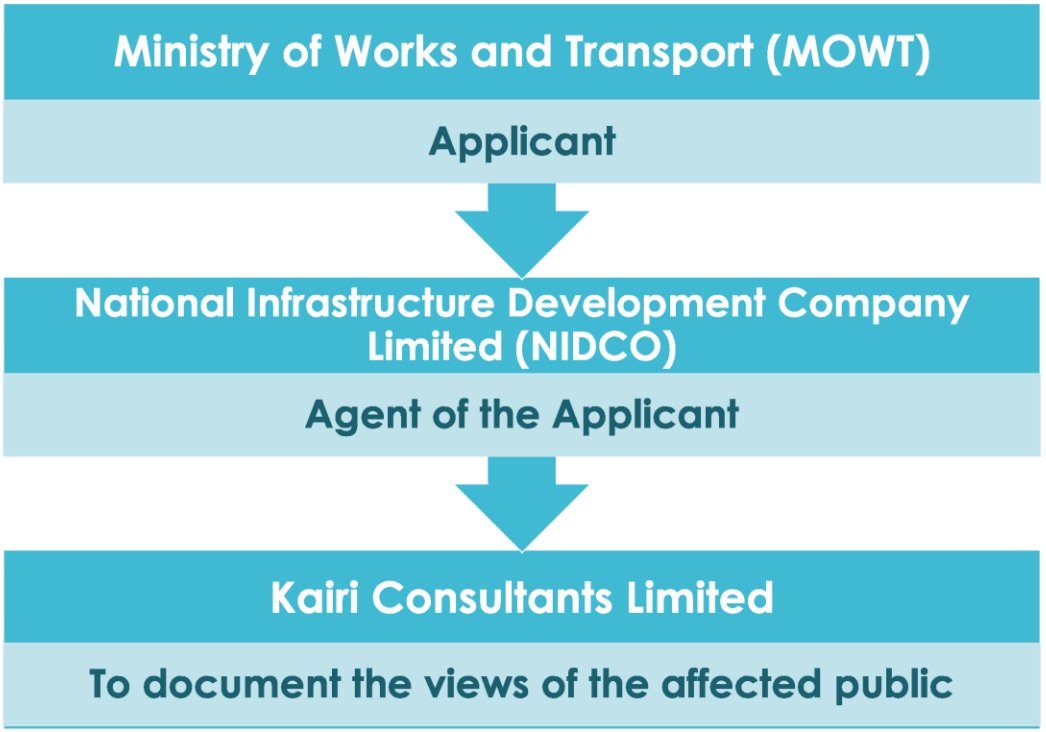
KAIRI
CONSULTANTS LTD.
An integrated approach to development.

Outline of this Evening's Presentation

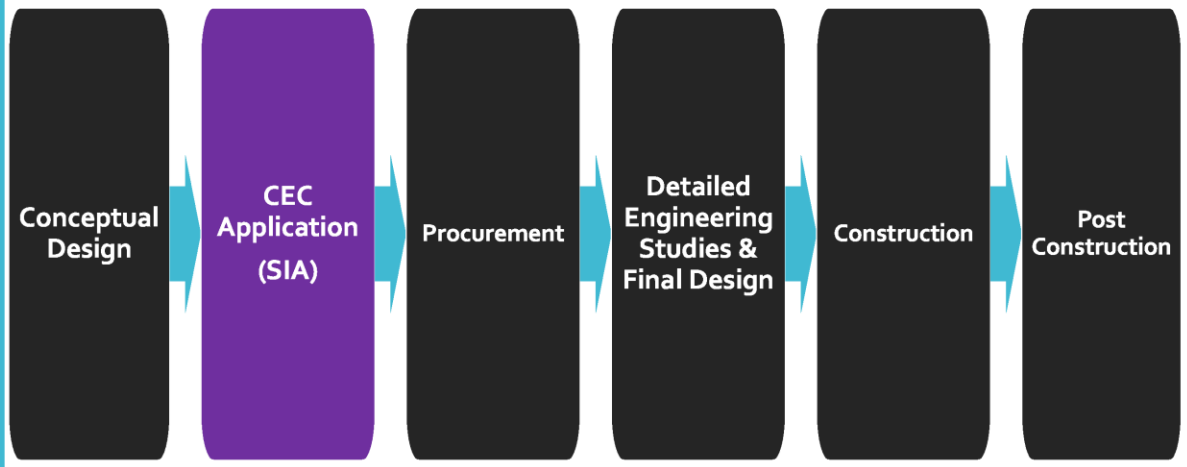


Overview of the Social Impact Assessment Process

The role of each entity in the SIA process



Stages of the Project



History of Stakeholder Engagement for the Certificate of Environmental Clearance



- Provide communities and other stakeholders with information on:
  - Purpose and need for the proposed project
  - The project location and its components
  - Project alternatives and designs under consideration
  - The activities to be undertaken as part of the project

Information to be provided at this SIA Public Meeting

- Provide communities and other stakeholders with information on:
  - Anticipated impacts/risks associated with the proposed project and proposed mitigation measures
  - Studies to be undertaken as part of the project
  - Plans for conducting the SIA

Information to be provided at this SIA Public Meeting

Objectives of Social Impact Assessment (SIA)

- To identify and assess (qualitatively and quantitatively) the **type and extent of impacts to the human environment arising from the proposed project.**
- To examine the **potential socio-cultural impacts** (positive and negative) of this project on the wider community

Entities Involved in the SIA

Facilitators of the SIA Process

- **Ministry of Works and Transport (MOWT)** – the Applicant
- **National Infrastructure Development Company Limited (NIDCO)** – the agent of the applicant
- **Kairi Consultants Limited** (contracted to conduct the SIA)

Key Stakeholders

- Residents
- Locally affected communities or individuals and their formal or informal representatives
- Civil society – local community-based and non-governmental organisations (CBOs & NGOs)
- Local businesses and private sector organisations
- Sensitive Human Receptors – hospitals, schools, churches
- Central Government Ministries including and statutory agencies and local government authorities
- Politicians (Councillors and Parliamentary Representatives)
- Road users
- The public

Components of the SIA



Socio-cultural Baseline Study

- The Socio-cultural Baseline Study determines and describes what exist in **the immediate and wider potential impact area**.
- Socio-cultural baseline shall include:
  - **Socio-demographic characteristics** of communities within the study area
  - **Resource use**
  - **Main development concerns of the study area**
  - **Map illustrations** which depict communities within the area of potential impact and provide a spatial information about the socio-cultural conditions of the study area

Impact Assessment

- Will provide a **clear understanding of the likely benefits/positive and/or negative impacts of the proposal**, and to **assess the effectiveness of any proposed mitigation measures**
- Will also **highlight changes that may occur before the project commences** in light of previous, ongoing or future activities that could reasonably be determined to have a combined effect.

Mitigation Strategy and Management Plan

- Aim to **propose realistic, feasible measures by employing Best Available Technologies Not Entailing Excessive Cost (BATNEEC) and Best Practicable Environmental Options (BPEO) to avoid, mitigate or remedy such impacts to acceptable levels**
- Mitigation measures to be addressed in the form of a **Management Plan**

Mitigation Strategy and Management Plan, cont'd

- The **Management Plan** will:
  - identify potential negative impacts of each phase of the project; and
  - describe the specific measures to be taken to avoid, manage or compensate for identified potential negative impacts.
- Mitigation measures shall **specifically describe how existing adverse impacts, if any, would be handled to prevent a cumulative effect with respect to the intended project.**

Monitoring and Intervention Strategy

- A detailed monitoring plan will be provided for the different aspects of the project to ensure that mitigation measures are achieving their objectives
- Where monitoring indicates that objectives are not being met, contingency plans to minimise adverse situations that may arise (or that have arisen) will be described
- Monitoring programmes shall address the impacts of the project on the receiving environment

Stakeholder Engagement

Purpose of Stakeholder Engagement

- **To garner and integrate feedback from all identified stakeholders into the project design.**
- To allow communities and other stakeholders that can potentially be affected by the proposed project and the wider public to:
  - **understand the project and its impacts on them and their socio-cultural and physical environment**,
  - Inform the baseline study, and
  - **to have their views and concerns aired and addressed.**

Stakeholder Engagement Process

- All persons shall be given an opportunity (fair hearing) to express any concerns on any of the project components.
- All comments/questions from the meetings and other stakeholder forums shall be documented and submitted as the Stakeholder Engagement Report within the SIA Report, including a verbatim record of the proceedings of the public meetings.

Stakeholder Engagement Process, cont'd

- The information gathered shall be representative of all stakeholders and shall address the concerns raised during the consultation process.
- A Stakeholder Engagement Report will be prepared capturing stakeholder concerns raised during the consultation process.

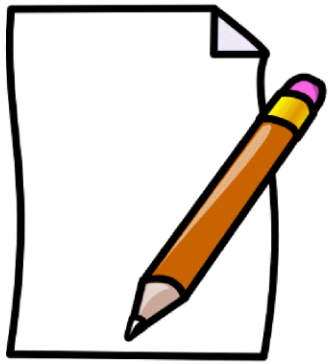
Grievance Redress Process

- Main objective to provide affected stakeholders with access to a **transparent, fair, and equitable process that can act with some degree of independence from the project**
- Will be operational **throughout the project life cycle**
- Features:
  - Clear and public process for handling grievances
  - An understandable, accessible and culturally appropriate grievance process
  - Appropriately scaled process(s) to address project and stakeholder needs
  - Good record-keeping protocols to facilitate effective grievance management

Grievance Redress Process - Steps for Filing a Complaint



How to Lodge a Grievance During the SIA Process



Contact person
The Corporate Communication Unit
(Director of Highways Office)

Telephone
625-1225

Email
communications@mowt.gov.tt

Anticipated Impacts and Risks

Issues raised by participants during past consultations

- **Effect of the proposed vehicular overpass on existing infrastructure:**
  - Existing drainage and flood conditions
  - Wastewater treatment plant
  - Traffic management during construction
  - Encroachment of the overpass on vacant open lot near Victoria Keyes and Powder Magazine Phase II
  - Land acquisition
  - Change in real estate value because of the presence of the overpass

Issues raised by participants during past consultations, cont'd

- **Effect of construction and operation of the overpass on:**
  - **human health** – respiratory illnesses and associated medical costs due to dust
  - **the environment** – coastal waters, air and noise pollution
  - **increased access to neighbouring communities** - which could increase the incidence of crime

Issues raised by participants during past consultations, cont'd

- Effect of the overpass on vulnerable populations:
  - Mobility of persons with disabilities
  - Safety concerns of children/students in crossing roadways as a result of anticipated increased vehicular traffic
- Reduction in land area allocated for recreation/green space
- Residents' access to proposed Westpark Savannah (west of the Diego Martin Highway – Cocorite Farms)
- Concerns about transparency and the sharing of project information with neighbouring communities

Anticipated impacts/risks

Impact / Risk	Proposed Mitigation Measure
Drainage and flooding	A drainage study will be conducted during the final design stage that will provide a detailed drainage design; with possible construction of additional detention ponds which will drain to the Diego Martin River
Wastewater treatment plant and other utilities	All utilities will be identified and a decision about the need for relocation of the plant and other utilities will be made at the final design stage
Traffic management during construction	Mitigation measures to be provided at next public meeting

Anticipated impacts/risks, cont'd

Impact/Risk	Proposed Mitigation Measure
Noise and vibration	Impact of proposed project on air quality to be determined as a part of the SIA Mitigation measures to be provided at next public meeting
Dust emission during construction	Impact of proposed project on air quality to be determined as a part of the SIA Contractor's Dust Management Plan – which provides details on measures contractors are expected to follow

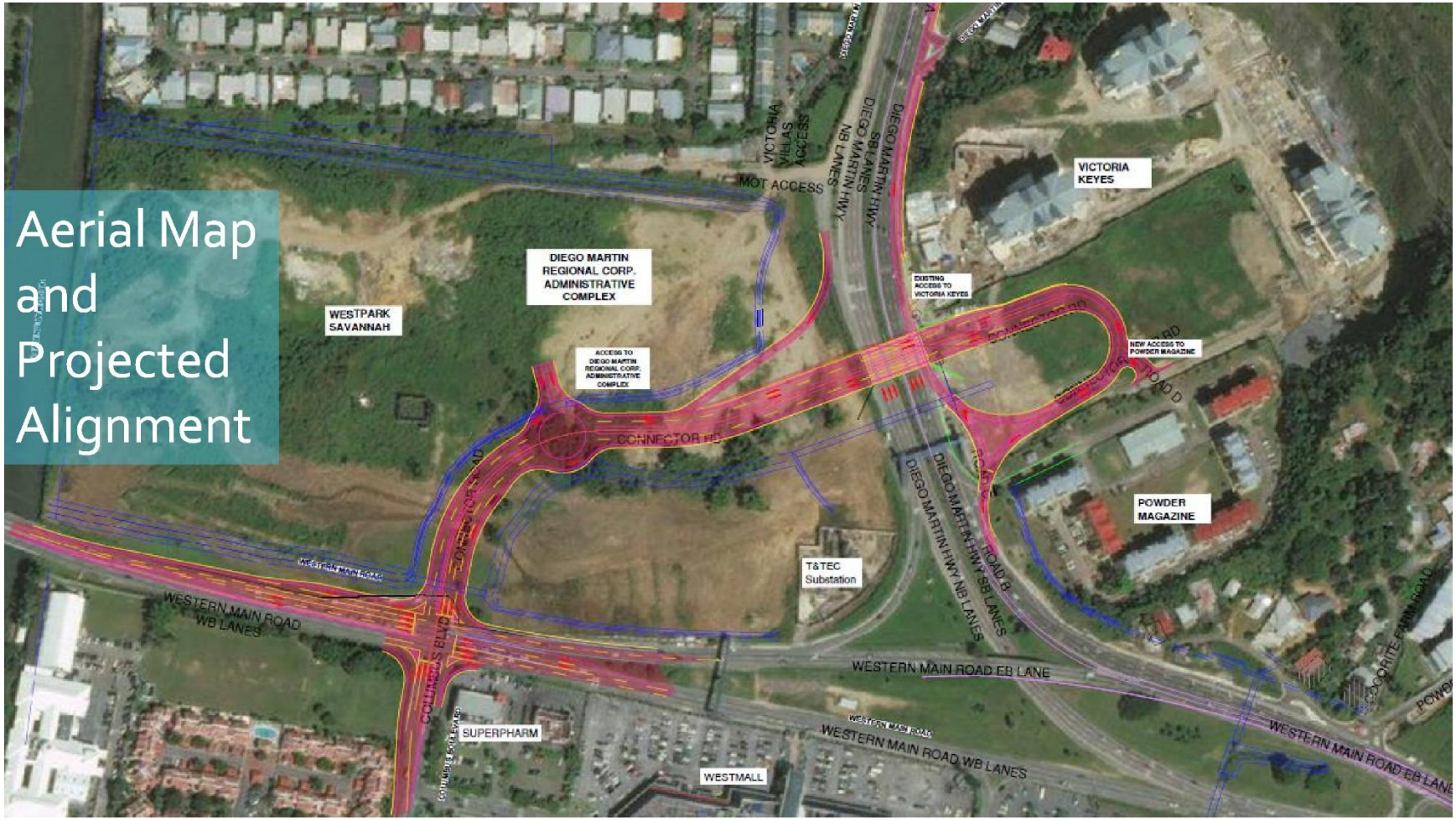
Anticipated impacts/risks, cont'd

Impact/Risk	Proposed Mitigation Measure
Loss of open space	One hectare of green space will be available
Land acquisition	Possibly no longer an issue based on the new conceptual design
Change in real estate value	To be addressed as part of the SIA; mitigation measures to be provided at next public meeting
Health risk – respiratory illnesses and associated medical costs	Reduced risked due to control of dust emissions during construction

Anticipated impacts/risks, cont'd

Impact / Risk	Proposed Mitigation Measure
The environment – waterways	Mitigation measures to be provided at next public meeting
Increase in crime in neighbouring communities	Mitigation measures to be provided at the next public meeting
Access to new green space/ Cocorite Farms	The overpass will provide full access to pedestrians (including students) crossing to and from the green space and proposed Diego Martin Regional Corporation building to the Diego Martin Highway
Sharing of project information	Information about the project can be accessed and grievances can be lodged through the Project's Grievance Redress Mechanism

Stakeholder Feedback


Aerial Map and Projected Alignment
VICTORIA KEYES
DIEGO MARTIN REGIONAL CORP. ADMINISTRATIVE COMPLEX
WESTPARK SAVANNAH
MOT ACCESS
VICTORIA VILLAS ACCESS
DIEGO MARTIN HWY SB LANES
DIEGO MARTIN HWY NB LANES
EXISTING ACCESS TO VICTORIA KEYES
NEW ACCESS TO POWDER MAGAZINE
ACCESS TO DIEGO MARTIN REGIONAL CORP. ADMINISTRATIVE COMPLEX
CONNECTOR RD
ROAD D
ROAD B
POWDER MAGAZINE
T&TEC Substation
WESTERN MAIN ROAD WB LANES
COLUMBUS BLVD
WESTERN MAIN ROAD EB LANE
SUPERPHARM
WESTMALL

Project Schedule



Project Schedule



Status- Social Impact Assessment (CEC)

- Following previous public consultations held in October and November 2018, the Environmental Management Authority (EMA) requested a Social Impact Assessment (SIA) as part of the requirements for the Certificate of Environmental Clearance (CEC).

- In May 2019, NIDCO engaged Kairi Consultants Ltd to undertake this assessment. As part of the SIA process, the EMA has requested that two (2) public meetings be held in order to effectively determine and communicate the social impacts of the project to the affected public and to indicate the proper channels for these residents and/or businesses to submit any grievances or suggestions they may have for the project.

Status- Procurement

- In May 2019 NIDCO cancelled the tender issued in June 2018 for detailed design and construction of a vehicular overpass in the vicinity of Powder Magazine and related road improvements based on the original Design
- In May 2019, NIDCO re-invited tenders for these Design-Build Services based on Trintoplan's conceptual redesign
- Anticipated date for start of Design Build Contract : October 2019
- Designs at 60% stage February 2020
- Expected completion of Design and Construction: within 24 months

Re-Design Summary

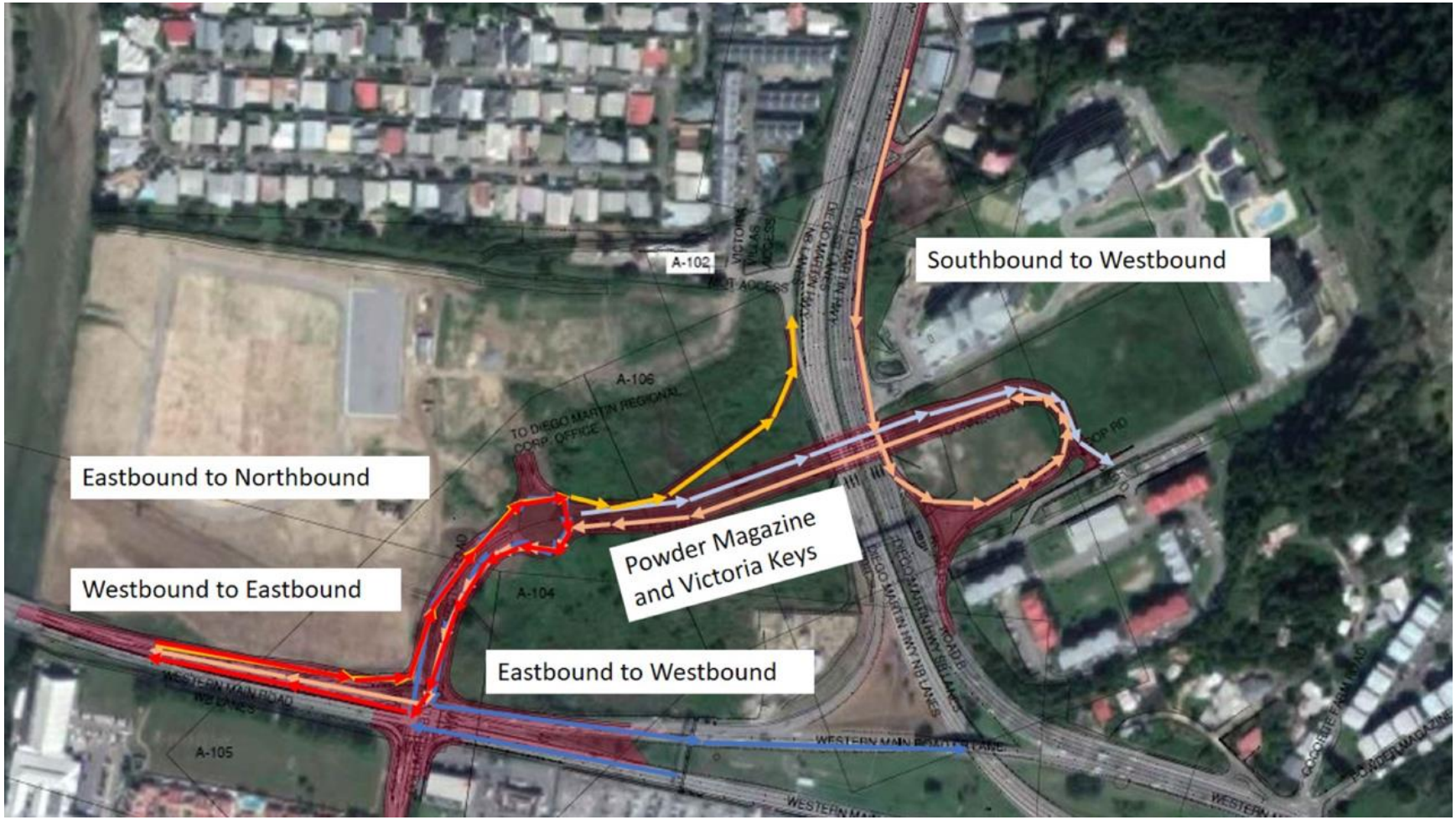
Designs cater for all traffic movements

- Southbound to Westbound
- Westbound to Eastbound
- Including movements for Victoria Keys and Powder Magazine Heading North
- Access provided for Diego Martin Regional Corporation offices and West Park Savannah

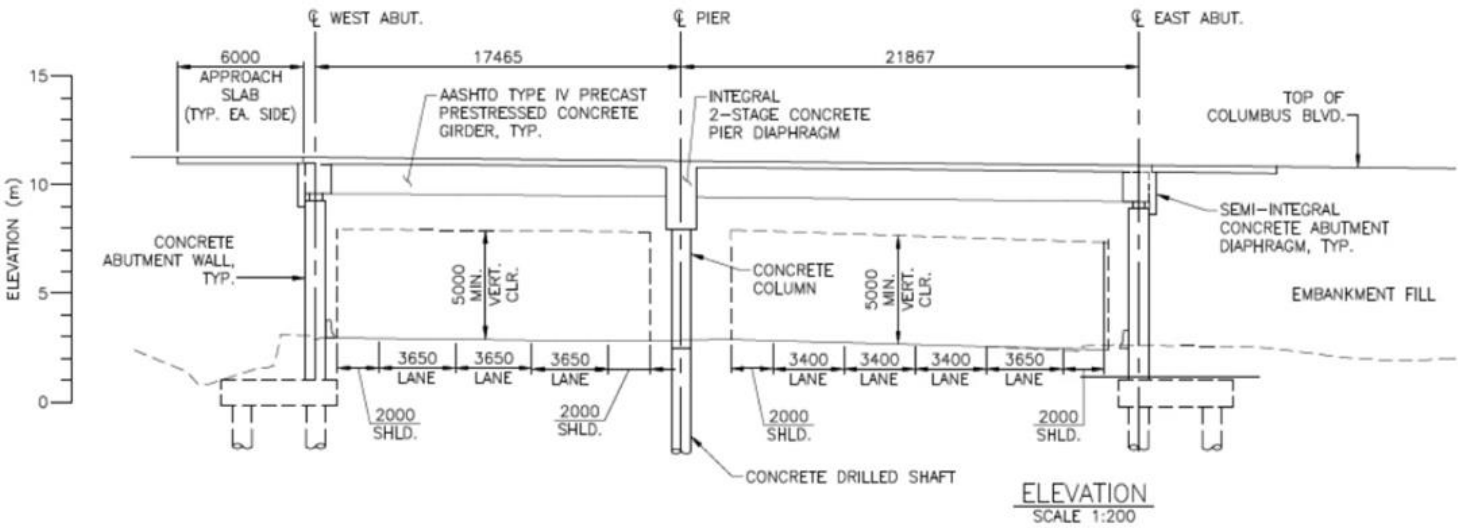
Caters for Drainage Improvements

Lower Social Impact

- No land acquisition anticipated at this time
- Existing Entrance for Victoria Keys maintained
- Lower disruption to daily traffic (only bridge works will directly impact on Diego Martin Highway)


Southbound to Westbound
Eastbound to Northbound
Powder Magazine and Victoria Keys
Westbound to Eastbound
Eastbound to Westbound
A-102
A-106
A-104
A-105
TO DIEGO MARTIN REGIONAL CORP. OFFICE
WESTERN MAIN ROAD

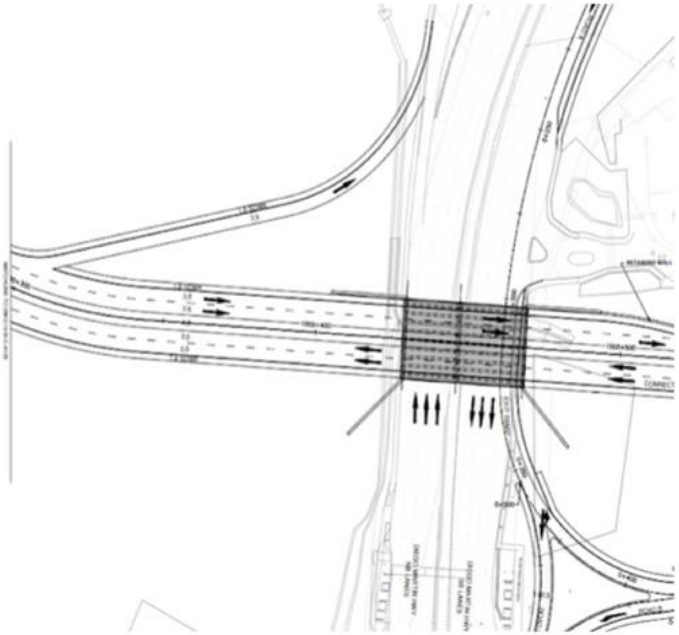
KEY COMPONENTS 4



OVERPASS

Section through Overpass Structure over the Diego Martin Highway

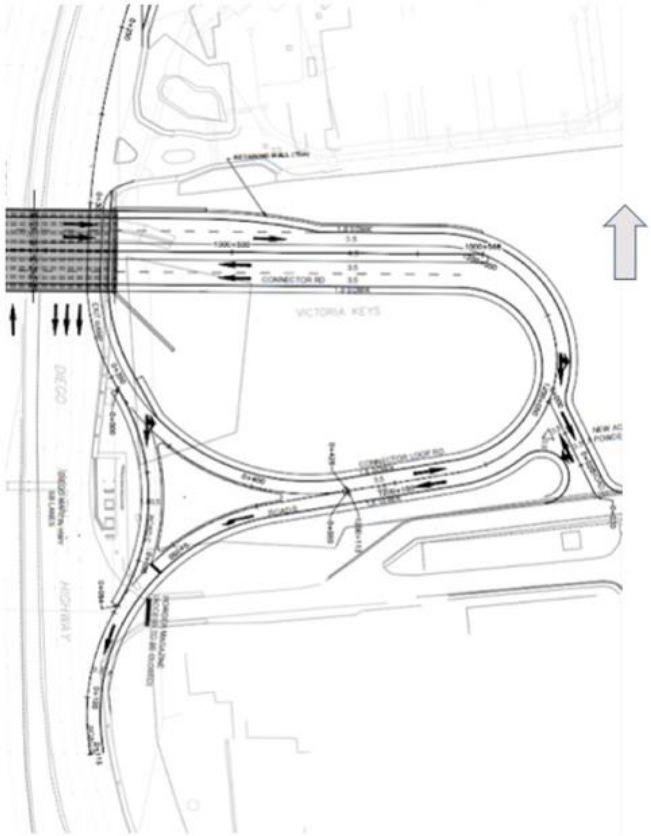
KEY COMPONENTS 3



OVERPASS AND NORTHBOUND RAMP

4 Lane Overpass Structure over the Diego Martin Highway and northbound ramp from the Western Connector Road

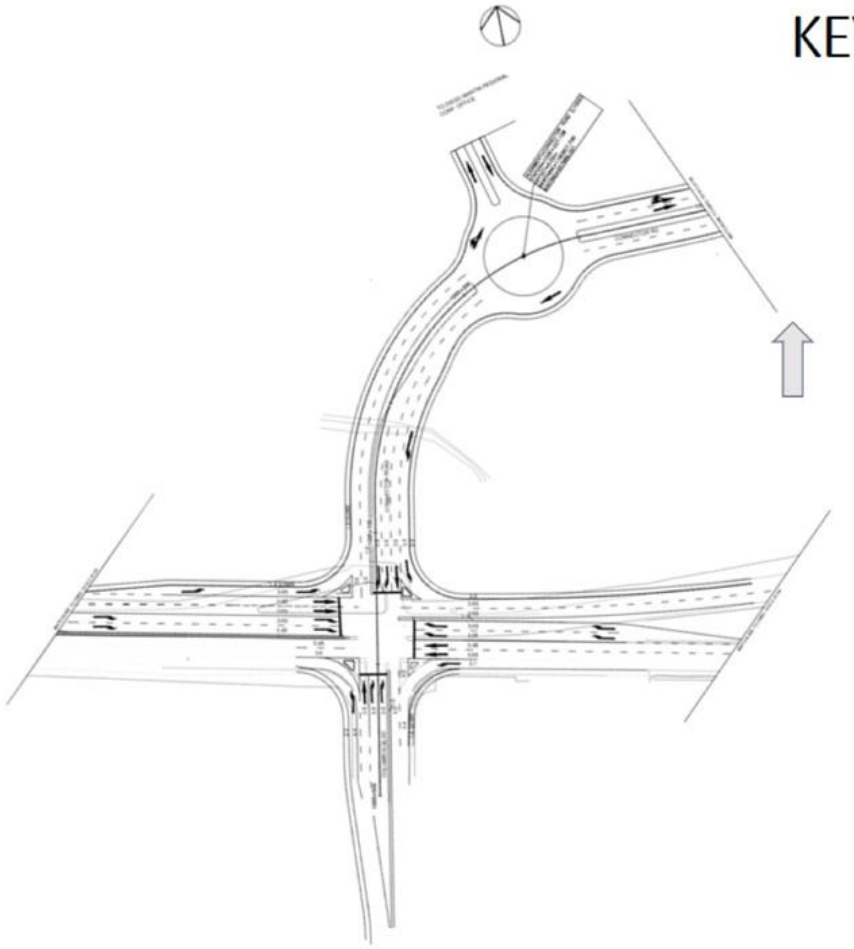
KEY COMPONENTS 2



EASTERN CONNECTOR RD & NEW ACCESS & EGRESS

Eastern Connector Road, new Powder Mag. 2 entrance & new exit for Powder Mag. 2 & Victoria Keys.

KEY COMPONENTS 1



Fully signalized intersection and Western Connector road

Fully signalized Intersection at Columbus Blvd., 4 lane Western Connector Rd & Roundabout access to new developments


Victoria Gardens
Frontage Road
Victoria Keyes
Proposed Diego Martin Regional Corporation Complex
Vehicular Overpass
Proposed WestPark Savannah
Western Connector Road
Eastern Connector Road
Powder Magazine
Superpharm
A-102
A-106
A-104
A-105
WESTERN MAIN ROAD WB LANES
WESTERN MAIN ROAD EB LANES



Considerations for Revised Design

LOCAL CONDITIONS



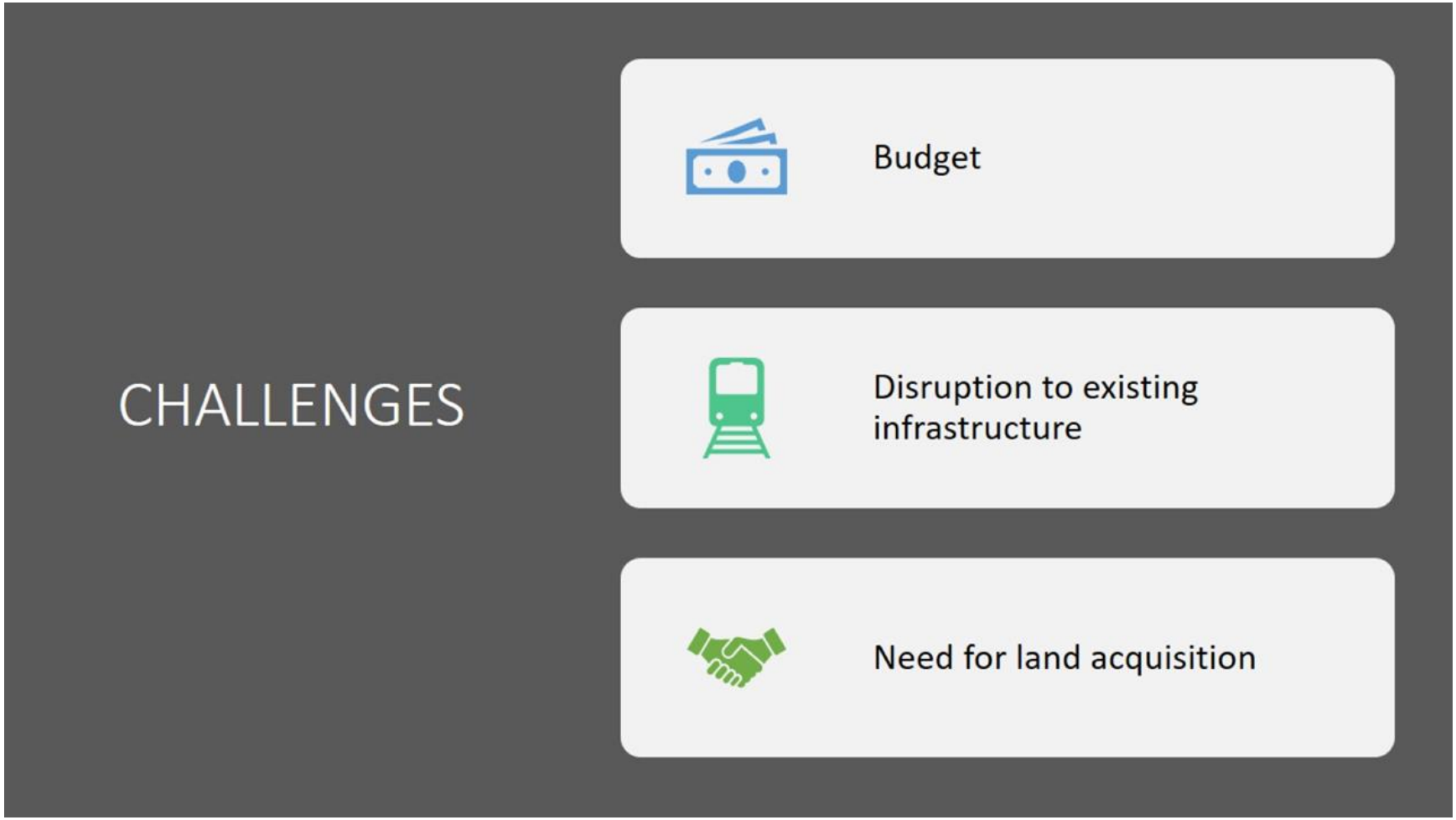


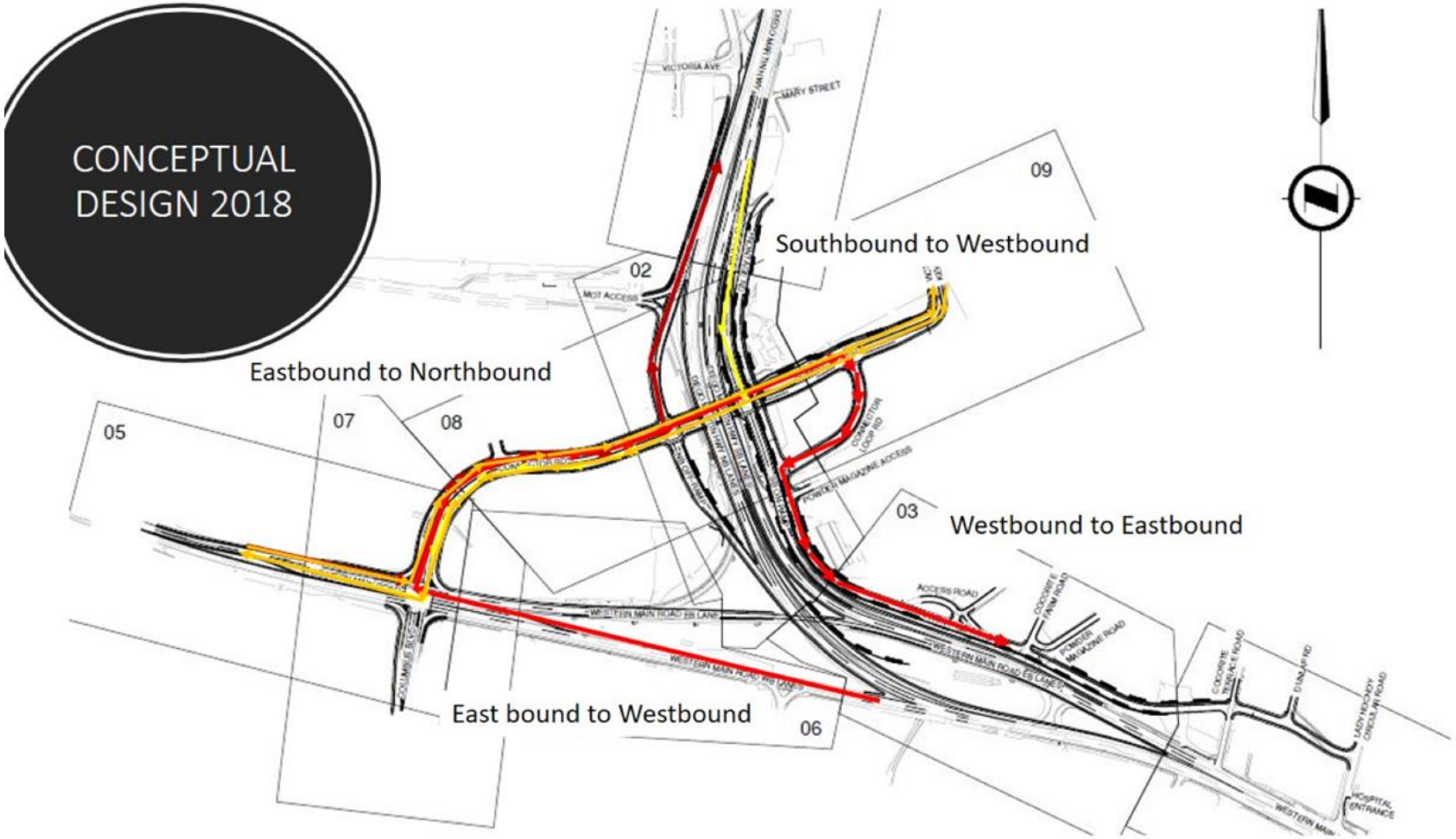


Design Revisions

- In 2019, a decision was made to reduce the project scope due to budgetary constraints and to address general concerns of the affected residents and businesses.

- In May 2019, NIDCO engaged Trintoplan Consultants Ltd to review WSP's conceptual design from 2018 and present another option with a reduced scope whilst still improving connectivity from the Diego Martin valley to the Western Peninsula. The new option will also provide less disruption to the neighbouring residents in the operational phase.


CHALLENGES
Budget
Disruption to existing infrastructure
Need for land acquisition


CONCEPTUAL DESIGN 2018
Southbound to Westbound
Eastbound to Northbound
Westbound to Eastbound
East bound to Westbound
02
03
05
06
07
08
09
VICTORIA AVE
MARY STREET
M37 ACCESS
COMMUTOR LOOP RD
POWDER MAGAZINE ACCESS
ACCESS ROAD
WESTERN MAIN ROAD
HOSPITAL ENTRANCE

Design Alternatives from Feasibility Study



Connector Road and Tight Diamond Interchange on Diego Martin Highway

The Connector Road and Tight Diamond Interchange on Diego Martin Highway was developed and found to provide an acceptable level of service and was further developed as part of the conceptual design.

Diamond Interchange and Frontage Road System (Local Access)

The access road located closest to the Diego Martin Highway and Western Main Road, was called the Frontage Road and it was combined with the tight diamond interchange to remove numerous direct access along the highway. **This was the preferred option.**





Diamond Interchange and Back Access Road System (Local Access)

The Back Access Road option, which is located furthest away from Western Main Road, was evaluated. It was found that it required more right-of-way; it had more neighbourhood impact and was costlier than the Frontage Road option.

Design Alternatives From Feasibility Study



Southbound to Westbound Directional Ramp

The ramp would pass above the eastbound lanes of Western Main Road, passing over the northbound lanes of Diego Martin Highway, making this ramp two levels tall. It was determined there was insufficient space to accommodate this ramp.

Diego Martin Highway and Western Main Road Roundabout

A large roundabout alternative was developed to allow this movement. It was determined that the traffic volumes at this location were too large for a roundabout to operate at an acceptable level of service.





Connector Road and At-Grade Intersection on Diego Martin Highway

The Connector Road and At-Grade Intersection on Diego Martin Highway was developed and found to provide an acceptable level of service. This option was further developed as part of the conceptual design.

No Action Alternative

The forecasted total vehicle registrations in Trinidad and Tobago would increase to 845,000,1,080,000 and 1,285,000 by 2020, 2030 and 2040 respectively.

The future traffic demand was forecast to grow at an average rate of 1.75% per annum. This is a mid-range traffic growth estimate and the actual growth rate could be higher or lower.

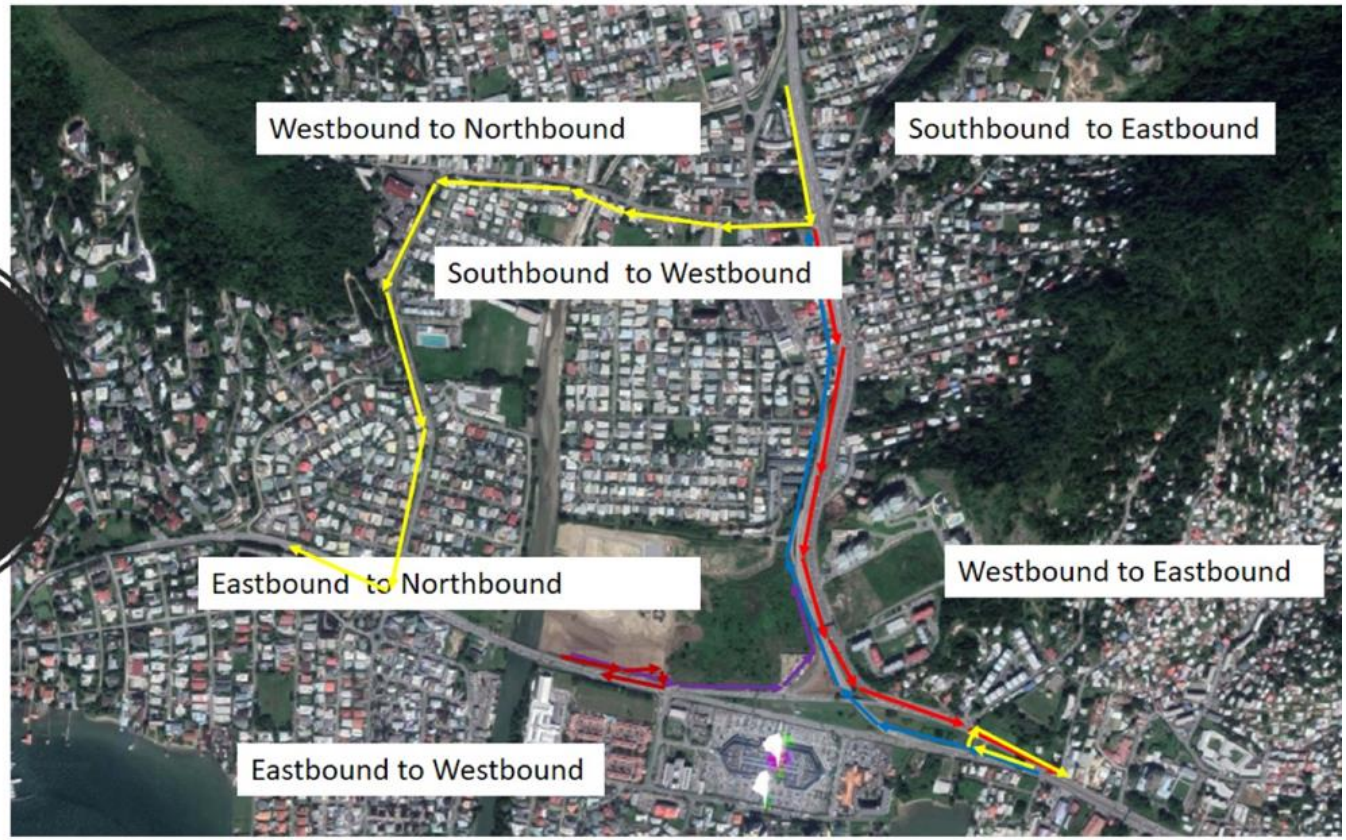
Traffic volumes are estimated to increase annually by approximately 1.76% between 2015 and 2040. By 2040, the traffic volumes are projected to increase by 61% over the 2015 volumes.

The 2040 traffic volumes are viewed as being too large to be realistically accommodated with traditional road improvements with the existing highway corridors.

No Action means increased traffic congestion, and a higher level of pollutants to neighbouring residents due to potentially longer periods of stand-still traffic.



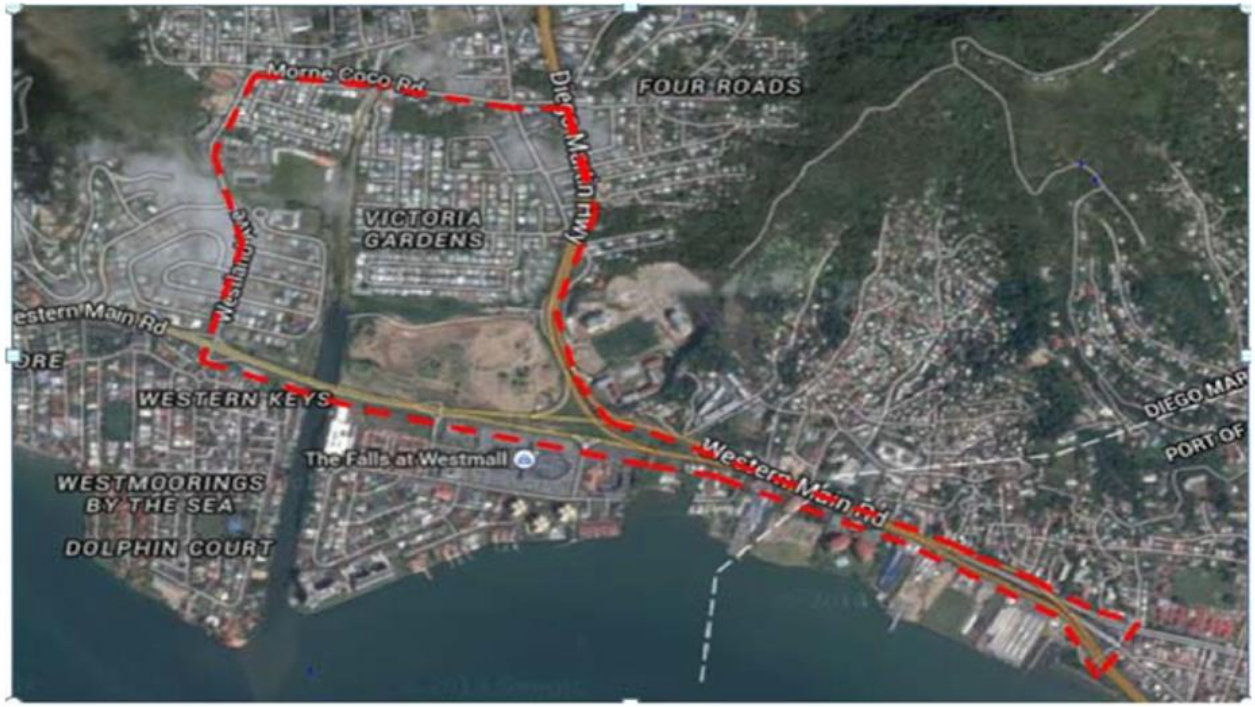
EXISTING TRAFFIC ARRANGEMENTS



Feasibility Study Objectives

- Improved road network in subject area
- Providing the road user and pedestrians with affordable, safe and efficient connectivity with least impact to the environment and stakeholders.
- Solving problem of no direct connection Southbound to Westbound;
- Inefficient traffic signal operations, and unsafe traffic operations throughout;
- Multiple access points from driveways and intersecting streets along the Diego Martin Highway /Western Main Road corridor;
- No westbound through movement at the Morne Coco Road / Diego Martin Highway intersection;
- Flooding at locations;
- Lack of safe, convenient facilities for pedestrian movements; and
- No capacity to accommodate future traffic growth.

Feasibility Study Limits



Overview

As far back as the 1990's due to increasing development in the Diego Martin Valley, and in keeping with its planned Highway network improvements, the Ministry of Works and Transport (MOWT) had plans to improve the intersection of the Diego Martin Highway and Western Main Road.

Cabinet approved the construction of the overpass via Cabinet Minute No. 2320 of September 11, 2003 and Cabinet Minute No. 1949 of July 19, 2013.

In 2015, MOWT through the National Infrastructure Development Company Ltd (NIDCO), undertook a Feasibility Study with the aim of eliminating conflicts, improving access and improving safety along the Diego Martin Highway/ Western Main Road Intersection.

In March to May 2015, public consultations were held with individual stakeholders and community groups to discuss concerns, comments or special issues . The feedback from these consultations along with the analysis of the data collected including future projections ,formed the basis for the conceptual designs.

Purpose of the project

1. Provide upgraded transportation facilities to accommodate current and future growth and development of the Western Peninsula.

2. Improve the connectivity to the Western Peninsula from the Diego Martin Valley by removing unnecessary routing which contribute to eastbound congestion and delays .

3. Provide access to new developments situated adjacent to the proposed site and improve existing accesses to adjacent developments and communities.

4. Improve road safety and network efficiency by eliminating unsafe movements (eg. u-turn at Cocorite) and circuitous movements (turn at Cocorite Fishing Facility) .

....

Project Location



LOCATION PLAN

Contents of Presentation

Project Location

Purpose of the project

Overview

No Action Alternative

Project Alternatives

Conceptual Design 2015

Project Status

Revised Conceptual Design 2019

Project Schedule

PANEL

Moderator/ Presenter
(Social Impact Assessment)
Dr. Ralph Henry,
Kairi Consultants Limited

Conceptual Design & Project Information)
Ms. Andrea Abel,
Trintoplan Consultants Limited

Director of Highways,
Ministry of Works & Transport
Navin Ramsingh

Programme Manager
NIDCO
Kenneth Crichlow

Physical Impact Specialist EHSU,
MOWT
Tennile Noel

Participatory Engagement Specialist
Dr. Fredericka Deare,
Kairi Consultants Limited


Works & Infrastructure
NIDCO
CONSTRUCTION OF A VEHICULAR OVERPASS
IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS



5.7.2 PUBLIC CONSULTATION 2 – SEPTEMBER 26TH, 2019

Public Consultation

Social Impact Assessment of the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements

Certificate of Environmental Clearance: CEC5500/2018

September 26, 2019

MINISTRY OF Works & Transport

NIDCO
National Infrastructure Development Company Limited

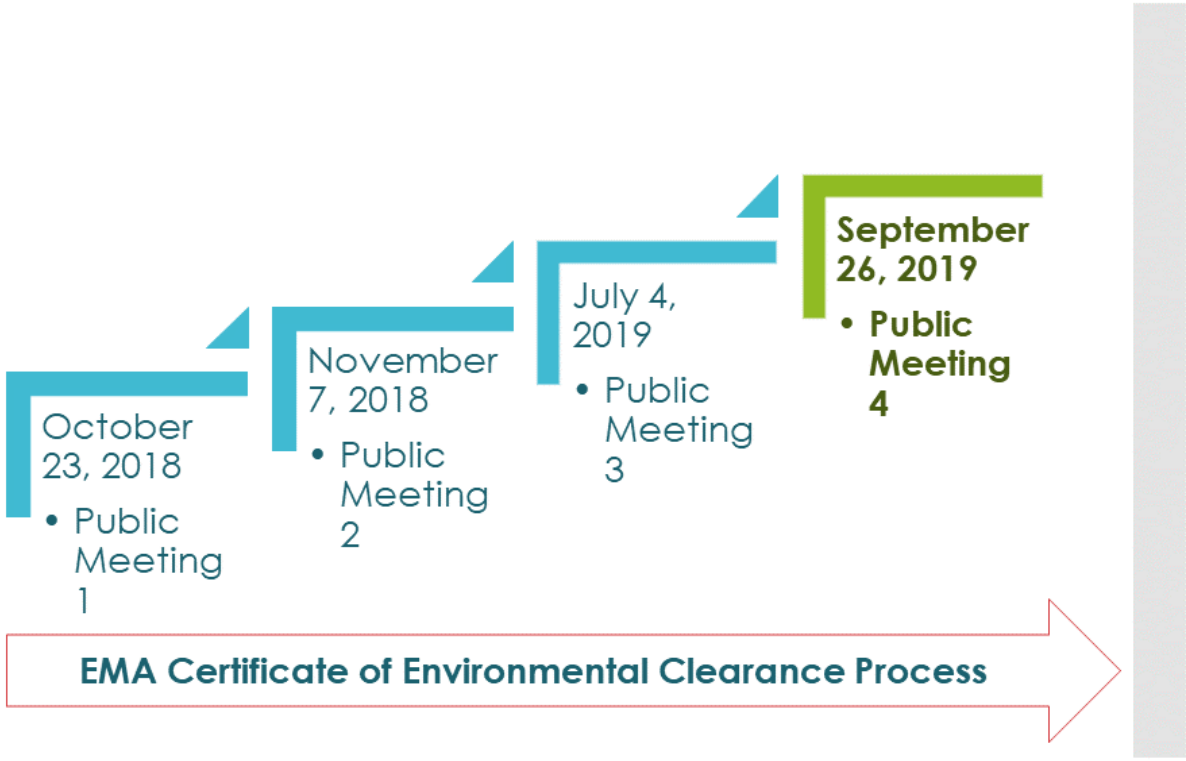
KAIRI
CONSULTANTS LTD.
An integrated approach to development.

Outline of Presentation

- Social Impact Assessment Process
- Definition of The Study Area
- Description of The Socio-cultural Characteristics Of The Study Area
- Analysis of Potential Impacts
- Mitigation Strategy and Management Plan
- Monitoring and Intervention Strategy

Social Impact Assessment Process

History of Stakeholder Engagement for the Certificate of Environmental Clearance



- Provide communities and other stakeholders with information on:
  - Definition Of The Study Area
  - Description Of The Socio-cultural Characteristics Of The Study Area
  - Key Concerns coming out of the Focus Group Discussions and Public Consultation held on July 4th 2019
  - Analysis of Potential Impacts
  - Mitigation Strategy and Management Plan
  - Monitoring and Intervention Strategy

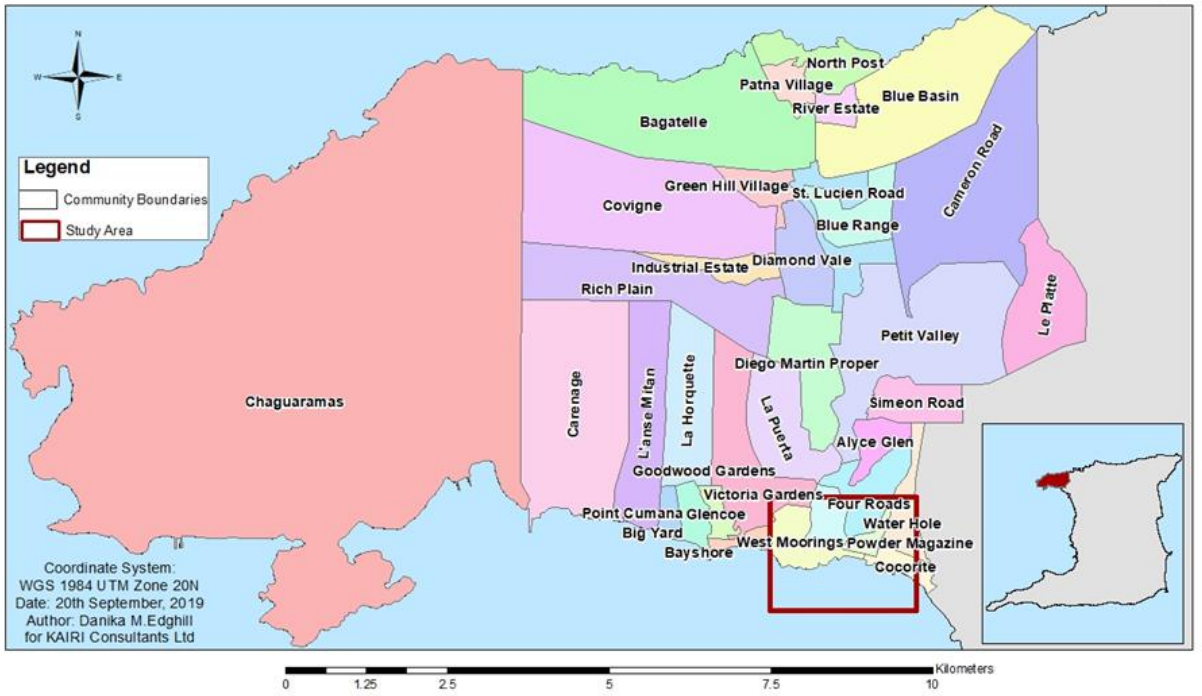
Information to be provided at this SIA Public Meeting

Objectives of Social Impact Assessment (SIA)

- To identify and assess (qualitatively and quantitatively) the **type and extent of impacts to the human environment arising from the proposed project.**
- To examine the **potential socio-cultural impacts** (positive and negative) of this project on the wider community

Definition of The Study Area

Social Impact Assessment Study Limits for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements



DEFINING THE STUDY AREA

Northern Limit

Morne Coco Road at the Four Roads intersection.

Southern Limit

Coastline from Westmoorings to Cocorite

Eastern limit

Cocorite section of Western Main Road, outside Peake's Marine and the communities of Fort George

Western limit

Western Main Road at Westmoorings/Westlands Ave



LOCATION PLAN

Description of The Socio-cultural Characteristics Of The Study Area

Socio-cultural Baseline Study

- The Socio-cultural Baseline Study determines and describes what exist in **the immediate and wider potential impact area**.
- Socio-cultural baseline shall include:
  - **Socio-demographic characteristics** of communities within the study area
  - **Resource use**

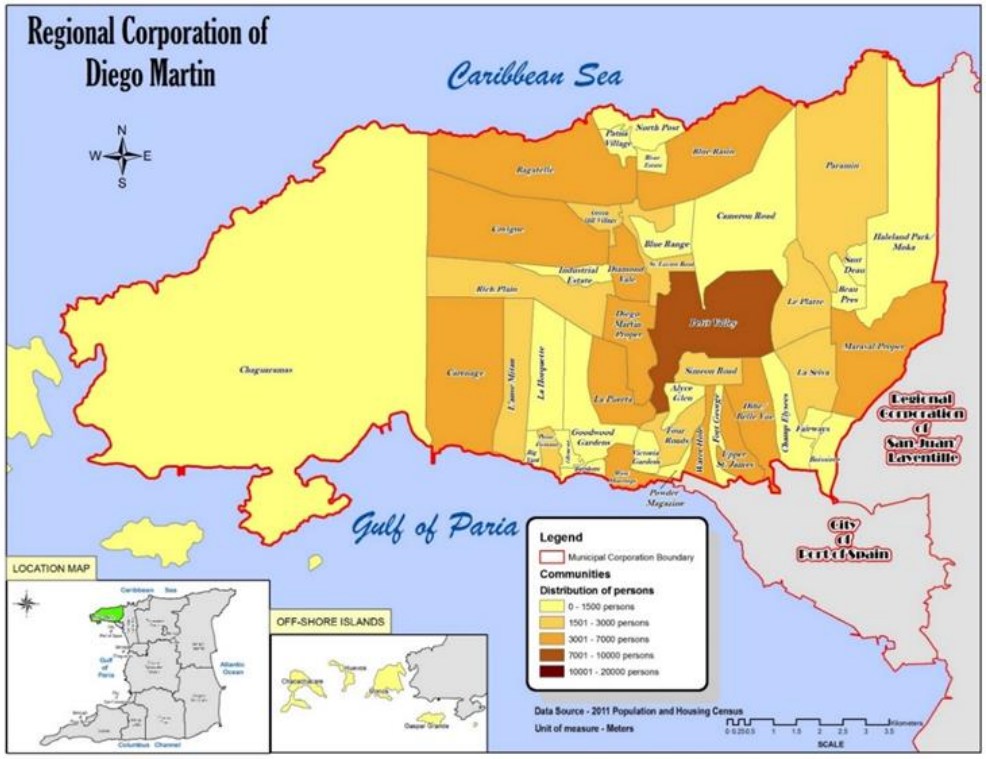
Country/ Region	Non-Institutional Population		Number of Occupied Private Households		Average Household Size		Average Annual Rate of Growth in Population	Average Annual Rate of Growth in Households
	2000	2011	2000	2011	2000	2011	2000-2011	2000-2011
Trinidad and Tobago	1,250,652	1,322,546	343,180	401,382	3.6	3.3	0.5%	1.5%
Trinidad	1,197,426	1,261,812	328,000	381,257	3.7	3.3	0.5%	1.4%
Diego Martin	103,930	102,340	29,352	32,404	3.5	3.2	-0.1%	0.9%

Source: Central Statistical Office - Trinidad & Tobago 2011 Housing and Population Census

Demographic Characteristics 2000-2011

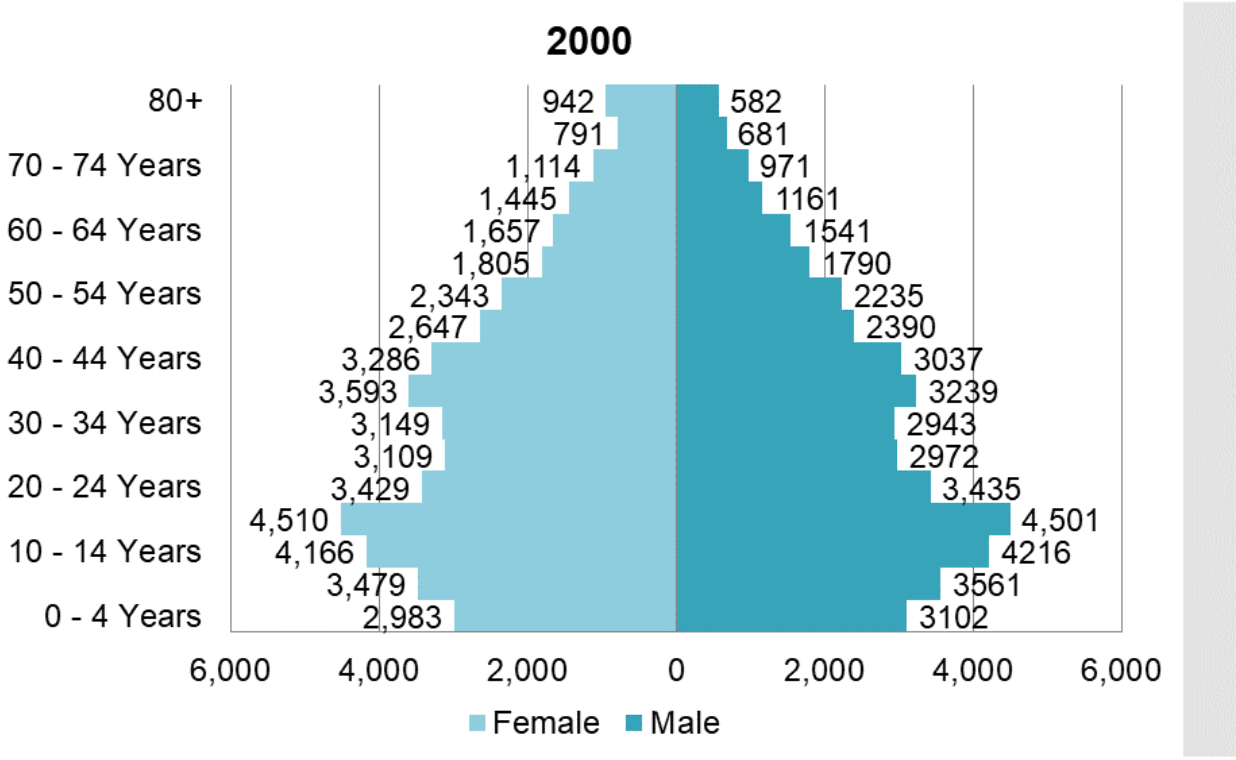
Population Density by Community in the Municipality of Diego Martin 2011

Year	Density (Per Sq. km)	Population
1990	728	91,778
2000	839	105,720
2011	817	102,957



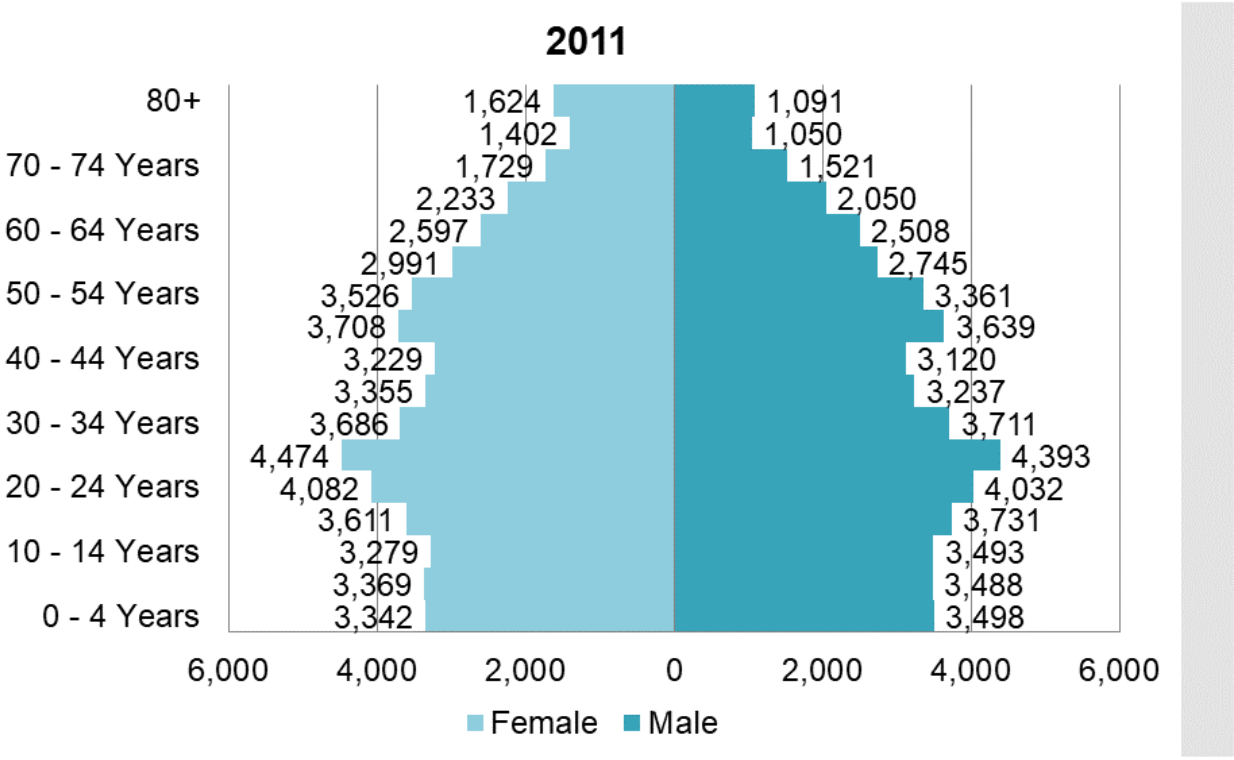
Source: Central Statistical Office - Trinidad & Tobago 2011 Housing and Population Census

Age/Sex Composition of the Population of Diego Martin, 2000



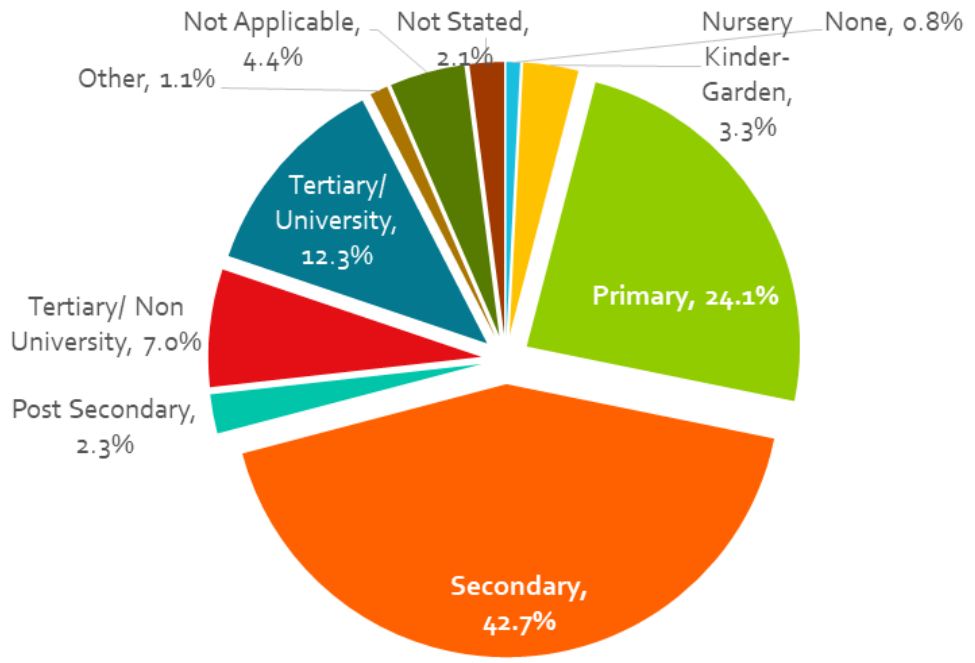
Source: Central Statistical Office - Trinidad & Tobago 2011 Housing and Population Census

Age/Sex Composition of the Population of Diego Martin, 2011

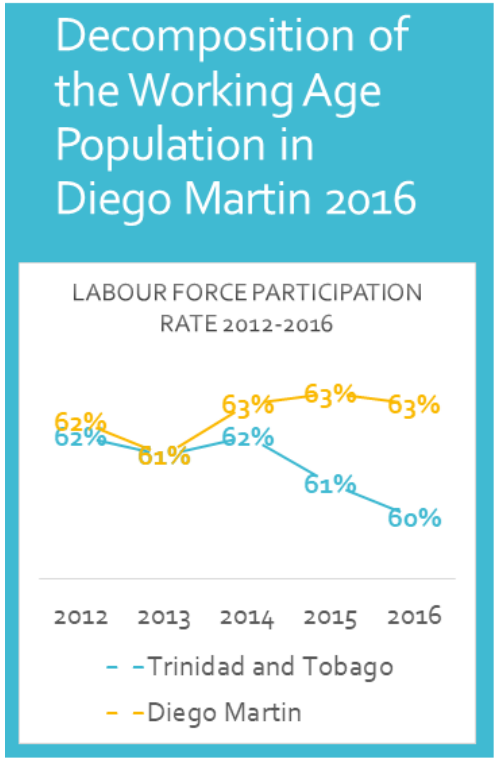


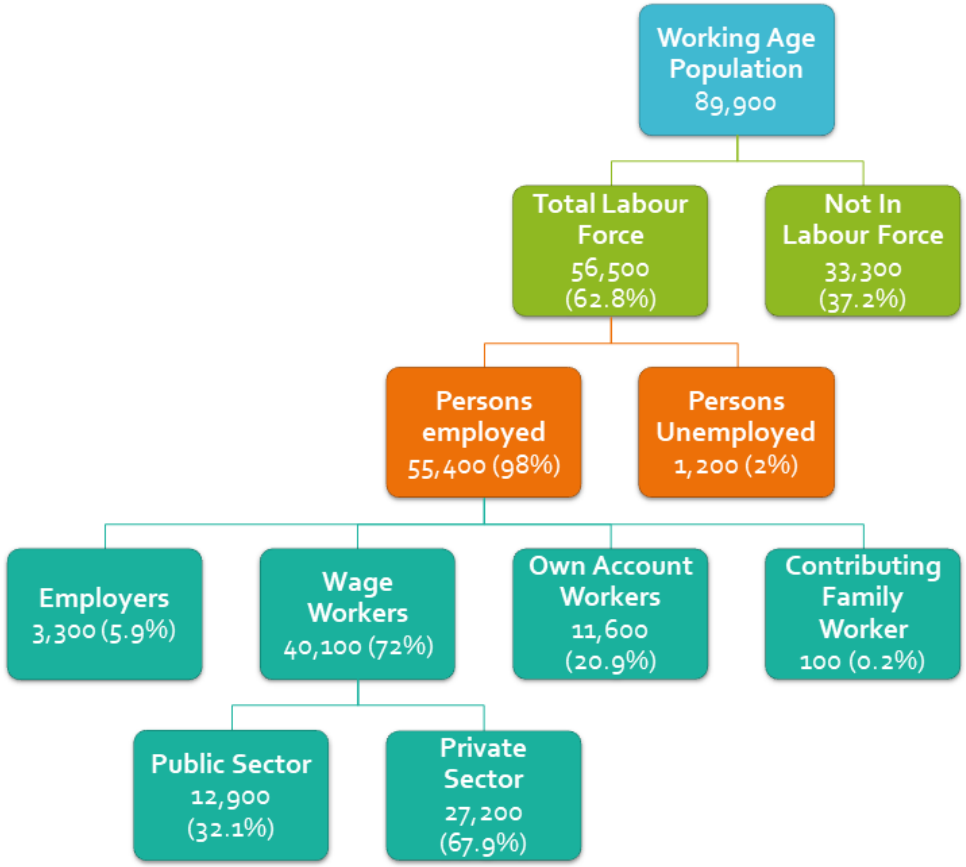
Source: Central Statistical Office - Trinidad & Tobago 2011 Housing and Population Census

Socio-demographic characteristics o Educational Attainment 2011



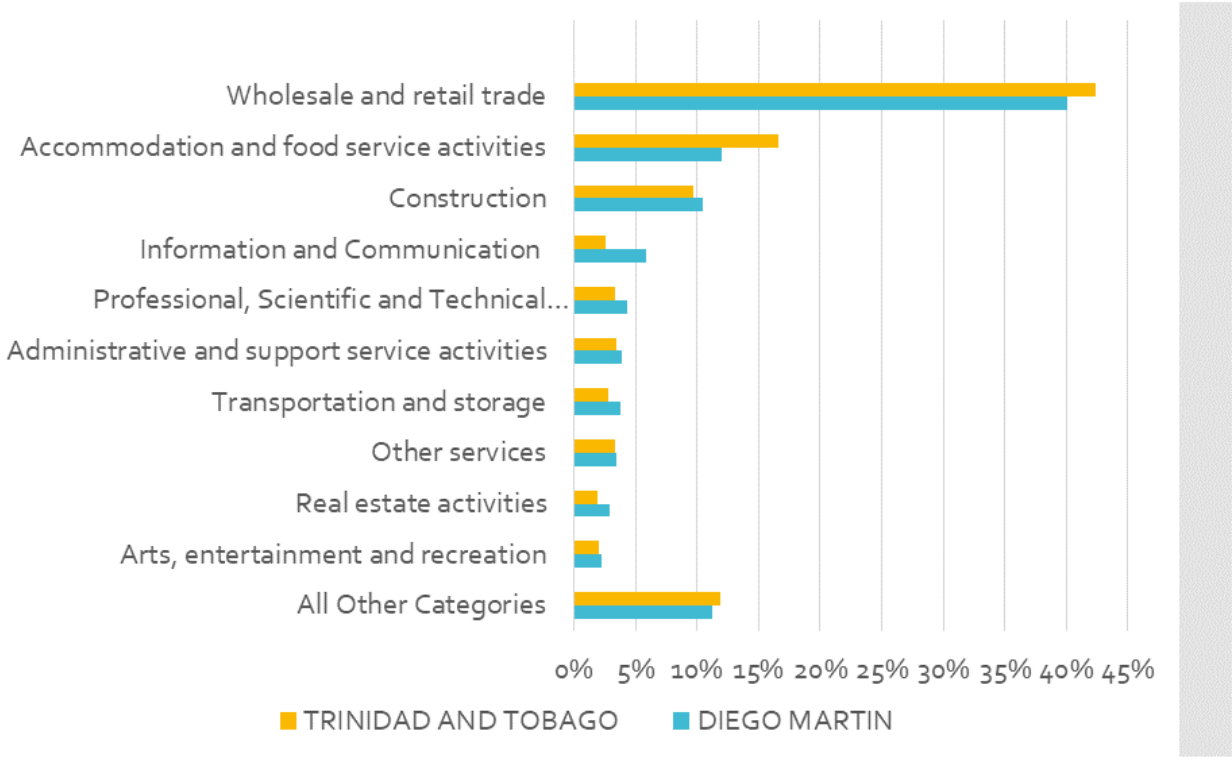
Source: Central Statistical Office -Trinidad & Tobago 2011 Housing and Population Census





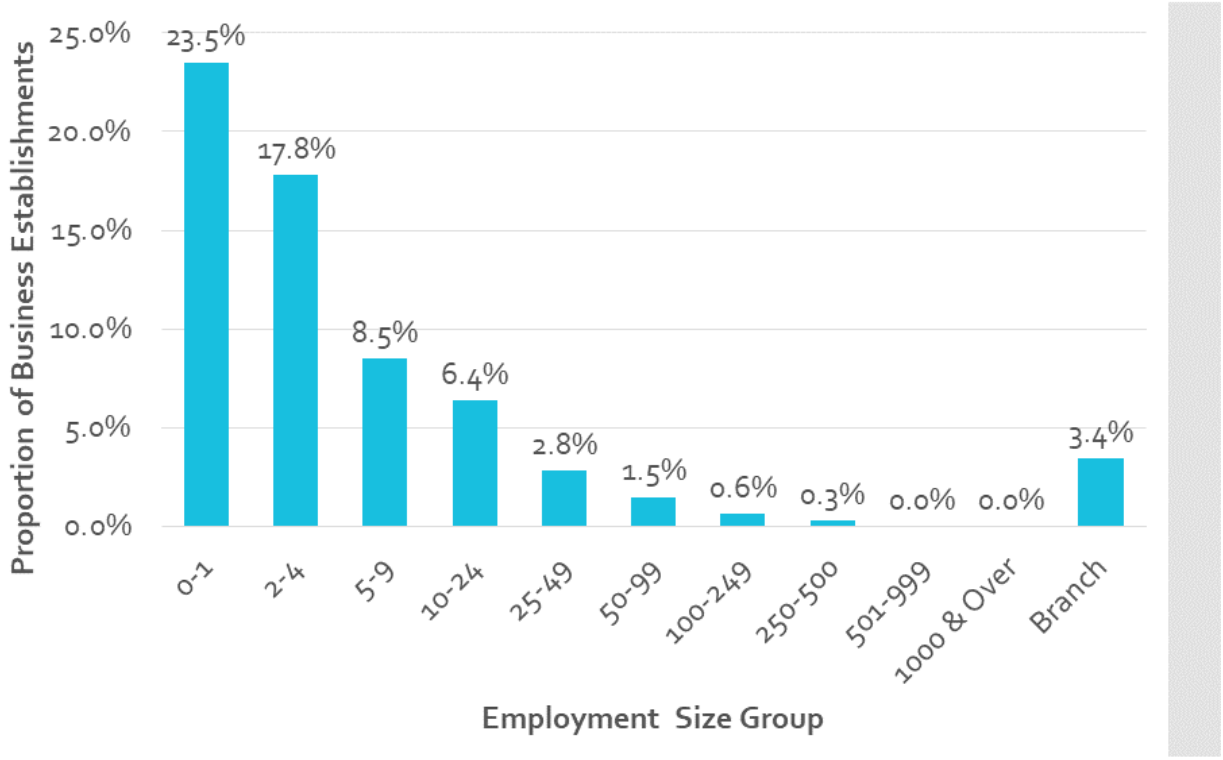
Source: Central Statistical Office - Continuous Sample Survey of the Population 2016

Local Economy - Percentage of Business Establishments in Diego Martin and Trinidad and Tobago as at 2018

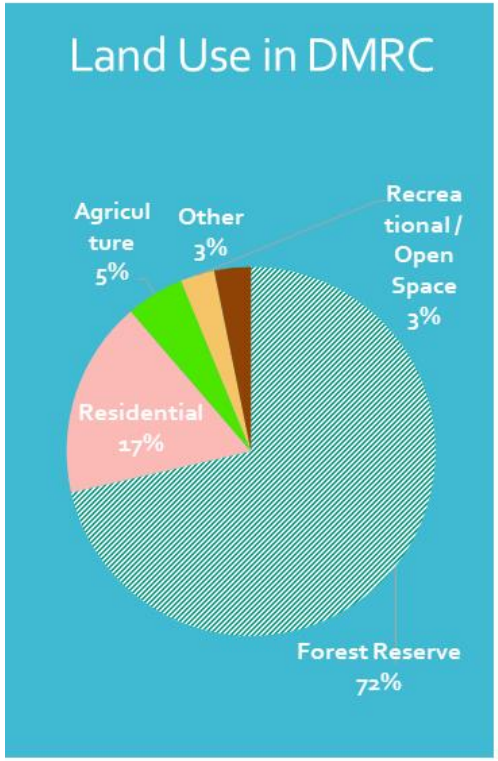


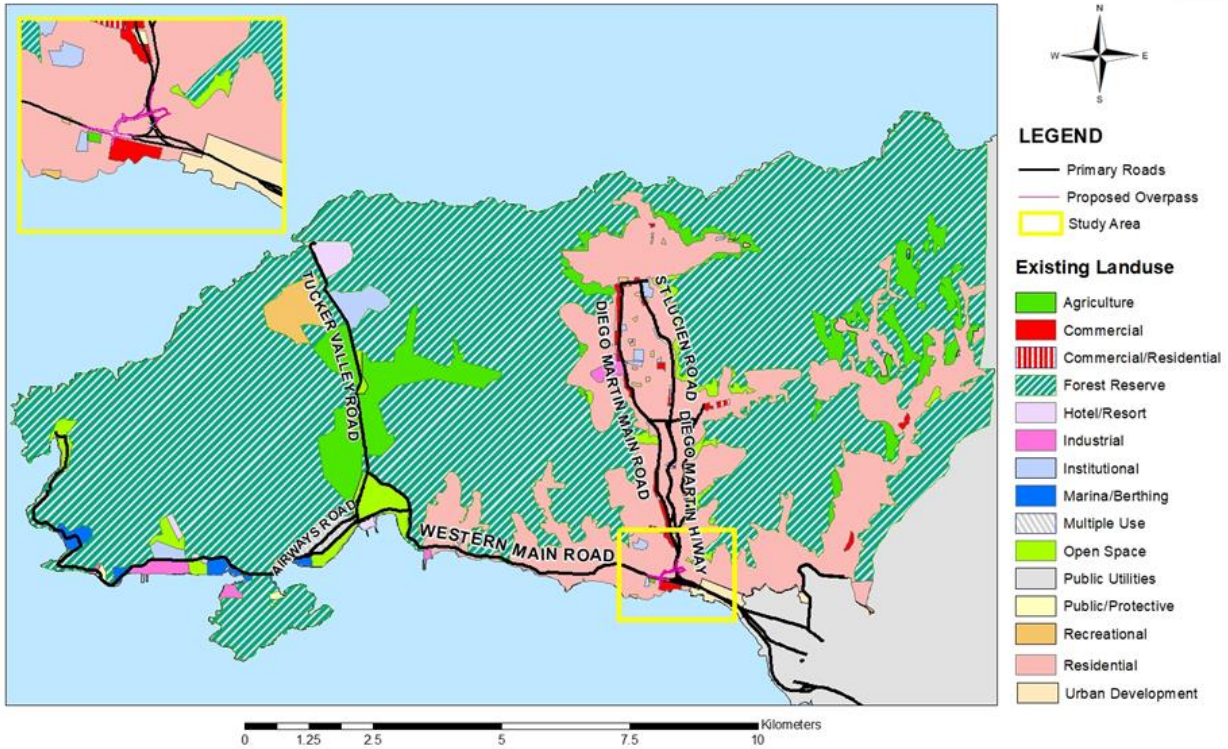
Source: Central Statistical Office - Business Surveys Establishments Register 2019

Employment Patterns - Business Establishments in Diego Martin by Employment Size Group 2016



Source: Central Statistical Office - Business Surveys Establishments Register 2019





Source: Town and Country Planning Division, Ministry of Planning & Development 2009

Households with a vehicle for private use 2011 (%)

Baseline

More than half of DMRC households in 2011 (54%) owned at least one vehicle for private use

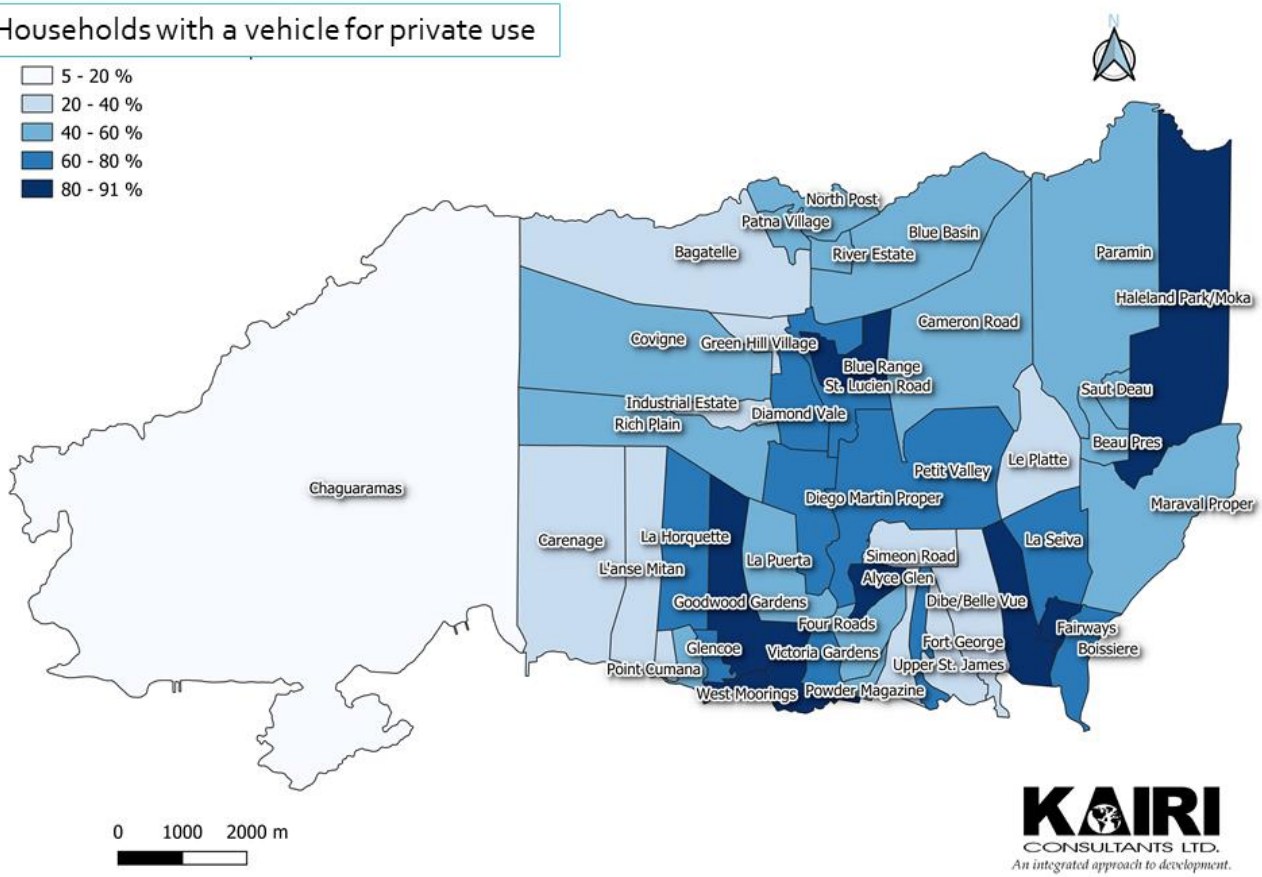
Trends

Vehicle sales nationally continue to charge along

There are currently close to one million vehicles nationally

Average annual new registrations > 25,000/year

Average monthly registration > 2,000 vehicles

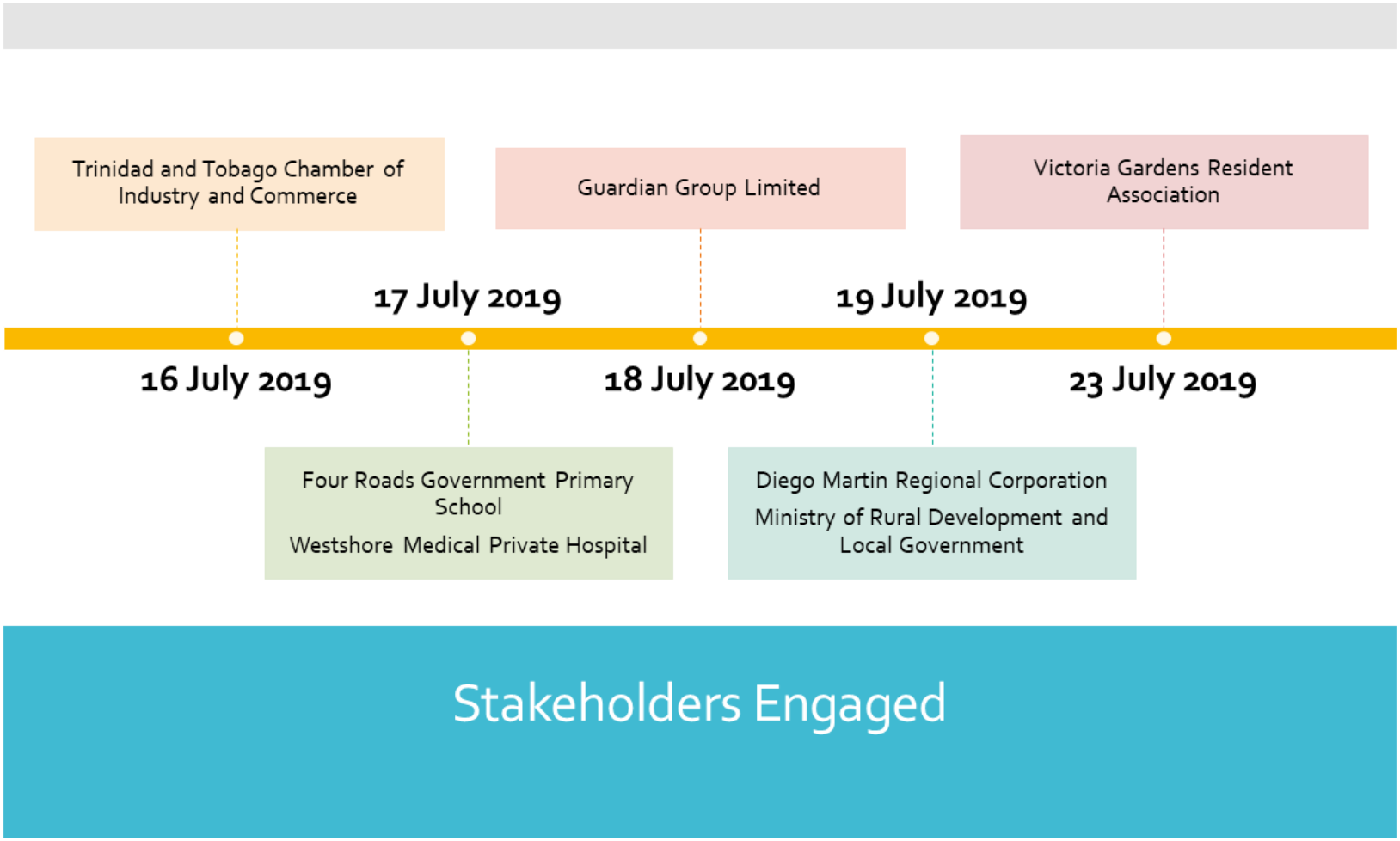


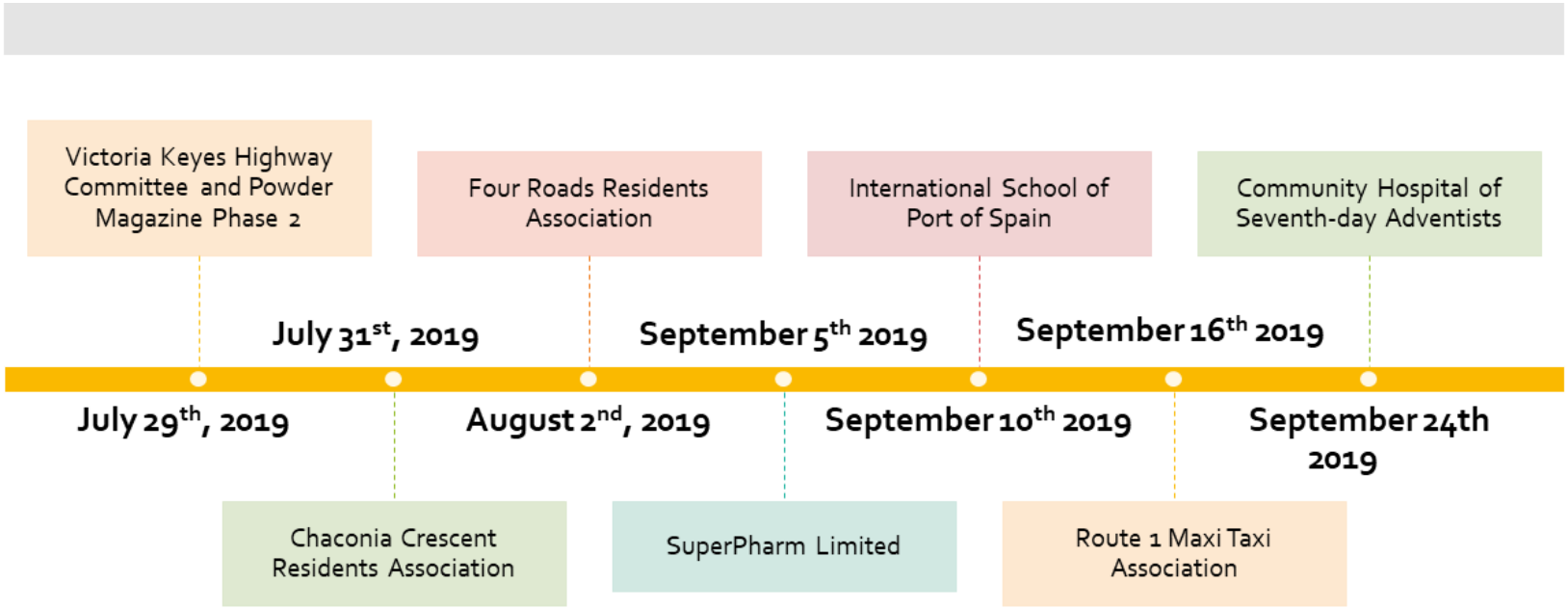
Source: Central Statistical Office - Trinidad & Tobago 2011 Housing and Population Census

Analysis of Potential Impacts

Description of Focus Group Discussions

- Kairi Consultants Limited conducted focus group discussions with the following stakeholders over the period July to September 2019.
  - Trinidad and Tobago Chamber of Industry and Commerce
  - Four Roads Government Primary School
  - WestShore Medical
  - Guardian Group Limited
  - Diego Martin Regional Corporation
  - Ministry of Rural Development and Local Government
  - Victoria Gardens Residents' Association
  - Victoria Keyes Residents' Association
  - Chaconia Crescent Residents' Association
  - Four Roads Association
  - SuperPharm Ltd
  - Route 1 Maxi Taxi Association
  - Community Hospital of Seventh-Day Adventists
- 1 Stakeholder responded in writing to key concerns


Trinidad and Tobago Chamber of Industry and Commerce
Guardian Group Limited
Victoria Gardens Resident Association
16 July 2019
17 July 2019
18 July 2019
19 July 2019
23 July 2019
Four Roads Government Primary School
Westshore Medical Private Hospital
Diego Martin Regional Corporation
Ministry of Rural Development and Local Government
Stakeholders Engaged



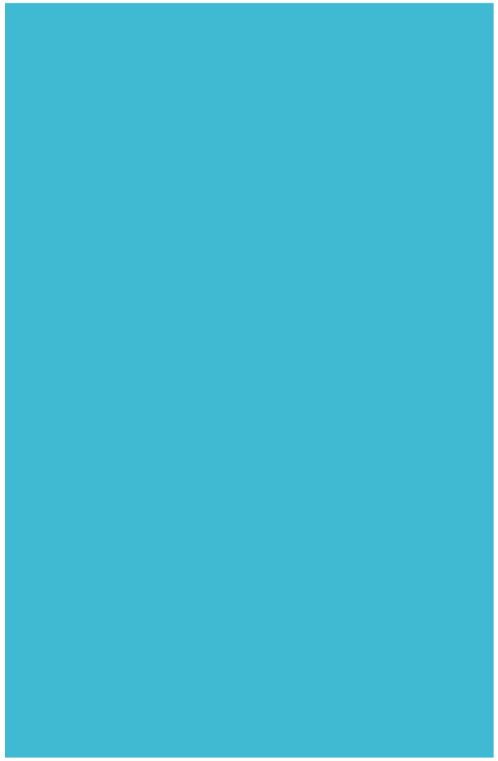
Stakeholders Engaged, cont'd

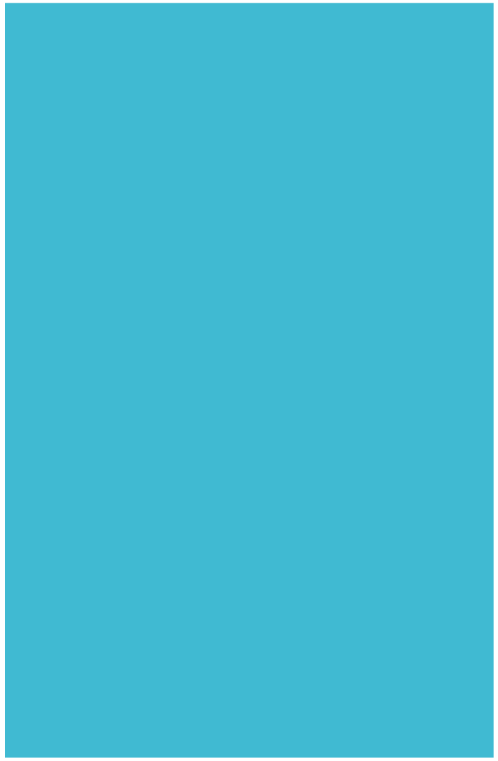
Issue	Actions to be Taken
The project adding to the existing drainage challenges including: - Inadequate capacity of the mouth of Diego Martin river to accommodate the additional flow (not being dredged) resulting from the overpass. - Flooding issues at the West Park site in the event of heavy rainfall events. - Drainage problem is compounded by raw sewage observed in manholes in Victoria Gardens. - Adequacy of the existing drainage pond. - Location of new drainage infrastructure on the West Park site. - Narrow and clogged drains in Four Roads community.	1. A site visit was held with Highways Division, Drainage Division and Victoria Gardens residents on Mon 12th August, 2019. 2. Trintoplan presented the conceptual drainage design.

Issues Raised in Stakeholder Engagement Process Drainage

Issue	Actions to be Taken
Alternative solutions to vehicular overpass - Re-opening of bow tie (4) including the suggestion to re-open the bow tie and use concrete blocks to prevent persons from going left unto the Western Main Road until after the highway has a split after the Western Main Road. - coastal causeway, - a coastal railway, - having a water taxi from Port-of Spain with stops at West Mall, Pt. Cumana, Carenage, and Chaguaramas. - Building a ramp at the intersection of the western main road and Columbus boulevard to allow for seamless traffic - Removal of traffic light at Columbus boulevard	Trintoplan presented the safety concerns of the bowtie on Western Main Road.

Issues Raised in Stakeholder Engagement Process Alternative Solutions to Traffic in the Study Area





Issue	Actions to be Taken
Disagreement of use of West Park green space for built development	Two meetings were held with the MORDLG on 19th July 2019 and 12th September 2019. Discussions included the following: • MORDLG indicated that the proposed building (DMRC Building) was always intended to be constructed on the north-eastern quadrant of Cocorite Farms (as currently designed). • The West Park Savannah proposed completion date: 30th September 2019. Only small building was constructed to house the security, washrooms and parking. The remaining area will be green space – jogging and recreational activities. • Public meeting- Invitations were sent to the MORDLG and DMRC to attend the public meeting scheduled for 26th September 2019.

Issues Raised in Stakeholder Engagement Process

Drainage

Issue	Actions to be Taken
Concerns about adverse health impacts during construction of the overpass (used the extension of the Diego Martin Highway (in the vicinity of Powder Magazine as an example)	Kairi's presentation includes the analysis of impacts and mitigation measures during 2 year construction period.

Issues Raised in Stakeholder Engagement Process
Air and Noise Pollution During and Post Construction

Issue	Actions to be Taken
Concerns about how stakeholder's comments are used in modifying the conceptual design (the need to go beyond just stating by stakeholders what is said in the stakeholder consultation report to showing how and why each question or comment will be or will not be on board. This will be the revised project design and project planning)	Trintoplan's presentation addressed how stakeholders' concerns were considered in the conceptual design. Kairi's presentation includes an explanation of the Grievance Redress Process.

Issues Raised in Stakeholder Engagement Process
SIA Process

Issue	Actions to be Taken
The need to address environmental impacts/risks including the call for conducting a full EIA	Kairi's presentation includes: • Analysis of impacts • Mitigation measures

Issues Raised in Stakeholder Engagement Process SIA Process

Impact Assessment

- Will provide a **clear understanding of the likely benefits/positive and/or negative impacts of the proposal**, and to **assess the effectiveness of any proposed mitigation measures**
- Will also **highlight changes that may occur before the project commences** in light of previous, ongoing or future activities that could reasonably be determined to have a combined effect.

Extent	Definition
Onsite	Within the immediate vicinity of the proposed overpass
Localised	Within 1km of the proposed overpass which are expected to affect the terrestrial, riverine and the nearshore environments.
Regional	Within the municipality of Diego Martin
National	Outside the defined regional area.

IMPACT EXTENT

Duration	Definition
Short-Term	Limited to the site preparation/ construction phase of the proposed overpass, or
	Occurring intermittently during the maintenance phase of the proposed overpass but not for more than 3 years.
Medium-Term	Extending from the construction phase into the maintenance phase, but not for more than 2 years
	Occurring intermittently during the maintenance of the proposed overpass for a period of three years or more.
Long-Term	Extending from the construction phase into the maintenance phase by more than 2 years, or
	Occurring continually during the maintenance of the overpass

Impact Duration

Intensity	Definition
Very Small	Effects on a few persons but no significant effects on the functioning or sustainability of social groups, specific ecosystems, services or resources.
Minor	Marked effects on several individuals, and limited effects on the functioning or sustainability of social groups, specific ecosystems, services, or resources. The effect is temporary.
Medium	Significant effects on the functioning or sustainability of social groups, specific ecosystems, services, or resources.
Major	Serious impairment on the functioning or sustainability of social groups, specific ecosystems, services, or resources. The changes result in significant disturbance that persists or is non-recoverable.

Impact Intensity

Detail	Impact			Direct/ Indirect	Rating
	Intensity	Duration	Extent		
During Construction					
Employment of labour from the municipality	Minor	Medium Term	Localised	Direct	**Moderate**
Increased Congestion (Columbus Boulevard Intersection)	Minor	Short Term	Localised	Indirect	**Low**

Impacts On The Socio-economic Environment During Construction

Detail	Impact			Direct/ Indirect	Rating
	Intensity	Duration	Extent		
Post-Construction					
Closure of bowtie on Western Main Road (Disruption to direct resident access and taxi Services)	Major	Long Term	Regional	Direct	**Moderate**
Possible Increase in Crime to areas with enhanced access	Minor	Long Term	Localised	Direct	**Moderate**

Impacts On The Socio-economic Environment Post-Construction

Detail	Impact			Direct/ Indirect	Rating
	Intensity	Duration	Extent		
During Construction					
Air Pollution	Minor	Medium Term	Localised	Direct	Moderate
Noise Pollution	Minor	Medium Term	Localised	Direct	Moderate

Impacts On Community Health During Construction

Detail	Impact			Direct/ Indirect	Rating
	Intensity	Duration	Extent		
Post-Construction					
Increased Runoff from Overpass and ancillary works (Drainage)	Major	Long Term	Localised	Direct	**High**
Air Pollution (post construction)	Minor	Long Term	Localised	Direct	**Moderate**
Noise Pollution (post construction)	Minor	Long Term	Localised	Direct	**Moderate**
Reduction in Green Space	Medium	Long Term	Localised	Direct	**High**

Impacts On Community Health Post Construction

Mitigation Strategy and Management Plan

Mitigation Strategy and Management Plan

- Aim to **propose realistic, feasible measures by employing Best Available Technologies Not Entailing Excessive Cost (BATNEEC) and Best Practicable Environmental Options (BPEO) to avoid, mitigate or remedy such impacts to acceptable levels**
- Mitigation measures to be addressed in the form of a **Management Plan**

Management Plan

- The **Management Plan** will:
  - identify potential negative impacts of each phase of the project; and
  - describe the specific measures to be taken to avoid, manage or compensate for identified potential negative impacts.
- Mitigation measures shall **specifically describe how existing adverse impacts, if any, would be handled to prevent a cumulative effect with respect to the intended project.**

Impact	Rating (Pre-Mitigation)	Proposed Mitigation Measures	Rating (Post-Mitigation)
Employment of labour from the municipality	**Moderate**	• Construction contracts include the requirement for the recruitment of local unskilled labour	**Low**
Increased Congestion in other areas (Columbus Boulevard Intersection)	**Low**	• Traffic Management Plan for Phase of Project Taking Place at Columbus Boulevard	**Mitigated**

Impact	Rating (Pre-Mitigation)	Proposed Mitigation Measures	Rating (Post-Mitigation)
Post-Construction			
Closure of bowtie on Western Main Road	**Moderate**	• Public Education on new route to get from Port-of-Spain to Cocorite/ Community Hospital • Comprehensive Signage along the Western Main Road and the Diego Martin Highway inform motorists of new routes	**Low**
Increased Congestion in other areas	**Moderate**	• Monitor population and traffic growth as an 'early-warning' measure of possible highway capacity issues and need for corrective measures	**Low**
Perceived increase Crime	**Moderate**	• Provide adequate street lighting for the proposed overpass • Hard barriers to prevent vehicles from going over the barriers • Recommend increased police patrols in the area • *CCTV (with infrared) along the proposed overpass and monitoring by private security agency*	**Low**

Impact	Rating (Pre-Mitigation)	Proposed Mitigation Measures	Rating (Post-Mitigation)
Air Pollution (During Construct-ion)	**Moderate**	• Clear only the area needed for construction, leaving vegetation in other areas intact as far as practical, thereby reducing the area from which dust can be formed. • Pave or vegetate cleared areas as early as practical. • Keep stockpiles to a minimum and use as soon as practical, thereby reducing a source of dust. • Cover smaller stockpiles, or store fine aggregates in bins or silos. This prevents exposure of material to the wind.	**Low**

Impact	Rating (Pre-Mitigation)	Proposed Mitigation Measures	Rating (Post-Mitigation)
Air Pollution (During Construct-ion)	Moderate	• Wash truck tyres before exiting the construction site onto existing paved roads, eliminating the chance for trapped earth to become suspended in the air as dust. • During earthworks implement dust control measures at source, including frequently wetting bare surfaces and access ways, thereby limiting opportunities for the formation of atmospheric dust. • Cover all transport vehicles (with tarpaulins etc.) moving materials and fill to and from the site to prevent material flying up from the load into the air as dust.	Low

Impact	Rating (Pre-Mitigation)	Proposed Mitigation Measures	Rating (Post-Mitigation)
Noise Pollution (During Construct-ion)	**Moderate**	• Use of augured piles which are less noise intense. • Regularly inspect and maintain heavy vehicles and equipment (including mufflers) to ensure noise emission control systems are properly functioning; • To the extent possible, schedule noise intense works within normal working hours (8:00 am to 4:00 pm). Where noise intense works are to be carried out in close proximity to schools and hospitals, notify Principals and Managers/CEOs of these works. • Avoid night-time work to the extent that is practical. Inform the residents along haul routes and at the respective project sites of noisy activities in the area.	**Low**

Impact	Rating (Pre-Mitigation)	Proposed Mitigation Measures	Rating (Post-Mitigation)
Increased Runoff from Overpass and ancillary works (Drainage)	**High**	• Design drainage systems to accommodate the increased runoff. • Inspect all drains and culverts on a regular basis and clear any obstructions as soon as practical. • Drainage works including the construction of new culverts, • Replacements of existing culverts and cleaning of drains are included in the scope of the overpass project. • Continuous dredging of the river	**Low**
Air and Noise Pollution (post construct-ion	Moderate	• Provision and maintenance of shrubbery and trees to muffle noise and absorb some particulates in atmosphere • Setbacks would be maintained to new habitable buildings	**Low**

Monitoring and Intervention Strategy

Impact	Pre-mitigation	Post-mitigation	Monitoring (key performance indicators)
Concurrent Construction of the DMRC Complex	Moderate	Low	Number of complaints resolved relating to cumulative impacts of projects in the total number of these specific complaints received
Employment of labour from the municipality	Moderate	Low	List of persons employed from neighbouring communities and the municipality of Diego Martin
Disruption of Taxi Services	Moderate	Low	Recorded feedback from taxi drivers and maxi-taxi drivers associations
Increased congestion in other areas (Columbus Boulevard Intersection/Four Roads Intersection)	High	Moderate	

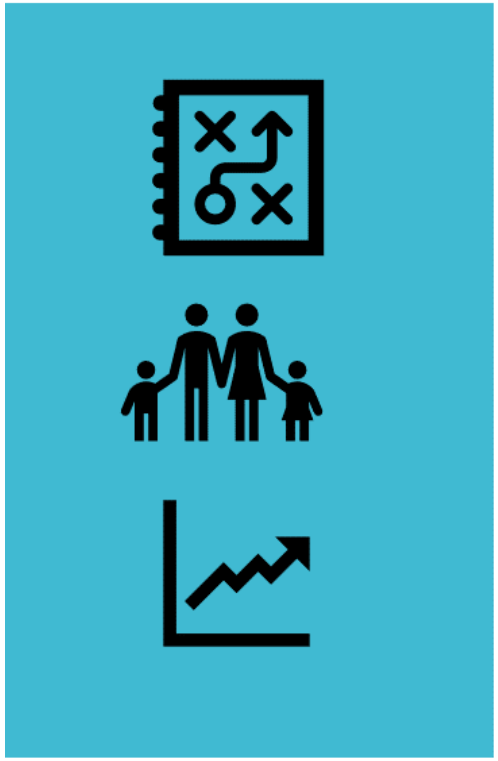
Monitoring plan

Impact	Pre-mitigation	Post-mitigation	Monitoring (key performance indicators)
Closure of bowtie on Western Main Road	Moderate	Low	Vehicular fatality and accidents
Perceived increase crime	Moderate	Low	Recorded stakeholder meetings with neighbourhood watch groups to monitoring perception of project-related crime
Air Pollution (During Construction)	Moderate	Low	Sensitive receptors to be placed around the dwellings and construction in order to monitor the potential air pollution.

Monitoring

Impact	Pre-mitigation	Post-mitigation	Monitoring (key performance indicators)
Noise Pollution (During Construction)	Moderate	Low	Sensitive receptors to be placed around the dwellings and construction in order to establish baseline and to monitor the potential noise pollution.
Increased Runoff from Overpass and ancillary works (Drainage)	High	Low	Incidence of onsite flooding
Air and Noise Pollution (post construction)	Moderate	Low	Onsite air quality and noise quality complaints from public received by GRM

Monitoring



Grievance Redress Plan

GRP Overview

- Critical for Stakeholder Engagement Process
- Requirement of EMA's TOR
- Mitigation of adverse environmental and social risk
- Fosters stakeholder engagement & accountability

GRP Overview cont'd

- Provides consultative process for raising of concerns
- Real or perceived complaints
- Focus on grievances related to this project
- GRP starts when construction work begins
- GRP does not provide access to judicial or administrative remedies (mediation or arbitration)

Grievance Redress Process

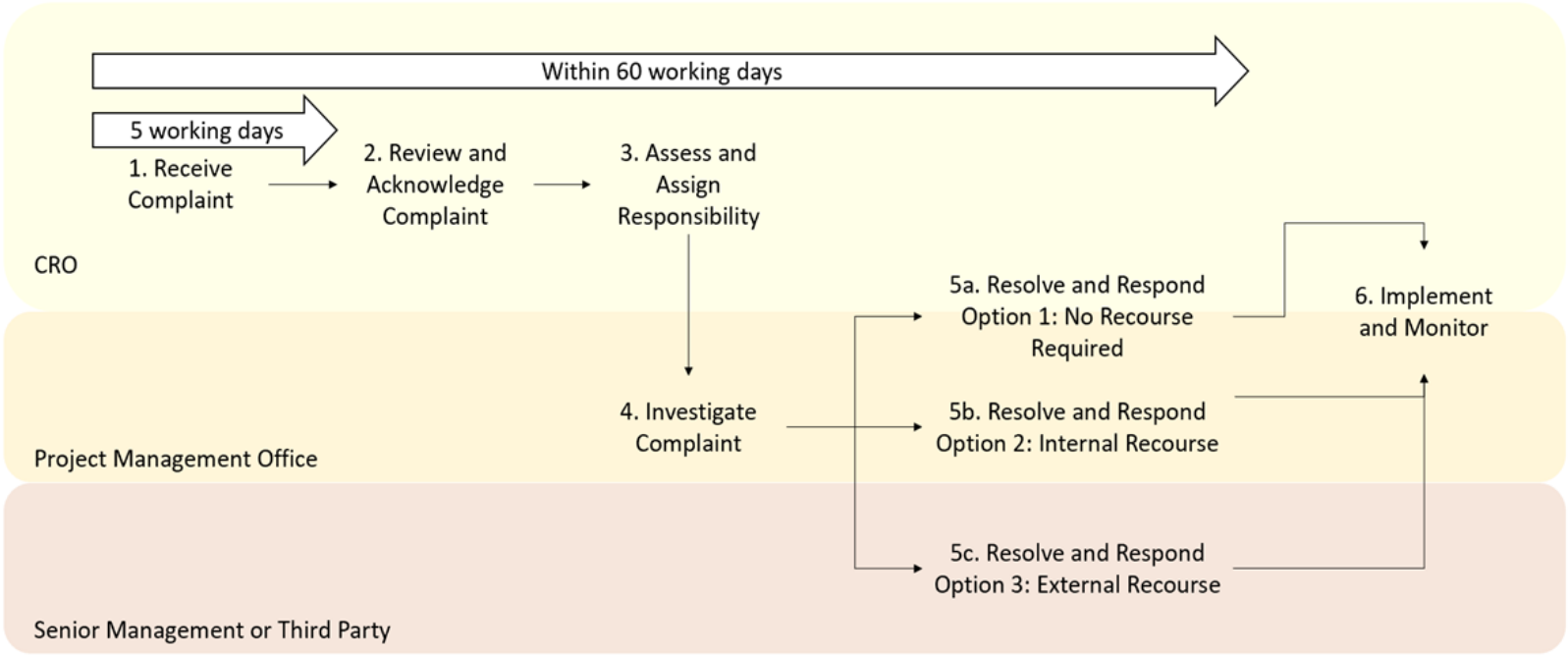
- Main objective to provide affected stakeholders with access to a **transparent, fair, and equitable process that can act with some degree of independence from the project**
- Will be operational **throughout the project life cycle**
- Features:
  - Clear and public process for handling grievances
  - An understandable, accessible and culturally appropriate grievance process
  - Appropriately scaled process(s) to address project and stakeholder needs
  - Good record-keeping protocols to facilitate effective grievance management

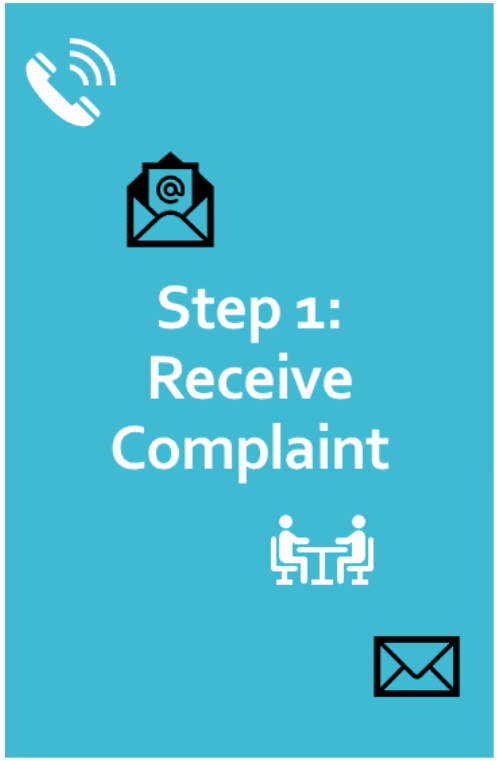
6 Steps of the Grievance Redress Process

1. Receive complaint;
2. Review and officially acknowledge complaint;
3. Assess and assign responsibility;
4. Investigate complaint;
5. Resolve and Officially Respond;
6. Implement, monitor and closeout.

GRM will resolve all complaints between forty five (45) to within sixty (60) working days, depending on the complexity of the complaint.

Grievance Redress Process - Steps for Filing a Complaint





Available Project GRP Channels for Receiving Stakeholder Complaints:

- Email
- Meeting with the Project CRO
- Letter Addressed to Project CRO

Grievance Redress Form must contain:

- The complainant (name and contact information);
- The nature of the grievance (when and where the project activity or incident(s) occurred) and its impact; and
- Suggestions for resolving the grievance.

Step 2: Review and Acknowledge Complaint



- The complaint will be entered into an electronic database which will be updated frequently
- The complaint will be categorised on the basis of the type of complaint:
  - Complaints that fall within the scope of the Project GRP
  - Complaints falling outside the scope of the Project GRP
- All complaints will be officially acknowledged **within 5 working days.**

Step 3: Assess and Assign Responsibility



- All project related complaints will be assessed and priority-rated.
- CRO will pass the complaint to the relevant department
- Rapid Assessment conducted
- Acknowledgement within 24-48 hours

Step 4: Investigate the Complaint



- Relevant complaints will be investigated and will include planned activities. Some investigations may be completed within a short time while an additional time will allocated depending on the complexity of the complaint.

Step 5: Resolve & Officially Respond



Option 1: No Recourse Required by Complainant

- Once the investigation is complete, the CRO will officially write the complainant on the solution.

Option 2: Internal Recourse

- Once the solution is rejected by the complainant, the CRO will provide an opportunity for the complainant to seek recourse with representatives from NIDCO, MOWT, and any other relevant agencies to resolve the complaint.

Option 3: External Recourse

- *Arm's length of Sponsor – EMA, Ombudsman*

Step 6: Implement, Monitor and Close-out



- Implement agreed solution, monitor and close off.

Questions & Comments

Ministry of Works & Infrastructure



NIDCO

CONSTRUCTION OF A VEHICULAR OVERPASS

IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

PANEL

Moderator/ Presenter
(Social Impact Assessment)
Dr. Ralph Henry,
Kairi Consultants Limited

Conceptual Design & Project Information)
Ms. Andrea Abel,
Trintoplan Consultants Limited

Director of Highways Ministry of Works and Transport
Mr. Chaitram Sooklal

Chief Technical Officer Ministry of Works and Transport
Mr. Navin Ramsingh

VP Engineering and Programme Management
NIDCO
Mr. Steve Garibsingh

Participatory Engagement Specialist
Dr. Fredericka Deare,
Kairi Consultants Limited

Physical Impact Specialist EHSU, MOWT
Ms. Tennile Noel

Contents of Presentation

- Project Process
- Project Context
- Overview of Previous Public Consultations 2018 and 2019
- Conceptual Design
- Concerns arising from Public Consultations
  - Why this design
  - Drainage Issues
  - Safety Issues
  - Construction Issues

Project Process

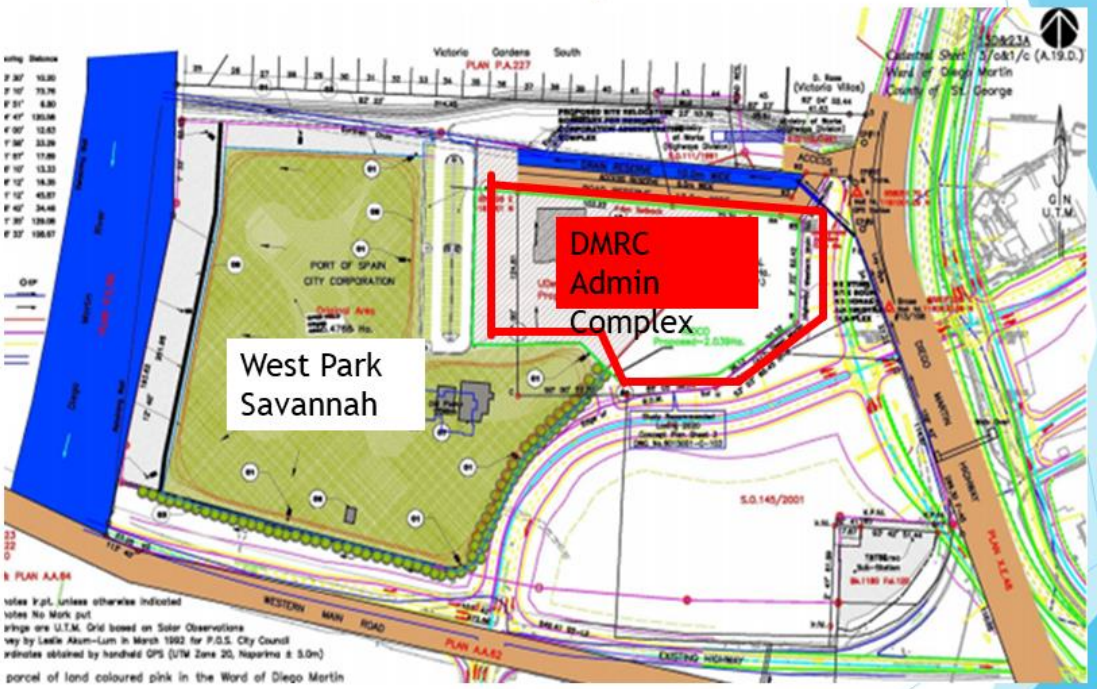
- The following are the stages in this process of this project
- Feasibility Study Inclusive of consultation with Key Stakeholders
- Conceptual Design Stage
- CEC Process - Inclusive of Public Consultations
- Revisions to Conceptual designs
- Granting of CEC with conditions
- Procurement of a Design-Build Contractor
- Contractor uses conceptual design and outcomes of the CEC process to finalize the design
- Construction

PROJECT CONTEXT- Location



LOCATION PLAN

PROJECT CONTEXT – Developments on Cocorite Farms



PROJECT CONTEXT - Overview

As far back as the 1990's due to increasing development in the Diego Martin Valley, and in keeping with its planned Highway network improvements, the Ministry of Works and Transport (MOWT) had plans to improve the intersection of the Diego Martin Highway and Western Main Road.

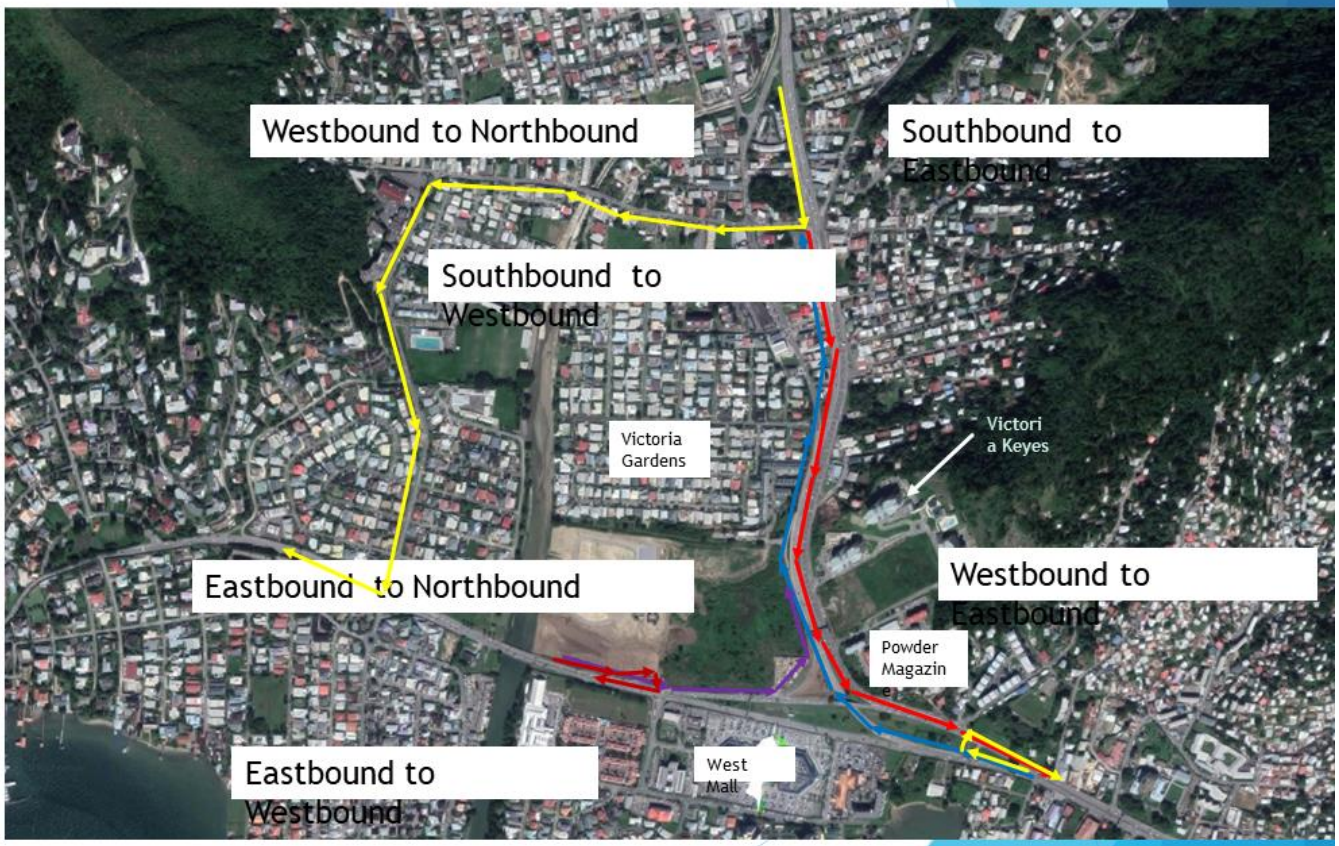
Cabinet approved the construction of the overpass via Cabinet Minute No. 2320 of September 11, 2003 and Cabinet Minute No. 1949 of July 19, 2013.

In 2015, MOWT through the National Infrastructure Development Company Ltd (NIDCO), undertook a Feasibility Study with the aim of eliminating conflicts, improving access and improving safety along the Diego Martin Highway/ Western Main Road Intersection.

In March to May 2015, public consultations were held with individual stakeholders and community groups to discuss concerns, comments or special issues . The feedback from these consultations along with the analysis of the data collected including future projections ,formed the basis for the conceptual designs.

PROJECT CONTEXT-

Existing Arrangements



PROJECT CONTEXT -Traffic Volumes

The forecasted total vehicle registrations in Trinidad and Tobago would increase to 845,000,1,080,000 and 1,285,000 by 2020, 2030 and 2040 respectively.

The future traffic demand was forecast to grow at an average rate of 1.75% per annum. This is a mid-range traffic growth estimate and the actual growth rate could be higher or lower.

Traffic volumes are estimated to increase annually by approximately 1.76% between 2015 and 2040. By 2040, the traffic volumes are projected to increase by 61% over the 2015 volumes.

The 2030 traffic volumes for the section are viewed as being too large to be realistically accommodated with traditional road improvements with the existing highway corridors. From the traffic projections in the feasibility study, the peak hourly traffic volume on Westland Avenue will be 1136 vehicles per hour. This is above the capacity of the road.

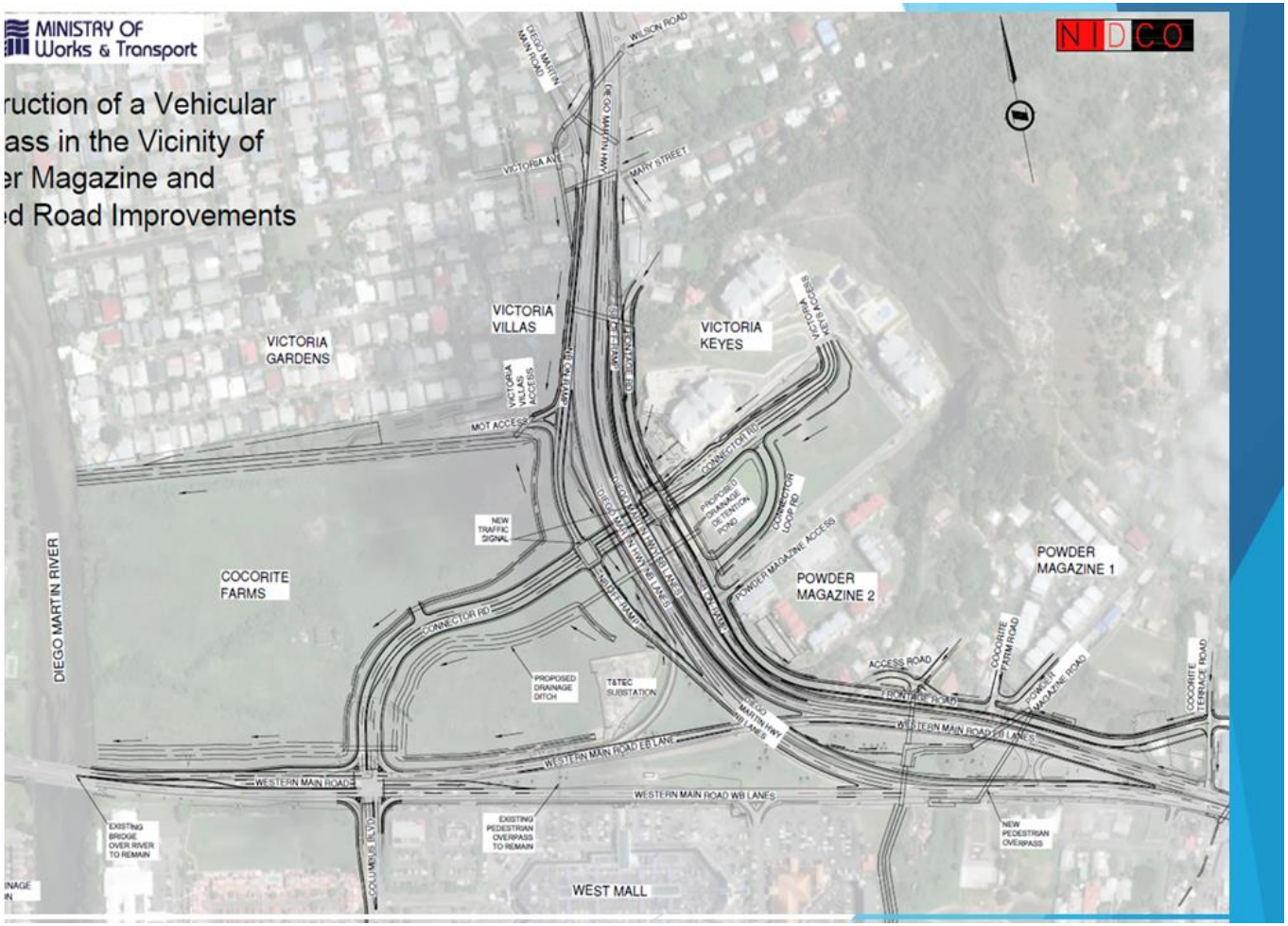
No Action means increased traffic congestion, and a higher level of pollutants to neighbouring residents due to potentially longer periods of stand-still traffic.



OVERVIEW OF CONSULTATIONS 2018

- Dates: 23rd October, 2018 and 7th November, 2018
- Outlined results of the Feasibility Study
- The Conceptual Design was presented
- The procurement process was presented

CONSULTATION 1
Original Design By WSP



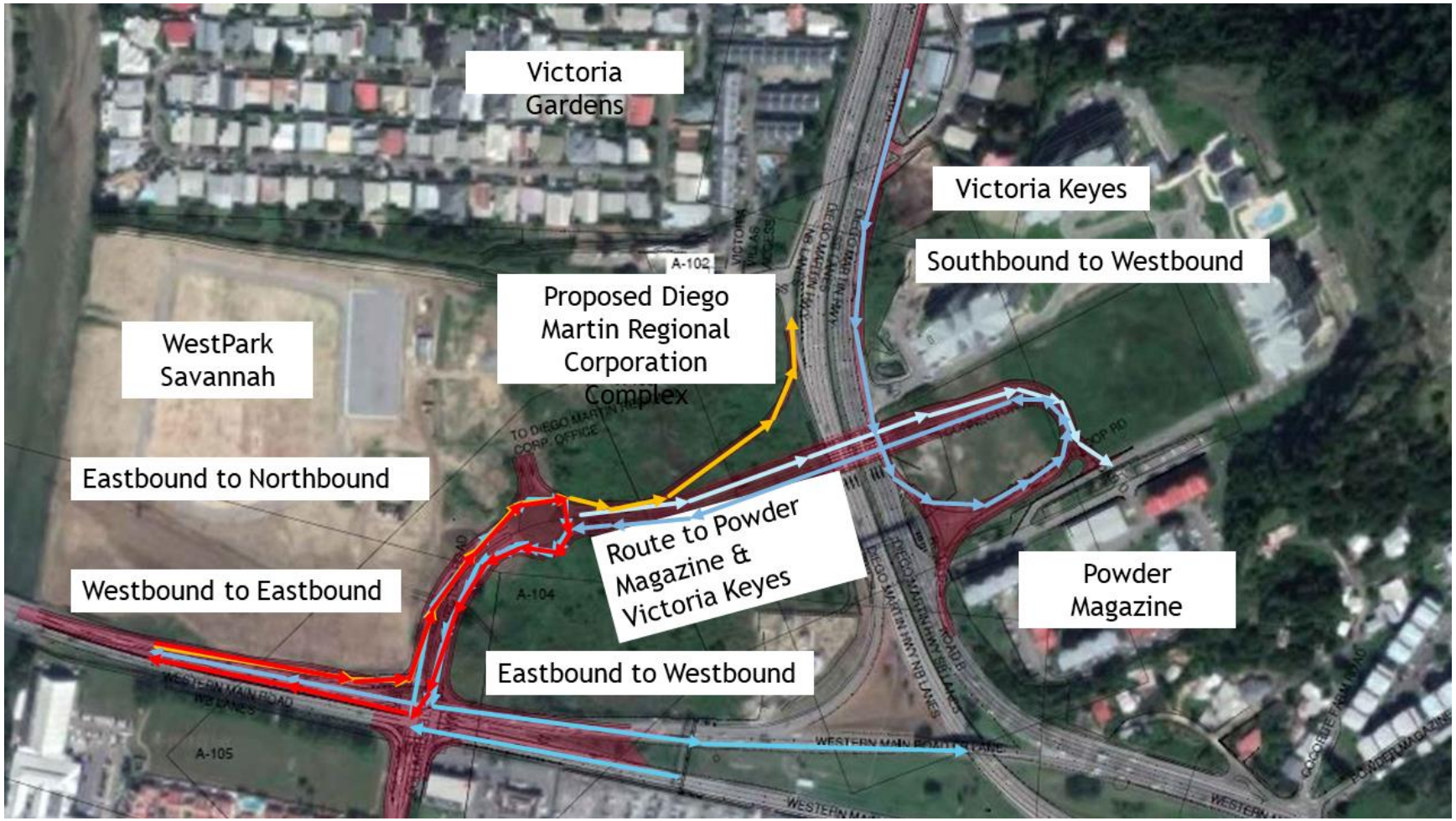
OVERVIEW OF PUBLIC CONSULTATION 2019

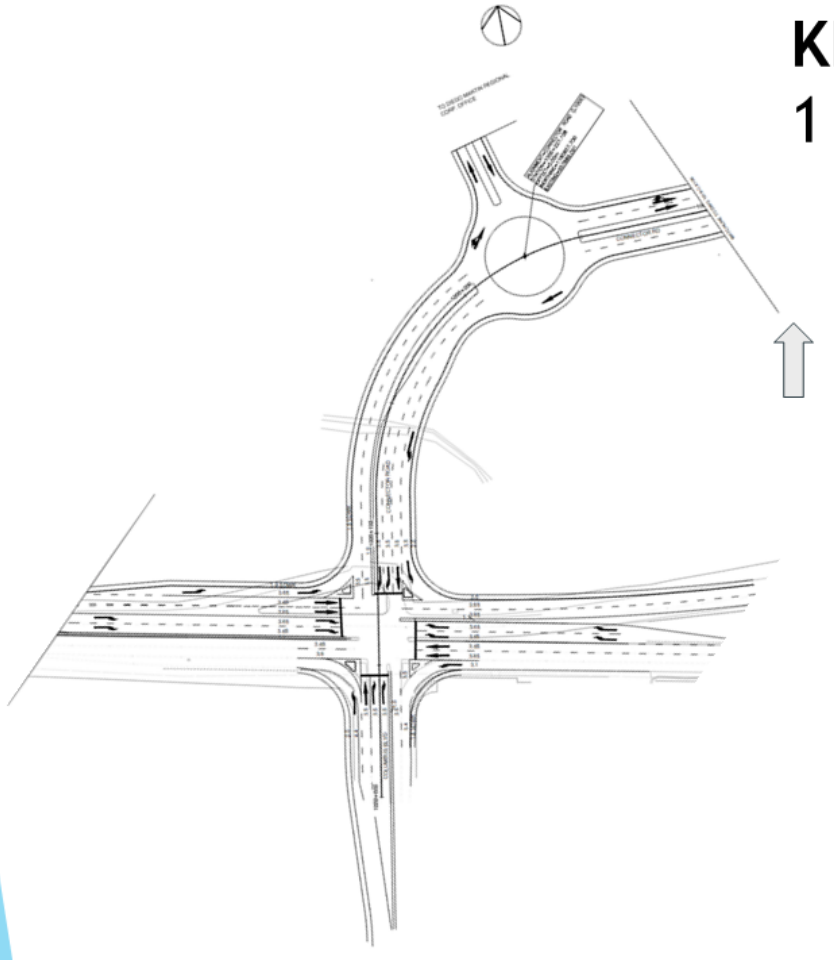
- Date: July 4, 2019
- Revised Conceptual Design was presented
- The status of procurement was given

Considerations for Revised Design

Elements to be adjusted/removed from the scope of works	• Vehicular overpass shifted southward to not affect the entrance for Victoria Keys • Frontage Road removed eliminating the need for property acquisition
Traffic movements to be accommodated	• Westbound to Eastbound movement • Southbound to Westbound movement • Southbound to Northbound movement
Proposed developments at Cocorite Farms to be accommodated	• Diego Martin Regional Corporation Administrative Complex and branch of First Citizens • West Park Savannah
Existing entrances at Victoria Keys and Powder Magazine to be accommodated/re-organized	• These have exits directly on to the Southbound Diego Martin Highway. • Currently there is no accommodation for persons from these developments heading to the North or to the West • Existing pedestrian walkover to be retained


Victoria Gardens
Frontage Road
Victoria Keyes
Proposed Diego Martin Regional Corporation Complex
WestPark Savannah
Vehicular Overpass
Eastern Connector Road
Western Connector Road
Powder Magazine
A-102
A-104
A-105
WESTERN MAIN ROAD WB LANES
WESTERN MAIN ROAD EB LANES

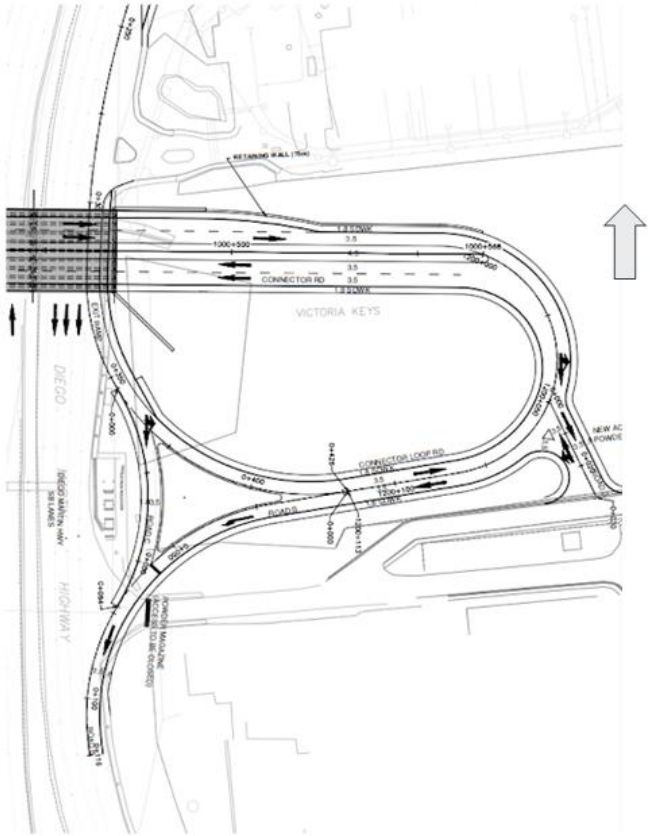

Victoria Gardens
Victoria Keyes
Southbound to Westbound
Proposed Diego Martin Regional Corporation Complex
WestPark Savannah
Eastbound to Northbound
Route to Powder Magazine & Victoria Keyes
Powder Magazine
Westbound to Eastbound
Eastbound to Westbound
A-102
A-104
A-105



KEY COMPONENTS

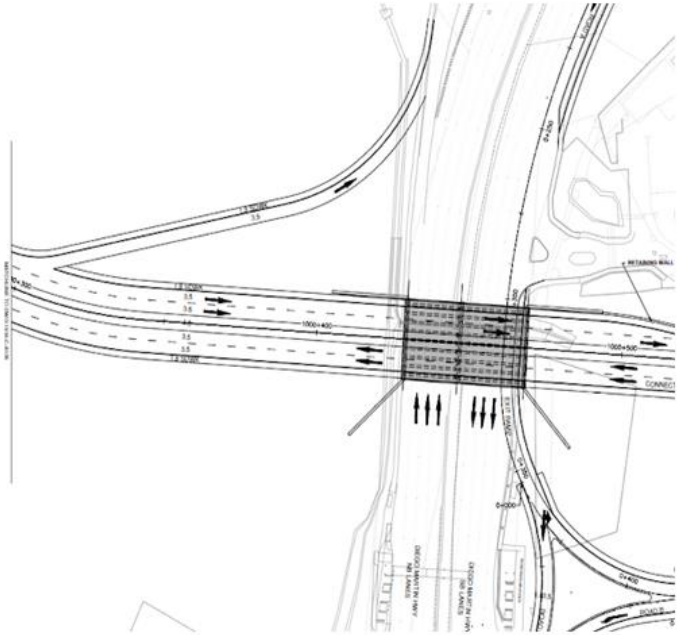
1

Fully signalized intersection and Western Connector road



KEY COMPONENTS 2

EASTERN CONNECTOR RD & NEW ACCESS & EGRESS

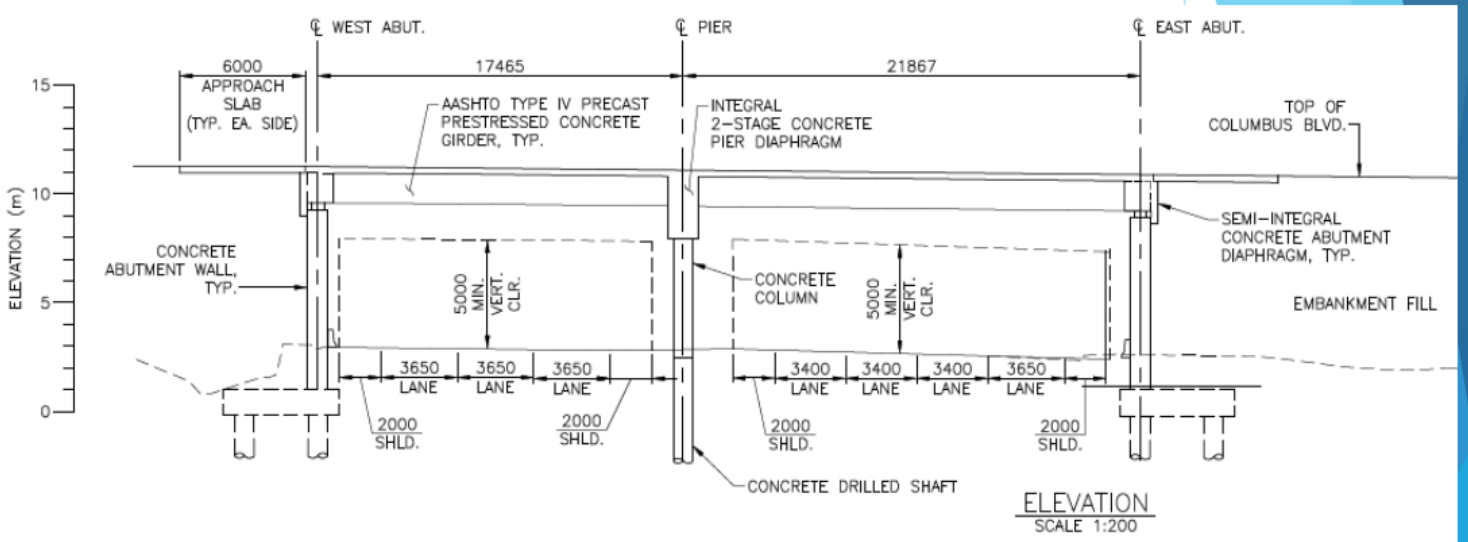


KEY COMPONENTS 3

OVERPASS AND NORTHBOUND RAMP

4

KEY COMPONENTS 4



OVERPASS

Section through Overpass Structure over the Diego Martin Highway

Issues arising from Public Consultations

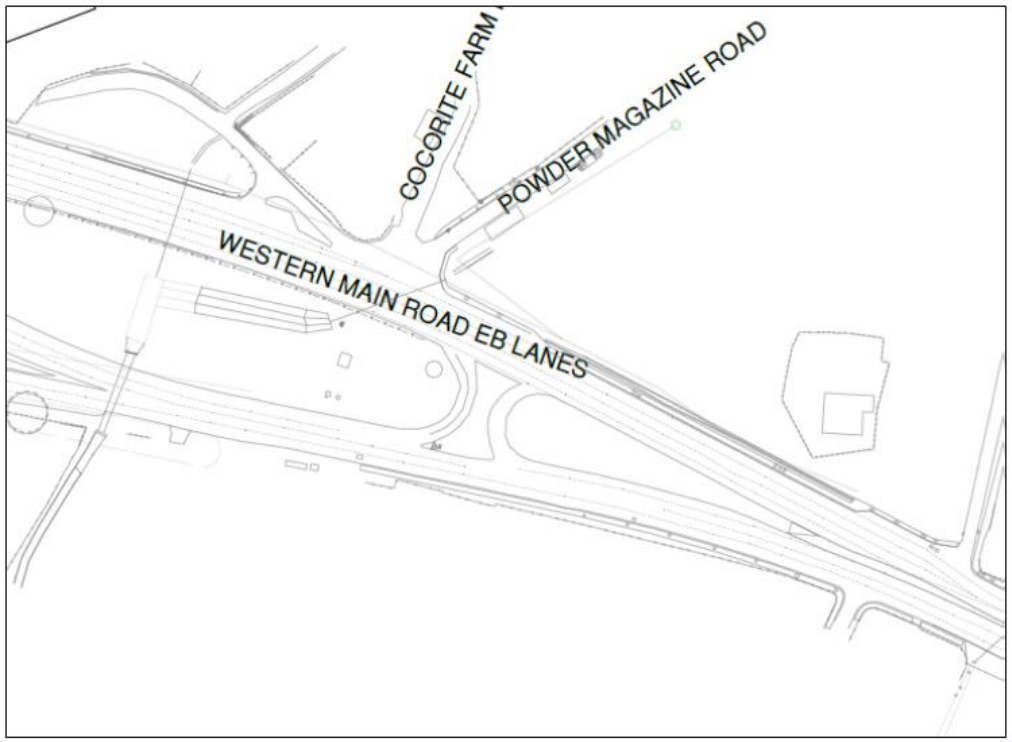
- Concerns have been raised about the following
  - Was consideration given to maintaining existing arrangements
  - There are concerns about drainage issues in the project vicinity
  - Impacts of construction on the surrounding residents (persons and buildings)
  - Safety concerns with regard to the design

Issues arising from the Consultations

- Maintaining the existing status quo

- Alternative of either doing nothing or re-opening of the bow tie.
  - Traffic volumes in 2015 showed that there was 660 vehicles per hour on Westland Avenue. Projections for traffic into the project period indicate the following
    - 2020 Peak flow 806 vehicles per hour
    - 2030 Peak Flow 1036 vehicles per hour
    - 2040 Peak Flow 1282 per hour
  - Considering the road width, the presence of entrances, other intersections, the capacity would be this is beyond the capacity of the road
- Re-opening of the bow-ties
  - This is a safety concern

Bowtie



Accident Statistics WMR Cocorite

Statistics are only kept for fatal accidents

. 2012-2017

. 8 fatalities

1 driver,

3 passengers

4 pedestrians

Fatal Accidents Cocorite

CRIME AND PROBLEM ANALYSIS BRANCH

Mateo Building
#112 Henry Street, Port of Spain
REPUBLIC OF TRINIDAD AND TOBAGO

19th September, 2019
Data on Road Fatalities in the Western Division in the vicinity of the Cocorite Bowtie
(Source Crime and Problem Analysis Branch TTPS)

DAY	MONTH	YEAR	DIVISION	STATION	LOCATIONS
Sat	Feb	2012	Western	St. James	East along Western Main Road, Cocorite
Fri	Jun	2012	Western	St. James	Western Main Road, Cocorite
Sat	Nov	2012	Western	Carenage	Western Main Road, Cocorite
Sun	Mar	2014	Western	Four Roads	Western Main Rd Cocorite
Sun	Mar	2014	Western	Four Roads	Western Main Rd Cocorite
Sat	Aug	2015	Western	St. James	Western Main Road, Cocorite
Mon	Sep	2016	Western	St. James	West along the Western Main Road, Cocorite
Thu	May	2017	Western	St. James	Sea View Drive Waterhole Cocorite

Issues arising from the Consultations

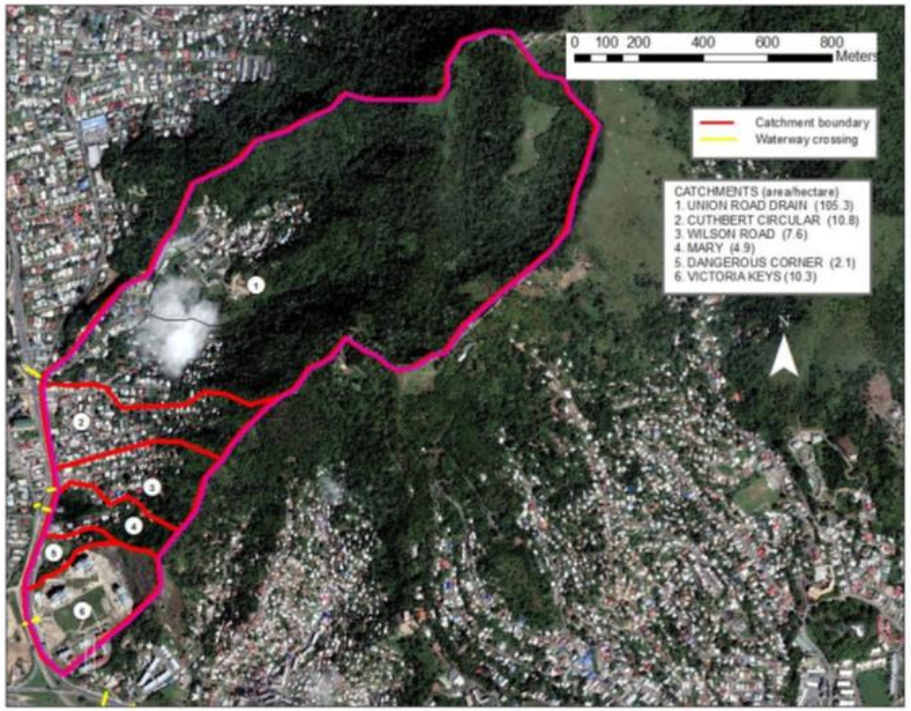
Drainage Issues

- Areas of flooding identified in Victoria Gardens
- Areas of flooding identified in the interchange
- Dredging of the Diego Martin River



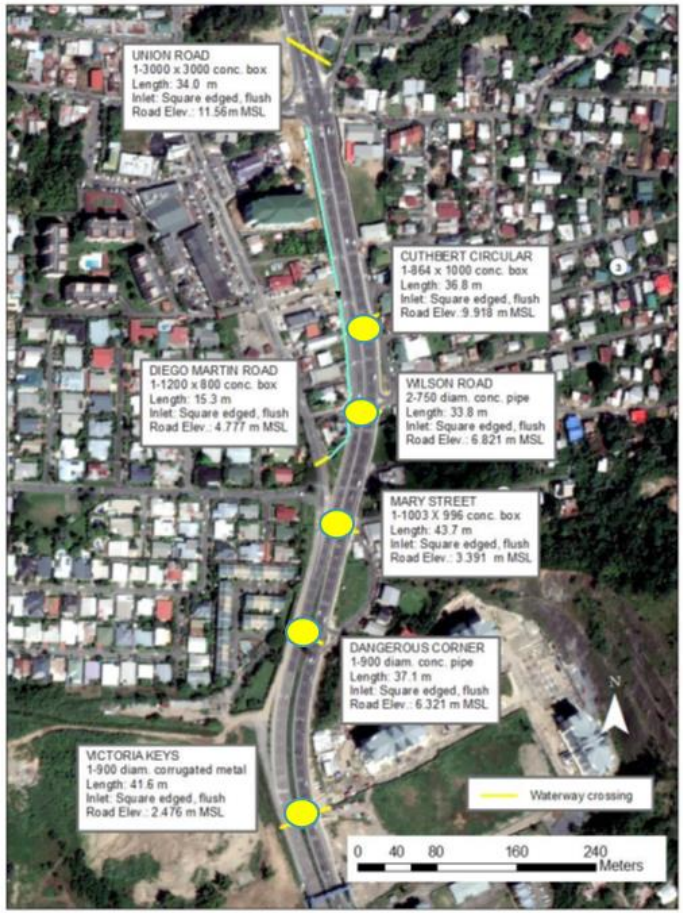
Location of Catchments

- Union Road 105 Ha (outside area)
- **Cuthbert Circular 10.8 Hectares**
- **Wilson Road 7.6 Hectares**
- **Mary Street 4.9 Hectares**
- **Dangerous Corner 2.1 Hectares**
- **Victoria Keyes 10.3 Hectares**



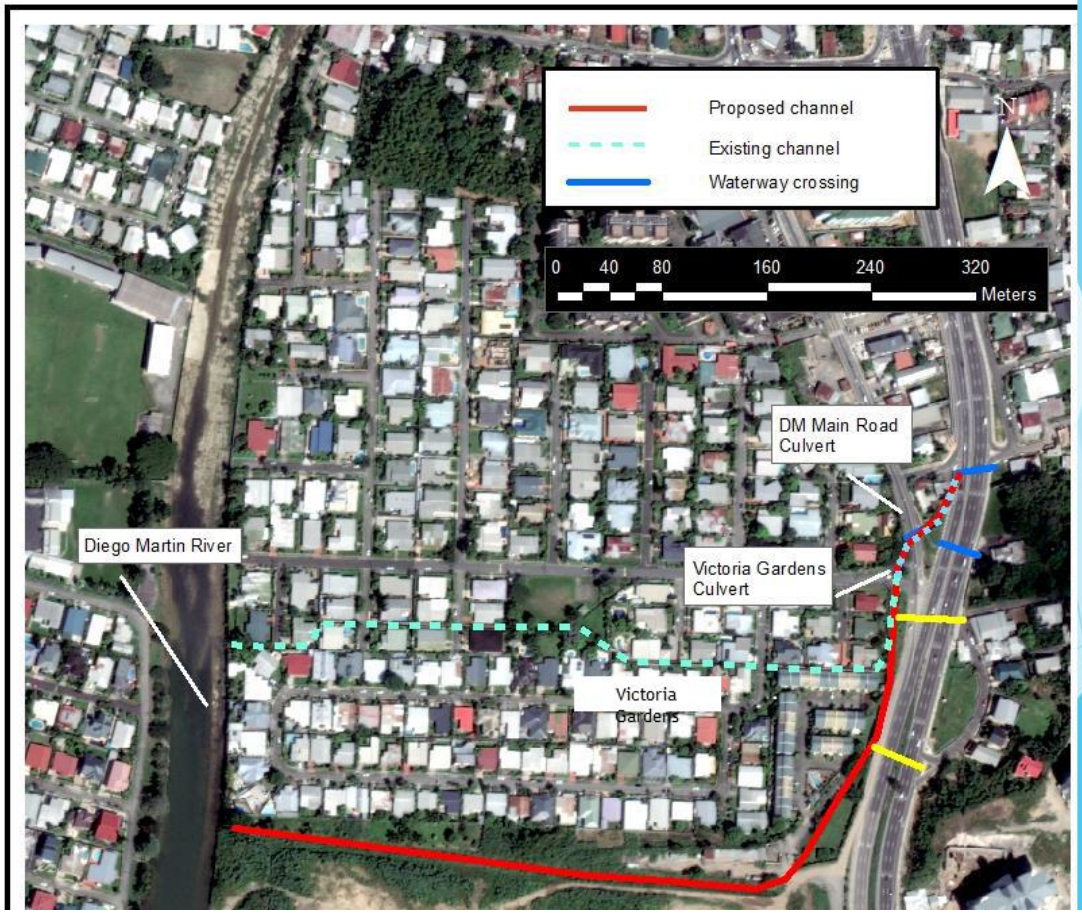
Culverts Outfalling from Catchments

- Cuthbert Circular
- Wilson Road / Diego Martin Main Road
- Mary Street
- Dangerous Corner
- Victoria Keyes



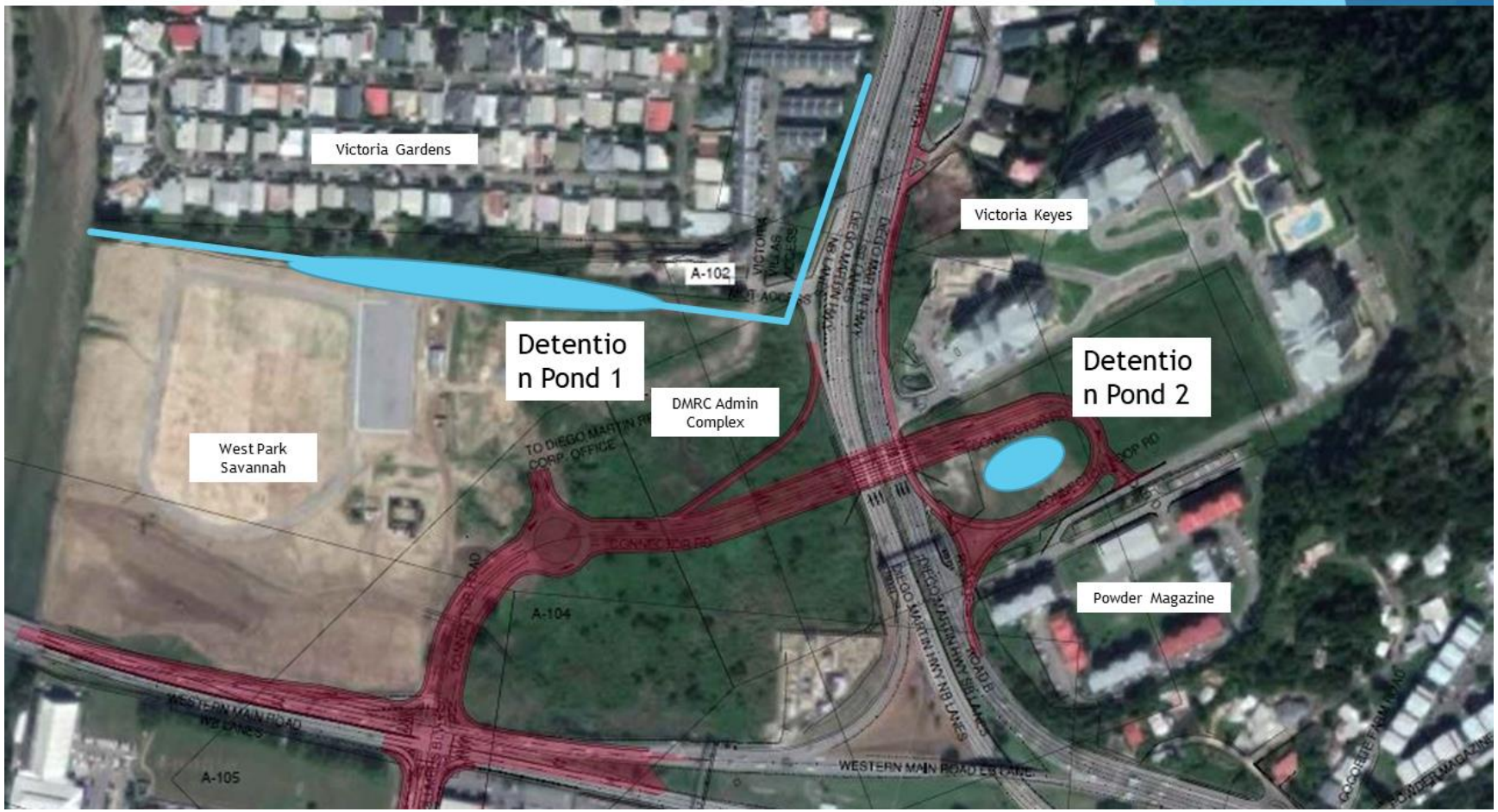
Solution

- The existin
  cannot be v
  it is propos
  new channe
  to the earth
  Cocorite Fa



Solution for flooding for Highway

- A storm water management plan has been developed.
- Design Parameters
  - 1:50 year design flood
  - Cater for Climate Change
  - Caters for future development, i.e. further removal of forest cover
- Outcome of Design
  - Two Detention Ponds. Detention Pond 1 with capacity 14000 cubic metres.
  - Detention Pond 2 with capacity of 3500 cubic metres


Victoria Gardens
Victoria Keyes
A-102
Detentio
n Pond 1
DMRC Admin
Complex
Detentio
n Pond 2
West Park
Savannah
TO DIEGO MARTIN REGIONAL CORP. OFFICE
CONNECTOR RD
A-104
Powder Magazine
WESTERN MAIN ROAD NB LANES
A-105
WESTERN MAIN ROAD SB LANE

Solution to Flooding on Western Main Road

- Drains in the south of Cocorite Farms.
- Drainage Incorporated in designs for West Park Savannah
- Drainage incorporated in designs for Diego Martin Regional Corporation Administrative Complex

Maintenance of Waterways

- The Drainage Division of the Ministry of Works has a programme of desilting. Works in the Diego Martin River in 2019 are as follows:

  1. Western Main Road upstream to bridge on Morne Coco Road

  2. Upstream Bridge on Crystal Stream to Bridge on Sierra Leone Road

  3. Upstream Sierra Leone Rd to Bridge on Wendy Fitzwilliam

  4. Downstream Bridge on Diego Martin Main Road to Mason St

Issues arising from the Consultations Construction Issues

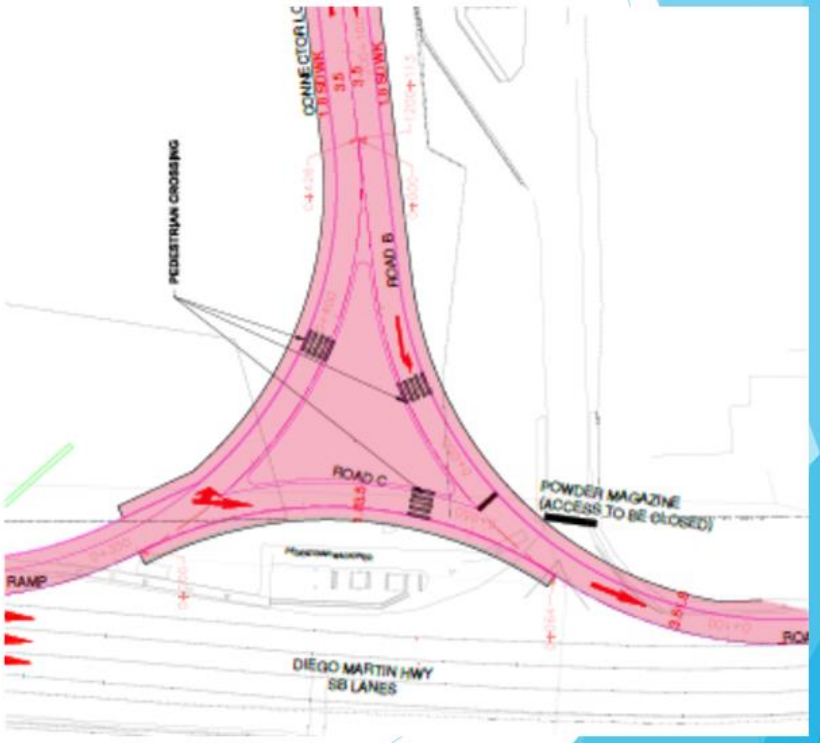
- Vibrations due to Piling
- Structural effects on existing structures

Issues arising from the Consultations Safety Issues

- Three issues raised
  - Pedestrian conflicts with traffic at the walk-over for Powder Magazine
  - Vehicle conflicts at the northbound ramp at Victoria Villas
  - With the closure of the bow-tie, this removes option for ambulances and thus increasing travel time for ambulances (Westshore Medical and Community Hospital)

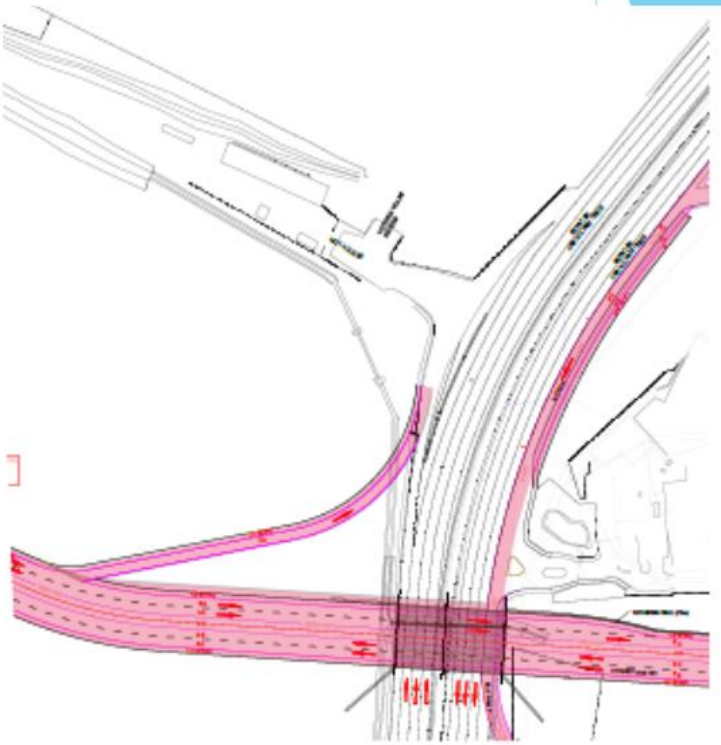
Pedestrians using walkover to Powder Magazine

- Pedestrian crossings are proposed at three locations
- Each crossing only has to deal with one lane of traffic.



Vehicle conflict from Northbound ramp

- Vehicles on DMH will have the right of way.
- There will be a stop line and yield sign for vehicles heading north on the ramp.
- Beyond that point, there is 100m to the DMH northbound lane.



Travel Time Concerns

- The increased distance is approximately 1200m. Travel time is dependent on speed.
- Using 40km/hour average speed the time is 108 seconds.



THANK YOU
PRESENTATION BY KAIRI

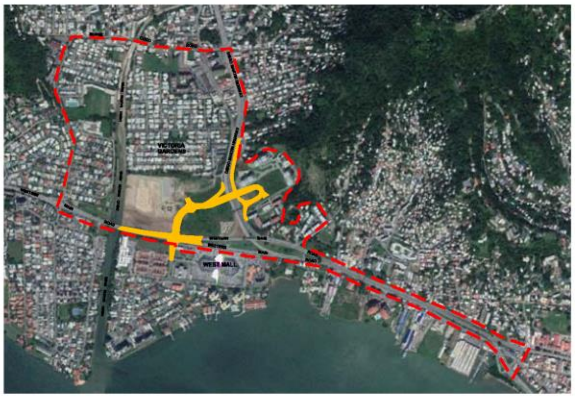


6 Appendix F – Wet Season Ambient Air And Noise Monitoring And Discussion Of Impacts For The Construction Of A Vehicular Overpass In The Vicinity Of Powder Magazine And Related Road Improvements

National Infrastructure Development Co. Ltd.

CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

(AMBIENT AIR AND NOISE MONITORING AND DISCUSSIONS OF IMPACTS)



ECO REPORT No. 27/2019

DECEMBER 18, 2019

PREPARED BY

Ecoengineering Consultants Limited

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email: ecoeng@ecoenggroup.com

ENVIRONMENTALLY APPROPRIATE DEVELOPMENT FOR THE CARIBBEAN

NATIONAL INFRASTRUCTURE DEVELOPMENT COMPANY LIMITED
(NIDCO)

CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

(AMBIENT AIR AND NOISE MONITORING AND DISCUSSION OF IMPACTS)

Eco Report No. 27/2019

December 19, 2019

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Eco Report No. 27/2019 December 19, 2019

NATIONAL INFRASTRUCTURE DEVELOPMENT COMPANY LIMITED

CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

(AMBIENT AIR AND NOISE MONITORING AND DISCUSSION OF IMPACTS)

1 INTRODUCTION

1.1 Authorisation and Layout of Report

Ecoengineering Consultants Limited (Ecoengineering) was contracted by the National Infrastructure Development Company Limited (NIDCO) to conduct Baseline Air Quality and Noise Monitoring for the construction of a vehicular overpass in the vicinity of Powder Magazine. This Report was prepared in general accordance with Ecoengineering's proposal dated October 9, 2019 which was accepted on October 23, 2019 and in accordance with the Noise Pollution Control Rules (NPCR) and Air Pollution Rules (APR) reporting requirements.

This report consists of 5 chapters and 2 appendices. The remainder of this introductory chapter presents the background to this assignment. It also includes a summary of the staff who worked on this assignment. The following chapters are thus summarised:

- Chapter 2 – Regulatory Framework;
- Chapter 3 – Method Statement;
- Chapter 4 – Results and Discussion; and
- Chapter 5 – Potential Impacts.

1.2 Background

The National Infrastructure Development Company (NIDCO) Limited intends to design and build a vehicular overpass in the vicinity of Powder Magazine and related improvements including link roads, ramps and drainage. To this end, NIDCO applied to the Environmental Management Authority (EMA) for a Certificate of Environmental Clearance (CEC) to conduct the works. Based on issues raised by stakeholders at public consultations for the project held in July and September 2019 and to satisfy some of the stakeholders, NIDCO has decided to undertake new testing of air quality and noise levels to update baseline measurements.

1.3 Objectives

The objective of this monitoring exercise is to establish baseline ambient air and noise within the project area.

1.4 Study Team

The following are the key staff who worked on this assignment:

Ecoengineering Consultants Limited (Eco):

Eco was responsible for overseeing the Air Quality and Noise Monitoring Data Collection. Eco was responsible for conducting the noise monitoring on this project. The team included:

- Ms. Debbie Reyes, Senior Environmental Scientist / Study Manager,
- Ms. Linda Sammy, Senior Environmental Scientist / Quality Control,
- Ms. Joanne Reyes, Environmental Scientist,
- Mr. Asif Khan, Lead Technician, and
- Ms. Yasmin Leon, Technician.

Kaizen Environmental Services (Trinidad) Limited (KESTL)

KESTL was responsible for conducting ambient air quality on this project. The team included:

- Mr. Yasin Khan, Team Leader, and
- Mr. Anthony Chariah.

2 REGULATORY FRAMEWORK

This chapter describes the legislative and regulatory framework under which the monitoring for the proposed Diego Martin Overpass will be undertaken.

The two pieces of applicable legislation which will govern the monitoring are:

- Noise Pollution Rules, 2001; and
- Air Pollution Rules, 2014.

2.1 Noise Pollution Control Rules, 2001

Noise emissions in Trinidad and Tobago are regulated on the basis of the Noise Pollution Control Rules, 2001, issued by the Environmental Management Authority. In the Noise Pollution Control Rules, limits are set for 30-minute equivalent continuous sound pressure levels (L_{eq}) and maximum instantaneous unweighted peak sound pressure level (L_{peak}).

Separate limits are set for daytime and night-time. "Daytime" is classified as the hours between 8:00 am and 8:00 pm and "night-time" as the hours between 8:00 pm and 8:00 am. Separate noise limits are set for different areas in the country. Specifically, individual limits are set for Industrial Areas, Environmentally Sensitive Areas and the General Area. "Industrial Areas" are defined as areas expressly approved for industry by a competent government agency, "Environmentally Sensitive Areas" are those so designated by the EMA, and the "General Area" consists of all other areas. The proposed works fall within the General Area.

The following limits are set for the General Area:

Daytime Limits - On Mondays to Sundays of every week from 8:00 am to 8:00 pm on each day:

- *the sound pressure level when measured as equivalent continuous sound pressure level shall not be more than 5 dBA above the background sound pressure level; and*
- *the sound pressure level when measured as instantaneous unweighted peak sound pressure level shall not exceed 120 dB (peak).*

Notwithstanding the above, no person shall emit or cause to be emitted any sound that causes the sound pressure level when measured as the equivalent continuous sound pressure level to exceed 80 dBA.

Night time Limits - On Mondays to Sundays of every week from 8:00 pm to 8:00 am on each day:

- *α) the sound pressure level when measured as equivalent continuous sound pressure level shall not be more than 5 dBA above the background sound pressure level; and*
- *β) the sound pressure level when measured as instantaneous unweighted peak sound pressure level shall not exceed 115 dB (peak).*

Notwithstanding the above, no person shall emit or cause to be emitted any sound that causes the sound pressure level when measured as the equivalent continuous sound pressure level to exceed 65 dBA.

It should be noted that the Rules set both absolute limits and limits based on increases over background. Unfortunately, there is no historical noise data available for the locations being considered in this study. As such, measured noise levels can only be compared with the absolute limits. In fact, the noise levels measured during this study would constitute background noise levels which can be used for comparison during future studies.

2.2 Air Pollution Rules, 2014

The Air Pollution Rules, 2014, define an air pollutant as any of the substances mentioned in the First Schedule of the Rules, at or in excess of the maximum permissible levels prescribed therein. Table 1 below lists the maximum permissible limits for applicable parameters and the durations over which each limit occurs. It must be noted that the rules contain no limits for VOCs. Additionally, there are no World Bank or World Health Organization (WHO) guidelines available to put total VOCs into context.

TABLE 1: AIR POLLUTION RULES 2014, MAXIMUM PERMISSIBLE LIMITS

PARAMETER		AVERAGING TIME	MAXIMUM PERMISSIBLE LIMIT ($\mu g/m^3$)
Particulates	TSP	24 hours	150
	PM_{10}	24 hours	75
	$PM_{2.5}$	24 hours	65
Non-Metallic Inorganic Pollutants	NO_2	1 hour	200
	CO	8 hours	10 000
	SO_2	24 hours	125
	Ozone	8 hours	120

3 METHOD STATEMENT

This section describes the method used for the air and noise monitoring conducted under the following sub-sections:

- Schedule for Air Quality and Noise Monitoring
- Monitoring Locations and Duration;
- Environmental Setting;
- Sensitive Receptors;
- Meteorological Conditions;
- Equipment; and
- Quality Control.

3.1 Schedule for Air Quality and Noise Monitoring

3.1.1 Air Quality

Air quality monitoring was conducted for three (3) events over a two (2) week period (see Table 2) at five (5) locations (see Figure 1) by Kaizen Environmental Services Limited (KESTL).

TABLE 2: AIR QUALITY MONITORING SCHEDULE

LOCATION	DESCRIPTION		
	EVENT 1	EVENT 2	EVENT 3
Loc 1	November 14 to 15, 2019	November 19 to 20, 2019	November 26 to 27, 2019
Loc 2	November 13 to 14, 2019	November 18 to 19, 2019	November 25 to 26, 2019
Loc 3			
Loc 4			
Loc 5	November 14 to 15, 2019	November 19 to 20, 2019	November 26 to 27, 2019

3.1.2 Noise Monitoring

Noise monitoring was conducted by Ecoengineering Consultants Limited at the same five (5) locations as the air quality monitoring locations (see Section 3.1.1 and Figure 1). The dates of the noise monitoring were as follows:

- November 17, 2019 (weekend); and
- November 21, 2019 (weekday).



Ecoengineering Consultants Ltd. 62 EASTERN MAIN ROAD ST. AUGUSTINE PHONE: (868) 645-4420 FAX: (868) 662-7292 e-mail : ecoeng@ecoenggroup.com	ECO REPORT NO. 27/2019 DATE: 11/12/19	CLIENT: NATIONAL INFRASTRUCTURE DEVELOPMENT COMPANY LIMITED (NIDCO) PROJECT: CONSTRUCTION OF VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS DWG. NAME: AIR AND NOISE MONITORING LOCATIONS	FIGURE NUMBER: 1

3.2 Monitoring Locations and Duration

3.2.1 Air Quality

Ambient air quality monitoring was conducted for three (3) events over a two (2) week period at five (5) locations (see Figure 1 and Photographs 1 to 5) by Kaizen Environmental Services Limited (KESTL). The parameters monitored were:

- Total Particulate Matter (TSP),
- Particulate Matter (PM_{10}),
- Particulate Matter ($PM_{2.5}$),
- Volatile Organic Compounds (VOCs),
- Sulphur Dioxide (SO_2),
- Nitrogen Dioxide (NO_2),
- Carbon Monoxide (CO), and
- Ozone (O_3).

At each location, air quality parameters were monitored over a 24-hour period. A GARMIN GPS hand-held Unit was used to acquire the exact coordinate of the sampling locations and recorded and documented (see Table 3) below.



PHOTOGRAPH 1: LOCATION 1 –
200M WEST OF SUPERPHARM



PHOTOGRAPH 2: LOCATION 2 –
WEST OF DIEGO MARTIN RIVER



PHOTOGRAPH 3: LOCATION 3 –
SOUTH OF VICTORIA GARDENS ENTRANCE



PHOTOGRAPH 4: LOCATION 4 –
NORTH OF HDC DEVELOPMENT



PHOTOGRAPH 5: LOCATION 5 –
SOUTH OF VICTORIA KEYES

3.2.2 Noise

Noise monitoring was conducted by Ecoengineering Consultants Limited at the same five (5) locations as the air quality monitoring locations (see Table 3 and Figure 1). Photographs 6 to 10 shows noise monitoring at each of the five locations.

Equivalent continuous sound pressure levels (L_{eq}) and Instantaneous unweighted peak sound pressure levels (L_{peak}) was monitored at each location over 30 minutes in the morning and 30 minutes in the afternoon with a logging interval of 1 minute. Measurements at each location were conducted on a weekday and a weekend.

A GARMIN GPS hand-held Unit was used to acquire the exact coordinate of the sampling locations, and was recorded and documented (see Table 1) below.

TABLE 3: AIR QUALITY AND NOISE MONITORING LOCATIONS

LOCATION	DESCRIPTION	GPS COORDINATES	
		NORTHING	EASTING
Loc 1	200 m west of Superpharm	1180922	657843
Loc 2	Immediately west of Diego Martin River, near fenced West Moorings Community playground	1181164	657681
Loc 3	South of Victoria Gardens entrance in the vicinity of the existing MOWT building	1181214	658178
Loc 4	North of HDC development, west of preschool	1181039	658376
Loc 5	Vicinity of Victoria Keyes	1181066	658304



PHOTOGRAPH 6: LOCATION 1



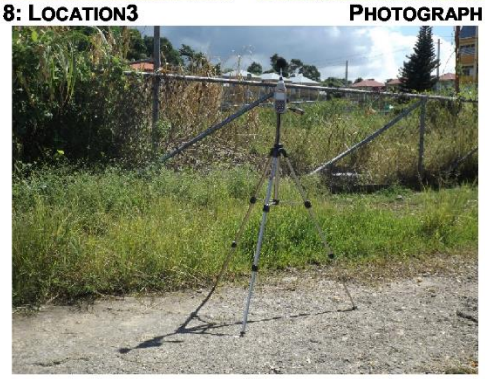
PHOTOGRAPH 7: LOCATION 2



PHOTOGRAPH 8: LOCATION3



PHOTOGRAPH 9: LOCATION 4



PHOTOGRAPH 10: LOCATION 5

3.3 Environmental Setting

3.3.1 Sources of Noise and Air Emissions

A significant source of noise within the project area was road traffic. Other sources of noise were the occasional ambulance siren, vehicle horns, barking dogs and birds chirping. Locations 1 and 5 were heavily trafficked by vehicles traversing the area regularly as the monitoring occurred along the Western Main Road. Traffic flow within these areas can be described as high.

The main sources of air emissions in the area were exhaust emissions from vehicles along the Western Main Road. As mentioned previously, traffic flow at locations 1 and 5 can be described as high. At Location 3, there was exposed soil to the south of the monitoring location (see Photograph 11). At Locations 1 and 5, the dispersion characteristics are excellent since these sites are surrounded by wide open spaces. While Locations 2, 3 and 4 are surrounded by houses and buildings so the dispersion characteristics are not as good.



PHOTOGRAPH 11: EXPOSED TOP SOIL SOUTH OF LOCATION 3

3.4 Sensitive Receptors

The key sensitive receptors in the area include a pre-school in the vicinity of Location 4, the International School of Port of Spain in the vicinity of Location 1, playgrounds in the vicinity of Locations 2 and 4 and Dunross Preparatory School at Location 2 (see Figure 1). Apart from this, the area is mostly residential, with communities such as Victoria Gardens, Victoria Keys, Powder Magazine, and commercial buildings and restaurants such as SuperPharm, West Mall and KFC.

3.5 Meteorological Conditions

3.5.1 Noise

Weather conditions during the first monitoring period on November 17, 2019 were sunny with no precipitation. During the second monitoring period on November 21, 2019 it was sunny during the morning period. However, around 2:00 p.m., the weather changed and was overcast with heavy showers and thunder for approximately 30 minutes. Noise monitoring was not conducted during this period.

3.5.2 Air Quality

During the air quality monitoring events, there was generally sunny conditions during Events 1 and 2 and light to heavy rain for Event 3.

3.6 Equipment

3.6.1 Noise

The equipment that was used on this monitoring exercise includes the following:

- Quest Sound Pro DL Meter;
- Quest Model QE7052 Remote Microphone; and
- Quest Model QC-10 Sound Calibrator (1000 Hz, 114 dB).

The Quest Sound Pro DL Meter is a Type 2 precision integrating instrument designed for use in noise surveys for commercial, industrial and environmental situations. The Quest Sound Pro DL Meter conforms to the following standards:

- IEC 61672-1-200 Class 2;
- ANSI S1.4-1983 (R2001) Class 1;
- ANSI S1.43-1997 (R2002) Type 2; and
- IEC 61260: 2001 Class 1.

This instrument has a total measurement range of between 20 and 140 dB, selectable response characteristics (slow, fast, peak and impulse), 3 weighting options ("A", "C" and "Linear") and offer output to serial devices (computers and/or printers) through an RS-232C interface or a USB interface (Pro DL). Additionally, this meter allows the user to select which parameters are to be logged and the exchange rates (3, 4, 5 or 6 dB) at which integrations are performed.

3.6.2 Air Quality

The method and instrumentation used by KESTL during the monitoring exercise for each parameter is shown in Table 4 below.

TABLE 4: METHODOLOGY AND INSTRUMENTATION (AIR QUALITY MONITORING)

PARAMETER	METHOD AND INSTRUMENT
Particulate Matter (PM_{10} and $PM_{2.5}$)	PM_{10} and $PM_{2.5}$ was measured in accordance with the equipment specified in the USEPA's Code of Federal Regulations (CFR) 40 CFR Chapter 1 Part 50 Appendix J and L: "Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High Volume Method)"
Total Suspended Particulates (TSP)	TSP was measured in accordance with the equipment specified in the USEPA's Code of Federal Regulations (CFR) 40 CFR Chapter 1 Part 50 Appendix B: "Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High Volume Method)"
Volatile Organic Compounds (VOCs)	VOCs were measured using a CrowCon Detective 4-Gas Monitor. The Crowcon portable emissions analyser is capable of monitoring gas simultaneously and providing warning of hazardous levels. This monitor has a Concentration Range of 0-100 ppm and a Resolution/Detection Limit of 0.10 ppm.
Sulphur Dioxide (SO_2)	The concentration of SO_2 was determined in accordance with US EPA 40 CFR Part 50 Appendix A: "Reference Method for the Determination of Sulphur Dioxide in the Atmosphere (Pararosaniline Method)." The lower detection limit of SO_2 in 10 ml of TCM is 0.75µg. This represents a concentration of 13 µgSO_2/m^3
Nitrogen Dioxide (NO_2)	NO_2 concentrations was determined in accordance with the US EPA Designated Equivalent Method NO-EQN-1277-026, "Sodium Arsenite Method for the Determination of Nitrogen Dioxide in the Atmosphere." In order to conform to the requirements of the EMA, this method will be modified slightly.
Carbon Monoxide (CO)	The Thermo Scientific Model 48i Caron Monoxide Analyzer is a US EPA Reference Method RFCA-0981-054. The Thermo Scientific Model 48i was configured to store data at fifteen (15) minute intervals over each twenty-four (24) hour monitoring event.
Ozone (O_3)	For the measurements of O3, the Aeroqual Series 500-USEPA Tier II & III Indicative Method was used. The Aeroqual Series 500 will be configured to store data at fifteen (15) minute intervals over a twenty-four (24) hour monitoring event.

3.6.3 Meteorological Station

Meteorological data was collected using a Davis Vantage pro2 Plus Met. Station. The station measured wind speed, wind direction, temperature, barometric pressure, rainfall, relative humidity and solar radiation were taken.

3.7 Quality Control

3.7.1 Noise

The sound level meters are factory calibrated annually (see Appendix A). The calibrator was factory calibrated within one year of the start of this project. In addition, prior to the start of monitoring the instruments were field calibrated. Ecoengineering's technicians are trained and experienced in the use of the noise monitoring equipment.

3.7.2 Air Quality

KESTL's services and performance adhere to an effective quality assurance and control program which is outlined as follows:

- Kaizen's Environmental Technicians are professionally trained and certified.
- All equipment used is calibrated periodically and by competent personnel (see Appendix B).
- All Test Methods and procedures are done in accordance with specified job requirements and applicable standards.
- Data resulting from tests and analysis is compared with standards by accredited and regulating bodies.

4 RESULTS AND DISCUSSION

4.1 Results

4.1.1 Noise Results

This section summarizes the readings for the noise monitoring exercise undertaken on November 17 and 21, 2019. Table 5 lists the L_{eq} values for morning and afternoon monitoring on a weekday and weekend. Copies of the instrument log sheets are included in Appendix C.

TABLE 5: SOUND PRESSURE LEVELS (WEEKDAY AND WEEKEND)

LOCATIONS	DATE / TIME	PARAMETERS	
		L_{eq} (dBA)	L_{peak} (dB)
Loc 1	Weekday (morning)	72.5	100.3
	Weekday (afternoon)	71.7	99.3
	Weekend (morning)	71.1	115.9
	Weekend (afternoon)	71.3	95.9
Loc 2	Weekday (morning)	51.8	85.7
	Weekday (afternoon)	54.0	89.2
	Weekend (morning)	49.1	77.4
	Weekend (afternoon)	48.1	86.6
Loc 3	Weekday (morning)	62.2	103.4
	Weekday (afternoon)	56.2	96.6
	Weekend (morning)	61.4	103.5
	Weekend (afternoon)	52.4	88.5
Loc 4	Weekday (morning)	59.5	89.5
	Weekday (afternoon)	59.6	94.5
	Weekend (morning)	57.9	87.2
	Weekend (afternoon)	58.6	88.4
Loc 5	Weekday (morning)	72.5	96.6
	Weekday (afternoon)	71.5	103.5
	Weekend (morning)	71.3	96.1
	Weekend (afternoon)	72.1	102.4
Noise Pollution Rules, 2001 (General Area)		**80 dBA**	**115 dB**

4.1.2 Air Quality Results

The results for air quality monitoring undertaken during Events 1, 2 and 3 are attached in Appendix D and summarised in Tables 6 to 17.

4.1.2.1 Event 1

TABLE 6: AMBIENT AIR QUALITY TESTING RESULTS –$PM_{2.5}$, PM_{10} AND TSP (24-HOUR)

Location No.	Sample Period/ 2019	Parameter Concentration		
		$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	TSP ($\mu g/m^3$)
1	November 14th	6	19	37
2	November 13th	2	3	8
3		5	15	32
4		4	7	14
5	November 14th	6	10	23
EMA STEL (24-hr average)		**65**	**75**	**150**

Note:
a) Results reported to the nearest whole number
b) EMA – Environmental Management Authority of Trinidad and Tobago
c) STEL – Short-term Maximum Permissible Level

TABLE 7: AMBIENT AIR QUALITY TESTING RESULTS –SO_2 (24-HOUR)

Location No	Sample Period/ 2019	Parameter Concentration
		SO_2 ($\mu g/m^3$)
1	November 14th	BDL
2	November 13th	BDL
3		BDL
4		BDL
5	November 14th	BDL
EMA STEL (24-hr)		**125**

Note:
a) BDL – Below Detection Limit
b) SO_2 Method Detection Limit = 13 $\mu g/Nm^3$

TABLE 8: AMBIENT AIR QUALITY TESTING RESULTS – NO_2 (1-HOUR)

Location No	Sample Period/ 2019	Parameter Concentration
		NO_2 ($\mu g/m^3$)
1	November 14th	BDL
2	November 13th	BDL
3		BDL
4		BDL
5	November 14th	BDL
EMA STEL (1-hr)		**200**

Note:

a) BDL – Below Detection Limit
b) NO_2 Modified Method Detection Limit = 20 $\mu g/Nm^3$

TABLE 9: AMBIENT AIR QUALITY TESTING RESULTS – CARBON MONOXIDE (CO), VOLATILE ORGANIC COMPOUNDS (VOCS) AND OZONE (O_3)

Location	Sampling Date/ 2019	Sampling Period		Avg 8-Hr CO Concentration ($\mu g/m^3$)	Avg 8-Hr VOC Concentration ($\mu g/m^3$)	Avg 8-Hr O_3 Concentration ($\mu g/m^3$)
		Start	End			
1	November 14th	14:35	22:34	913	0.8	35
	November 14th – 15th	22:35	06:34	851	0.9	28
	November 15th	06:35	14:35	929	1.1	36
2	November 13th	12:03	20:02	755	1.2	41
	November 13th – 14th	20:03	04:02	724	0.9	30
	November 14th	04:03	12:03	774	1.4	38
3	November 13th	13:01	21:00	757	1.1	39
	November 13th – 14th	21:01	05:00	730	1.1	26
	November 14th	05:01	13:01	765	1.2	37
4	November 13th	14:03	22:02	903	1.0	45
	November 13th – 14th	22:03	06:02	879	0.6	22
	November 14th	06:03	14:03	917	1.1	34

Location	Sampling Date/	Sampling Period		Avg 8-Hr CO Concentration	Avg 8-Hr VOC Concentration	Avg 8-Hr O_3 Concentration
5	November 14th	13:35	21:34	964	0.8	37
	November 14th – 15th	21:35	05:34	911	1.2	32
	November 15th	05:35	13:35	1014	1.0	40
EMA STEL (8-hour average)				**10 000**	**N/A**	**120**

Note:

a) Results reported to the nearest whole number
b) There are no guidelines for VOCs in ambient air.

4.1.2.2 Event 2

TABLE 10: AMBIENT AIR QUALITY TESTING RESULTS PARTICULATE MATTER ($PM_{2.5}$ PM_{10} AND TSP)

Location No.	Sample Period/ 2019	Parameter Concentration		
		$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	TSP ($\mu g/m^3$)
1	November 19th – 20th	3	7	21
2	November 18th – 19th	3	16	20
3		5	10	17
4		5	11	19
5	November 19th – 20th	1	14	21
EMA STEL (24-hr average)		**65**	**75**	**150**

Note:

a) Results reported to the nearest whole number

TABLE 11: AMBIENT AIR QUALITY TESTING RESULTS –SO_2 (24-HOUR)

Location No	Sample Period/ 2019	Parameter Concentration
		SO_2 (µg/m^3)
1	November 19th – 20th	BDL
2	November 18th – 19th	BDL
3		BDL
4		BDL
5	November 19th – 20th	BDL
EMA STEL (24-hr)		**125**

Note:

a) BDL – Below Detection Limit
b) SO_2 Method Detection Limit = 13 µg/Nm^3

TABLE 12: AMBIENT AIR QUALITY TESTING RESULTS – NO_2 (1-HOUR)

Location No	Sample Period/ 2019	Parameter Concentration
		NO_2 (µg/m^3)
1	November 19th	BDL
2	November 18th	BDL
3		BDL
4		BDL
5	November 19th	BDL
EMA STEL (1-hr)		**200**

Note:

a) BDL – Below Detection Limit
b) NO_2 Modified Method Detection Limit = 20 µg/Nm^3

TABLE 13: AMBIENT AIR QUALITY TESTING RESULTS – CARBON MONOXIDE (CO), VOLATILE ORGANIC COMPOUNDS (VOCS) AND OZONE (O_3)

Loc	Sampling Date/ 2019	Sampling Period		Avg 8-Hr CO Concentration ($\mu g/m^3$)	Avg 8-Hr VOC Concentration ($\mu g/m^3$)	Avg 8-Hr O_3 Concentration ($\mu g/m^3$)
		Start	End			
1	November 19th	14:02	22:01	1084	0.8	47
	November 19th – 20th	22:02	06:01	893	1.0	36
	November 20th	06:02	14:02	1054	1.3	43
2	November 18th	11:03	19:02	867	1.2	35
	November 18th – 19th	19:03	03:02	692	0.9	29
	November 19th	03:03	11:03	852	0.6	31
3	November 18th	12:00	19:59	892	0.9	35
	November 18th – 19th	20:00	03:59	683	0.2	27
	November 19th	04:00	12:00	894	0.8	31
4	November 18th	13:02	21:01	1011	0.9	49
	November 18th – 19th	21:02	05:01	773	0.6	47
	November 19th	05:02	13:02	962	0.8	48
5	November 19th	13:01	21:00	1080	1.2	49
	November 19th – 20th	21:01	05:00	877	0.7	47
	November 20th	05:01	13:01	1094	0.9	48
EMA STEL (8-hour average)				**10 000**	N/A	120

Note:

a) Results reported to the nearest whole number
b) There are no guidelines for VOCs in ambient air.

4.1.2.3 Event 3

TABLE 14: AMBIENT AIR QUALITY TESTING RESULTS PARTICULATE MATTER ($PM_{2.5}$ PM_{10} AND TSP)

Location No.	Sample Period/ 2019	Parameter Concentration		
		$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	TSP ($\mu g/m^3$)
1	November 26th – 27th	11	29	62
2	November 25th – 26th	5	8	16
3		7	10	20
4		10	16	28
5	November 26th – 27th	8	16	28
EMA STEL (24-hr average)		**65**	**75**	**150**

Note:

a) Results reported to the nearest whole number

TABLE 15: AMBIENT AIR QUALITY TESTING RESULTS –SO_2 (24-HOUR)

Location No	Sample Period/ 2019	Parameter Concentration
		SO_2 ($\mu g/m^3$)
1	November 26th – 27th	BDL
2	November 25th – 26th	BDL
3		BDL
4		BDL
5	November 26th – 27th	BDL
EMA STEL (24-hr)		**125**

Note:

a) BDL – Below Detection Limit

b) SO_2 Method Detection Limit = 13 $\mu g/Nm^3$

TABLE 16: AMBIENT AIR QUALITY TESTING RESULTS – NO_2 (1-HOUR)

Location No	Sample Period/ 2019	Parameter Concentration
		NO_2 ($\mu g/m^3$)
1	November 25th - 26th	BDL
2		BDL
3		BDL
4		BDL
5		BDL
EMA STEL (1-hr)		**200**

Note:

a) *BDL – Below Detection Limit*
b) *NO_2 Modified Method Detection Limit = 20 $\mu g/Nm^3$*

TABLE 17: AMBIENT AIR QUALITY TESTING RESULTS – CARBON MONOXIDE (CO), VOLATILE ORGANIC COMPOUNDS (VOCS) AND OZONE (O_3)

Loc	Sampling Date/ 2019	Sampling Period		Avg 8-Hr CO Concentration ($\mu g/m^3$)	Avg 8-Hr VOC Concentration ($\mu g/m^3$)	Avg 8-Hr O_3 Concentration ($\mu g/m^3$)
		Start	End			
1	November 26th	15:30	23:29	886	0.1	43
	November 26h – 27th	23:30	07:29	750	0.1	42
	November 27th	07:30	15:30	945	0.1	43
2	November 25th	11:30	19:29	1002	0.1	31
	November 25th – 26th	19:30	03:29	775	0.1	32
	November 26th	03:30	11:30	941	0.1	35
3	November 25th	12:30	20:29	993	0.1	36
	November 25th – 26th	20:30	04:29	678	0.1	36
	November 26th	04:30	12:30	1012	0.1	36
4	November 25th	13:30	21:29	862	0.1	42

Loc	Sampling Date/	Sampling Period		Avg 8-Hr CO Concentration	Avg 8-Hr VOC Concentration	Avg 8-Hr O_3 Concentration
	November 25th – 26th	21:30	05:29	709	0.1	43
	November 26th	05:30	12:30	1100	0.1	43
5	November 26th	15:00	22:59	775	0.1	41
	November 26th – 27th	23:00	06:59	743	0.1	43
	November 27th	07:00	15:00	1068	0.1	41
EMA STEL (8-hour average)				**10 000**	N/A	120

Note:

a) Results reported to the nearest whole number
b) There are no guidelines for VOCs in ambient air.

5 DISCUSSION

5.1 Noise

5.1.1 Comparison of Locations

Locations 1 (located west of Superpharm) and 5 (located along the Diego Martin Highway in the vicinity of Victoria Keys) had similar L_{eq} values which were in the range of 71.1 dBA and 72.5 dBA as compared to the other three locations (all within residential areas) where lower L_{eq} values ranging between 48.1 dBA and 62.2 dBA were recorded (see Figures 2 and 3). The highest L_{peak} of 115 dB was recorded at Location 1. The highest L_{peak} at the other four locations was 103.5 dB (see Figures 4 and 5). Noise at Locations 1 and 5 can be attributed to high vehicular traffic. Noise sources at Locations 2, 3 and 4 included barking dogs, natural sounds of animals (birds chirping, etc) and the occasional vehicle.

None of the recorded L_{eq} levels exceeded the applicable noise limits stipulated in the NPCR when compared with the absolute limits. However, the morning L_{peak} was slightly exceeded at Location 1 on the weekend.

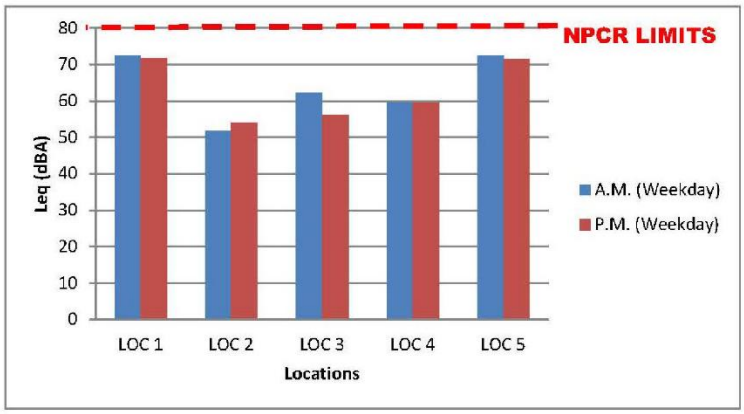


FIGURE 2: L_{EQ} RESULTS (WEEKDAY)

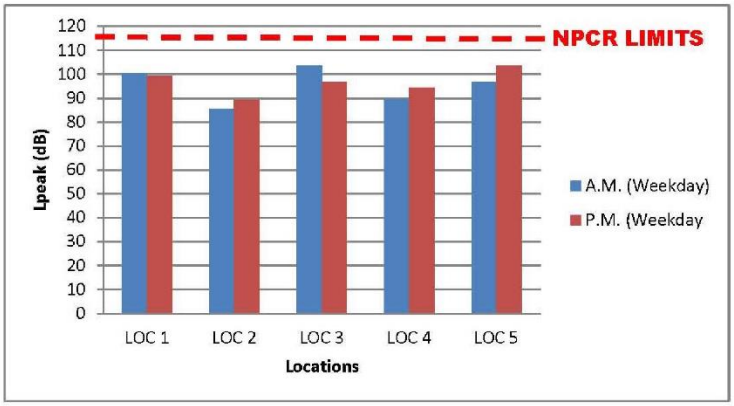


FIGURE 3: L_{PEAK} RESULTS (WEEKDAY)

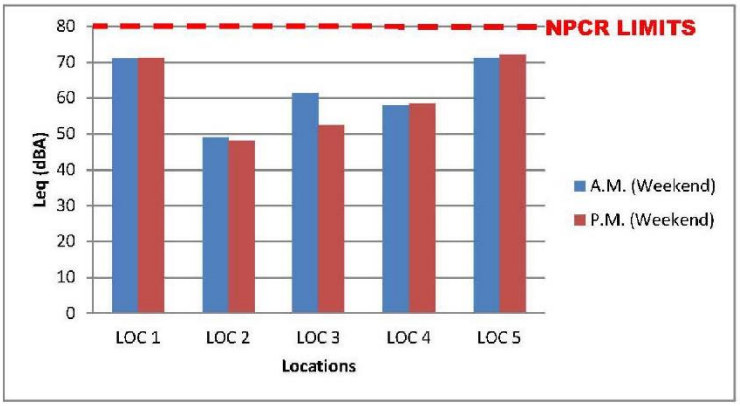


FIGURE 4: L_{EQ} RESULTS (WEEKEND)

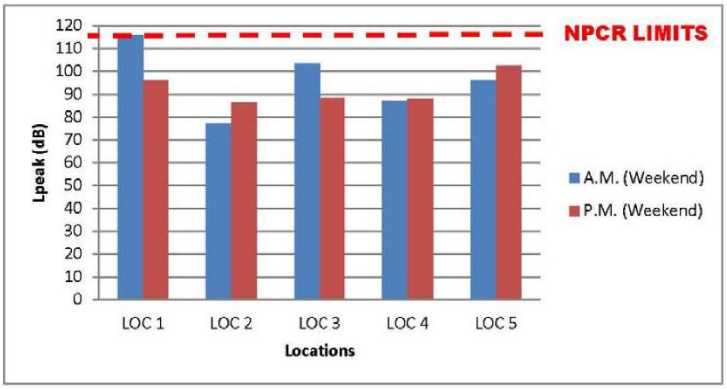


FIGURE 5: L_{PEAK} RESULTS (WEEKEND)

5.1.2 Comparison of Morning and Afternoon

Table 18 summarizes the sound pressure level for morning and afternoon during the weekend and weekday monitoring.

TABLE 18: MORNING AND AFTERNOON SOUND PRESSURE LEVELS

LOCATION	L_{EQ} (dBA)		L_{PEAK} (dB)	
	WEEKEND	WEEKDAY	WEEKEND	WEEKDAY
MORNING				
Loc 1	71.1	72.5	115.9	100.3
Loc 2	49.1	51.8	77.4	85.7
Loc 3	61.4	62.2	103.5	103.4
Loc 4	57.9	59.5	87.2	89.5
Loc 5	71.3	72.5	96.1	96.6
AFTERNOON				
Loc 1	71.3	71.7	95.9	99.3
Loc 2	48.1	54	86.6	89.2
Loc 3	52.4	56.2	88.5	96.6
Loc 4	58.6	59.6	88.4	94.5
Loc 5	72.1	71.5	102.4	103.5

Morning and afternoon L_{eq} sound pressure levels fluctuated during the monitoring periods for both the weekday and weekend. Morning L_{eq} values ranged from 51.8 dBA to 79.1 dBA and were higher than values recorded for the afternoon period with L_{eq} values of 48.1 dBA to 72.1 dBA being recorded (see Figures 6 and 7). Similarly, morning L_{peak} values (ranging between 85.7 dB to 115.9 dB) were higher than afternoon values (88.4 dB to 103.5 dB) (see Figures 8 and 9). The highest morning L_{eq} was recorded at Location 2 on the weekend while the lowest was also at Location 2 but on the weekday. The highest morning L_{peak} was measured at Location 1 on the weekend and this value exceeded the NPCR limit of 115 dB. The highest afternoon L_{peak} was measured at Location 5 on the weekday. Both locations are in close proximity to heavily trafficked roadways where the major source of noise is vehicular traffic and the sound of sirens and revving engines. Noise is likely to be higher during the week due to higher volumes of traffic associated with school and work.

The values for the weekday and weekend monitoring ranged from 51.8 dBA to 72.5 dBA and 57.9 dBA to 79.1 dBA for the morning sessions and from 54.0 dBA to 71.7 dBA and 48.1 dBA to 72.1 dBA for the weekday and weekend afternoon sessions respectively (see Figure 6 and 7). The morning values were higher during the weekday monitoring. This can be attributed to vehicle noises and natural sounds from animals (birds, dogs, etc.).

L_{peak} values ranged between 85.7 dB to 103.4 dB and 77.4 dB to 115.9 dB for the morning session and between 89.2 dB to 103.5 dB and 88.4 dB to 102.4 dB for the afternoon session (see Figure 8 and 9). The highest reading was taken at Location 1 during the weekend monitoring session. This can be attributed to vehicle noises (ambulance siren, vehicles revving, etc.).

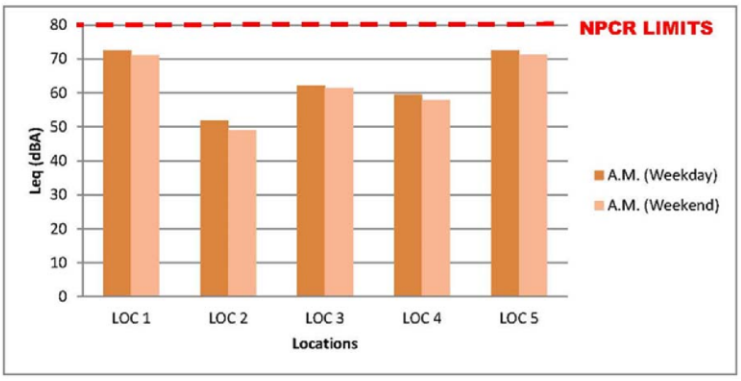


FIGURE 6: COMPARISON OF L_{EQ} RESULTS (WEEKDAY AND WEEKEND) MORNING PERIOD

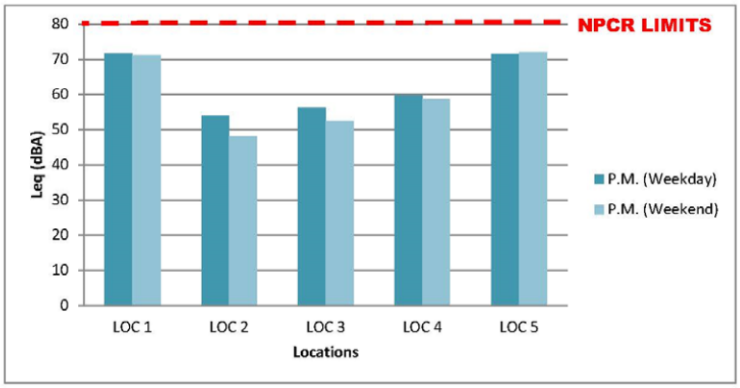


FIGURE 7: COMPARISON OF L_{EQ} RESULTS (WEEKDAY AND WEEKEND) AFTERNOON PERIOD

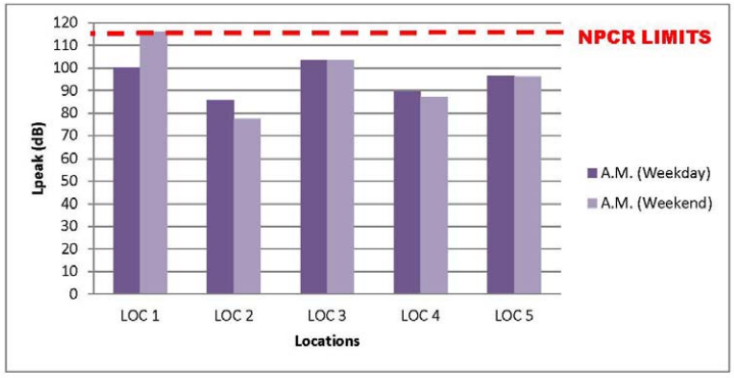


FIGURE 8: COMPARISON OF L_{PEAK} RESULTS (WEEKDAY AND WEEKEND) MORNING PERIOD

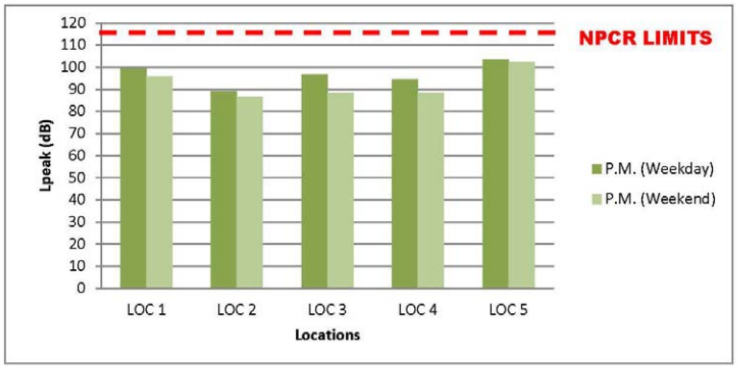


FIGURE 9: COMPARISON OF L_{PEAK} RESULTS (WEEKDAY AND WEEKEND) AFTERNOON PERIOD

5.1.3 Comparison of Weekday and Weekend

Weekday L_{eq} values ranged from 51.8 dBA at Location 2 (morning) to 72.5 dBA at Locations 1 and 5 and 54.0 dBA at Location 2 to 71.7 dBA at Location 1 (afternoon). As compared to L_{eq} values on the weekend ranging from 61.4 dBA at Location 3 to 79.1 dBA at Location 2 (morning) and 48.1 dBA at Location 2 to 72.1 dBA at Location 5, the weekday readings were not significantly higher. The highest L_{peak} reading (115.9 dB) was recorded on the weekend at Location 1 during the morning period.

5.1.4 Summary of Findings

During the monitoring period, none of the L_{eq} or L_{peak} values were over the limits specified in the Noise Pollution Control Rules, 2001, except for one L_{peak} measurement at Location 1 The L_{eq} results from the noise monitoring exercise will be used as background noise levels for comparison with noise monitoring conducted during construction of the vehicular overpass.

5.2 Air Quality

5.2.1 $PM_{2.5}$, PM_{10}, and Total Suspended Particulates (TSP)

During the three monitoring events, $PM_{2.5}$ concentrations ranged between 2 µg/m^3 and 6 µg/m^3 (Event 1), 1 µg/m^3 and 5 µg/m^3 (Event 2) and 5 µg/m^3 and 11 µg/m^3 (Event 3).

The concentrations for PM_{10} ranged between 3 µg/m^3 and 9 µg/m^3 (Event 1), 7 µg/m^3 and 16 µg/m^3 (Event 2) and 8 µg/m^3 and 29 µg/m^3 (Event 3).

The concentrations for TSP ranged between 8 µg/m^3 and 37 µg/m^3 (Event 1), 17 µg/m^3 and 21 µg/m^3 (Event 2) and 16 µg/m^3 and 62 µg/m^3 (Event 3).

These three parameters were well below the maximum permissible limits stated in the Air Pollution Rules, 2014 with TSP having a limit of 150 µg/m3 and $PM_{2.5}$ and PM_{10} having limits of 65 µg/m^3 and 75 µg/m^3 respectively. Thus, there were no exceedances of those limits during the three monitoring events.

These values will be used as the baseline for comparison with air quality monitoring conducted during construction of the vehicular overpass.

5.2.2 Non-Metallic Inorganic Pollutants

At the five monitoring locations NO_2, CO, SO_2 and O_3 were detected at each location during all three events at very low concentrations. They did not exceed the maximum permissible limits stated in the Air Pollution Rules, 2014 with NO_2 having a limit of 200 µg/m^3, CO having a limit of 10,000 µg/m^3, O_3 with a limit of 120 µg/m^3. There are no guidelines for VOCs in ambient air.

6 POTENTIAL IMPACTS

6.1 Impaired Air Quality (Dust)

6.1.1 Nature of Concern

Dust is the primary air quality concern arising from cleared areas, excavation works and the movement of construction vehicles and equipment and also from stockpiles of aggregate. None of the measurements of particulate matter during all three events exceeded the applicable permissible limits in the APR. Dust is released into the air from the contact of tyres and working parts with the ground, particularly when equipment and vehicles travel over unpaved areas, thereby contributing to the 'kick-up' of dust into the air.

Dust is a nuisance causing discomfort among persons affected and could also exacerbate illnesses such as asthma and bronchitis. At high concentrations, dust can also affect plants by coating the leaves and impeding photosynthesis. The potential concern of dust on air quality is most pronounced in the dry season when winds are also highest.

6.1.2 Management Options

The following management options can be employed for the control of dust emissions during construction:

- Clear only the area needed for construction, leaving vegetation in other areas intact as far as practical, thereby reducing the area from which dust can be formed.
- Install dust screens close to sensitive receptors to reduce the amount of dust leaving the construction area.
- Designate a Community Relations Officer to deal with complaints from affected persons in the project area.
- Vegetate or pave cleared areas as early as practical.
- Keep stockpiles to a minimum and use as soon as practical, thereby reducing a source of dust.
- Cover smaller stockpiles, or store fine aggregates in bins or silos. This prevents exposure of material to the wind.
- Wash truck tyres before exiting the construction site onto existing paved roads.
- During earthworks (including excavation) implement dust control measures at source, including frequently wetting bare surfaces and access way.

6.2 Noise

6.2.1 Nature of Concern

Baseline noise data gathered show that noise in the project area is compliant with the absolute limit for L_{eq} in the NPCR. Additionally, all L_{peak} values were compliant with the limit in the NPCR except at Location 1 where it went over limit. In addition to vehicles traversing the area such as motor cycles, light motor vehicles and heavy motor vehicles, construction vehicles and

equipment will also emit noise from their engines, exhaust, horns and alarms. Demolition of structures will be a source of intense noise and vibrations. . Noise levels emitted by equipment will vary depending on factors such as the type of equipment used, the operation being performed and the condition of the equipment. Therefore, noise generated due to the project would be dependent upon the selected method of construction and the manner in which materials and equipment are moved within the project area (Society of Automotive Engineers, 1976). The equivalent sound level (L_{eq}) of the construction or operation activity also depends on the fraction of time that the equipment is operated over the period. Construction noise and vibration can affect persons and structures in nearby communities at and around the project site.

Noise during construction is exempt from the limits in the NPCR, when work is conducted during the hours of 7 am to 7 pm daytime. Outside of these hours, a noise variation is required for noise emissions which exceed the limit of the Rules (see Section 2.1).

6.2.2 Management Options

The following mitigation measures can be employed for the control of noise and vibrations:

- Ensure that noise-generating equipment are routinely maintained and inspected to reduce unnecessary increases in noise levels;
- Ensure that existing acoustic controls on all noise-generating equipment are functional.
- Designate a Community Relations Officer to deal with complaints from affected persons in the project area.
- Limit construction activities to the period 7:00 am to 7:00 pm where practical.
- If noisy night work is necessary near residences, obtain a Variation from the EMA.
- Inform surrounding communities and groups of noisy construction activities such as jack hammering (if necessary) ahead of the start of works.
- Schedule construction activities near places of worship (if any) so as to avoid times of services. If possible, work in the vicinity of schools should be scheduled for the school vacation periods.
- Inform relevant stakeholders (including neighbouring businesses, government agencies, religious leaders and school principals) of construction activities in advance.

APPENDIX A

CALIBRATION CERTIFICATES

ANNEX 1

AIR QUALITY

CROWCON Detective MultiGas Monitor

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-45704
DATE: 2019-10-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 45704

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*

TEMPERATURE: 25.8°C

RELATIVE HUMIDITY: 51.5%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-44094
DATE: 2019-10-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 44094

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*

TEMPERATURE: 25.8°C

RELATIVE HUMIDITY: 51.6%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-42045
DATE: 2019-10-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 42045

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*

TEMPERATURE: 25.9°C

RELATIVE HUMIDITY: 51.4%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

Aeroqual

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32159

Calibration Date: 25 Feb 2019 14:51

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1221

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.005	0.110	0.523	0.000
AQL Sensor (Std. Dev) /ppm	0.000	0.001	0.002	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: **Takao Yamasaki**

Date: **25 Feb 2019**

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32151

Calibration Date: 25 Feb 2019 14:50

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1225

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.004	0.109	0.510	0.000
AQL Sensor (Std. Dev) /ppm	0.001	0.001	0.001	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: **Takao Yamasaki**

Date: **25 Feb 2019**

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32142

Calibration Date: 25 Feb 2019 14:50

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1232

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.005	0.113	0.506	0.000
AQL Sensor (Std. Dev) /ppm	0.002	0.001	0.003	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: Takao Yamasaki

Date: 25 Feb 2019

aeroqual

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 31862

Calibration Date: 25 Jan 2019 14:51

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1048

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.003	0.111	0.511	0.000
AQL Sensor (Std. Dev) /ppm	0.001	0.001	0.001	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: Takao Yamasaki

Date: 25 Jan 2019

$PM_{2.5}$ High Volume Sampler

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

PM2.5 High Volume Sampler Calibration

DATE: October 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-711768
Serial# : 711768
Sampler: Staplex

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

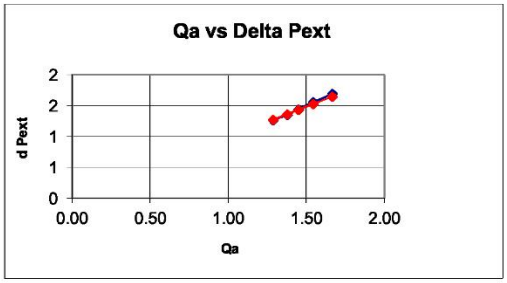
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	27.3	**Ta (°K)**	300.3	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.96	**Pa (mm Hg)**	760.984	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.143603**
6.9	1.669	6.6	1.693	1.6502	**intercept, b2:**	**-0.214450**
5.9	1.544	5.6	1.559	1.5259	**corr. coeff, r2**	**0.998751**
5.2	1.450	4.8	1.443	1.4325		
4.7	1.379	4.2	1.350	1.3619	**SFR**	**1.135**
4.1	1.289	3.7	1.267	1.2720	**SSP**	**2.71**



Amrit Persad Maharaj
Instrumentation Technician

Red line is the regression line.

* delta Pext = m1(Qa + b1)	
E(x)	7.332
E(y)	7.2426
E(x2)	10.8375
E(y2)	10.8077
E(xy)	10.7063
n	5
avg x = E(x)/n	1.4664
avg y = E(y)/n	1.4485
(Ex)2	53.7555
(Ey)2	52.4553
m	0.99482
b	-0.01025

For Regression Model:

slope:	0.99482	**for plot of Qa vs Pext = m1(Qa + b1)**
Intercept:	-0.01025	
corr. Coeff	1.0000	

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Environmental Services (T'dad) Ltd

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FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

PM2.5 High Volume Sampler Calibration

DATE: October 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4735
Serial# : 4735
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

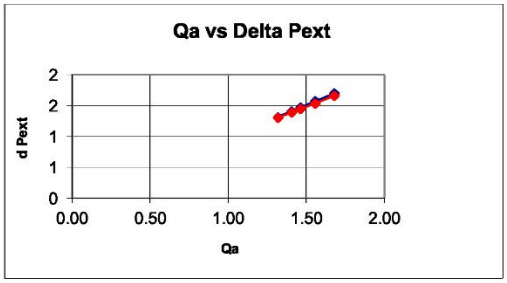
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	27.3	**Ta (°K)**	300.3	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.96	**Pa (mm Hg)**	760.984	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.072916**
7	1.681	6.7	1.705	1.6621	**intercept, b2:**	**-0.097978**
6	1.557	5.7	1.573	1.5388	**corr. coeff, r2**	**0.999998**
5.3	1.464	5	1.473	1.4463		
4.9	1.408	4.6	1.413	1.3906	**SFR**	**1.135**
4.3	1.320	4	1.318	1.3027	**SSP**	**2.89**



Amrit Persad Maharaj
Instrumentation Technician

Red line is the regression line.
* delta Pext = m1(Qa + b1)

E(x)	7.430
E(y)	7.3404
E(x2)	11.1187
E(y2)	11.2851
E(xy)	10.9850
n	5
avg x = E(x)/n	1.4860
avg y = E(y)/n	1.4681
(Ex)2	55.2071
(Ey)2	53.8819
m	0.99482
b	-0.01025

For Regression Model:

slope:	0.99482	**for plot of Qa vs Pext = m1(Qa + b1)**
Intercept:	-0.01025	
corr. Coeff	1.0000	

KAIZEN
Environmental Services (T'dad) Ltd

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Email: inquiries@kaizen-tt.com

PM2.5 High Volume Sampler Calibration

DATE: October 9th 2019
Technician: Amrit Persad Maharaj

Certificate # 010319-4732
Serial# : 4732
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

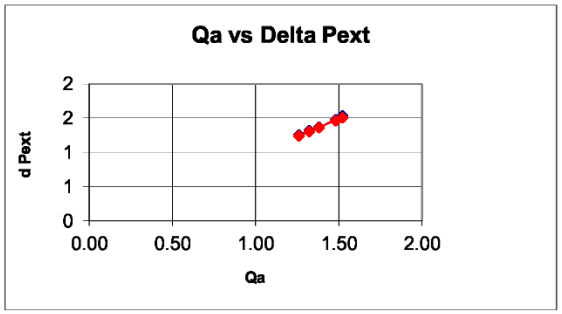
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	28.6	**Ta (°K)**	301.6	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.054142**
5.7	1.521	5.4	1.534	1.5028	**intercept, b2:**	**-0.078530**
5.4	1.481	5	1.476	1.4627	**corr. coeff, r2**	**0.997657**
4.7	1.382	4.3	1.369	1.3647		
4.3	1.322	4	1.320	1.3053	**SFR**	**1.140**
3.9	1.260	3.6	1.252	1.2431	**SSP**	**2.90**



Amrit Persad Maharaj
Instrumentation Technician

yellow line is the regression line.
* delta Pext = m1(Qa + b1)

E(x)	6.966
E(y)	6.8786
E(x2)	9.7517
E(y2)	9.7140
E(xy)	9.6298
n	5
avg x = E(x)/n	1.3932
avg y = E(y)/n	1.3757
(Ex)2	48.5241
(Ey)2	47.3153
m	0.99482
b	-0.01025

For Regression Model:

slope:	0.99482	**for plot of Qa vs Pext = m1(Qa + b1)**
intercept:	-0.01025	
corr. Coeff	1.0000	

PM_{10} High Volume Sampler

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

PM10 High Volume Sampler Calibration

DATE: October 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-711770
Serial# : 711770
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

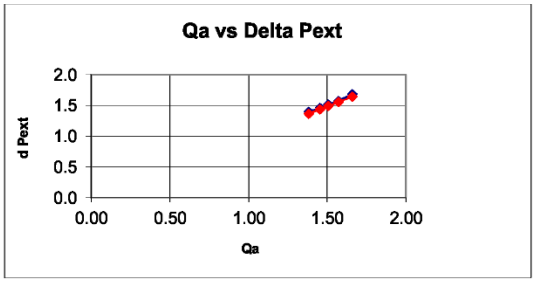
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.009309**
6.8	1.661	6.5	1.683	1.6420	**intercept, b2:**	**-0.001603**
6.1	1.574	5.7	1.576	1.5552	**corr. coeff, r2**	**0.997414**
5.6	1.508	5.3	1.520	1.4901		
5.2	1.454	4.9	1.461	1.4359	**SFR**	**1.141**
4.7	1.383	4.5	1.401	1.3651	**SSP**	**3.03**



Amrit Persad Maharaj
Instrumentation Technician

Red line is the regression line.
* delta Pext = m1(Qa + b1)

E(x)	7.579
E(y)	7.4882
E(x2)	11.5334
E(y2)	11.7249
E(xy)	11.3960
n	5
avg x = E(x)/n	1.5157
avg y = E(y)/n	1.4976
(Ex)2	57.4367
(Ey)2	56.0733
m	0.99482
b	-0.01025

For Regression Model:

slope:	0.99482	**for plot of Qa vs Pext = m1(Qa + b1)**
Intercept:	-0.01025	
corr. Coeff	1.0000	

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
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Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

PM10 High Volume Sampler Calibration

DATE: October 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4734
Serial# : 4734
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

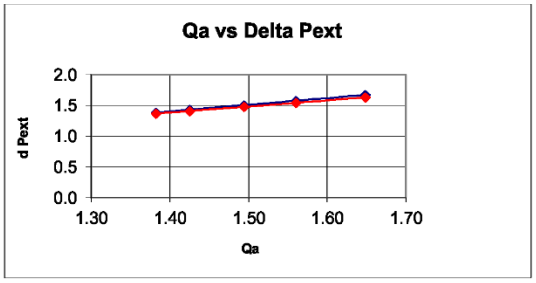
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.072142**
6.7	1.649	6.4	1.670	1.6299	**intercept, b2:**	**-0.097217**
6	1.561	5.7	1.576	1.5424	**corr. coeff, r2**	**0.999999**
5.5	1.495	5.2	1.505	1.4767		
5	1.426	4.7	1.431	1.4080	**SFR**	**1.141**
4.7	1.383	4.4	1.385	1.3651	**SSP**	**2.91**



Amrit Persad Maharaj
Instrumentation Technician

Red line is the regression line.
* delta Pext = m1(Qa + b1)

E(x)	7.512
E(y)	7.4220
E(x2)	11.3317
E(y2)	11.5069
E(xy)	11.1961
n	5
avg x = E(x)/n	1.5024
avg y = E(y)/n	1.4844
(Ex)2	56.4331
(Ey)2	55.0868
m	0.99482
b	-0.01025

For Regression Model:

slope:	0.99482	**for plot of Qa vs Pext = m1(Qa + b1)**
Intercept:	-0.01025	
corr. Coeff	1.0000	

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

PM10 High Volume Sampler Calibration

DATE: October 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4733
Serial# : 4733
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

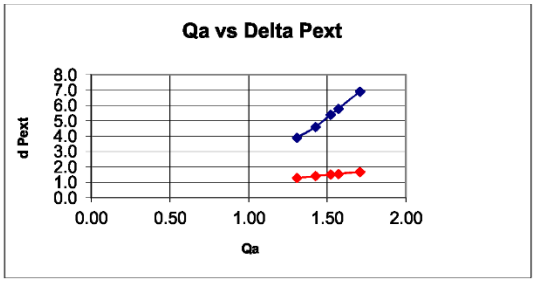
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**7.560747**
7.2	1.709	7.8	6.900	1.6896	**intercept, b2:**	**-6.076769**
6.1	1.574	7.33	5.800	1.5552	**corr. coeff, r2**	**0.997793**
5.7	1.521	6.9	5.400	1.5033		
5	1.426	6.53	4.600	1.4080	**SFR**	**1.141**
4.2	1.307	5.7	3.900	1.2905	**SSP**	**14.88**



Amrit Persad Maharaj
Instrumentation Technician

Red line is the regression line.
* delta Pext = m1(Qa + b1)

E(x)	7.537
E(y)	7.4465
E(x2)	11.4524
E(y2)	146.7800
E(xy)	11.3159
n	5
avg x = E(x)/n	1.5074
avg y = E(y)/n	1.4893
(Ex)2	56.8034
(Ey)2	55.4508
m	0.99482
b	-0.01025

For Regression Model:

slope:	0.99482	**for plot of Qa vs Pext = m1(Qa + b1)**
Intercept:	-0.01025	
corr. Coeff	1.0000	

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

PM10 High Volume Sampler Calibration

DATE: October 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-2480
Serial# : 2480
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

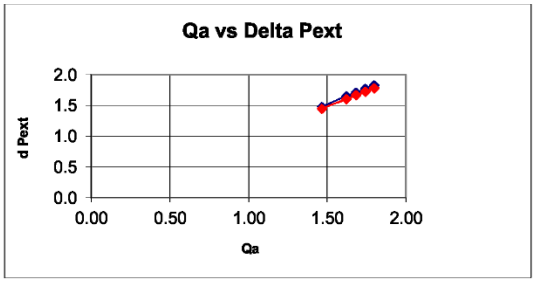
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.060066**
8	1.801	7.7	1.832	1.7810	**intercept, b2:**	**-0.074936**
7.5	1.744	7.2	1.772	1.7244	**corr. coeff, r2**	**0.999042**
7	1.685	6.7	1.709	1.6660		
6.5	1.624	6.3	1.657	1.6054	**SFR**	**1.141**
5.3	1.467	5	1.476	1.4496	**SSP**	**2.95**



Amrit Persad Maharaj
Instrumentation Technician

Red line is the regression line.
* delta Pext = m1(Qa + b1)

E(x)	8.321
E(y)	8.2263
E(x2)	13.9123
E(y2)	14.3401
E(xy)	13.7550
n	5
avg x = E(x)/n	1.6641
avg y = E(y)/n	1.6453
(Ex)2	69.2332
(Ey)2	67.6723
m	0.99482
b	-0.01025

For Regression Model:

slope:	0.99482	**for plot of Qa vs Pext = m1(Qa + b1)**
Intercept:	-0.01025	
corr. Coeff	1.0000	

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

PM10 High Volume Sampler Calibration

DATE: October 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-1328
Serial# : 1328
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

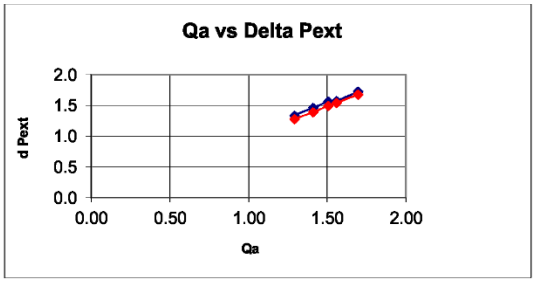
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**0.932154**
7.1	1.697	6.8	1.722	1.6778	**intercept, b2:**	**0.139218**
6	1.561	5.7	1.576	1.5424	**corr. coeff, r2**	**0.995687**
5.6	1.508	5.6	1.562	1.4901		
4.9	1.411	4.9	1.461	1.3938	**SFR**	**1.141**
4.1	1.292	4.1	1.337	1.2750	**SSP**	**3.32**



Amrit Persad Maharaj
Instrumentation Technician

Red line is the regression line.
* delta Pext = m1(Qa + b1)

E(x)	7.469
E(y)	7.3791
E(x2)	11.2507
E(y2)	11.8120
E(xy)	11.1159
n	5
avg x = E(x)/n	1.4938
avg y = E(y)/n	1.4758
(Ex)2	55.7863
(Ey)2	54.4512
m	0.99482
b	-0.01025

For Regression Model:

slope:	0.99482	**for plot of Qa vs Pext = m1(Qa + b1)**
Intercept:	-0.01025	
corr. Coeff	1.0000	

SKC Sampling Pump

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-634661

DATE: 27/10/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 634661

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
3.0 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Tel.: (868) 299-0009,
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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-634635

DATE: 27/10/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 634635

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
3.1 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-562657

DATE: 27/10/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 562657

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
2.9 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

Thermo CO Analyzer

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
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Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-1220553760

DATE: 28/10/2019

ANALYSER TYPE: Thermo 450i H_2S / SO_2 Analyzer

Span		Calibration Gas Used		
As Found	**As Left**	**Span**	**Gas Manufacturer**	**Gas Lot #**
0	0	*Air Zero Grade (THC< 1ppm)*	CALGAZ	152802
10	10	*10 ppm H_2S*	CALGAZ	273152
5	5	*5 ppm SO_2*	CALGAZ	282367

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-1205951890

DATE: 28/10/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	**As Left**	**Span**	**Gas Manufacturer**	**Gas Lot #**
0	0	*Air Zero Grade (THC< 1ppm)*	CALGAZ	152802
49	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-1108347541

DATE: 28/10/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	**As Left**	**Span**	**Gas Manufacturer**	**Gas Lot #**
0	0	*Air Zero Grade (THC< 1ppm)*	CALGAZ	152802
50	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-1108347540

DATE: 28/10/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	**As Left**	**Span**	**Gas Manufacturer**	**Gas Lot #**
0	0	*Air Zero Grade (THC< 1ppm)*	CALGAZ	152802
50	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-710821552

DATE: 28/10/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	**As Left**	**Span**	**Gas Manufacturer**	**Gas Lot #**
0	0	*Air Zero Grade (THC< 1ppm)*	CALGAZ	152802
50	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

TSP High Volume Sampler

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

TSP High Volume Sampler Calibration

DATE: October 23th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-2576
Serial# : 2576
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

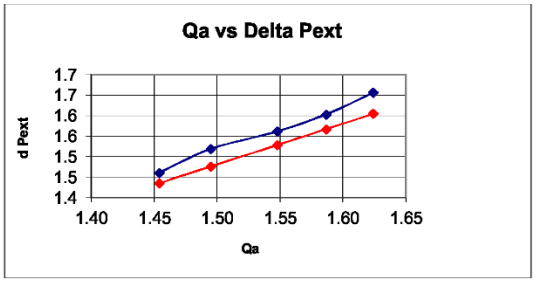
Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

Conditions

Ta:(°C)	28.5	**Ta (°K)**	301.5	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.094582**
6.5	1.624	6.3	1.656	1.6046	**intercept, b2:**	**-0.127347**
6.2	1.587	5.9	1.603	1.5671	**corr. coeff, r2**	**0.995148**
5.9	1.548	5.6	1.562	1.5287		
5.5	1.495	5.3	1.519	1.4760	**SFR**	**1.139**
5.2	1.454	4.9	1.461	1.4352	**SSP**	**2.88**



Amrit Persad Maharaj
Instrumentation Technician

Red line is the regression line.
* delta Pext = m1(Qa + b1)

E(x)	7.708
E(y)	7.6115
E(x2)	11.9029
E(y2)	12.1933
E(xy)	11.7533
n	5
avg x = E(x)/n	1.5417
avg y = E(y)/n	1.5223
(Ex)2	59.4210
(Ey)2	57.9350
m	0.99571
b	-0.01278

For Regression Model:

slope:	0.99571	**for plot of Qa vs Pext = m1(Qa + b1)**
Intercept:	-0.01278	
corr. Coeff	1.0000	

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

TSP High Volume Sampler Calibration

DATE: October 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-2576
Serial# : 2158
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

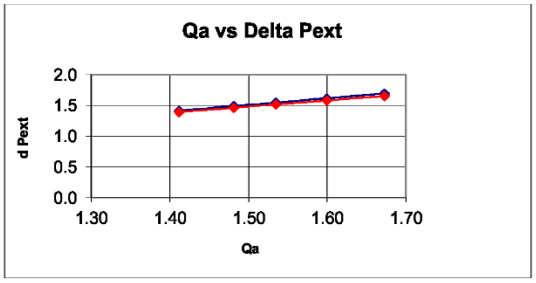
Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

Conditions

Ta:(°C)	28.5	**Ta (°K)**	301.5	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.072053**
6.9	1.673	6.6	1.695	1.6532	**intercept, b2:**	**-0.098219**
6.3	1.599	6	1.616	1.5797	**corr. coeff, r2**	**0.999999**
5.8	1.535	5.5	1.548	1.5157		
5.4	1.482	5.1	1.490	1.4625	**SFR**	**1.139**
4.9	1.412	4.6	1.415	1.3932	**SSP**	**2.90**



Amrit Persad Maharaj
Instrumentation Technician

Red line is the regression line.
* delta Pext = m1(Qa + b1)

E(x)	7.701
E(y)	7.6042
E(x2)	11.9027
E(y2)	12.1062
E(xy)	11.7532
n	5
avg x = E(x)/n	1.5402
avg y = E(y)/n	1.5208
(Ex)2	59.3083
(Ey)2	57.8242
m	0.99571
b	-0.01278

For Regression Model:

slope:	0.99571	**for plot of Qa vs Pext = m1(Qa + b1)**
Intercept:	-0.01278	
corr. Coeff	1.0000	

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

TSP High Volume Sampler Calibration

DATE: October 23rd 2019
Techinician : Amrit Persad Maharaj

Certificate #: 010319-4731
Serial# : 4731
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

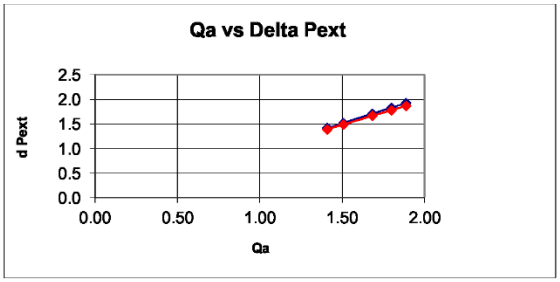
Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.068727**
8.8	1.889	8.5	1.925	1.8679	**intercept, b2:**	**-0.093403**
8	1.801	7.7	1.832	1.7810	**corr. coeff, r2**	**0.999998**
7	1.686	6.7	1.709	1.6660		
5.6	1.509	5.3	1.520	1.4901	**SFR**	**1.141**
4.9	1.413	4.6	1.416	1.3938	**SSP**	**2.91**



Amrit Persad Maharaj
Instrumentation Technician

Red line is the regression line.
* delta Pext = m1(Qa + b1)

E(x)	8.298
E(y)	8.1988
E(x2)	13.9292
E(y2)	14.2965
E(xy)	13.7633
n	5
avg x = E(x)/n	1.6597
avg y = E(y)/n	1.6398
(Ex)2	68.8614
(Ey)2	67.2195
m	0.99571
b	-0.01278

For Regression Model:

slope:	0.99571	**for plot of Qa vs Pext = m1(Qa + b1)**
Intercept:	-0.01278	
corr. Coeff	1.0000	

KAIZEN
Environmental Services (T'dad) Ltd

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FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

TSP High Volume Sampler Calibration

DATE: October 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4728
Serial# : 4728
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

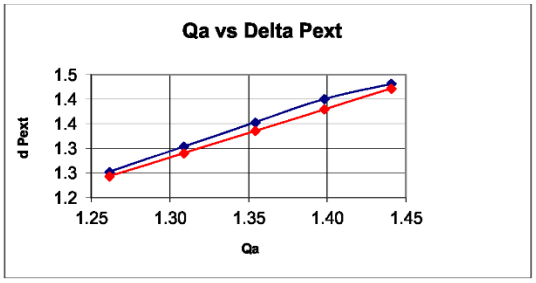
Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.014525**
5.1	1.441	4.7	1.431	1.4220	**intercept, b2:**	**-0.024242**
4.8	1.398	4.5	1.401	1.3795	**corr. coeff, r2**	**0.997630**
4.5	1.354	4.2	1.353	1.3357		
4.2	1.309	3.9	1.304	1.2905	**SFR**	**1.141**
3.9	1.262	3.6	1.253	1.2435	**SSP**	**2.94**



Amrit Persad Maharaj
Instrumentation Technician

Red line is the regression line.
* delta Pext = m1(Qa + b1)

E(x)	6.764
E(y)	6.6713
E(x2)	9.1710
E(y2)	9.1097
E(xy)	9.0452
n	5
avg x = E(x)/n	1.3528
avg y = E(y)/n	1.3343
(Ex)2	45.7546
(Ey)2	44.5058
m	0.99571
b	-0.01278

For Regression Model:

slope:	0.99571	**for plot of Qa vs Pext = m1(Qa + b1)**
Intercept:	-0.01278	
corr. Coeff	1.0000	

ANNEX 2

NOISE

TSI INCORPORATED – OCONOMOWOC
1060 Corporate Center Drive, Oconomowoc, WI 53066 USA
tel 651 490 2811 + toll free 800 245 0779 + web www.tsi.com

An ISO 9001 Registered Company

Certificate of Calibration

Certificate No: 795998 BGG110027

Submitted By: ENGINEERING, APPLIED SCIENCE & TECHNOLOGY LTD (EAST)
62 EASTERN MAIN ROAD
ST. AUGUSTINE

Serial Number:	BGG110027	Date Received:	5/20/2019
Customer ID:	E.A.S.T.	Date Issued:	5/22/2019
Model:	SOUNDPRO DL-2 SLM	Valid Until:	5/22/2020

Test Conditions:

Temperature:	18°C to 29°C
Humidity:	20% to 80%
Barometric Pressure:	890 mbar to 1050 mbar

Model Conditions:

As Found:	IN TOLERANCE
As Left:	IN TOLERANCE

SubAssemblies:

Description:	Serial Number:
TYPE 2 PREAMP	1207 1451
MICROPHONE QE 7052 1/2 IN. ELECTRET	30708

Calibrated per Procedure: 53V899

Reference Standard(s):

I.D. Number	Device	Last Calibration Date	Calibration Due
EF000176	QUEST-CAL	12/11/2018	12/11/2019
ET0000556	B&K ENSEMBLE	6/23/2018	10/31/2019

Measurement Uncertainty:

+/- 2.2% ACOUSTIC (0.19DB)
Estimated at 95% Confidence Level (k=2)

Calibrated By: Brian L Bayer 5/22/2019
BRIAN BAYER **Service Technician**

This report certifies that all calibration equipment used in the test is traceable to NIST, and applies only to the unit identified under equipment above. This report must not be reproduced except in its entirety without the written approval of TSI Incorporated.

098-393 Rev. B

TSI INCORPORATED – OCONOMOWOC
1060 Corporate Center Drive, Oconomowoc, WI 53066 USA
tel 651 490 2811 + toll free 800 245 0779 + web www.tsi.com

An ISO 9001 Registered Company

Certificate of Calibration

Certificate No: 795998 QIG110126

Submitted By: ENGINEERING, APPLIED SCIENCE & TECHNOLOGY LTD (EAST)
62 EASTERN MAIN ROAD
ST. AUGUSTINE

Serial Number:	QIG110126	Date Received:	5/20/2019
Customer ID:	E.A.S.T.	Date Issued:	5/22/2019
Model:	QC-10 CALIBRATOR	Valid Until:	5/22/2020

Test Conditions:

Temperature:	18°C to 29°C
Humidity:	20% to 80%
Barometric Pressure:	890 mbar to 1050 mbar

Model Conditions:

As Found:	IN TOLERANCE
As Left:	IN TOLERANCE

SubAssemblies:

Description:	Serial Number:

Calibrated per Procedure: 56V981

Reference Standard(s):

I.D. Number	Device	Last Calibration	Date Calibration Due
ET0000556	B&K ENSEMBLE	6/23/2018	10/31/2019
T00230	FLUKE 45 MULTIMETER	2/22/2018	2/22/2020

Measurement Uncertainty:

+/- 1.1% ACOUSTIC (0.1DB) +/- 1.4% VAC +/- 0.012% HZ
Estimated at 95% Confidence Level (k=2)

Calibrated By: Brian L Bayer 5/22/2019
BRIAN BAYER **Service Technician**

This report certifies that all calibration equipment used in the test is traceable to NIST, and applies only to the unit identified under equipment above. This report must not be reproduced except in its entirety without the written approval of TSI Incorporated.

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ANNEX 3

MET STATION

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE #: 040418-A70426N737

DATE: 2019-10-27

ANALYSER TYPE: Davis Meteorological Station

SERIAL #: A70426N737

Sensor	Date Checked	Response
UV	*040418*	**OK**
Rain Gauge	*040418*	**OK**
Wind Monitor	*040418*	**OK**
Wind Direction	*040418*	**OK**
Temp & Humidity	*040418*	**OK**
Pressure	*040418*	**OK**

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with Davis factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

APPENDIX B

CURRICULA VITAE AND BIOGRAPHIES OF KEY STAFF

ANNEX 1

ECOENGINEERING

MS. DEBBIE REYES

DEBBIE REYES

Date of Birth: October 08, 1974

Nationality: Citizen of Trinidad and Tobago

Current Post: Environmental Scientist / Ecologist
Ecoengineering Consultants Limited

Ms. Debbie Reyes is a senior Environmental Scientist / Ecologist with project experience throughout the Caricom Region. She has managed a number of EIAs for Ecoengineering in the following sectors: Offshore and Onshore Oil and Gas; Quarries, Golf Courses and Villa Developments in Anguilla and Tobago; Housing and Infrastructure Development, Tourism, Drainage. Debbie has also undertaken ecology surveys in Trinidad, Tobago, Antigua, Barbados, and St. Vincent and the Grenadines and has worked on Environmental Management Plans, Health, Safety and Environment (HSE) Management Plans, Risk Assessments and Emergency Response Plans.

EDUCATION

M.Sc. Natural Resources Management, 2004,
University of the West Indies, Cave Hill, Barbados

B.Sc. Zoology and Botany, 2000 (First Class Honours),
University of the West Indies, St. Augustine, Trinidad

OTHER TRAINING

Turn Down the Heat: From Climate Science to Action, Facilitated by the World Bank Group, 2016
Practical Application of Ecosystem Services to Impact Assessment and Environmental Decision-Making, 2013
Advanced Principles of Toxicology, 2011
Ecological Risk Assessment: Theory and Practice, 2008
National General Certificate in Occupational Safety & Health (OSHA, USA)
Point Lisas Energy Associates Safety, Health and Environment Training, 2013
Technical Writing, 2009
Personal Survival Techniques - Basic, 2004
30-hour Occupational Safety and Health, 2006
First Aid Training, 2009
Defensive Driving, 2005

PROFESSIONAL ASSOCIATIONS

Member, Society of Environmental Toxicology and Chemistry (SETAC)

EMPLOYMENT RECORD

Present	Managing Director, Ecoengineering Consultants Limited
2008-2013	General Manager, Ecoengineering Consultants Limited
1995 - Present	Ecologist, Ecoengineering Consultants Limited
1993 - 1995	Office Assistant, Design Engineering Services Limited
1993 - 1994	Junior Accountant, Hilo Food Stores Limited

WORK EXPERIENCE

A ENVIRONMENTAL IMPACT ASSESSMENTS (EIAs) AND RELATED STUDIES FOR TOURISM PROJECTS

2015	Senior Environmental Scientist, Environmental Component of Feasibility Studies and Design Consultancy Services for the Improvements to the Diego Martin Highway / Western Main Road Intersection and Related Improvements.
2014	Senior Environmental Scientist, Addendum to EIA for Resort Development at Las Cuevas.
2009	Study Manager, EIA for Villa Development at Long Bay, Anguilla
2007	Study Manager, EIA for Golf Course and Resort at Forest Estate, Anguilla.
2005	Study Manager, EIA for Golf Course and Resort at Savannah Bay, Anguilla.
2004	Environmental Scientist, EIA for Back of House Facility at Temenos Estates, Anguilla

B ENVIRONMENTAL IMPACT ASSESSMENTS (EIAs) AND RELATED STUDIES FOR LAND DEVELOPMENT PROJECTS

Current	Study Manager, Environmental and Social Assessment and Environmental and Social Management Framework for Urban Revitalization: Upgrading of Scarborough Esplanade, Tobago.

Current	Senior Environmental Scientist, Environmental and Social Assessments and Environmental and Social Management Framework for Urban Revitalization: Renovation of Eastside Plaza in Port of Spain, Trinidad.
2018	Senior Environmental Scientist, Response Document for EMA's Request for Further Information concerning a CEC Application for Quarry Expansion, Valencia.
2017	Study Manager, EIA for Limestone Quarry at Maracas, St. Joseph.
2015	Senior Environmental Scientist, Environmental Component for Integrated Strategic Redevelopment of the City Centre and International Water Centre of Port of Spain
2013	Study Manager, Environmental Management Plan for Paranam Industrial and Commercial Park, Suriname.
2013	Study Manager, Environmental and Social Impact Assessment for Paranam Industrial and Commercial Park, Suriname
2012/13	Senior Environmental Scientist, EIA for Quarry at Pine Road, Matura.
2010/11	Senior Environmental Scientist, IEIAs for Construction of Supreme Courts in Nine OECS Territories (Grenada, St. Vincent and the Grenadines, St. Lucia, Dominica, Antigua, St. Kitts, Nevis and British Virgin Islands and Anguilla.
2006	Study Manager, development of an Environmental Management Plan for the Wallerfield Technology and Innovation Park.
2004	Environmental Scientist, EIA for Orange Hill Housing Development, Tobago.
.	
2003	Environmental Scientist, EIA for an Industrial Park, Cove Estate, Tobago.

C ENVIRONMENTAL IMPACT ASSESSMENTS (EIAs) AND RELATED STUDIES FOR INFRASTRUCTURE AND ROADS PROJECTS

Current	Study Manager, Environmental Scoping Study and Environmental Management Plan for Scarborough Bye Pass Project.
Current	Study Manager, EIA for Valencia to Toco Roadway.
2019	Senior Environmental Scientist, EIA for the Upgrading of Crooked Tree Road and Causeway in Belize.
2009/10	Senior Environmental Scientist, EIA for Extension of Point Fortin Highway, Paria Suites to St. Mary's Junction Segment.

2009 Senior Environmental Scientist, EIA for Extension of Point Fortin Highway, Debe to Mon Desir Segment.

2009 Environmental Scientist, EIAs for Trinidad Rapid Rail Project.

2007 Environmental Scientist, EIA for Princes Town to Mayaro Highway.

2006 Environmental Scientist, EIA for Extension of Point Fortin Highway, Golconda to Debe Segment.

D ENVIRONMENTAL IMPACT ASSESSMENTS (EIAs) AND RELATED STUDIES FOR DRAINAGE PROJECTS

2013 Senior Environmental Scientist, Addendum to Detailed Assessment of Environmental Impacts for Caparo River Basin Drainage, Flood Mitigation and Water Supply Project.

2013 Senior Environmental Scientist, PEIA for Caparo River Basin Drainage, Flood Mitigation and Water Supply Project.

2013 Senior Environmental Scientist, Addendum to Detailed Assessment of Environmental Impacts for Caroni River Drainage Basin Study.

2012 Senior Environmental Scientist, PEIA for Caroni River Drainage Basin Study.

E CEC APPLICATIONS AND RELATED STUDIES

Current Senior Environmental Scientist, Baseline Studies and CEC Application for Drilling of Two Wells in Central Block, Trinidad.

2018 Senior Environmental Scientist, Response to the Request for Further Information from the Environmental Management Authority (EMA) concerning the establishment of a Workshop and Wastewater Treatment Plant at Pt. Lisas.

2018 Senior Environmental Scientist, Response to the Request for Further Information from the Environmental Management Authority (EMA) concerning the Expansion of an existing mining and processing operation in Guaracara.

2018 Senior Environmental Scientist, Response to the Request for Further Information from the Environmental Management Authority (EMA) concerning the expansion of a Quarry at Valencia.

2017 Senior Environmental Scientist, CEC Application for a Housing Development at Maracas, St. Joseph.

2016	Study Manager, Certificate of Environmental Clearance (CEC) Application for Limestone Quarry at Maracas, St. Joseph.
2015	Study Manager, Environmental Services associated with CEC Application for Concrete Batching Plant in Penal.
2015	Senior Environmental Scientist, CEC Application for a Single Family Dwelling Unit at Goodwood Park.
2015	Senior Environmental Scientist, CEC Application for a Warehousing Flex Space at Biljah Road, Chaguanas.
2014	Study Manager, CEC Application for Vendor's Mall at Charlotteville, Tobago.
2013	Senior Environmental Scientist, Response to the Request for Further Information from the Environmental Management Authority (EMA) concerning a Science City at Couva.
2013	Senior Environmental Scientist, CEC Applications for Flood Protection Works under the Caroni Drainage Basin Study.
2010/11	Study Manager, CEC Application for Exploratory Drilling in Block 2(ab) offshore the East Coast of Trinidad.

F OTHER STUDIES

Current	Study Manager, Sixth National Report for the United Nations Convention to Combat Desertification.
2018	Study Manager, Revision of the National Environmental Policy for Trinidad and Tobago, 2006.
2016	Study Manager, Environmental Component for Feasibility Study and Detailed Designs Consultancy Services for the South Oropouche River Basin Flood Mitigation And Integrated Watershed Management Project.
2016	Study Manager, Preparation of Rehabilitation Plan for Quarry at Matura.
2015	Study Manager, Environmental Studies associated with Construction of San Fernando WWTP and Sewers.
2015	Study Manager, Environmental Services associated with CEC Application for Concrete Batching Plant in Penal.
2015	Study Manager, Environmental Baseline Study for Maintenance Dredging at Port in Point Lisas.

2015	Senior Environmental Scientist, Review of Natural Environmental Issues for Proposed Housing Development at Trestrail Lands, D'abadie
2015	Study Manager, Environmental Baseline Studies for Steel Mill at La Brea.
2014	Senior Environmental Scientist, Monitoring of Effluent During Drilling and Monitoring of Sediment Post Drilling in the Gulf of Paria, La Brea.
2010	Study Manager, Preparation of a Protected Areas Systems Plan for St. Kitts and Nevis.
2004 / 2005	Study Manager, Characterization of Flora and Fauna at Bayfield, Tobago, being prepared for the Marketing Department of the Tobago House of Assembly.
2002	Environmental Scientist, Technical Manual for Post-Disaster Rapid Environmental Assessment for OECS – Environment & Sustainable Development Unit.
2001	Environmental Scientist, Environmental Scoping Exercise and Terms of Reference for Proposed Quarry, Perseverance, Grenada.
2001	Environmental Scientist, Soil Contamination Investigation at Prospect Power Station, Nevis.

MS. INDRANY LINDA SAMMY

INDRANY LINDA SAMMY

Date of Birth: December 2, 1960

Nationality: Citizen of Trinidad and Tobago

Current Post: Senior Environmental Scientist
Ecoengineering Consultants Limited

Ms. Linda Sammy is a senior Environmental Scientist with extensive experience in conducting environmental studies for a wide range of projects. She has been lead professional on the preparation of Environmental Management Plans (EMPs), monitoring Health, Safety and Environmental (HSE) Performance of contractors, and Environmental Monitoring. Linda has also worked on Environmental Impact Assessments for a diverse range of project types, as well as on Health, Safety and Environmental (HSE) Audits and Environmental Site Assessments. Linda has worked on projects in Trinidad and Tobago, St. Lucia, British Virgin Islands, Guyana, St. Vincent and Suriname.

EDUCATION

B.Sc. (Hons) Natural Sciences (Zoology, Chemistry, Biochemistry), University of the West Indies (1982).

M.Sc. (Distinction), Food Technology, University of the West Indies, (1985).

M.Sc. in Environmental Management, University of London (2008)

CONTINUING EDUCATION

Emergency Response Management (UTT, 2009).

Certificate in Managing Safely (Institute of Occupational Safety and Health, UK, 2001).

National General Certificate in Occupational Safety & Health (Credit) (NEBOSH, UK, 2001).

Tourism Planning (1999).

Advanced Environmental Management Systems Auditing (1998).

Government Institutes Environmental Audits Course (Orlando, Florida, USA) (1997).

RAB Accredited Lead Auditor Training Certificate Course (1996).

EMS Planning, Implementing and Formalising an Environmental Management System to BS 7750/ISO DIS 14001/EMAR (1996).

EMPLOYMENT:	ECOENGINEERING CONSULTANTS LIMITED
1994 - Present	Ecoengineering Consultants Limited, Senior Environmental Scientist
1988 - 1994	Caribbean Industrial Research Institute (CARIRI), Food Technologist
1988 to 1998	Food Technology Unit, UWI, St. Augustine, Part-time Lecturer
1987 - 1988	Cannings Foods Limited, Food Technologist
1984 to 1986	Food Technology Unit, UWI, St. Augustine, Laboratory Assistant

WORK EXPERIENCE

A ENVIRONMENTAL IMPACT ASSESSMENTS AND RELATED STUDIES

current	CEC Application for Campus Facility (Phase 2) for an Energy Service Company, South Trinidad.
2017-2019	EIA for Decommissioning of Power Station in POS, Trinidad.
2016	CEC Application for Oilfield Service Facility in Guapo, South Trinidad.
2014 / 2016	Study Manager, Environmental Impact Assessment for a Mid-Scale LNG Liquefaction Facility at La Brea, South Trinidad.
2014/2015	Study Manager, Environmental Impact Assessment for Fruit and Vegetable Crop Farm and Energy Services Facility at Picton IV Estate, Picton, Debe.
2013	Study Manager, Environmental Impact Assessment for Exploratory Drilling in the Mayaro-Guayaguayare Block (Onshore), Southeast Trinidad.
2012	Study Manager, Environmental Impact Assessment for Exploratory Drilling in the Guayaguayare Block (Onshore), South Trinidad.
2012	Study Manager, Environmental Scoping for the Reconstruction of Eleven Bridges. Bridges Reconstruction Programme (Phase 1 - Package B).
2011	Senior Environmental Scientist, Environmental Impact Assessment for Urea - Ammonia Expansion at Point Lisas.
2008	Study Manager, EIA for Land Clearance at Acono Road, Maracas Valley.
2005 / 06	Study Manager, EIA for an Integrated Resort at Las Cuevas.
2004	Study Manager, EIA for Revamp of 03 Ammonia Plant, Point Lisas.

2004 Environmental Scientist, Preliminary EIA for Decommissioning of Offshore Platforms.

2004 Environmental Scientist, Preliminary EIA for HFO Power Plant West-EPAR, Suriname.

B ENVIRONMENTAL AUDITS AND ENVIRONMENTAL SITE ASSESSMENTS

2016-2017 Senior Environmental Scientist, Preparation of Contract Documents and Supervision of Contract for Removal of Underground Storage Tanks and Soil Remediation at a site in Northwest Trinidad.

2015 Senior Environmental Scientist, Phase 1 ESA for Solomon Hochoy Highway Extension: Grant's Trace to Dunlop Roundabout, Trinidad.

2015 Senior Environmental Scientist, Environmental Due Diligence at a Land Treatment Facility, La Brea, South Trinidad.

2015 Study Manager, Environmental Compliance Audit at Fabrication Facility in Debe, South Trinidad.

2015 Phase I Environmental Site Assessment for Solomon Hochoy Highway Extension: Grant's Road to Dunlop Roundabout, Point Fortin, South Trinidad.

2012 Study Manager, Environmental Site Assessment (ESA) for Goudron Block, South Trinidad.

2011 Study Manager, ESA for Commercial Property at Chaguanas, Trinidad.

2010 Study Manager, ESA for Lowmans Bay Power Station, St. Vincent.

2010 Study Manager, ESA of operations of Delta Petroleum, Tortola, British Virgin Islands.

2009 Senior Environmental Scientist, Preliminary Environmental Site Assessment for Trinidad Rapid Rail Project.

2009 Lead Auditor, Environmental, Health and Safety Audit and Phase 1 Environmental Site Assessment (ESA) at a Paper Mill in O'Meara, Trinidad.

2009 Lead Auditor, Environmental, Health and Safety Audit and Phase 1 Environmental Site Assessment (ESA) at a Soft Drink Bottling Plant in Trincity, Trinidad.

2009 Team Leader, Environmental and Social Due Diligence Audit for a Chemical Plant at Point Lisas, Trinidad.

2007 Study Manager, ESAs at two sites within the Pointe-a-Pierre Oil Refinery.

2007 Lead Auditor, Environmental, Health and Safety Audit at a Diaper Factory in Aranguez, Trinidad.

2007/08 Study Manager, Phase 1 ESA for a Site at Union Industrial Estate, La Brea.

2003 Study Manager, Consideration of Environmental Factors in the Selection of Sites for the Palo Seco High School.

2003 Study Manager, Environmental Site Assessment for Two Gasoline Filling Stations and Two Undeveloped Sites in Paramaribo, Suriname.

2003 Study Manager, Phase I Environmental Site Assessment for a Proposed 6 km Pipeline Corridor in Southeast Trinidad.

C ENVIRONMENTAL MANAGEMENT PLANS AND RELATED PLANS

The following is a listing of stand-alone environmental management plans (EMPs) on which Ms. Sammy has worked. In addition, she has worked on EMPs on each of the Environmental Impact Assessments listed in Section A, above.

2018 Senior Environmental Scientist, Environmental Monitoring Plan for Offshore Drilling East Coast, Trinidad.

2016 & 2018 Senior Environmental Scientist, Quality Assurance Project Plan for Expansion of the Desalination Plant in Pt. Fortin.

2014 / 15 Study Manager, Environmental Management Plan for a large-diameter Water Pipeline from Piarco to Couva.

2013 Study Manager, Quality Assurance Project Plan, Solid Waste Management Plan and Sediment & Erosion Management Plan for Science City at Point Lisas.

2013 Study Manager, Quality Assurance Project Plan, Solid Waste Management Plan and Water Quality Management Plan for development at Picton IV Estate, South Trinidad.

2009 Study Manager, Environmental Scoping Report and Environmental Management Plan for Upgrade of Community Roads in Regions 3, 4, 5 and 6, Guyana.

2005 Study Manager, Environmental Action Plans for Rehabilitation of Five Roads in Trinidad and Tobago.

2004 / 05 Study Manager, Environmental Management Plan for Extension of Diego Martin Highway Extension.

D ENVIRONMENTAL MONITORING

In addition to the monitoring projects listed below, environmental monitoring would have been included in the EIA studies listed in Section A which Ms. Sammy would have managed.

2017	Senior Environmental Scientist, Noise and Water Quality Monitoring at 6 Locations for an Oilfield Service Company.
2016	Senior Environmental Scientist, Flow Measurements and Technical Assistance in Complying with Water Pollution Permit at a Snack Food Company in El Socorro.
2013	Study Manager, Environmental Baseline Studies for the Establishment of a Mid-Scale LNG Liquefaction Facility at La Brea, Soth Trinidad.
2007	Study Manager, Contamination Survey (sampling and testing of soil, surface water and ground water) of the site for an Ethanol Plant at Pointe-a-Pierre.
2007	Study Manager, Contamination Survey (sampling and testing of soil, surface water and ground water) of the site for an Ammonia Plant at Point Lisas.
2006	Study Manager, Contamination Survey (sampling and testing of soil, surface water and ground water) of the site for a Gas-to-Liquids Plant at Pointe-a-Pierre.
2003	Study Manager, Environmental Site Assessment (Phase I ESA supplemented with sampling and testing of soil, surface water and ground water) at a Warehouse Compound in Point Lisas.
2003	Study Manager, Contamination Survey (sampling and testing of soil, surface water and ground water) of a Proposed 3 km Pipeline Route from Rustville to Abyssinia, Southeast Trinidad.
2003	Study Manager, Environmental Site Assessment (Phase I ESA supplemented with sampling and testing of soil, surface water, ground water, suspected asbestos sheeting and suspected lead- and mercury- based paints) for a Proposed Natural Gas Receiving Station and a Construction Lay-Down Yard in Guayaguayare.
2002 / 03	Study Manager, Environmental Baseline Study (including sampling and testing of soil, surface water and ground water) for a Proposed Tank Farm in Guayaguayare.

E HSE MONITORING OF CONSTRUCTION

2015 / 16	Senior Environmental Scientist, HSE Supervision, Coastal Protection Works, Shore of Peace.
2011	Manager, HSE Supervision, Tamana Inteck Park, Wallerfield.
2009/2010	Manager, HSE Supervision, Cove Industrial Estate, Tobago.
2006/2009	Manager, HSE Supervision, National Highways Programme Year 3 Roads Rehabilitation Programme.
2006 / 2007	Manager, HSE Supervision, Diego Martin Highway Extension from Sierra Leone Road to Wendy Fitzwilliam Boulevard.

F OTHER STUDIES

current	Environmental Scientist, Sixth National Report, United Nations Convention to Combat Dessertification (UNCCD)
2018	Environmental Scientist, Revision of the National Environmental Policy for Trinidad and Tobago, 2006.

MS. JOANNE REYES

JOANNE REYES

Date of Birth: January 13, 1981

Nationality: Citizen of Trinidad and Tobago

Current Post: Environmental Scientist / HSE Officer
Ecoengineering Consultants Limited

Joanne Reyes is an Environmental Scientist / HSE Officer and holds a Bachelor of Science Degree in Occupational, Safety, Health and Environment from the University of Greenwich. She holds a Certificate in Level 1 AutoCAD from the University of the West Indies in St. Augustine, Trinidad, and a Certificate in OSHA General Industry. She has also received training in TFOET, Fundamentals of Risk Assessment and Effective Accident/Incident Investigation. Joanne has considerable experience in HSE Inspections on construction sites and Environmental Monitoring. She has conducted monitoring of air, noise, soil, sediment, light and stream flow on a variety of projects including industrial and construction sites, oil fields, forest, wetlands, surface waters and a power station.

EDUCATION

B.Sc., Occupational, Safety, Health and Environment (Second Class Honours) University of Greenwich, SBCS (2017)

University of Greenwich, SBCS, Matriculation to Occupational, Safety, Health and Environment (2015)

University of the West Indies, Open Campus, Health Safety and Environmental Management (2014)

RBTT Roytec, Certificate for the Administrative Assistant (2001)

SITAL, Certificate in Office Administration (2003)

Engineering Institute, UWI, Certificate in Level 1 AutoCAD (2006)

JARIC Environment, Safety and Health Services Limited, Certificate in OSHA General Industry (2007)

COMPUTER LITERACY

Working knowledge of:

- Microsoft Office
- Word Perfect
- Windows XP
- Adobe Acrobat
- AutoCad Map R3, AutoCAD 2005, 2010, 2011, 2013
- WRPLOT View
- Open Source GIS

OTHER TRAINING

- Point Lisas Energy Association (PLEA) of Upstream Operators Safety Training (2019)
- BasicPlus CPR, AED and First Aid for Adults (8 hr) (2018)
- Tropical Further Offshore Emergency Training (TFOET) (2018)
- Emergency Medicine and You, UWI (2013)
- Seven Seas Water Safety Orientation (2013)
- Petrotrin/Trinmar Operations Safety Orientation (2013)
- IPSL, Ammonia Division Safety Orientation (2018)
- Effective Accident/Incident Investigation (2012)
- Fundamentals of Risk Assessment Workshop (2011)
- Defensive Driving (2006)

EMPLOYMENT RECORD

October 2017 - Present	Environmental Scientist / HSE Officer, Ecoengineering Consultants Limited
June 2013 - September 2017	HSE Officer, Ecoengineering Consultants Limited
April 2008 - May 2013	Technician - Draftsman/Safety Officer, Ecoengineering Consultants Limited
October 2007 - April 2008	Technician - Draftsman , Ecoengineering Consultants Limited
January 2001 - September 2007	Administrative Assistant, Ecoengineering Consultants Limited
July 1998 - December 2000	Receptionist/Clerk, Ecoengineering Consultants Limited.

WORK EXPERIENCE

CEC Applications

2017	Environmental Scientist, Response to EMA's Request for Further Information concerning an application for a CEC for Establishment of a Crematorium Unit in Diego Martin.

Environmental Monitoring

2019	Environmental Scientist, Air, Noise and Water Quality Monitoring as part of an ESIA for Geothermal Wells in Grenada.
2013-present	Environmental Scientist, Compliance Monitoring for Outfall and Effluent discharge at a Desalination Plant in Point Fortin.
Present	Environmental Scientist, Flow Characteristics of a site stream in the Point Lisas Industrial Estate.
2017	Health and Safety Technician, Environmental Due Diligence Study for a steel plant in Point Lisas.
2016 - 2017	Health and Safety Technician, Surface and Marine Water Sampling for the Decommissioning of a Power Station in Port of Spain.

2016	Health and Safety Technician, Ambient Air Quality Monitoring for a Sand and Gravel Quarry in Guaico, Sangre Grande.
2016	Health and Safety Technician, Ambient Air Quality monitoring for an ammonia plant in Point Lisas.
2016	Health and Safety Technician, Water and Soil Sampling for tank excavation and soil remediation works in St. James.
2015	Health and Safety Technician, Water Quality and Sediment Sampling for Port Expansion project in La Brea.
2014 - 2015	Health and Safety Technician, Sewage Waste Water Monitoring for an offshore installation in the Gulf of Paria.
2013 - 2015	Health and Safety Technician, Effluent Monitoring at a discharge location for a Desalination Plant in Point Fortin.
2013 - 2014	Health and Safety Technician, Benthic Sampling and Temperature, pH and Salinity Profiling a Desalination plant in Point Fortin.
2013	Health and Safety Technician, Ambient Marine Water Quality Monitoring and Sampling at Marine Outfall, Point Lisas.
2012 - 2013	Health and Safety Technician, Air and Noise Monitoring for Caroni River Basin Drainage Study.
2012	Health and Safety Technician, Thermal Effluent Monitoring for Power Station in Port of Spain.
2012	Health and Safety Technician, Occupational Noise Monitoring at Facility in Reform Village, Gasparillo.
2011	Health and Safety Technician, Air and Noise Monitoring for Power Station in St. Vincent.
2011	Health and Safety Technician, Air and Noise Monitoring for Exploratory Drilling in the Guayaguayare Block (Onshore).
2010	Safety Officer, Monitoring staff in the collection of water, sediment and benthic macrofauna samples within the Offshore Segment of the Guayaguayare Block as part of the EIA for Exploratory Drilling.
2010	Health and Safety Technician, Air and Noise Monitoring for Exploratory Drilling of 3 wells in Block 2AB.

2010	Health and Safety Technician, Assessment of the Mangrove Wetland System Southwest of the CNC Plant Facility.
2008 - 2010	Health and Safety Technician, Particulate Matter (PM_{10}) Monitoring at the AUM Downstream Complex.
2008 - 2010	Health and Safety Technician, Compliance Monitoring at Tamana In Tech Park, Wallerfield.
2008 - 2013	Health and Safety Technician, Monitoring of Flow Characteristics of CNC Site Stream.
2008	Health and Safety Technician, Air Monitoring for clearing of 7.5 ha of Land at Acono Road, Maracas Valley, St. Joseph.
2008	Health and Safety Technician, Noise Monitoring for EIA works at the Proposed Water Treatment Plants at Matura and Salybia.
2008	Health and Safety Technician, Light Monitoring and Soil Sampling for EIA for a Road Tank Wagon Loading Facility at Pointe-A-Pierre.
2008	Health and Safety Technician, Soil Sampling for Contamination Study at the Lube Oil Tank Farm, Petrotrin Refinery, Pointe-A-Pierre.
2008	Health and Safety Technician, Ambient Monitoring of the Couva River.

Construction Supervision

2015 - 2016	Health and Safety Inspector, Health, Safety and Environmental Inspections for Cliff Stabilization Works at a site in South Oropouche.
2011	Health and Safety Inspector, Baseline Studies at Cove, Tobago.
2007 - 2010	Health and Safety Inspector, Health, Safety and Environmental Inspections at Tamana In Tech Park, Wallerfield.
2007 - 2009	Health and Safety Inspector, National Highway Program - Year III Roads Rehabilitation Package1 & 2.

Health and Safety Management Audits

2019	HSE Auditor, Air, Noise and Water Quality Monitoring as part of an ESIA for Geothermal Wells in Grenada.
2017-present	HSE Auditor, Compliance Monitoring for Outfall and Effluent discharge at a Desalination Plant in Point Fortin.
2018-present	HSE Auditor, Flow Characteristics of a site stream in the Point Lisas Industrial Estate.
2018	HSE Auditor, Establishment of a Residential Development in Maracas, St. Joseph.
2018	HSE Audior, Flow Characteristics of a site stream in the Point Lisas Industrial Estate.
2018	HSE Auditor, Waste Characterization for review of the National Waste Management Strategy in Grenada.
2018	HSE Auditor, Response to Request for Further Information for Quarry in Mayo.
2017	HSE Auditor, Environmental Due Diligence Study for a steel plant in Point Lisas.
2017	HSE Auditor, CEC for Establishment of a pipeline in Point Lisas.
2017	HSE Auditor, Social Surveys for the Decommissioning of a Power Station in Port of Spain.
2016	HSE Auditor, Surface and Marine Water Sampling for the Decommissioning of a Power Station in Port of Spain.
2016	HSE Auditor, Compliance Monitoring for Outfall and Effluent discharge at a Desalination Plant in Point Fortin.
2016	HSE Auditor, Air and Noise monitoring for establishment of a quarry in Maracas, St. Joseph.
2016	HSE Auditor, Ambient Air Quality monitoring for an ammonia plant in Point Lisas.
2016	HSE Auditor, Drilling of boreholes for Surface and Ground Water Salinity Measurements in South Oropouche.
2016	HSE Auditor, Water and Soil Sampling for tank excavation and soil remediation works in St. James.
2015	HSE Auditor, Water Quality and Sediment Sampling for Port Expansion project in La Brea.

2014 - 2015	HSE Auditor, Sewage Waste Water Monitoring for an offshore installation in the Gulf of Paria.
2013 - 2014	HSE Auditor, Benthic Sampling and Temperature, pH and Salinity Profiling a Desalination plant in Point Fortin.
2014	HSE Auditor, CEC Application for development works on a 267 acre mega-farm in south Trinidad.
2013	HSE Auditor, EIA for the establishment of a Residential Development in Maracas, St. Joseph.
2013	HSE Auditor, Effluent Monitoring at a discharge location for a Desalination Plant in Point Fortin.
2013	HSE Auditor, Ecological Survey for the Establishment of Mid-scale LNG Plant at La Brea.
2013	HSE Auditor, Decommissioning of Weather Station site at Cove, Tobago.
2012	HSE Auditor, Overall Health and Safety practices during Access clearing, drilling and surveying for site in Guayaguayare.
2011	HSE Auditor, Ecological Survey for Baseline Studies at Cove, Tobago.

OECS Projects

2019	Environmental Scientist, Air, Noise and Water Quality Monitoring as part of an ESIA for Geothermal Wells in Grenada.
2018	Technician, Waste Characterization for review of the National Waste Management Strategy in Grenada.
2011	Health and Safety Technician, Air and Noise Monitoring for Power Station in St. Vincent.

Other Environmental Studies

2019	Environmental Scientist, Air, Noise and Water Quality Monitoring as part of an ESIA for Geothermal Wells in Grenada.
2019	Environmental Scientist, Baseline Data Collection as part of an EIA for a roadway from Valencia to Toco.

2019	Environmental Scientist, Environmental Impact Assessment for a Campus, South Oropouche.
2019	Environmental Scientist, Scoping Report for a Bye Pass road in Scarborough, Tobago
2018	Technician, Waste Characterization for review of the National Waste Management Strategy in Grenada.

MR. ASIF KHAN

ASIF KHAN

Date of Birth: October 11, 1971

Nationality: Citizen of Trinidad and Tobago

Current Post: Senior Draughtsman/LeadTechnician,
Ecoengineering Consultants Limited

UNIVERSITY TRAINING

University of the West Indies, Geographical / Land Information Systems (In Progress).

University of the West Indies, Certificate in Architectural Draughting (2004).

Mr. Asif Khan is a Senior Draughtsman/Lead Technician with significant experience in environmental monitoring. He has been involve in environmental monitoring exercises; ecological surveys; and environmental impact assessments. He has experience in environmental sampling techniques which include; Water Quality Monitoring, Surveying, Terrestrial Flora and Fauna Surveying, Noise and Air Monitoring, Soil Sampling.

SPECIALIST TRAINING

University of the West Indies (2019) A World of GIS

IPSL/CNC Safety Orientation (AUM Division) 2018

BasicPlus CPR, AED and First Aid for Adults (8 hr) (2018)

Point Lisas Energy Association (PLEA) of Upstream Operators Safety Training (2017)

Occupational Health and Safety for General Industry (30 hr) 2009

Teledyne Instruments (2009): Continuous Stack Emissions Monitoring - One-Day Seminar.

Falck Nutec (2007) Sea Survival Training

HHSL Safety Systems Limited (2004): Helicopter Survival Training Programme

Caribbean Fisheries Training And Development Institute (2003): Personal Survival Techniques (Basic)

Ecoengineering Consultants Limited (2002,1998): Technical Writing Course

University of the West Indies (2001): PC Upgrade and Maintenance

Quest Technologies (2000): Fundamentals of Noise, Heat Stress, Gas Detection, and Indoor Air Quality - One-Day Seminar.

John Donaldson Technical Institute (1999): Advanced AutoCAD

Royal Bank Institute of Business and Technology (ROYTEC) (1998): Web Development using Frontpage '98

John Donaldson Technical Institute (1997): Basic AutoCAD

ONLINE TRAINING (esri)

Learning ArcGIS Desktop (for ArcGIS 10.0) (2015)

Getting Started with the Geodatabase (2015)

Working with Geodatabase Domains and Subtypes in ArcGIS (2015)

Creating Dynamic Maps Using Esri Maps for Office (2016)

Advance Techniques for Cartographic Representations (2016)

Building Models for GIS Analysis Using ArcGIS (2016)

Exploring Spatial Patterns in Your Data Using ArcGIS (2016)

Introduction to Surface Modeling Using ArcGIS (2016)

Deriving Rasters for Terrain Analysis Using ArcGIS (2016)

Solving Spatial Problems Using ArcGIS (2016)

COMPUTER LITERACY

Working knowledge of:

- AutoCAD (MAP R3, R14, 2013, 2016)
- Arcview 3.2, ArcMAP 9.3, 10.3, QGIS (Gis Software)

- Windows Operating System
- Microsoft Office
- Corel WordPerfect
- Fugawi (GPS Software)
- R2V Software

EMPLOYMENT RECORD

1996 to present	Senior Draughtsman/Lead Technician, Ecoengineering Consultants Limited

WORK EXPERIENCE

A OECS PROJECTS

- Air, Noise and Water Quality Monitoring as part of an ESIA for Geothermal Wells in Grenada (Ongoing)
- Air and Noise Monitoring for Power Station in St. Vincent (2011)

B ROADS, HIGHWAYS AND OTHER INFRASTRUCTURE

- Diego Martin Interchange (2015)
- Environmental Monitoring for Trinidad and Tobago Rapid Rail Project (2009)
- Point Fortin Highway Extension, Trinidad (2009)

C GEOGRAPHICAL INFORMATION SYSTEMS APPLICATIONS (GIS)

- EIA for the De-Energizing, Decommission, Dismantling, Demolition and Remediation of the Port of Spain Power Station and Associated Infrastructure (2016 - 2017)
- EIA for the Establishment of a Limestone Quarry at La Caurita Estate, Maracas, St. Joseph (2016)
- ESA for Solomon Hochoy Highway Extension (2015)
- EIA for the Establishment of a Mid-Scale Liquefaction facility at the Labidco Estate, La Brea (2015)
- EIA for Exploratory Drilling in the Mayaro-Guayaguayare Block, Onshore, Southeast Trinidad (2012)
- EIA for upgrade and development of the Southern Main Road from Paria Suites to St. Mary's Junction (2010)

D ENVIRONMENTAL MONITORING

Water Quality Monitoring:

- Valencia to Toco Roadway Project (2019)
- Grenada Geothermal Energy Development (2019)
- EIA for New Campus Facility at Oropouche (2019)
- Application for Water Pollution Rules (2018)
- Environmental Due Diligence Study, Pt Lisas (2017, 2018)
- Tucker Energy Services (2017)
- EIA for Decommissioning of Powerplant, Port of Spain (2016, 2017)
- TCL Baseline Survey (2015)
- Port Expansion, La Brea (on-going)
- Baseline Data Collection at Union Estate, La Brea (2015)
- Diego Martin Interchange (2015)
- Water Quality Profiling for a Desalination Plant, Pt. Fortin (2013-2014)
- Housing Development at Maracas Valley, St. Joseph (2013)
- Mid-Scale LNG Plant at La Brea (2013)
- MHTL AUM II Complex (2013)
- IPSL Marine Sampling (2013)
- Baseline Studies at Cove, Tobago (2011-2012)
- Voyager, Exploratory Drilling in Guayaguayare Block, Onshore (2010)
- Deepening and Expansion of Sea Lots Harbour (2009).
- Trinidad and Tobago Rapid Rail Project (2009)
- Point Fortin Highway Extension, Trinidad (2009)
- Expansion of Port of Spain Harbour (1998).
- Desalcott, Trinidad
- NGC 36" Cross Island Pipeline Project
- NGC Accumulator Station Site, Abyssinia, South Trinidad.
- Villa Resort Development, Speyside Tobago
- Coastal Protection Works Along the North Coast Road, Trinidad

Sediment and Soil Sampling:

- EIA for New Campus Facility at Oropouche (2019)
- CEC Application for Las Cuevas Wall and River Mouth Works (2018)
- Environmental Baseline Assessment (2018)
- Environmental Due Diligence Study, Pt Lisas (2017, 2018)
- EIA for Decommissioning of Powerplant, Port of Spain (2017)
- TCL Baseline Survey (2015)
- Port Expansion, La Brea (on-going)
- Baseline Data Collection at Union Estate, La Brea (2015)
- Diego Martin Interchange (2015)
- Maintenance Dredging for Mittal Turning Basin, Pt. Lisas (2014)
- Sediment sampling for a Desalination Plant, Pt. Fortin (2013-2014)
- MHTL AUM II Complex (2013)

- IPSL Marine Sampling (2013)
- Baseline Studies at Cove, Tobago (2011-2012)
- Voyager, Exploratory Drilling in Guayaguayare Block, Onshore (2010)
- Deepening and Expansion of Sea Lots Harbour (2009).
- Trinidad and Tobago Rapid Rail Project (2009)
- Point Fortin Highway Extension, Trinidad (2009)
- Expansion of Port of Spain Harbour (1998).
- Atlantic LNG Plant, Trinidad
- Desalcott, Trinidad
- NGC Accumulator Station Site, Abyssinia, South Trinidad.
- Venture Production (Trinidad) Limited.
- NGC 36" Cross Island Pipeline Project
- Phoenix Park Gas Processors Limited.

Noise Monitoring:

- Grenada Geothermal Energy Development (2019)
- EIA for New Campus Facility at Oropouche (2019)
- Rising Star Restaurant Grill and Lounge (2018)
- Steel Restaurant Noise Monitoring (2017)
- EIA for Decommissioning of Powerplant, Port of Spain (2017)
- Tucker Energy Services (2017)
- Baseline Noise Monitoring for Quarry at Maracas, St Joseph (2016)
- Baseline noise monitoring for San Fernando Wastewater Treatment Plant and associated sewers (2015).
- Port Expansion, La Brea (on-going)
- Baseline Data Collection at Union Estate, La Brea (2015)
- Diego Martin Interchange (2015)
- Guayaguayare Bridge Reconstruction (2014)
- EIA for the development of Picton IV Estate (2014)
- Housing Development at Maracas Valley, St. Joseph (2013)
- Mid-Scale LNG Plant at La Brea (2013)
- Caroni Drainage Basin Study (2012-2013)
- EIA for Sand and Gravel Mining at Matura (2012)
- Baseline Studies at Cove, Tobago (2011-2012)
- Niko Exploratory Drilling in Blocks 2ab (2010)
- Coral Sands Development, Pigeon Point Tobago.
- Bacolet Stadium, Tobago.
- Expansion of Emperor Valley Zoo, Trinidad.
- 4 Residential/Commercial Land Developments (Tobago, Trinidad)
- Atlantic LNG Plant, Trinidad
- Cove Industrial Estate, Tobago
- Venture Production (Trinidad) Limited.
- Phoenix Park Gas Processors Limited.
- NGC Accumulator Station Site, Abyssinia, South Trinidad.
- Villa Resort Development, Speyside Tobago

Air Monitoring:

- Grenada Geothermal Energy Development (2019)
- EIA for Decommissioning of Powerplant, Port of Spain (2016, 2017)
- Ambient Air Quality Monitoring at YARA Trinidad Limited (2016)
- Baseline Air Monitoring for Quarry at Maracas, St Joseph (2016)
- Baseline Air monitoring for San Fernando Wastewater Treatment Plant and associated sewers (2015).
- Port Expansion, La Brea (on-going)
- Baseline Data Collection at Union Estate (on-going)
- Diego Martin Interchange (2015)
- EIA for the development of Picton IV Estate (2014)
- Housing Development at Maracas Valley, St. Joseph (2013)
- Mid-Scale LNG Plant at La Brea (2013)
- Caroni Drainage Basin Study (2012-2013)
- CEP Dominica Our Lady of Fair Haven Cathedral (2012)
- EIA for Sand and Gravel Mining at Matura (2012)
- Baseline Studies at Cove, Tobago (2011-2012)
- Niko Exploratory Drilling in Blocks 2ab (2010)
- Trinidad and Tobago Rapid Rail Project (2009)
- Coral Sands Development, Pigeon Point Tobago.
- Bacolet Stadium, Tobago.
- Emperor Valley Zoo, Trinidad.
- Cove Industrial Estate, Tobago
- Villa Resort Development, Speyside Tobago
- Atlantic LNG Plant, Trinidad

Ecological Surveys:

- Trinidad and Tobago Rapid Rail Project (2009)
- Point Fortin Highway Extension, Trinidad (2009)
- Ecology Survey at National Quarry Site
- NGC Accumulator Station Site, Abyssinia, South Trinidad.
- Venture Production (Trinidad) Limited.
- NGC 36" Cross Island Pipeline Project
- Coral Sands Development, Pigeon Point Tobago.
- Bacolet Stadium, Tobago.
- Cove Industrial Estate, Tobago
- Atlantic LNG Plant, Trinidad
- Coastal Protection Works Along the North Coast Road, Trinidad

E ENVIRONMENTAL AUDITS

- Contamination Survey along proposed Right-of-Way for Natural Gas Pipeline, Guayaguayare, South Trinidad. (2003)

- Environmental Audit of Proposed Accumulator Station Site, Abyssinia, South Trinidad. (2003)
- Environmental Audit of Proposed Oil Tank Farm, South Trinidad. (2003)
- Environmental Audit of Five Oilfields (three on-shore and two marine) for Venture Production (Trinidad) Limited. (1999)

F ENVIRONMENTAL IMPACT ASSESSMENTS

Manufacturing Industries:

- 2 Ethanol Dehydration Plants (2005, 2006).
- Gas to Liquids Plant at Pointe-a-Pierre (2006).
- Urea Ammonium Nitrate Complex (2005).
- Natural Gas Liquids Processing Plant (original and four expansions) (1998, 2004 and 2005).
- Liquified Natural Gas Plant (original plant and 2 expansions) (1996, 2000, 2002).
- Original Iron Carbide Plant and Two Additional Plants (1996, 1998).

Petroleum Industry

- Sediment Sampling for Offshore Dredging (2009)

Ports, Marinas and Coastal Structures:

- Maintenance Dredging for Mittal Turning Basin, Pt. Lisas (2014)
- Water Quality Profiling for a Desalination Plant, Pt. Fortin (2013-2014)
- IPSL Marine Sampling (2013)
- Deepening and Expansion of Sea Lots Harbour (2009)
- Deepening and Expansion of Port of Spain Harbour (1998)

Land Development:

- 4 Residential/Commercial Land Developments (Tobago, Trinidad)
- Ecology and Water Quality Survey at Quarry Site

Tourism and Recreation:

- Coral Sands Development, Pigeon Point Tobago.
- Bacolet Stadium, Tobago
- Expansion of Emperor Valley Zoo, Trinidad.

Roads, Highways and other infrastructure:

- Diego Martin Interchange (2015)
- Environmental Monitoring for Trinidad and Tobago Rapid Rail Project (2009)
- Point Fortin Highway Extension, Trinidad (2009)

G WASTE CHARACTERIZATION AND TREATMENT

1998 Technician, Waste Water Characterization Study at the Port of Spain Power Station (undertaken for Powergen).

MS. YASMIN LEON

YASMIN LEON

Date of Birth: November 13, 1979

Nationality: Citizen of Trinidad and Tobago

Current Post: Messenger / Driver / Technician,
Ecoengineering Consultants Limited

Ms. Yasmin Leon is a Technician at Ecoengineering with significant experience in environmental monitoring. She has been involved in environmental monitoring exercises and has experience in environmental sampling techniques which include; Water Quality Monitoring, Noise and Air Quality Monitoring, Soil and Benthic Sampling.

SPECIALIST TRAINING

Certificate in Occupational Safety and Health, Cipriani College of Labour and Co-Operative Studies (In Progress)

Point Lisas Energy Association (PLEA) of Upstream Operators Safety Training (2019)

IPSL/CNC Safety Orientation (AUM Division) 2018

BasicPlus CPR, AED and First Aid for Adults (8 hr) (2018)

Tropical Basic Offshore Safety Induction & Emergency Training (T-BOSIET) (2018)

COMPUTER LITERACY

Working knowledge of:

- Microsoft Office
- Corel WordPerfect

EMPLOYMENT RECORD

2007 to present Messenger / Driver /Technician,
Ecoengineering Consultants Limited

WORK EXPERIENCE

ENVIRONMENTAL MONITORING

Noise Monitoring:

- EIA for New Campus Facility at Oropouche (2019)
- Rising Star Restaurant Grill and Lounge (2018)
- Steel Restaurant Noise Monitoring (2017)
- EIA for Decommissioning of Powerplant, Port of Spain (2017)
- Tucker Energy Services (2017)
- Baseline Noise Monitoring for Quarry at Maracas, St Joseph (2016)

Air Monitoring:

- EIA for Decommissioning of Powerplant, Port of Spain (2016, 2017)
- Baseline Air Monitoring for Quarry at Maracas, St Joseph (2016)

Water Quality Monitoring:

- Valencia to Toco Roadway Project (2019)
- EIA for Decommissioning of Powerplant, Port of Spain (2016, 2017)

Sediment and Soil Sampling:

- EIA for New Campus Facility at Oropouche (2019)
- EIA for Decommissioning of Powerplant, Port of Spain (2017)

ANNEX 2

KESTL

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

Yasin Khan – Team Leader
Measurements Section – PROJECTServices Division

Mr. Yasin Khan is presently employed at Kaizen environmental Services Limited as a Team Leader in the Project Services Division – Measurements Section where he is responsible for supervising, managing and motivating team members on a daily basis.

Mr. Khan has been employed with Kaizen Environmental Services Ltd. for the past six years where he has gained extensive knowledge and training in Environmental and Occupational monitoring and sampling according to EPA and EMA guidelines. His work experiences include performing Ambient Air Quality Monitoring for a broad range of toxic air pollutants, Stack Emission Testing (Point Source Testing), Noise testing and Indoor Air Quality Monitoring.

Mr. Khan possesses a Bachelors in Business Marketing and in currently perusing his NEBOSH Certificate. Past experiences include working at Edoo's Welding as a repair Technician.

Training received are Environmental Water, Soil and Air Sampling and Procedures, Stack Emission Testing Monitoring and Sampling Training, Noise Monitoring Training, Ambient Air Quality Monitoring and Sampling Training.

Anthony Chariah
Environmental Technician | PROJECT Services Division

Mr. Anthony Chariah is presently employed at Kaizen Environmental Services Limited as an Environmental Technician in the Project Services Department where he is responsible for executing the environmental fieldwork component of projects. This includes pre planning, data collection, and management, the operation of equipment, testing and preparation of technical information.

Mr. Chariah has been under the Project Services Division for four years now where he has gained knowledge and training in Environmental and Occupational monitoring and sampling according to US EPA and EMA guidelines. His work experiences include performing Ambient Air Quality monitoring, Indoor Air Quality monitoring, Stack Emission testing (Point Source Testing) and Noise testing.

Mr. Chariah possesses a BSc. Environmental and Natural Resources Management and Geography together with a NEBOSH National General Certificate in Occupational Health and Safety. Past experience includes working as a California Industrial Engineering Services Company Limited.

APPENDIX C

NOISE RESULTS

ANNEX 1

NOVEMBER 17, 2019 (WEEKEND)

LOCATION 1

DMO Location 1 -AM

11/18/2019

Information Panel

Name	S001_BGG110027_18112019_093127
Start Time	17/11/2019 07:58:51 AM
Stop Time	17/11/2019 08:28:51 AM
Device Name	BGG110027
Model Type	SoundPro DL
Device Firmware Rev	R.13H
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	71.1 dB	Lmax	1	90.3 dB
Lmin	1	44.5 dB	Lpk	1	115.9 dB
Rtime	1	00:30:00			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	Flat
Response	2	FAST			

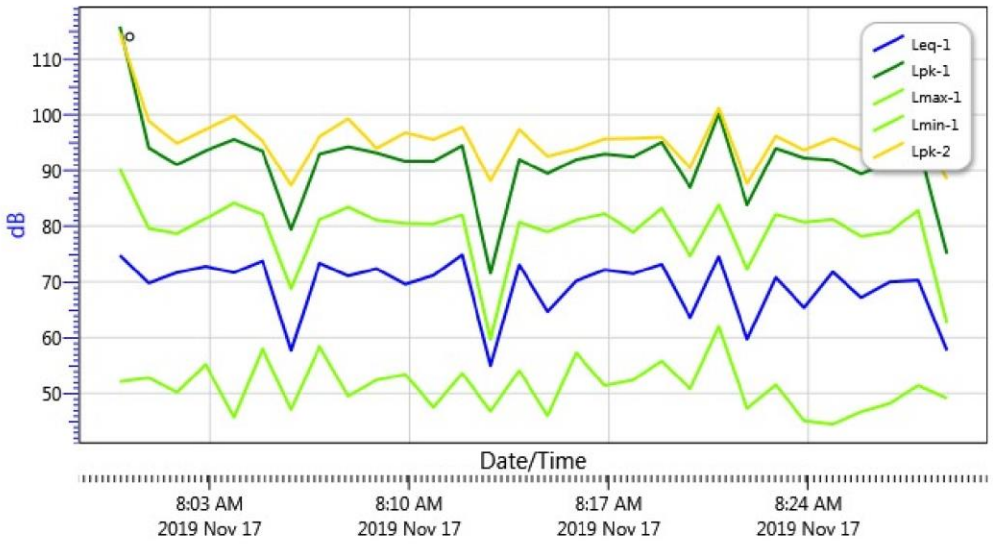
Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
17/11/2019 07:59:51 AM	74.8	90.3	52.1	115.9
08:00:51 AM	69.8	79.6	52.8	94.1
08:01:51 AM	71.7	78.7	50.2	91.1
08:02:51 AM	72.8	81.4	55.2	93.6
08:03:51 AM	71.7	84.2	45.7	95.6
08:04:51 AM	73.8	82.2	58	93.5
08:05:51 AM	57.7	68.8	47.1	79.4
08:06:51 AM	73.4	81.2	58.4	93
08:07:51 AM	71.1	83.5	49.5	94.3
08:08:51 AM	72.4	81.1	52.4	93.2
08:09:51 AM	69.6	80.5	53.4	91.7
08:10:51 AM	71.2	80.4	47.5	91.7

08:11:51 AM	74.9	82.1	53.6	94.5
08:12:51 AM	55	59.7	46.8	71.6
08:13:51 AM	73.1	80.7	54.1	92
08:14:51 AM	64.7	79	46	89.5
08:15:51 AM	70.2	81.1	57.3	92
08:16:51 AM	72.2	82.3	51.4	93
08:17:51 AM	71.5	78.9	52.4	92.5
08:18:51 AM	73.2	83.3	55.8	95.1
08:19:51 AM	63.6	74.7	50.8	87
08:20:51 AM	74.6	83.9	62	100.2
08:21:51 AM	59.7	72.3	47.3	83.9
08:22:51 AM	70.8	82.2	51.5	94
08:23:51 AM	65.4	80.7	45.1	92.3
08:24:51 AM	71.8	81.2	44.5	91.9
08:25:51 AM	67.2	78.2	46.7	89.4
08:26:51 AM	70	79	48.2	91.5
08:27:51 AM	70.3	82.9	51.4	94.7
08:28:51 AM	57.7	62.6	49.1	75.1

Logged Data Chart

S001_BGG110027_18112019_093127: Logged Data Chart



DMO Location 1 PM

11/18/2019

Information Panel

Name	S006_BGG110027_18112019_093205
Start Time	17/11/2019 12:02:31 PM
Stop Time	17/11/2019 12:32:31 PM
Device Name	BGG110027
Model Type	SoundPro DL
Device Firmware Rev	R.13H
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	71.3 dB	Lmax	1	84.6 dB
Lmin	1	45 dB	Lpk	1	95.9 dB
Rtime	1	00:30:00			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	Flat
Response	2	FAST			

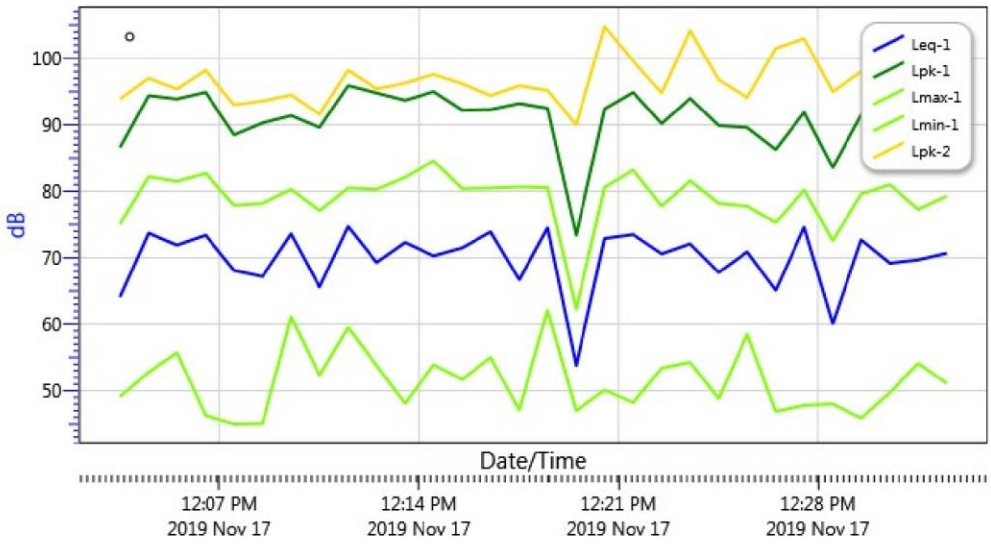
Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
17/11/2019 12:03:31 PM	64.1	75.1	49.1	86.6
12:04:31 PM	73.7	82.2	52.8	94.4
12:05:31 PM	71.9	81.5	55.7	93.9
12:06:31 PM	73.4	82.7	46.3	94.9
12:07:31 PM	68.1	77.9	45	88.5
12:08:31 PM	67.2	78.2	45.1	90.3
12:09:31 PM	73.6	80.3	61.1	91.4
12:10:31 PM	65.6	77.1	52.3	89.6
12:11:31 PM	74.7	80.5	59.5	95.9
12:12:31 PM	69.3	80.3	53.8	94.8
12:13:31 PM	72.3	82.1	48.1	93.7
12:14:31 PM	70.3	84.6	53.9	95

12:15:31 PM	71.5	80.4	51.7	92.2
12:16:31 PM	73.9	80.5	55	92.3
12:17:31 PM	66.7	80.7	47.1	93.2
12:18:31 PM	74.5	80.6	62.1	92.5
12:19:31 PM	53.8	62.3	47	73.4
12:20:31 PM	72.9	80.6	50.1	92.4
12:21:31 PM	73.5	83.2	48.2	94.9
12:22:31 PM	70.6	77.8	53.4	90.2
12:23:31 PM	72.1	81.6	54.3	94
12:24:31 PM	67.8	78.2	48.8	89.9
12:25:31 PM	70.9	77.8	58.5	89.6
12:26:31 PM	65.1	75.3	46.9	86.3
12:27:31 PM	74.6	80.2	47.8	91.9
12:28:31 PM	60.1	72.6	48	83.6
12:29:31 PM	72.7	79.6	45.9	91.5
12:30:31 PM	69.2	81	49.7	92.3
12:31:31 PM	69.7	77.3	54.1	89.7
12:32:31 PM	70.7	79.3	51.1	90.6

Logged Data Chart

S006_BGG110027_18112019_093205: Logged Data Chart



LOCATION 2

DMO Location 2 -AM

11/18/2019

Information Panel

Name	S002_BGG110027_18112019_093138
Start Time	17/11/2019 08:36:41 AM
Stop Time	17/11/2019 09:06:41 AM
Device Name	BGG110027
Model Type	SoundPro DL
Device Firmware Rev	R.13H
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	49.1 dB	Lmax	1	62.9 dB
Lmin	1	40.1 dB	Lpk	1	77.4 dB
Rtime	1	00:30:00			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	Flat
Response	2	FAST			

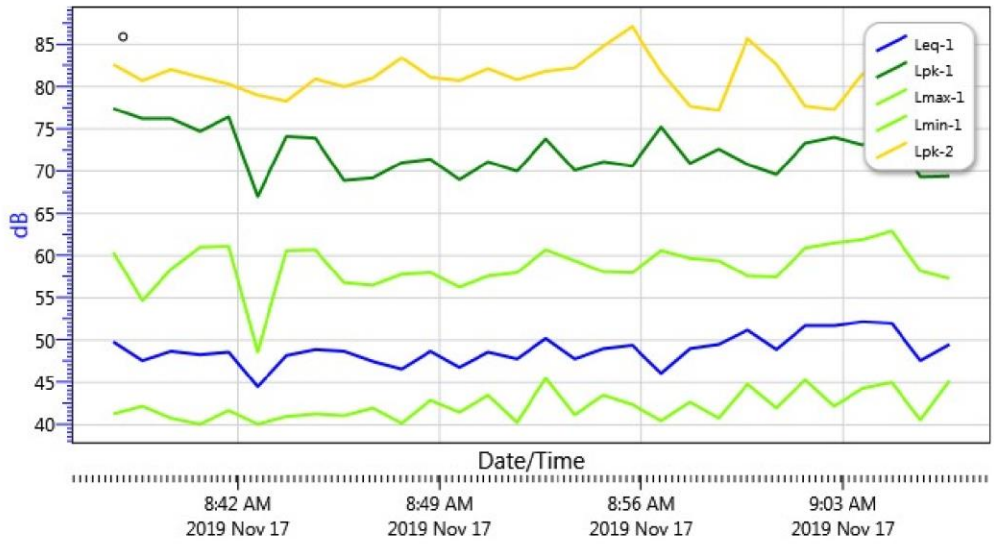
Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
17/11/2019 08:37:41 AM	49.8	60.4	41.3	77.4
08:38:41 AM	47.6	54.7	42.2	76.2
08:39:41 AM	48.7	58.4	40.8	76.2
08:40:41 AM	48.3	61	40.1	74.7
08:41:41 AM	48.6	61.1	41.7	76.4
08:42:41 AM	44.5	48.6	40.1	67
08:43:41 AM	48.2	60.6	41	74.1
08:44:41 AM	48.9	60.7	41.3	73.9
08:45:41 AM	48.7	56.8	41.1	68.9
08:46:41 AM	47.5	56.5	42	69.2
08:47:41 AM	46.6	57.8	40.2	71
08:48:41 AM	48.7	58	42.9	71.4

08:49:41 AM	46.8	56.3	41.5	69
08:50:41 AM	48.6	57.6	43.5	71.1
08:51:41 AM	47.8	58	40.3	70
08:52:41 AM	50.2	60.7	45.5	73.8
08:53:41 AM	47.8	59.4	41.2	70.1
08:54:41 AM	49	58.1	43.5	71.1
08:55:41 AM	49.4	58	42.4	70.6
08:56:41 AM	46.1	60.6	40.5	75.2
08:57:41 AM	49	59.7	42.7	70.9
08:58:41 AM	49.5	59.4	40.8	72.6
08:59:41 AM	51.2	57.6	44.8	70.8
09:00:41 AM	48.9	57.5	42	69.6
09:01:41 AM	51.7	60.9	45.3	73.3
09:02:41 AM	51.7	61.5	42.2	74
09:03:41 AM	52.2	61.9	44.3	73.1
09:04:41 AM	52	62.9	45	74.9
09:05:41 AM	47.6	58.2	40.6	69.3
09:06:41 AM	49.5	57.3	45.2	69.4

Logged Data Chart

S002_BGG110027_18112019_093138: Logged Data Chart



DMO Location 2 PM

11/18/2019

Information Panel

Name	S007_BGG110027_18112019_093212
Start Time	17/11/2019 12:39:05 PM
Stop Time	17/11/2019 01:09:05 PM
Device Name	BGG110027
Model Type	SoundPro DL
Device Firmware Rev	R.13H
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	48.1 dB	Lmax	1	68.9 dB
Lmin	1	42.2 dB	Lpk	1	86.6 dB
Rtime	1	00:30:00			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	Flat
Response	2	FAST			

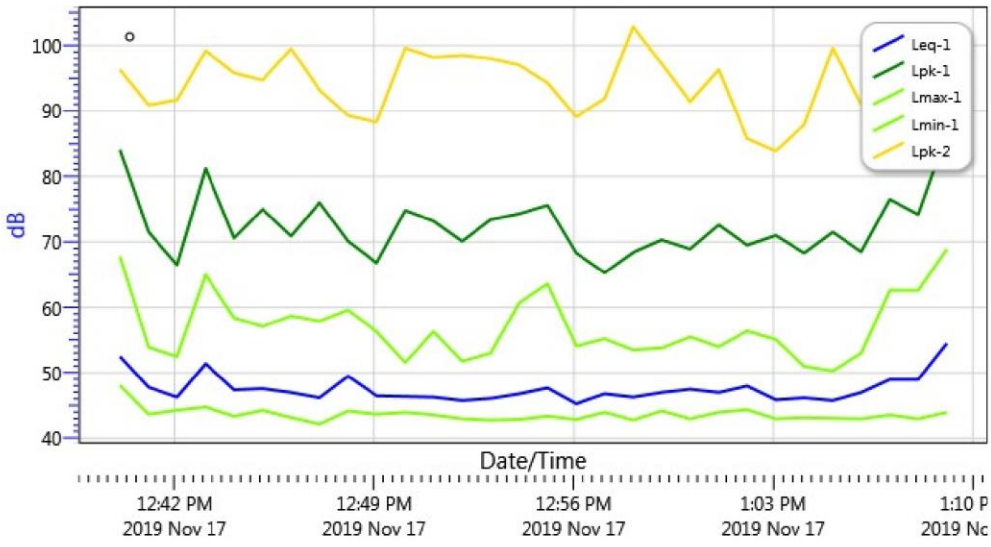
Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
17/11/2019 12:40:05 PM	52.5	67.8	48.1	84.1
12:41:05 PM	47.8	53.9	43.7	71.5
12:42:05 PM	46.3	52.5	44.3	66.5
12:43:05 PM	51.4	65	44.8	81.2
12:44:05 PM	47.4	58.4	43.4	70.6
12:45:05 PM	47.6	57.1	44.3	75
12:46:05 PM	47	58.7	43.2	70.9
12:47:05 PM	46.2	57.9	42.2	76
12:48:05 PM	49.5	59.6	44.2	70.1
12:49:05 PM	46.5	56.3	43.7	66.8
12:50:05 PM	46.4	51.6	44	74.8
12:51:05 PM	46.3	56.3	43.6	73.2

12:52:05 PM	45.8	51.8	43	70.1
12:53:05 PM	46.1	53	42.8	73.4
12:54:05 PM	46.8	60.7	42.9	74.3
12:55:05 PM	47.7	63.6	43.4	75.6
12:56:05 PM	45.3	54.1	42.9	68.3
12:57:05 PM	46.8	55.2	44	65.3
12:58:05 PM	46.3	53.5	42.8	68.4
12:59:05 PM	47	53.8	44.2	70.3
01:00:05 PM	47.5	55.5	43	68.9
01:01:05 PM	47	54	44	72.6
01:02:05 PM	48	56.4	44.4	69.5
01:03:05 PM	45.9	55.1	43	71
01:04:05 PM	46.2	51	43.2	68.3
01:05:05 PM	45.8	50.3	43.1	71.5
01:06:05 PM	47	53	43	68.5
01:07:05 PM	49	62.6	43.6	76.5
01:08:05 PM	49	62.6	43	74.2
01:09:05 PM	54.5	68.9	44	86.6

Logged Data Chart

S007_BGG110027_18112019_093212: Logged Data Chart



LOCATION 3

DMO Location 3 -AM

11/18/2019

Information Panel

Name	S003_BGG110027_18112019_093145
Start Time	17/11/2019 09:24:55 AM
Stop Time	17/11/2019 09:54:55 AM
Device Name	BGG110027
Model Type	SoundPro DL
Device Firmware Rev	R.13H
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	61.4 dB	Lmax	1	86.7 dB
Lmin	1	47.5 dB	Lpk	1	103.5 dB
Rtime	1	00:30:00			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	Flat
Response	2	FAST			

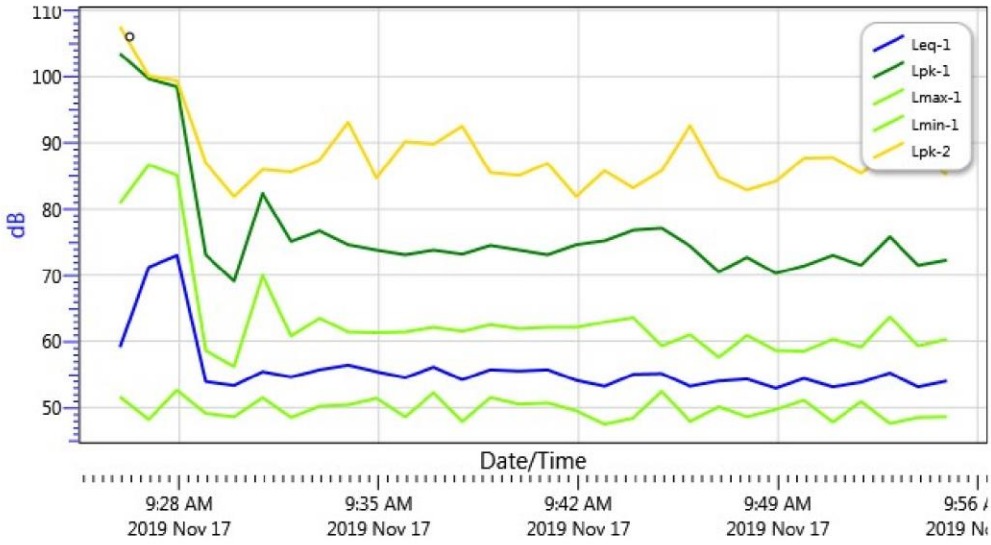
Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
17/11/2019 09:25:55 AM	59.1	80.9	51.6	103.5
09:26:55 AM	71.2	86.7	48.2	99.7
09:27:55 AM	73	85.1	52.6	98.5
09:28:55 AM	53.9	58.6	49.1	73.1
09:29:55 AM	53.3	56.2	48.6	69.1
09:30:55 AM	55.4	70	51.5	82.4
09:31:55 AM	54.6	60.8	48.5	75.1
09:32:55 AM	55.7	63.5	50.2	76.7
09:33:55 AM	56.4	61.4	50.4	74.6
09:34:55 AM	55.4	61.3	51.4	73.8
09:35:55 AM	54.5	61.4	48.6	73.1
09:36:55 AM	56.1	62.1	52.2	73.8

09:37:55 AM	54.2	61.5	47.9	73.2
09:38:55 AM	55.7	62.5	51.5	74.5
09:39:55 AM	55.5	61.9	50.5	73.8
09:40:55 AM	55.7	62.1	50.7	73.1
09:41:55 AM	54.1	62.1	49.5	74.6
09:42:55 AM	53.2	62.9	47.5	75.2
09:43:55 AM	55	63.6	48.4	76.8
09:44:55 AM	55.1	59.3	52.4	77.1
09:45:55 AM	53.2	61	47.9	74.4
09:46:55 AM	54	57.6	50.1	70.5
09:47:55 AM	54.3	60.9	48.6	72.7
09:48:55 AM	52.9	58.6	49.7	70.3
09:49:55 AM	54.4	58.5	51.1	71.4
09:50:55 AM	53.1	60.3	47.8	73
09:51:55 AM	53.8	59.1	50.9	71.5
09:52:55 AM	55.2	63.7	47.6	75.8
09:53:55 AM	53.1	59.3	48.5	71.5
09:54:55 AM	54	60.3	48.6	72.3

Logged Data Chart

S003_BGG110027_18112019_093145: Logged Data Chart



DMO Location 3 PM

11/18/2019

Information Panel

Name	S008_BGG110027_18112019_093219
Start Time	17/11/2019 01:16:25 PM
Stop Time	17/11/2019 01:46:25 PM
Device Name	BGG110027
Model Type	SoundPro DL
Device Firmware Rev	R.13H
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	52.4 dB	Lmax	1	66.4 dB
Lmin	1	44.4 dB	Lpk	1	88.5 dB
Rtime	1	00:30:00			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	Flat
Response	2	FAST			

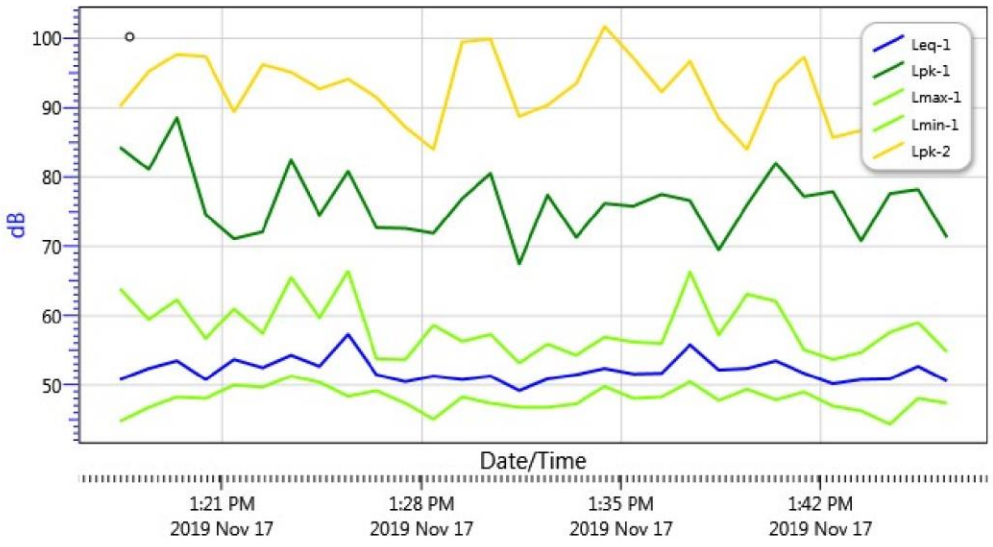
Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
17/11/2019 01:17:25 PM	50.8	63.9	44.8	84.3
01:18:25 PM	52.4	59.5	46.8	81.1
01:19:25 PM	53.5	62.3	48.3	88.5
01:20:25 PM	50.8	56.7	48.1	74.6
01:21:25 PM	53.7	61	50	71.1
01:22:25 PM	52.5	57.4	49.7	72.1
01:23:25 PM	54.3	65.5	51.3	82.5
01:24:25 PM	52.7	59.7	50.4	74.5
01:25:25 PM	57.3	66.4	48.4	80.8
01:26:25 PM	51.5	53.8	49.2	72.7
01:27:25 PM	50.5	53.7	47.4	72.6
01:28:25 PM	51.3	58.6	45.1	71.9

01:29:25 PM	50.8	56.3	48.3	76.9
01:30:25 PM	51.3	57.3	47.4	80.5
01:31:25 PM	49.2	53.2	46.8	67.5
01:32:25 PM	50.9	55.9	46.8	77.4
01:33:25 PM	51.5	54.3	47.3	71.3
01:34:25 PM	52.4	56.9	49.8	76.2
01:35:25 PM	51.6	56.2	48.1	75.8
01:36:25 PM	51.7	56	48.3	77.5
01:37:25 PM	55.8	66.3	50.5	76.6
01:38:25 PM	52.2	57.2	47.8	69.5
01:39:25 PM	52.4	63.1	49.4	76
01:40:25 PM	53.5	62.1	47.9	82
01:41:25 PM	51.7	55.1	49	77.2
01:42:25 PM	50.2	53.7	47	77.9
01:43:25 PM	50.8	54.7	46.3	70.8
01:44:25 PM	50.9	57.6	44.4	77.6
01:45:25 PM	52.7	59	48.1	78.2
01:46:25 PM	50.6	54.8	47.4	71.3

Logged Data Chart

S008_BGG110027_18112019_093219: Logged Data Chart



LOCATION 4

DMO Location 4 -AM

11/18/2019

Information Panel

Name	S004_BGG110027_18112019_093151
Start Time	17/11/2019 10:04:33 AM
Stop Time	17/11/2019 10:34:33 AM
Device Name	BGG110027
Model Type	SoundPro DL
Device Firmware Rev	R.13H
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	57.9 dB	Lmax	1	72.8 dB
Lmin	1	49.3 dB	Lpk	1	87.2 dB
Rtime	1	00:30:00			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	Flat
Response	2	FAST			

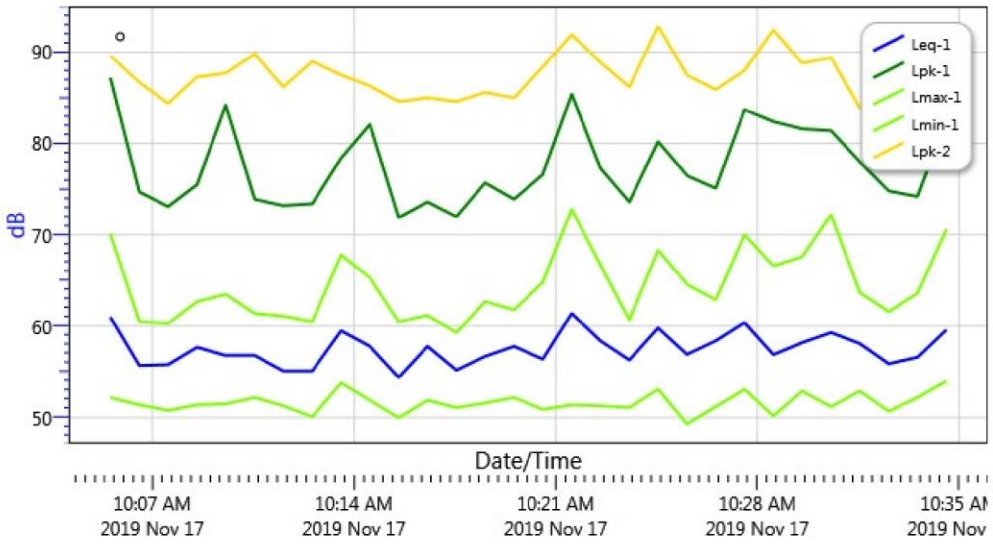
Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
17/11/2019 10:05:33 AM	61	70.1	52.2	87.2
10:06:33 AM	55.7	60.5	51.4	74.7
10:07:33 AM	55.8	60.3	50.8	73.1
10:08:33 AM	57.7	62.7	51.4	75.5
10:09:33 AM	56.8	63.5	51.5	84.2
10:10:33 AM	56.8	61.4	52.2	73.9
10:11:33 AM	55.1	61.1	51.3	73.2
10:12:33 AM	55.1	60.5	50.1	73.4
10:13:33 AM	59.5	67.8	53.8	78.4
10:14:33 AM	57.8	65.3	51.9	82.1
10:15:33 AM	54.4	60.5	50	71.9
10:16:33 AM	57.8	61.2	51.9	73.6

10:17:33 AM	55.2	59.3	51.1	72
10:18:33 AM	56.7	62.7	51.6	75.7
10:19:33 AM	57.8	61.8	52.2	73.9
10:20:33 AM	56.4	64.8	50.9	76.6
10:21:33 AM	61.4	72.8	51.4	85.4
10:22:33 AM	58.4	66.7	51.3	77.3
10:23:33 AM	56.3	60.7	51.1	73.6
10:24:33 AM	59.8	68.3	53.1	80.2
10:25:33 AM	56.9	64.6	49.3	76.5
10:26:33 AM	58.4	62.9	51.2	75.1
10:27:33 AM	60.4	70	53.1	83.7
10:28:33 AM	56.9	66.6	50.2	82.4
10:29:33 AM	58.2	67.6	52.9	81.6
10:30:33 AM	59.3	72.2	51.2	81.4
10:31:33 AM	58.1	63.7	52.9	78
10:32:33 AM	55.9	61.6	50.7	74.8
10:33:33 AM	56.6	63.6	52.2	74.2
10:34:33 AM	59.6	70.6	54	82.7

Logged Data Chart

S004_BGG110027_18112019_093151: Logged Data Chart



DMO Location 4 -PM

11/18/2019

Information Panel

Name	S009_BGG110027_18112019_093226
Start Time	17/11/2019 01:55:51 PM
Stop Time	17/11/2019 02:25:51 PM
Device Name	BGG110027
Model Type	SoundPro DL
Device Firmware Rev	R.13H
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	58.6 dB	Lmax	1	70.6 dB
Lmin	1	50.5 dB	Lpk	1	88.4 dB
Rtime	1	00:30:00			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	Flat
Response	2	FAST			

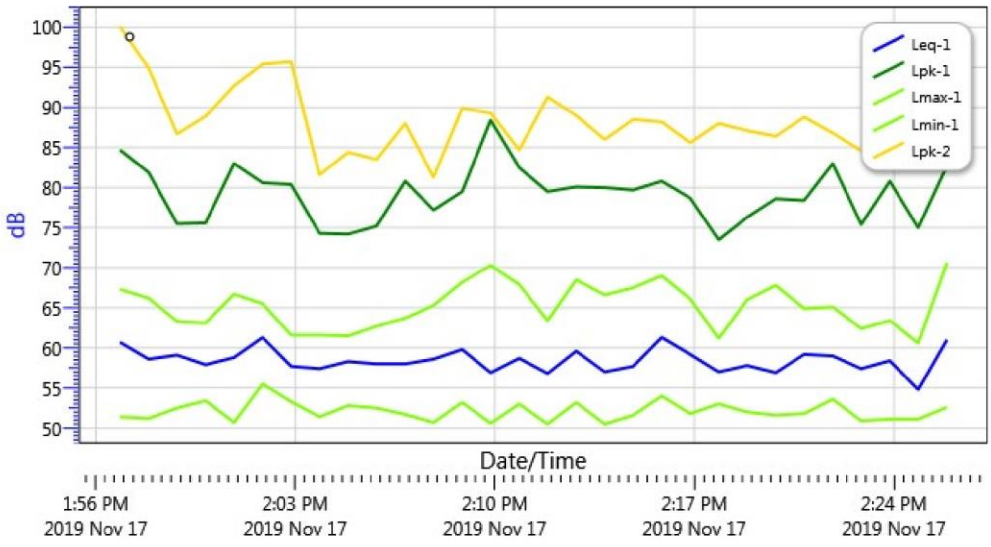
Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
17/11/2019 01:56:51 PM	60.7	67.3	51.4	84.7
01:57:51 PM	58.6	66.2	51.2	81.9
01:58:51 PM	59.1	63.3	52.5	75.5
01:59:51 PM	57.9	63.1	53.4	75.6
02:00:51 PM	58.8	66.7	50.7	83
02:01:51 PM	61.3	65.5	55.5	80.6
02:02:51 PM	57.7	61.6	53.3	80.4
02:03:51 PM	57.4	61.6	51.4	74.3
02:04:51 PM	58.3	61.5	52.8	74.2
02:05:51 PM	58	62.7	52.5	75.2
02:06:51 PM	58	63.7	51.7	80.8
02:07:51 PM	58.6	65.3	50.7	77.2

02:08:51 PM	59.8	68.2	53.2	79.5
02:09:51 PM	56.9	70.3	50.6	88.4
02:10:51 PM	58.7	67.9	53	82.5
02:11:51 PM	56.8	63.4	50.5	79.5
02:12:51 PM	59.6	68.5	53.2	80.1
02:13:51 PM	57	66.6	50.5	80
02:14:51 PM	57.7	67.5	51.6	79.7
02:15:51 PM	61.3	69	54	80.8
02:16:51 PM	59.2	66.1	51.8	78.7
02:17:51 PM	57	61.2	53	73.5
02:18:51 PM	57.8	66	52	76.3
02:19:51 PM	56.9	67.8	51.6	78.6
02:20:51 PM	59.2	64.9	51.8	78.4
02:21:51 PM	59	65.1	53.6	83
02:22:51 PM	57.4	62.4	50.9	75.4
02:23:51 PM	58.4	63.4	51.1	80.8
02:24:51 PM	54.8	60.6	51.1	75
02:25:51 PM	61	70.6	52.6	82.7

Logged Data Chart

S009_BGG110027_18112019_093226: Logged Data Chart



LOCATION 5

DMO Location 5 -AM

11/18/2019

Information Panel

Name	S005_BGG110027_18112019_093158
Start Time	17/11/2019 10:39:08 AM
Stop Time	17/11/2019 11:09:08 AM
Device Name	BGG110027
Model Type	SoundPro DL
Device Firmware Rev	R.13H
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	71.3 dB	Lmax	1	83.8 dB
Lmin	1	47.4 dB	Lpk	1	96.1 dB
Rtime	1	00:30:00			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	Flat
Response	2	FAST			

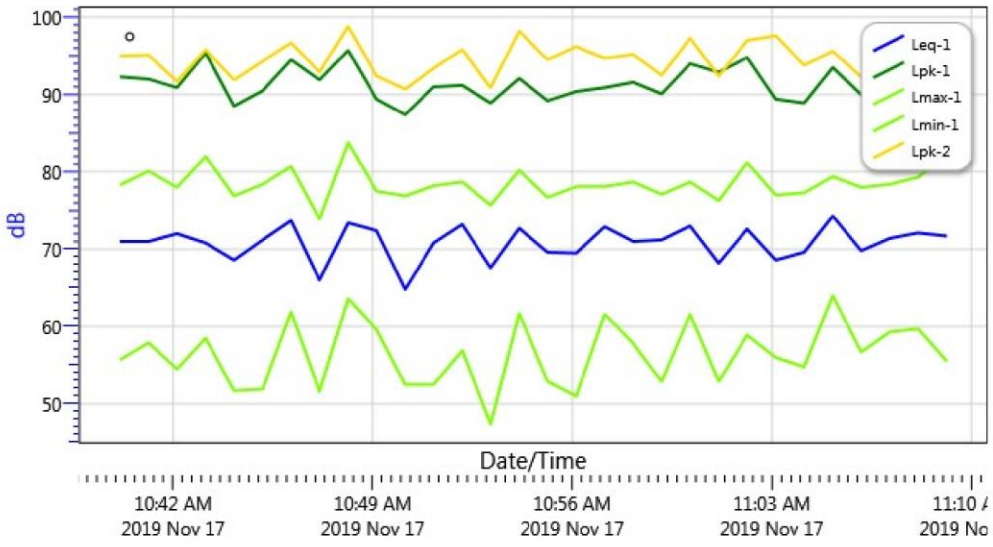
Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
17/11/2019 10:40:08 AM	71	78.3	55.7	92.3
10:41:08 AM	71	80.1	57.9	92
10:42:08 AM	72	78	54.5	90.9
10:43:08 AM	70.8	82	58.5	95.4
10:44:08 AM	68.6	76.9	51.7	88.5
10:45:08 AM	71.2	78.4	51.9	90.5
10:46:08 AM	73.7	80.7	61.9	94.5
10:47:08 AM	66	73.9	51.6	91.9
10:48:08 AM	73.4	83.8	63.6	95.7
10:49:08 AM	72.4	77.5	59.6	89.4
10:50:08 AM	64.8	76.9	52.5	87.4
10:51:08 AM	70.8	78.2	52.5	91

10:52:08 AM	73.2	78.7	56.9	91.2
10:53:08 AM	67.6	75.7	47.4	88.9
10:54:08 AM	72.7	80.2	61.7	92.1
10:55:08 AM	69.6	76.7	52.9	89.2
10:56:08 AM	69.5	78.1	51	90.4
10:57:08 AM	72.9	78.1	61.6	90.9
10:58:08 AM	71	78.7	57.8	91.6
10:59:08 AM	71.2	77.1	52.9	90.1
11:00:08 AM	73	78.7	61.6	94
11:01:08 AM	68.2	76.3	52.9	92.9
11:02:08 AM	72.6	81.2	58.9	94.8
11:03:08 AM	68.6	77	56	89.4
11:04:08 AM	69.6	77.3	54.8	88.9
11:05:08 AM	74.3	79.4	64	93.5
11:06:08 AM	69.8	78	56.7	90
11:07:08 AM	71.4	78.4	59.3	91.6
11:08:08 AM	72.1	79.3	59.7	89.9
11:09:08 AM	71.7	82.4	55.5	96.1

Logged Data Chart

S005_BGG110027_18112019_093158: Logged Data Chart



DMO Location 5 PM

11/18/2019

Information Panel

Name	S010_BGG110027_18112019_093234
Start Time	17/11/2019 02:29:55 PM
Stop Time	17/11/2019 02:59:55 PM
Device Name	BGG110027
Model Type	SoundPro DL
Device Firmware Rev	R.13H
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	72.1 dB	Lmax	1	94.1 dB
Lmin	1	50.8 dB	Lpk	1	102.4 dB
Rtime	1	00:30:00			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	Flat
Response	2	FAST			

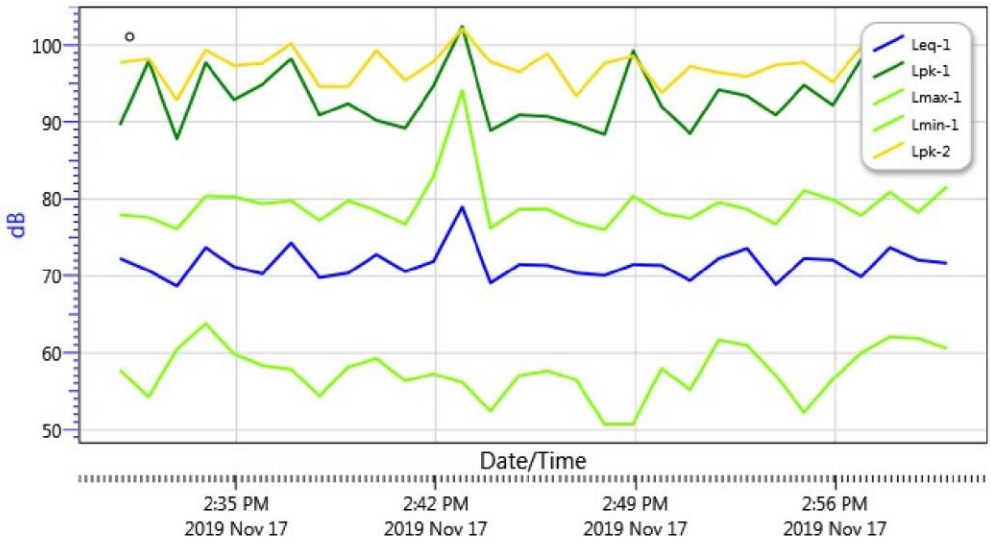
Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
17/11/2019 02:30:55 PM	72.3	78	57.8	89.6
02:31:55 PM	70.7	77.6	54.3	97.9
02:32:55 PM	68.7	76.1	60.5	87.8
02:33:55 PM	73.7	80.4	63.8	97.7
02:34:55 PM	71.2	80.3	59.9	92.9
02:35:55 PM	70.3	79.4	58.4	94.9
02:36:55 PM	74.3	79.8	57.9	98.2
02:37:55 PM	69.8	77.2	54.4	90.9
02:38:55 PM	70.4	79.8	58.2	92.4
02:39:55 PM	72.8	78.5	59.3	90.2
02:40:55 PM	70.6	76.7	56.4	89.2
02:41:55 PM	71.9	82.9	57.3	94.7

02:42:55 PM	79	94.1	56.2	102.4
02:43:55 PM	69.1	76.2	52.5	88.9
02:44:55 PM	71.5	78.7	57.1	90.9
02:45:55 PM	71.4	78.7	57.7	90.7
02:46:55 PM	70.4	76.9	56.5	89.7
02:47:55 PM	70.1	76	50.8	88.4
02:48:55 PM	71.5	80.4	50.8	99.3
02:49:55 PM	71.4	78.2	58	92
02:50:55 PM	69.4	77.5	55.2	88.5
02:51:55 PM	72.3	79.6	61.7	94.2
02:52:55 PM	73.6	78.7	61	93.4
02:53:55 PM	68.9	76.7	57.1	90.9
02:54:55 PM	72.3	81.1	52.3	94.8
02:55:55 PM	72.1	79.9	56.6	92.2
02:56:55 PM	69.9	77.9	60	98.1
02:57:55 PM	73.7	80.9	62.1	93.5
02:58:55 PM	72.1	78.3	61.9	90.8
02:59:55 PM	71.7	81.6	60.6	89.3

Logged Data Chart

S010_BGG110027_18112019_093234: Logged Data Chart



ANNEX 2

NOVEMBER 21, 2019 (WEEKDAY)

LOCATION 1

DMO Location 1 AM

11/22/2019

Information Panel

Name	S011_BGG110027_22112019_140355
Start Time	21/11/2019 07:59:58 AM
Stop Time	21/11/2019 08:29:58 AM
Device Name	BGG110027
Model Type	SoundPro DL
Device Firmware Rev	R.13H
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	72.5 dB	Lmax	1	91.9 dB
Lmin	1	47 dB	Lpk	1	100.3 dB
Rtime	1	00:30:00			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	Flat
Response	2	FAST			

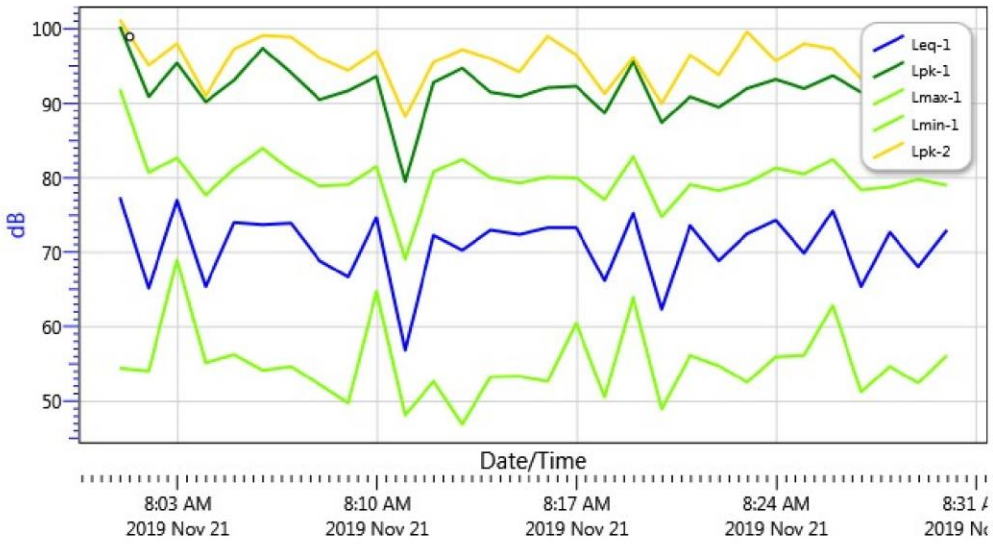
Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
21/11/2019 08:00:58 AM	77.4	91.9	54.5	100.3
08:01:58 AM	65.2	80.7	54.1	90.9
08:02:58 AM	77	82.7	69	95.4
08:03:58 AM	65.4	77.7	55.2	90.2
08:04:58 AM	74	81.2	56.3	93.1
08:05:58 AM	73.7	84	54.2	97.4
08:06:58 AM	73.9	81	54.7	94.1
08:07:58 AM	68.9	78.9	52.3	90.5
08:08:58 AM	66.7	79.1	49.8	91.7
08:09:58 AM	74.7	81.5	64.8	93.6
08:10:58 AM	56.9	69.1	48.2	79.5
08:11:58 AM	72.3	80.8	52.7	92.8

08:12:58 AM	70.3	82.5	47	94.7
08:13:58 AM	73	80	53.3	91.5
08:14:58 AM	72.4	79.3	53.4	90.9
08:15:58 AM	73.3	80.1	52.7	92.1
08:16:58 AM	73.3	80	60.5	92.3
08:17:58 AM	66.2	77.1	50.6	88.7
08:18:58 AM	75.3	82.9	64	95.6
08:19:58 AM	62.4	74.8	49	87.4
08:20:58 AM	73.6	79.1	56.2	90.9
08:21:58 AM	68.9	78.3	54.8	89.5
08:22:58 AM	72.5	79.3	52.6	92
08:23:58 AM	74.3	81.3	56	93.2
08:24:58 AM	69.9	80.5	56.2	92
08:25:58 AM	75.6	82.5	62.9	93.7
08:26:58 AM	65.4	78.4	51.3	91.5
08:27:58 AM	72.7	78.8	54.7	91.4
08:28:58 AM	68.1	79.8	52.5	90.6
08:29:58 AM	73	79	56.2	91

Logged Data Chart

S011_BGG110027_22112019_140355: Logged Data Chart



DMO Location 1 -PM

11/22/2019

Information Panel

Name	S016_BGG110027_22112019_140429
Start Time	21/11/2019 12:30:37 PM
Stop Time	21/11/2019 01:00:37 PM
Device Name	BGG110027
Model Type	SoundPro DL
Device Firmware Rev	R.13H
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	71.7 dB	Lmax	1	83.8 dB
Lmin	1	46.3 dB	Lpk	1	99.3 dB
Rtime	1	00:30:00			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	Flat
Response	2	FAST			

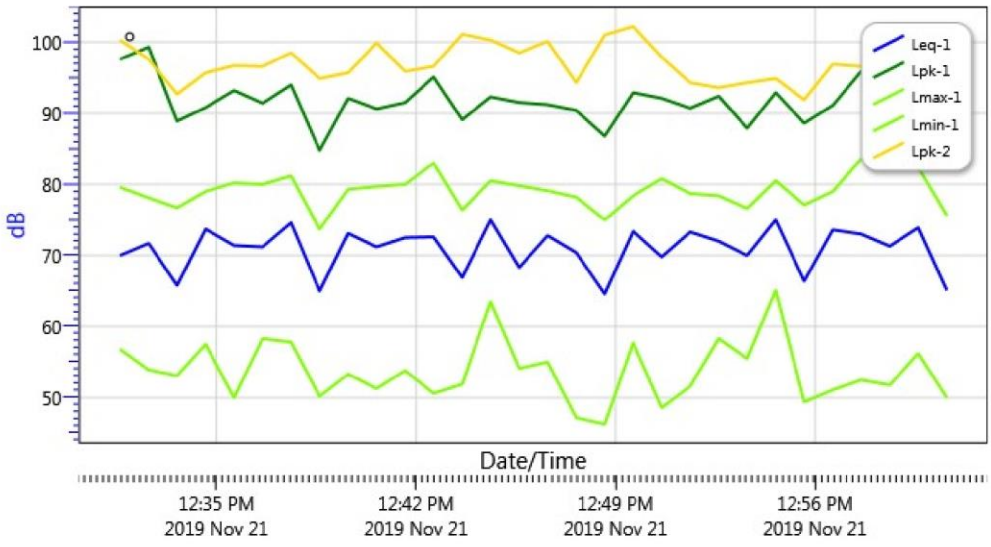
Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
21/11/2019 12:31:37 PM	70	79.6	56.8	97.6
12:32:37 PM	71.7	78.1	53.9	99.3
12:33:37 PM	65.8	76.7	53.1	88.9
12:34:37 PM	73.7	79	57.5	90.8
12:35:37 PM	71.4	80.2	50	93.2
12:36:37 PM	71.2	80	58.3	91.4
12:37:37 PM	74.6	81.2	57.8	94
12:38:37 PM	65	73.7	50.2	84.8
12:39:37 PM	73.1	79.3	53.3	92.1
12:40:37 PM	71.2	79.7	51.3	90.6
12:41:37 PM	72.5	80	53.8	91.5
12:42:37 PM	72.6	83	50.6	95.1

12:43:37 PM	66.9	76.4	51.9	89.1
12:44:37 PM	75	80.5	63.5	92.3
12:45:37 PM	68.3	79.8	54.1	91.5
12:46:37 PM	72.8	79.1	55	91.2
12:47:37 PM	70.4	78.2	47.2	90.4
12:48:37 PM	64.6	75	46.3	86.8
12:49:37 PM	73.4	78.4	57.7	92.9
12:50:37 PM	69.8	80.8	48.6	92.1
12:51:37 PM	73.3	78.7	51.6	90.7
12:52:37 PM	72	78.4	58.3	92.4
12:53:37 PM	70	76.6	55.5	87.9
12:54:37 PM	75	80.5	65.1	92.9
12:55:37 PM	66.4	77.1	49.4	88.6
12:56:37 PM	73.6	79	51.1	91.1
12:57:37 PM	73	83.6	52.5	95.9
12:58:37 PM	71.3	83.8	51.8	95
12:59:37 PM	73.9	82.4	56.2	94.3
01:00:37 PM	65.1	75.6	50	87.2

Logged Data Chart

S016_BGG110027_22112019_140429: Logged Data Chart



LOCATION 2

DMO Location 2 -AM

11/22/2019

Information Panel

Name	S012_BGG110027_22112019_140406
Start Time	21/11/2019 08:49:57 AM
Stop Time	21/11/2019 09:19:57 AM
Device Name	BGG110027
Model Type	SoundPro DL
Device Firmware Rev	R.13H
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	51.8 dB	Lmax	1	70.8 dB
Lmin	1	42.8 dB	Lpk	1	85.7 dB
Rtime	1	00:30:00			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	Flat
Response	2	FAST			

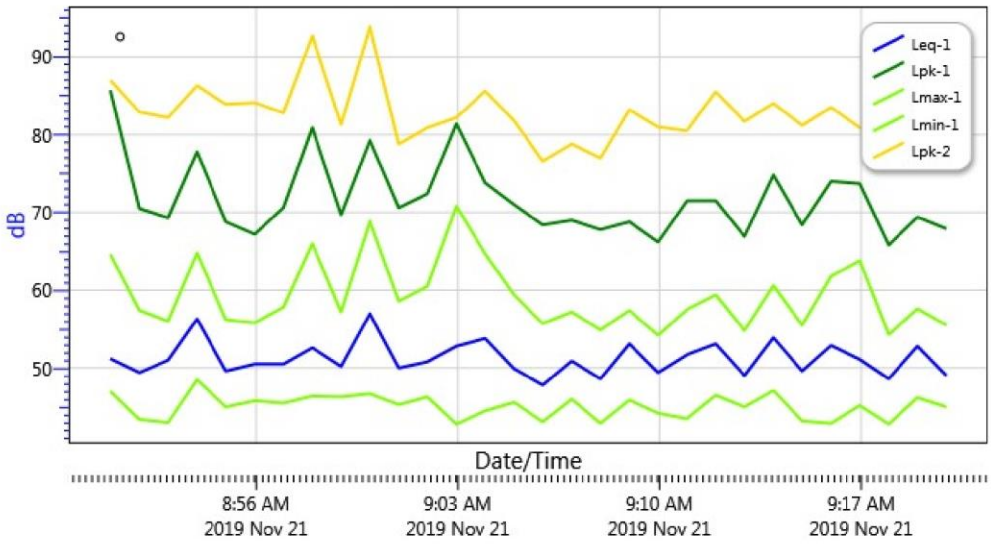
Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
21/11/2019 08:50:57 AM	51.2	64.6	47	85.7
08:51:57 AM	49.4	57.4	43.4	70.5
08:52:57 AM	51	56	43	69.3
08:53:57 AM	56.3	64.8	48.5	77.8
08:54:57 AM	49.6	56.2	45	68.8
08:55:57 AM	50.5	55.8	45.8	67.2
08:56:57 AM	50.5	57.8	45.5	70.6
08:57:57 AM	52.6	66	46.4	80.9
08:58:57 AM	50.2	57.2	46.3	69.7
08:59:57 AM	57	68.9	46.7	79.3
09:00:57 AM	50	58.6	45.3	70.6
09:01:57 AM	50.8	60.5	46.3	72.4

09:02:57 AM	52.8	70.8	42.8	81.4
09:03:57 AM	53.8	64.7	44.5	73.8
09:04:57 AM	49.9	59.4	45.6	71
09:05:57 AM	47.8	55.7	43.1	68.4
09:06:57 AM	50.9	57.2	46	69
09:07:57 AM	48.6	54.9	42.9	67.8
09:08:57 AM	53.1	57.4	45.9	68.8
09:09:57 AM	49.4	54.2	44.2	66.2
09:10:57 AM	51.7	57.5	43.5	71.5
09:11:57 AM	53.1	59.4	46.5	71.5
09:12:57 AM	49	54.8	45	66.9
09:13:57 AM	53.9	60.6	47.1	74.8
09:14:57 AM	49.6	55.5	43.2	68.4
09:15:57 AM	52.9	61.8	42.9	74
09:16:57 AM	51.1	63.8	45.2	73.7
09:17:57 AM	48.6	54.3	42.8	65.8
09:18:57 AM	52.8	57.6	46.2	69.4
09:19:57 AM	49	55.5	45	67.9

Logged Data Chart

S012_BGG110027_22112019_140406: Logged Data Chart



DMO Location 2 PM

11/22/2019

Information Panel

Name	S017_BGG110027_22112019_140435
Start Time	21/11/2019 01:13:01 PM
Stop Time	21/11/2019 01:43:01 PM
Device Name	BGG110027
Model Type	SoundPro DL
Device Firmware Rev	R.13H
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	54 dB	Lmax	1	71.4 dB
Lmin	1	42.3 dB	Lpk	1	89.2 dB
Rtime	1	00:30:00			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	Flat
Response	2	FAST			

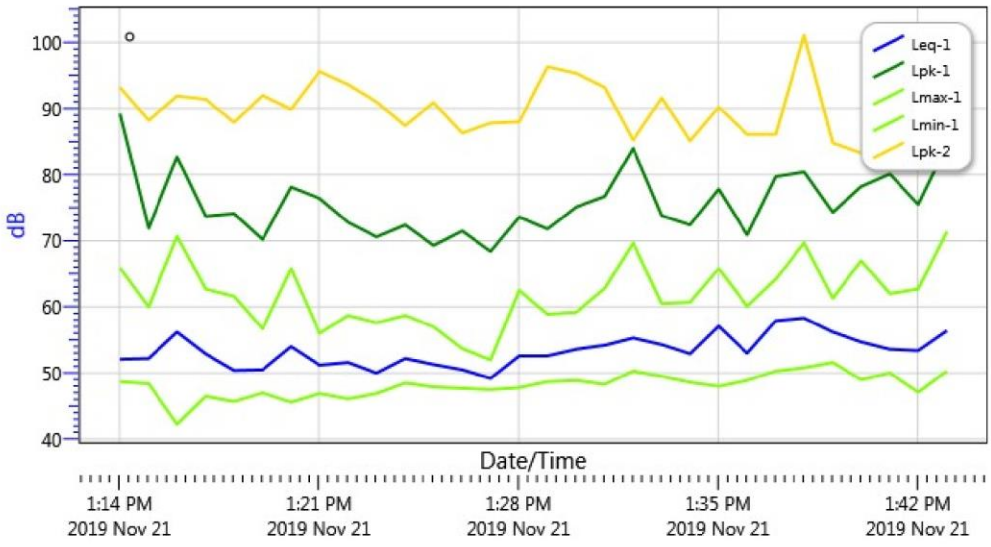
Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
21/11/2019 01:14:01 PM	52.1	65.9	48.7	89.2
01:15:01 PM	52.2	60	48.4	71.9
01:16:01 PM	56.2	70.7	42.3	82.7
01:17:01 PM	52.9	62.7	46.5	73.7
01:18:01 PM	50.4	61.6	45.7	74.1
01:19:01 PM	50.5	56.7	47	70.2
01:20:01 PM	54	65.8	45.6	78.1
01:21:01 PM	51.2	56	46.9	76.4
01:22:01 PM	51.6	58.7	46.1	72.8
01:23:01 PM	50	57.6	46.9	70.6
01:24:01 PM	52.2	58.7	48.5	72.4
01:25:01 PM	51.3	57	47.9	69.3

01:26:01 PM	50.5	53.7	47.7	71.5
01:27:01 PM	49.2	52	47.5	68.4
01:28:01 PM	52.6	62.5	47.8	73.6
01:29:01 PM	52.6	58.9	48.7	71.8
01:30:01 PM	53.6	59.2	48.9	75.1
01:31:01 PM	54.2	62.8	48.3	76.7
01:32:01 PM	55.3	69.7	50.3	84
01:33:01 PM	54.3	60.5	49.5	73.8
01:34:01 PM	52.9	60.7	48.6	72.4
01:35:01 PM	57.1	65.8	48	77.8
01:36:01 PM	53	60.1	48.9	70.9
01:37:01 PM	57.9	64.2	50.3	79.7
01:38:01 PM	58.3	69.7	50.8	80.4
01:39:01 PM	56.2	61.3	51.6	74.3
01:40:01 PM	54.7	67	49	78.2
01:41:01 PM	53.6	62	50	80.1
01:42:01 PM	53.4	62.7	47.1	75.5
01:43:01 PM	56.4	71.4	50.3	84.4

Logged Data Chart

S017_BGG110027_22112019_140435: Logged Data Chart



LOCATION 3

DMO Location 3 AM

11/22/2019

Information Panel

Name	S013_BGG110027_22112019_140411
Start Time	21/11/2019 09:29:31 AM
Stop Time	21/11/2019 09:59:31 AM
Device Name	BGG110027
Model Type	SoundPro DL
Device Firmware Rev	R.13H
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	62.2 dB	Lmax	1	91 dB
Lmin	1	45.4 dB	Lpk	1	103.4 dB
Rtime	1	00:30:00			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	Flat
Response	2	FAST			

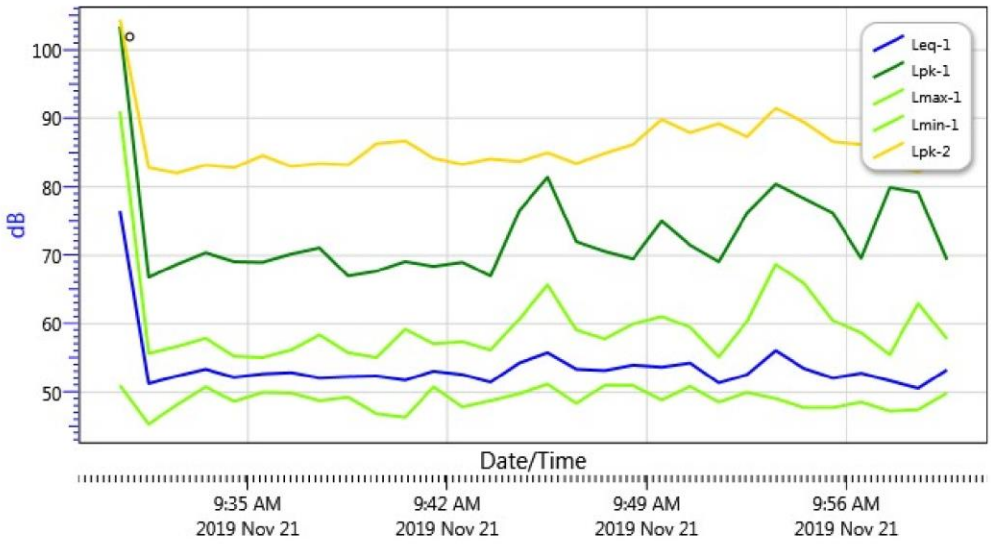
Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
21/11/2019 09:30:31 AM	76.5	91	51	103.4
09:31:31 AM	51.3	55.7	45.4	66.8
09:32:31 AM	52.4	56.7	48.2	68.7
09:33:31 AM	53.4	57.9	50.8	70.4
09:34:31 AM	52.2	55.3	48.7	69.1
09:35:31 AM	52.7	55.1	50	69
09:36:31 AM	52.9	56.2	49.9	70.2
09:37:31 AM	52.1	58.4	48.8	71.1
09:38:31 AM	52.3	55.8	49.3	67
09:39:31 AM	52.4	55.1	46.9	67.7
09:40:31 AM	51.8	59.2	46.4	69.1
09:41:31 AM	53.1	57.1	50.8	68.4

09:42:31 AM	52.6	57.4	47.9	69
09:43:31 AM	51.5	56.2	48.8	67
09:44:31 AM	54.3	60.7	49.8	76.5
09:45:31 AM	55.8	65.7	51.2	81.4
09:46:31 AM	53.4	59.1	48.4	72
09:47:31 AM	53.2	57.8	51	70.6
09:48:31 AM	54	60	51	69.5
09:49:31 AM	53.7	61.1	48.9	75
09:50:31 AM	54.3	59.5	50.9	71.5
09:51:31 AM	51.4	55.2	48.6	69.1
09:52:31 AM	52.6	60.4	50	76.2
09:53:31 AM	56.1	68.7	49.1	80.4
09:54:31 AM	53.5	65.9	47.8	78.3
09:55:31 AM	52.1	60.5	47.8	76.2
09:56:31 AM	52.8	58.7	48.6	69.6
09:57:31 AM	51.7	55.5	47.3	79.9
09:58:31 AM	50.6	63	47.5	79.2
09:59:31 AM	53.3	57.8	49.9	69.4

Logged Data Chart

S013_BGG110027_22112019_140411: Logged Data Chart



DMO Location 3 PM

11/22/2019

Information Panel

Name	S018_BGG110027_22112019_140441
Start Time	21/11/2019 02:26:42 PM
Stop Time	21/11/2019 02:56:42 PM
Device Name	BGG110027
Model Type	SoundPro DL
Device Firmware Rev	R.13H
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	56.2 dB	Lmax	1	81.4 dB
Lmin	1	47.3 dB	Lpk	1	96.6 dB
Rtime	1	00:30:00			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	Flat
Response	2	FAST			

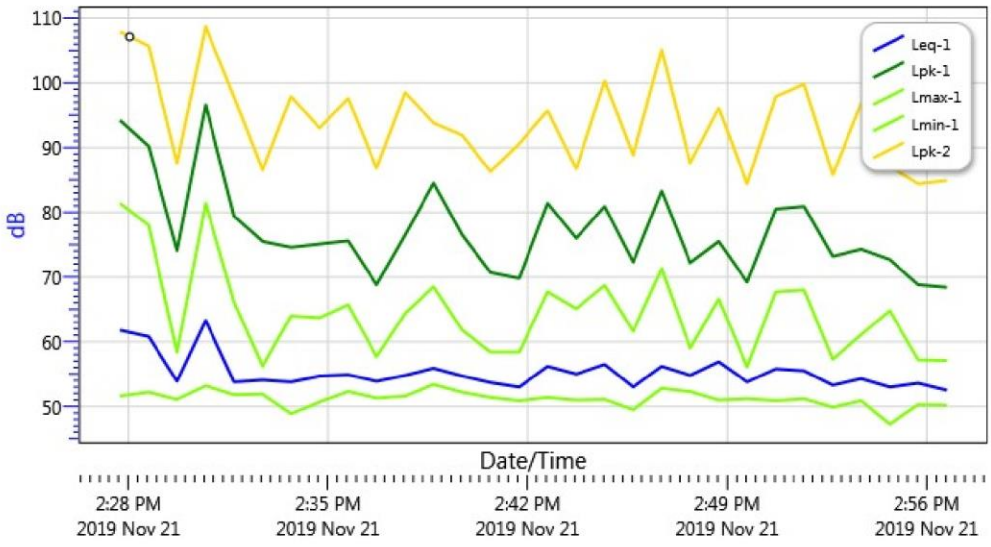
Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
21/11/2019 02:27:42 PM	61.8	81.4	51.6	94.2
02:28:42 PM	60.8	78	52.2	90.2
02:29:42 PM	53.9	58.4	51.1	74.1
02:30:42 PM	63.3	81.4	53.2	96.6
02:31:42 PM	53.8	66.1	51.8	79.4
02:32:42 PM	54.1	56.2	51.9	75.5
02:33:42 PM	53.8	64	48.9	74.6
02:34:42 PM	54.7	63.7	50.7	75.1
02:35:42 PM	54.9	65.7	52.3	75.6
02:36:42 PM	53.9	57.7	51.3	68.8
02:37:42 PM	54.8	64.4	51.6	76.5
02:38:42 PM	55.9	68.5	53.4	84.5

02:39:42 PM	54.7	61.8	52.2	76.5
02:40:42 PM	53.7	58.4	51.4	70.7
02:41:42 PM	53	58.4	50.9	69.8
02:42:42 PM	56.2	67.7	51.4	81.4
02:43:42 PM	55	65.1	51	76
02:44:42 PM	56.5	68.7	51.1	80.9
02:45:42 PM	53	61.6	49.5	72.3
02:46:42 PM	56.2	71.3	52.8	83.3
02:47:42 PM	54.8	59	52.3	72.2
02:48:42 PM	56.9	66.6	51	75.5
02:49:42 PM	53.8	56.1	51.2	69.2
02:50:42 PM	55.8	67.7	50.9	80.5
02:51:42 PM	55.5	68	51.2	80.9
02:52:42 PM	53.3	57.3	49.9	73.2
02:53:42 PM	54.3	61.1	50.9	74.3
02:54:42 PM	53	64.8	47.3	72.7
02:55:42 PM	53.6	57.2	50.3	68.8
02:56:42 PM	52.5	57.1	50.2	68.4

Logged Data Chart

S018_BGG110027_22112019_140441: Logged Data Chart



LOCATION 4

DMO Location 4 AM

11/22/2019

Information Panel

Name	S014_BGG110027_22112019_140417
Start Time	21/11/2019 10:09:00 AM
Stop Time	21/11/2019 10:39:00 AM
Device Name	BGG110027
Model Type	SoundPro DL
Device Firmware Rev	R.13H
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	59.5 dB	Lmax	1	76.3 dB
Lmin	1	50.3 dB	Lpk	1	89.5 dB
Rtime	1	00:30:00			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	Flat
Response	2	FAST			

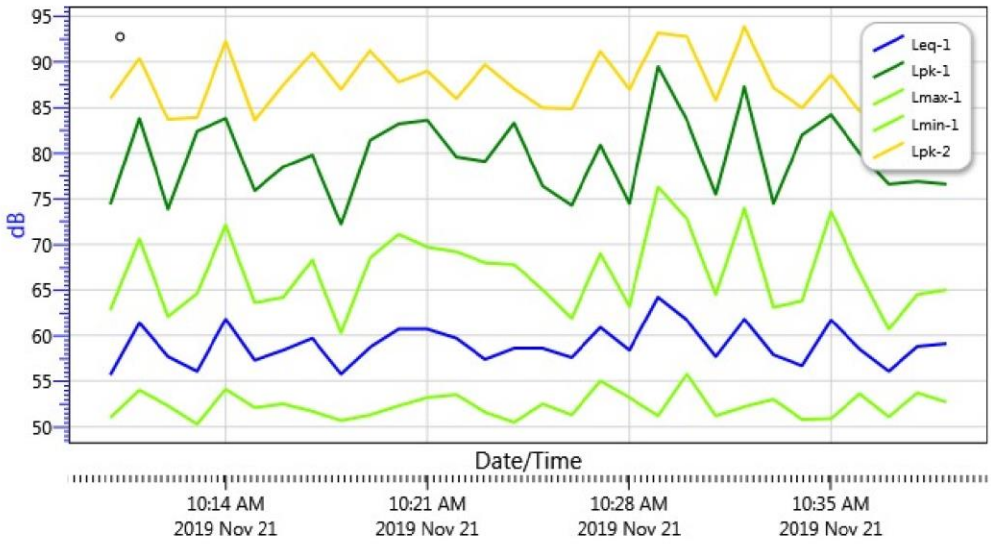
Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
21/11/2019 10:10:00 AM	55.7	62.8	51	74.4
10:11:00 AM	61.4	70.6	54	83.8
10:12:00 AM	57.7	62.1	52.3	73.9
10:13:00 AM	56.1	64.6	50.3	82.4
10:14:00 AM	61.8	72.1	54.1	83.8
10:15:00 AM	57.3	63.6	52.1	75.9
10:16:00 AM	58.4	64.2	52.5	78.5
10:17:00 AM	59.7	68.3	51.7	79.8
10:18:00 AM	55.8	60.3	50.7	72.2
10:19:00 AM	58.7	68.5	51.3	81.4
10:20:00 AM	60.7	71.1	52.3	83.2
10:21:00 AM	60.7	69.7	53.2	83.6

10:22:00 AM	59.7	69.2	53.5	79.6
10:23:00 AM	57.4	68	51.6	79.1
10:24:00 AM	58.6	67.8	50.5	83.3
10:25:00 AM	58.6	65	52.5	76.4
10:26:00 AM	57.6	61.9	51.3	74.3
10:27:00 AM	60.9	69	55	80.9
10:28:00 AM	58.4	63.2	53.2	74.5
10:29:00 AM	64.2	76.3	51.2	89.5
10:30:00 AM	61.7	72.8	55.8	83.6
10:31:00 AM	57.7	64.5	51.2	75.5
10:32:00 AM	61.8	74	52.2	87.3
10:33:00 AM	57.9	63.1	53	74.5
10:34:00 AM	56.7	63.8	50.8	82
10:35:00 AM	61.7	73.6	50.9	84.2
10:36:00 AM	58.5	66.8	53.6	80
10:37:00 AM	56.1	60.7	51.1	76.6
10:38:00 AM	58.8	64.5	53.7	76.9
10:39:00 AM	59.1	65	52.7	76.6

Logged Data Chart

S014_BGG110027_22112019_140417: Logged Data Chart



DMO Location 4 PM

11/22/2019

Information Panel

Name	S019_BGG110027_22112019_140447
Start Time	21/11/2019 03:09:22 PM
Stop Time	21/11/2019 03:39:22 PM
Device Name	BGG110027
Model Type	SoundPro DL
Device Firmware Rev	R.13H
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	59.6 dB	Lmax	1	80.3 dB
Lmin	1	51.4 dB	Lpk	1	94.5 dB
Rtime	1	00:30:00			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	Flat
Response	2	FAST			

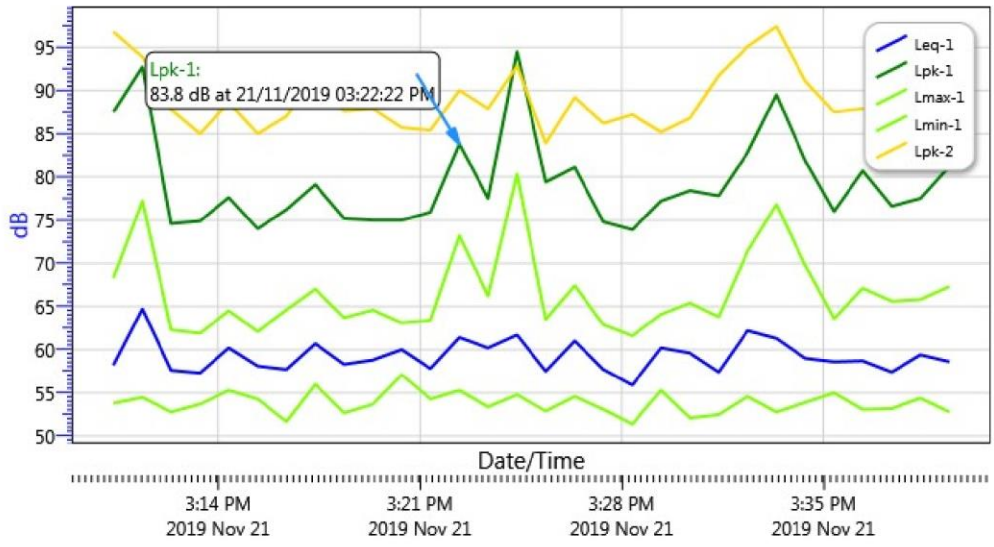
Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
21/11/2019 03:10:22 PM	58.2	68.3	53.8	87.5
03:11:22 PM	64.7	77.2	54.5	92.7
03:12:22 PM	57.6	62.3	52.8	74.6
03:13:22 PM	57.3	61.9	53.7	74.9
03:14:22 PM	60.2	64.5	55.3	77.6
03:15:22 PM	58.1	62.1	54.3	74
03:16:22 PM	57.7	64.6	51.7	76.2
03:17:22 PM	60.7	67	56	79.1
03:18:22 PM	58.3	63.7	52.7	75.2
03:19:22 PM	58.8	64.6	53.7	75
03:20:22 PM	60	63.1	57.1	75
03:21:22 PM	57.8	63.4	54.3	75.9

03:22:22 PM	61.4	73.2	55.3	83.8
03:23:22 PM	60.2	66.2	53.4	77.5
03:24:22 PM	61.7	80.3	54.8	94.5
03:25:22 PM	57.5	63.5	52.9	79.4
03:26:22 PM	61	67.4	54.6	81.1
03:27:22 PM	57.7	62.9	53.1	74.8
03:28:22 PM	55.9	61.6	51.4	73.9
03:29:22 PM	60.2	64.1	55.3	77.2
03:30:22 PM	59.6	65.4	52.1	78.4
03:31:22 PM	57.4	63.8	52.5	77.8
03:32:22 PM	62.2	71.4	54.6	82.8
03:33:22 PM	61.3	76.8	52.8	89.5
03:34:22 PM	59	69.8	53.9	81.9
03:35:22 PM	58.6	63.6	55	76
03:36:22 PM	58.7	67.1	53.1	80.7
03:37:22 PM	57.4	65.6	53.2	76.6
03:38:22 PM	59.4	65.8	54.4	77.5
03:39:22 PM	58.6	67.3	52.8	81.2

Logged Data Chart

S019_BGG110027_22112019_140447: Logged Data Chart



LOCATION 5

DMO Location 5 AM

11/22/2019

Information Panel

Name	S015_BGG110027_22112019_140423
Start Time	21/11/2019 10:46:03 AM
Stop Time	21/11/2019 11:16:03 AM
Device Name	BGG110027
Model Type	SoundPro DL
Device Firmware Rev	R.13H
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	72.5 dB	Lmax	1	85 dB
Lmin	1	52.5 dB	Lpk	1	96.6 dB
Rtime	1	00:30:00			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	Flat
Response	2	FAST			

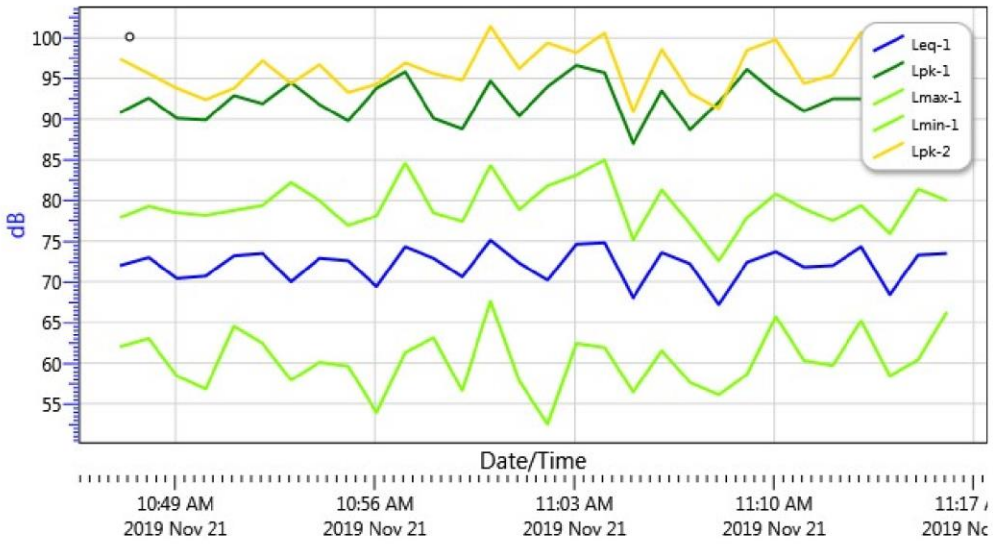
Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
21/11/2019 10:47:03 AM	72	77.9	62	90.8
10:48:03 AM	73	79.3	63	92.6
10:49:03 AM	70.4	78.5	58.4	90.1
10:50:03 AM	70.7	78.2	56.8	89.9
10:51:03 AM	73.2	78.8	64.5	92.9
10:52:03 AM	73.5	79.4	62.4	91.9
10:53:03 AM	70	82.2	57.9	94.5
10:54:03 AM	72.9	80	60.1	91.8
10:55:03 AM	72.6	76.9	59.6	89.8
10:56:03 AM	69.4	78.1	53.9	93.8
10:57:03 AM	74.3	84.6	61.3	95.8
10:58:03 AM	72.9	78.5	63.1	90.1

10:59:03 AM	70.6	77.4	56.6	88.8
11:00:03 AM	75.1	84.3	67.6	94.7
11:01:03 AM	72.3	78.9	57.8	90.4
11:02:03 AM	70.2	81.8	52.5	94
11:03:03 AM	74.6	83.1	62.4	96.6
11:04:03 AM	74.8	85	61.9	95.7
11:05:03 AM	68	75.1	56.4	87
11:06:03 AM	73.6	81.3	61.5	93.5
11:07:03 AM	72.2	77.1	57.6	88.7
11:08:03 AM	67.2	72.6	56.1	92.1
11:09:03 AM	72.4	77.9	58.6	96.1
11:10:03 AM	73.7	80.8	65.7	93.2
11:11:03 AM	71.8	79	60.3	91
11:12:03 AM	72	77.5	59.7	92.5
11:13:03 AM	74.3	79.4	65.2	92.5
11:14:03 AM	68.4	75.9	58.4	87.8
11:15:03 AM	73.3	81.4	60.4	94.4
11:16:03 AM	73.5	80	66.3	91.6

Logged Data Chart

S015_BGG110027_22112019_140423: Logged Data Chart



DMO Location 5 PM

11/22/2019

Information Panel

Name	S020_BGG110027_22112019_140453
Start Time	21/11/2019 03:44:34 PM
Stop Time	21/11/2019 04:14:34 PM
Device Name	BGG110027
Model Type	SoundPro DL
Device Firmware Rev	R.13H
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	71.5 dB	Lmax	1	88.3 dB
Lmin	1	56.8 dB	Lpk	1	103.5 dB
Rtime	1	00:30:00			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	Flat
Response	2	FAST			

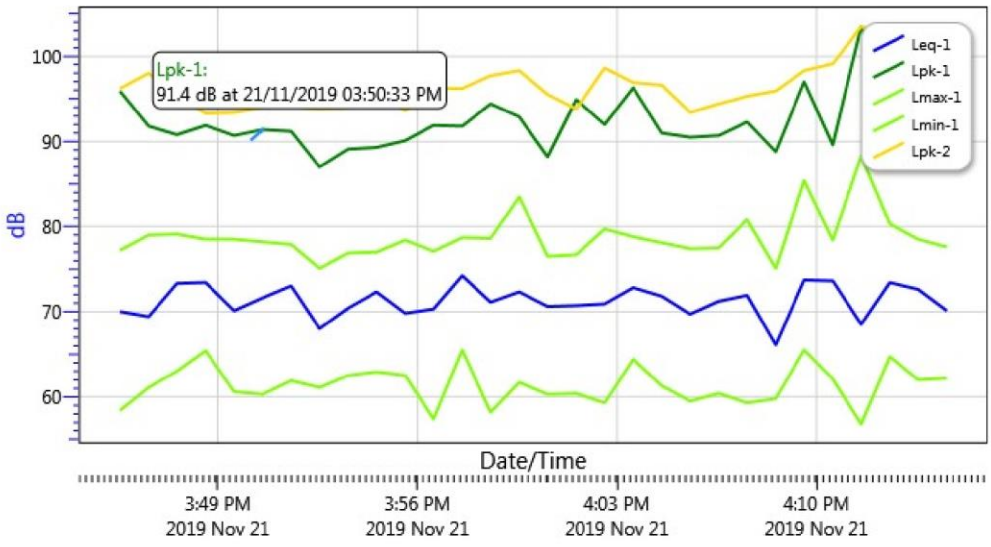
Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
21/11/2019 03:45:34 PM	70	77.2	58.4	95.9
03:46:34 PM	69.4	79	61.1	91.8
03:47:34 PM	73.3	79.1	63	90.8
03:48:34 PM	73.4	78.5	65.4	91.9
03:49:34 PM	70.1	78.5	60.6	90.7
03:50:34 PM	71.6	78.2	60.3	91.4
03:51:34 PM	73	77.9	61.9	91.2
03:52:34 PM	68	75.1	61.1	87
03:53:34 PM	70.4	76.9	62.5	89.1
03:54:34 PM	72.3	77	62.9	89.3
03:55:34 PM	69.8	78.4	62.5	90.1
03:56:34 PM	70.3	77.1	57.4	91.9

03:57:34 PM	74.2	78.7	65.5	91.8
03:58:34 PM	71.1	78.6	58.2	94.4
03:59:34 PM	72.3	83.5	61.7	92.9
04:00:34 PM	70.6	76.5	60.3	88.2
04:01:34 PM	70.7	76.7	60.4	94.9
04:02:34 PM	70.9	79.7	59.3	92
04:03:34 PM	72.8	78.8	64.4	96.3
04:04:34 PM	71.8	78.1	61.3	91
04:05:34 PM	69.7	77.4	59.5	90.5
04:06:34 PM	71.2	77.5	60.4	90.7
04:07:34 PM	71.9	80.8	59.3	92.3
04:08:34 PM	66.1	75.1	59.8	88.8
04:09:34 PM	73.7	85.4	65.5	97
04:10:34 PM	73.6	78.4	62.1	89.6
04:11:34 PM	68.5	88.3	56.8	103.5
04:12:34 PM	73.4	80.3	64.7	94.6
04:13:34 PM	72.6	78.5	62	90.9
04:14:34 PM	70.1	77.6	62.2	89.8

Logged Data Chart

S020_BGG110027_22112019_140453: Logged Data Chart



APPENDIX D

AIR QUALITY RESULTS

EVENT 1

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REPORT

Ambient Air Quality Monitoring

For

Construction of the Diego Martin Vehicular Overpass

November 2019

Event 1

Prepared For

Ecoengineering – Consultants Limited
#62 Eastern Main Road, St. Augustine,
Trinidad W.I

Prepared By

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Davie Selal
Trainee Administrative Technician II,
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   (v) Aeroqual (O_3)
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B. Map of Monitoring Location

C. Accreditation Certificates

D. Laboratory Data
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F. Raw Data
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EXECUTIVE SUMMARY

Kaizen Environmental Services (Trinidad) Limited (Kaizen) was commissioned to conduct Ambient Air Quality Monitoring by Ecoengineering – Consultants Limited. Monitoring was conducted for the Construction of the Diego Martin Vehicular Overpass.

The parameters measured were as follows:

1. Particulate Matter 2.5 ($PM_{2.5}$)
2. Particulate Matter 10 (PM_{10})
3. Total Suspended Particulates (TSP)
4. Nitrogen Dioxide (NO_2)
5. Sulphur Dioxide (SO_2)
6. Carbon Monoxide (CO)
7. Ozone (O_3)
8. Volatile Organic Compounds (VOCs)

Fieldwork was conducted during the period November 13th – 15th, 2019.

SUMMARY OF RESULTS

Based on the investigation conducted on November 13th – 15th, 2019, the following conclusions can be made:

- The 24-hour average concentrations obtained for **Particulate Matter ($PM_{2.5}$ and PM_{10})** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's[a] Air Pollution Rules 2014.

- The 24-hour average concentrations obtained for **Total Suspended Particulates (TSP)** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's Air Pollution Rules 2014.

- The 1-hour concentrations obtained for **Nitrogen Dioxide (NO_2)** at all locations sampled were in compliance with the guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: NO_2 was below the detection limit at all locations monitored

- The 24-hour average concentrations obtained for **Sulphur Dioxide (SO_2)** at all locations sampled were in compliance with their respective guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: SO_2 was below the detection limit at all locations monitored

[a] EMA – Environmental Management Authority of Trinidad and Tobago

- The 8-hour average concentrations obtained for **Carbon Monoxide (CO)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

- The 8-hour average concentrations obtained for **Ozone (O_3)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

- The 8-hour average concentrations for **Volatile Organic Compounds (VOCs)** were obtained at all sampling locations. The concentrations obtained were within the range of 0.6 $\mu g/m^3$ to 1.2 $\mu g/m^3$. There are no EMA guidelines for **VOCs.**

1.0 Introduction

Kaizen Environmental Services (Trinidad) Limited (Kaizen) was commissioned to conduct Ambient Air Quality Monitoring by Ecoengineering – Consultants Limited. Monitoring was conducted for the Construction of the Diego Martin Vehicular Overpass.

Fieldwork was conducted during the period November 13th – 15th, 2019.

2.0 Monitoring Locations and Parameters

Five (5) locations were selected by Ecoengineering – Consultants Limited for the ambient air monitoring as follows:

Table 1: Monitoring Locations and Parameters

Location No.	Co-ordinates	Parameters Monitored
1	20P0657831 UTM1180930	Particulate Matter 2.5 ($PM_{2.5}$) Particulate Matter 10 (PM_{10}) Total Suspended Particulates (TSP) Nitrogen Dioxide (NO_2) Sulphur Dioxide (SO_2) Carbon Monoxide (CO) Ozone (O_3) Volatile Organic Compounds (VOCs)
2	20P0657681 UTM1181156	
3	20P0658177 UTM1181216	
4	20P0658383 UTM1181049	
5	20P0658294 UTM1181091	

3.0 Test Methodology

3.1 Particulate Matter ($PM_{2.5}$ and PM_{10}) Monitoring

$PM_{2.5}$ & PM_{10} was measured in accordance with the US EPA's[b] "*Compendium of Methods for the Determination of Inorganic Compounds in Ambient Air - Compendium Method IO 2.1: Sampling of Ambient Air for Total Suspended Particulate Matter (SPM) and PM_{10} Using High Volume (HV) Sampler*".

The $PM_{2.5}$ high volume sampler utilized meets the US EPA's Reference Method: *40 CFR Part 50 Appendix L.*

The PM_{10} high volume sampler utilized meets the US EPA's Reference Method: *40 CFR Part 50 Appendix J.*

The $PM_{2.5}$ & PM_{10} sampler was calibrated prior to use in the field (*Calibration Certificate is appended–Attachment A (i) and (ii) respectively*)

3.2 Total Suspended Particulate Matter (TSP)

TSP was measured in accordance with equipment specified in the USEPA's *Code of Federal regulations (CFR) 40 CFR Chapter 1 Part 50 Appendix B Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method).*
The TSP sampler was calibrated prior to use in the field (*Calibration Certificate is appended–Attachment A (iii)*.

3.3 Nitrogen Dioxide (NO_2)

NO_2 concentrations were determined in accordance with the US EPA Designated Equivalent Method *NO – EQN – 1277 – 026, "Sodium Arsenite Method for the Determination of Nitrogen Dioxide in the Atmosphere".*

A sample of the ambient air is bubbled at a low flow rate through an impinger containing a sodium arsenite and sodium hydroxide solution for the full 24-hour sampling period. The concentration of the nitrite ion produced during sampling is determined colorimetrically by reacting the nitrite ion with phosphoric acid and N – (1-naphthyl)-ethylene diamine di-hydrochloride and measuring the absorbance of the highly colored azo dye at 540 nm. A vacuum pump was used to draw the ambient air through the sampling solution contained in the impinger.
Based on results from a collaborative study conducted by the US EPA, the lower detectable limit of the method is estimated to be 9 $\mu g/m^3$ for a 24-hour period.

[b] US EPA – United States Environmental Protection Agency

Modified Method to monitor the concentration of NO_2 in accordance to the EMA's Air Pollution Rules, 2014: The sampling time was reduced to one (1) hour or sixty (60) minutes with a sample flow rate of 2 L/min which is reflected in the formula for the calculation of volume of air sampled. The new detectable limit of the method is calculated to be 20 $\mu g/m^3$.

The following formulae were used in the determination of NO_2:

Volume of air sampled:
$V = (F_i + F_f / 2) \times t_s \times 10^{-6}$

Where:
V = Volume of air sampled, m^3
F_i = Air flow rate before sampling, cm^3/min
F_f = Air flow rate after sampling, cm^3/min
t_s = Sampling time, 60 minutes
10^{-6} = conversion of cm^3 to m^3

NO_2 Concentration in Air:
(Concentration of NO_2 (mg/L) x 50 / Volume of air sampled x 0.82) x Dilution factor

Where:
Concentration of NO_2 (mg/L) = obtained from lab analysis report
Volume of absorbing reagent used in sampling, ml = 50
Volume of air sampled = obtained from previous calculation
Sampling efficiency = 0.82
Dilution factor = 1

3.4 Sulphur Dioxide (SO_2)

The concentration of SO_2 was determined in accordance with US EPA 40 CFR Part 50 Appendix A: *"Reference Method for the Determination of Sulphur Dioxide in the Atmosphere (Pararosaniline Method).*

With this Method, a measured volume of air was bubbled through a solution of 0.04 M potassium tetrachloromercurate (TCM), which was contained in an impinger train assembly. The SO_2 present in the air stream reacts with the TCM solution to form a stable monochlorosulfanomercurate complex. Once formed, this complex resists air oxidation and is stable in the presence of strong oxidants such as ozone and oxides of nitrogen. During subsequent analysis, the complex is reacted with acid bleached pararosaniline methyl sulfonic acid. The optical density of this species is determined spectrophotometrically at 548 nm and is directly related to the amount of SO_2 collected.

Based on results from a collaborative study conducted by the US EPA, the lower limit of detection of SO_2 in 10 ml of TCM is 0.75 µg. This represents a concentration of 13 µg SO_2/ m^3 (0.005 ppm) for a 24-hour period.

3.5 Carbon Monoxide (CO)

The Thermo Scientific Model 48i Carbon Monoxide Analyzer is an U.S. EPA Reference Method: *RFCA-0981-054.*

The Model 48i Carbon Monoxide (CO) absorbs infrared radiation at a wavelength of 4.6 microns. The instrument electronics transform the basic analyzer signal into a linear output. The 48i uses an exact calibration curve to accurately linearize the instrument output over any range up to a concentration of 10,000ppm. The CO samplers were calibrated prior to use in the field (*Calibration Certificate is appended – Attachment A (iv)*.

3.6 Ozone (O_3)

For this measurement of Ozone, the Aeroqual Series 500-USEPA Tier II & III Indicative method was used; comparable to USEPA studies. *See Attachment D – Ozone Comparative Study*

3.7 Volatile Organic Compounds (VOCs)

For monitoring of VOCs, Crowcon portable emissions analyzer was utilized, and was calibrated prior to use in the field (*Test Certificate is appended –Attachment A (ii)*).

The Crowcon Gas Detective portable emissions analyzer is a microprocessor controlled portable gas detector, which is capable of monitoring up to four (4) gas types simultaneously and providing warning of hazardous levels.

Using electrochemical, catalytic, and thermal conductivity sensors, this instrument was configured to detect any practical combination of oxygen, toxic and flammable gas.

The Crowcon was fitted with electrochemical sensors to measure VOC concentrations. The concentration ranges and resolution/ detection limits of this instrument VOC are as follows:

Sensor/ Parameter	Range (ppm)	Resolution/ Detection Limit (ppm)
VOC	0 – 100	1.0

The Crowcon was configured to log averages at 15-minute intervals.

4.0 Results

4.1 Particulate Matter ($PM_{2.5}$ and PM_{10}), Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2), and Carbon Monoxide (CO), Ozone (O_3), Total Suspended Particulate Matter (TSP) and Volatile Organic Compounds (VOCs) Results

Table 2 presents the results of the Particulate Matter ($PM_{2.5}$ and PM_{10}) and Total Suspended Particulate (TSP) Monitoring. The results in this table have been compared to standards outlined by the EMA in the Air Pollution Rules, 2014.

Table 2: Ambient Air Quality Testing Results Particulate Matter ($PM_{2.5}$ PM_{10} and TSP)

Location No.	Sample Period/ 2019	Parameter Concentration		
		$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	TSP ($\mu g/m^3$)
1	November 14th	6	19	37
2	November 13th	2	3	8
3		5	15	32
4		4	7	14
5	November 14th	6	10	23
EMA[c] STEL[d] (24-hr average)		**65**	**75**	**150**

Note:

a) Results reported to the nearest whole number

[c] EMA – Environmental Management Authority of Trinidad and Tobago
[d] STEL – Short-term Maximum Permissible Level

Table 3 displays the results of the 24 hour monitoring event for SO_2. The results were compared to their respective short term permissible levels as stipulated by the EMA in their Air Pollution Rules, 2014.

Table 3: Ambient Air Quality Testing Results –SO_2 (24-hour)

Location No	Sample Period/ 2019	Parameter Concentration
		SO_2 ($\mu g/m^3$)
1	November 14th	BDL
2	November 13th	BDL
3		BDL
4		BDL
5	November 14th	BDL
EMA STEL (24-hr)		**125**

Note:

a) BDL – Below Detection Limit
b) SO_2 Method Detection Limit = 13 $\mu g/Nm^3$

Table 4 displays the data for the 1-hour monitoring event for NO_2. The results were compared to the relevant limits as stated by the EMA in the Air Pollution Rules, 2014.

Table 4: Ambient Air Quality Testing Results – NO_2 (1-hour)

Location No	Sample Period/ 2019	Parameter Concentration
		NO_2 ($\mu g/m^3$)
1	November 14th	BDL
2	November 13th	BDL
3		BDL
4		BDL
5	November 14th	BDL
EMA[e] STEL[f] (1-hr)		**200**

Note:

a) BDL – Below Detection Limit
b) NO_2 Modified Method Detection Limit = 20 $\mu g/Nm^3$

[e] EMA – Environmental Management Authority of Trinidad and Tobago
[f] STEL – Short-term Maximum Permissible Level

Table 5 displays the results of the CO, VOC and O_3 monitoring. The results were compared to the 8-hour limit as stated by the EMA in the Air Pollution Rules, 2014.

Table 5: Ambient Air Quality Testing Results – Carbon Monoxide (CO), Volatile Organic Compounds (VOCs) and Ozone (O_3)

Location	Sampling Date/ 2019	Sampling Period		Avg 8-Hr CO Concentration ($\mu g/m^3$)	Avg 8-Hr VOC Concentration ($\mu g/m^3$)	Avg 8-Hr O_3 Concentration ($\mu g/m^3$)
		Start	End			
1	November 14th	14:35	22:34	913	0.8	35
	November 14th – 15th	22:35	06:34	851	0.9	28
	November 15th	06:35	14:35	929	1.1	36
2	November 13th	12:03	20:02	755	1.2	41
	November 13th – 14th	20:03	04:02	724	0.9	30
	November 14th	04:03	12:03	774	1.4	38
3	November 13th	13:01	21:00	757	1.1	39
	November 13th – 14th	21:01	05:00	730	1.1	26
	November 14th	05:01	13:01	765	1.2	37
4	November 13th	14:03	22:02	903	1.0	45
	November 13th – 14th	22:03	06:02	879	0.6	22
	November 14th	06:03	14:03	917	1.1	34
5	November 14th	13:35	21:34	964	0.8	37
	November 14th – 15th	21:35	05:34	911	1.2	32
	November 15th	05:35	13:35	1014	1.0	40
EMA STEL (8-hour average)				**10 000**	**N/A**	**120**

Note:

a) Results reported to the nearest whole number
b) There are no guidelines for VOCs in ambient air.

4.2 Meteorological Monitoring

Table 6: Summary of Meteorological Conditions during Monitoring Periods (November 13th – 15th, 2019)

Date/ 2019	Average Wind Speed (m/s)	Average Temperature (°C)	Average Relative Humidity (%)	Average Barometric Pressure (mmHg)	Total Rainfall (mm)
November 13th – 15th	1.0	25.4	86.1	766.1	0

The raw meteorological data is attached as *Appendix F*.

5.0 Conclusion

Based on the investigation conducted on November 13th – 15th, 2019, the following conclusions can be made:

- The 24-hour average concentrations obtained for **Particulate Matter ($PM_{2.5}$ and PM_{10})** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's[g] Air Pollution Rules 2014.

- The 24-hour average concentrations obtained for **Total Suspended Particulates (TSP)** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's Air Pollution Rules 2014.

- The 1-hour concentrations obtained for **Nitrogen Dioxide (NO_2)** at all locations sampled were in compliance with the guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: NO_2 was below the detection limit at all locations monitored

- The 24-hour average concentrations obtained for **Sulphur Dioxide (SO_2)** at all locations sampled were in compliance with their respective guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: SO_2 was below the detection limit at all locations monitored

- The 8-hour average concentrations obtained for **Carbon Monoxide (CO)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

[g] EMA – Environmental Management Authority of Trinidad and Tobago

- The 8-hour average concentrations obtained for **Ozone (O_3)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

- The 8-hour average concentrations for **Volatile Organic Compounds (VOCs)** were obtained at all sampling locations. The concentrations obtained were within the range of 0.6 $\mu g/m^3$ to 1.2 $\mu g/m^3$. There are no EMA guidelines for **VOCs.**

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ATTACHMENTS

A. Calibration Certificates

- (i) $PM_{2.5}$ High Volume Samplers
- (ii) PM_{10} High Volume Samplers
- (iii) TSP Samplers
- (iv) Thermo Scientific (CO)
- (v) Aeroqual (O_3)
- (vi) SKC Pumps (NO_2 and SO_2)
- (vii) Crowncon Gas Detective (VOCs)
- (viii) Analytical Balance

B. Map of Monitoring Location

C. Accreditation Certificate

D. Laboratory Data

- (i) Chain of Custody
- (ii) Analytical Results

E. Ozone Comparative Study

F. Raw Data

- (i) Carbon Monoxide (CO)
- (ii) Volatile Organic Compounds (VOCs)
- (iii) Ozone (O_3)
- (iv) Filter Weights

G. Meteorological Data

- (i) Raw Meteorological Data
- (ii) Wind Rose Plot
- (iii) Calibration Certificate – Davis Met Station

H. Biographies of Personnel

A. Calibration Certificates

(i) $PM_{2.5}$ High Volume Samplers

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

PM2.5 High Volume Sampler Calibration

DATE: Nov 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4735
Serial# : 4735
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

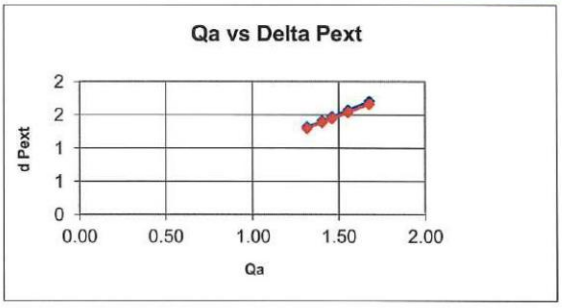
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	27.3	**Ta (°K)**	300.3	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.96	**Pa (mm Hg)**	760.984	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.072916**
7	1.681	6.7	1.705	1.6621	**intercept, b2:**	**-0.097978**
6	1.557	5.7	1.573	1.5388	**corr. coeff, r2**	**0.999998**
5.3	1.464	5	1.473	1.4463		
4.9	1.408	4.6	1.413	1.3906	**SFR**	**1.135**
4.3	1.320	4	1.318	1.3027	**SSP**	**2.89**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

KAIZEN
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Tel.: (868) 299-0009,
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Email: inquiries@kaizen-tt.com

PM2.5 High Volume Sampler Calibration

DATE: November 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-711768
Serial# : 711768
Sampler: Staplex

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

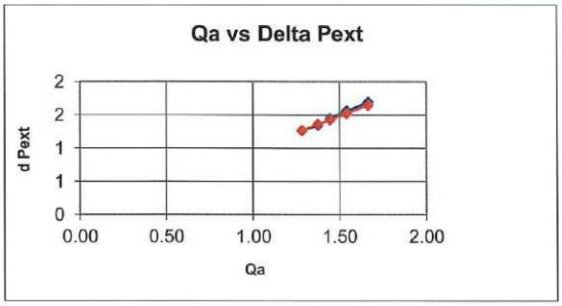
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	27.3	**Ta (°K)**	300.3	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.96	**Pa (mm Hg)**	760.984	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.143603**
6.9	1.669	6.6	1.693	1.6502	**intercept, b2:**	**-0.214450**
5.9	1.544	5.6	1.559	1.5259	**corr. coeff, r2**	**0.998751**
5.2	1.450	4.8	1.443	1.4325		
4.7	1.379	4.2	1.350	1.3619	**SFR**	**1.135**
4.1	1.289	3.7	1.267	1.2720	**SSP**	**2.71**



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Email: inquiries@kaizen-tt.com

PM2.5 High Volume Sampler Calibration

DATE: November 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-711768
Serial# : 711768
Sampler: Staplex

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

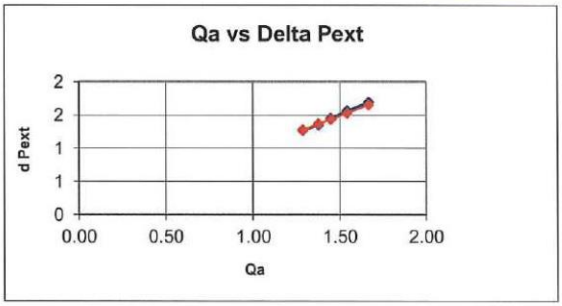
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	27.3	**Ta (°K)**	300.3	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.96	**Pa (mm Hg)**	760.984	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.143603**
6.9	1.669	6.6	1.693	1.6502	**intercept, b2:**	**-0.214450**
5.9	1.544	5.6	1.559	1.5259	**corr. coeff, r2**	**0.998751**
5.2	1.450	4.8	1.443	1.4325		
4.7	1.379	4.2	1.350	1.3619	**SFR**	**1.135**
4.1	1.289	3.7	1.267	1.2720	**SSP**	**2.71**



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Instrumentation Technician

(ii) PM_{10} High Volume Samplers

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Email: inquiries@kaizen-tt.com

PM10 High Volume Sampler Calibration

DATE: Nov 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-2480
Serial# : 2480
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

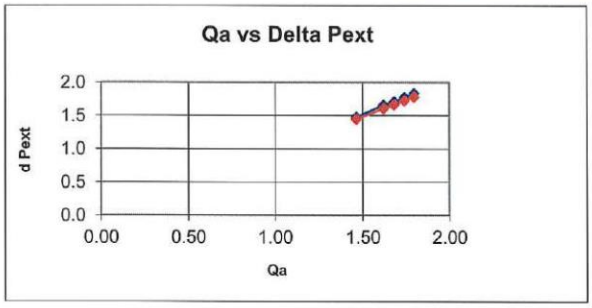
Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext
8	1.801	7.7	1.832	1.7810
7.5	1.744	7.2	1.772	1.7244
7	1.685	6.7	1.709	1.6660
6.5	1.624	6.3	1.657	1.6054
5.3	1.467	5	1.476	1.4496

slope, m2:	**1.060066**
intercept, b2:	**-0.074936**
corr. coeff, r2	**0.999042**
SFR	**1.141**
SSP	**2.95**



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PM10 High Volume Sampler Calibration

DATE: Nov 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4733
Serial# : 4733
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

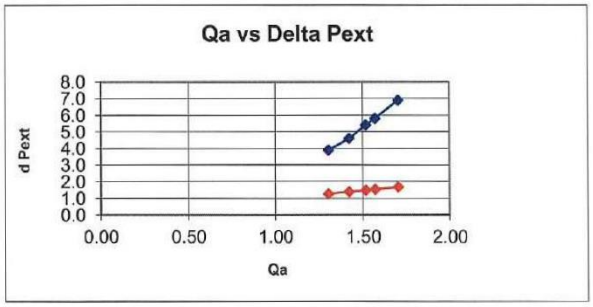
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**7.560747**
7.2	1.709	7.8	6.900	1.6896	**intercept, b2:**	**-6.076769**
6.1	1.574	7.33	5.800	1.5552	**corr. coeff, r2**	**0.997793**
5.7	1.521	6.9	5.400	1.5033		
5	1.426	6.53	4.600	1.4080	**SFR**	**1.141**
4.2	1.307	5.7	3.900	1.2905	**SSP**	**14.88**



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Instrumentation Technician

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Email: inquiries@kaizen-tt.com

PM10 High Volume Sampler Calibration

DATE: Nov 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4734
Serial# : 4734
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

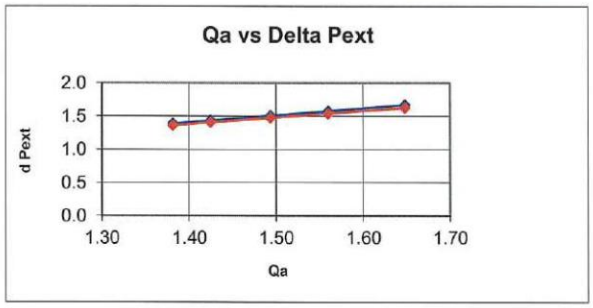
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.072142**
6.7	1.649	6.4	1.670	1.6299	**intercept, b2:**	**-0.097217**
6	1.561	5.7	1.576	1.5424	**corr. coeff, r2**	**0.999999**
5.5	1.495	5.2	1.505	1.4767		
5	1.426	4.7	1.431	1.4080	**SFR**	**1.141**
4.7	1.383	4.4	1.385	1.3651	**SSP**	**2.91**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

(iii) TSP Samplers

KAIZEN
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Email: inquiries@kaizen-tt.com

TSP High Volume Sampler Calibration

DATE: October 23rd 2019
Techinician : Amrit Persad Maharaj

Certificate #: 010319-4731
Serial# : 4731
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

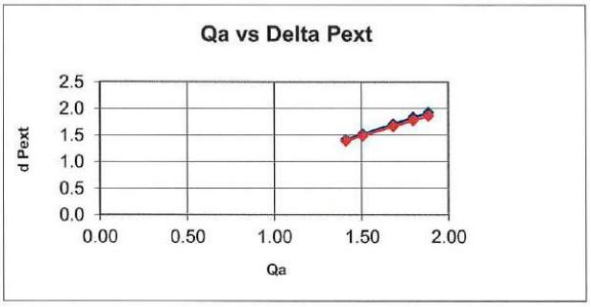
Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.068727**
8.8	1.889	8.5	1.925	1.8679	**intercept, b2:**	**-0.093403**
8	1.801	7.7	1.832	1.7810	**corr. coeff, r2**	**0.999998**
7	1.686	6.7	1.709	1.6660		
5.6	1.509	5.3	1.520	1.4901	**SFR**	**1.141**
4.9	1.413	4.6	1.416	1.3938	**SSP**	**2.91**



amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

KAIZEN
Environmental Services (T'dad) Ltd

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Email: inquiries@kaizen-tt.com

TSP High Volume Sampler Calibration

DATE: October 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4728
Serial# : 4728
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

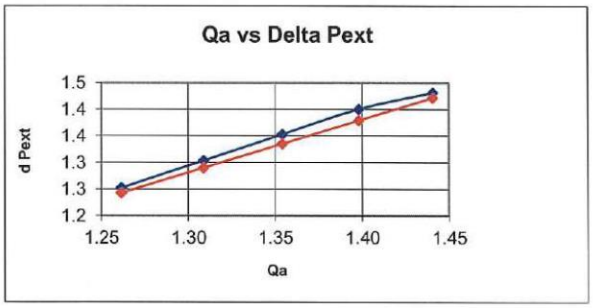
Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.014525**
5.1	1.441	4.7	1.431	1.4220	**intercept, b2:**	**-0.024242**
4.8	1.398	4.5	1.401	1.3795	**corr. coeff, r2**	**0.997630**
4.5	1.354	4.2	1.353	1.3357		
4.2	1.309	3.9	1.304	1.2905	**SFR**	**1.141**
3.9	1.262	3.6	1.253	1.2435	**SSP**	**2.94**



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Amrit Persad Maharaj
Instrumentation Technician

KAIZEN
Environmental Services (T'dad) Ltd

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Email: inquiries@kaizen-tt.com

TSP High Volume Sampler Calibration

DATE: October 23rd 2019
Techinician : Amrit Persad Maharaj

Certificate #: 010319-4730
Serial# : 4730
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

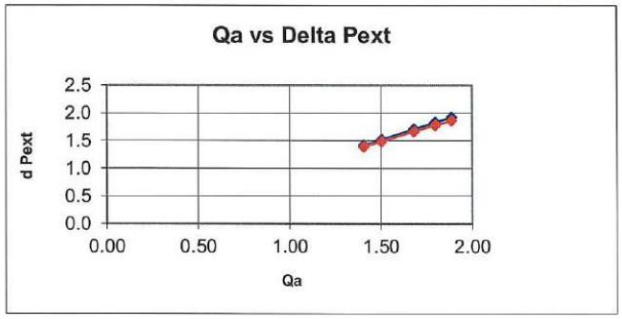
Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.068727**
8.8	1.889	8.5	1.925	1.8679	**intercept, b2:**	**-0.093403**
8	1.801	7.7	1.832	1.7810	**corr. coeff, r2**	**0.999998**
7	1.686	6.7	1.709	1.6660		
5.6	1.509	5.3	1.520	1.4901	**SFR**	**1.141**
4.9	1.413	4.6	1.416	1.3938	**SSP**	**2.91**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

(iv) Thermo Scientific (CO&H_2S)

KAIZEN
Environmental Services (T'dad) Ltd

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Tel.: (868) 299-0009,
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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-1108347540

DATE: 28/10/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	As Left	Span	Gas Manufacturer	Gas Lot #
0	0	*Air Zero Grade (THC<1ppm)*	CALGAZ	152802
50	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-1108347541

DATE: 28/10/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	As Left	Span	Gas Manufacturer	Gas Lot #
0	0	*Air Zero Grade (THC<1ppm)*	CALGAZ	152802
50	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-710821552

DATE: 28/10/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	As Left	Span	Gas Manufacturer	Gas Lot #
0	0	*Air Zero Grade (THC<1ppm)*	CALGAZ	152802
50	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

(v) Aeroqual (O_3)

aeroqual

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32159

Calibration Date: 25 Feb 2019 14:51

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1221

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.005	0.110	0.523	0.000
AQL Sensor (Std. Dev) /ppm	0.000	0.001	0.002	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: Takao Yamasaki

Date: 25 Feb 2019

aeroqual

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32151

Calibration Date: 25 Feb 2019 14:50

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1225

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.004	0.109	0.510	0.000
AQL Sensor (Std. Dev) /ppm	0.001	0.001	0.001	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: **Takao Yamasaki**

Date: **25 Feb 2019**

aeroqual

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32142

Calibration Date: 25 Feb 2019 14:50

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1232

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.005	0.113	0.506	0.000
AQL Sensor (Std. Dev) /ppm	0.002	0.001	0.003	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: Takao Yamasaki

Date: 25 Feb 2019

(vi) SKC Pumps (NO_2 and SO_2)

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
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Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-634661

DATE: 27/10/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 634661

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
3.0 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-562657

DATE: 27/10/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 562657

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
2.9 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-634635

DATE: 27/10/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 634635

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
3.1 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

(vii) Crowncon Gas Detective (VOCs)

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-42045
DATE: 2019-10-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 42045

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*
VOC	0	0	10	10	*10 ppm Isobutylene*

TEMPERATURE: 25.9°C

RELATIVE HUMIDITY: 51.4%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-45704
DATE: 2019-10-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 45704

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*
VOC	0	0	10	10	*10 ppm Isobutylene*

TEMPERATURE: 25.8°C

RELATIVE HUMIDITY: 51.5%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-44094
DATE: 2019-10-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 44094

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*
VOC	0	0	10	10	*10 ppm Isobutylene*

TEMPERATURE: 25.8°C

RELATIVE HUMIDITY: 51.6%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

(viii) Analytical Balance

Location:
University of the West Indies
St. Augustine Campus, Trinidad & Tobago
Mailing Address:
Tunapuna Post Office, Trinidad & Tobago
Tel: (868) 299-0210
Fax: (868) 662-7177
Email: cams@cariri.com
Website: www.cariri.com

Caribbean Industrial Research Institute

ACCREDITED
Calibration Laboratory
LAB NO. CL-134

CALIBRATION CERTIFICATE

Date of Issue: September 06, 2018 | Certificate No.: C060018

Project No.: EC03834140/18 | Page 1 of 3

CLIENT: Kaizen Environmental Services (Trinidad) Ltd.

ADDRESS: Unit 8 Rajkumar Street, Mission Road, Freeport

CALIBRATION LOCATION: Kaizen Environmental Services (Trinidad) Ltd., Balance Room

EQUIPMENT: Electronic Balance

MANUFACTURER: Sartorius

MODEL NO.: AC 210S 00016

SERIAL NO.: 40305246

EQUIPMENT NO.: ASD-EQ-BAL001

CAPACITY/RESOLUTION: 100g / 0.0001g

CALIBRATION TYPE: As Found

CALIBRATION DATE: September 04, 2018

1. This report relates solely to the specific sample of the product which has been analysed or calibrated by CARIRI as the basis for preparing the report. It shall not be used for certification, advertising or marketing of products produced by the same manufacturer or the Client without the prior written consent of the Chief Executive Officer of CARIRI.

2. This report may not be reproduced, other than in full, except with the prior written authorization from the Chief Executive Officer / Chairman of CARIRI.

The uncertainties are for a confidence probability of approximately 95 percent and coverage factor k = 1.96

CARIBBEAN INDUSTRIAL RESEARCH INSTITUTE
CALIBRATION CERTIFICATE

Certificate No.: C060018
Project No.: EC03834140/18

PROCEDURE:
The electronic balance was calibrated in accordance with UKAS Lab 14 and CARIRI's SOP: CAMS.M1

TRACEABILITY:
The values and units of measurement of the reference weights are traceable to the SI (International System of Units), through reference standards maintained at the National Physical Laboratory (England), NIST (USA) and other recognized standards laboratories.

OBSERVATIONS:
The Internal, External and Sensivity calibration functions on the balance are inoperative. As a result these functions could not be used to adjust the balance readout.

AMBIENT CONDITIONS:
Temperature: 25±2°C, Relative Humidity: 70±5%RH

REFERENCE MASS

Serial No.	Weights Applied (g)	Certificate No.	Laboratory No.	Class	Uncertainty (g)
41950	0.005 to 200	M49398	0438	E2	0.0001

REPEATABILITY
Applied Load (g): 100

Unloaded Reading(A)	Loaded Reading (B)	Difference (B-A)	Readability
0.0000	99.8325	99.8325	0.0001
0.0000	99.8326	99.8326	
0.0000	99.8324	99.8324	
0.0000	99.8325	99.8325	
0.0000	99.8324	99.8324	
0.0000	99.8325	99.8325	
0.0000	99.8326	99.8326	
0.0000	99.8327	99.8327	
0.0000	99.8327	99.8327	
0.0000	99.8325	99.8325	

Standard Deviation (g): 0.0001

LINEARITY

Applied Load (g)	Indicated Reading (g)	Error
0.005	0.0051	0.0001
0.02	0.0201	0.0001
0.1	0.1003	0.0003
1	0.9984	-0.0016
5	4.9918	-0.0082
20	19.9663	-0.0337
30	29.9499	-0.0501
50	49.9163	-0.0837
70	69.8829	-0.1171
100	99.8327	-0.1673

Maximum Error (g): 0.1673

CARIBBEAN INDUSTRIAL RESEARCH INSTITUTE
CALIBRATION CERTIFICATE

Certificate No.: C060018
Project No.: EC03834140/18

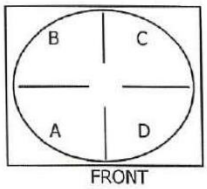
ECCENTRICITY

Applied Load (g): 20

Position	Reading (g)
Front Left (A)	19.9657
Rear Left (B)	19.1502
Rear Right (C)	19.9663
Front Right (D)	19.9669

Maximum deviation across balance pan (g): 0.8167

Uncertainty of Calibration (g): ±0.46210



Calibrator: N. Jonas

Signature: .....

Approved Signatory: M. Andrews

Signature: .....

End of Certificate

B. Map of Monitoring Location


Location 3
N
Location 2
Location 5
Diego Martin Hwy
Location 4
Main Rd
Location 1
Western Main Rd

C. Accreditation Certificates

TT LABS
TRINIDAD AND TOBAGO
laboratory
Accreditation
Service

CERTIFICATE OF ACCREDITATION

KAIZEN ENVIRONMENTAL SERVICES (TRINIDAD) LTD

Testing Laboratory No.: LAS-005

is an accredited Laboratory which fulfils the requirements of ISO/IEC 17025 and has demonstrated competence to carry out tests as per a defined scope for:

CHEMICAL AND MICROBIOLOGICAL TESTING

as per attached schedule

While this certificate remains valid, the Accredited Laboratory named above is authorized to issue TTLABS-endorsed certificates.

Karlene Carolyn Lewis
Manager, TTLABS

"Recognised as the official national laboratory accrediting body by the Ministry of Trade, Industry, Investment and Communication of the Republic of Trinidad and Tobago"

Initial Accreditation date: 3rd September 2014

This certificate issued on: 21st September 2017

"This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrated technical competence for a defined scope and the operation of a laboratory quality management system. (refer to joint ISO-ILAC-IAF Communiqué dated 18 June 2005)"

Canadian Association
for Laboratory Accreditation Inc.

CALA

Certificate of Accreditation

Kaizen Lab
KaizenLAB Inc.
333-50th Ave. S.E.
Calgary, Alberta

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

Accreditation No.: A2925
Issued On: October 17, 2017
Accreditation Date: January 31, 2005
Expiry Date: April 16, 2020

President & CEO

This certificate is the property of the Canadian Association for Laboratory Accreditation Inc. and must be returned on request. Reproduction must follow policy in place at date of issue. For the specific tests to which this accreditation applies, please refer to the laboratory's scope of accreditation at www.cala.ca

D. Laboratory Data

(i) Chain of Custody

PROJECTServices

DIVISION OF KAIZEN ENVIRONMENTAL SERVICES LIMITED

it # 8, Rajkumar Street, Mission Road, Freeport. Trinidad, W.I.
: (868) 299-0009 Fax: (868) 673-5997

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

Kaizen Lab File #: 427579-1-5 NO PSD 1696

ate Submitted: 15/11/2019 | Date Required: 22/11/2019

ervice Requested:
- Regular (10 days) ☐
- Rush (within 5 days) + 25% ☑
- Priority (3 days) + 50% ☐
- Emergency (next day) + 100% ☐

ANALYSIS REQUESTED

SAMPLE ID	DATE SAMPLED	SAMPLED TYPE	NO2	
CO - ENGINEERING				
DIEGO MARTAIN)				
- Loc 1	14/11/2019		/	-1
- Loc 2	13/11/2019	NO_x ABSORBING SOLUTION	/	-2
- Loc 3	13/11/2019		/	-3
- Loc 4	13/11/2019		/	-4
- Loc 5	14/11/2019		/	-5

ent: HENRY LUE FATT Phone: SAME AS ABOVE

ntact: Fax:

port Address: P.O.#:

Client Job #:

ing Address: # Samples Submitted: 5

Preservatives:

cial Requests:

Relinquished By: A. CHARIAH	Received By: STEVE RAMLISSOON
Date: 15/11/2019	Date: 19/11/2019
Time: 1800h	Time: 2:46 PM

Sample Condition Upon Receipt:

Frozen ☐ Cold ☐ Ambient ☐ Head Space (yes/no): _____

Other (breakage, leakage, illegible etc.): _____

LED BY: A. CHARIAH
NAME IN BLOCK LETTERS

A.
SIGNATURE

DATE: 15/11/2019

- File Copy Yellow - Lab Copy

Pronto 652-3577

PROJECTServices

A DIVISION OF KAIZEN ENVIRONMENTAL SERVICES LIMITED

Unit # 8, Rajkumar Street, Mission Road, Freeport, Trinidad, W.I.
Tel: (868) 299-0009 Fax: (868) 673-5997

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

Kaizen Lab File # **303981** PSD 1697

Date Submitted: 15/11/2019 Date Required: ~~22/11/2019~~ 22-NOV, 19

Service Requested:
- Regular (10 days) ☐
- Rush (within 5 days) + 25% ☑
- Priority (3 days) + 50% ☐
- Emergency (next day) + 100% ☐

ANALYSIS REQUESTED

	SAMPLE ID	DATE SAMPLED	SAMPLED TYPE	50x
	Eco-Engineering (Diego Martain)			
1	-Loc 1	14/11/2019		☑
2	-Loc 2	13/11/2019	50x Absorbing Solution	☑
3	-Loc 3	13/11/2019		☑
4	-Loc 4	13/11/2019		☑
5	-Loc 5	14/11/2019		☑

Client: Henry Lue Fatt Phone: Same As Above
Contact Fax:
Report Address: P.O #:
Client Job #:
Billing Address: # Samples Submitted: 5
Preservatives:
Special Requests.

Relinquished By: A. Chariah	Received By: BD
Date: 15/11/2019	Date: 22 NOV, 19
Time: 1800h	Time: 1240PM

Sample Condition Upon Receipt: Temp: 17.3°C
Frozen ☐ Cold ☐ Ambient ☐ Head Space (yes/no): _____
Other (breakage, leakage, illegible etc.):

SAMPLED BY: A. Chariah
NAME IN BLOCK LETTERS
A. Chariah
SIGNATURE

DATE: 15/11/2019

White - File Copy Yellow - Lab Copy

Pronto 652-3577

(ii) Analytical Results

KaizenLAB
Analytical Division of Kaizen Environmental Services (Trinidad) Ltd.

Unit 8 Rajkumar Street,
Mission Road, Freeport.
Email: kaizenlab@kaizen-tt.com
Tel: (868) 299-0009
Fax: (868) 673-6774

ANALYSIS DATA REPORT

Customer:	KESTL- PSD	**Customer Contact:**	Henry Lue-Fatt
Customer's Address:	Unit 8 Rajkumar Street, Mission Road, Freeport.		
Client Project #:	19-002	**Lab File #:**	427579
Item(s) Analyzed:	Liquid Samples		
Date of Sampling:	13-Nov-19 & 14-Nov-19	**Sampling Location:**	Eco Engineering (Diego Martin)
Sampling Condition:	n/a	**Sampled By:**	PSD Staff - A. Chariah
Sampling Plan Used:	n/a		
Date of Receipt:	19-Nov-19	**Date of Testing:**	21-Nov-19
Report Date:	25-Nov-19		

ANALYSIS RESULTS

Analysis: Nitrite-N

Sample ID	Units	Results
		Nitrite-N
427579-1, Loc 1	mg/L	<0.04
427579-2, Loc 2	mg/L	<0.04
427579-3, Loc 3	mg/L	<0.04
427579-4, Loc 4	mg/L	<0.04
427579-5, Loc 5	mg/L	<0.04

** Detailed Test Methodologies and QA/QC data available upon request.*

***Test Methodologies:** Nitrite-N: EPA-EQN-1277-026

Discussion: None

Comments: The results in this test report relate only to the items as received and tested.

Report Authorized by: Devika Rooplal
Devika Rooplal
Laboratory Manager

This test report shall not be reproduced except in full, without written approval of the laboratory.

333 50th Ave. S.E.
Calgary, AB. T2G 2B3
Phone (403) 297-0868
Fax: (403) 297-0869

KaizenLAB

ANALYTICAL REPORT

Client: Kaizen Environmental Services (Trinidad) Ltd.
Unit 8, Rajkumar Street, Mission Road
Freeport, Trinidad, West Indies

Attention: Henry Lue-Fatt

KaizenLAB JOB #:	303981
DATE RECEIVED:	22-Nov-2019
DATE REPORTED:	28-Nov-2019
PROJECT ID:	Eco-Engineering (Diego Martin)
LOCATION:	

KaizenLAB Sample #: 303981_001 **Sample ID:** Loc 1
Date Sampled: 14-Nov-2019 **Matrix:** Water

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 303981_002 **Sample ID:** Loc 2
Date Sampled: 13-Nov-2019 **Matrix:** Water

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 303981_003 **Sample ID:** Loc 3
Date Sampled: 13-Nov-2019 **Matrix:** Water

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 303981_004 **Sample ID:** Loc 4
Date Sampled: 13-Nov-2019 **Matrix:** Water

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 303981_005 **Sample ID:** Loc 5
Date Sampled: 14-Nov-2019 **Matrix:** Water

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

333 50th Ave. S.E.
Calgary, AB, T2G 2B3
Phone (403) 297-0868
Fax: (403) 297-0869

KaizenLAB

Test Methodologies

SO2 in Water - Determination of SO2 Absorbed in Potassium Trichlormercurate

Final Review by:

Loida Agacid
Client Services Administrator

Note: The results in this report relate only to the items tested and as received. Information is available for any items in 7.8.2.1 of ISO/IEC 17025:2017 that cannot be put on a test report. The report shall not be reproduced except in full without written approval of KaizenLAB. The validity of results may be affected if the information is provided by the customer.

E. Comparative Study – Ozone (O_3)

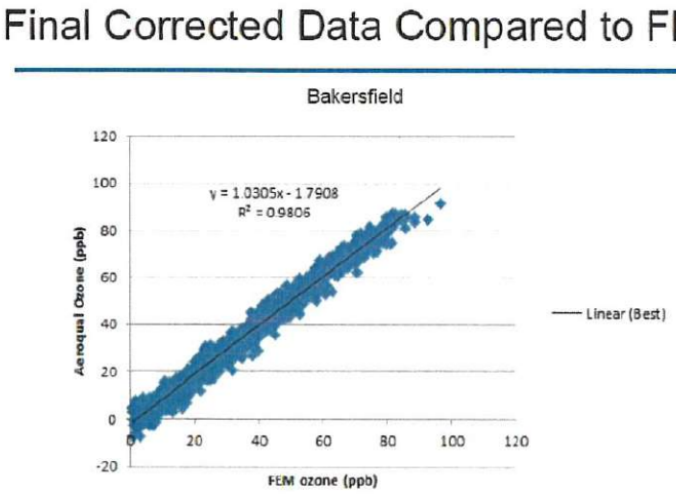
The Aeroqual's Series 500 portable ozone monitors were chosen by an air quality consultancy based in California, USA to better understand the spatial and temporal distribution of ozone in an area.

Twenty three monitors were co-located next to a federal reference method (FEM) monitoring stations to check their precision and accuracy before being distributed across an area of about 100 square miles. The monitors collected and transmitted ozone concentrations every minute for six weeks. Afterwards the monitors were co-located with reference monitoring stations to quantify drift. The data was analyzed and a report was produced.

Co-location of the Series 500 monitors established accuracy to within +/- 3 ppb of the federal reference monitors. See example in figure below.
The study demonstrated that there are strong spatial gradients in ozone over short distances even in rural areas. In addition, the new site at Di Giorgio actually measures higher concentrations than the old Bear Mountain site, and therefore is a good replacement site. In addition, it was determined that the new site was representative of concentrations experienced in the city of Arvin and is therefore useful for real-time warnings regarding poor air quality for citizens in Arvin.
The results of this study provide important supporting evidence for the District's formal attainment request to EPA. In addition the study provides a strong scientific foundation for future decision making about managing the air resources of the San Joaquin Valley.

The final report can be found at:
http://www.valleyair.org/Air_Quality_Plans/docs/2013Attainment/OzoneSaturationStudy.pdf.

Data is courtesy of STI, 2013.



F. Raw Data

(i) Carbon Monoxide (CO)

CO DATA

Location 1		Location 2		Location 3	
Date Time	co	Date Time	co	Date Time	co
14/11/2019 14:35	953.504	13/11/2019 12:03	651.604	13/11/2019 13:01	747.688
14/11/2019 14:50	954.494	13/11/2019 12:18	738.908	13/11/2019 13:16	774.81
14/11/2019 15:05	1013.771	13/11/2019 12:33	685.222	13/11/2019 13:31	714.704
14/11/2019 15:20	866.547	13/11/2019 12:48	668.783	13/11/2019 13:46	746.348
14/11/2019 15:35	920.59	13/11/2019 13:03	726.085	13/11/2019 14:01	769.03
14/11/2019 15:50	1076.501	13/11/2019 13:18	713.246	13/11/2019 14:16	728.497
14/11/2019 16:05	901.911	13/11/2019 13:33	760.715	13/11/2019 14:31	781.967
14/11/2019 16:20	1036.089	13/11/2019 13:48	810.161	13/11/2019 14:46	843.403
14/11/2019 16:35	1074.79	13/11/2019 14:03	762.003	13/11/2019 15:01	760.603
14/11/2019 16:50	860.026	13/11/2019 14:18	842.826	13/11/2019 15:16	780.678
14/11/2019 17:05	1026.043	13/11/2019 14:33	804.492	13/11/2019 15:31	847.089
14/11/2019 17:20	1061.213	13/11/2019 14:48	788.76	13/11/2019 15:46	757.22
14/11/2019 17:35	1064.084	13/11/2019 15:03	825.543	13/11/2019 16:01	812.229
14/11/2019 17:50	1076.462	13/11/2019 15:18	839.914	13/11/2019 16:16	794.591
14/11/2019 18:05	1012.832	13/11/2019 15:33	756.698	13/11/2019 16:31	770.608
14/11/2019 18:20	943.864	13/11/2019 15:48	840.461	13/11/2019 16:46	765.645
14/11/2019 18:35	1029.003	13/11/2019 16:03	839.697	13/11/2019 17:01	829.548
14/11/2019 18:50	888.409	13/11/2019 16:18	837.87	13/11/2019 17:16	808.459
14/11/2019 19:05	777.16	13/11/2019 16:33	788.608	13/11/2019 17:31	768.658
14/11/2019 19:20	789.737	13/11/2019 16:48	694.938	13/11/2019 17:46	743.987
14/11/2019 19:35	811.797	13/11/2019 17:03	744.163	13/11/2019 18:01	706.416
14/11/2019 19:50	793.504	13/11/2019 17:18	728.78	13/11/2019 18:16	670.345
14/11/2019 20:05	883.296	13/11/2019 17:33	704.207	13/11/2019 18:31	779.639
14/11/2019 20:20	838.033	13/11/2019 17:48	772.382	13/11/2019 18:46	733.45
14/11/2019 20:35	776.128	13/11/2019 18:03	793.533	13/11/2019 19:01	657.996
14/11/2019 20:50	871.24	13/11/2019 18:18	706.964	13/11/2019 19:16	752.711
14/11/2019 21:05	854.127	13/11/2019 18:33	725.284	13/11/2019 19:31	741.344
14/11/2019 21:20	750.712	13/11/2019 18:48	711.448	13/11/2019 19:46	763.325
14/11/2019 21:35	845.095	13/11/2019 19:03	767.223	13/11/2019 20:01	659.941
14/11/2019 21:50	814.365	13/11/2019 19:18	718.761	13/11/2019 20:16	784.364
14/11/2019 22:05	835.838	13/11/2019 19:33	653.34	13/11/2019 20:31	761.098
14/11/2019 22:20	822.376	13/11/2019 19:48	764.053	13/11/2019 20:46	660.57
14/11/2019 22:35	799.677	13/11/2019 20:03	770.966	13/11/2019 21:01	747.375
14/11/2019 22:50	779.666	13/11/2019 20:18	667.954	13/11/2019 21:16	723.489
14/11/2019 23:05	789.254	13/11/2019 20:33	759.873	13/11/2019 21:31	760.265
14/11/2019 23:20	859.202	13/11/2019 20:48	700.25	13/11/2019 21:46	666.54
14/11/2019 23:35	878.858	13/11/2019 21:03	668.848	13/11/2019 22:01	715.487
14/11/2019 23:50	833.555	13/11/2019 21:18	714.652	13/11/2019 22:16	733.852
15/11/2019 00:05	832.032	13/11/2019 21:33	666.245	13/11/2019 22:31	694.704
15/11/2019 00:20	818.202	13/11/2019 21:48	764.203	13/11/2019 22:46	711.138
15/11/2019 00:35	848.328	13/11/2019 22:03	799.16	13/11/2019 23:01	753.635
15/11/2019 00:50	885.624	13/11/2019 22:18	655.415	13/11/2019 23:16	691.538
15/11/2019 01:05	800.533	13/11/2019 22:33	748.858	13/11/2019 23:31	757.861
15/11/2019 01:20	846.307	13/11/2019 22:48	756.323	13/11/2019 23:46	684.672

15/11/2019 01:35	757.162	13/11/2019 23:03	686.997	14/11/2019 00:01	776.675
15/11/2019 01:50	767.86	13/11/2019 23:18	682.958	14/11/2019 00:16	689.241
15/11/2019 02:05	897.343	13/11/2019 23:33	773.342	14/11/2019 00:31	794.362
15/11/2019 02:20	797.24	13/11/2019 23:48	751.282	14/11/2019 00:46	738.647
15/11/2019 02:35	861.402	14/11/2019 00:03	744.341	14/11/2019 01:01	664.325
15/11/2019 02:50	867.221	14/11/2019 00:18	745.184	14/11/2019 01:16	687.451
15/11/2019 03:05	877.589	14/11/2019 00:33	660.386	14/11/2019 01:31	740.749
15/11/2019 03:20	833.673	14/11/2019 00:48	691.005	14/11/2019 01:46	744.162
15/11/2019 03:35	762.813	14/11/2019 01:03	720.735	14/11/2019 02:01	763.197
15/11/2019 03:50	845.253	14/11/2019 01:18	768.63	14/11/2019 02:16	691.152
15/11/2019 04:05	884.303	14/11/2019 01:33	656.961	14/11/2019 02:31	778.459
15/11/2019 04:20	864.204	14/11/2019 01:48	666.151	14/11/2019 02:46	765.834
15/11/2019 04:35	852.178	14/11/2019 02:03	686.088	14/11/2019 03:01	675.334
15/11/2019 04:50	813.234	14/11/2019 02:18	776.632	14/11/2019 03:16	663.056
15/11/2019 05:05	827.022	14/11/2019 02:33	778.861	14/11/2019 03:31	680.148
15/11/2019 05:20	923.408	14/11/2019 02:48	674.873	14/11/2019 03:46	671.752
15/11/2019 05:35	863.459	14/11/2019 03:03	672.785	14/11/2019 04:01	688.33
15/11/2019 05:50	969.825	14/11/2019 03:18	724.576	14/11/2019 04:16	782.552
15/11/2019 06:05	986.441	14/11/2019 03:33	794.778	14/11/2019 04:31	821.767
15/11/2019 06:20	1006.232	14/11/2019 03:48	852.553	14/11/2019 04:46	893.023
15/11/2019 06:35	1036.983	14/11/2019 04:03	871.054	14/11/2019 05:01	823.41
15/11/2019 06:50	976.978	14/11/2019 04:18	858.135	14/11/2019 05:16	812.3
15/11/2019 07:05	990.773	14/11/2019 04:33	788.787	14/11/2019 05:31	760.334
15/11/2019 07:20	943.001	14/11/2019 04:48	896.116	14/11/2019 05:46	855.317
15/11/2019 07:35	1040.593	14/11/2019 05:03	784.581	14/11/2019 06:01	815.488
15/11/2019 07:50	991.29	14/11/2019 05:18	865.004	14/11/2019 06:16	781.564
15/11/2019 08:05	884.868	14/11/2019 05:33	892.175	14/11/2019 06:31	845.831
15/11/2019 08:20	1036.034	14/11/2019 05:48	789.505	14/11/2019 06:46	814.641
15/11/2019 08:35	885.112	14/11/2019 06:03	757.41	14/11/2019 07:01	723.243
15/11/2019 08:50	831.589	14/11/2019 06:18	688.892	14/11/2019 07:16	758.7
15/11/2019 09:05	893.872	14/11/2019 06:33	729.503	14/11/2019 07:31	689.366
15/11/2019 09:20	882.253	14/11/2019 06:48	663.528	14/11/2019 07:46	735.304
15/11/2019 09:35	865.136	14/11/2019 07:03	701.623	14/11/2019 08:01	660.222
15/11/2019 09:50	762.652	14/11/2019 07:18	703.523	14/11/2019 08:16	684.671
15/11/2019 10:05	821.429	14/11/2019 07:33	773.658	14/11/2019 08:31	674.815
15/11/2019 10:20	827.974	14/11/2019 07:48	705.519	14/11/2019 08:46	769.36
15/11/2019 10:35	817.013	14/11/2019 08:03	766.597	14/11/2019 09:01	713.324
15/11/2019 10:50	826.170	14/11/2019 08:18	692.768	14/11/2019 09:16	724.125
15/11/2019 11:05	753.498	14/11/2019 08:33	779.194	14/11/2019 09:31	666.106
15/11/2019 11:20	758.143	14/11/2019 08:48	751.003	14/11/2019 09:46	656.605
15/11/2019 11:35	836.634	14/11/2019 09:03	810.243	14/11/2019 10:01	789.113
15/11/2019 11:50	838.616	14/11/2019 09:18	775.672	14/11/2019 10:16	835.034
15/11/2019 12:05	962.407	14/11/2019 09:33	706.969	14/11/2019 10:31	832.706
15/11/2019 12:20	1070.782	14/11/2019 09:48	704.43	14/11/2019 10:46	842.238
15/11/2019 12:35	1089.985	14/11/2019 10:03	798.298	14/11/2019 11:01	812.222
15/11/2019 12:50	995.38	14/11/2019 10:18	824.324	14/11/2019 11:16	709.663
15/11/2019 13:05	1048.909	14/11/2019 10:33	837.867	14/11/2019 11:31	802.519

15/11/2019 13:20	1022.58	14/11/2019 10:48	749.197	14/11/2019 11:46	815.314
15/11/2019 13:35	1095.68	14/11/2019 11:03	788.512	14/11/2019 12:01	816.059
15/11/2019 13:50	973.426	14/11/2019 11:18	725.198	14/11/2019 12:16	701.107
15/11/2019 14:05	1006.54	14/11/2019 11:33	743.777	14/11/2019 12:31	745.716
15/11/2019 14:20	963.354	14/11/2019 11:48	849.037	14/11/2019 12:46	801.362

CO DATA (Continued)

Location 4		Location 5	
Date Time	co	Date Time	co
13/11/2019 14:03	876.960	14/11/2019 13:35	979.434
13/11/2019 14:18	918.638	14/11/2019 13:50	1067.090
13/11/2019 14:33	996.567	14/11/2019 14:05	955.265
13/11/2019 14:48	931.718	14/11/2019 14:20	1060.896
13/11/2019 15:03	930.239	14/11/2019 14:35	1017.183
13/11/2019 15:18	955.766	14/11/2019 14:50	1020.334
13/11/2019 15:33	856.392	14/11/2019 15:05	934.959
13/11/2019 15:48	987.435	14/11/2019 15:20	1060.650
13/11/2019 16:03	952.451	14/11/2019 15:35	1016.571
13/11/2019 16:18	873.119	14/11/2019 15:50	1017.116
13/11/2019 16:33	961.656	14/11/2019 16:05	1052.175
13/11/2019 16:48	959.454	14/11/2019 16:20	1066.950
13/11/2019 17:03	950.699	14/11/2019 16:35	917.187
13/11/2019 17:18	998.179	14/11/2019 16:50	1075.215
13/11/2019 17:33	857.961	14/11/2019 17:05	978.182
13/11/2019 17:48	868.983	14/11/2019 17:20	1017.163
13/11/2019 18:03	853.275	14/11/2019 17:35	1040.864
13/11/2019 18:18	941.024	14/11/2019 17:50	995.498
13/11/2019 18:33	925.173	14/11/2019 18:05	994.172
13/11/2019 18:48	834.29	14/11/2019 18:20	1076.162
13/11/2019 19:03	933.872	14/11/2019 18:35	923.860
13/11/2019 19:18	803.714	14/11/2019 18:50	900.796
13/11/2019 19:33	817.8	14/11/2019 19:05	844.517
13/11/2019 19:48	840.46	14/11/2019 19:20	805.300
13/11/2019 20:03	913.263	14/11/2019 19:35	910.730
13/11/2019 20:18	896.53	14/11/2019 19:50	871.376
13/11/2019 20:33	868.577	14/11/2019 20:05	844.126
13/11/2019 20:48	884.24	14/11/2019 20:20	865.805
13/11/2019 21:03	866.873	14/11/2019 20:35	940.005
13/11/2019 21:18	829.245	14/11/2019 20:50	863.669
13/11/2019 21:33	912.316	14/11/2019 21:05	910.531
13/11/2019 21:48	912.599	14/11/2019 21:20	817.168
13/11/2019 22:03	878.763	14/11/2019 21:35	918.058
13/11/2019 22:18	802.858	14/11/2019 21:50	845.210
13/11/2019 22:33	890.663	14/11/2019 22:05	929.912
13/11/2019 22:48	920.61	14/11/2019 22:20	889.938
13/11/2019 23:03	902.614	14/11/2019 22:35	800.970
13/11/2019 23:18	889.509	14/11/2019 22:50	820.770
13/11/2019 23:33	902.015	14/11/2019 23:05	834.233
13/11/2019 23:48	836.348	14/11/2019 23:20	849.801
14/11/2019 00:03	905.588	14/11/2019 23:35	883.167
14/11/2019 00:18	814.109	14/11/2019 23:50	926.634
14/11/2019 00:33	887.223	15/11/2019 00:05	856.522
14/11/2019 00:48	906.896	15/11/2019 00:20	925.788

14/11/2019 01:03	842.228	15/11/2019 00:35	929.619
14/11/2019 01:18	816.118	15/11/2019 00:50	898.961
14/11/2019 01:33	892.189	15/11/2019 01:05	872.462
14/11/2019 01:48	945.187	15/11/2019 01:20	864.358
14/11/2019 02:03	899.957	15/11/2019 01:35	841.843
14/11/2019 02:18	884.896	15/11/2019 01:50	879.358
14/11/2019 02:33	813.006	15/11/2019 02:05	847.185
14/11/2019 02:48	858.824	15/11/2019 02:20	844.944
14/11/2019 03:03	882.707	15/11/2019 02:35	870.523
14/11/2019 03:18	856.134	15/11/2019 02:50	808.756
14/11/2019 03:33	850.442	15/11/2019 03:05	937.676
14/11/2019 03:48	826.114	15/11/2019 03:20	884.771
14/11/2019 04:03	831.128	15/11/2019 03:35	803.720
14/11/2019 04:18	985.782	15/11/2019 03:50	1053.349
14/11/2019 04:33	856.896	15/11/2019 04:05	983.808
14/11/2019 04:48	958.478	15/11/2019 04:20	1040.991
14/11/2019 05:03	890.953	15/11/2019 04:35	1020.012
14/11/2019 05:18	996.57	15/11/2019 04:50	1034.334
14/11/2019 05:33	852.616	15/11/2019 05:05	1170.842
14/11/2019 05:48	850.428	15/11/2019 05:20	1073.156
14/11/2019 06:03	968.509	15/11/2019 05:35	1199.667
14/11/2019 06:18	891.612	15/11/2019 05:50	1164.192
14/11/2019 06:33	970.717	15/11/2019 06:05	1060.426
14/11/2019 06:48	910.929	15/11/2019 06:20	1045.123
14/11/2019 07:03	996.752	15/11/2019 06:35	1025.587
14/11/2019 07:18	967.062	15/11/2019 06:50	1084.118
14/11/2019 07:33	995.483	15/11/2019 07:05	1044.295
14/11/2019 07:48	911.25	15/11/2019 07:20	1136.974
14/11/2019 08:03	954.897	15/11/2019 07:35	1014.128
14/11/2019 08:18	952.536	15/11/2019 07:50	1102.233
14/11/2019 08:33	857.449	15/11/2019 08:05	1107.699
14/11/2019 08:48	900.7	15/11/2019 08:20	989.836
14/11/2019 09:03	860.576	15/11/2019 08:35	981.650
14/11/2019 09:18	865.417	15/11/2019 08:50	963.004
14/11/2019 09:33	921.864	15/11/2019 09:05	967.740
14/11/2019 09:48	840.357	15/11/2019 09:20	986.929
14/11/2019 10:03	801.574	15/11/2019 09:35	914.340
14/11/2019 10:18	904.264	15/11/2019 09:50	906.226
14/11/2019 10:33	877.23	15/11/2019 10:05	931.723
14/11/2019 10:48	852.461	15/11/2019 10:20	994.167
14/11/2019 11:03	816.563	15/11/2019 10:35	989.987
14/11/2019 11:18	987.558	15/11/2019 10:50	948.056
14/11/2019 11:33	900.813	15/11/2019 11:05	1016.671
14/11/2019 11:48	969.002	15/11/2019 11:20	974.289
14/11/2019 12:03	968.089	15/11/2019 11:35	1017.132
14/11/2019 12:18	964.025	15/11/2019 11:50	930.97
14/11/2019 12:33	946.955	15/11/2019 12:05	953.163

14/11/2019 12:48	950.928	15/11/2019 12:20	1002.787
14/11/2019 13:03	885.174	15/11/2019 12:35	980.296
14/11/2019 13:18	942.188	15/11/2019 12:50	952.895
14/11/2019 13:33	947.037	15/11/2019 13:05	1033.526
14/11/2019 13:48	877.493	15/11/2019 13:20	1013.227

(ii) Volatile Organic Compounds (VOCs)

VOC DATA

Location 1		Location 2		Location 3	
Date/Time		Date/Time		Date/Time	
Thu Nov 14 2019 14:35:00	1.0	Wed Nov 13 2019 12:03:00	2.0	Wed Nov 13 2019 13:01:00	0.0
Thu Nov 14 2019 15:05:00	2.0	Wed Nov 13 2019 12:33:00	1.0	Wed Nov 13 2019 13:31:00	0.0
Thu Nov 14 2019 15:35:00	0.0	Wed Nov 13 2019 13:03:00	1.0	Wed Nov 13 2019 14:01:00	1.0
Thu Nov 14 2019 16:05:00	0.0	Wed Nov 13 2019 13:33:00	2.0	Wed Nov 13 2019 14:31:00	2.0
Thu Nov 14 2019 16:35:00	2.0	Wed Nov 13 2019 14:03:00	2.0	Wed Nov 13 2019 15:01:00	2.0
Thu Nov 14 2019 17:05:00	0.0	Wed Nov 13 2019 14:33:00	0.0	Wed Nov 13 2019 15:31:00	0.0
Thu Nov 14 2019 17:35:00	1.0	Wed Nov 13 2019 15:03:00	1.0	Wed Nov 13 2019 16:01:00	2.0
Thu Nov 14 2019 18:05:00	2.0	Wed Nov 13 2019 15:33:00	1.0	Wed Nov 13 2019 16:31:00	2.0
Thu Nov 14 2019 18:35:00	0.0	Wed Nov 13 2019 16:03:00	2.0	Wed Nov 13 2019 17:01:00	2.0
Thu Nov 14 2019 19:05:00	2.0	Wed Nov 13 2019 16:33:00	0.0	Wed Nov 13 2019 17:31:00	2.0
Thu Nov 14 2019 19:35:00	2.0	Wed Nov 13 2019 17:03:00	2.0	Wed Nov 13 2019 18:01:00	1.0
Thu Nov 14 2019 20:05:00	0.0	Wed Nov 13 2019 17:33:00	2.0	Wed Nov 13 2019 18:31:00	0.0
Thu Nov 14 2019 20:35:00	0.0	Wed Nov 13 2019 18:03:00	0.0	Wed Nov 13 2019 19:01:00	2.0
Thu Nov 14 2019 21:05:00	1.0	Wed Nov 13 2019 18:33:00	2.0	Wed Nov 13 2019 19:31:00	0.0
Thu Nov 14 2019 21:35:00	0.0	Wed Nov 13 2019 19:03:00	0.0	Wed Nov 13 2019 20:01:00	1.0
Thu Nov 14 2019 22:05:00	0.0	Wed Nov 13 2019 19:33:00	1.0	Wed Nov 13 2019 20:31:00	1.0
Thu Nov 14 2019 22:35:00	2.0	Wed Nov 13 2019 20:03:00	2.0	Wed Nov 13 2019 21:01:00	1.0
Thu Nov 14 2019 23:05:00	1.0	Wed Nov 13 2019 20:33:00	2.0	Wed Nov 13 2019 21:31:00	1.0
Thu Nov 14 2019 23:35:00	1.0	Wed Nov 13 2019 21:03:00	2.0	Wed Nov 13 2019 22:01:00	1.0
Fri Nov 15 2019 00:05:00	0.0	Wed Nov 13 2019 21:33:00	2.0	Wed Nov 13 2019 22:31:00	0.0
Fri Nov 15 2019 00:35:00	0.0	Wed Nov 13 2019 22:03:00	0.0	Wed Nov 13 2019 23:01:00	1.0
Fri Nov 15 2019 01:05:00	1.0	Wed Nov 13 2019 22:33:00	1.0	Wed Nov 13 2019 23:31:00	2.0
Fri Nov 15 2019 01:35:00	2.0	Wed Nov 13 2019 23:03:00	1.0	Thu Nov 14 2019 00:01:00	1.0
Fri Nov 15 2019 02:05:00	0.0	Wed Nov 13 2019 23:33:00	1.0	Thu Nov 14 2019 00:31:00	1.0
Fri Nov 15 2019 02:35:00	0.0	Thu Nov 14 2019 00:03:00	0.0	Thu Nov 14 2019 01:01:00	1.0
Fri Nov 15 2019 03:05:00	0.0	Thu Nov 14 2019 00:33:00	0.0	Thu Nov 14 2019 01:31:00	2.0
Fri Nov 15 2019 03:35:00	2.0	Thu Nov 14 2019 01:03:00	0.0	Thu Nov 14 2019 02:01:00	1.0
Fri Nov 15 2019 04:05:00	0.0	Thu Nov 14 2019 01:33:00	0.0	Thu Nov 14 2019 02:31:00	1.0
Fri Nov 15 2019 04:35:00	2.0	Thu Nov 14 2019 02:03:00	0.0	Thu Nov 14 2019 03:01:00	0.0
Fri Nov 15 2019 05:05:00	0.0	Thu Nov 14 2019 02:33:00	2.0	Thu Nov 14 2019 03:31:00	2.0
Fri Nov 15 2019 05:35:00	1.0	Thu Nov 14 2019 03:03:00	0.0	Thu Nov 14 2019 04:01:00	1.0
Fri Nov 15 2019 06:05:00	2.0	Thu Nov 14 2019 03:33:00	2.0	Thu Nov 14 2019 04:31:00	2.0
Fri Nov 15 2019 06:35:00	2.0	Thu Nov 14 2019 04:03:00	0.0	Thu Nov 14 2019 05:01:00	0.0
Fri Nov 15 2019 07:05:00	2.0	Thu Nov 14 2019 04:33:00	1.0	Thu Nov 14 2019 05:31:00	2.0
Fri Nov 15 2019 07:35:00	1.0	Thu Nov 14 2019 05:03:00	0.0	Thu Nov 14 2019 06:01:00	1.0
Fri Nov 15 2019 08:05:00	1.0	Thu Nov 14 2019 05:33:00	0.0	Thu Nov 14 2019 06:31:00	2.0
Fri Nov 15 2019 08:35:00	1.0	Thu Nov 14 2019 06:03:00	2.0	Thu Nov 14 2019 07:01:00	1.0
Fri Nov 15 2019 09:05:00	1.0	Thu Nov 14 2019 06:33:00	1.0	Thu Nov 14 2019 07:31:00	0.0
Fri Nov 15 2019 09:35:00	1.0	Thu Nov 14 2019 07:03:00	2.0	Thu Nov 14 2019 08:01:00	0.0
Fri Nov 15 2019 10:05:00	1.0	Thu Nov 14 2019 07:33:00	2.0	Thu Nov 14 2019 08:31:00	1.0
Fri Nov 15 2019 10:35:00	0.0	Thu Nov 14 2019 08:03:00	2.0	Thu Nov 14 2019 09:01:00	2.0
Fri Nov 15 2019 11:05:00	1.0	Thu Nov 14 2019 08:33:00	2.0	Thu Nov 14 2019 09:31:00	1.0
Fri Nov 15 2019 11:35:00	1.0	Thu Nov 14 2019 09:03:00	2.0	Thu Nov 14 2019 10:01:00	2.0
Fri Nov 15 2019 12:05:00	0.0	Thu Nov 14 2019 09:33:00	2.0	Thu Nov 14 2019 10:31:00	2.0

Fri Nov 15 2019 12:35:00	0.0	Thu Nov 14 2019 10:03:00	1.0	Thu Nov 14 2019 11:01:00	2.0
Fri Nov 15 2019 13:05:00	2.0	Thu Nov 14 2019 10:33:00	2.0	Thu Nov 14 2019 11:31:00	1.0
Fri Nov 15 2019 13:35:00	1.0	Thu Nov 14 2019 11:03:00	2.0	Thu Nov 14 2019 12:01:00	1.0
Fri Nov 15 2019 14:05:00	2.0	Thu Nov 14 2019 11:33:00	1.0	Thu Nov 14 2019 12:31:00	1.0

VOC DATA (Continued)

Location 4		Location 5	
Date/Time		Date/Time	
Wed Nov 13 2019 14:03:00	0.0	Thu Nov 14 2019 13:35:00	0.0
Wed Nov 13 2019 14:33:00	1.0	Thu Nov 14 2019 14:05:00	0.0
Wed Nov 13 2019 15:03:00	2.0	Thu Nov 14 2019 14:35:00	2.0
Wed Nov 13 2019 15:33:00	1.0	Thu Nov 14 2019 15:05:00	0.0
Wed Nov 13 2019 16:03:00	1.0	Thu Nov 14 2019 15:35:00	1.0
Wed Nov 13 2019 16:33:00	1.0	Thu Nov 14 2019 16:05:00	1.0
Wed Nov 13 2019 17:03:00	1.0	Thu Nov 14 2019 16:35:00	1.0
Wed Nov 13 2019 17:33:00	2.0	Thu Nov 14 2019 17:05:00	0.0
Wed Nov 13 2019 18:03:00	0.0	Thu Nov 14 2019 17:35:00	2.0
Wed Nov 13 2019 18:33:00	1.0	Thu Nov 14 2019 18:05:00	2.0
Wed Nov 13 2019 19:03:00	2.0	Thu Nov 14 2019 18:35:00	1.0
Wed Nov 13 2019 19:33:00	0.0	Thu Nov 14 2019 19:05:00	0.0
Wed Nov 13 2019 20:03:00	0.0	Thu Nov 14 2019 19:35:00	2.0
Wed Nov 13 2019 20:33:00	2.0	Thu Nov 14 2019 20:05:00	0.0
Wed Nov 13 2019 21:03:00	0.0	Thu Nov 14 2019 20:35:00	1.0
Wed Nov 13 2019 21:33:00	2.0	Thu Nov 14 2019 21:05:00	0.0
Wed Nov 13 2019 22:03:00	0.0	Thu Nov 14 2019 21:35:00	2.0
Wed Nov 13 2019 22:33:00	0.0	Thu Nov 14 2019 22:05:00	1.0
Wed Nov 13 2019 23:03:00	0.0	Thu Nov 14 2019 22:35:00	1.0
Wed Nov 13 2019 23:33:00	1.0	Thu Nov 14 2019 23:05:00	0.0
Thu Nov 14 2019 00:03:00	1.0	Thu Nov 14 2019 23:35:00	2.0
Thu Nov 14 2019 00:33:00	1.0	Fri Nov 15 2019 00:05:00	2.0
Thu Nov 14 2019 01:03:00	1.0	Fri Nov 15 2019 00:35:00	1.0
Thu Nov 14 2019 01:33:00	0.0	Fri Nov 15 2019 01:05:00	1.0
Thu Nov 14 2019 02:03:00	1.0	Fri Nov 15 2019 01:35:00	1.0
Thu Nov 14 2019 02:33:00	1.0	Fri Nov 15 2019 02:05:00	2.0
Thu Nov 14 2019 03:03:00	2.0	Fri Nov 15 2019 02:35:00	2.0
Thu Nov 14 2019 03:33:00	0.0	Fri Nov 15 2019 03:05:00	2.0
Thu Nov 14 2019 04:03:00	0.0	Fri Nov 15 2019 03:35:00	0.0
Thu Nov 14 2019 04:33:00	0.0	Fri Nov 15 2019 04:05:00	0.0
Thu Nov 14 2019 05:03:00	2.0	Fri Nov 15 2019 04:35:00	0.0
Thu Nov 14 2019 05:33:00	0.0	Fri Nov 15 2019 05:05:00	2.0
Thu Nov 14 2019 06:03:00	1.0	Fri Nov 15 2019 05:35:00	2.0
Thu Nov 14 2019 06:33:00	2.0	Fri Nov 15 2019 06:05:00	0.0
Thu Nov 14 2019 07:03:00	1.0	Fri Nov 15 2019 06:35:00	0.0
Thu Nov 14 2019 07:33:00	2.0	Fri Nov 15 2019 07:05:00	2.0
Thu Nov 14 2019 08:03:00	2.0	Fri Nov 15 2019 07:35:00	0.0
Thu Nov 14 2019 08:33:00	2.0	Fri Nov 15 2019 08:05:00	2.0
Thu Nov 14 2019 09:03:00	0.0	Fri Nov 15 2019 08:35:00	2.0
Thu Nov 14 2019 09:33:00	2.0	Fri Nov 15 2019 09:05:00	0.0
Thu Nov 14 2019 10:03:00	0.0	Fri Nov 15 2019 09:35:00	1.0
Thu Nov 14 2019 10:33:00	1.0	Fri Nov 15 2019 10:05:00	1.0
Thu Nov 14 2019 11:03:00	2.0	Fri Nov 15 2019 10:35:00	2.0
Thu Nov 14 2019 11:33:00	1.0	Fri Nov 15 2019 11:05:00	2.0

Thu Nov 14 2019 12:03:00	2.0	Fri Nov 15 2019 11:35:00	0.0
Thu Nov 14 2019 12:33:00	0.0	Fri Nov 15 2019 12:05:00	0.0
Thu Nov 14 2019 13:03:00	0.0	Fri Nov 15 2019 12:35:00	2.0
Thu Nov 14 2019 13:33:00	0.0	Fri Nov 15 2019 13:05:00	0.0

(iii) Ozone (O_3)

O3 DATA

Location 1		Location 2		Location 3	
Date Time	O3 (µg/m³)	Date Time	O3 (µg/m³)	Date Time	O3 (µg/m³)
14/11/2019 14:35	44.755	13/11/2019 12:03	54.427	13/11/2019 13:01	52.441
14/11/2019 14:50	50.747	13/11/2019 12:18	55.738	13/11/2019 13:16	41.179
14/11/2019 15:05	50.353	13/11/2019 12:33	49.164	13/11/2019 13:31	44.739
14/11/2019 15:20	42.133	13/11/2019 12:48	49.365	13/11/2019 13:46	26.785
14/11/2019 15:35	44.261	13/11/2019 13:03	44.977	13/11/2019 14:01	32.364
14/11/2019 15:50	41.908	13/11/2019 13:18	47.26	13/11/2019 14:16	48.085
14/11/2019 16:05	43.716	13/11/2019 13:33	44.8	13/11/2019 14:31	42.501
14/11/2019 16:20	41.772	13/11/2019 13:48	47.653	13/11/2019 14:46	38.978
14/11/2019 16:35	39.979	13/11/2019 14:03	46.567	13/11/2019 15:01	43.392
14/11/2019 16:50	41.209	13/11/2019 14:18	44.183	13/11/2019 15:16	42.213
14/11/2019 17:05	31.023	13/11/2019 14:33	47.763	13/11/2019 15:31	41.657
14/11/2019 17:20	35.86	13/11/2019 14:48	48.672	13/11/2019 15:46	34.953
14/11/2019 17:35	29.24	13/11/2019 15:03	39.471	13/11/2019 16:01	41.53
14/11/2019 17:50	32.002	13/11/2019 15:18	40.012	13/11/2019 16:16	41.385
14/11/2019 18:05	30.711	13/11/2019 15:33	46.005	13/11/2019 16:31	46.047
14/11/2019 18:20	35.256	13/11/2019 15:48	44.805	13/11/2019 16:46	43.301
14/11/2019 18:35	35.109	13/11/2019 16:03	38.764	13/11/2019 17:01	44.855
14/11/2019 18:50	35.23	13/11/2019 16:18	41.1	13/11/2019 17:16	41.896
14/11/2019 19:05	39.415	13/11/2019 16:33	38.186	13/11/2019 17:31	40.501
14/11/2019 19:20	37.665	13/11/2019 16:48	41.652	13/11/2019 17:46	41.55
14/11/2019 19:35	33.937	13/11/2019 17:03	38.561	13/11/2019 18:01	40.712
14/11/2019 19:50	34.58	13/11/2019 17:18	37.961	13/11/2019 18:16	39.43
14/11/2019 20:05	33.375	13/11/2019 17:33	31.82	13/11/2019 18:31	37.267
14/11/2019 20:20	29.403	13/11/2019 17:48	31.357	13/11/2019 18:46	34.518
14/11/2019 20:35	26.104	13/11/2019 18:03	38.265	13/11/2019 19:01	34.122
14/11/2019 20:50	24.731	13/11/2019 18:18	32.954	13/11/2019 19:16	34.952
14/11/2019 21:05	22.866	13/11/2019 18:33	35.008	13/11/2019 19:31	36.483
14/11/2019 21:20	25.187	13/11/2019 18:48	37.88	13/11/2019 19:46	34.984
14/11/2019 21:35	26.324	13/11/2019 19:03	29.675	13/11/2019 20:01	31.578
14/11/2019 21:50	25.915	13/11/2019 19:18	31.759	13/11/2019 20:16	32.842
14/11/2019 22:05	24.985	13/11/2019 19:33	32.312	13/11/2019 20:31	33.91
14/11/2019 22:20	25.892	13/11/2019 19:48	31.742	13/11/2019 20:46	32.958
14/11/2019 22:35	28.106	13/11/2019 20:03	31.864	13/11/2019 21:01	32.866
14/11/2019 22:50	28.802	13/11/2019 20:18	33.851	13/11/2019 21:16	30.111
14/11/2019 23:05	28.895	13/11/2019 20:33	33.912	13/11/2019 21:31	29.558
14/11/2019 23:20	28.593	13/11/2019 20:48	32.659	13/11/2019 21:46	29.747
14/11/2019 23:35	27.3	13/11/2019 21:03	32.605	13/11/2019 22:01	27.797
14/11/2019 23:50	25.757	13/11/2019 21:18	32.673	13/11/2019 22:16	25.783
15/11/2019 00:05	25.999	13/11/2019 21:33	29.887	13/11/2019 22:31	26.234
15/11/2019 00:20	23.909	13/11/2019 21:48	29.484	13/11/2019 22:46	23.554
15/11/2019 00:35	25.416	13/11/2019 22:03	29.914	13/11/2019 23:01	23.662
15/11/2019 00:50	24.463	13/11/2019 22:18	29.578	13/11/2019 23:16	23.315
15/11/2019 01:05	27.706	13/11/2019 22:33	29.328	13/11/2019 23:31	22.822
15/11/2019 01:20	24.113	13/11/2019 22:48	28.157	13/11/2019 23:46	23.865

15/11/2019 01:35	23.722	13/11/2019 23:03	29.941	14/11/2019 00:01	22.02
15/11/2019 01:50	24.976	13/11/2019 23:18	29.764	14/11/2019 00:16	17.096
15/11/2019 02:05	25.788	13/11/2019 23:33	30.153	14/11/2019 00:31	22.891
15/11/2019 02:20	25.641	13/11/2019 23:48	29.754	14/11/2019 00:46	25.731
15/11/2019 02:35	26.491	14/11/2019 00:03	29.115	14/11/2019 01:01	25.769
15/11/2019 02:50	26.322	14/11/2019 00:18	28.861	14/11/2019 01:16	26.817
15/11/2019 03:05	26.018	14/11/2019 00:33	29.684	14/11/2019 01:31	29.932
15/11/2019 03:20	26.643	14/11/2019 00:48	29.005	14/11/2019 01:46	29.168
15/11/2019 03:35	27.254	14/11/2019 01:03	29.763	14/11/2019 02:01	29.236
15/11/2019 03:50	26.772	14/11/2019 01:18	31.661	14/11/2019 02:16	24.78
15/11/2019 04:05	28.836	14/11/2019 01:33	31.081	14/11/2019 02:31	25.776
15/11/2019 04:20	29.501	14/11/2019 01:48	28.665	14/11/2019 02:46	29.198
15/11/2019 04:35	32.546	14/11/2019 02:03	32.51	14/11/2019 03:01	27.731
15/11/2019 04:50	31.204	14/11/2019 02:18	30.68	14/11/2019 03:16	28.921
15/11/2019 05:05	30.626	14/11/2019 02:33	30.656	14/11/2019 03:31	30.171
15/11/2019 05:20	31.204	14/11/2019 02:48	31.427	14/11/2019 03:46	30.128
15/11/2019 05:35	29.76	14/11/2019 03:03	28.394	14/11/2019 04:01	26.93
15/11/2019 05:50	30.47	14/11/2019 03:18	27.922	14/11/2019 04:16	21.621
15/11/2019 06:05	30.587	14/11/2019 03:33	27.565	14/11/2019 04:31	23.901
15/11/2019 06:20	32.151	14/11/2019 03:48	26.326	14/11/2019 04:46	26.807
15/11/2019 06:35	30.565	14/11/2019 04:03	29.988	14/11/2019 05:01	26.189
15/11/2019 06:50	30.146	14/11/2019 04:18	26.88	14/11/2019 05:16	24.247
15/11/2019 07:05	28.036	14/11/2019 04:33	27.478	14/11/2019 05:31	23.378
15/11/2019 07:20	27.772	14/11/2019 04:48	27.31	14/11/2019 05:46	25.254
15/11/2019 07:35	26.924	14/11/2019 05:03	27.427	14/11/2019 06:01	26.69
15/11/2019 07:50	24.886	14/11/2019 05:18	26.987	14/11/2019 06:16	26.206
15/11/2019 08:05	25.112	14/11/2019 05:33	28.879	14/11/2019 06:31	28.545
15/11/2019 08:20	24.236	14/11/2019 05:48	26.929	14/11/2019 06:46	28.635
15/11/2019 08:35	27.481	14/11/2019 06:03	26.827	14/11/2019 07:01	29.823
15/11/2019 08:50	25.783	14/11/2019 06:18	25.516	14/11/2019 07:16	30.626
15/11/2019 09:05	23.977	14/11/2019 06:33	28.861	14/11/2019 07:31	31.238
15/11/2019 09:20	24.623	14/11/2019 06:48	29.845	14/11/2019 07:46	26.175
15/11/2019 09:35	25.68	14/11/2019 07:03	29.43	14/11/2019 08:01	31.785
15/11/2019 09:50	25.614	14/11/2019 07:18	29.357	14/11/2019 08:16	35.271
15/11/2019 10:05	27.715	14/11/2019 07:33	36.049	14/11/2019 08:31	40.346
15/11/2019 10:20	28.106	14/11/2019 07:48	39.79	14/11/2019 08:46	38.923
15/11/2019 10:35	30.493	14/11/2019 08:03	39.323	14/11/2019 09:01	40.924
15/11/2019 10:50	36.343	14/11/2019 08:18	36.281	14/11/2019 09:16	43.139
15/11/2019 11:05	36.363	14/11/2019 08:33	43.173	14/11/2019 09:31	47.654
15/11/2019 11:20	40.967	14/11/2019 08:48	46.498	14/11/2019 09:46	41.691
15/11/2019 11:35	44.434	14/11/2019 09:03	43.42	14/11/2019 10:01	44.567
15/11/2019 11:50	45.485	14/11/2019 09:18	47.197	14/11/2019 10:16	41.915
15/11/2019 12:05	52.968	14/11/2019 09:33	46.174	14/11/2019 10:31	46.188
15/11/2019 12:20	50.176	14/11/2019 09:48	45.755	14/11/2019 10:46	45.445
15/11/2019 12:35	52.312	14/11/2019 10:03	46.281	14/11/2019 11:01	33.811
15/11/2019 12:50	44.72	14/11/2019 10:18	38.564	14/11/2019 11:16	38.898
15/11/2019 13:05	56.051	14/11/2019 10:33	55.64	14/11/2019 11:31	47.707

15/11/2019 13:20	49.525	14/11/2019 10:48	48.956	14/11/2019 11:46	43.29
15/11/2019 13:35	41.047	14/11/2019 11:03	54.821	14/11/2019 12:01	44.973
15/11/2019 13:50	43.122	14/11/2019 11:18	53.116	14/11/2019 12:16	46.515
15/11/2019 14:05	45.242	14/11/2019 11:33	54.324	14/11/2019 12:31	48.853
15/11/2019 14:20	48.046	14/11/2019 11:48	54.179	14/11/2019 12:46	46.526

O3 DATA (Continued)

Location 4		Location 5	
Date Time	O3 (µg/m³)	Date Time	O3 (µg/m³)
13/11/2019 14:03	51.679	14/11/2019 13:35	38.67
13/11/2019 14:18	55.918	14/11/2019 13:50	34.801
13/11/2019 14:33	56.465	14/11/2019 14:05	32.466
13/11/2019 14:48	54.997	14/11/2019 14:20	31.542
13/11/2019 15:03	54.095	14/11/2019 14:35	46.747
13/11/2019 15:18	56.651	14/11/2019 14:50	47.42
13/11/2019 15:33	51.877	14/11/2019 15:05	40.584
13/11/2019 15:48	55.329	14/11/2019 15:20	42.103
13/11/2019 16:03	57.066	14/11/2019 15:35	39.43
13/11/2019 16:18	53.586	14/11/2019 15:50	35.502
13/11/2019 16:33	56.656	14/11/2019 16:05	38.21
13/11/2019 16:48	51.389	14/11/2019 16:20	29.661
13/11/2019 17:03	45.368	14/11/2019 16:35	25.32
13/11/2019 17:18	51.875	14/11/2019 16:50	24.805
13/11/2019 17:33	41.689	14/11/2019 17:05	20.537
13/11/2019 17:48	53.811	14/11/2019 17:20	22.522
13/11/2019 18:03	51.17	14/11/2019 17:35	36.855
13/11/2019 18:18	51.736	14/11/2019 17:50	30.766
13/11/2019 18:33	51.009	14/11/2019 18:05	33.53
13/11/2019 18:48	45.939	14/11/2019 18:20	32.733
13/11/2019 19:03	46.224	14/11/2019 18:35	28.164
13/11/2019 19:18	44.707	14/11/2019 18:50	24.594
13/11/2019 19:33	40.927	14/11/2019 19:05	30.162
13/11/2019 19:48	33.831	14/11/2019 19:20	29.302
13/11/2019 20:03	34.793	14/11/2019 19:35	48.024
13/11/2019 20:18	34.336	14/11/2019 19:50	64.227
13/11/2019 20:33	28.791	14/11/2019 20:05	52.807
13/11/2019 20:48	29.321	14/11/2019 20:20	52.521
13/11/2019 21:03	27.966	14/11/2019 20:35	45.594
13/11/2019 21:18	24.886	14/11/2019 20:50	45.024
13/11/2019 21:33	23.435	14/11/2019 21:05	44.878
13/11/2019 21:48	30.031	14/11/2019 21:20	41.529
13/11/2019 22:03	29.13	14/11/2019 21:35	38.296
13/11/2019 22:18	31.22	14/11/2019 21:50	37.654
13/11/2019 22:33	30.029	14/11/2019 22:05	29.798
13/11/2019 22:48	28.145	14/11/2019 22:20	26.704
13/11/2019 23:03	28.26	14/11/2019 22:35	26.246
13/11/2019 23:18	23.219	14/11/2019 22:50	23.246
13/11/2019 23:33	17.248	14/11/2019 23:05	26.016
13/11/2019 23:48	16.47	14/11/2019 23:20	24.217
14/11/2019 00:03	16.184	14/11/2019 23:35	25.719
14/11/2019 00:18	16.362	14/11/2019 23:50	34.664
14/11/2019 00:33	16.513	15/11/2019 00:05	47.456
14/11/2019 00:48	24.083	15/11/2019 00:20	46.778

14/11/2019 01:03	31.313	15/11/2019 00:35	25.89
14/11/2019 01:18	31.034	15/11/2019 00:50	29.8
14/11/2019 01:33	21.34	15/11/2019 01:05	31.783
14/11/2019 01:48	21.501	15/11/2019 01:20	41.014
14/11/2019 02:03	22.189	15/11/2019 01:35	36.544
14/11/2019 02:18	22.719	15/11/2019 01:50	36.229
14/11/2019 02:33	24.807	15/11/2019 02:05	35.893
14/11/2019 02:48	27.578	15/11/2019 02:20	32.938
14/11/2019 03:03	26.991	15/11/2019 02:35	33.578
14/11/2019 03:18	7.09	15/11/2019 02:50	24.152
14/11/2019 03:33	20.465	15/11/2019 03:05	28.056
14/11/2019 03:48	21.152	15/11/2019 03:20	46.125
14/11/2019 04:03	15.232	15/11/2019 03:35	40.298
14/11/2019 04:18	21.874	15/11/2019 03:50	31.906
14/11/2019 04:33	20.863	15/11/2019 04:05	32.223
14/11/2019 04:48	21.848	15/11/2019 04:20	31.722
14/11/2019 05:03	21.123	15/11/2019 04:35	23.151
14/11/2019 05:18	19.938	15/11/2019 04:50	32.323
14/11/2019 05:33	18.805	15/11/2019 05:05	31.663
14/11/2019 05:48	20.193	15/11/2019 05:20	21.149
14/11/2019 06:03	19.056	15/11/2019 05:35	31.167
14/11/2019 06:18	15.772	15/11/2019 05:50	32.375
14/11/2019 06:33	15.897	15/11/2019 06:05	37.436
14/11/2019 06:48	15.635	15/11/2019 06:20	30.177
14/11/2019 07:03	12.936	15/11/2019 06:35	26.325
14/11/2019 07:18	15.155	15/11/2019 06:50	26.04
14/11/2019 07:33	13.087	15/11/2019 07:05	46.489
14/11/2019 07:48	19.91	15/11/2019 07:20	44.809
14/11/2019 08:03	20.737	15/11/2019 07:35	37.5
14/11/2019 08:18	27.198	15/11/2019 07:50	35.726
14/11/2019 08:33	28.205	15/11/2019 08:05	34.896
14/11/2019 08:48	25.665	15/11/2019 08:20	38.443
14/11/2019 09:03	23.072	15/11/2019 08:35	41.416
14/11/2019 09:18	27.322	15/11/2019 08:50	45.03
14/11/2019 09:33	37.168	15/11/2019 09:05	41.327
14/11/2019 09:48	39.604	15/11/2019 09:20	41.776
14/11/2019 10:03	36.958	15/11/2019 09:35	39.012
14/11/2019 10:18	38.107	15/11/2019 09:50	41.425
14/11/2019 10:33	41.749	15/11/2019 10:05	52.594
14/11/2019 10:48	41.253	15/11/2019 10:20	42.769
14/11/2019 11:03	38.296	15/11/2019 10:35	43.57
14/11/2019 11:18	46.959	15/11/2019 10:50	48.531
14/11/2019 11:33	47.56	15/11/2019 11:05	49.683
14/11/2019 11:48	47.576	15/11/2019 11:20	46.23
14/11/2019 12:03	53.418	15/11/2019 11:35	43.428
14/11/2019 12:18	54.086	15/11/2019 11:50	46.567
14/11/2019 12:33	60.22	15/11/2019 12:05	43.249

14/11/2019 12:48	48.542	15/11/2019 12:20	52.985
14/11/2019 13:03	43.343	15/11/2019 12:35	32.251
14/11/2019 13:18	45.206	15/11/2019 12:50	37.071
14/11/2019 13:33	47.376	15/11/2019 13:05	34.112
14/11/2019 13:48	52.214	15/11/2019 13:20	36.273

(iv) Filter Weights

Location	Date 2019	Parameters	Pre-Weight (g)	Post-Weight (g)
1	November 14th – 15th	$PM_{2.5}$	4.3367	4.3462
		PM_{10}	4.3429	4.3749
		TSP	2.5447	2.6066
2	November 13th – 14th	$PM_{2.5}$	4.3396	4.3431
		PM_{10}	4.3389	4.3440
		TSP	2.5751	2.5883
3	November 13th – 14th	$PM_{2.5}$	4.3143	4.3230
		PM_{10}	4.3372	4.3432
		TSP	2.8870	2.9400
4	November 13th – 14th	$PM_{2.5}$	4.3075	4.3145
		PM_{10}	4.3023	4.3123
		TSP	2.8958	2.9182
5	November 14th – 15th	$PM_{2.5}$	4.2794	4.2889
		PM_{10}	4.2864	4.3032
		TSP	2.8815	2.9186

G. Meteorological Data

(i) Raw Meteorological Data

month	day	year	hour	Temp degC	Precip mm	Pressure mb	RH %	Wdir10m deg	Wspeed10m ms-1
11	13	2019	0	26.4	0	766.6	84.0	0	1.6
11	13	2019	100	26.4	0	766.6	85.0	339	1.2
11	13	2019	200	26.3	0	766.4	86.0	339	1.4
11	13	2019	300	26.1	0	766.4	87.0	339	1.4
11	13	2019	400	26.1	0	766.4	87.0		1.2
11	13	2019	500	26.2	0	766.4	87.0	88	1.0
11	13	2019	600	26.3	0	766.4	87.0	45	1.0
11	13	2019	700	26.2	0	766.4	84.0	45	1.5
11	13	2019	800	25.8	0	766.1	81.0	339	1.9
11	13	2019	900	24.9	1	766.1	79.0	22	1.8
11	13	2019	1000	24.8	1	766.1	83.0	22	1.8
11	13	2019	1100	25.4	1	765.9	83.0	45	1.5
11	13	2019	1200	26.1	1	765.9	82.0	22	0.8
11	13	2019	1300	26.1	1	765.6	83.0	0	0.9
11	13	2019	1400	26.6	1	765.6	83.0	22	0.6
11	13	2019	1500	26.6	1	765.6	83.0	68	0.4
11	13	2019	1600	27.0	1	765.6	82.0	68	0.5
11	13	2019	1700	26.5	1	765.6	86.0	292	0.6
11	13	2019	1800	26.5	1	765.4	87.0	292	0.6
11	13	2019	1900	26.4	1	765.4	89.0	292	0.9
11	13	2019	2000	27.0	0	765.4	87.0	292	1.1
11	13	2019	2100	27.1	0	765.4	84.0		0.8
11	13	2019	2200	27.0	0	765.4	86.0	339	0.3
11	13	2019	2300	27.3	0	765.4	84.0	318	0.8
11	13	2019	2400	27.0	0	765.1	85.0	292	0.8
11	13	2019	0	27.3	0	765.1	83.0	292	1.3
11	13	2019	100	27.1	0	765.1	85.0	318	0.7
11	13	2019	200	27.2	0	765.1	85.0	339	0.8
11	13	2019	300	27.2	0	764.9	84.0	339	1.3
11	13	2019	400	26.9	0	764.9	84.0	339	0.8
11	13	2019	500	27.3	0	764.9	84.0		1.1
11	13	2019	600	27.6	0	764.9	83.0	339	1.6
11	13	2019	700	27.3	0	764.9	84.0		1.4
11	13	2019	800	27.7	0	764.6	83.0		1.2
11	13	2019	900	27.7	0	764.6	82.0	22	1.1
11	13	2019	1000	27.5	0	764.6	83.0	339	0.9
11	13	2019	1100	28.0	0	764.6	81.0	125	0.9
11	13	2019	1200	28.2	0	764.6	80.0	88	0.8
11	13	2019	1300	28.2	0	764.6	80.0	102	1.0
11	13	2019	1400	27.9	0	764.6	81.0	88	0.8
11	13	2019	1500	27.6	0	764.6	81.0	88	0.8
11	13	2019	1600	27.6	0	764.6	81.0	45	0.8
11	13	2019	1700	28.0	0	764.6	80.0	68	0.8
11	13	2019	1800	27.7	0	764.6	81.0	270	0.5

11	13	2019	1900	27.7	0	764.6	81.0	318	1.2
11	13	2019	2000	27.9	0	764.6	82.0	339	0.9
11	13	2019	2100	27.5	0	764.6	84.0	22	0.8
11	13	2019	2200	27.3	0	764.6	84.0	0	0.9
11	13	2019	2300	27.2	0	764.6	82.0	22	1.1
11	13	2019	2400	27.1	0	764.6	82.0	22	0.8
11	13	2019	0	27.0	0	764.6	83.0	22	0.7
11	13	2019	100	26.9	0	764.6	82.0	22	1.1
11	13	2019	200	26.8	0	764.6	82.0	45	0.7
11	13	2019	300	26.7	0	764.6	82.0	22	0.7
11	13	2019	400	27.1	0	764.6	81.0	45	1.0
11	13	2019	500	27.2	0	764.6	81.0	68	0.8
11	13	2019	600	27.1	0	764.6	81.0	102	0.9
11	13	2019	700	27.1	0	764.6	81.0	68	0.4
11	13	2019	800	26.9	0	764.6	81.0	68	0.8
11	13	2019	900	26.9	0	764.6	82.0	45	0.8
11	13	2019	1000	26.8	0	764.6	82.0	22	0.6
11	13	2019	1100	26.7	0	764.6	82.0	45	0.7
11	13	2019	1200	26.6	0	764.6	82.0	45	0.6
11	13	2019	1300	26.5	0	764.9	82.0	22	0.8
11	13	2019	1400	26.3	0	764.9	82.0	22	0.6
11	13	2019	1500	26.2	0	764.9	82.0	0	0.8
11	13	2019	1600	26.2	0	764.9	82.0	0	0.9
11	13	2019	1700	26.1	0	764.9	84.0	22	1.3
11	13	2019	1800	25.9	0	765.1	86.0	0	1.1
11	13	2019	1900	25.7	0	765.1	87.0		1.3
11	13	2019	2000	25.5	0	764.9	89.0	22	1.3
11	13	2019	2100	25.3	0	765.1	89.0	22	1.5
11	13	2019	2200	25.1	0	765.1	90.0	339	1.3
11	13	2019	2300	25.1	0	765.1	90.0		1.4
11	13	2019	2400	25.0	0	765.1	91.0	0	1.3
11	13	2019	0	24.9	0	765.1	91.0	22	1.5
11	13	2019	100	24.9	0	765.1	91.0	0	1.7
11	13	2019	200	24.9	0	765.1	90.0	45	1.3
11	13	2019	300	24.9	0	765.1	89.0	45	1.2
11	13	2019	400	25.0	0	765.1	89.0	22	0.9
11	13	2019	500	25.0	0	765.1	88.0	22	1.3
11	13	2019	600	25.0	0	765.4	87.0	22	0.9
11	13	2019	700	25.1	0	765.4	87.0	68	1.3
11	13	2019	800	25.1	0	765.4	87.0	45	1.0
11	13	2019	900	25.1	0	765.6	87.0	45	0.9
11	13	2019	1000	25.0	0	765.6	88.0	68	0.8
11	13	2019	1100	24.9	0	765.6	88.0	22	0.8
11	13	2019	1200	24.9	0	765.6	87.0	45	0.7
11	13	2019	1300	24.8	0	765.9	85.0	45	0.7
11	13	2019	1400	24.8	0	765.9	83.0	68	1.1
11	13	2019	1500	24.9	0	765.9	81.0	68	1.2

11	13	2019	1600	25.0	0	765.9	80.0	22	1.0
11	13	2019	1700	25.0	0	765.9	78.0	68	1.0
11	13	2019	1800	25.1	0	765.9	78.0	68	1.0
11	13	2019	1900	25.1	0	765.9	76.0	68	0.8
11	13	2019	2000	25.1	0	766.1	76.0	45	0.8
11	13	2019	2100	25.1	0	766.1	76.0	22	0.8
11	13	2019	2200	25.1	0	766.1	76.0	270	0.8
11	13	2019	2300	25.0	0	766.1	76.0	270	0.2
11	13	2019	2400	25.0	0	766.1	76.0	225	0.5
11	13	2019	0	24.9	0	766.1	77.0	113	0.5
11	13	2019	100	24.9	0	766.1	78.0	102	0.4
11	13	2019	200	24.9	0	766.4	78.0	88	0.3
11	13	2019	300	24.8	0	766.4	79.0	270	0.4
11	13	2019	400	24.8	0	766.4	79.0	318	0.1
11	13	2019	500	24.7	0	766.4	80.0	318	0.7
11	13	2019	600	24.8	0	766.4	81.0	22	0.7
11	13	2019	700	24.7	0	766.4	80.0	45	0.9
11	13	2019	800	24.7	0	766.4	79.0	45	0.8
11	13	2019	900	24.7	0	766.4	79.0	22	0.9
11	13	2019	1000	24.7	0	766.4	80.0	22	1.2
11	13	2019	1100	24.7	0	766.4	79.0	22	1.3
11	13	2019	1200	24.7	0	766.4	79.0	225	0.8
11	13	2019	1300	24.7	0	766.6	79.0	88	1.0
11	13	2019	1400	24.7	0	766.6	79.0	339	1.3
11	13	2019	1500	24.7	0	766.6	80.0	0	0.8
11	13	2019	1600	24.6	0	766.6	80.0	68	1.5
11	13	2019	1700	24.7	0	766.6	81.0	88	1.1
11	13	2019	1800	24.6	0	766.6	81.0	68	1.1
11	13	2019	1900	24.6	0	766.6	82.0	102	1.1
11	13	2019	2000	24.6	0	766.6	82.0	68	1.0
11	13	2019	2100	24.6	0	766.6	82.0	0	1.3
11	13	2019	2200	24.6	0	766.6	83.0	22	1.1
11	13	2019	2300	24.6	0	766.6	83.0	68	1.4
11	13	2019	2400	24.6	0	766.9	83.0	45	0.8
11	13	2019	0	24.5	0	766.9	84.0	68	1.0
11	13	2019	100	24.5	0	766.9	85.0	22	1.0
11	13	2019	200	24.5	0	766.9	86.0	88	1.1
11	13	2019	300	24.5	0	766.9	86.0	88	0.7
11	13	2019	400	24.4	0	767.2	87.0	88	0.7
11	13	2019	500	24.4	0	767.2	87.0	45	0.4
11	13	2019	600	24.3	0	767.2	88.0	292	0.7
11	13	2019	700	24.2	0	767.2	88.0	68	0.8
11	13	2019	800	24.3	0	767.2	89.0	22	0.7
11	13	2019	900	24.2	0	766.9	89.0	88	0.7
11	13	2019	1000	24.3	0	766.9	89.0	68	1.0
11	13	2019	1100	24.3	0	766.9	89.0	68	0.9
11	13	2019	1200	24.3	0	766.9	89.0	68	0.9

11	13	2019	1300	24.3	0	766.9	89.0	113	0.7
11	13	2019	1400	24.2	0	766.9	89.0	68	0.7
11	13	2019	1500	24.2	0	766.9	89.0	292	0.4
11	13	2019	1600	24.1	0	766.9	89.0	68	0.9
11	13	2019	1700	24.2	0	766.9	90.0	125	1.0
11	13	2019	1800	24.2	0	766.9	90.0	45	0.8
11	13	2019	1900	24.2	0	766.9	90.0	45	0.8
11	14	2019	2000	24.2	0	766.9	89.0	88	0.8
11	14	2019	2100	24.1	0	766.6	89.0	68	0.8
11	14	2019	2200	24.1	0	766.6	88.0	88	0.8
11	14	2019	2300	24.2	0	766.6	88.0	102	0.4
11	14	2019	2400	24.1	0	766.6	88.0	22	0.6
11	14	2019	0	24.1	0	766.6	88.0	45	0.3
11	14	2019	100	24.0	0	766.6	88.0	22	0.7
11	14	2019	200	24.0	0	766.6	88.0	22	0.8
11	14	2019	300	24.1	0	766.6	88.0	68	0.9
11	14	2019	400	24.2	0	766.4	89.0	22	0.4
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11	14	2019	600	24.2	0	766.4	90.0	0	1.0
11	14	2019	700	24.1	0	766.4	91.0	100	0.7
11	14	2019	800	24.1	0	766.4	91.0	113	0.9
11	14	2019	900	24.1	0	766.1	90.0	22	1.4
11	14	2019	1000	24.1	0	766.1	90.0	45	1.0
11	14	2019	1100	24.1	0	766.1	91.0	22	1.1
11	14	2019	1200	24.1	0	766.1	91.0	22	1.0
11	14	2019	1300	24.0	0	765.9	91.0		0.7
11	14	2019	1400	24.0	0	765.9	91.0	68	1.2
11	14	2019	1500	24.0	0	765.9	90.0	88	0.8
11	14	2019	1600	24.0	0	765.9	90.0	68	0.8
11	14	2019	1700	23.9	0	765.9	90.0	113	0.5
11	14	2019	1800	23.9	0	765.9	90.0	45	0.8
11	14	2019	1900	23.9	0	765.9	90.0	45	0.5
11	14	2019	2000	23.9	0	765.9	90.0	68	0.4
11	14	2019	2100	23.8	0	765.9	90.0	88	0.7
11	14	2019	2200	23.8	0	765.9	89.0	88	0.9
11	14	2019	2300	23.9	0	765.9	89.0	102	0.6
11	14	2019	2400	23.8	0	765.9	89.0	68	0.0
11	14	2019	0	23.8	0	765.9	90.0	45	0.4
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11	14	2019	900	23.7	0	765.6	90.0	88	0.5

11	14	2019	1000	23.7	0	765.6	90.0	45	0.4
11	14	2019	1100	23.7	0	765.6	90.0	88	0.7
11	14	2019	1200	23.7	0	765.9	91.0	102	0.9
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11	14	2019	1400	23.7	0	765.9	91.0	68	0.8
11	14	2019	1500	23.6	0	765.6	91.0	88	0.6
11	14	2019	1600	23.6	0	765.6	92.0	45	0.6
11	14	2019	1700	23.5	0	765.9	92.0	68	0.8
11	14	2019	1800	23.6	0	765.9	92.0	68	0.9
11	14	2019	1900	23.6	0	765.9	91.0	68	0.8
11	14	2019	2000	23.6	0	765.9	91.0	22	0.6
11	14	2019	2100	23.6	0	765.9	91.0	22	0.6
11	14	2019	2200	23.5	0	765.9	92.0	45	0.6
11	14	2019	2300	23.5	0	765.9	92.0	68	0.6
11	14	2019	2400	23.5	0	765.9	92.0	68	0.7
11	14	2019	0	23.6	0	765.9	92.0	68	0.6
11	14	2019	100	23.6	0	765.9	92.0	68	0.4
11	14	2019	200	23.6	0	765.9	92.0	68	0.5
11	14	2019	300	23.5	0	765.9	91.0	68	0.5
11	14	2019	400	23.5	0	765.9	91.0	68	0.6
11	14	2019	500	23.5	0	765.9	92.0	68	0.7
11	14	2019	600	23.6	0	766.1	92.0	45	0.3
11	14	2019	700	23.6	0	766.1	92.0	102	0.5
11	14	2019	800	23.6	0	766.1	91.0	100	0.6
11	14	2019	900	23.6	0	766.1	91.0	22	0.7
11	14	2019	1000	23.6	0	766.1	91.0	22	0.7
11	14	2019	1100	23.7	0	766.1	91.0		0.5
11	14	2019	1200	23.7	0	766.1	91.0	22	0.6
11	14	2019	1300	23.7	0	766.4	90.0	22	0.9
11	14	2019	1400	23.7	0	766.4	90.0	22	1.1
11	14	2019	1500	23.8	0	766.4	90.0	0	0.8
11	14	2019	1600	23.8	0	766.4	89.0	45	0.9
11	14	2019	1700	23.9	0	766.4	89.0	68	1.1
11	14	2019	1800	23.9	0	766.4	89.0	102	0.4
11	14	2019	1900	23.9	0	766.4	89.0	22	1.0
11	14	2019	2000	23.9	0	766.6	89.0	22	0.7
11	14	2019	2100	23.9	0	766.6	90.0	45	0.7
11	14	2019	2200	23.9	0	766.6	90.0	339	0.7
11	14	2019	2300	24.0	0	766.9	90.0	45	0.8
11	14	2019	2400	24.5	0	766.9	88.0	0	0.7
11	14	2019	0	24.9	0	766.9	87.0	68	1.2
11	14	2019	100	24.8	0	766.9	88.0	88	0.9
11	14	2019	200	24.8	0	766.9	88.0	88	1.1
11	14	2019	300	24.8	0	766.9	88.0	88	0.8
11	14	2019	400	24.8	0	767.2	88.0	88	1.1
11	14	2019	500	24.8	0	767.2	88.0	102	0.7
11	14	2019	600	24.8	0	767.2	89.0	100	0.6

11	14	2019	700	24.8	0	767.2	89.0	100	0.3
11	14	2019	800	24.7	0	767.2	90.0	125	0.2
11	14	2019	900	25.2	0	767.4	88.0	88	0.4
11	14	2019	1000	25.3	0	767.4	88.0	100	0.4
11	14	2019	1100	25.3	0	767.4	88.0	225	0.5
11	14	2019	1200	25.3	0	767.4	88.0	225	0.7
11	14	2019	1300	25.9	0	767.7	85.0	102	1.3
11	14	2019	1400	25.9	0	767.7	84.0	88	1.4
11	14	2019	1500	25.7	0	767.7	86.0	247	0.5
11	14	2019	1600	25.6	0	767.7	86.0	339	0.4
11	14	2019	1700	25.7	0	767.7	87.0	113	0.7
11	14	2019	1800	25.8	0	767.7	87.0	125	0.5
11	14	2019	1900	26.2	0	767.9	84.0	102	1.4
11	14	2019	2000	26.1	0	767.9	83.0	68	1.0
11	14	2019	2100	26.2	0	767.9	81.0	125	0.8
11	14	2019	2200	26.3	0	767.9	81.0	102	1.0
11	14	2019	2300	26.5	0	767.9	82.0	113	1.0
11	14	2019	2400	26.3	0	767.9	81.0	45	1.3
11	14	2019	0	26.4	0	767.9	80.0	102	1.6
11	14	2019	100	26.7	0	767.9	80.0	102	1.3
11	14	2019	200	26.9	0	767.9	79.0	88	1.0
11	14	2019	300	27.0	0	767.9	78.0	88	1.3
11	14	2019	400	26.8	0	768.2	77.0	102	1.3
11	14	2019	500	26.9	0	768.2	80.0	22	0.8
11	14	2019	600	26.9	0	768.2	81.0	100	0.7
11	14	2019	700	26.8	0	767.9	81.0	88	0.9
11	14	2019	800	26.7	0	767.9	79.0	202	0.4
11	14	2019	900	26.8	0	767.9	79.0	292	0.8
11	14	2019	1000	27.0	0	767.9	80.0	247	0.5
11	14	2019	1100	27.4	0	767.9	78.0	100	0.5
11	14	2019	1200	27.4	0	767.9	76.0	88	1.1
11	14	2019	1300	27.5	0	767.9	76.0	102	1.2
11	14	2019	1400	27.7	0	767.9	77.0	22	1.8
11	14	2019	1500	27.6	0	767.9	75.0	102	1.4
11	14	2019	1600	27.7	0	767.9	77.0	68	0.9
11	14	2019	1700	27.3	0	767.9	78.0	225	0.7
11	14	2019	1800	27.7	0	767.9	77.0	113	1.0
11	14	2019	1900	28.0	0	767.9	77.0	125	0.9
11	14	2019	2000	28.3	0	767.7	75.0	113	1.8
11	14	2019	2100	28.2	0	767.7	76.0	102	0.9
11	14	2019	2200	27.9	0	767.7	77.0	339	0.9
11	14	2019	2300	27.6	0	767.7	78.0	22	0.8
11	14	2019	2400	28.1	0	767.7	77.0	113	0.8
11	14	2019	0	28.4	0	767.7	76.0		0.8
11	14	2019	100	28.5	0	767.4	77.0	102	0.9
11	14	2019	200	28.3	0	767.4	74.0	270	0.8
11	14	2019	300	28.7	0	767.4	77.0	68	1.1

11	14	2019	400	28.2	0	767.4	80.0	113	0.8
11	14	2019	500	27.8	0	767.4	81.0	68	0.8
11	14	2019	600	28.0	0	767.2	82.0	125	0.6
11	14	2019	700	28.1	0	767.2	80.0	202	1.0
11	14	2019	800	27.7	0	767.2	81.0	202	0.8
11	14	2019	900	27.6	0	767.2	81.0	225	0.8
11	14	2019	1000	27.8	0	767.2	81.0	270	0.8
11	14	2019	1100	27.5	0	766.9	82.0	102	0.9
11	14	2019	1200	27.3	0	766.9	83.0	339	0.8
11	14	2019	1300	27.3	0	766.9	82.0	22	1.1
11	14	2019	1400	27.0	0	766.9	83.0	339	1.1
11	14	2019	1500	26.9	0	766.9	85.0	0	0.8
11	14	2019	1600	26.8	0	766.6	84.0	0	1.8
11	14	2019	1700	26.8	0	766.6	84.0	339	1.5
11	14	2019	1800	27.0	0	766.6	84.0	339	1.9
11	14	2019	1900	26.8	0	766.6	84.0	0	1.9
11	14	2019	2000	27.1	0	766.4	83.0	339	1.6
11	14	2019	2100	27.7	0	766.4	82.0	339	1.7
11	14	2019	2200	27.7	0	766.4	82.0	318	1.9
11	14	2019	2300	27.2	0	766.4	83.0	339	1.9
11	14	2019	2400	27.6	0	766.4	82.0	318	1.6
11	14	2019	0	27.5	0	766.4	83.0	318	1.8
11	14	2019	100	27.6	0	766.4	82.0		2.1
11	14	2019	200	27.5	0	766.1	83.0	339	1.6
11	14	2019	300	27.6	0	766.1	81.0	318	2.2
11	14	2019	400	27.5	0	766.1	82.0	339	2.3
11	14	2019	500	27.5	0	766.1	82.0	339	2.0
11	14	2019	600	27.6	0	765.9	81.0	0	1.6
11	14	2019	700	27.7	0	765.9	81.0	22	1.4
11	14	2019	800	27.7	0	765.9	81.0	339	1.6
11	14	2019	900	27.7	0	765.9	80.0	22	1.3
11	14	2019	1000	27.7	0	765.9	80.0		1.8
11	14	2019	1100	27.6	0	765.6	80.0	339	1.8
11	14	2019	1200	27.6	0	765.6	80.0	0	1.4
11	14	2019	1300	27.6	0	765.6	79.0	339	2.2
11	14	2019	1400	27.4	0	765.6	81.0	339	2.1
11	14	2019	1500	27.8	0	765.6	80.0	339	1.6
11	14	2019	1600	27.9	0	765.6	80.0	339	1.4
11	14	2019	1700	27.7	0	765.6	80.0	339	1.8
11	14	2019	1800	27.7	0	765.6	81.0	318	1.7
11	14	2019	1900	27.6	0	765.4	79.0	339	1.9
11	14	2019	2000	27.6	0	765.6	80.0	339	1.2
11	14	2019	2100	27.5	0	765.6	80.0	339	2.1
11	14	2019	2200	27.8	0	765.4	80.0	318	1.7
11	14	2019	2300	27.7	0	765.4	80.0	0	1.4
11	14	2019	2400	27.7	0	765.4	80.0	318	1.9
11	14	2019	0	27.3	0	765.4	82.0	292	1.7

11	14	2019	100	27.7	0	765.6	81.0	339	1.3
11	14	2019	200	27.6	0	765.6	80.0	339	1.9
11	14	2019	300	27.2	0	765.4	81.0	339	1.9
11	14	2019	400	27.2	0	765.4	83.0	318	1.6
11	14	2019	500	27.2	0	765.4	83.0	0	1.4
11	14	2019	600	27.3	0	765.6	82.0	247	1.0
11	14	2019	700	27.3	0	765.6	81.0	318	1.6
11	14	2019	800	26.9	0	765.6	83.0	292	1.5
11	14	2019	900	27.0	0	765.6	83.0	22	1.4
11	14	2019	1000	27.2	0	765.6	82.0	339	1.3
11	14	2019	1100	27.2	0	765.6	83.0	292	1.2
11	14	2019	1200	27.2	0	765.6	82.0	339	1.1
11	14	2019	1300	27.1	0	765.6	82.0	318	1.5
11	14	2019	1400	26.9	0	765.6	82.0	318	1.3
11	14	2019	1500	26.8	0	765.6	84.0	318	1.0
11	14	2019	1600	26.7	0	765.6	84.0	318	1.1
11	14	2019	1700	26.8	0	765.6	84.0	318	1.7
11	14	2019	1800	26.7	0	765.6	84.0	22	1.9
11	14	2019	1900	26.5	0	765.6	84.0	0	2.0
11	14	2019	2000	26.3	0	765.6	84.0	22	1.8
11	14	2019	2100	26.4	0	765.6	85.0	339	1.6
11	14	2019	2200	26.3	0	765.6	85.0	22	1.7
11	14	2019	2300	26.2	0	765.6	86.0		1.2
11	14	2019	2400	26.2	0	765.9	85.0	339	1.4
11	14	2019	0	26.1	0	765.9	86.0	22	0.8
11	14	2019	100	26.0	0	765.9	86.0	339	1.0
11	14	2019	200	26.0	0	765.9	86.0	339	1.7
11	14	2019	300	25.8	0	765.6	86.0	339	1.3
11	14	2019	400	25.7	0	765.6	87.0		1.2
11	14	2019	500	25.5	0	765.6	87.0	22	1.0
11	14	2019	600	25.5	0	765.6	87.0	102	0.7
11	14	2019	700	25.4	0	765.9	87.0	45	1.3
11	14	2019	800	25.2	0	765.9	88.0	22	1.0
11	14	2019	900	25.1	0	765.9	88.0	339	1.1
11	14	2019	1000	25.1	0	765.9	89.0	45	0.7
11	14	2019	1100	25.0	0	765.9	89.0	22	1.1
11	14	2019	1200	24.9	0	765.9	89.0	22	1.0
11	14	2019	1300	24.9	0	765.9	89.0	22	1.1
11	14	2019	1400	24.9	0	765.9	89.0	0	1.0
11	14	2019	1500	24.9	0	765.9	89.0	0	1.4
11	14	2019	1600	24.9	0	765.9	89.0	0	1.8
11	14	2019	1700	24.8	0	765.9	90.0	22	1.7
11	14	2019	1800	24.9	0	765.9	90.0	0	1.3
11	14	2019	1900	24.8	0	765.9	90.0	0	1.2
11	14	2019	2000	24.8	0	765.9	90.0	339	1.3
11	14	2019	2100	24.8	0	765.9	90.0	202	0.7
11	14	2019	2200	24.9	0	765.9	90.0	225	1.0

11	14	2019	2300	24.8	0	766.1	90.0	22	1.1
11	14	2019	2400	24.8	0	766.1	90.0	292	1.3
11	14	2019	0	24.8	0	766.1	90.0	45	1.3
11	14	2019	100	24.8	0	766.1	90.0	88	1.6
11	14	2019	200	24.8	0	766.1	90.0		1.4
11	14	2019	300	24.7	0	766.1	90.0	45	1.6
11	14	2019	400	24.7	0	766.1	90.0	68	1.3
11	14	2019	500	24.7	0	766.1	90.0	102	1.4
11	14	2019	600	24.7	0	766.4	91.0	22	1.4
11	14	2019	700	24.7	0	766.4	91.0	100	1.1
11	14	2019	800	24.7	0	766.4	91.0	270	1.3
11	14	2019	900	24.7	0	766.4	91.0	102	1.2
11	14	2019	1000	24.7	0	766.4	91.0	318	1.6
11	14	2019	1100	24.7	0	766.4	91.0	22	1.2
11	14	2019	1200	24.6	0	766.4	90.0	247	1.4
11	14	2019	1300	24.6	0	766.4	90.0		1.4
11	14	2019	1400	24.6	0	766.4	89.0	339	1.1
11	14	2019	1500	24.5	0	766.4	90.0	0	1.1
11	14	2019	1600	24.5	0	766.4	90.0	292	1.3
11	14	2019	1700	24.5	0	766.4	90.0	22	1.5
11	14	2019	1800	24.5	0	766.4	90.0	22	1.4
11	14	2019	1900	24.5	0	766.4	90.0	339	1.7
11	14	2019	2000	24.5	0	766.4	90.0	318	1.0
11	14	2019	2100	24.5	0	766.6	90.0		1.7
11	14	2019	2200	24.5	0	766.6	90.0	45	1.8
11	14	2019	2300	24.5	0	766.6	91.0	318	1.1
11	14	2019	2400	24.5	0	766.6	91.0	22	1.8
11	14	2019	0	24.5	0	766.6	91.0	339	1.9
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11	14	2019	200	24.6	0	766.6	91.0	45	1.6
11	14	2019	300	24.6	0	766.6	91.0	22	2.0
11	14	2019	400	24.6	0	766.6	91.0	339	1.8
11	14	2019	500	24.6	0	766.9	91.0	22	2.0
11	14	2019	600	24.6	0	766.9	91.0	0	1.9
11	14	2019	700	24.6	0	766.9	91.0	0	1.7
11	14	2019	800	24.6	0	766.9	91.0	0	1.2
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11	14	2019	1000	24.6	0	766.9	91.0	0	1.8
11	14	2019	1100	24.6	0	766.9	91.0	45	1.2
11	14	2019	1200	24.5	0	766.9	91.0	339	1.6
11	14	2019	1300	24.6	0	766.9	91.0	0	1.4
11	14	2019	1400	24.6	0	766.9	90.0		1.7
11	14	2019	1500	24.6	0	766.9	90.0	22	1.4
11	14	2019	1600	24.6	0	766.9	90.0	339	1.4
11	14	2019	1700	24.6	0	766.9	91.0	45	1.1
11	14	2019	1800	24.6	0	766.9	91.0	0	1.2
11	14	2019	1900	24.5	0	766.9	91.0		0.9

11	14	2019	2000	24.5	0	766.9	91.0	68	0.8
11	14	2019	2100	24.5	0	766.9	91.0	102	0.6
11	14	2019	2200	24.5	0	766.9	91.0	22	1.0
11	14	2019	2300	24.5	0	766.9	90.0	22	1.0
11	14	2019	2400	24.5	0	766.9	90.0	45	1.1
11	14	2019	0	24.5	0	766.9	90.0	22	1.2
11	14	2019	100	24.4	0	766.6	90.0	22	1.0
11	14	2019	200	24.4	0	766.6	90.0	22	1.0
11	14	2019	300	24.3	0	766.6	90.0	68	1.2
11	14	2019	400	24.3	0	766.6	90.0	45	1.1
11	14	2019	500	24.3	0	766.6	90.0	22	0.9
11	14	2019	600	24.2	0	766.6	90.0	68	1.1
11	14	2019	700	24.2	0	766.6	90.0	0	1.2
11	15	2019	800	24.2	0	766.4	90.0	0	0.7
11	15	2019	900	24.2	0	766.4	90.0	22	1.1
11	15	2019	1000	24.2	0	766.4	90.0	22	0.6
11	15	2019	1100	24.2	0	766.4	90.0	45	0.6
11	15	2019	1200	24.1	0	766.1	91.0	22	0.7
11	15	2019	1300	24.1	0	766.1	91.0	45	0.7
11	15	2019	1400	24.1	0	766.1	91.0	0	0.9
11	15	2019	1500	24.1	0	766.1	91.0	22	1.2
11	15	2019	1600	24.2	0	766.1	90.0		1.3
11	15	2019	1700	24.2	0	766.1	90.0	22	1.5
11	15	2019	1800	24.3	0	766.1	90.0	0	1.1
11	15	2019	1900	24.2	0	766.1	91.0	0	0.9
11	15	2019	2000	24.2	0	766.1	91.0	0	0.9
11	15	2019	2100	24.2	0	766.1	91.0	0	1.1
11	15	2019	2200	24.2	0	765.9	91.0	22	1.4
11	15	2019	2300	24.2	0	765.9	91.0	22	0.9
11	15	2019	2400	24.2	0	765.6	91.0	0	1.0
11	15	2019	0	24.1	0	765.6	89.0	22	1.4
11	15	2019	100	24.1	0	765.6	88.0		1.6
11	15	2019	200	24.2	0	765.6	87.0	88	1.0
11	15	2019	300	24.2	0	765.6	87.0	68	0.9
11	15	2019	400	24.2	0	765.6	88.0	45	1.0
11	15	2019	500	24.2	0	765.4	89.0	45	0.8
11	15	2019	600	24.2	0	765.4	89.0	68	0.5
11	15	2019	700	24.1	0	765.4	90.0	318	0.9
11	15	2019	800	24.1	0	765.4	90.0	100	0.6
11	15	2019	900	24.1	0	765.4	91.0	22	0.7
11	15	2019	1000	24.0	0	765.1	91.0		0.6
11	15	2019	1100	24.0	0	765.1	91.0	88	0.5
11	15	2019	1200	24.0	0	765.1	91.0	68	0.4
11	15	2019	1300	24.0	0	765.1	91.0	22	0.6
11	15	2019	1400	24.0	0	765.1	91.0	68	0.6
11	15	2019	1500	24.0	0	765.4	91.0	88	1.1
11	15	2019	1600	24.0	0	765.4	91.0	88	0.5

11	15	2019	1700	24.1	0	765.1	91.0	88	0.6
11	15	2019	1800	24.0	0	765.1	91.0	113	0.1
11	15	2019	1900	24.0	0	765.4	91.0	102	0.5
11	15	2019	2000	24.0	0	765.4	91.0	88	0.6
11	15	2019	2100	24.0	0	765.1	92.0	68	0.5
11	15	2019	2200	23.9	0	765.1	92.0	88	0.6
11	15	2019	2300	23.9	0	765.1	91.0	68	0.5
11	15	2019	2400	23.9	0	765.1	91.0	225	0.4
11	15	2019	0	23.9	0	765.1	91.0	22	0.9
11	15	2019	100	23.9	0	765.1	91.0	22	1.0
11	15	2019	200	23.9	0	765.1	90.0	22	0.8
11	15	2019	300	23.9	0	765.1	90.0		0.3
11	15	2019	400	23.9	0	765.1	90.0	22	0.5
11	15	2019	500	23.9	0	765.1	90.0	68	0.4
11	15	2019	600	23.8	0	765.1	89.0	45	0.7
11	15	2019	700	23.8	0	765.4	89.0	22	0.6
11	15	2019	800	23.8	0	765.4	89.0	45	0.4
11	15	2019	900	23.8	0	765.4	90.0	68	0.8
11	15	2019	1000	23.8	0	765.4	90.0	102	0.8
11	15	2019	1100	23.9	0	765.4	90.0	22	0.6
11	15	2019	1200	23.8	0	765.4	90.0	22	0.8
11	15	2019	1300	23.8	0	765.4	90.0	45	0.9
11	15	2019	1400	23.8	0	765.4	90.0	22	1.3
11	15	2019	1500	23.9	0	765.4	90.0	0	1.4
11	15	2019	1600	23.9	0	765.4	91.0	22	1.4
11	15	2019	1700	23.9	0	765.6	91.0		1.1
11	15	2019	1800	23.8	0	765.6	91.0	0	0.9
11	15	2019	1900	23.8	0	765.6	91.0	22	0.8
11	15	2019	2000	23.8	0	765.6	91.0	88	0.3
11	15	2019	2100	23.8	0	765.6	91.0	68	0.5
11	15	2019	2200	23.7	0	765.6	90.0	45	0.3
11	15	2019	2300	23.7	0	765.6	88.0	45	0.7
11	15	2019	2400	23.7	0	765.9	87.0	45	0.7
11	15	2019	0	23.7	0	765.9	86.0	68	0.6
11	15	2019	100	23.7	0	765.9	86.0	68	0.4
11	15	2019	200	23.8	0	765.9	86.0	22	0.6
11	15	2019	300	23.8	0	765.9	86.0	68	0.9
11	15	2019	400	23.9	0	765.9	86.0	45	0.9
11	15	2019	500	23.9	0	766.1	87.0	45	0.8
11	15	2019	600	23.9	0	766.1	87.0	45	0.8
11	15	2019	700	23.9	0	766.1	88.0	68	0.8
11	15	2019	800	23.9	0	766.1	88.0	0	0.9
11	15	2019	900	23.9	0	766.1	88.0	45	0.7
11	15	2019	1000	24.0	0	766.1	88.0	45	0.7
11	15	2019	1100	24.1	0	766.1	89.0	68	0.6
11	15	2019	1200	24.6	0	766.4	87.0	22	0.9
11	15	2019	1300	24.8	0	766.4	86.0	22	0.7

11	15	2019	1400	24.9	0	766.4	87.0	22	0.8
11	15	2019	1500	24.9	0	766.4	87.0	88	0.8
11	15	2019	1600	24.8	0	766.4	87.0	88	0.9
11	15	2019	1700	24.8	0	766.4	88.0	339	0.6
11	15	2019	1800	24.7	0	766.4	88.0	113	1.1
11	15	2019	1900	24.7	0	766.6	89.0	113	0.9
11	15	2019	2000	24.6	0	766.6	90.0	113	0.8
11	15	2019	2100	24.3	0	766.6	91.0	202	0.2
11	15	2019	2200	24.8	0	766.6	89.0	102	0.8
11	15	2019	2300	24.8	0	766.6	89.0	202	0.5
11	15	2019	2400	24.7	0	766.6	90.0	125	0.7
11	15	2019	0	24.9	0	766.9	90.0	125	0.7
11	15	2019	100	25.5	0	766.9	88.0	100	0.6
11	15	2019	200	25.9	0	766.9	85.0	113	0.7
11	15	2019	300	26.0	0	766.9	84.0	88	1.3
11	15	2019	400	25.9	0	766.9	84.0	88	0.7
11	15	2019	500	25.8	0	767.2	85.0	225	0.3
11	15	2019	600	25.8	0	767.2	85.0	225	0.4
11	15	2019	700	25.7	0	767.2	85.0	318	0.4
11	15	2019	800	25.7	0	767.2	83.0	292	0.6
11	15	2019	900	25.9	0	767.2	82.0	45	0.5
11	15	2019	1000	26.0	0	767.2	84.0	102	0.6
11	15	2019	1100	25.9	0	767.2	85.0	113	1.0
11	15	2019	1200	26.3	0	767.2	82.0	113	1.2
11	15	2019	1300	26.3	0	767.2	81.0	113	1.4
11	15	2019	1400	26.5	0	767.2	78.0	102	1.6
11	15	2019	1500	26.5	0	767.2	79.0	102	1.1
11	15	2019	1600	26.7	0	767.2	78.0	102	0.8
11	15	2019	1700	26.4	0	767.4	83.0	113	0.8
11	15	2019	1800	26.5	0	767.4	83.0	125	0.8
11	15	2019	1900	26.4	0	767.4	85.0	202	1.0
11	15	2019	2000	26.3	0	767.4	84.0	202	1.0
11	15	2019	2100	26.2	0	767.2	84.0	225	0.8
11	15	2019	2200	26.2	0	767.2	84.0	225	0.5
11	15	2019	2300	26.2	0	767.2	84.0	270	0.6
11	15	2019	2400	26.9	0	767.2	83.0	292	0.8
11	15	2019	0	27.2	0	767.2	82.0	247	1.0
11	15	2019	100	26.3	0	767.2	85.0	270	1.9
11	15	2019	200	25.6	0	767.2	87.0	270	1.7
11	15	2019	300	25.5	0	767.2	89.0	318	1.4
11	15	2019	400	25.2	0	767.2	92.0	339	1.3
11	15	2019	500	24.8	1	767.2	93.0	318	1.3
11	15	2019	600	24.7	1	767.2	93.0	247	0.8
11	15	2019	700	24.8	1	767.2	93.0	292	0.8
11	15	2019	800	24.9	1	766.9	93.0	125	0.2
11	15	2019	900	25.0	1	766.9	93.0	225	0.4
11	15	2019	1000	25.0	1	766.9	93.0	292	0.2

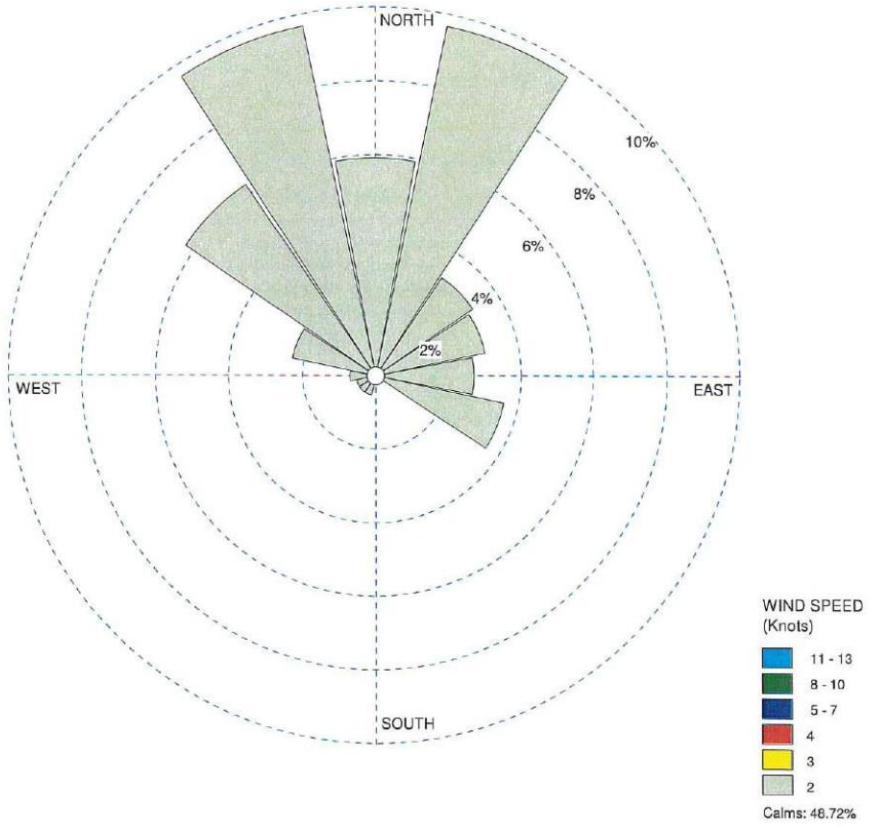
11	15	2019	1100	25.1	1	766.9	93.0	318	0.3
11	15	2019	1200	25.2	1	766.9	90.0	270	0.6
11	15	2019	1300	25.6	1	766.6	91.0	292	0.8
11	15	2019	1400	25.6	1	766.6	90.0	225	1.4
11	15	2019	1500	25.8	1	766.4	89.0	225	1.5
11	15	2019	1600	25.8	0	766.4	89.0	270	1.4
11	15	2019	1700	25.5	0	766.4	90.0	247	1.0
11	15	2019	1800	25.3	0	766.4	91.0	318	1.0
11	15	2019	1900	25.0	0	766.4	90.0	339	1.4
11	15	2019	2000	24.8	0	766.1	90.0	318	1.4
11	15	2019	2100	24.9	0	766.1	88.0	0	1.5
11	15	2019	2200	25.1	0	766.1	86.0		1.8
11	15	2019	2300	25.3	0	766.1	85.0	318	1.9
11	15	2019	2400	25.8	0	766.1	84.0	339	2.0
11	15	2019	0	26.1	0	765.9	83.0	339	1.6
11	15	2019	100	26.3	0	765.9	82.0		2.1
11	15	2019	200	26.6	0	765.9	83.0	292	1.5
11	15	2019	300	26.5	0	765.9	82.0	318	1.6
11	15	2019	400	26.5	0	765.6	83.0	292	1.6
11	15	2019	500	26.1	0	765.6	85.0	292	1.7
11	15	2019	600	26.3	0	765.6	85.0	292	1.1
11	15	2019	700	26.4	0	765.6	84.0	318	1.7
11	15	2019	800	26.5	0	765.6	85.0	339	1.6
11	15	2019	900	26.6	0	765.6	84.0	318	1.5
11	15	2019	1000	26.8	0	765.6	84.0	318	1.8
11	15	2019	1100	26.5	0	765.4	84.0	292	2.3
11	15	2019	1200	26.4	0	765.4	84.0	339	2.3
11	15	2019	1300	26.8	0	765.4	83.0	292	1.7
11	15	2019	1400	27.2	0	765.4	82.0	292	2.4
11	15	2019	1500	26.0	0	765.4	84.0	318	3.0
11	15	2019	1600	25.3	0	765.4	88.0	339	2.0
11	15	2019	1700	25.4	0	765.4	88.0	0	1.5
11	15	2019	1800	25.2	0	765.1	90.0	318	1.4
11	15	2019	1900	25.0	0	765.1	91.0	318	1.0
11	15	2019	2000	25.1	0	765.1	91.0	339	0.8
11	15	2019	2100	25.4	0	765.1	90.0	339	1.1
11	15	2019	2200	25.2	0	764.9	89.0	292	2.1
11	15	2019	2300	25.1	0	764.9	89.0	318	1.5
11	15	2019	2400	25.3	0	764.6	90.0	318	2.0
11	15	2019	0	25.7	0	764.6	86.0		2.5
11	15	2019	100	25.2	0	764.6	89.0	318	2.7
11	15	2019	200	25.1	0	764.6	89.0	339	2.2
11	15	2019	300	25.1	0	764.6	89.0	0	1.5
11	15	2019	400	25.1	0	764.6	89.0	318	1.4
11	15	2019	500	25.1	0	764.4	90.0	318	1.5
11	15	2019	600	25.2	0	764.4	89.0	339	1.4
11	15	2019	700	25.9	0	764.4	88.0	318	1.0

11	15	2019	800	26.5		0	764.4	83.0	339	1.7

(ii) Wind Rose Plot

WIND ROSE PLOT:

Ecoengineering Consultants Limited
13th - 15th November, 2019



COMMENTS:		COMPANY NAME: Ecoengineering Consultants Limited	
		MODELER: Kaizen Environmental Service (Trinidad) Limited	
			PROJECT NO.: 19-9282-1

WRPLOT View - Lakes Environmental Software

(iii) Calibration Certificate – Davis Met Station

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE #: 040418-A70426N737

DATE: 2019-10-27

ANALYSER TYPE: Davis Meteorological Station

SERIAL #: A70426N737

Sensor	Date Checked	Response
UV	*040418*	**OK**
Rain Gauge	*040418*	**OK**
Wind Monitor	*040418*	**OK**
Wind Direction	*040418*	**OK**
Temp & Humidity	*040418*	**OK**
Pressure	*040418*	**OK**

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with Davis factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

H. Biographies of Personnel

Anthony Chariah
Environmental Technician | PROJECT Services Division

Mr. Anthony Chariah is presently employed at Kaizen Environmental Services Limited as an Environmental Technician in the Project Services Department where he is responsible for executing the environmental fieldwork component of projects. This includes pre planning, data collection, and management, the operation of equipment, testing and preparation of technical information.

Mr. Chariah has been under the Project Services Division for four years now where he has gained knowledge and training in Environmental and Occupational monitoring and sampling according to US EPA and EMA guidelines. His work experiences include performing Ambient Air Quality monitoring, Indoor Air Quality monitoring, Stack Emission testing (Point Source Testing) and Noise testing.

Mr. Chariah possesses a BSc. Environmental and Natural Resources Management and Geography together with a NEBOSH National General Certificate in Occupational Health and Safety. Past experience includes working as a California Industrial Engineering Services Company Limited.

Yasin Khan – Team Leader
Measurements Section – PROJECT Services Division

Mr. Yasin Khan is presently employed at Kaizen environmental Services Limited as a Team Leader in the Project Services Division – Measurements Section where he is responsible for supervising, managing and motivating team members on a daily basis.

Mr. Khan has been employed with Kaizen Environmental Services Ltd. for the past six years where he has gained extensive knowledge and training in Environmental and Occupational monitoring and sampling according to EPA and EMA guidelines. His work experiences include performing Ambient Air Quality Monitoring for a broad range of toxic air pollutants, Stack Emission Testing (Point Source Testing), Noise testing and Indoor Air Quality Monitoring.

Mr. Khan possesses a Bachelors in Business Marketing and in currently perusing his NEBOSH Certificate. Past experiences include working at Edoo's Welding as a repair Technician.

Training received are Environmental Water, Soil and Air Sampling and Procedures, Stack Emission Testing Monitoring and Sampling Training, Noise Monitoring Training, Ambient Air Quality Monitoring and Sampling Training.

EVENT 2

PROJECTServices
A DIVISION OF KAIZEN ENVIRONMENTAL SERVICES TRINIDAD LIMITED

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REPORT

Ambient Air Quality Monitoring

For

Construction of the Diego Martin Vehicular Overpass

November 2019

Event 2

Prepared For

Ecoengineering – Consultants Limited
#62 Eastern Main Road, St. Augustine,
Trinidad W.I

Prepared By

Kaizen Environmental Services (Trinidad) Limited
Unit #8 Rajkumar Street, Mission Road,
Freeport,
Trinidad, W.I.

Davie Selal
Davie Selal
Trainee Administrative Technician II,
Reporting and Client Relations

Silas Poliah
Quality Control

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H. Biographies of Personnel

EXECUTIVE SUMMARY

Kaizen Environmental Services (Trinidad) Limited (Kaizen) was commissioned to conduct Ambient Air Quality Monitoring by Ecoengineering – Consultants Limited. Monitoring was conducted for the Construction of the Diego Martin Vehicular Overpass.

The parameters measured were as follows:

1. Particulate Matter 2.5 ($PM_{2.5}$)
2. Particulate Matter 10 (PM_{10})
3. Total Suspended Particulates (TSP)
4. Nitrogen Dioxide (NO_2)
5. Sulphur Dioxide (SO_2)
6. Carbon Monoxide (CO)
7. Ozone (O_3)
8. Volatile Organic Compounds (VOCs)

Fieldwork was conducted during the period November 18th – 20th, 2019.

SUMMARY OF RESULTS

Based on the investigation conducted on November 18th – 20th, 2019, the following conclusions can be made:

- The 24-hour average concentrations obtained for **Particulate Matter ($PM_{2.5}$ and PM_{10})** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's[a] Air Pollution Rules 2014.

- The 24-hour average concentrations obtained for **Total Suspended Particulates (TSP)** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's Air Pollution Rules 2014.

- The 1-hour concentrations obtained for **Nitrogen Dioxide (NO_2)** at all locations sampled were in compliance with the guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: NO_2 was below the detection limit at all locations monitored

- The 24-hour average concentrations obtained for **Sulphur Dioxide (SO_2)** at all locations sampled were in compliance with their respective guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: SO_2 was below the detection limit at all locations monitored

[a] EMA – Environmental Management Authority of Trinidad and Tobago

- The 8-hour average concentrations obtained for **Carbon Monoxide (CO)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

- The 8-hour average concentrations obtained for **Ozone (O_3)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

- The 8-hour average concentrations for **Volatile Organic Compounds (VOCs)** were obtained at all sampling locations. The concentrations obtained were within the range of 0.2 $\mu g/m^3$ to 1.3 $\mu g/m^3$. There are no EMA guidelines for **VOCs.**

1.0 Introduction

Kaizen Environmental Services (Trinidad) Limited (Kaizen) was commissioned to conduct Ambient Air Quality Monitoring by Ecoengineering – Consultants Limited. Monitoring was conducted for the Construction of the Diego Martin Vehicular Overpass.

Fieldwork was conducted during the period November 18th – 20th, 2019.

2.0 Monitoring Locations and Parameters

Five (5) locations were selected by Ecoengineering – Consultants Limited for the ambient air monitoring as follows:

Table 1: Monitoring Locations and Parameters

Location No.	Co-ordinates	Parameters Monitored
1	20P0657831 UTM1180930	Particulate Matter 2.5 ($PM_{2.5}$) Particulate Matter 10 (PM_{10}) Total Suspended Particulates (TSP) Nitrogen Dioxide (NO_2) Sulphur Dioxide (SO_2) Carbon Monoxide (CO) Ozone (O_3) Volatile Organic Compounds (VOCs)
2	20P0657681 UTM1181156	
3	20P0658177 UTM1181216	
4	20P0658383 UTM1181049	
5	20P0658294 UTM1181091	

3.0 Test Methodology

3.1 Particulate Matter ($PM_{2.5}$ and PM_{10}) Monitoring

$PM_{2.5}$ & PM_{10} was measured in accordance with the US EPA's[b] "*Compendium of Methods for the Determination of Inorganic Compounds in Ambient Air - Compendium Method IO 2.1: Sampling of Ambient Air for Total Suspended Particulate Matter (SPM) and PM_{10} Using High Volume (HV) Sampler*".

The $PM_{2.5}$ high volume sampler utilized meets the US EPA's Reference Method: *40 CFR Part 50 Appendix L.*

The PM_{10} high volume sampler utilized meets the US EPA's Reference Method: *40 CFR Part 50 Appendix J.*

The $PM_{2.5}$ & PM_{10} sampler was calibrated prior to use in the field (*Calibration Certificate is appended–Attachment A (i) and (ii) respectively*)

3.2 Total Suspended Particulate Matter (TSP)

TSP was measured in accordance with equipment specified in the USEPA's *Code of Federal regulations (CFR) 40 CFR Chapter 1 Part 50 Appendix B Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method).*
The TSP sampler was calibrated prior to use in the field (*Calibration Certificate is appended–Attachment A (iii)*).

3.3 Nitrogen Dioxide (NO_2)

NO_2 concentrations were determined in accordance with the US EPA Designated Equivalent Method *NO – EQN – 1277 – 026, "Sodium Arsenite Method for the Determination of Nitrogen Dioxide in the Atmosphere".*

A sample of the ambient air is bubbled at a low flow rate through an impinger containing a sodium arsenite and sodium hydroxide solution for the full 24-hour sampling period. The concentration of the nitrite ion produced during sampling is determined colorimetrically by reacting the nitrite ion with phosphoric acid and N – (1-naphthyl)-ethylene diamine di-hydrochloride and measuring the absorbance of the highly colored azo dye at 540 nm. A vacuum pump was used to draw the ambient air through the sampling solution contained in the impinger.
Based on results from a collaborative study conducted by the US EPA, the lower detectable limit of the method is estimated to be 9 $\mu g/m^3$ for a 24-hour period.

[b] US EPA – United States Environmental Protection Agency

Modified Method to monitor the concentration of NO_2 in accordance to the EMA's Air Pollution Rules, 2014: The sampling time was reduced to one (1) hour or sixty (60) minutes with a sample flow rate of 2 L/min which is reflected in the formula for the calculation of volume of air sampled. The new detectable limit of the method is calculated to be 20 $\mu g/m^3$.

The following formulae were used in the determination of NO_2:

Volume of air sampled:
$V = (F_i + F_f / 2) \times t_s \times 10^{-6}$

Where:
V = Volume of air sampled, m^3
F_i = Air flow rate before sampling, cm^3/min
F_f = Air flow rate after sampling, cm^3/min
t_s = Sampling time, 60 minutes
10^{-6} = conversion of cm^3 to m^3

NO_2 Concentration in Air:
(Concentration of NO_2 (mg/L) x 50 / Volume of air sampled x 0.82) x Dilution factor

Where:
Concentration of NO_2 (mg/L) = obtained from lab analysis report
Volume of absorbing reagent used in sampling, ml = 50
Volume of air sampled = obtained from previous calculation
Sampling efficiency = 0.82
Dilution factor = 1

3.4 Sulphur Dioxide (SO_2)

The concentration of SO_2 was determined in accordance with US EPA 40 CFR Part 50 Appendix A: *"Reference Method for the Determination of Sulphur Dioxide in the Atmosphere (Pararosaniline Method).*

With this Method, a measured volume of air was bubbled through a solution of 0.04 M potassium tetrachloromercurate (TCM), which was contained in an impinger train assembly. The SO_2 present in the air stream reacts with the TCM solution to form a stable monochlorosulfanomercurate complex. Once formed, this complex resists air oxidation and is stable in the presence of strong oxidants such as ozone and oxides of nitrogen. During subsequent analysis, the complex is reacted with acid bleached pararosaniline methyl sulfonic acid. The optical density of this species is determined spectrophotometrically at 548 nm and is directly related to the amount of SO_2 collected.

Based on results from a collaborative study conducted by the US EPA, the lower limit of detection of SO_2 in 10 ml of TCM is 0.75 µg. This represents a concentration of 13 µg SO_2/ m^3 (0.005 ppm) for a 24-hour period.

3.5 Carbon Monoxide (CO)

The Thermo Scientific Model 48i Carbon Monoxide Analyzer is an U.S. EPA Reference Method: *RFCA-0981-054.*

The Model 48i Carbon Monoxide (CO) absorbs infrared radiation at a wavelength of 4.6 microns. The instrument electronics transform the basic analyzer signal into a linear output. The 48i uses an exact calibration curve to accurately linearize the instrument output over any range up to a concentration of 10,000ppm. The CO samplers were calibrated prior to use in the field (*Calibration Certificate is appended – Attachment A (iv)*.

3.6 Ozone (O_3)

For this measurement of Ozone, the Aeroqual Series 500-USEPA Tier II & III Indicative method was used; comparable to USEPA studies. *See Attachment D – Ozone Comparative Study*

3.7 Volatile Organic Compounds (VOCs)

For monitoring of VOCs, Crowcon portable emissions analyzer was utilized, and was calibrated prior to use in the field (*Test Certificate is appended –Attachment A (ii)*).

The Crowcon Gas Detective portable emissions analyzer is a microprocessor controlled portable gas detector, which is capable of monitoring up to four (4) gas types simultaneously and providing warning of hazardous levels.

Using electrochemical, catalytic, and thermal conductivity sensors, this instrument was configured to detect any practical combination of oxygen, toxic and flammable gas.

The Crowcon was fitted with electrochemical sensors to measure VOC concentrations. The concentration ranges and resolution/ detection limits of this instrument VOC are as follows:

Sensor/ Parameter	Range (ppm)	Resolution/ Detection Limit (ppm)
VOC	0 – 100	1.0

The Crowcon was configured to log averages at 15-minute intervals.

4.0 Results

4.1 Particulate Matter ($PM_{2.5}$ and PM_{10}), Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2), and Carbon Monoxide (CO), Ozone (O_3), Total Suspended Particulate Matter (TSP) and Volatile Organic Compounds (VOCs) Results

Table 2 presents the results of the Particulate Matter ($PM_{2.5}$ and PM_{10}) and Total Suspended Particulate (TSP) Monitoring. The results in this table have been compared to standards outlined by the EMA in the Air Pollution Rules, 2014.

Table 2: Ambient Air Quality Testing Results Particulate Matter ($PM_{2.5}$ PM_{10} and TSP)

Location No.	Sample Period/ 2019	Parameter Concentration		
		$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	TSP ($\mu g/m^3$)
1	November $19^{th} - 20^{th}$	3	7	21
2	November $18^{th} - 19^{th}$	3	16	20
3		5	10	17
4		5	11	19
5	November $19^{th} - 20^{th}$	1	14	21
EMA[c] STEL[d] (24-hr average)		**65**	**75**	**150**

Note:

a) Results reported to the nearest whole number

[c] EMA – Environmental Management Authority of Trinidad and Tobago
[d] STEL – Short-term Maximum Permissible Level

Table 3 displays the results of the 24 hour monitoring event for SO_2. The results were compared to their respective short term permissible levels as stipulated by the EMA in their Air Pollution Rules, 2014.

Table 3: Ambient Air Quality Testing Results –SO_2 (24-hour)

Location No	Sample Period/ 2019	Parameter Concentration
		SO_2 (µg/m³)
1	November 19th – 20th	BDL
2	November 18th – 19th	BDL
3		BDL
4		BDL
5	November 19th – 20th	BDL
EMA STEL (24-hr)		**125**

Note:

a) BDL – Below Detection Limit
b) SO_2 Method Detection Limit = 13 µg/Nm³

Table 4 displays the data for the 1-hour monitoring event for NO_2. The results were compared to the relevant limits as stated by the EMA in the Air Pollution Rules, 2014.

Table 4: Ambient Air Quality Testing Results – NO_2 (1-hour)

Location No	Sample Period/ 2019	Parameter Concentration
		NO_2 (µg/m³)
1	November 19th	BDL
2	November 18th	BDL
3		BDL
4		BDL
5	November 19th	BDL
EMA[e] STEL[f] (1-hr)		**200**

Note:

a) BDL – Below Detection Limit
b) NO_2 Modified Method Detection Limit = 20 µg/Nm³

[e] EMA – Environmental Management Authority of Trinidad and Tobago
[f] STEL – Short-term Maximum Permissible Level

Table 5 displays the results of the CO, VOC and O_3 monitoring. The results were compared to the 8-hour limit as stated by the EMA in the Air Pollution Rules, 2014.

Table 5: Ambient Air Quality Testing Results – Carbon Monoxide (CO), Volatile Organic Compounds (VOCs) and Ozone (O_3)

Location	Sampling Date/ 2019	Sampling Period		Avg 8-Hr CO Concentration ($\mu g/m^3$)	Avg 8-Hr VOC Concentration ($\mu g/m^3$)	Avg 8-Hr O_3 Concentration ($\mu g/m^3$)
		Start	End			
1	November 19th	14:02	22:01	1084	0.8	47
	November 19th – 20th	22:02	06:01	893	1.0	36
	November 20th	06:02	14:02	1054	1.3	43
2	November 18th	11:03	19:02	867	1.2	35
	November 18th – 19th	19:03	03:02	692	0.9	29
	November 19th	03:03	11:03	852	0.6	31
3	November 18th	12:00	19:59	892	0.9	35
	November 18th – 19th	20:00	03:59	683	0.2	27
	November 19th	04:00	12:00	894	0.8	31
4	November 18th	13:02	21:01	1011	0.9	49
	November 18th – 19th	21:02	05:01	773	0.6	47
	November 19th	05:02	13:02	962	0.8	48
5	November 19th	13:01	21:00	1080	1.2	49
	November 19th – 20th	21:01	05:00	877	0.7	47
	November 20th	05:01	13:01	1094	0.9	48
EMA STEL (8-hour average)				**10 000**	N/A	120

Note:

a) Results reported to the nearest whole number
b) There are no guidelines for VOCs in ambient air.

4.2 Meteorological Monitoring

Table 6: Summary of Meteorological Conditions during Monitoring Periods (November 18th – 20th, 2019)

Date/ 2019	Average Wind Speed (m/s)	Average Temperature (°C)	Average Relative Humidity (%)	Average Barometric Pressure (mmHg)	Total Rainfall (mm)
November 18th – 20th	0.7	26.9	85.1	761.6	1.7

The raw meteorological data is attached as *Appendix F*.

5.0 Conclusion

Based on the investigation conducted on November 18th – 20th, 2019, the following conclusions can be made:

- The 24-hour average concentrations obtained for **Particulate Matter ($PM_{2.5}$ and PM_{10})** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's[g] Air Pollution Rules 2014.

- The 24-hour average concentrations obtained for **Total Suspended Particulates (TSP)** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's Air Pollution Rules 2014.

- The 1-hour concentrations obtained for **Nitrogen Dioxide (NO_2)** at all locations sampled were in compliance with the guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: NO_2 was below the detection limit at all locations monitored

- The 24-hour average concentrations obtained for **Sulphur Dioxide (SO_2)** at all locations sampled were in compliance with their respective guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: SO_2 was below the detection limit at all locations monitored

- The 8-hour average concentrations obtained for **Carbon Monoxide (CO)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

[g] EMA – Environmental Management Authority of Trinidad and Tobago

- The 8-hour average concentrations obtained for **Ozone (O_3)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

- The 8-hour average concentrations for **Volatile Organic Compounds (VOCs)** were obtained at all sampling locations. The concentrations obtained were within the range of 0.2 $\mu g/m^3$ to 1.3 $\mu g/m^3$. There are no EMA guidelines for **VOCs.**

PROJECTServices
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ATTACHMENTS

A. Calibration Certificates

- (i) $PM_{2.5}$ High Volume Samplers
- (ii) PM_{10} High Volume Samplers
- (iii) TSP Samplers
- (iv) Thermo Scientific (CO)
- (v) Aeroqual (O_3)
- (vi) SKC Pumps (NO_2 and SO_2)
- (vii) Crowncon Gas Detective (VOCs)
- (viii) Analytical Balance

B. Map of Monitoring Location

C. Accreditation Certificate

D. Laboratory Data

- (i) Chain of Custody
- (ii) Analytical Results

E. Ozone Comparative Study

F. Raw Data

- (i) Carbon Monoxide (CO)
- (ii) Volatile Organic Compounds (VOCs)
- (iii) Ozone (O_3)
- (iv) Filter Weights

G. Meteorological Data

- (i) Raw Meteorological Data
- (ii) Wind Rose Plot
- (iii) Calibration Certificate – Davis Met Station

H. Biographies of Personnel

A. Calibration Certificates

(i) $PM_{2.5}$ High Volume Samplers

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PM2.5 High Volume Sampler Calibration

DATE: Nov 9th 2019
Technician: Amrit Persad Maharaj

Certificate # 010319-4732
Serial# : 4732
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

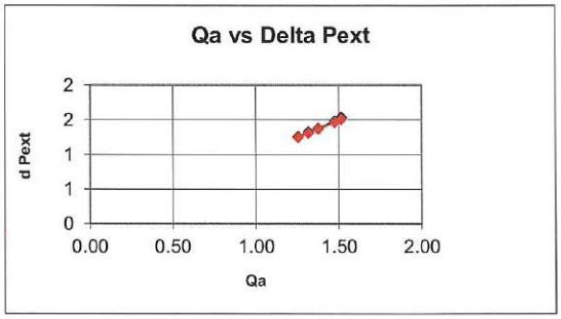
Conditions

Ta:(°C)	28.6	**Ta (°K)**	301.6	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext
5.7	1.521	5.4	1.534	1.5028
5.4	1.481	5	1.476	1.4627
4.7	1.382	4.3	1.369	1.3647
4.3	1.322	4	1.320	1.3053
3.9	1.260	3.6	1.252	1.2431

slope, m2:	**1.054142**
intercept, b2:	**-0.078530**
corr. coeff, r2	**0.997657**
SFR	**1.140**
SSP	**2.90**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
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Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

PM2.5 High Volume Sampler Calibration

DATE: Nov 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4735
Serial# : 4735
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

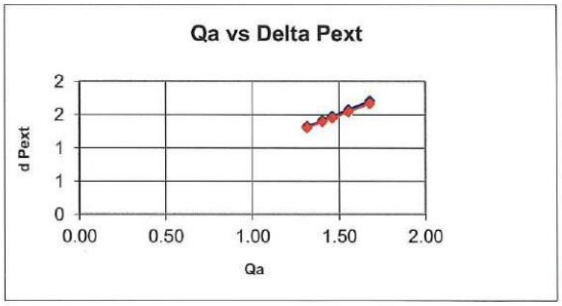
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	27.3	**Ta (°K)**	300.3	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.96	**Pa (mm Hg)**	760.984	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.072916**
7	1.681	6.7	1.705	1.6621	**intercept, b2:**	**-0.097978**
6	1.557	5.7	1.573	1.5388	**corr. coeff, r2**	**0.999998**
5.3	1.464	5	1.473	1.4463		
4.9	1.408	4.6	1.413	1.3906	**SFR**	**1.135**
4.3	1.320	4	1.318	1.3027	**SSP**	**2.89**



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Amrit Persad Maharaj
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Email: inquiries@kaizen-tt.com

PM2.5 High Volume Sampler Calibration

DATE: November 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-711768
Serial# : 711768
Sampler: Staplex

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

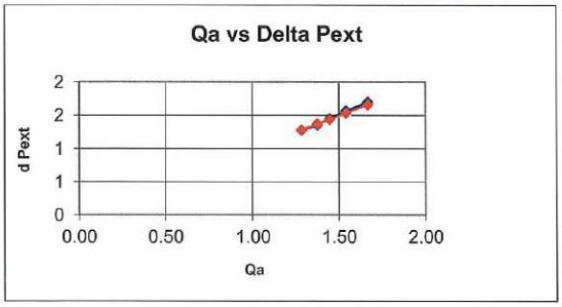
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	27.3	**Ta (°K)**	300.3	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.96	**Pa (mm Hg)**	760.984	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.143603**
6.9	1.669	6.6	1.693	1.6502	**intercept, b2:**	**-0.214450**
5.9	1.544	5.6	1.559	1.5259	**corr. coeff, r2**	**0.998751**
5.2	1.450	4.8	1.443	1.4325		
4.7	1.379	4.2	1.350	1.3619	**SFR**	**1.135**
4.1	1.289	3.7	1.267	1.2720	**SSP**	**2.71**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

(ii) PM_{10} High Volume Samplers

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PM10 High Volume Sampler Calibration

DATE: Nov 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-2480
Serial# : 2480
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

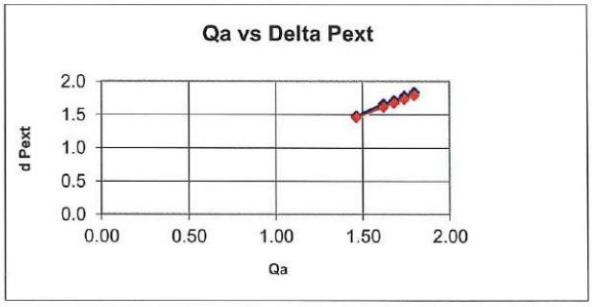
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.060066**
8	1.801	7.7	1.832	1.7810	**intercept, b2:**	**-0.074936**
7.5	1.744	7.2	1.772	1.7244	**corr. coeff, r2**	**0.999042**
7	1.685	6.7	1.709	1.6660		
6.5	1.624	6.3	1.657	1.6054	**SFR**	**1.141**
5.3	1.467	5	1.476	1.4496	**SSP**	**2.95**



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PM10 High Volume Sampler Calibration

DATE: Nov 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4733
Serial# : 4733
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

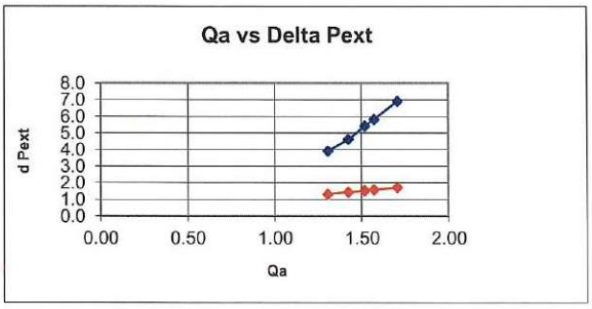
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**7.560747**
7.2	1.709	7.8	6.900	1.6896	**intercept, b2:**	**-6.076769**
6.1	1.574	7.33	5.800	1.5552	**corr. coeff, r2**	**0.997793**
5.7	1.521	6.9	5.400	1.5033		
5	1.426	6.53	4.600	1.4080	**SFR**	**1.141**
4.2	1.307	5.7	3.900	1.2905	**SSP**	**14.88**



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PM10 High Volume Sampler Calibration

DATE: Nov 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4734
Serial# : 4734
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

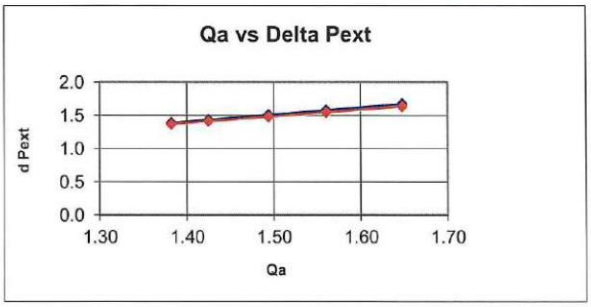
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.072142**
6.7	1.649	6.4	1.670	1.6299	**intercept, b2:**	**-0.097217**
6	1.561	5.7	1.576	1.5424	**corr. coeff, r2**	**0.999999**
5.5	1.495	5.2	1.505	1.4767		
5	1.426	4.7	1.431	1.4080	**SFR**	**1.141**
4.7	1.383	4.4	1.385	1.3651	**SSP**	**2.91**



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Amrit Persad Maharaj
Instrumentation Technician

(iii) TSP Samplers

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TSP High Volume Sampler Calibration

DATE: October 23rd 2019
Techinician : Amrit Persad Maharaj

Certificate #: 010319-4731
Serial# : 4731
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

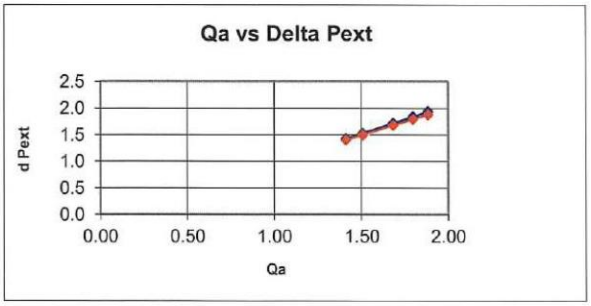
Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.068727**
8.8	1.889	8.5	1.925	1.8679	**intercept, b2:**	**-0.093403**
8	1.801	7.7	1.832	1.7810	**corr. coeff, r2**	**0.999998**
7	1.686	6.7	1.709	1.6660		
5.6	1.509	5.3	1.520	1.4901	**SFR**	**1.141**
4.9	1.413	4.6	1.416	1.3938	**SSP**	**2.91**



amrit persad maharaj.

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Instrumentation Technician

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TSP High Volume Sampler Calibration

DATE: October 23rd 2019
Techinician : Amrit Persad Maharaj

Certificate #: 010319-4730
Serial# : 4730
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

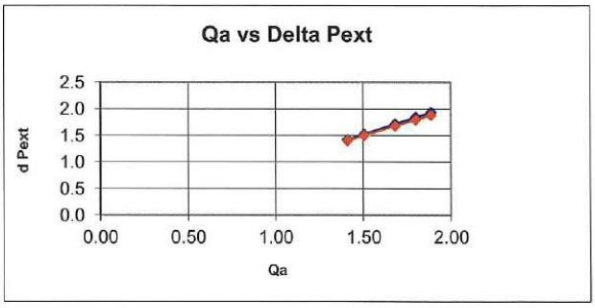
Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.068727**
8.8	1.889	8.5	1.925	1.8679	**intercept, b2:**	**-0.093403**
8	1.801	7.7	1.832	1.7810	**corr. coeff, r2**	**0.999998**
7	1.686	6.7	1.709	1.6660		
5.6	1.509	5.3	1.520	1.4901	**SFR**	**1.141**
4.9	1.413	4.6	1.416	1.3938	**SSP**	**2.91**



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Amrit Persad Maharaj
Instrumentation Technician

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FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

TSP High Volume Sampler Calibration

DATE: October 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4728
Serial# : 4728
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

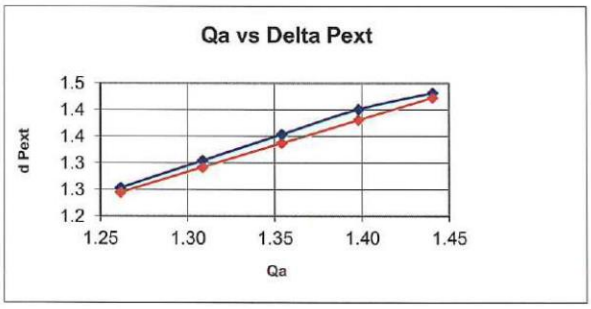
Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.014525**
5.1	1.441	4.7	1.431	1.4220	**intercept, b2:**	**-0.024242**
4.8	1.398	4.5	1.401	1.3795	**corr. coeff, r2**	**0.997630**
4.5	1.354	4.2	1.353	1.3357		
4.2	1.309	3.9	1.304	1.2905	**SFR**	**1.141**
3.9	1.262	3.6	1.253	1.2435	**SSP**	**2.94**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

(iv) Thermo Scientific ($CO\&H_2S$)

KAIZEN
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VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-710821552

DATE: 28/10/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	As Left	Span	Gas Manufacturer	Gas Lot #
0	0	*Air Zero Grade (THC<1ppm)*	CALGAZ	152802
50	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-1108347540

DATE: 28/10/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	As Left	Span	Gas Manufacturer	Gas Lot #
0	0	*Air Zero Grade (THC<1ppm)*	CALGAZ	152802
50	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-1108347541

DATE: 28/10/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	As Left	Span	Gas Manufacturer	Gas Lot #
0	0	*Air Zero Grade (THC<1ppm)*	CALGAZ	152802
50	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

(v) Aeroqual (O_3)

aeroqual

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32159

Calibration Date: 25 Feb 2019 14:51

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1221

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.005	0.110	0.523	0.000
AQL Sensor (Std. Dev) /ppm	0.000	0.001	0.002	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: **Takao Yamasaki**

Date: **25 Feb 2019**

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32151

Calibration Date: 25 Feb 2019 14:50

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1225

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.004	0.109	0.510	0.000
AQL Sensor (Std. Dev) /ppm	0.001	0.001	0.001	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: Takao Yamasaki

Date: 25 Feb 2019

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32142

Calibration Date: 25 Feb 2019 14:50

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1232

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.005	0.113	0.506	0.000
AQL Sensor (Std. Dev) /ppm	0.002	0.001	0.003	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: **Takao Yamasaki**

Date: **25 Feb 2019**

(vi) SKC Pumps (NO_2 and SO_2)

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-562657

DATE: 27/10/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 562657

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
2.9 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-634661

DATE: 27/10/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 634661

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
3.0 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-634635

DATE: 27/10/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 634635

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
3.1 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

(vii) Crowncon Gas Detective (VOCs)

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-44094
DATE: 2019-10-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 44094

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*
VOC	0	0	10	10	*10 ppm Isobutylene*

TEMPERATURE: 25.8°C

RELATIVE HUMIDITY: 51.6%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-45704
DATE: 2019-10-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 45704

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*
VOC	0	0	10	10	*10 ppm Isobutylene*

TEMPERATURE: 25.8°C

RELATIVE HUMIDITY: 51.5%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-42045
DATE: 2019-10-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 42045

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*
VOC	0	0	10	10	*10 ppm Isobutylene*

TEMPERATURE: 25.9°C

RELATIVE HUMIDITY: 51.4%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

(viii) Analytical Balance

Location:
University of the West Indies
St. Augustine Campus, Trinidad & Tobago
Mailing Address:
Tunapuna Post Office, Trinidad & Tobago
Tel: (868) 299-0210
Fax: (868) 662-7177
Email: cams@cariri.com
Website: www.cariri.com

CARIRI
Caribbean Industrial Research Institute

ACCREDITED
Calibration Laboratory
LAB NO. CL-134

CALIBRATION CERTIFICATE

Date of Issue: September 06, 2018

Certificate No.: C060018

Project No.: EC03834140/18

CLIENT: Kaizen Environmental Services (Trinidad) Ltd.

ADDRESS: Unit 8 Rajkumar Street, Mission Road, Freeport

CALIBRATION LOCATION: Kaizen Environmental Services (Trinidad) Ltd., Balance Room

EQUIPMENT: Electronic Balance

MANUFACTURER: Sartorius

MODEL NO.: AC 210S 00016

SERIAL NO.: 40305246

EQUIPMENT NO.: ASD-EQ-BAL001

CAPACITY/RESOLUTION: 100g / 0.0001g

CALIBRATION TYPE: As Found

CALIBRATION DATE: September 04, 2018

1. This report relates solely to the specific sample of the product which has been analysed or calibrated by CARIRI as the basis for preparing the report. It shall not be used for certification, advertising or marketing of products produced by the same manufacturer or the Client without the prior written consent of the Chief Executive Officer of CARIRI.

2. This report may not be reproduced, other than in full, except with the prior written authorization from the Chief Executive Officer / Chairman of CARIRI.

The uncertainties are for a confidence probability of approximately 95 percent and coverage factor k = 1.96

CARIBBEAN INDUSTRIAL RESEARCH INSTITUTE
CALIBRATION CERTIFICATE

Certificate No.: C060018
Project No.: EC03834140/18

PROCEDURE:
The electronic balance was calibrated in accordance with UKAS Lab 14 and CARIRI's SOP: CAMS.M1

TRACEABILITY:
The values and units of measurement of the reference weights are traceable to the SI (International System of Units), through reference standards maintained at the National Physical Laboratory (England), NIST (USA) and other recognized standards laboratories.

OBSERVATIONS:
The Internal, External and Sensivity calibration functions on the balance are inoperative. As a result these functions could not be used to adjust the balance readout.

AMBIENT CONDITIONS:
Temperature: 25±2°C, Relative Humidity: 70±5%RH

REFERENCE MASS

Serial No.	Weights Applied (g)	Certificate No.	Laboratory No.	Class	Uncertainty (g)
41950	0.005 to 200	M49398	0438	E2	0.0001

REPEATABILITY
Applied Load (g): 100

Unloaded Reading(A)	Loaded Reading (B)	Difference (B-A)	Readability
0.0000	99.8325	99.8325	0.0001
0.0000	99.8326	99.8326	
0.0000	99.8324	99.8324	
0.0000	99.8325	99.8325	
0.0000	99.8324	99.8324	
0.0000	99.8325	99.8325	
0.0000	99.8326	99.8326	
0.0000	99.8327	99.8327	
0.0000	99.8327	99.8327	
0.0000	99.8325	99.8325	
Standard Deviation (g):	0.0001		

LINEARITY

Applied Load (g)	Indicated Reading (g)	Error
0.005	0.0051	0.0001
0.02	0.0201	0.0001
0.1	0.1003	0.0003
1	0.9984	-0.0016
5	4.9918	-0.0082
20	19.9663	-0.0337
30	29.9499	-0.0501
50	49.9163	-0.0837
70	69.8829	-0.1171
100	99.8327	-0.1673
Maximum Error (g):	0.1673	

CARIBBEAN INDUSTRIAL RESEARCH INSTITUTE
CALIBRATION CERTIFICATE

Certificate No.: C060018
Project No.: EC03834140/18

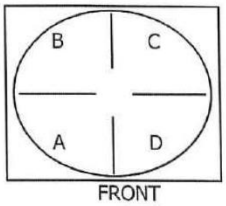
ECCENTRICITY

Applied Load (g): 20

Position	Reading (g)
Front Left (A)	19.9657
Rear Left (B)	19.1502
Rear Right (C)	19.9663
Front Right (D)	19.9669

Maximum deviation across balance pan (g): 0.8167

Uncertainty of Calibration (g): ±0.46210



Calibrator: N. Jonas

Signature: .....

Approved Signatory: M. Andrews

Signature: .....

End of Certificate

B. Map of Monitoring Location


Location 3
N
Location 2
Location 5
Diego Martin Hwy
Location 4
Main Rd
Location 1
Western Main Rd

C. Accreditation Certificates

TT LABS
TRINIDAD AND TOBAGO
laboratory
Accreditation
Service

CERTIFICATE OF ACCREDITATION

KAIZEN ENVIRONMENTAL SERVICES (TRINIDAD) LTD

Testing Laboratory No.: LAS-005

is an accredited Laboratory which fulfils the requirements of ISO/IEC 17025 and has demonstrated competence to carry out tests as per a defined scope for:

CHEMICAL AND MICROBIOLOGICAL TESTING

as per attached schedule

While this certificate remains valid, the Accredited Laboratory named above is authorized to issue TTLABS-endorsed certificates.

Karlene Carolyn Lewis
Manager, TTLABS

"Recognised as the official national laboratory accrediting body by the Ministry of Trade, Industry, Investment and Communication of the Republic of Trinidad and Tobago"

Initial Accreditation date: 3rd September 2014

This certificate issued on: 21st September 2017

"This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrated technical competence for a defined scope and the operation of a laboratory quality management system. (refer to joint ISO-ILAC-IAF Communiqué dated 18 June 2005)"

Canadian Association for Laboratory Accreditation Inc.

CALA

Certificate of Accreditation

Kaizen Lab
KaizenLAB Inc.
333-50th Ave. S.E.
Calgary, Alberta

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

Accreditation No.: A2925
Issued On: October 17, 2017
Accreditation Date: January 31, 2005
Expiry Date: April 16, 2020

President & CEO

CALA

This certificate is the property of the Canadian Association for Laboratory Accreditation Inc. and must be returned on request. Reproduction must follow policy in place at date of issue. For the specific tests to which this accreditation applies, please refer to the laboratory's scope of accreditation at www.cala.ca

D. Laboratory Data

(i) Chain of Custody

PROJECTServices

A DIVISION OF KAIZEN ENVIRONMENTAL SERVICES LIMITED

Unit # 8, Rajkumar Street, Mission Road, Freeport, Trinidad, W.I.
Tel: (868) 299-0009 Fax: (868) 673-5997

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

Kaizen Lab File #: 427628-1-5 Nº PSD 1701

Date Submitted: 22/11/2019 | Date Required: 2/12/2019

Service Requested:
- Regular (10 days) ☐
- Rush (within 5 days) + 25% ☑
- Priority (3 days) + 50% ☐
- Emergency (next day) + 100% ☐

ANALYSIS REQUESTED

SAMPLE ID	DATE SAMPLED	SAMPLED TYPE	NOx												
Eco - Engineering															
Diego Martin															
- Loc 1	19/11/2019		/												-1
- Loc 2	18/11/2019	NOx Absorbing	/												-2
- Loc 3	18/11/2019	Solution	/												-3
- Loc 4	18/11/2019		/												-4
- Loc 5	19/11/2019		/												-5

Client: Henry Lue Fatt | Phone: Same As Above
Contact: | Fax:
Report Address: | P.O.#:
Client Job #:
Billing Address: | # Samples Submitted: 5
Preservatives:
Special Requests:

Relinquished By: A. Chariah | Received By: S. Ramkissoon Jr.
Date: 22/11/2019 | Date: 26/11/19
Time: 1600h | Time: 11:33 PM

Sample Condition Upon Receipt:
Frozen ☐ Cold ☐ Ambient ☐ Head Space (yes/no):
Other (breakage, leakage, illegible etc.):

SAMPLED BY: A. Chariah
NAME IN BLOCK LETTERS
A. [signature]
SIGNATURE

DATE: 22/11/2019

White - File Copy Yellow - Lab Copy

Pronto 652-3577

PROJECTServices

A DIVISION OF KAIZEN ENVIRONMENTAL SERVICES LIMITED

Unit # 8, Rajkumar Street, Mission Road, Freeport. Trinidad, W.I.
Tel: (868) 299-0009 Fax: (868) 673-5997

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

Kaizen Lab File # 304140 ? PSD 1702

4 Dec 19

Date Submitted: 22/11/2019 Date Required: 2/12/2019

Service Requested:
- Regular (10 days) ☐
- Rush (within 5 days) + 25% ☑
- Priority (3 days) + 50% ☐
- Emergency (next day) + 100% ☐

	SAMPLE ID	DATE SAMPLED	SAMPLED TYPE	ANALYSIS REQUESTED: SO_4
	Eco-Engineering, Diego Martin			
1	- Loc 1	19/11/2019	SO_4 Absorbing Solution	✓
2	- Loc 2	18/11/2019		✓
3	- Loc 3	18/11/2019		✓
4	- Loc 4	18/11/2019		✓
5	- Loc 5	19/11/2019		✓

Client: Henry Lue Tatt Phone: Same As Above
Contact Fax:
Report Address: P.O.#:
Client Job #:
Billing Address: # Samples Submitted: 5
Preservatives:
Special Requests:

Relinquished By: A. Charran Received By: SC
Date: 22/11/2019 Date: 28 Nov 19
Time: 1600h Time: 11:00

Sample Condition Upon Receipt: Temp: 15.8°C
Frozen ☐ Cold ☐ Ambient ☐ Head Space (yes/no):
Other (breakage, leakage, illegible etc.):

SAMPLED BY: A. Charran
NAME IN BLOCK LETTERS
A. Charran
SIGNATURE

DATE: 22/11/2019

White - File Copy Yellow - Lab Copy

Pronto 652-3577

(ii) Analytical Results

KaizenLAB
Analytical Division of Kaizen Environmental Services (Trinidad) Ltd.

Unit 8 Rajkumar Street,
Mission Road, Freeport.
Email: kaizenlab@kaizen-tt.com
Tel: (868) 299-0009
Fax: (868) 673-6774

ANALYSIS DATA REPORT

Customer:	KESTL- PSD	**Customer Contact:**	Henry Lue-Fatt
Customer's Address:	Unit 8 Rajkumar Street, Mission Road, Freeport.		
Client Project #:	19-002	**Lab File #:**	427628
Item(s) Analyzed:	Liquid Samples		
Date of Sampling:	18-Nov-19 & 19-Nov-19	**Sampling Location:**	Eco Engineering (Diego Martin)
Sampling Condition:	n/a	**Sampled By:**	PSD Staff - A. Chariah
Sampling Plan Used:	n/a		
Date of Receipt:	26-Nov-19	**Date of Testing:**	28-Nov-19
Report Date:	28-Nov-19		

ANALYSIS RESULTS

Analysis: Nitrite-N

Sample ID	Units	Results
		Nitrite-N
427628-1, Loc 1	mg/L	<0.04
427628-2, Loc 2	mg/L	<0.04
427628-3, Loc 3	mg/L	<0.04
427628-4, Loc 4	mg/L	<0.04
427628-5, Loc 5	mg/L	<0.04

** Detailed Test Methodologies and QA/QC data available upon request.*

***Test Methodologies:** Nitrite-N: EPA-EQN-1277-026

Discussion: None

Comments: The results in this test report relate only to the items as received and tested.

Report Authorized by: Devika Rooplal
Devika Rooplal
Laboratory Manager

This test report shall not be reproduced except in full, without written approval of the laboratory.

333 50th Ave. S.E.
Calgary, AB, T2G 2B3
Phone (403) 297-0868
Fax: (403) 297-0869

KaizenLAB

ANALYTICAL REPORT

Client: Kaizen Environmental Services (Trinidad) Ltd.
Unit 8, Rajkumar Street, Mission Road
Freeport, Trinidad, West Indies

Attention: Henry Lue-Fatt

KaizenLAB JOB #:	304140
DATE RECEIVED:	28-Nov-2019
DATE REPORTED:	04-Dec-2019
PROJECT ID:	Eco-Engineering Diego Martin
LOCATION:	

KaizenLAB Sample #: 304140_001 **Sample ID:** Loc 1
Date Sampled: 19-Nov-2019 **Matrix:** LIQUID

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 304140_002 **Sample ID:** Loc 2
Date Sampled: 18-Nov-2019 **Matrix:** LIQUID

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 304140_003 **Sample ID:** Loc 3
Date Sampled: 18-Nov-2019 **Matrix:** LIQUID

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 304140_004 **Sample ID:** Loc 4
Date Sampled: 18-Nov-2019 **Matrix:** LIQUID

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 304140_005 **Sample ID:** Loc 5
Date Sampled: 19-Nov-2019 **Matrix:** LIQUID

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

333 50th Ave. S.E.
Calgary, AB, T2G 2B3
Phone (403) 297-0868
Fax: (403) 297-0869

KaizenLAB

Test Methodologies

SO2 in Water - Determination of SO2 Absorbed in Potassium Trichlormercurate

Final Review by:

Zakia Biswas
Client Service Representative / Project Coordinator

Note: The results in this report relate only to the items tested and as received. Information is available for any items in 7.8.2.1 of ISO/IEC 17025:2017 that cannot be put on a test report. The report shall not be reproduced except in full without written approval of KaizenLAB. The validity of results may be affected if the information is provided by the customer.

E. Comparative Study – Ozone (O_3)

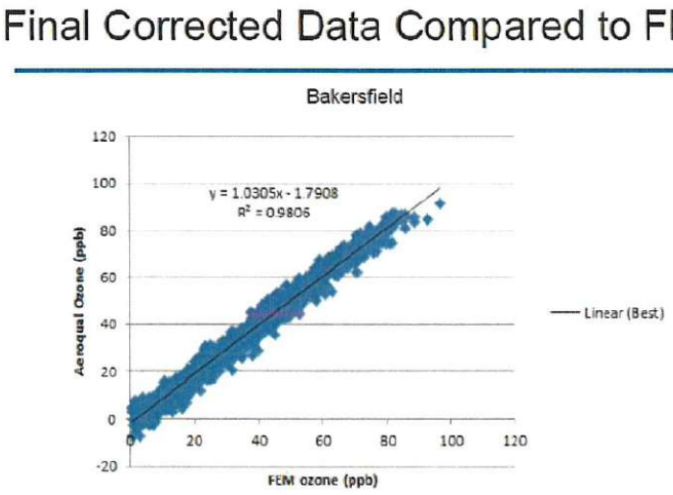
The Aeroqual's Series 500 portable ozone monitors were chosen by an air quality consultancy based in California, USA to better understand the spatial and temporal distribution of ozone in an area.

Twenty three monitors were co-located next to a federal reference method (FEM) monitoring stations to check their precision and accuracy before being distributed across an area of about 100 square miles. The monitors collected and transmitted ozone concentrations every minute for six weeks. Afterwards the monitors were co-located with reference monitoring stations to quantify drift. The data was analyzed and a report was produced.

Co-location of the Series 500 monitors established accuracy to within +/- 3 ppb of the federal reference monitors. See example in figure below.
The study demonstrated that there are strong spatial gradients in ozone over short distances even in rural areas. In addition, the new site at Di Giorgio actually measures higher concentrations than the old Bear Mountain site, and therefore is a good replacement site. In addition, it was determined that the new site was representative of concentrations experienced in the city of Arvin and is therefore useful for real-time warnings regarding poor air quality for citizens in Arvin.
The results of this study provide important supporting evidence for the District's formal attainment request to EPA. In addition the study provides a strong scientific foundation for future decision making about managing the air resources of the San Joaquin Valley.

The final report can be found at:
http://www.valleyair.org/Air_Quality_Plans/docs/2013Attainment/OzoneSaturationStudy.pdf.

Data is courtesy of STI, 2013.



F. Raw Data

(i) Carbon Monoxide (CO)

CO DATA

Location 1		Location 2		Location 3	
Date Time	co	Date Time	co	Date Time	co
19/11/2019 14:02	1193.969	18/11/2019 11:03	771.719	18/11/2019 12:00	798.347
19/11/2019 14:17	1011.286	18/11/2019 11:18	1055.018	18/11/2019 12:15	931.838
19/11/2019 14:32	1177.881	18/11/2019 11:33	1001.517	18/11/2019 12:30	967.563
19/11/2019 14:47	984.096	18/11/2019 11:48	1035.404	18/11/2019 12:45	948.470
19/11/2019 15:02	964.089	18/11/2019 12:03	993.676	18/11/2019 13:00	931.897
19/11/2019 15:17	1051.646	18/11/2019 12:18	865.873	18/11/2019 13:15	1078.579
19/11/2019 15:32	1183.167	18/11/2019 12:33	876.458	18/11/2019 13:30	784.215
19/11/2019 15:47	1090.868	18/11/2019 12:48	1076.929	18/11/2019 13:45	906.671
19/11/2019 16:02	1128.471	18/11/2019 13:03	861.885	18/11/2019 14:00	971.731
19/11/2019 16:17	1086.551	18/11/2019 13:18	1066.988	18/11/2019 14:15	904.896
19/11/2019 16:32	999.149	18/11/2019 13:33	814.611	18/11/2019 14:30	869.599
19/11/2019 16:47	1036.888	18/11/2019 13:48	897.662	18/11/2019 14:45	889.068
19/11/2019 17:02	1290.627	18/11/2019 14:03	876.582	18/11/2019 15:00	974.75
19/11/2019 17:17	1146.658	18/11/2019 14:18	996.578	18/11/2019 15:15	770.831
19/11/2019 17:32	1143.488	18/11/2019 14:33	881.462	18/11/2019 15:30	879.162
19/11/2019 17:47	998.056	18/11/2019 14:48	895.032	18/11/2019 15:45	1050.22
19/11/2019 18:02	1298.117	18/11/2019 15:03	933.911	18/11/2019 16:00	980.74
19/11/2019 18:17	970.509	18/11/2019 15:18	843.013	18/11/2019 16:15	1012.988
19/11/2019 18:32	1271.843	18/11/2019 15:33	922.963	18/11/2019 16:30	756.677
19/11/2019 18:47	1127.803	18/11/2019 15:48	978.051	18/11/2019 16:45	1024.427
19/11/2019 19:02	1029.045	18/11/2019 16:03	757.474	18/11/2019 17:00	901.454
19/11/2019 19:17	1161.769	18/11/2019 16:18	682.524	18/11/2019 17:15	803.397
19/11/2019 19:32	1138.443	18/11/2019 16:33	803.328	18/11/2019 17:30	875.273
19/11/2019 19:47	993.690	18/11/2019 16:48	652.516	18/11/2019 17:45	937.396
19/11/2019 20:02	1046.656	18/11/2019 17:03	699.074	18/11/2019 18:00	708.791
19/11/2019 20:17	1173.758	18/11/2019 17:18	709.446	18/11/2019 18:15	706.003
19/11/2019 20:32	883.585	18/11/2019 17:33	652.613	18/11/2019 18:30	934.92
19/11/2019 20:47	863.017	18/11/2019 17:48	881.271	18/11/2019 18:45	940.252
19/11/2019 21:02	1110.341	18/11/2019 18:03	817.335	18/11/2019 19:00	954.513
19/11/2019 21:17	1154.465	18/11/2019 18:18	971.87	18/11/2019 19:15	856.759
19/11/2019 21:32	1184.180	18/11/2019 18:33	907.877	18/11/2019 19:30	850.821
19/11/2019 21:47	793.824	18/11/2019 18:48	550.236	18/11/2019 19:45	632.505
19/11/2019 22:02	803.483	18/11/2019 19:03	555.341	18/11/2019 20:00	617.243
19/11/2019 22:17	762.370	18/11/2019 19:18	681.709	18/11/2019 20:15	710.314
19/11/2019 22:32	976.934	18/11/2019 19:33	605.463	18/11/2019 20:30	700.795
19/11/2019 22:47	930.556	18/11/2019 19:48	553.848	18/11/2019 20:45	587.725
19/11/2019 23:02	779.293	18/11/2019 20:03	768.604	18/11/2019 21:00	660.239
19/11/2019 23:17	979.027	18/11/2019 20:18	773.891	18/11/2019 21:15	659.865
19/11/2019 23:32	923.765	18/11/2019 20:33	761.856	18/11/2019 21:30	667.184
19/11/2019 23:47	897.938	18/11/2019 20:48	782.597	18/11/2019 21:45	705.421
20/11/2019 00:02	878.816	18/11/2019 21:03	613.15	18/11/2019 22:00	738.563
20/11/2019 00:17	984.342	18/11/2019 21:18	663.187	18/11/2019 22:15	716.893
20/11/2019 00:32	990.775	18/11/2019 21:33	765.126	18/11/2019 22:30	718.558
20/11/2019 00:47	883.623	18/11/2019 21:48	580.428	18/11/2019 22:45	701.998

20/11/2019 01:02	905.928	18/11/2019 22:03	740.544	18/11/2019 23:00	783.743
20/11/2019 01:17	837.416	18/11/2019 22:18	649.242	18/11/2019 23:15	771.437
20/11/2019 01:32	919.834	18/11/2019 22:33	684.17	18/11/2019 23:30	657.359
20/11/2019 01:47	947.753	18/11/2019 22:48	637.823	18/11/2019 23:45	728.179
20/11/2019 02:02	916.287	18/11/2019 23:03	779.159	19/11/2019 00:00	629.3
20/11/2019 02:17	790.619	18/11/2019 23:18	628.102	19/11/2019 00:15	681.939
20/11/2019 02:32	940.271	18/11/2019 23:33	734.658	19/11/2019 00:30	681.551
20/11/2019 02:47	821.241	18/11/2019 23:48	759.622	19/11/2019 00:45	727.126
20/11/2019 03:02	771.837	19/11/2019 00:03	691.079	19/11/2019 01:00	591.457
20/11/2019 03:17	921.399	19/11/2019 00:18	578.854	19/11/2019 01:15	643.717
20/11/2019 03:32	780.115	19/11/2019 00:33	670.998	19/11/2019 01:30	705.864
20/11/2019 03:47	866.319	19/11/2019 00:48	713.274	19/11/2019 01:45	769.304
20/11/2019 04:02	970.391	19/11/2019 01:03	732.351	19/11/2019 02:00	736.509
20/11/2019 04:17	862.000	19/11/2019 01:18	667.683	19/11/2019 02:15	615.875
20/11/2019 04:32	870.889	19/11/2019 01:33	592.667	19/11/2019 02:30	631.192
20/11/2019 04:47	821.970	19/11/2019 01:48	657.676	19/11/2019 02:45	596.771
20/11/2019 05:02	967.901	19/11/2019 02:03	739.342	19/11/2019 03:00	614.958
20/11/2019 05:17	889.940	19/11/2019 02:18	768.441	19/11/2019 03:15	714.178
20/11/2019 05:32	967.726	19/11/2019 02:33	743.769	19/11/2019 03:30	718.96
20/11/2019 05:47	1010.963	19/11/2019 02:48	859.997	19/11/2019 03:45	669.951
20/11/2019 06:02	941.768	19/11/2019 03:03	700.179	19/11/2019 04:00	876.868
20/11/2019 06:17	913.590	19/11/2019 03:18	845.421	19/11/2019 04:15	808.238
20/11/2019 06:32	991.225	19/11/2019 03:33	992.422	19/11/2019 04:30	757.504
20/11/2019 06:47	1260.179	19/11/2019 03:48	910.721	19/11/2019 04:45	1003.012
20/11/2019 07:02	1221.968	19/11/2019 04:03	772.497	19/11/2019 05:00	943.672
20/11/2019 07:17	964.211	19/11/2019 04:18	844.799	19/11/2019 05:15	910.693
20/11/2019 07:32	1108.312	19/11/2019 04:33	807.425	19/11/2019 05:30	852.441
20/11/2019 07:47	1178.706	19/11/2019 04:48	941.5	19/11/2019 05:45	949.447
20/11/2019 08:02	1054.984	19/11/2019 05:03	788.19	19/11/2019 06:00	997.091
20/11/2019 08:17	986.161	19/11/2019 05:18	783.925	19/11/2019 06:15	1067.081
20/11/2019 08:32	1103.416	19/11/2019 05:33	1012.334	19/11/2019 06:30	945.623
20/11/2019 08:47	1007.530	19/11/2019 05:48	753.926	19/11/2019 06:45	789.83
20/11/2019 09:02	1232.147	19/11/2019 06:03	997.448	19/11/2019 07:00	1029.806
20/11/2019 09:17	998.805	19/11/2019 06:18	787.199	19/11/2019 07:15	1093.242
20/11/2019 09:32	1215.915	19/11/2019 06:33	1031.176	19/11/2019 07:30	883.298
20/11/2019 09:47	946.786	19/11/2019 06:48	724.567	19/11/2019 07:45	856.262
20/11/2019 10:02	1039.950	19/11/2019 07:03	715.046	19/11/2019 08:00	770.138
20/11/2019 10:17	1102.295	19/11/2019 07:18	883.455	19/11/2019 08:15	968.057
20/11/2019 10:32	883.333	19/11/2019 07:33	992.854	19/11/2019 08:30	666.992
20/11/2019 10:47	898.439	19/11/2019 07:48	780.74	19/11/2019 08:45	753.773
20/11/2019 11:02	1041.920	19/11/2019 08:03	812.975	19/11/2019 09:00	907.553
20/11/2019 11:17	996.233	19/11/2019 08:18	681.722	19/11/2019 09:15	928.226
20/11/2019 11:32	1182.433	19/11/2019 08:33	880.273	19/11/2019 09:30	926.626
20/11/2019 11:47	1136.696	19/11/2019 08:48	853.014	19/11/2019 09:45	930.563
20/11/2019 12:02	958.059	19/11/2019 09:03	957.25	19/11/2019 10:00	821.65
20/11/2019 12:17	990.221	19/11/2019 09:18	986.483	19/11/2019 10:15	865.444
20/11/2019 12:32	952.900	19/11/2019 09:33	760.027	19/11/2019 10:30	786.423

20/11/2019 12:47	1145.730	19/11/2019 09:48	991.366	19/11/2019 10:45	825.474
20/11/2019 13:02	1147.480	19/11/2019 10:03	750.391	19/11/2019 11:00	917.88
20/11/2019 13:17	1075.358	19/11/2019 10:18	893.902	19/11/2019 11:15	938.305
20/11/2019 13:32	1091.808	19/11/2019 10:33	752.082	19/11/2019 11:30	888.154
20/11/2019 13:47	968.760	19/11/2019 10:48	893.381	19/11/2019 11:45	953.343

CO DATA (Continued)

Location 4		Location 5	
Date Time	co	Date Time	co
18/11/2019 13:02	970.320	19/11/2019 13:01	983.826
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18/11/2019 13:32	940.846	19/11/2019 13:31	1092.007
18/11/2019 13:47	1175.078	19/11/2019 13:46	988.274
18/11/2019 14:02	997.376	19/11/2019 14:01	1098.525
18/11/2019 14:17	1068.311	19/11/2019 14:16	1163.891
18/11/2019 14:32	1053.565	19/11/2019 14:31	1169.751
18/11/2019 14:47	1095.078	19/11/2019 14:46	1271.652
18/11/2019 15:02	999.812	19/11/2019 15:01	964.241
18/11/2019 15:17	1184.28	19/11/2019 15:16	1153.169
18/11/2019 15:32	1141.026	19/11/2019 15:31	1175.683
18/11/2019 15:47	1144.773	19/11/2019 15:46	1181.314
18/11/2019 16:02	965.556	19/11/2019 16:01	1020.34
18/11/2019 16:17	1091.243	19/11/2019 16:16	1240.02
18/11/2019 16:32	1080.562	19/11/2019 16:31	1210.897
18/11/2019 16:47	1154.199	19/11/2019 16:46	1108.757
18/11/2019 17:02	887.735	19/11/2019 17:01	1045.396
18/11/2019 17:17	1087.25	19/11/2019 17:16	1161.381
18/11/2019 17:32	1154.689	19/11/2019 17:31	983.652
18/11/2019 17:47	952.407	19/11/2019 17:46	972.112
18/11/2019 18:02	841.699	19/11/2019 18:01	987.529
18/11/2019 18:17	785.99	19/11/2019 18:16	1158.578
18/11/2019 18:32	975.594	19/11/2019 18:31	1083.732
18/11/2019 18:47	1034.714	19/11/2019 18:46	1166.086
18/11/2019 19:02	938.577	19/11/2019 19:01	904.065
18/11/2019 19:17	1060.138	19/11/2019 19:16	948.684
18/11/2019 19:32	926.075	19/11/2019 19:31	1159.524
18/11/2019 19:47	903.262	19/11/2019 19:46	1017.607
18/11/2019 20:02	833.091	19/11/2019 20:01	987.318
18/11/2019 20:17	1046.346	19/11/2019 20:16	953.702
18/11/2019 20:32	1083.767	19/11/2019 20:31	1116.47
18/11/2019 20:47	857.459	19/11/2019 20:46	973.225
18/11/2019 21:02	850.066	19/11/2019 21:01	973.22
18/11/2019 21:17	841.276	19/11/2019 21:16	852.492
18/11/2019 21:32	855.047	19/11/2019 21:31	941.806
18/11/2019 21:47	679.624	19/11/2019 21:46	803.154
18/11/2019 22:02	700.866	19/11/2019 22:01	973.961
18/11/2019 22:17	845.341	19/11/2019 22:16	800.736
18/11/2019 22:32	836.06	19/11/2019 22:31	893.82
18/11/2019 22:47	704.562	19/11/2019 22:46	884.769
18/11/2019 23:02	657.775	19/11/2019 23:01	799.242
18/11/2019 23:17	835.751	19/11/2019 23:16	805.13
18/11/2019 23:32	749.109	19/11/2019 23:31	812.713
18/11/2019 23:47	752.101	19/11/2019 23:46	958.185

19/11/2019 00:02	695.198	20/11/2019 00:01	876.354
19/11/2019 00:17	739.487	20/11/2019 00:16	880.033
19/11/2019 00:32	829.273	20/11/2019 00:31	827.733
19/11/2019 00:47	862.472	20/11/2019 00:46	948.467
19/11/2019 01:02	724.418	20/11/2019 01:01	807.805
19/11/2019 01:17	745.95	20/11/2019 01:16	757.526
19/11/2019 01:32	735.38	20/11/2019 01:31	780.878
19/11/2019 01:47	693.477	20/11/2019 01:46	862.428
19/11/2019 02:02	709.386	20/11/2019 02:01	996.873
19/11/2019 02:17	879.237	20/11/2019 02:16	960.602
19/11/2019 02:32	875.113	20/11/2019 02:31	943.092
19/11/2019 02:47	747.102	20/11/2019 02:46	786.931
19/11/2019 03:02	769.204	20/11/2019 03:01	769.788
19/11/2019 03:17	713.183	20/11/2019 03:16	955.791
19/11/2019 03:32	887.378	20/11/2019 03:31	890.195
19/11/2019 03:47	746.486	20/11/2019 03:46	894.128
19/11/2019 04:02	706.658	20/11/2019 04:01	822.92
19/11/2019 04:17	786.664	20/11/2019 04:16	963.299
19/11/2019 04:32	753.323	20/11/2019 04:31	934.792
19/11/2019 04:47	839.579	20/11/2019 04:46	898.497
19/11/2019 05:02	876.303	20/11/2019 05:01	863.467
19/11/2019 05:17	939.292	20/11/2019 05:16	921.531
19/11/2019 05:32	1028.918	20/11/2019 05:31	995.944
19/11/2019 05:47	1186.506	20/11/2019 05:46	1131.043
19/11/2019 06:02	1030.31	20/11/2019 06:01	1133.793
19/11/2019 06:17	1010.613	20/11/2019 06:16	1259.432
19/11/2019 06:32	1088.936	20/11/2019 06:31	1178.465
19/11/2019 06:47	919.297	20/11/2019 06:46	1219.682
19/11/2019 07:02	1146.166	20/11/2019 07:01	1205.16
19/11/2019 07:17	860.522	20/11/2019 07:16	1182.02
19/11/2019 07:32	895.97	20/11/2019 07:31	968.699
19/11/2019 07:47	879.75	20/11/2019 07:46	1243.548
19/11/2019 08:02	897.1	20/11/2019 08:01	1281.318
19/11/2019 08:17	951.511	20/11/2019 08:16	1256.636
19/11/2019 08:32	1191.8	20/11/2019 08:31	1073.499
19/11/2019 08:47	786.217	20/11/2019 08:46	889.912
19/11/2019 09:02	753.951	20/11/2019 09:01	1144.485
19/11/2019 09:17	1019.401	20/11/2019 09:16	1174.471
19/11/2019 09:32	803.224	20/11/2019 09:31	1031.972
19/11/2019 09:47	1058.354	20/11/2019 09:46	959.435
19/11/2019 10:02	822.668	20/11/2019 10:01	1087.887
19/11/2019 10:17	781.648	20/11/2019 10:16	1123.527
19/11/2019 10:32	1073.04	20/11/2019 10:31	950.483
19/11/2019 10:47	1075.029	20/11/2019 10:46	1150.55
19/11/2019 11:02	866.282	20/11/2019 11:01	966.431
19/11/2019 11:17	1030.794	20/11/2019 11:16	1104.935
19/11/2019 11:32	984.771	20/11/2019 11:31	1096.061

19/11/2019 11:47	1062.478	20/11/2019 11:46	970.691
19/11/2019 12:02	892.098	20/11/2019 12:01	1018.284
19/11/2019 12:17	964.618	20/11/2019 12:16	1126.44
19/11/2019 12:32	859.091	20/11/2019 12:31	1186.113
19/11/2019 12:47	1032.796	20/11/2019 12:46	1115.078

(ii) Volatile Organic Compounds (VOCs)

VOC DATA

Location 1		Location 2		Location 3	
Date/Time		Date/Time		Date/Time	
Tue Nov 19 2019 14:01:00	0.0	Mon Nov 18 2019 11:01:00	2.0	Mon Nov 18 2019 12:00:00	0.0
Tue Nov 19 2019 14:31:00	0.0	Mon Nov 18 2019 11:31:00	1.0	Mon Nov 18 2019 12:30:00	0.0
Tue Nov 19 2019 15:01:00	0.0	Mon Nov 18 2019 12:01:00	2.0	Mon Nov 18 2019 13:00:00	1.0
Tue Nov 19 2019 15:31:00	0.0	Mon Nov 18 2019 12:31:00	2.0	Mon Nov 18 2019 13:30:00	1.0
Tue Nov 19 2019 16:01:00	0.0	Mon Nov 18 2019 13:01:00	2.0	Mon Nov 18 2019 14:00:00	1.0
Tue Nov 19 2019 16:31:00	0.0	Mon Nov 18 2019 13:31:00	1.0	Mon Nov 18 2019 14:30:00	2.0
Tue Nov 19 2019 17:01:00	0.0	Mon Nov 18 2019 14:01:00	0.0	Mon Nov 18 2019 15:00:00	2.0
Tue Nov 19 2019 17:31:00	0.0	Mon Nov 18 2019 14:31:00	0.0	Mon Nov 18 2019 15:30:00	0.0
Tue Nov 19 2019 18:01:00	1.0	Mon Nov 18 2019 15:01:00	2.0	Mon Nov 18 2019 16:00:00	0.0
Tue Nov 19 2019 18:31:00	1.0	Mon Nov 18 2019 15:31:00	0.0	Mon Nov 18 2019 16:30:00	2.0
Tue Nov 19 2019 19:01:00	1.0	Mon Nov 18 2019 16:01:00	1.0	Mon Nov 18 2019 17:00:00	1.0
Tue Nov 19 2019 19:31:00	2.0	Mon Nov 18 2019 16:31:00	2.0	Mon Nov 18 2019 17:30:00	0.0
Tue Nov 19 2019 20:01:00	2.0	Mon Nov 18 2019 17:01:00	1.0	Mon Nov 18 2019 18:00:00	2.0
Tue Nov 19 2019 20:31:00	2.0	Mon Nov 18 2019 17:31:00	1.0	Mon Nov 18 2019 18:30:00	1.0
Tue Nov 19 2019 21:01:00	2.0	Mon Nov 18 2019 18:01:00	2.0	Mon Nov 18 2019 19:00:00	2.0
Tue Nov 19 2019 21:31:00	1.0	Mon Nov 18 2019 18:31:00	0.0	Mon Nov 18 2019 19:30:00	0.0
Tue Nov 19 2019 22:01:00	0.0	Mon Nov 18 2019 19:01:00	1.0	Mon Nov 18 2019 20:00:00	0.0
Tue Nov 19 2019 22:31:00	2.0	Mon Nov 18 2019 19:31:00	0.0	Mon Nov 18 2019 20:30:00	0.0
Tue Nov 19 2019 23:01:00	2.0	Mon Nov 18 2019 20:01:00	2.0	Mon Nov 18 2019 21:00:00	0.0
Tue Nov 19 2019 23:31:00	2.0	Mon Nov 18 2019 20:31:00	1.0	Mon Nov 18 2019 21:30:00	0.0
Wed Nov 20 2019 00:01:00	1.0	Mon Nov 18 2019 21:01:00	1.0	Mon Nov 18 2019 22:00:00	0.0
Wed Nov 20 2019 00:31:00	1.0	Mon Nov 18 2019 21:31:00	1.0	Mon Nov 18 2019 22:30:00	0.0
Wed Nov 20 2019 01:01:00	1.0	Mon Nov 18 2019 22:01:00	2.0	Mon Nov 18 2019 23:00:00	0.0
Wed Nov 20 2019 01:31:00	1.0	Mon Nov 18 2019 22:31:00	1.0	Mon Nov 18 2019 23:30:00	0.0
Wed Nov 20 2019 02:01:00	0.0	Mon Nov 18 2019 23:01:00	0.0	Tue Nov 19 2019 00:00:00	0.0
Wed Nov 20 2019 02:31:00	1.0	Mon Nov 18 2019 23:31:00	1.0	Tue Nov 19 2019 00:30:00	0.0
Wed Nov 20 2019 03:01:00	0.0	Tue Nov 19 2019 00:01:00	0.0	Tue Nov 19 2019 01:00:00	1.0
Wed Nov 20 2019 03:31:00	0.0	Tue Nov 19 2019 00:31:00	0.0	Tue Nov 19 2019 01:30:00	0.0
Wed Nov 20 2019 04:01:00	1.0	Tue Nov 19 2019 01:01:00	1.0	Tue Nov 19 2019 02:00:00	1.0
Wed Nov 20 2019 04:31:00	2.0	Tue Nov 19 2019 01:31:00	2.0	Tue Nov 19 2019 02:30:00	0.0
Wed Nov 20 2019 05:01:00	0.0	Tue Nov 19 2019 02:01:00	1.0	Tue Nov 19 2019 03:00:00	1.0
Wed Nov 20 2019 05:31:00	2.0	Tue Nov 19 2019 02:31:00	0.0	Tue Nov 19 2019 03:30:00	0.0
Wed Nov 20 2019 06:01:00	1.0	Tue Nov 19 2019 03:01:00	0.0	Tue Nov 19 2019 04:00:00	2.0
Wed Nov 20 2019 06:31:00	1.0	Tue Nov 19 2019 03:31:00	0.0	Tue Nov 19 2019 04:30:00	2.0
Wed Nov 20 2019 07:01:00	2.0	Tue Nov 19 2019 04:01:00	0.0	Tue Nov 19 2019 05:00:00	0.0
Wed Nov 20 2019 07:31:00	0.0	Tue Nov 19 2019 04:31:00	0.0	Tue Nov 19 2019 05:30:00	2.0
Wed Nov 20 2019 08:01:00	2.0	Tue Nov 19 2019 05:01:00	0.0	Tue Nov 19 2019 06:00:00	2.0
Wed Nov 20 2019 08:31:00	2.0	Tue Nov 19 2019 05:31:00	0.0	Tue Nov 19 2019 06:30:00	1.0
Wed Nov 20 2019 09:01:00	1.0	Tue Nov 19 2019 06:01:00	0.0	Tue Nov 19 2019 07:00:00	1.0
Wed Nov 20 2019 09:31:00	1.0	Tue Nov 19 2019 06:31:00	1.0	Tue Nov 19 2019 07:30:00	0.0
Wed Nov 20 2019 10:01:00	1.0	Tue Nov 19 2019 07:01:00	1.0	Tue Nov 19 2019 08:00:00	0.0
Wed Nov 20 2019 10:31:00	0.0	Tue Nov 19 2019 07:31:00	0.0	Tue Nov 19 2019 08:30:00	0.0
Wed Nov 20 2019 11:01:00	2.0	Tue Nov 19 2019 08:01:00	0.0	Tue Nov 19 2019 09:00:00	0.0
Wed Nov 20 2019 11:31:00	2.0	Tue Nov 19 2019 08:31:00	1.0	Tue Nov 19 2019 09:30:00	0.0

Wed Nov 20 2019 12:01:00	2.0	Tue Nov 19 2019 09:01:00	2.0	Tue Nov 19 2019 10:00:00	0.0
Wed Nov 20 2019 12:31:00	0.0	Tue Nov 19 2019 09:31:00	2.0	Tue Nov 19 2019 10:30:00	1.0
Wed Nov 20 2019 13:01:00	2.0	Tue Nov 19 2019 10:01:00	0.0	Tue Nov 19 2019 11:00:00	2.0
Wed Nov 20 2019 13:31:00	1.0	Tue Nov 19 2019 10:31:00	2.0	Tue Nov 19 2019 11:30:00	0.0

VOC DATA

Location 4		Location 5	
Date/Time		Date/Time	
Mon Nov 18 2019 13:01:00	0.0	Tue Nov 19 2019 13:03:00	2.0
Mon Nov 18 2019 13:31:00	1.0	Tue Nov 19 2019 13:33:00	0.0
Mon Nov 18 2019 14:01:00	2.0	Tue Nov 19 2019 14:03:00	2.0
Mon Nov 18 2019 14:31:00	2.0	Tue Nov 19 2019 14:33:00	0.0
Mon Nov 18 2019 15:01:00	2.0	Tue Nov 19 2019 15:03:00	0.0
Mon Nov 18 2019 15:31:00	1.0	Tue Nov 19 2019 15:33:00	1.0
Mon Nov 18 2019 16:01:00	1.0	Tue Nov 19 2019 16:03:00	2.0
Mon Nov 18 2019 16:31:00	0.0	Tue Nov 19 2019 16:33:00	1.0
Mon Nov 18 2019 17:01:00	0.0	Tue Nov 19 2019 17:03:00	0.0
Mon Nov 18 2019 17:31:00	1.0	Tue Nov 19 2019 17:33:00	1.0
Mon Nov 18 2019 18:01:00	1.0	Tue Nov 19 2019 18:03:00	2.0
Mon Nov 18 2019 18:31:00	1.0	Tue Nov 19 2019 18:33:00	1.0
Mon Nov 18 2019 19:01:00	2.0	Tue Nov 19 2019 19:03:00	1.0
Mon Nov 18 2019 19:31:00	0.0	Tue Nov 19 2019 19:33:00	2.0
Mon Nov 18 2019 20:01:00	1.0	Tue Nov 19 2019 20:03:00	2.0
Mon Nov 18 2019 20:31:00	0.0	Tue Nov 19 2019 20:33:00	2.0
Mon Nov 18 2019 21:01:00	0.0	Tue Nov 19 2019 21:03:00	0.0
Mon Nov 18 2019 21:31:00	0.0	Tue Nov 19 2019 21:33:00	0.0
Mon Nov 18 2019 22:01:00	0.0	Tue Nov 19 2019 22:03:00	1.0
Mon Nov 18 2019 22:31:00	0.0	Tue Nov 19 2019 22:33:00	1.0
Mon Nov 18 2019 23:01:00	0.0	Tue Nov 19 2019 23:03:00	2.0
Mon Nov 18 2019 23:31:00	0.0	Tue Nov 19 2019 23:33:00	2.0
Tue Nov 19 2019 00:01:00	0.0	Wed Nov 20 2019 00:03:00	2.0
Tue Nov 19 2019 00:31:00	0.0	Wed Nov 20 2019 00:33:00	1.0
Tue Nov 19 2019 01:01:00	0.0	Wed Nov 20 2019 01:03:00	0.0
Tue Nov 19 2019 01:31:00	1.0	Wed Nov 20 2019 01:33:00	1.0
Tue Nov 19 2019 02:01:00	2.0	Wed Nov 20 2019 02:03:00	1.0
Tue Nov 19 2019 02:31:00	0.0	Wed Nov 20 2019 02:33:00	0.0
Tue Nov 19 2019 03:01:00	2.0	Wed Nov 20 2019 03:03:00	0.0
Tue Nov 19 2019 03:31:00	2.0	Wed Nov 20 2019 03:33:00	0.0
Tue Nov 19 2019 04:01:00	0.0	Wed Nov 20 2019 04:03:00	0.0
Tue Nov 19 2019 04:31:00	2.0	Wed Nov 20 2019 04:33:00	0.0
Tue Nov 19 2019 05:01:00	0.0	Wed Nov 20 2019 05:03:00	0.0
Tue Nov 19 2019 05:31:00	0.0	Wed Nov 20 2019 05:33:00	1.0
Tue Nov 19 2019 06:01:00	2.0	Wed Nov 20 2019 06:03:00	2.0
Tue Nov 19 2019 06:31:00	1.0	Wed Nov 20 2019 06:33:00	2.0
Tue Nov 19 2019 07:01:00	1.0	Wed Nov 20 2019 07:03:00	0.0
Tue Nov 19 2019 07:31:00	2.0	Wed Nov 20 2019 07:33:00	2.0
Tue Nov 19 2019 08:01:00	0.0	Wed Nov 20 2019 08:03:00	2.0
Tue Nov 19 2019 08:31:00	0.0	Wed Nov 20 2019 08:33:00	0.0
Tue Nov 19 2019 09:01:00	2.0	Wed Nov 20 2019 09:03:00	0.0
Tue Nov 19 2019 09:31:00	1.0	Wed Nov 20 2019 09:33:00	0.0
Tue Nov 19 2019 10:01:00	0.0	Wed Nov 20 2019 10:03:00	0.0
Tue Nov 19 2019 10:31:00	2.0	Wed Nov 20 2019 10:33:00	0.0

Tue Nov 19 2019 11:01:00	1.0	Wed Nov 20 2019 11:03:00	2.0
Tue Nov 19 2019 11:31:00	0.0	Wed Nov 20 2019 11:33:00	2.0
Tue Nov 19 2019 12:01:00	0.0	Wed Nov 20 2019 12:03:00	2.0
Tue Nov 19 2019 12:31:00	0.0	Wed Nov 20 2019 12:33:00	0.0

(iii) Ozone (O_3)

O3 DATA

Location 1		Location 2		Location 3	
Date Time	O3 (µg/m³)	Date Time	O3 (µg/m³)	Date Time	O3 (µg/m³)
19/11/2019 14:00	39.886	18/11/2019 11:01	36.772	18/11/2019 12:01	36.371
19/11/2019 14:15	42.602	18/11/2019 11:16	33.263	18/11/2019 12:16	31.161
19/11/2019 14:30	53.526	18/11/2019 11:31	38.485	18/11/2019 12:31	36.971
19/11/2019 14:45	49.871	18/11/2019 11:46	31.742	18/11/2019 12:46	32.532
19/11/2019 15:00	48.13	18/11/2019 12:01	30.765	18/11/2019 13:01	36.826
19/11/2019 15:15	36.566	18/11/2019 12:16	32.585	18/11/2019 13:16	39.486
19/11/2019 15:30	53.92	18/11/2019 12:31	32.292	18/11/2019 13:31	30.48
19/11/2019 15:45	49.876	18/11/2019 12:46	35.632	18/11/2019 13:46	33.247
19/11/2019 16:00	54.721	18/11/2019 13:01	31.286	18/11/2019 14:01	38.688
19/11/2019 16:15	46.087	18/11/2019 13:16	36.945	18/11/2019 14:16	31.063
19/11/2019 16:30	53.775	18/11/2019 13:31	38.806	18/11/2019 14:31	38.567
19/11/2019 16:45	53.804	18/11/2019 13:46	39.107	18/11/2019 14:46	32.345
19/11/2019 17:00	44.658	18/11/2019 14:01	37.654	18/11/2019 15:01	36.489
19/11/2019 17:15	46.601	18/11/2019 14:16	32.368	18/11/2019 15:16	37.333
19/11/2019 17:30	44.801	18/11/2019 14:31	36.014	18/11/2019 15:31	39.155
19/11/2019 17:45	40.667	18/11/2019 14:46	31.943	18/11/2019 15:46	31.187
19/11/2019 18:00	53.966	18/11/2019 15:01	39.014	18/11/2019 16:01	38.912
19/11/2019 18:15	36.301	18/11/2019 15:16	35.702	18/11/2019 16:16	33.408
19/11/2019 18:30	36.707	18/11/2019 15:31	35.524	18/11/2019 16:31	39.244
19/11/2019 18:45	47.102	18/11/2019 15:46	39.635	18/11/2019 16:46	36.276
19/11/2019 19:00	47.205	18/11/2019 16:01	33.804	18/11/2019 17:01	39.73
19/11/2019 19:15	39.483	18/11/2019 16:16	33.59	18/11/2019 17:16	39.169
19/11/2019 19:30	47.566	18/11/2019 16:31	31.126	18/11/2019 17:31	31.741
19/11/2019 19:45	50.827	18/11/2019 16:46	36.074	18/11/2019 17:46	30.053
19/11/2019 20:00	43.289	18/11/2019 17:01	38.901	18/11/2019 18:01	30.463
19/11/2019 20:15	41.979	18/11/2019 17:16	34.748	18/11/2019 18:16	34.828
19/11/2019 20:30	54.711	18/11/2019 17:31	32.947	18/11/2019 18:31	37.52
19/11/2019 20:45	44.692	18/11/2019 17:46	36.842	18/11/2019 18:46	32.936
19/11/2019 21:00	38.563	18/11/2019 18:01	36.226	18/11/2019 19:01	32.205
19/11/2019 21:15	53.177	18/11/2019 18:16	34.11	18/11/2019 19:16	39.222
19/11/2019 21:30	53.665	18/11/2019 18:31	32.937	18/11/2019 19:31	33.56
19/11/2019 21:45	46.449	18/11/2019 18:46	35.923	18/11/2019 19:46	33.151
19/11/2019 22:00	46.138	18/11/2019 19:01	34.804	18/11/2019 20:01	33.628
19/11/2019 22:15	39.476	18/11/2019 19:16	38.808	18/11/2019 20:16	31.57
19/11/2019 22:30	42.276	18/11/2019 19:31	25.06	18/11/2019 20:31	33.568
19/11/2019 22:45	42.906	18/11/2019 19:46	31.055	18/11/2019 20:46	31.072
19/11/2019 23:00	39.791	18/11/2019 20:01	31.575	18/11/2019 21:01	33.054
19/11/2019 23:15	31.681	18/11/2019 20:16	31.013	18/11/2019 21:16	21.475
19/11/2019 23:30	31.332	18/11/2019 20:31	30.357	18/11/2019 21:31	20.546
19/11/2019 23:45	32.585	18/11/2019 20:46	30.669	18/11/2019 21:46	22.264
20/11/2019 00:00	38.153	18/11/2019 21:01	30.376	18/11/2019 22:01	21.161
20/11/2019 00:15	32.56	18/11/2019 21:16	27.227	18/11/2019 22:16	20.878
20/11/2019 00:30	34.572	18/11/2019 21:31	22.828	18/11/2019 22:31	26.878
20/11/2019 00:45	32.124	18/11/2019 21:46	28.037	18/11/2019 22:46	31.685

20/11/2019 01:00	38.307	18/11/2019 22:01	32.077	18/11/2019 23:01	27.313
20/11/2019 01:15	35.976	18/11/2019 22:16	33.742	18/11/2019 23:16	20.304
20/11/2019 01:30	31.029	18/11/2019 22:31	28.565	18/11/2019 23:31	20.687
20/11/2019 01:45	34.586	18/11/2019 22:46	24.572	18/11/2019 23:46	32.039
20/11/2019 02:00	38.753	18/11/2019 23:01	25.698	19/11/2019 00:01	22.786
20/11/2019 02:15	34.392	18/11/2019 23:16	26.285	19/11/2019 00:16	20.862
20/11/2019 02:30	31.458	18/11/2019 23:31	22.1	19/11/2019 00:31	25.315
20/11/2019 02:45	39.97	18/11/2019 23:46	21.563	19/11/2019 00:46	21.861
20/11/2019 03:00	37.897	19/11/2019 00:01	34.937	19/11/2019 01:01	33.158
20/11/2019 03:15	32.066	19/11/2019 00:16	29.263	19/11/2019 01:16	30.221
20/11/2019 03:30	35.888	19/11/2019 00:31	24.804	19/11/2019 01:31	33.363
20/11/2019 03:45	38.5	19/11/2019 00:46	31.428	19/11/2019 01:46	26.694
20/11/2019 04:00	37.335	19/11/2019 01:01	26.108	19/11/2019 02:01	32.786
20/11/2019 04:15	39.409	19/11/2019 01:16	27.895	19/11/2019 02:16	29.688
20/11/2019 04:30	37.931	19/11/2019 01:31	34.077	19/11/2019 02:31	26.82
20/11/2019 04:45	38.607	19/11/2019 01:46	34.224	19/11/2019 02:46	20.605
20/11/2019 05:00	31.106	19/11/2019 02:01	32.884	19/11/2019 03:01	28.15
20/11/2019 05:15	30.208	19/11/2019 02:16	28.297	19/11/2019 03:16	34.214
20/11/2019 05:30	33.943	19/11/2019 02:31	30.12	19/11/2019 03:31	24.621
20/11/2019 05:45	36.421	19/11/2019 02:46	25.841	19/11/2019 03:46	30.259
20/11/2019 06:00	33.187	19/11/2019 03:01	32.947	19/11/2019 04:01	23.724
20/11/2019 06:15	38.08	19/11/2019 03:16	26.806	19/11/2019 04:16	30.819
20/11/2019 06:30	38.136	19/11/2019 03:31	23.407	19/11/2019 04:31	33.69
20/11/2019 06:45	33.085	19/11/2019 03:46	21.296	19/11/2019 04:46	33.001
20/11/2019 07:00	34.023	19/11/2019 04:01	31.048	19/11/2019 05:01	27.176
20/11/2019 07:15	37.575	19/11/2019 04:16	32.039	19/11/2019 05:16	21.768
20/11/2019 07:30	37.771	19/11/2019 04:31	30.715	19/11/2019 05:31	34.872
20/11/2019 07:45	34.53	19/11/2019 04:46	25.444	19/11/2019 05:46	24.884
20/11/2019 08:00	34.659	19/11/2019 05:01	20.8	19/11/2019 06:01	25.151
20/11/2019 08:15	36.591	19/11/2019 05:16	26.577	19/11/2019 06:16	33.543
20/11/2019 08:30	34.913	19/11/2019 05:31	28.541	19/11/2019 06:31	25.884
20/11/2019 08:45	31.499	19/11/2019 05:46	26.711	19/11/2019 06:46	28.674
20/11/2019 09:00	34.544	19/11/2019 06:01	28.535	19/11/2019 07:01	33.826
20/11/2019 09:15	47.47	19/11/2019 06:16	28.539	19/11/2019 07:16	27.432
20/11/2019 09:30	55.203	19/11/2019 06:31	27.097	19/11/2019 07:31	28.033
20/11/2019 09:45	46.834	19/11/2019 06:46	36.585	19/11/2019 07:46	33.615
20/11/2019 10:00	55.921	19/11/2019 07:01	28.922	19/11/2019 08:01	31.957
20/11/2019 10:15	52.76	19/11/2019 07:16	39.929	19/11/2019 08:16	31.999
20/11/2019 10:30	48.607	19/11/2019 07:31	39.684	19/11/2019 08:31	25.29
20/11/2019 10:45	50.563	19/11/2019 07:46	34.966	19/11/2019 08:46	34.066
20/11/2019 11:00	47.172	19/11/2019 08:01	28.864	19/11/2019 09:01	35.429
20/11/2019 11:15	50.272	19/11/2019 08:16	26.595	19/11/2019 09:16	38.966
20/11/2019 11:30	54.988	19/11/2019 08:31	27.521	19/11/2019 09:31	38.743
20/11/2019 11:45	39.68	19/11/2019 08:46	29.144	19/11/2019 09:46	30.51
20/11/2019 12:00	46.917	19/11/2019 09:01	38.871	19/11/2019 10:01	27.292
20/11/2019 12:15	38.372	19/11/2019 09:16	35.218	19/11/2019 10:16	32.546
20/11/2019 12:30	46.001	19/11/2019 09:31	38.983	19/11/2019 10:31	37.862

20/11/2019 12:45	52.848	19/11/2019 09:46	30.586	19/11/2019 10:46	28.67
20/11/2019 13:00	43.868	19/11/2019 10:01	29.55	19/11/2019 11:01	36.058
20/11/2019 13:15	38.928	19/11/2019 10:16	37.072	19/11/2019 11:16	39.221
20/11/2019 13:30	53.075	19/11/2019 10:31	39.738	19/11/2019 11:31	32.234
20/11/2019 13:45	53.9	19/11/2019 10:46	37.283	19/11/2019 11:46	34.075

O3 DATA

Location 4		Location 5	
Date Time	O3 (µg/m³)	Date Time	O3 (µg/m³)
18/11/2019 13:03	51.713	19/11/2019 13:02	47.002
18/11/2019 13:18	42.628	19/11/2019 13:17	55.936
18/11/2019 13:33	48.949	19/11/2019 13:32	46.862
18/11/2019 13:48	45.148	19/11/2019 13:47	45.894
18/11/2019 14:03	54.509	19/11/2019 14:02	55.936
18/11/2019 14:18	51.749	19/11/2019 14:17	46.714
18/11/2019 14:33	50.967	19/11/2019 14:32	55.419
18/11/2019 14:48	55.974	19/11/2019 14:47	47.81
18/11/2019 15:03	41.736	19/11/2019 15:02	53.216
18/11/2019 15:18	42.065	19/11/2019 15:17	46.79
18/11/2019 15:33	54.766	19/11/2019 15:32	49.54
18/11/2019 15:48	52.029	19/11/2019 15:47	49.372
18/11/2019 16:03	53.684	19/11/2019 16:02	51.386
18/11/2019 16:18	54.004	19/11/2019 16:17	48.395
18/11/2019 16:33	51.319	19/11/2019 16:32	42.577
18/11/2019 16:48	52.499	19/11/2019 16:47	55.806
18/11/2019 17:03	47.716	19/11/2019 17:02	50.063
18/11/2019 17:18	47.557	19/11/2019 17:17	48.419
18/11/2019 17:33	55.573	19/11/2019 17:32	52.974
18/11/2019 17:48	55.142	19/11/2019 17:47	46.851
18/11/2019 18:03	53.965	19/11/2019 18:02	45.386
18/11/2019 18:18	46.429	19/11/2019 18:17	41.204
18/11/2019 18:33	48.012	19/11/2019 18:32	52.217
18/11/2019 18:48	40.201	19/11/2019 18:47	41.162
18/11/2019 19:03	42.174	19/11/2019 19:02	54.525
18/11/2019 19:18	44.597	19/11/2019 19:17	51.306
18/11/2019 19:33	49.003	19/11/2019 19:32	54.402
18/11/2019 19:48	41.848	19/11/2019 19:47	44.142
18/11/2019 20:03	46.133	19/11/2019 20:02	42.374
18/11/2019 20:18	44.109	19/11/2019 20:17	55.921
18/11/2019 20:33	54.005	19/11/2019 20:32	54.283
18/11/2019 20:48	42.492	19/11/2019 20:47	40.96
18/11/2019 21:03	47.34	19/11/2019 21:02	46.974
18/11/2019 21:18	45.661	19/11/2019 21:17	41.054
18/11/2019 21:33	45.835	19/11/2019 21:32	46.819
18/11/2019 21:48	41.118	19/11/2019 21:47	47.051
18/11/2019 22:03	51.261	19/11/2019 22:02	51.96
18/11/2019 22:18	49.461	19/11/2019 22:17	46.78
18/11/2019 22:33	44.228	19/11/2019 22:32	54.586
18/11/2019 22:48	45.706	19/11/2019 22:47	43.385
18/11/2019 23:03	49.825	19/11/2019 23:02	47.714
18/11/2019 23:18	45.004	19/11/2019 23:17	49.369
18/11/2019 23:33	46.486	19/11/2019 23:32	41.071
18/11/2019 23:48	51.812	19/11/2019 23:47	50.717

19/11/2019 00:03	48.782	20/11/2019 00:02	45.505
19/11/2019 00:18	50.294	20/11/2019 00:17	42.965
19/11/2019 00:33	42.559	20/11/2019 00:32	42.425
19/11/2019 00:48	42.906	20/11/2019 00:47	44.537
19/11/2019 01:03	44.187	20/11/2019 01:02	43.358
19/11/2019 01:18	47.392	20/11/2019 01:17	42.519
19/11/2019 01:33	40.451	20/11/2019 01:32	46.163
19/11/2019 01:48	52.882	20/11/2019 01:47	41.469
19/11/2019 02:03	44.489	20/11/2019 02:02	54.331
19/11/2019 02:18	55.91	20/11/2019 02:17	44.058
19/11/2019 02:33	47.391	20/11/2019 02:32	43.705
19/11/2019 02:48	45.068	20/11/2019 02:47	54.297
19/11/2019 03:03	53.732	20/11/2019 03:02	42.85
19/11/2019 03:18	46.592	20/11/2019 03:17	53.944
19/11/2019 03:33	43.874	20/11/2019 03:32	53.353
19/11/2019 03:48	48.285	20/11/2019 03:47	42.149
19/11/2019 04:03	55.826	20/11/2019 04:02	40.996
19/11/2019 04:18	51.173	20/11/2019 04:17	48.061
19/11/2019 04:33	47.286	20/11/2019 04:32	48.41
19/11/2019 04:48	43.179	20/11/2019 04:47	50.835
19/11/2019 05:03	45.251	20/11/2019 05:02	49.083
19/11/2019 05:18	51.548	20/11/2019 05:17	47.877
19/11/2019 05:33	40.967	20/11/2019 05:32	49.779
19/11/2019 05:48	42.218	20/11/2019 05:47	40.234
19/11/2019 06:03	44.629	20/11/2019 06:02	47.153
19/11/2019 06:18	54.049	20/11/2019 06:17	55.33
19/11/2019 06:33	49.519	20/11/2019 06:32	42.328
19/11/2019 06:48	46.027	20/11/2019 06:47	52.219
19/11/2019 07:03	55.076	20/11/2019 07:02	53.535
19/11/2019 07:18	45.159	20/11/2019 07:17	54.445
19/11/2019 07:33	55.015	20/11/2019 07:32	41.628
19/11/2019 07:48	53.321	20/11/2019 07:47	53.71
19/11/2019 08:03	43.015	20/11/2019 08:02	45.938
19/11/2019 08:18	43.083	20/11/2019 08:17	50.983
19/11/2019 08:33	46.83	20/11/2019 08:32	41.805
19/11/2019 08:48	54.197	20/11/2019 08:47	42.639
19/11/2019 09:03	40.684	20/11/2019 09:02	43.94
19/11/2019 09:18	43.852	20/11/2019 09:17	52.943
19/11/2019 09:33	54.507	20/11/2019 09:32	47.314
19/11/2019 09:48	44.394	20/11/2019 09:47	42.262
19/11/2019 10:03	49.1	20/11/2019 10:02	45.804
19/11/2019 10:18	45.211	20/11/2019 10:17	46.88
19/11/2019 10:33	48.096	20/11/2019 10:32	42.241
19/11/2019 10:48	46.404	20/11/2019 10:47	54.876
19/11/2019 11:03	47.292	20/11/2019 11:02	49.202
19/11/2019 11:18	54.029	20/11/2019 11:17	53.978
19/11/2019 11:33	49.824	20/11/2019 11:32	53.583

19/11/2019 11:48	47.947	20/11/2019 11:47	41.014
19/11/2019 12:03	55.862	20/11/2019 12:02	49.964
19/11/2019 12:18	49.963	20/11/2019 12:17	40.419
19/11/2019 12:33	41.374	20/11/2019 12:32	54.424
19/11/2019 12:48	55.039	20/11/2019 12:47	46.703

(iv) Filter Weights

Location	Date 2019	Parameters	Pre-Weight (g)	Post-Weight (g)
1	November 19th – 20th	$PM_{2.5}$	4.4044	4.4091
		PM_{10}	4.4030	4.4148
		TSP	2.6212	2.6566
2	November 18th – 19th	$PM_{2.5}$	4.4029	4.4078
		PM_{10}	4.3297	4.3556
		TSP	2.5787	2.6121
3	November 18th – 19th	$PM_{2.5}$	4.3827	4.3917
		PM_{10}	4.3622	4.3790
		TSP	2.5979	2.6203
4	November 18th – 19th	$PM_{2.5}$	4.4110	4.4188
		PM_{10}	4.4410	4.4581
		TSP	2.5767	2.6040
5	November 19th – 20th	$PM_{2.5}$	4.3606	4.3715
		PM_{10}	4.4187	4.4294
		TSP	2.5759	2.6112

G. Meteorological Data

(i) Raw Meteorological Data

month	day	year	hour	Temp degC	Precip mm	Pressure mb	RH %	Wdir10m deg	Wspeed10m ms-1
11	18	2019	0	28.8	0	761.2	77.0	22	1.3
11	18	2019	100	28.7	0	761.2	78.0	22	0.9
11	18	2019	200	28.8	0	761.2	76.0	22	1.3
11	18	2019	300	29.4	0	761.1	74.0	22	0.8
11	18	2019	400	29.6	0	761.2	74.0	22	1.6
11	18	2019	500	29.1	0	761.1	74.0	22	1.6
11	18	2019	600	29.1	0	761.1	74.0	22	1.3
11	18	2019	700	29.3	0	761.0	75.0	45	1.3
11	18	2019	800	29.1	0	761.0	75.0	68	1.3
11	18	2019	900	29.8	0	760.8	72.0	45	1.2
11	18	2019	1000	30.3	0	760.8	70.0	22	1.8
11	18	2019	1100	30.4	0	760.7	70.0	22	1.4
11	18	2019	1200	29.9	0	760.7	72.0	339	1.2
11	18	2019	1300	29.8	0	760.5	73.0	45	1.5
11	18	2019	1400	30.1	0	760.5	72.0	45	1.1
11	18	2019	1500	30.5	0	760.5	71.0	22	1.7
11	18	2019	1600	30.8	0	760.5	70.0	45	1.7
11	18	2019	1700	30.8	0	760.5	71.0	22	1.5
11	18	2019	1800	30.4	0	760.4	72.0	22	1.2
11	18	2019	1900	29.9	0	760.3	73.0	22	1.3
11	18	2019	2000	29.6	0	760.3	74.0	45	1.6
11	18	2019	2100	29.3	0	760.3	77.0	68	1.4
11	18	2019	2200	28.3	3	760.3	81.0	68	1.4
11	18	2019	2300	27.3	8	760.5	83.0	88	1.8
11	18	2019	2400	26.5	17	760.7	88.0	113	2.9
11	18	2019	0	25.7	56	760.8	94.0	113	1.6
11	18	2019	100	25.3	84	760.8	94.0	45	1.2
11	18	2019	200	25.1	82	760.6	96.0	68	0.9
11	18	2019	300	25.1	56	760.5	96.0	68	0.8
11	18	2019	400	25.2	22	760.5	96.0	45	0.8
11	18	2019	500	25.5	8	760.3	94.0	45	1.1
11	18	2019	600	25.7	4	760.1	93.0	45	1.2
11	18	2019	700	25.7	3	760.2	94.0	88	1.2
11	18	2019	800	25.7	2	760.0	92.0	88	1.7
11	18	2019	900	26.0	2	760.1	91.0	68	1.2
11	18	2019	1000	26.8	0	760.2	88.0	68	1.2
11	18	2019	1100	26.8	0	760.2	86.0	45	1.3
11	18	2019	1200	27.0	0	760.3	85.0	45	1.4
11	18	2019	1300	27.6	0	760.1	83.0	45	1.2
11	18	2019	1400	28.0	0	760.1	82.0	45	1.3
11	18	2019	1500	27.9	0	760.0	83.0	68	1.6
11	18	2019	1600	27.8	0	760.1	81.0	68	1.6
11	18	2019	1700	28.3	0	760.1	80.0	68	1.0
11	18	2019	1800	29.0	0	760.0	79.0	45	1.3

11	18	2019	1900	29.2	0	760.0	78.0	45	1.2
11	18	2019	2000	29.2	0	759.9	79.0	68	1.0
11	18	2019	2100	28.6	0	760.0	80.0	68	1.0
11	18	2019	2200	28.2	0	760.0	82.0	68	1.2
11	18	2019	2300	28.0	0	760.0	83.0	68	1.1
11	18	2019	2400	27.9	0	760.0	83.0	45	1.0
11	18	2019	0	28.1	0	760.0	82.0	45	0.8
11	18	2019	100	28.2	0	760.0	83.0	45	0.5
11	18	2019	200	28.3	0	760.2	84.0	0	0.6
11	18	2019	300	28.3	0	760.2	84.0	22	0.3
11	18	2019	400	28.7	0	760.0	83.0	202	0.4
11	18	2019	500	28.7	0	760.0	82.0	22	0.5
11	18	2019	600	28.6	0	760.0	82.0	45	0.4
11	18	2019	700	28.5	0	760.0	82.0	22	0.6
11	18	2019	800	28.3	0	760.0	83.0	45	0.5
11	18	2019	900	28.3	0	760.0	83.0	45	0.5
11	18	2019	1000	28.4	0	760.1	84.0	292	0.9
11	18	2019	1100	28.2	0	760.3	85.0	270	0.4
11	18	2019	1200	28.1	0	760.2	85.0	102	0.1
11	18	2019	1300	27.8	0	760.3	85.0	68	0.4
11	18	2019	1400	27.8	0	760.3	86.0	45	0.1
11	18	2019	1500	27.8	0	760.3	87.0	68	0.3
11	18	2019	1600	27.6	0	760.3	87.0	88	0.1
11	18	2019	1700	27.5	0	760.4	88.0	202	0.5
11	18	2019	1800	27.2	0	760.5	89.0	225	0.1
11	18	2019	1900	27.0	0	760.7	89.0	247	0.4
11	18	2019	2000	27.1	0	760.6	90.0	292	0.4
11	18	2019	2100	27.0	0	760.7	90.0	318	0.2
11	18	2019	2200	27.0	0	760.7	89.0	292	0.9
11	18	2019	2300	27.2	0	760.8	87.0	318	0.7
11	18	2019	2400	27.2	0	760.9	88.0	102	0.6
11	18	2019	0	26.8	0	761.0	89.0	102	0.2
11	18	2019	100	26.8	0	761.1	89.0	68	0.9
11	18	2019	200	26.6	0	761.1	89.0	68	0.8
11	18	2019	300	26.6	0	761.2	89.0	45	0.5
11	18	2019	400	26.6	0	761.2	89.0	68	0.2
11	18	2019	500	26.5	0	761.1	90.0	68	0.5
11	18	2019	600	26.3	0	761.1	90.0	22	1.1
11	18	2019	700	26.2	0	761.2	90.0	45	0.8
11	18	2019	800	26.2	0	761.2	90.0	88	0.7
11	18	2019	900	26.2	0	761.3	90.0	45	0.6
11	18	2019	1000	26.2	0	761.4	90.0	88	0.6
11	18	2019	1100	26.1	0	761.4	90.0	102	0.5
11	18	2019	1200	26.1	0	761.4	91.0	88	0.8
11	18	2019	1300	26.0	0	761.5	90.0	88	0.5
11	18	2019	1400	26.0	0	761.5	90.0	45	0.8
11	18	2019	1500	26.0	0	761.5	90.0	88	0.6

11	18	2019	1600	26.0	0	761.5	90.0	88	0.4
11	18	2019	1700	26.0	0	761.5	91.0	88	0.4
11	18	2019	1800	25.8	0	761.5	91.0	68	0.8
11	18	2019	1900	25.8	0	761.5	91.0	68	0.6
11	18	2019	2000	25.8	0	761.4	91.0	68	0.6
11	18	2019	2100	25.8	0	761.6	91.0	68	0.6
11	18	2019	2200	25.7	0	761.5	91.0	88	0.3
11	18	2019	2300	25.7	0	761.5	91.0	88	0.8
11	18	2019	2400	25.7	0	761.5	91.0	88	0.7
11	18	2019	0	25.8	0	761.5	91.0	68	0.4
11	18	2019	100	25.8	0	761.5	91.0	88	0.3
11	18	2019	200	25.7	0	761.5	91.0	102	0.4
11	18	2019	300	25.7	0	761.6	92.0	88	0.3
11	18	2019	400	25.7	0	761.7	91.0	88	0.5
11	18	2019	500	25.7	0	761.8	91.0	88	0.3
11	18	2019	600	25.7	0	761.8	92.0	88	0.6
11	18	2019	700	25.7	0	761.7	92.0	102	0.1
11	18	2019	800	25.7	0	761.7	91.0	88	0.5
11	18	2019	900	25.7	0	761.8	91.0	88	0.5
11	18	2019	1000	25.7	0	761.7	91.0	88	0.6
11	18	2019	1100	25.6	0	761.8	92.0	102	0.2
11	18	2019	1200	25.6	0	761.8	92.0	88	0.6
11	18	2019	1300	25.6	0	761.9	92.0	88	0.4
11	18	2019	1400	25.6	0	761.8	92.0	88	0.1
11	18	2019	1500	25.5	0	761.9	92.0	88	0.6
11	18	2019	1600	25.5	0	762.0	92.0	88	0.7
11	18	2019	1700	25.5	0	762.0	92.0	88	0.8
11	18	2019	1800	25.5	0	762.0	92.0	68	0.5
11	18	2019	1900	25.4	0	762.0	92.0	45	0.9
11	18	2019	2000	25.5	0	762.0	92.0	68	0.7
11	18	2019	2100	25.4	0	762.0	92.0	88	0.5
11	18	2019	2200	25.4	0	762.0	92.0	68	0.6
11	18	2019	2300	25.3	0	762.0	93.0	45	0.9
11	18	2019	2400	25.3	0	762.0	94.0	68	0.5
11	18	2019	0	25.1	0	762.0	94.0	68	0.6
11	18	2019	100	25.1	0	762.0	94.0	68	0.7
11	18	2019	200	25.4	0	762.0	92.0	68	0.6
11	18	2019	300	25.5	0	762.0	92.0	88	0.4
11	18	2019	400	25.4	0	761.9	92.0	68	0.7
11	18	2019	500	25.4	0	762.0	92.0	45	0.6
11	18	2019	600	25.4	0	762.0	92.0	68	0.4
11	18	2019	700	25.3	0	762.0	93.0	68	0.4
11	18	2019	800	25.2	0	762.1	93.0	45	0.6
11	18	2019	900	25.2	0	762.1	92.0	102	0.4
11	18	2019	1000	25.2	0	762.0	92.0	68	0.6
11	18	2019	1100	25.2	0	762.1	92.0	45	1.2
11	18	2019	1200	25.2	0	762.0	92.0	68	1.1

11	18	2019	1300	25.2	0	762.0	92.0	45	1.1
11	18	2019	1400	25.2	0	762.1	92.0	45	0.9
11	18	2019	1500	25.2	0	761.9	93.0	68	0.6
11	18	2019	1600	25.1	0	761.9	92.0	88	0.4
11	18	2019	1700	25.1	0	761.9	92.0	68	0.6
11	18	2019	1800	25.2	0	761.9	91.0	45	0.9
11	18	2019	1900	25.3	0	761.9	90.0	68	0.9
11	19	2019	2000	25.3	0	761.9	90.0	68	0.6
11	19	2019	2100	25.3	0	761.8	90.0	45	0.4
11	19	2019	2200	25.2	0	761.7	91.0	68	0.5
11	19	2019	2300	25.1	0	761.6	92.0	68	0.7
11	19	2019	2400	25.3	0	761.6	89.0	0	0.9
11	19	2019	0	25.3	0	761.6	92.0	88	0.4
11	19	2019	100	25.1	0	761.5	92.0	68	0.3
11	19	2019	200	25.1	0	761.5	91.0	88	0.6
11	19	2019	300	25.1	0	761.5	92.0	88	0.3
11	19	2019	400	24.9	0	761.4	92.0	88	0.4
11	19	2019	500	25.0	0	761.3	92.0	102	0.3
11	19	2019	600	25.0	0	761.5	92.0	88	0.5
11	19	2019	700	25.0	0	761.5	93.0	88	0.4
11	19	2019	800	24.9	0	761.5	93.0	68	0.4
11	19	2019	900	24.8	0	761.5	93.0	100	0.4
11	19	2019	1000	24.8	0	761.5	93.0	68	0.6
11	19	2019	1100	24.8	0	761.3	93.0	88	0.6
11	19	2019	1200	24.8	0	761.3	93.0	68	0.7
11	19	2019	1300	24.8	0	761.2	93.0	68	0.9
11	19	2019	1400	24.8	0	761.3	93.0	88	0.7
11	19	2019	1500	25.0	0	761.3	92.0	68	0.7
11	19	2019	1600	24.9	0	761.1	92.0	88	0.9
11	19	2019	1700	24.8	0	761.1	93.0	88	0.6
11	19	2019	1800	24.8	0	761.2	93.0	68	0.7
11	19	2019	1900	24.8	0	761.1	92.0	88	0.6
11	19	2019	2000	24.8	0	761.1	92.0	88	0.6
11	19	2019	2100	24.8	0	761.0	92.0	45	0.8
11	19	2019	2200	24.8	0	761.1	93.0	68	0.6
11	19	2019	2300	24.8	0	761.1	93.0	68	0.3
11	19	2019	2400	24.8	0	761.0	93.0	88	0.4
11	19	2019	0	24.6	0	760.9	94.0	68	0.6
11	19	2019	100	24.6	0	760.9	94.0	88	0.5
11	19	2019	200	24.7	0	760.8	93.0	68	0.9
11	19	2019	300	24.7	0	760.8	93.0	88	0.7
11	19	2019	400	24.8	0	760.9	93.0	68	0.5
11	19	2019	500	24.9	0	760.7	92.0	45	0.5
11	19	2019	600	24.8	0	760.8	93.0	68	0.8
11	19	2019	700	24.8	0	760.8	93.0	88	0.7
11	19	2019	800	24.7	0	760.8	94.0	88	0.4
11	19	2019	900	24.7	0	760.8	94.0	45	0.6

11	19	2019	1000	24.7	0	760.8	94.0	68	0.6
11	19	2019	1100	24.8	0	760.8	93.0	45	0.5
11	19	2019	1200	24.8	0	760.8	92.0	88	0.4
11	19	2019	1300	24.9	0	761.0	92.0	45	0.8
11	19	2019	1400	24.9	0	760.9	92.0	22	0.6
11	19	2019	1500	24.8	0	761.0	93.0	68	0.7
11	19	2019	1600	24.8	0	761.2	93.0	88	0.4
11	19	2019	1700	24.8	0	761.2	93.0	88	0.5
11	19	2019	1800	24.8	0	761.1	93.0	68	0.7
11	19	2019	1900	24.8	0	761.0	93.0	102	0.3
11	19	2019	2000	24.9	0	761.2	92.0	45	0.6
11	19	2019	2100	25.1	0	761.2	92.0	22	0.8
11	19	2019	2200	25.0	0	761.2	92.0	88	0.7
11	19	2019	2300	25.0	0	761.4	92.0	113	0.4
11	19	2019	2400	24.9	0	761.5	93.0	88	0.3
11	19	2019	0	24.9	0	761.4	93.0	88	0.3
11	19	2019	100	25.0	0	761.5	92.0	88	0.2
11	19	2019	200	25.1	0	761.5	92.0	88	0.2
11	19	2019	300	25.0	0	761.6	93.0	88	0.2
11	19	2019	400	24.9	0	761.5	93.0	88	0.1
11	19	2019	500	24.9	0	761.6	93.0	88	0.1
11	19	2019	600	24.9	0	761.6	93.0	88	0.1
11	19	2019	700	24.8	0	761.7	94.0	88	0.1
11	19	2019	800	24.7	0	761.8	94.0	88	0.1
11	19	2019	900	24.7	0	761.8	94.0	88	0.0
11	19	2019	1000	24.6	0	761.9	94.0	88	0.1
11	19	2019	1100	24.6	0	761.9	95.0	88	0.0
11	19	2019	1200	24.6	0	762.0	95.0	102	0.0
11	19	2019	1300	24.7	0	762.0	94.0	100	0.4
11	19	2019	1400	24.7	0	762.0	94.0	100	0.1
11	19	2019	1500	24.7	0	762.0	94.0	100	0.3
11	19	2019	1600	24.8	0	762.0	94.0	100	0.2
11	19	2019	1700	25.0	0	762.0	93.0	100	0.1
11	19	2019	1800	25.1	0	762.0	92.0	125	0.3
11	19	2019	1900	25.9	0	762.1	87.0	202	1.1
11	19	2019	2000	26.2	0	762.3	89.0	125	0.9
11	19	2019	2100	26.2	0	762.6	88.0	202	1.1
11	19	2019	2200	26.3	0	762.7	87.0	225	1.1
11	19	2019	2300	26.0	0	762.8	89.0	247	0.8
11	19	2019	2400	25.5	6	763.0	90.0	202	1.1
11	19	2019	0	25.1	23	763.0	90.0	113	1.3
11	19	2019	100	24.9	29	763.0	90.0	102	2.9
11	19	2019	200	24.1	44	763.0	94.0	100	2.5
11	19	2019	300	23.8	52	762.9	94.0	100	1.7
11	19	2019	400	24.4	41	763.0	90.0	88	1.8
11	19	2019	500	24.4	12	763.0	93.0	113	0.2
11	19	2019	600	24.3	6	763.0	92.0	247	0.6

11	19	2019	700	24.4	3	763.0	93.0	225	0.5
11	19	2019	800	24.2	1	763.1	96.0	100	0.4
11	19	2019	900	24.0	1	763.1	96.0	102	0.2
11	19	2019	1000	24.1	1	763.0	96.0	100	0.4
11	19	2019	1100	24.0	2	763.2	97.0	102	0.6
11	19	2019	1200	24.0	2	763.0	97.0	100	0.3
11	19	2019	1300	24.0	4	763.2	97.0	100	0.0
11	19	2019	1400	24.2	5	763.1	97.0	100	0.3
11	19	2019	1500	24.3	5	763.0	97.0	88	0.4
11	19	2019	1600	24.5	5	763.2	97.0	102	0.4
11	19	2019	1700	24.6	3	763.0	96.0	113	0.4
11	19	2019	1800	24.7	3	763.2	96.0	102	0.5
11	19	2019	1900	24.8	1	763.2	96.0	102	0.6
11	19	2019	2000	25.2	0	763.1	95.0	88	0.3
11	19	2019	2100	25.7	0	763.0	94.0	88	0.2
11	19	2019	2200	26.1	0	763.1	93.0	202	0.2
11	19	2019	2300	26.4	0	763.0	91.0	202	0.0
11	19	2019	2400	26.4	0	763.2	90.0	125	0.1
11	19	2019	0	26.5	0	763.2	90.0	125	0.0
11	19	2019	100	26.7	0	763.2	90.0	125	0.1
11	19	2019	200	26.9	0	763.3	90.0	113	0.3
11	19	2019	300	26.9	0	763.3	89.0	102	0.4
11	19	2019	400	27.3	0	763.2	88.0	102	0.4
11	19	2019	500	27.6	0	763.2	87.0	113	0.2
11	19	2019	600	28.1	0	763.2	86.0	113	0.0
11	19	2019	700	28.3	0	763.3	86.0	100	0.8
11	19	2019	800	27.9	0	763.3	87.0	100	0.8
11	19	2019	900	28.0	0	763.3	85.0	100	0.1
11	19	2019	1000	28.5	0	763.4	84.0	100	0.2
11	19	2019	1100	28.8	0	763.4	82.0	202	0.3
11	19	2019	1200	29.3	0	763.3	80.0	247	0.9
11	19	2019	1300	29.4	0	763.2	80.0	247	0.6
11	19	2019	1400	30.2	0	763.2	78.0	225	0.5
11	19	2019	1500	30.4	0	763.3	77.0	202	0.6
11	19	2019	1600	30.9	0	763.2	76.0	202	0.5
11	19	2019	1700	30.8	0	763.1	76.0	225	0.9
11	19	2019	1800	30.9	0	763.2	74.0	202	0.7
11	19	2019	1900	30.7	0	763.1	73.0	247	1.5
11	19	2019	2000	31.0	0	763.0	72.0	225	0.9
11	19	2019	2100	31.2	0	763.0	71.0	202	0.7
11	19	2019	2200	30.5	0	763.0	72.0	202	0.8
11	19	2019	2300	30.1	0	763.0	73.0	225	0.6
11	19	2019	2400	30.1	0	763.0	71.0	247	0.8
11	19	2019	0	30.0	0	763.0	72.0	225	1.0
11	19	2019	100	30.2	0	762.9	70.0	202	0.5
11	19	2019	200	30.8	0	762.9	68.0	247	0.9
11	19	2019	300	30.9	0	762.7	68.0	270	1.2

11	19	2019	400	31.3	0	762.7	67.0	247	1.0
11	19	2019	500	31.4	0	762.7	68.0	247	1.7
11	19	2019	600	30.9	0	762.7	69.0	270	1.4
11	19	2019	700	30.8	0	762.7	69.0	270	1.0
11	19	2019	800	30.5	0	762.7	70.0	100	1.6
11	19	2019	900	30.6	0	762.6	70.0	202	0.8
11	19	2019	1000	31.4	0	762.6	67.0	202	0.7
11	19	2019	1100	32.3	0	762.6	65.0	225	0.6
11	19	2019	1200	31.4	0	762.6	68.0	270	1.6
11	19	2019	1300	30.5	0	762.6	69.0	318	2.0
11	19	2019	1400	30.3	0	762.6	71.0	270	2.5
11	19	2019	1500	28.6	0	763.0	76.0	318	2.5
11	19	2019	1600	27.3	0	763.0	79.0	270	3.1
11	19	2019	1700	26.6	0	763.0	81.0	270	2.4
11	19	2019	1800	26.2	0	763.0	84.0	270	1.6
11	19	2019	1900	25.8	0	763.0	82.0	292	2.1
11	19	2019	2000	25.7	0	762.7	82.0	113	1.6
11	19	2019	2100	25.6	0	762.7	83.0	113	1.1
11	19	2019	2200	25.3	5	762.5	85.0	113	0.7
11	19	2019	2300	25.3	5	762.2	85.0	247	0.6
11	19	2019	2400	25.5	5	762.0	83.0	247	0.5
11	19	2019	0	25.6	0	762.0	85.0	202	0.5
11	19	2019	100	25.7	0	762.2	85.0	247	0.7
11	19	2019	200	25.9	0	762.3	86.0	247	0.4
11	19	2019	300	26.1	0	762.3	85.0	125	0.3
11	19	2019	400	26.3	0	762.3	84.0	125	0.1
11	19	2019	500	26.5	0	762.3	81.0	100	0.2
11	19	2019	600	26.3	0	762.3	85.0	102	0.6
11	19	2019	700	26.1	0	762.0	85.0	100	0.4
11	19	2019	800	26.4	0	761.8	84.0	125	0.3
11	19	2019	900	26.9	0	761.8	79.0	225	0.3
11	19	2019	1000	27.3	0	761.8	77.0	125	0.3
11	19	2019	1100	27.8	0	761.5	75.0	125	0.3
11	19	2019	1200	28.1	0	761.6	73.0	202	0.2
11	19	2019	1300	28.4	0	761.6	72.0	247	0.8
11	19	2019	1400	28.3	0	761.5	73.0	270	1.1
11	19	2019	1500	28.8	0	761.4	70.0	247	1.2
11	19	2019	1600	29.4	0	761.4	69.0	247	1.2
11	19	2019	1700	30.2	0	761.2	67.0	247	1.4
11	19	2019	1800	29.9	0	761.4	69.0	247	1.7
11	19	2019	1900	29.6	0	761.5	70.0	270	1.1
11	19	2019	2000	29.4	0	761.5	70.0	247	0.9
11	19	2019	2100	29.6	0	761.3	69.0	270	0.6
11	19	2019	2200	30.1	0	761.4	69.0	202	0.6
11	19	2019	2300	29.8	0	761.4	70.0	247	0.6
11	19	2019	2400	29.6	0	761.2	71.0	247	0.5
11	19	2019	0	29.9	0	761.2	71.0	202	0.3

11	19	2019	100	30.0	0	761.1	71.0	202	0.7
11	19	2019	200	29.8	0	761.1	71.0	225	1.0
11	19	2019	300	30.3	0	761.1	69.0	125	0.5
11	19	2019	400	30.5	0	761.0	67.0	125	0.5
11	19	2019	500	30.8	0	761.0	67.0	247	0.8
11	19	2019	600	30.9	0	760.9	66.0	100	1.0
11	19	2019	700	30.2	0	761.1	66.0	202	0.7
11	19	2019	800	29.9	0	761.1	67.0	202	0.5
11	19	2019	900	30.1	0	761.1	65.0	125	0.5
11	19	2019	1000	30.1	0	761.2	66.0	113	1.2
11	19	2019	1100	29.6	0	761.2	67.0	113	0.8
11	19	2019	1200	29.2	0	761.2	68.0	100	1.7
11	19	2019	1300	29.2	0	761.1	68.0	125	1.1
11	19	2019	1400	29.9	0	761.1	66.0	125	0.9
11	19	2019	1500	30.2	0	761.2	65.0	225	0.8
11	19	2019	1600	30.2	0	761.1	65.0	270	0.5
11	19	2019	1700	30.3	0	761.1	65.0	247	0.8
11	19	2019	1800	30.1	0	761.2	66.0	225	0.9
11	19	2019	1900	29.9	0	761.0	66.0	270	1.1
11	19	2019	2000	29.8	0	761.1	66.0	270	0.7
11	19	2019	2100	30.1	0	761.1	65.0	202	0.5
11	19	2019	2200	30.2	0	761.2	65.0	202	0.6
11	19	2019	2300	29.8	0	761.2	66.0	202	1.0
11	19	2019	2400	29.4	0	761.2	67.0	100	0.8
11	19	2019	0	29.2	0	761.2	69.0	247	0.8
11	19	2019	100	28.9	0	761.2	70.0	125	0.3
11	19	2019	200	28.8	0	761.2	71.0	113	0.3
11	19	2019	300	28.6	0	761.2	72.0	225	0.5
11	19	2019	400	28.4	0	761.2	72.0	225	0.6
11	19	2019	500	28.3	0	761.2	72.0	270	0.2
11	19	2019	600	28.2	0	761.3	73.0	113	0.5
11	19	2019	700	27.9	0	761.3	76.0	88	0.8
11	19	2019	800	27.6	0	761.5	79.0	68	0.8
11	19	2019	900	27.4	0	761.5	80.0	88	0.9
11	19	2019	1000	27.1	0	761.6	81.0	88	0.8
11	19	2019	1100	26.9	0	761.6	82.0	88	0.8
11	19	2019	1200	26.8	0	761.8	83.0	88	0.9
11	19	2019	1300	26.8	0	761.8	83.0	88	0.7
11	19	2019	1400	26.8	0	762.0	83.0	68	0.9
11	19	2019	1500	26.9	0	762.1	82.0	102	0.8
11	19	2019	1600	27.0	0	762.0	81.0	68	0.6
11	19	2019	1700	27.0	0	762.1	82.0	88	0.6
11	19	2019	1800	26.8	0	762.2	82.0	68	0.6
11	19	2019	1900	26.8	0	762.3	83.0	68	0.6
11	19	2019	2000	26.7	0	762.3	83.0	88	0.9
11	19	2019	2100	26.7	0	762.3	83.0	88	0.6
11	19	2019	2200	26.7	0	762.4	83.0	68	0.6

11	19	2019	2300	26.7	0	762.4	83.0	88	0.8
11	19	2019	2400	26.8	0	762.5	83.0	68	0.6
11	19	2019	0	26.8	0	762.4	83.0	68	0.6
11	19	2019	100	26.7	0	762.6	83.0	45	0.4
11	19	2019	200	26.7	0	762.6	83.0	68	0.6
11	19	2019	300	26.6	0	762.3	83.0	68	0.9
11	19	2019	400	26.6	0	762.3	83.0	88	0.9
11	19	2019	500	26.7	0	762.5	83.0	88	1.2
11	19	2019	600	26.6	0	762.3	83.0	68	0.7
11	19	2019	700	26.6	0	762.6	84.0	68	0.6
11	19	2019	800	26.6	0	762.5	83.0	45	0.9
11	19	2019	900	26.6	0	762.5	83.0	68	0.6
11	19	2019	1000	26.5	0	762.8	84.0	102	0.5
11	19	2019	1100	26.5	0	762.8	84.0	100	0.6
11	19	2019	1200	26.5	0	763.0	83.0	100	0.3
11	19	2019	1300	26.6	0	763.0	83.0	125	0.2
11	19	2019	1400	26.8	0	763.0	81.0	125	0.1
11	19	2019	1500	27.0	0	763.0	81.0	202	0.2
11	19	2019	1600	27.1	0	763.0	81.0	247	0.9
11	19	2019	1700	27.3	0	763.1	80.0	270	1.5
11	19	2019	1800	27.4	0	763.0	78.0	225	0.8
11	19	2019	1900	27.4	0	763.1	77.0	125	0.6
11	19	2019	2000	27.3	0	763.0	79.0	202	0.2
11	19	2019	2100	27.2	0	763.0	78.0	202	0.1
11	19	2019	2200	27.1	0	763.0	81.0	100	0.5
11	19	2019	2300	26.7	0	763.1	83.0	102	0.5
11	19	2019	2400	26.5	0	763.1	84.0	88	0.4
11	19	2019	0	26.4	0	763.2	84.0	88	0.1
11	19	2019	100	26.5	0	763.3	84.0	88	0.1
11	19	2019	200	26.4	0	763.2	84.0	88	0.2
11	19	2019	300	26.4	0	763.2	84.0	88	0.6
11	19	2019	400	26.2	0	763.3	86.0	68	0.6
11	19	2019	500	26.0	0	763.2	86.0	88	0.6
11	19	2019	600	26.1	0	763.2	85.0	100	0.4
11	19	2019	700	26.2	0	763.3	85.0	88	0.5
11	19	2019	800	26.2	0	763.3	85.0	88	0.7
11	19	2019	900	26.1	0	763.2	86.0	88	0.7
11	19	2019	1000	26.1	0	763.1	86.0	88	0.5
11	19	2019	1100	26.1	0	763.1	85.0	88	0.8
11	19	2019	1200	26.1	0	763.0	85.0	88	0.5
11	19	2019	1300	26.0	0	763.2	85.0	102	0.4
11	19	2019	1400	25.9	0	763.2	86.0	102	0.5
11	19	2019	1500	25.8	0	763.1	86.0	88	0.3
11	19	2019	1600	25.9	0	763.2	85.0	88	0.6
11	19	2019	1700	25.9	0	763.2	85.0	88	0.2
11	19	2019	1800	25.9	0	763.0	84.0	102	0.3
11	19	2019	1900	26.0	0	763.0	85.0	88	0.4

11	19	2019	2000	25.9	0	763.0	85.0	68	0.6
11	19	2019	2100	25.8	0	763.0	85.0	88	0.5
11	19	2019	2200	25.6	0	763.0	86.0	102	0.8
11	19	2019	2300	25.6	0	763.0	86.0	68	0.8
11	19	2019	2400	25.8	0	763.0	85.0	68	0.4
11	19	2019	0	25.8	0	763.0	85.0	45	0.3
11	19	2019	100	25.7	0	763.0	86.0	68	0.6
11	19	2019	200	25.5	0	763.0	86.0	88	0.8
11	19	2019	300	25.3	0	762.9	87.0	88	0.4
11	19	2019	400	25.4	0	763.0	87.0	88	0.3
11	19	2019	500	25.3	0	762.9	87.0	88	0.3
11	19	2019	600	25.3	0	762.9	86.0	88	0.7
11	19	2019	700	25.4	0	763.0	86.0	88	0.5
11	20	2019	800	25.4	0	762.8	85.0	88	1.0
11	20	2019	900	25.5	0	762.9	85.0	88	0.3
11	20	2019	1000	25.5	0	762.9	86.0	68	0.6
11	20	2019	1100	25.3	0	762.7	86.0	45	0.4
11	20	2019	1200	25.2	0	762.7	87.0	88	0.4
11	20	2019	1300	25.1	0	762.7	87.0	88	1.0
11	20	2019	1400	25.1	0	762.7	86.0	88	0.5
11	20	2019	1500	25.0	0	762.5	87.0	88	0.4
11	20	2019	1600	25.0	0	762.4	87.0	88	0.6
11	20	2019	1700	25.1	0	762.5	87.0	68	0.3
11	20	2019	1800	25.0	0	762.5	87.0	88	0.3
11	20	2019	1900	25.2	0	762.3	86.0	88	0.3
11	20	2019	2000	25.1	0	762.2	87.0	88	0.3
11	20	2019	2100	24.9	0	762.1	87.0	102	0.1
11	20	2019	2200	24.8	0	762.2	88.0	102	0.2
11	20	2019	2300	24.8	0	762.2	88.0	102	0.3
11	20	2019	2400	24.7	0	762.1	89.0	88	0.1
11	20	2019	0	24.7	0	762.1	89.0	88	0.0
11	20	2019	100	24.7	0	762.3	89.0	88	0.0
11	20	2019	200	24.7	0	762.0	89.0	88	0.0
11	20	2019	300	24.8	0	762.0	89.0	88	0.5
11	20	2019	400	24.8	0	762.1	89.0	68	0.2
11	20	2019	500	24.8	0	762.0	89.0	68	0.3
11	20	2019	600	24.7	0	762.0	89.0	68	0.3
11	20	2019	700	24.7	0	762.1	89.0	88	0.4
11	20	2019	800	24.8	0	761.9	88.0	88	0.3
11	20	2019	900	24.9	0	762.0	88.0	88	0.2
11	20	2019	1000	25.0	0	762.0	88.0	88	0.2
11	20	2019	1100	25.0	0	762.0	88.0	88	0.4
11	20	2019	1200	25.1	0	762.0	88.0	68	0.3
11	20	2019	1300	25.1	0	762.0	88.0	68	0.4
11	20	2019	1400	25.0	0	762.0	88.0	68	0.3
11	20	2019	1500	25.0	0	762.0	88.0	68	0.2
11	20	2019	1600	25.1	0	761.8	88.0	68	0.3

11	20	2019	1700	25.1	0	761.8	88.0	68	0.2
11	20	2019	1800	25.1	0	762.0	89.0	68	0.1
11	20	2019	1900	24.9	0	761.8	89.0	68	0.1
11	20	2019	2000	25.0	0	761.8	89.0	68	0.3
11	20	2019	2100	25.0	0	761.8	89.0	68	0.1
11	20	2019	2200	25.0	0	761.8	90.0	68	0.0
11	20	2019	2300	25.0	0	761.8	90.0	68	0.3
11	20	2019	2400	25.1	0	761.8	89.0	45	0.4
11	20	2019	0	25.0	0	761.8	90.0	88	0.3
11	20	2019	100	25.0	0	762.0	90.0	88	0.2
11	20	2019	200	24.9	0	761.8	90.0	88	0.3
11	20	2019	300	24.9	0	761.9	90.0	68	0.5
11	20	2019	400	25.0	0	762.0	90.0	88	0.3
11	20	2019	500	25.0	0	762.0	90.0	88	0.1
11	20	2019	600	25.0	0	762.0	91.0	68	0.4
11	20	2019	700	25.0	0	762.1	91.0	68	0.3
11	20	2019	800	25.0	0	762.1	91.0	102	0.3
11	20	2019	900	25.0	0	762.0	91.0	102	0.3
11	20	2019	1000	25.0	0	762.1	91.0	102	0.0
11	20	2019	1100	25.0	0	762.2	91.0	88	0.3
11	20	2019	1200	25.0	0	762.0	91.0	68	0.2
11	20	2019	1300	25.0	0	762.3	91.0	68	0.3
11	20	2019	1400	25.0	0	762.3	91.0	68	0.2
11	20	2019	1500	24.9	0	762.2	92.0	68	0.0
11	20	2019	1600	24.9	0	762.2	92.0	68	0.1
11	20	2019	1700	25.0	0	762.3	91.0	22	0.6
11	20	2019	1800	25.0	0	762.2	91.0	100	0.4
11	20	2019	1900	25.1	0	762.2	91.0	113	0.1
11	20	2019	2000	25.2	0	762.0	91.0	100	0.3
11	20	2019	2100	25.2	0	762.0	92.0	100	0.2
11	20	2019	2200	25.1	0	761.9	92.0	113	0.1
11	20	2019	2300	25.2	0	762.0	91.0	113	0.2
11	20	2019	2400	25.2	0	762.2	92.0	113	0.1
11	20	2019	0	25.3	0	762.0	91.0	100	0.5
11	20	2019	100	25.3	0	762.1	91.0	88	0.3
11	20	2019	200	25.2	0	762.1	91.0	45	0.6
11	20	2019	300	25.1	0	762.2	91.0	45	0.8
11	20	2019	400	25.0	0	762.3	92.0	88	0.3
11	20	2019	500	25.0	0	762.4	92.0	88	0.2
11	20	2019	600	25.0	0	762.4	92.0	88	0.4
11	20	2019	700	25.0	0	762.4	92.0	88	0.3
11	20	2019	800	25.0	0	762.4	92.0	68	0.3
11	20	2019	900	25.0	0	762.5	92.0	45	0.0
11	20	2019	1000	25.1	0	762.6	91.0	45	0.2
11	20	2019	1100	25.1	0	762.7	92.0	45	0.3
11	20	2019	1200	25.3	0	762.7	90.0	292	0.7
11	20	2019	1300	25.6	0	762.7	90.0	292	0.3

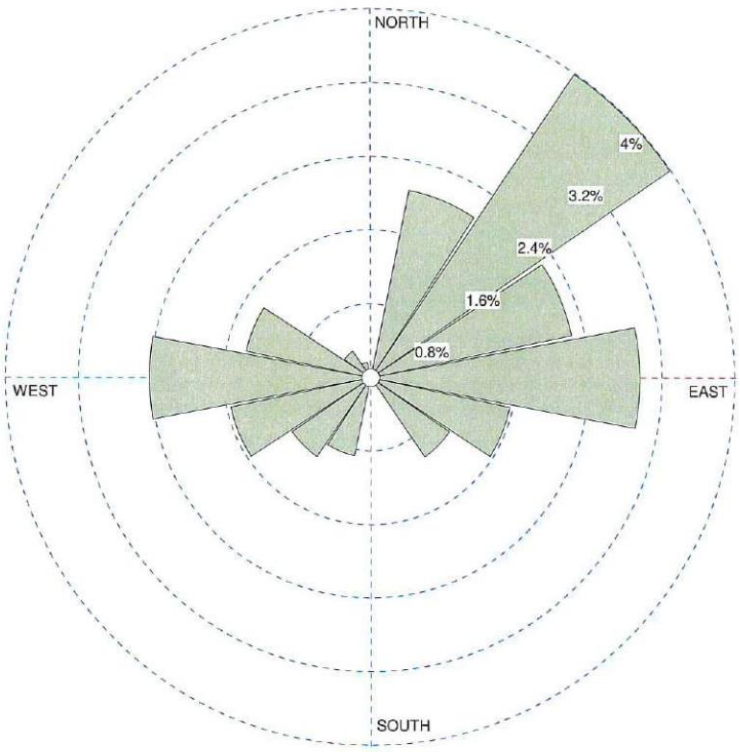
11	20	2019	1400	25.5	0	762.8	90.0	102	0.3
11	20	2019	1500	25.5	0	762.7	91.0	102	0.3
11	20	2019	1600	25.6	0	762.7	90.0	102	0.3
11	20	2019	1700	25.7	0	762.8	90.0	102	0.1
11	20	2019	1800	26.1	0	762.7	87.0	247	1.0
11	20	2019	1900	26.9	0	762.7	84.0	125	0.6
11	20	2019	2000	26.8	0	762.9	84.0	68	0.5
11	20	2019	2100	26.8	0	762.9	84.0	88	0.8
11	20	2019	2200	26.8	0	763.0	85.0	88	0.5
11	20	2019	2300	26.7	0	763.0	86.0	45	0.5
11	20	2019	2400	26.7	0	763.1	85.0	88	0.6
11	20	2019	0	26.8	0	763.1	84.0	88	0.6
11	20	2019	100	27.1	0	763.2	83.0	102	0.5
11	20	2019	200	27.2	0	763.3	83.0	88	0.4
11	20	2019	300	27.4	0	763.2	82.0	102	0.4
11	20	2019	400	27.8	0	763.2	80.0	68	0.5
11	20	2019	500	28.5	0	763.3	76.0	113	0.6
11	20	2019	600	29.3	0	763.3	74.0	102	0.6
11	20	2019	700	29.2	0	763.4	75.0	100	0.5
11	20	2019	800	29.1	0	763.5	73.0	102	0.6
11	20	2019	900	29.3	0	763.5	70.0	45	1.3
11	20	2019	1000	29.2	0	763.5	70.0	45	1.1
11	20	2019	1100	29.2	0	763.5	71.0	88	0.6
11	20	2019	1200	29.1	0	763.5	73.0	102	0.8
11	20	2019	1300	28.7	0	763.5	74.0	100	0.6
11	20	2019	1400	28.7	0	763.6	72.0	88	0.7
11	20	2019	1500	29.6	0	763.7	68.0	88	0.1
11	20	2019	1600	30.9	0	763.7	66.0	113	0.3
11	20	2019	1700	30.8	0	763.8	65.0	100	0.7
11	20	2019	1800	30.4	0	763.8	66.0	68	0.4
11	20	2019	1900	31.0	0	763.7	65.0	270	0.8
11	20	2019	2000	30.7	0	763.7	66.0	292	1.4
11	20	2019	2100	30.9	0	763.5	65.0	202	0.5
11	20	2019	2200	31.3	0	763.5	65.0	22	0.8
11	20	2019	2300	31.4	0	763.5	64.0	45	1.1
11	20	2019	2400	31.1	0	763.5	64.0	45	1.0
11	20	2019	0	31.1	0	763.5	64.0	88	1.0
11	20	2019	100	31.2	0	763.5	63.0	88	0.6
11	20	2019	200	31.8	0	763.5	61.0	100	0.5
11	20	2019	300	32.2	0	763.5	60.0	88	0.6
11	20	2019	400	32.3	0	763.7	61.0	102	0.4
11	20	2019	500	32.1	0	763.8	63.0	0	0.7
11	20	2019	600	31.4	0	763.7	65.0	202	0.6
11	20	2019	700	31.0	0	763.7	65.0	202	0.5
11	20	2019	800	30.9	0	763.5	65.0	125	1.1
11	20	2019	900	30.7	0	763.6	66.0	102	0.9
11	20	2019	1000	30.9	0	763.5	65.0	102	0.6

11	20	2019	1100	31.1	0	763.5	65.0	88	0.8
11	20	2019	1200	31.2	0	763.4	66.0	0	0.9
11	20	2019	1300	31.0	0	763.4	65.0	45	0.9
11	20	2019	1400	31.4	0	763.4	63.0	45	1.0
11	20	2019	1500	31.4	0	763.3	63.0	45	0.6
11	20	2019	1600	31.4	0	763.3	66.0	292	1.9
11	20	2019	1700	30.5	0	763.1	69.0	292	1.9
11	20	2019	1800	30.5	0	763.0	69.0	292	2.0
11	20	2019	1900	30.3	0	763.0	69.0	292	1.3
11	20	2019	2000	30.5	0	762.9	67.0	292	1.2
11	20	2019	2100	30.5	0	762.9	66.0	292	1.1
11	20	2019	2200	30.9	0	762.9	64.0	292	0.9
11	20	2019	2300	31.1	0	762.7	63.0	68	0.5
11	20	2019	2400	32.0	0	762.7	61.0	270	1.1
11	20	2019	0	32.0	0	762.7	61.0	247	1.4
11	20	2019	100	32.2	0	762.7	59.0	247	1.3
11	20	2019	200	32.8	0	762.5	58.0	202	1.0
11	20	2019	300	32.8	0	762.5	59.0	113	1.4
11	20	2019	400	32.5	0	762.3	58.0	225	0.6
11	20	2019	500	33.1	0	762.3	58.0	225	1.0
11	20	2019	600	32.9	0	762.2	59.0	202	0.8
11	20	2019	700	32.6	0	762.1	60.0	125	2.0
11	20	2019	800	32.7	0	762.0	59.0	100	1.1
11	20	2019	900	32.6	0	762.0	60.0	125	1.5
11	20	2019	1000	32.7	0	762.0	58.0	125	1.0
11	20	2019	1100	32.7	0	761.8	57.0	125	1.5
11	20	2019	1200	32.1	0	761.8	60.0	100	2.1
11	20	2019	1300	32.1	0	761.8	60.0	113	1.7
11	20	2019	1400	32.0	0	761.7	61.0	100	2.4
11	20	2019	1500	31.4	0	761.6	62.0	100	2.6
11	20	2019	1600	32.0	0	761.4	60.0	125	0.8
11	20	2019	1700	32.7	0	761.4	59.0	113	1.8
11	20	2019	1800	32.0	0	761.2	61.0	102	1.8
11	20	2019	1900	31.9	0	761.2	60.0	100	1.3
11	20	2019	2000	31.9	0	761.2	60.0	225	1.5
11	20	2019	2100	32.3	0	761.0	59.0	202	0.9
11	20	2019	2200	32.3	0	761.0	59.0	225	1.0
11	20	2019	2300	32.6	0	761.0	58.0	225	1.1
11	20	2019	2400	32.0	0	760.8	60.0	270	1.8
11	20	2019	0	32.4	0	760.8	59.0	225	1.3
11	20	2019	100	32.9	0	760.7	58.0	247	0.7

(ii) Wind Rose Plot

WIND ROSE PLOT:

Ecoengineering Consultants Limited
18th - 20th November, 2019



WIND SPEED
(Knots)

- 11 - 13
- 8 - 10
- 5 - 7
- 4
- 3
- 2

Calms: 78.37%

COMMENTS:		COMPANY NAME: Ecoengineering Consultants Limited	
		MODELER: Kaizen Environmental Service (Trinidad) Limited	
			PROJECT NO.: 19-9282-2

WRPLOT View - Lakes Environmental Software

(iii) Calibration Certificate – Davis Met Station

KAIZEN
Environmental Services (T'dad) Ltd

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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE #: 040418-A70426N737

DATE: 2019-10-27

ANALYSER TYPE: Davis Meteorological Station

SERIAL #: A70426N737

Sensor	Date Checked	Response
UV	*040418*	**OK**
Rain Gauge	*040418*	**OK**
Wind Monitor	*040418*	**OK**
Wind Direction	*040418*	**OK**
Temp & Humidity	*040418*	**OK**
Pressure	*040418*	**OK**

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with Davis factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by: amrit persad maharaj

Verified by:

Amrit Persad Maharaj
Instrumentation Technician

Deodath Maharaj
Instrumentation Team Leader

H. Biographies of Personnel

Anthony Chariah
Environmental Technician | PROJECT Services Division

Mr. Anthony Chariah is presently employed at Kaizen Environmental Services Limited as an Environmental Technician in the Project Services Department where he is responsible for executing the environmental fieldwork component of projects. This includes pre planning, data collection, and management, the operation of equipment, testing and preparation of technical information.

Mr. Chariah has been under the Project Services Division for four years now where he has gained knowledge and training in Environmental and Occupational monitoring and sampling according to US EPA and EMA guidelines. His work experiences include performing Ambient Air Quality monitoring, Indoor Air Quality monitoring, Stack Emission testing (Point Source Testing) and Noise testing.

Mr. Chariah possesses a BSc. Environmental and Natural Resources Management and Geography together with a NEBOSH National General Certificate in Occupational Health and Safety. Past experience includes working as a California Industrial Engineering Services Company Limited.

Deven Hadai
Environmental Technician | PROJECT Services Division

Mr. Deven Hadai is presently employed at Kaizen Environmental Services (Trinidad) Limited as an Environmental Technician in the Project Services Department where he is responsible for executing environmental fieldwork projects, data analysis, and metrology reporting. This includes equipment use, service, calibration, and testing together with data collection, processing, and reporting.

Mr. Hadai possesses a BSc. Physics with minors in Environmental Physics and Material Science together with a Diploma in Mechanical Engineering. Past experience includes working as a Maintenance Technician with Preventative Maintenance Limited at Arcelor Mittal and as a Maintenance Planner at Sammy's Multilift Services Limited. The main role involved as Maintenance Technician included maintenance of all conveyors present on the compound. This included repairs to mechanical parts of conveyors and repairs to conveyor belts by cold splicing. Maintenance planning involved planning and scheduling of reactive, routine and breakdown repairs on equipment.

EVENT 3

PROJECTServices
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REPORT

Ambient Air Quality Monitoring

For

Construction of the Diego Martin Vehicular Overpass

November 2019

Event 3

Prepared For

Ecoengineering – Consultants Limited
#62 Eastern Main Road, St. Augustine,
Trinidad W.I

Prepared By

Kaizen Environmental Services (Trinidad) Limited
Unit #8 Rajkumar Street, Mission Road,
Freeport,
Trinidad, W.I.

Davie Selal
Davie Selal
Trainee Administrative Technician II,
Reporting and Client Relations

Silas Poliah
Quality Control

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H. Biographies of Personnel

EXECUTIVE SUMMARY

Kaizen Environmental Services (Trinidad) Limited (Kaizen) was commissioned to conduct Ambient Air Quality Monitoring by Ecoengineering – Consultants Limited. Monitoring was conducted for the Construction of the Diego Martin Vehicular Overpass.

The parameters measured were as follows:

1. Particulate Matter 2.5 ($PM_{2.5}$)
2. Particulate Matter 10 (PM_{10})
3. Total Suspended Particulates (TSP)
4. Nitrogen Dioxide (NO_2)
5. Sulphur Dioxide (SO_2)
6. Carbon Monoxide (CO)
7. Ozone (O_3)
8. Volatile Organic Compounds (VOCs)

Fieldwork was conducted during the period November 25th – 27th, 2019.

SUMMARY OF RESULTS

Based on the investigation conducted on November 25th – 27th, 2019, the following conclusions can be made:

- The 24-hour average concentrations obtained for **Particulate Matter ($PM_{2.5}$ and PM_{10})** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's[a] Air Pollution Rules 2014.

- The 24-hour average concentrations obtained for **Total Suspended Particulates (TSP)** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's Air Pollution Rules 2014.

- The 1-hour concentrations obtained for **Nitrogen Dioxide (NO_2)** at all locations sampled were in compliance with the guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: NO_2 was below the detection limit at all locations monitored

- The 24-hour average concentrations obtained for **Sulphur Dioxide (SO_2)** at all locations sampled were in compliance with their respective guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: SO_2 was below the detection limit at all locations monitored

[a] EMA – Environmental Management Authority of Trinidad and Tobago

- The 8-hour average concentrations obtained for **Carbon Monoxide (CO)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

- The 8-hour average concentrations obtained for **Ozone (O_3)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

- The 8-hour average concentrations for **Volatile Organic Compounds (VOCs)** were obtained at all sampling locations. The concentrations obtained were 0.1 $\mu g/m^3$. There are no EMA guidelines for **VOCs.**

1.0 Introduction

Kaizen Environmental Services (Trinidad) Limited (Kaizen) was commissioned to conduct Ambient Air Quality Monitoring by Ecoengineering – Consultants Limited. Monitoring was conducted for the Construction of the Diego Martin Vehicular Overpass.

Fieldwork was conducted during the period November 25th – 27th, 2019.

2.0 Monitoring Locations and Parameters

Five (5) locations were selected by Ecoengineering – Consultants Limited for the ambient air monitoring as follows:

Table 1: Monitoring Locations and Parameters

Location No.	Co-ordinates	Parameters Monitored
1	20P0657831 UTM1180930	Particulate Matter 2.5 ($PM_{2.5}$) Particulate Matter 10 (PM_{10}) Total Suspended Particulates (TSP) Nitrogen Dioxide (NO_2) Sulphur Dioxide (SO_2) Carbon Monoxide (CO) Ozone (O_3) Volatile Organic Compounds (VOCs)
2	20P0657681 UTM1181156	
3	20P0658177 UTM1181216	
4	20P0658383 UTM1181049	
5	20P0658294 UTM1181091	

3.0 Test Methodology

3.1 Particulate Matter ($PM_{2.5}$ and PM_{10}) Monitoring

$PM_{2.5}$ & PM_{10} was measured in accordance with the US EPA's[b] "*Compendium of Methods for the Determination of Inorganic Compounds in Ambient Air - Compendium Method IO 2.1: Sampling of Ambient Air for Total Suspended Particulate Matter (SPM) and PM_{10} Using High Volume (HV) Sampler*".

The $PM_{2.5}$ high volume sampler utilized meets the US EPA's Reference Method: *40 CFR Part 50 Appendix L.*

The PM_{10} high volume sampler utilized meets the US EPA's Reference Method: *40 CFR Part 50 Appendix J.*

The $PM_{2.5}$ & PM_{10} sampler was calibrated prior to use in the field (*Calibration Certificate is appended–Attachment A (i) and (ii) respectively*)

3.2 Total Suspended Particulate Matter (TSP)

TSP was measured in accordance with equipment specified in the USEPA's *Code of Federal regulations (CFR) 40 CFR Chapter 1 Part 50 Appendix B Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method).*
The TSP sampler was calibrated prior to use in the field (*Calibration Certificate is appended–Attachment A (iii*).

3.3 Nitrogen Dioxide (NO_2)

NO_2 concentrations were determined in accordance with the US EPA Designated Equivalent Method *NO – EQN – 1277 – 026, "Sodium Arsenite Method for the Determination of Nitrogen Dioxide in the Atmosphere".*

A sample of the ambient air is bubbled at a low flow rate through an impinger containing a sodium arsenite and sodium hydroxide solution for the full 24-hour sampling period. The concentration of the nitrite ion produced during sampling is determined colorimetrically by reacting the nitrite ion with phosphoric acid and N – (1-naphthyl)-ethylene diamine di-hydrochloride and measuring the absorbance of the highly colored azo dye at 540 nm. A vacuum pump was used to draw the ambient air through the sampling solution contained in the impinger.
Based on results from a collaborative study conducted by the US EPA, the lower detectable limit of the method is estimated to be 9 $\mu g/m^3$ for a 24-hour period.

[b] US EPA – United States Environmental Protection Agency

Modified Method to monitor the concentration of NO_2 in accordance to the EMA's Air Pollution Rules, 2014: The sampling time was reduced to one (1) hour or sixty (60) minutes with a sample flow rate of 2 L/min which is reflected in the formula for the calculation of volume of air sampled. The new detectable limit of the method is calculated to be 20 $\mu g/m^3$.

The following formulae were used in the determination of NO_2:

Volume of air sampled:
$V = (F_i + F_f / 2) \times t_s \times 10^{-6}$

Where:
V = Volume of air sampled, m^3
F_i = Air flow rate before sampling, cm^3/min
F_f = Air flow rate after sampling, cm^3/min
t_s = Sampling time, 60 minutes
10^{-6} = conversion of cm^3 to m^3

NO_2 Concentration in Air:
(Concentration of NO_2 (mg/L) x 50 / Volume of air sampled x 0.82) x Dilution factor

Where:
Concentration of NO_2 (mg/L) = obtained from lab analysis report
Volume of absorbing reagent used in sampling, ml = 50
Volume of air sampled = obtained from previous calculation
Sampling efficiency = 0.82
Dilution factor = 1

3.4 Sulphur Dioxide (SO_2)

The concentration of SO_2 was determined in accordance with US EPA 40 CFR Part 50 Appendix A: *"Reference Method for the Determination of Sulphur Dioxide in the Atmosphere (Pararosaniline Method).*

With this Method, a measured volume of air was bubbled through a solution of 0.04 M potassium tetrachloromercurate (TCM), which was contained in an impinger train assembly. The SO_2 present in the air stream reacts with the TCM solution to form a stable monochlorosulfanomercurate complex. Once formed, this complex resists air oxidation and is stable in the presence of strong oxidants such as ozone and oxides of nitrogen. During subsequent analysis, the complex is reacted with acid bleached pararosaniline methyl sulfonic acid. The optical density of this species is determined spectrophotometrically at 548 nm and is directly related to the amount of SO_2 collected.

Based on results from a collaborative study conducted by the US EPA, the lower limit of detection of SO_2 in 10 ml of TCM is 0.75 µg. This represents a concentration of 13 µg SO_2/ m^3 (0.005 ppm) for a 24-hour period.

3.5 Carbon Monoxide (CO)

The Thermo Scientific Model 48i Carbon Monoxide Analyzer is an U.S. EPA Reference Method: *RFCA-0981-054.*

The Model 48i Carbon Monoxide (CO) absorbs infrared radiation at a wavelength of 4.6 microns. The instrument electronics transform the basic analyzer signal into a linear output. The 48i uses an exact calibration curve to accurately linearize the instrument output over any range up to a concentration of 10,000ppm. The CO samplers were calibrated prior to use in the field (*Calibration Certificate is appended – Attachment A (iv)*.

3.6 Ozone (O_3)

For this measurement of Ozone, the Aeroqual Series 500-USEPA Tier II & III Indicative method was used; comparable to USEPA studies. *See Attachment D – Ozone Comparative Study*

3.7 Volatile Organic Compounds (VOCs)

For monitoring of VOCs, Crowcon portable emissions analyzer was utilized, and was calibrated prior to use in the field (*Test Certificate is appended –Attachment A (ii)*).

The Crowcon Gas Detective portable emissions analyzer is a microprocessor controlled portable gas detector, which is capable of monitoring up to four (4) gas types simultaneously and providing warning of hazardous levels.

Using electrochemical, catalytic, and thermal conductivity sensors, this instrument was configured to detect any practical combination of oxygen, toxic and flammable gas.

The Crowcon was fitted with electrochemical sensors to measure VOC concentrations. The concentration ranges and resolution/ detection limits of this instrument VOC are as follows:

Sensor/ Parameter	Range (ppm)	Resolution/ Detection Limit (ppm)
VOC	0 – 100	1.0

The Crowcon was configured to log averages at 15-minute intervals.

4.0 Results

4.1 Particulate Matter ($PM_{2.5}$ and PM_{10}), Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2), and Carbon Monoxide (CO), Ozone (O_3), Total Suspended Particulate Matter (TSP) and Volatile Organic Compounds (VOCs) Results

Table 2 presents the results of the Particulate Matter ($PM_{2.5}$ and PM_{10}) and Total Suspended Particulate (TSP) Monitoring. The results in this table have been compared to standards outlined by the EMA in the Air Pollution Rules, 2014.

Table 2: Ambient Air Quality Testing Results Particulate Matter ($PM_{2.5}$ PM_{10} and TSP)

Location No.	Sample Period/ 2019	Parameter Concentration		
		$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	TSP ($\mu g/m^3$)
1	November $26^{th} - 27^{th}$	11	29	62
2	November $25^{th} - 26^{th}$	5	8	16
3		7	10	20
4		10	16	28
5	November $26^{th} - 27^{th}$	8	16	28
EMA[c] STEL[d] (24-hr average)		**65**	**75**	**150**

Note:

a) Results reported to the nearest whole number

[c] EMA – Environmental Management Authority of Trinidad and Tobago
[d] STEL – Short-term Maximum Permissible Level

Table 3 displays the results of the 24 hour monitoring event for SO_2. The results were compared to their respective short term permissible levels as stipulated by the EMA in their Air Pollution Rules, 2014.

Table 3: Ambient Air Quality Testing Results –SO_2 (24-hour)

Location No	Sample Period/ 2019	Parameter Concentration
		SO_2 ($\mu g/m^3$)
1	November 26th – 27th	BDL
2	November 25th – 26th	BDL
3		BDL
4		BDL
5	November 26th – 27th	BDL
EMA STEL (24-hr)		**125**

Note:

a) BDL – Below Detection Limit
b) SO_2 Method Detection Limit = 13 $\mu g/Nm^3$

Table 4 displays the data for the 1-hour monitoring event for NO_2. The results were compared to the relevant limits as stated by the EMA in the Air Pollution Rules, 2014.

Table 4: Ambient Air Quality Testing Results – NO_2 (1-hour)

Location No	Sample Period/ 2019	Parameter Concentration
		NO_2 ($\mu g/m^3$)
1	November 26th	BDL
2	November 25th	BDL
3		BDL
4		BDL
5	November 26th	BDL
EMA[e] STEL[f] (1-hr)		**200**

Note:

a) BDL – Below Detection Limit
b) NO_2 Modified Method Detection Limit = 20 $\mu g/Nm^3$

[e] EMA – Environmental Management Authority of Trinidad and Tobago
[f] STEL – Short-term Maximum Permissible Level

Table 5 displays the results of the CO, VOC and O_3 monitoring. The results were compared to the 8-hour limit as stated by the EMA in the Air Pollution Rules, 2014.

Table 5: Ambient Air Quality Testing Results – Carbon Monoxide (CO), Volatile Organic Compounds (VOCs) and Ozone (O_3)

Location	Sampling Date/ 2019	Sampling Period		Avg 8-Hr CO Concentration ($\mu g/m^3$)	Avg 8-Hr VOC Concentration ($\mu g/m^3$)	Avg 8-Hr O_3 Concentration ($\mu g/m^3$)
		Start	End			
1	November 26th	15:30	23:29	886	0.1	43
	November 26th – 27th	23:30	07:29	750	0.1	42
	November 27th	07:30	15:30	945	0.1	43
2	November 25th	11:30	19:29	1002	0.1	31
	November 25th – 26th	19:30	03:29	775	0.1	32
	November 26th	03:30	11:30	941	0.1	35
3	November 25th	12:30	20:29	993	0.1	36
	November 25th – 26th	20:30	04:29	678	0.1	36
	November 26th	04:30	12:30	1012	0.1	36
4	November 25th	13:30	21:29	862	0.1	42
	November 25th – 26th	21:30	05:29	709	0.1	43
	November 26th	05:30	12:30	1100	0.1	43
5	November 26th	15:00	22:59	775	0.1	41
	November 26th – 27th	23:00	06:59	743	0.1	43
	November 27th	07:00	15:00	1068	0.1	41
EMA STEL (8-hour average)				**10 000**	**N/A**	**120**

Note:

a) Results reported to the nearest whole number
b) There are no guidelines for VOCs in ambient air.

4.2 Meteorological Monitoring

Table 6: Summary of Meteorological Conditions during Monitoring Periods (November 25th – 27th, 2019)

Date/ 2019	Average Wind Speed (m/s)	Average Temperature (°C)	Average Relative Humidity (%)	Average Barometric Pressure (mmHg)	Total Rainfall (mm)
November 25th – 27th	1.2	25.5	86.2	766.3	0.1

The raw meteorological data is attached as *Appendix F*.

5.0 Conclusion

Based on the investigation conducted on November 25th – 27th, 2019, the following conclusions can be made:

- The 24-hour average concentrations obtained for **Particulate Matter ($PM_{2.5}$ and PM_{10})** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's[g] Air Pollution Rules 2014.

- The 24-hour average concentrations obtained for **Total Suspended Particulates (TSP)** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's Air Pollution Rules 2014.

- The 1-hour concentrations obtained for **Nitrogen Dioxide (NO_2)** at all locations sampled were in compliance with the guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: NO_2 was below the detection limit at all locations monitored

- The 24-hour average concentrations obtained for **Sulphur Dioxide (SO_2)** at all locations sampled were in compliance with their respective guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: SO_2 was below the detection limit at all locations monitored

- The 8-hour average concentrations obtained for **Carbon Monoxide (CO)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

[g] EMA – Environmental Management Authority of Trinidad and Tobago

- The 8-hour average concentrations obtained for **Ozone (O_3)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

- The 8-hour average concentrations for **Volatile Organic Compounds (VOCs)** were obtained at all sampling locations. The concentrations obtained were 0.1 $\mu g/m^3$. There are no EMA guidelines for **VOCs.**

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ATTACHMENTS

A. Calibration Certificates

- (i) $PM_{2.5}$ High Volume Samplers
- (ii) PM_{10} High Volume Samplers
- (iii) TSP Samplers
- (iv) Thermo Scientific (CO)
- (v) Aeroqual (O_3)
- (vi) SKC Pumps (NO_2 and SO_2)
- (vii) Crowncon Gas Detective (VOCs)
- (viii) Analytical Balance

B. Map of Monitoring Location

C. Accreditation Certificate

D. Laboratory Data

- (i) Chain of Custody
- (ii) Analytical Results

E. Ozone Comparative Study

F. Raw Data

- (i) Carbon Monoxide (CO)
- (ii) Volatile Organic Compounds (VOCs)
- (iii) Ozone (O_3)
- (iv) Filter Weights

G. Meteorological Data

- (i) Raw Meteorological Data
- (ii) Wind Rose Plot
- (iii) Calibration Certificate - Davis Met Station

H. Biographies of Personnel

A. Calibration Certificates

(i) $PM_{2.5}$ High Volume Samplers

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PM2.5 High Volume Sampler Calibration

DATE: Nov 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4735
Serial# : 4735
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

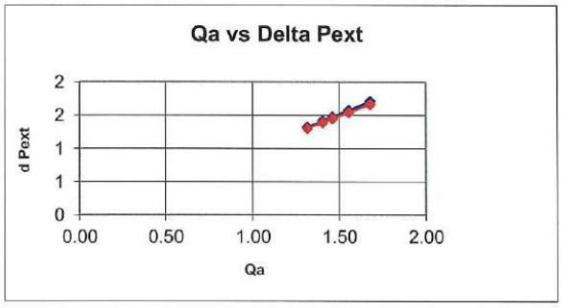
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	27.3	**Ta (°K)**	300.3	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.96	**Pa (mm Hg)**	760.984	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.072916**
7	1.681	6.7	1.705	1.6621	**intercept, b2:**	**-0.097978**
6	1.557	5.7	1.573	1.5388	**corr. coeff, r2**	**0.999998**
5.3	1.464	5	1.473	1.4463		
4.9	1.408	4.6	1.413	1.3906	**SFR**	**1.135**
4.3	1.320	4	1.318	1.3027	**SSP**	**2.89**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

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PM2.5 High Volume Sampler Calibration

DATE: November 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-711768
Serial# : 711768
Sampler: Staplex

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

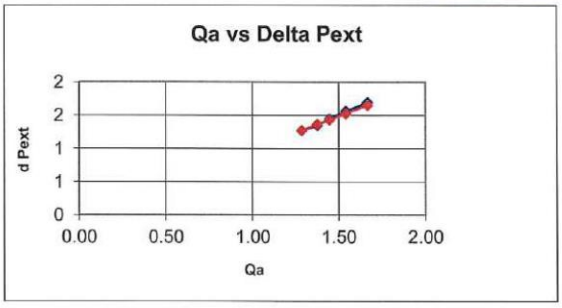
Conditions

Ta:(°C)	27.3	**Ta (°K)**	300.3	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.96	**Pa (mm Hg)**	760.984	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext
6.9	1.669	6.6	1.693	1.6502
5.9	1.544	5.6	1.559	1.5259
5.2	1.450	4.8	1.443	1.4325
4.7	1.379	4.2	1.350	1.3619
4.1	1.289	3.7	1.267	1.2720

slope, m2:	**1.143603**
intercept, b2:	**-0.214450**
corr. coeff, r2	**0.998751**
SFR	**1.135**
SSP	**2.71**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

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FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

PM2.5 High Volume Sampler Calibration

DATE: Nov 9th 2019
Technician: Amrit Persad Maharaj

Certificate # 010319-4732
Serial# : 4732
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

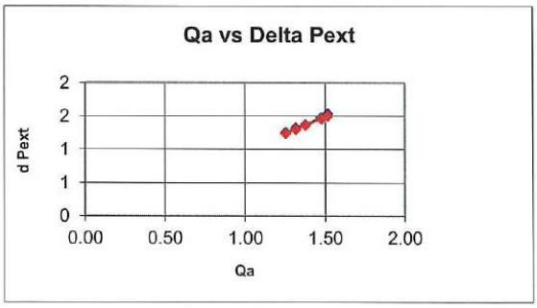
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	28.6	**Ta (°K)**	301.6	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.054142**
5.7	1.521	5.4	1.534	1.5028	**intercept, b2:**	**-0.078530**
5.4	1.481	5	1.476	1.4627	**corr. coeff, r2**	**0.997657**
4.7	1.382	4.3	1.369	1.3647		
4.3	1.322	4	1.320	1.3053	**SFR**	**1.140**
3.9	1.260	3.6	1.252	1.2431	**SSP**	**2.90**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

(ii) PM_{10} High Volume Samplers

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad. W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

PM10 High Volume Sampler Calibration

DATE: Nov 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-2480
Serial# : 2480
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

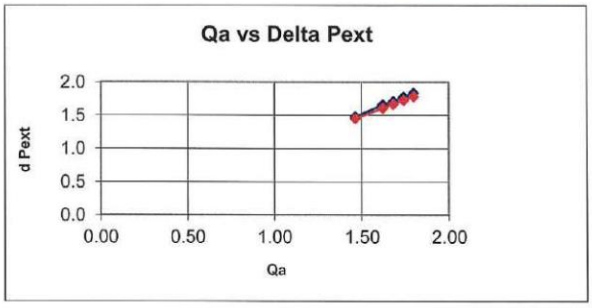
Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext
8	1.801	7.7	1.832	1.7810
7.5	1.744	7.2	1.772	1.7244
7	1.685	6.7	1.709	1.6660
6.5	1.624	6.3	1.657	1.6054
5.3	1.467	5	1.476	1.4496

slope, m2:	**1.060066**
intercept, b2:	**-0.074936**
corr. coeff, r2	**0.999042**
SFR	**1.141**
SSP	**2.95**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

KAIZEN
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Rajkumar Street,
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Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

PM10 High Volume Sampler Calibration

DATE: Nov 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4733
Serial# : 4733
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

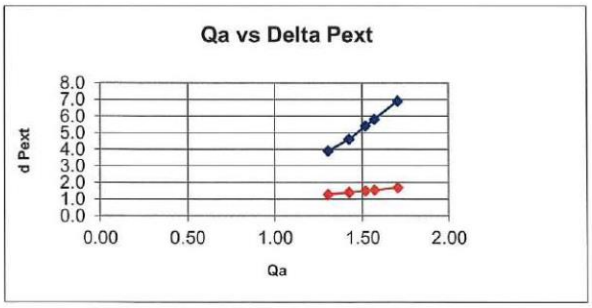
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**7.560747**
7.2	1.709	7.8	6.900	1.6896	**intercept, b2:**	**-6.076769**
6.1	1.574	7.33	5.800	1.5552	**corr. coeff, r2**	**0.997793**
5.7	1.521	6.9	5.400	1.5033		
5	1.426	6.53	4.600	1.4080	**SFR**	**1.141**
4.2	1.307	5.7	3.900	1.2905	**SSP**	**14.88**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

KAIZEN
Environmental Services (T'dad) Ltd

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Email: inquiries@kaizen-tt.com

PM10 High Volume Sampler Calibration

DATE: Nov 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4734
Serial# : 4734
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

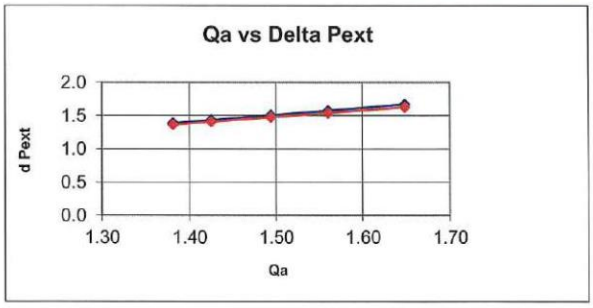
Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext
6.7	1.649	6.4	1.670	1.6299
6	1.561	5.7	1.576	1.5424
5.5	1.495	5.2	1.505	1.4767
5	1.426	4.7	1.431	1.4080
4.7	1.383	4.4	1.385	1.3651

slope, m2:	**1.072142**
intercept, b2:	**-0.097217**
corr. coeff, r2	**0.999999**
SFR	**1.141**
SSP	**2.91**



amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

(iii) TSP Samplers

KAIZEN
Environmental Services (T'dad) Ltd

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Email: inquiries@kaizen-tt.com

TSP High Volume Sampler Calibration

DATE: October 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4728
Serial# : 4728
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

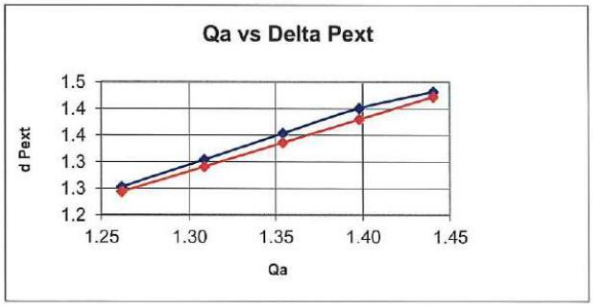
Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext
5.1	1.441	4.7	1.431	1.4220
4.8	1.398	4.5	1.401	1.3795
4.5	1.354	4.2	1.353	1.3357
4.2	1.309	3.9	1.304	1.2905
3.9	1.262	3.6	1.253	1.2435

slope, m2:	**1.014525**
intercept, b2:	**-0.024242**
corr. coeff, r2	**0.997630**
SFR	**1.141**
SSP	**2.94**



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Amrit Persad Maharaj
Instrumentation Technician

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TSP High Volume Sampler Calibration

DATE: October 23rd 2019
Techinician : Amrit Persad Maharaj

Certificate #: 010319-4731
Serial# : 4731
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

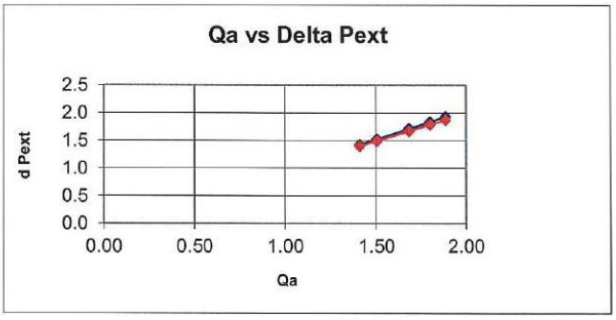
Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.068727**
8.8	1.889	8.5	1.925	1.8679	**intercept, b2:**	**-0.093403**
8	1.801	7.7	1.832	1.7810	**corr. coeff, r2**	**0.999998**
7	1.686	6.7	1.709	1.6660		
5.6	1.509	5.3	1.520	1.4901	**SFR**	**1.141**
4.9	1.413	4.6	1.416	1.3938	**SSP**	**2.91**



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Amrit Persad Maharaj
Instrumentation Technician

KAIZEN
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Email: inquiries@kaizen-tt.com

TSP High Volume Sampler Calibration

DATE: October 23rd 2019
Techinician : Amrit Persad Maharaj

Certificate #: 010319-4730
Serial# : 4730
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

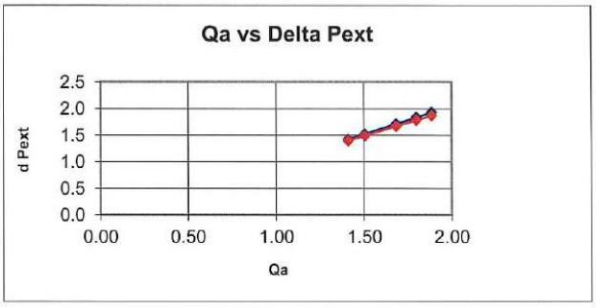
Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.068727**
8.8	1.889	8.5	1.925	1.8679	**intercept, b2:**	**-0.093403**
8	1.801	7.7	1.832	1.7810	**corr. coeff, r2**	**0.999998**
7	1.686	6.7	1.709	1.6660		
5.6	1.509	5.3	1.520	1.4901	**SFR**	**1.141**
4.9	1.413	4.6	1.416	1.3938	**SSP**	**2.91**



amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

(iv) Thermo Scientific ($CO\&H_2S$)

KAIZEN
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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-710821552

DATE: 28/10/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	As Left	Span	Gas Manufacturer	Gas Lot #
0	0	*Air Zero Grade (THC<1ppm)*	CALGAZ	152802
50	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-1108347541

DATE: 28/10/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	As Left	Span	Gas Manufacturer	Gas Lot #
0	0	*Air Zero Grade (THC<1ppm)*	CALGAZ	152802
50	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-1108347540

DATE: 28/10/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	As Left	Span	Gas Manufacturer	Gas Lot #
0	0	*Air Zero Grade (THC<1ppm)*	CALGAZ	152802
50	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

(v) Aeroqual (O_3)

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32159

Calibration Date: 25 Feb 2019 14:51

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1221

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.005	0.110	0.523	0.000
AQL Sensor (Std. Dev) /ppm	0.000	0.001	0.002	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: **Takao Yamasaki**

Date: **25 Feb 2019**

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32151

Calibration Date: 25 Feb 2019 14:50

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1225

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.004	0.109	0.510	0.000
AQL Sensor (Std. Dev) /ppm	0.001	0.001	0.001	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: Takao Yamasaki

Date: 25 Feb 2019

aeroqual

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32142

Calibration Date: 25 Feb 2019 14:50

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1232

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.005	0.113	0.506	0.000
AQL Sensor (Std. Dev) /ppm	0.002	0.001	0.003	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: **Takao Yamasaki**

Date: **25 Feb 2019**

(vi) SKC Pumps (NO_2 and SO_2)

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
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FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-562657

DATE: 27/10/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 562657

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
2.9 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Tel.: (868) 299-0009,
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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-634661

DATE: 27/10/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 634661

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
3.0 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Tel.: (868) 299-0009,
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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-634635

DATE: 27/10/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 634635

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
3.1 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

(vii) Crowncon Gas Detective (VOCs)

KAIZEN
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Rajkumar Street,
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Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-44094
DATE: 2019-10-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 44094

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*
VOC	0	0	10	10	*10 ppm Isobutylene*

TEMPERATURE: 25.8°C

RELATIVE HUMIDITY: 51.6%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-45704
DATE: 2019-10-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 45704

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*
VOC	0	0	10	10	*10 ppm Isobutylene*

TEMPERATURE: 25.8°C

RELATIVE HUMIDITY: 51.5%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-42045
DATE: 2019-10-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 42045

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*
VOC	0	0	10	10	*10 ppm Isobutylene*

TEMPERATURE: 25.9°C

RELATIVE HUMIDITY: 51.4%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

(viii) Analytical Balance

Location:
University of the West Indies
St. Augustine Campus, Trinidad & Tobago
Mailing Address:
Tunapuna Post Office, Trinidad & Tobago
Tel: (868) 299-0210
Fax: (868) 662-7177
Email: cams@cariri.com
Website: www.cariri.com

CARIRI
Caribbean Industrial Research Institute

ACCREDITED
Calibration Laboratory
LAB NO. CL-134

CALIBRATION CERTIFICATE

Date of Issue: September 06, 2018

Certificate No.: C060018

Project No.: EC03834140/18

CLIENT: Kaizen Environmental Services (Trinidad) Ltd.

ADDRESS: Unit 8 Rajkumar Street, Mission Road, Freeport

CALIBRATION LOCATION: Kaizen Environmental Services (Trinidad) Ltd., Balance Room

EQUIPMENT: Electronic Balance

MANUFACTURER: Sartorius

MODEL NO.: AC 210S 00016

SERIAL NO.: 40305246

EQUIPMENT NO.: ASD-EQ-BAL001

CAPACITY/RESOLUTION: 100g / 0.0001g

CALIBRATION TYPE: As Found

CALIBRATION DATE: September 04, 2018

1. This report relates solely to the specific sample of the product which has been analysed or calibrated by CARIRI as the basis for preparing the report. It shall not be used for certification, advertising or marketing of products produced by the same manufacturer or the Client without the prior written consent of the Chief Executive Officer of CARIRI.

2. This report may not be reproduced, other than in full, except with the prior written authorization from the Chief Executive Officer / Chairman of CARIRI.

The uncertainties are for a confidence probability of approximately 95 percent and coverage factor k = 1.96

CARIBBEAN INDUSTRIAL RESEARCH INSTITUTE
CALIBRATION CERTIFICATE

Certificate No.: C060018
Project No.: EC03834140/18

PROCEDURE:
The electronic balance was calibrated in accordance with UKAS Lab 14 and CARIRI's SOP: CAMS.M1

TRACEABILITY:
The values and units of measurement of the reference weights are traceable to the SI (International System of Units), through reference standards maintained at the National Physical Laboratory (England), NIST (USA) and other recognized standards laboratories.

OBSERVATIONS:
The Internal, External and Sensivity calibration functions on the balance are inoperative. As a result these functions could not be used to adjust the balance readout.

AMBIENT CONDITIONS:
Temperature: 25±2°C, Relative Humidity: 70±5%RH

REFERENCE MASS

Serial No.	Weights Applied (g)	Certificate No.	Laboratory No.	Class	Uncertainty (g)
41950	0.005 to 200	M49398	0438	E2	0.0001

REPEATABILITY
Applied Load (g): 100

Unloaded Reading(A)	Loaded Reading (B)	Difference (B-A)	Readability
0.0000	99.8325	99.8325	0.0001
0.0000	99.8326	99.8326	
0.0000	99.8324	99.8324	
0.0000	99.8325	99.8325	
0.0000	99.8324	99.8324	
0.0000	99.8325	99.8325	
0.0000	99.8326	99.8326	
0.0000	99.8327	99.8327	
0.0000	99.8327	99.8327	
0.0000	99.8325	99.8325	

Standard Deviation (g): 0.0001

LINEARITY

Applied Load (g)	Indicated Reading (g)	Error
0.005	0.0051	0.0001
0.02	0.0201	0.0001
0.1	0.1003	0.0003
1	0.9984	-0.0016
5	4.9918	-0.0082
20	19.9663	-0.0337
30	29.9499	-0.0501
50	49.9163	-0.0837
70	69.8829	-0.1171
100	99.8327	-0.1673

Maximum Error (g): 0.1673

CARIBBEAN INDUSTRIAL RESEARCH INSTITUTE
CALIBRATION CERTIFICATE

Certificate No.: C060018
Project No.: EC03834140/18

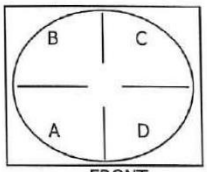
ECCENTRICITY

Applied Load (g): 20

Position	Reading (g)
Front Left (A)	19.9657
Rear Left (B)	19.1502
Rear Right (C)	19.9663
Front Right (D)	19.9669

Maximum deviation across balance pan (g): 0.8167

Uncertainty of Calibration (g): ±0.46210



Calibrator: N. Jonas

Signature: .....

Approved Signatory: M. Andrews

Signature: .....

End of Certificate

B. Map of Monitoring Location


Location 3
N
Location 2
Location 5
Diego Martin Hwy
Location 4
Main Rd
Location 1
Western Main Rd

C. Accreditation Certificates

TT LABS
TRINIDAD AND TOBAGO
laboratory
Accreditation
Service

CERTIFICATE OF ACCREDITATION

KAIZEN ENVIRONMENTAL SERVICES (TRINIDAD) LTD

Testing Laboratory No.: LAS-005

is an accredited Laboratory which fulfils the requirements of ISO/IEC 17025 and has demonstrated competence to carry out tests as per a defined scope for:

CHEMICAL AND MICROBIOLOGICAL TESTING

as per attached schedule

While this certificate remains valid, the Accredited Laboratory named above is authorized to issue TTLABS-endorsed certificates.

Karlene Carolyn Lewis
Manager, TTLABS

"Recognised as the official national laboratory accrediting body by the Ministry of Trade, Industry, Investment and Communication of the Republic of Trinidad and Tobago"

Initial Accreditation date: 3rd September 2014

This certificate issued on: 21st September 2017

"This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrated technical competence for a defined scope and the operation of a laboratory quality management system. (refer to joint ISO-ILAC-IAF Communiqué dated 18 June 2005)"

Canadian Association
for Laboratory Accreditation Inc.

CALA

Certificate of Accreditation

Kaizen Lab
KaizenLAB Inc.
333-50th Ave. S.E.
Calgary, Alberta

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

Accreditation No.: A2925
Issued On: October 17, 2017
Accreditation Date: January 31, 2005
Expiry Date: April 16, 2020

Andrew M. Adams
President & CEO

CALA

This certificate is the property of the Canadian Association for Laboratory Accreditation Inc. and must be returned on request. Reproduction must follow policy in place at date of issue. For the specific tests to which this accreditation applies, please refer to the laboratory's scope of accreditation at www.cala.ca

D. Laboratory Data

(i) Chain of Custody

PROJECTServices

A DIVISION OF KAIZEN ENVIRONMENTAL SERVICES LIMITED

Unit # 8, Rajkumar Street, Mission Road, Freeport, Trinidad, W.I.
Tel: (868) 299-0009 Fax: (868) 673-5997

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

Kaizen Lab File #: 427647-1-5 № PSD 1705

Date Submitted: 27/11/2019 | Date Required: 04/12/2019

Service Requested:
- Regular (10 days) ☐
- Rush (within 5 days) + 25% ☑
- Priority (3 days) + 50% ☐
- Emergency (next day) + 100% ☐

ANALYSIS REQUESTED

SAMPLE ID	DATE SAMPLED	SAMPLED TYPE	NOx 427647	
Eco Engineering				
Diego Martin				
-Loc 1	26/11/2019		✓	-1
-Loc 2	25/11/2019	NOx Absorbing	✓	-2
-Loc 3	25/11/2019	Solution	✓	-3
-Loc 4	25/11/2019		✓	-4
-Loc 5	26/11/2019		✓	-5

Client: Henry Lue Fatt Phone: Same As Above
Contact: Fax:
Report Address: P.O.#:
Client Job #:
Billing Address: # Samples Submitted: 5
Preservatives:
Special Requests:

Relinquished By: A. Chariah
Date: 27/11/2019
Time: 1600h

Received By: Brent [illegible]
Date: 28/11/19
Time: 12:14PM

Sample Condition Upon Receipt:
Frozen ☐ Cold ☐ Ambient ☐ Head Space (yes/no):
Other (breakage, leakage, illegible etc.):

SAMPLED BY: A. Chariah
NAME IN BLOCK LETTERS
A. [signature]
SIGNATURE

DATE: 27/11/2019

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Pronto 652-3577

PROJECTServices

A DIVISION OF KAIZEN ENVIRONMENTAL SERVICES LIMITED

Unit # 8, Rajkumar Street, Mission Road, Freeport, Trinidad, W.I.
Tel: (868) 299-0009 Fax: (868) 673-5997

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

Kaizen Lab File #: No PSD 1706

Date Submitted: 27/11/2019 Date Required: 04/12/2019

Service Requested:
- Regular (10 days) ☐
- Rush (within 5 days) + 25% ☑
- Priority (3 days) + 50% ☐
- Emergency (next day) + 100% ☐

ANALYSIS REQUESTED

SAMPLE ID	DATE SAMPLED	SAMPLED TYPE	SO2
Eco Engineering			
Diego Martin			
- Loc 1	26/11/2019		✓
- Loc 2	25/11/2019	SO_2 Absorbing Solution	✓
- Loc 3	25/11/2019		✓
- Loc 4	25/11/2019		✓
- Loc 5	26/11/2019		✓

Client: Henry Lee Tatt Phone: Same As Above
Contact: Fax:
Report Address: P.O.#:
Client Job #:
Billing Address: # Samples Submitted: 5
Preservatives:
Special Requests:

Relinquished By: A. Chariah	Received By:
Date: 27/11/2019	Date:
Time: 1600h	Time:

Sample Condition Upon Receipt:
Frozen ☐ Cold ☐ Ambient ☐ Head Space (yes/no):
Other (breakage, leakage, illegible etc.):

SAMPLED BY: A. Chariah (NAME IN BLOCK LETTERS)
A. (SIGNATURE)

DATE: 27/11/2019

Pronto 652-3577

White - File Copy Yellow - Lab Copy

(ii) Analytical Results

333 50th Ave. S.E.
Calgary, AB, T2G 2B3
Phone (403) 297-0868
Fax: (403) 297-0869

KaizenLAB

ANALYTICAL REPORT

Client: Kaizen Environmental Services (Trinidad) Ltd.
Unit 8, Rajkumar Street, Mission Road
Freeport, Trinidad, West Indies

Attention: Henry Lue-Fatt

KaizenLAB JOB #:	304159
DATE RECEIVED:	03-Dec-2019
DATE REPORTED:	06-Dec-2019
PROJECT ID:	Eco-Engineering Diego Martin
LOCATION:	

KaizenLAB Sample #: 304159_001 **Sample ID:** Loc 1
Date Sampled: 26-Nov-2019 **Matrix:** LIQUID

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 304159_002 **Sample ID:** Loc 2
Date Sampled: 25-Nov-2019 **Matrix:** LIQUID

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 304159_003 **Sample ID:** Loc 3
Date Sampled: 25-Nov-2019 **Matrix:** LIQUID

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 304159_004 **Sample ID:** Loc 4
Date Sampled: 25-Nov-2019 **Matrix:** LIQUID

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 304159_005 **Sample ID:** Loc 5
Date Sampled: 26-Nov-2019 **Matrix:** LIQUID

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

333 50th Ave. S.E.
Calgary, AB, T2G 2B3
Phone (403) 297-0868
Fax: (403) 297-0869

KaizenLAB

Test Methodologies

SO2 in Water - Determination of SO2 Absorbed in Potassium Trichlormercurate

Final Review by:

Zakia Biswas
Client Service Representative / Project Coordinator

Note: The results in this report relate only to the items tested and as received. Information is available for any items in 7.8.2.1 of ISO/IEC 17025:2017 that cannot be put on a test report. The report shall not be reproduced except in full without written approval of KaizenLAB. The validity of results may be affected if the information is provided by the customer.

KaizenLAB
Analytical Division of Kaizen Environmental Services (Trinidad) Ltd.

Unit 8 Rajkumar Street,
Mission Road, Freeport.
Email: kaizenlab@kaizen-tt.com
Tel: (868) 299-0009
Fax: (868) 673-6774

ANALYSIS DATA REPORT

Customer:	KESTL- PSD	**Customer Contact:**	Henry Lue-Fatt
Customer's Address:	Unit 8 Rajkumar Street, Mission Road, Freeport.		
Client Project #:	19-002	**Lab File #:**	427647
Item(s) Analyzed:	Liquid Samples		
Date of Sampling:	25-Nov-19 & 26-Nov-19	**Sampling Location:**	Eco Engineering (Diego Martin)
Sampling Condition:	n/a	**Sampled By:**	PSD Staff - A. Chariah
Sampling Plan Used:	n/a		
Date of Receipt:	28-Nov-19	**Date of Testing:**	28-Nov-19
Report Date:	28-Nov-19		

ANALYSIS RESULTS

Analysis: Nitrite-N

Sample ID	Units	Results
		Nitrite-N
427647-1, Loc 1	mg/L	<0.04
427647-2, Loc 2	mg/L	<0.04
427647-3, Loc 3	mg/L	<0.04
427647-4, Loc 4	mg/L	<0.04
427647-5, Loc 5	mg/L	<0.04

** Detailed Test Methodologies and QA/QC data available upon request.*

***Test Methodologies:** Nitrite-N: EPA-EQN-1277-026

Discussion: None

Comments: The results in this test report relate only to the items as received and tested.

Report Authorized by: Devika Rooplal
Devika Rooplal
Laboratory Manager

This test report shall not be reproduced except in full, without written approval of the laboratory.

E. Comparative Study – Ozone (O_3)

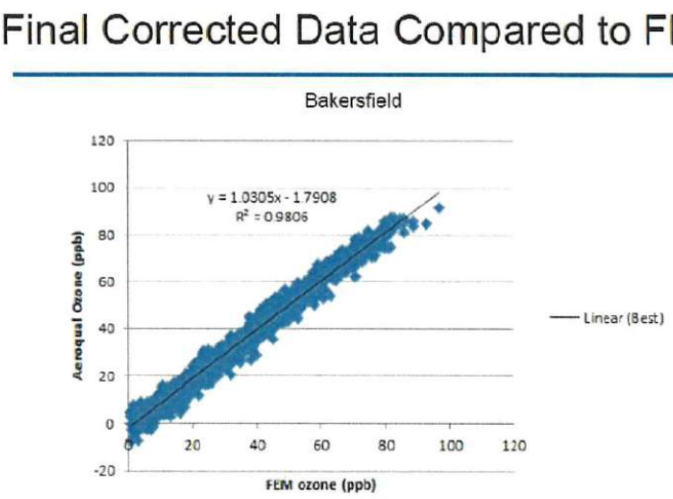
The Aeroqual's Series 500 portable ozone monitors were chosen by an air quality consultancy based in California, USA to better understand the spatial and temporal distribution of ozone in an area.

Twenty three monitors were co-located next to a federal reference method (FEM) monitoring stations to check their precision and accuracy before being distributed across an area of about 100 square miles. The monitors collected and transmitted ozone concentrations every minute for six weeks. Afterwards the monitors were co-located with reference monitoring stations to quantify drift. The data was analyzed and a report was produced.

Co-location of the Series 500 monitors established accuracy to within +/- 3 ppb of the federal reference monitors. See example in figure below.
The study demonstrated that there are strong spatial gradients in ozone over short distances even in rural areas. In addition, the new site at Di Giorgio actually measures higher concentrations than the old Bear Mountain site, and therefore is a good replacement site. In addition, it was determined that the new site was representative of concentrations experienced in the city of Arvin and is therefore useful for real-time warnings regarding poor air quality for citizens in Arvin.
The results of this study provide important supporting evidence for the District's formal attainment request to EPA. In addition the study provides a strong scientific foundation for future decision making about managing the air resources of the San Joaquin Valley.

The final report can be found at:
http://www.valleyair.org/Air_Quality_Plans/docs/2013Attainment/OzoneSaturationStudy.pdf.

Data is courtesy of STI, 2013.



F. Raw Data

(i) Carbon Monoxide (CO)

CO DATA

Location 1		Location 2		Location 3	
Date Time	co	Date Time	co	Date Time	co
26/11/2019 15:30	1222.795	25/11/2019 11:30	1080.716	25/11/2019 12:30	1010.279
26/11/2019 15:45	1287.457	25/11/2019 11:45	1161.396	25/11/2019 12:45	1247.066
26/11/2019 16:00	1145.969	25/11/2019 12:00	974.872	25/11/2019 13:00	1210.625
26/11/2019 16:15	1103.167	25/11/2019 12:15	1160.787	25/11/2019 13:15	1068.593
26/11/2019 16:30	1236.494	25/11/2019 12:30	894.337	25/11/2019 13:30	1100.150
26/11/2019 16:45	1201.736	25/11/2019 12:45	983.197	25/11/2019 13:45	1213.164
26/11/2019 17:00	1097.266	25/11/2019 13:00	1263.702	25/11/2019 14:00	926.830
26/11/2019 17:15	880.169	25/11/2019 13:15	1093.935	25/11/2019 14:15	926.046
26/11/2019 17:30	1064.665	25/11/2019 13:30	856.822	25/11/2019 14:30	1145.146
26/11/2019 17:45	1189.783	25/11/2019 13:45	1284.818	25/11/2019 14:45	1279.355
26/11/2019 18:00	1037.589	25/11/2019 14:00	1288.139	25/11/2019 15:00	881.23
26/11/2019 18:15	1211.045	25/11/2019 14:15	883.837	25/11/2019 15:15	935.157
26/11/2019 18:30	826.875	25/11/2019 14:30	1041.284	25/11/2019 15:30	1130.746
26/11/2019 18:45	639.695	25/11/2019 14:45	1217.254	25/11/2019 15:45	1257.552
26/11/2019 19:00	686.914	25/11/2019 15:00	1207.414	25/11/2019 16:00	979.763
26/11/2019 19:15	723.555	25/11/2019 15:15	927.362	25/11/2019 16:15	1007.473
26/11/2019 19:30	669.989	25/11/2019 15:30	951.543	25/11/2019 16:30	988.443
26/11/2019 19:45	618.054	25/11/2019 15:45	1257.946	25/11/2019 16:45	990.959
26/11/2019 20:00	937.992	25/11/2019 16:00	929.729	25/11/2019 17:00	856.873
26/11/2019 20:15	855.906	25/11/2019 16:15	1163.663	25/11/2019 17:15	1276.308
26/11/2019 20:30	770.996	25/11/2019 16:30	1227.074	25/11/2019 17:30	942.958
26/11/2019 20:45	562.319	25/11/2019 16:45	886.395	25/11/2019 17:45	1206.769
26/11/2019 21:00	935.119	25/11/2019 17:00	575.345	25/11/2019 18:00	982.322
26/11/2019 21:15	586.461	25/11/2019 17:15	890.15	25/11/2019 18:15	1193.044
26/11/2019 21:30	559.983	25/11/2019 17:30	882.854	25/11/2019 18:30	835.277
26/11/2019 21:45	998.005	25/11/2019 17:45	978.042	25/11/2019 18:45	505.144
26/11/2019 22:00	633.744	25/11/2019 18:00	932.925	25/11/2019 19:00	693.232
26/11/2019 22:15	663.682	25/11/2019 18:15	649.945	25/11/2019 19:15	896.915
26/11/2019 22:30	768.172	25/11/2019 18:30	789.2	25/11/2019 19:30	799.209
26/11/2019 22:45	839.420	25/11/2019 18:45	997.415	25/11/2019 19:45	595.229
26/11/2019 23:00	829.328	25/11/2019 19:00	965.082	25/11/2019 20:00	873.962
26/11/2019 23:15	556.791	25/11/2019 19:15	655.011	25/11/2019 20:15	817.077
26/11/2019 23:30	730.488	25/11/2019 19:30	901.02	25/11/2019 20:30	857.936
26/11/2019 23:45	782.897	25/11/2019 19:45	670.977	25/11/2019 20:45	742.391
27/11/2019 00:00	895.282	25/11/2019 20:00	780.491	25/11/2019 21:00	518.248
27/11/2019 00:15	985.046	25/11/2019 20:15	810.371	25/11/2019 21:15	500.66
27/11/2019 00:30	673.883	25/11/2019 20:30	863.075	25/11/2019 21:30	532.529
27/11/2019 00:45	821.448	25/11/2019 20:45	843.418	25/11/2019 21:45	553.54
27/11/2019 01:00	789.288	25/11/2019 21:00	619.683	25/11/2019 22:00	875.393
27/11/2019 01:15	871.611	25/11/2019 21:15	620.003	25/11/2019 22:15	872.957
27/11/2019 01:30	741.044	25/11/2019 21:30	800.878	25/11/2019 22:30	674.286
27/11/2019 01:45	969.743	25/11/2019 21:45	856.45	25/11/2019 22:45	848.976
27/11/2019 02:00	891.454	25/11/2019 22:00	996.307	25/11/2019 23:00	521.261
27/11/2019 02:15	661.163	25/11/2019 22:15	870.195	25/11/2019 23:15	817.387

27/11/2019 02:30	769.259	25/11/2019 22:30	778.284	25/11/2019 23:30	510.215
27/11/2019 02:45	647.644	25/11/2019 22:45	947.237	25/11/2019 23:45	638.532
27/11/2019 03:00	585.514	25/11/2019 23:00	752.928	26/11/2019 00:00	541.049
27/11/2019 03:15	921.540	25/11/2019 23:15	813.326	26/11/2019 00:15	803.783
27/11/2019 03:30	899.284	25/11/2019 23:30	833.724	26/11/2019 00:30	559.113
27/11/2019 03:45	948.474	25/11/2019 23:45	635.631	26/11/2019 00:45	463.593
27/11/2019 04:00	913.352	26/11/2019 00:00	878.881	26/11/2019 01:00	772.5
27/11/2019 04:15	719.978	26/11/2019 00:15	659.166	26/11/2019 01:15	538.617
27/11/2019 04:30	596.015	26/11/2019 00:30	860.051	26/11/2019 01:30	839.11
27/11/2019 04:45	925.306	26/11/2019 00:45	731.724	26/11/2019 01:45	682.531
27/11/2019 05:00	989.762	26/11/2019 01:00	751.029	26/11/2019 02:00	835.424
27/11/2019 05:15	739.121	26/11/2019 01:15	612.908	26/11/2019 02:15	858.005
27/11/2019 05:30	712.535	26/11/2019 01:30	596.286	26/11/2019 02:30	808.3
27/11/2019 05:45	388.407	26/11/2019 01:45	682.73	26/11/2019 02:45	464.532
27/11/2019 06:00	632.934	26/11/2019 02:00	628.659	26/11/2019 03:00	871.443
27/11/2019 06:15	749.860	26/11/2019 02:15	796.579	26/11/2019 03:15	712.755
27/11/2019 06:30	383.789	26/11/2019 02:30	861.797	26/11/2019 03:30	679.331
27/11/2019 06:45	558.407	26/11/2019 02:45	937.486	26/11/2019 03:45	533.484
27/11/2019 07:00	525.738	26/11/2019 03:00	762.281	26/11/2019 04:00	679.223
27/11/2019 07:15	579.725	26/11/2019 03:15	647.891	26/11/2019 04:15	600.788
27/11/2019 07:30	700.399	26/11/2019 03:30	726.642	26/11/2019 04:30	620.945
27/11/2019 07:45	666.976	26/11/2019 03:45	643.387	26/11/2019 04:45	848.53
27/11/2019 08:00	520.003	26/11/2019 04:00	691.392	26/11/2019 05:00	492.572
27/11/2019 08:15	521.375	26/11/2019 04:15	961.862	26/11/2019 05:15	471.077
27/11/2019 08:30	455.458	26/11/2019 04:30	635.837	26/11/2019 05:30	879.066
27/11/2019 08:45	719.650	26/11/2019 04:45	661.075	26/11/2019 05:45	820.104
27/11/2019 09:00	673.091	26/11/2019 05:00	757.723	26/11/2019 06:00	1202.989
27/11/2019 09:15	594.568	26/11/2019 05:15	582.374	26/11/2019 06:15	1246.429
27/11/2019 09:30	387.360	26/11/2019 05:30	986.31	26/11/2019 06:30	1285.76
27/11/2019 09:45	1022.156	26/11/2019 05:45	814.627	26/11/2019 06:45	1075.832
27/11/2019 10:00	898.822	26/11/2019 06:00	973.764	26/11/2019 07:00	996.927
27/11/2019 10:15	1250.856	26/11/2019 06:15	668.69	26/11/2019 07:15	889.445
27/11/2019 10:30	1113.280	26/11/2019 06:30	792.607	26/11/2019 07:30	932.434
27/11/2019 10:45	1293.817	26/11/2019 06:45	560.587	26/11/2019 07:45	1194.297
27/11/2019 11:00	1178.313	26/11/2019 07:00	1037.768	26/11/2019 08:00	1030.893
27/11/2019 11:15	873.958	26/11/2019 07:15	972.092	26/11/2019 08:15	945.136
27/11/2019 11:30	936.342	26/11/2019 07:30	972.823	26/11/2019 08:30	1056.688
27/11/2019 11:45	1073.174	26/11/2019 07:45	869.421	26/11/2019 08:45	1023.875
27/11/2019 12:00	944.307	26/11/2019 08:00	1088.447	26/11/2019 09:00	1171.69
27/11/2019 12:15	1003.350	26/11/2019 08:15	990.847	26/11/2019 09:15	1200.108
27/11/2019 12:30	1195.949	26/11/2019 08:30	1268.818	26/11/2019 09:30	884.79
27/11/2019 12:45	1015.971	26/11/2019 08:45	1162.993	26/11/2019 09:45	1105.745
27/11/2019 13:00	998.910	26/11/2019 09:00	1168.43	26/11/2019 10:00	1131.331
27/11/2019 13:15	1149.399	26/11/2019 09:15	1014.85	26/11/2019 10:15	895.24
27/11/2019 13:30	1280.677	26/11/2019 09:30	1228.941	26/11/2019 10:30	1002.855
27/11/2019 13:45	1180.962	26/11/2019 09:45	1146.158	26/11/2019 10:45	1215.85
27/11/2019 14:00	1168.268	26/11/2019 10:00	1060.428	26/11/2019 11:00	1262.525

27/11/2019 14:15	1052.310	26/11/2019 10:15	1250.668	26/11/2019 11:15	942.778
27/11/2019 14:30	1143.644	26/11/2019 10:30	1155.154	26/11/2019 11:30	984.828
27/11/2019 14:45	1086.043	26/11/2019 10:45	1106.266	26/11/2019 11:45	1250.71
27/11/2019 15:00	985.784	26/11/2019 11:00	1039.177	26/11/2019 12:00	1235.275
27/11/2019 15:15	1157.747	26/11/2019 11:15	1121.407	26/11/2019 12:15	1091.878

CO DATA (Continued)

Location 4		Location 5	
Date Time	co	Date Time	co
25/11/2019 13:30	934.988	26/11/2019 15:00	851.667
25/11/2019 13:45	1223.671	26/11/2019 15:15	1049.942
25/11/2019 14:00	891.074	26/11/2019 15:30	974.910
25/11/2019 14:15	994.492	26/11/2019 15:45	1239.555
25/11/2019 14:30	1007.004	26/11/2019 16:00	1010.104
25/11/2019 14:45	1071.859	26/11/2019 16:15	952.994
25/11/2019 15:00	1058.441	26/11/2019 16:30	968.611
25/11/2019 15:15	1113.608	26/11/2019 16:45	1062.175
25/11/2019 15:30	851.862	26/11/2019 17:00	1276.343
25/11/2019 15:45	1194.933	26/11/2019 17:15	879.71
25/11/2019 16:00	983.783	26/11/2019 17:30	653.36
25/11/2019 16:15	1295.694	26/11/2019 17:45	454.574
25/11/2019 16:30	1073.102	26/11/2019 18:00	495.909
25/11/2019 16:45	1227.995	26/11/2019 18:15	503.235
25/11/2019 17:00	1272.763	26/11/2019 18:30	663.85
25/11/2019 17:15	500.545	26/11/2019 18:45	861.842
25/11/2019 17:30	838.287	26/11/2019 19:00	648.306
25/11/2019 17:45	628.084	26/11/2019 19:15	748.477
25/11/2019 18:00	573.846	26/11/2019 19:30	702.274
25/11/2019 18:15	684.028	26/11/2019 19:45	830.138
25/11/2019 18:30	559.468	26/11/2019 20:00	578.556
25/11/2019 18:45	611.415	26/11/2019 20:15	460.297
25/11/2019 19:00	804.47	26/11/2019 20:30	564.119
25/11/2019 19:15	852.674	26/11/2019 20:45	786.794
25/11/2019 19:30	460.626	26/11/2019 21:00	899.841
25/11/2019 19:45	885.036	26/11/2019 21:15	569.039
25/11/2019 20:00	668.67	26/11/2019 21:30	769.45
25/11/2019 20:15	739.299	26/11/2019 21:45	620.379
25/11/2019 20:30	580.915	26/11/2019 22:00	627.533
25/11/2019 20:45	683.537	26/11/2019 22:15	742.748
25/11/2019 21:00	452.957	26/11/2019 22:30	701.359
25/11/2019 21:15	877.216	26/11/2019 22:45	667.842
25/11/2019 21:30	491.782	26/11/2019 23:00	570.725
25/11/2019 21:45	525.97	26/11/2019 23:15	778.84
25/11/2019 22:00	547.253	26/11/2019 23:30	523.246
25/11/2019 22:15	553.997	26/11/2019 23:45	781.87
25/11/2019 22:30	743.049	27/11/2019 00:00	534.85
25/11/2019 22:45	717.712	27/11/2019 00:15	565.647
25/11/2019 23:00	715.258	27/11/2019 00:30	809.57
25/11/2019 23:15	494.35	27/11/2019 00:45	585.262
25/11/2019 23:30	636.431	27/11/2019 01:00	597.697
25/11/2019 23:45	756.628	27/11/2019 01:15	801.967
26/11/2019 00:00	766.113	27/11/2019 01:30	609.335
26/11/2019 00:15	678.661	27/11/2019 01:45	528.729

26/11/2019 00:30	826.982	27/11/2019 02:00	859.952
26/11/2019 00:45	712.66	27/11/2019 02:15	451.588
26/11/2019 01:00	657.355	27/11/2019 02:30	528.291
26/11/2019 01:15	595.875	27/11/2019 02:45	657.742
26/11/2019 01:30	794.057	27/11/2019 03:00	750.535
26/11/2019 01:45	680.574	27/11/2019 03:15	628.212
26/11/2019 02:00	594.335	27/11/2019 03:30	476.945
26/11/2019 02:15	825.602	27/11/2019 03:45	738.374
26/11/2019 02:30	714.363	27/11/2019 04:00	844.241
26/11/2019 02:45	475.186	27/11/2019 04:15	633.599
26/11/2019 03:00	744.987	27/11/2019 04:30	527.957
26/11/2019 03:15	647.792	27/11/2019 04:45	864.008
26/11/2019 03:30	899.857	27/11/2019 05:00	559.458
26/11/2019 03:45	610.234	27/11/2019 05:15	1023.073
26/11/2019 04:00	890.901	27/11/2019 05:30	1165.214
26/11/2019 04:15	835.553	27/11/2019 05:45	1280.073
26/11/2019 04:30	609.898	27/11/2019 06:00	934.418
26/11/2019 04:45	828.324	27/11/2019 06:15	1107.619
26/11/2019 05:00	856.917	27/11/2019 06:30	1037.145
26/11/2019 05:15	1259.552	27/11/2019 06:45	1018.989
26/11/2019 05:30	1050.711	27/11/2019 07:00	929.68
26/11/2019 05:45	1146.228	27/11/2019 07:15	1215.949
26/11/2019 06:00	1291.919	27/11/2019 07:30	946.75
26/11/2019 06:15	1233.544	27/11/2019 07:45	1062.631
26/11/2019 06:30	1265.757	27/11/2019 08:00	1167.231
26/11/2019 06:45	1161.322	27/11/2019 08:15	941.62
26/11/2019 07:00	1007.966	27/11/2019 08:30	1212.224
26/11/2019 07:15	1072.807	27/11/2019 08:45	921.882
26/11/2019 07:30	1191.084	27/11/2019 09:00	1275.631
26/11/2019 07:45	900.709	27/11/2019 09:15	1207.677
26/11/2019 08:00	1017.92	27/11/2019 09:30	1095.714
26/11/2019 08:15	1161.74	27/11/2019 09:45	1082.008
26/11/2019 08:30	882.203	27/11/2019 10:00	1194.716
26/11/2019 08:45	1238.238	27/11/2019 10:15	881.874
26/11/2019 09:00	1115.432	27/11/2019 10:30	1010.656
26/11/2019 09:15	1190.78	27/11/2019 10:45	984.725
26/11/2019 09:30	900.833	27/11/2019 11:00	1107.092
26/11/2019 09:45	1233.131	27/11/2019 11:15	982.873
26/11/2019 10:00	1079.745	27/11/2019 11:30	1146.989
26/11/2019 10:15	1167.064	27/11/2019 11:45	1263.293
26/11/2019 10:30	1224.43	27/11/2019 12:00	1019.933
26/11/2019 10:45	878.899	27/11/2019 12:15	861.197
26/11/2019 11:00	1141.333	27/11/2019 12:30	1120.487
26/11/2019 11:15	877.084	27/11/2019 12:45	1207.888
26/11/2019 11:30	923.319	27/11/2019 13:00	885.034
26/11/2019 11:45	1142.849	27/11/2019 13:15	1067.848
26/11/2019 12:00	1195.128	27/11/2019 13:30	1270.927

26/11/2019 12:15	1124.495	27/11/2019 13:45	1062.337
26/11/2019 12:30	884.293	27/11/2019 14:00	1082.42
26/11/2019 12:45	950.827	27/11/2019 14:15	904.894
26/11/2019 13:00	1267.087	27/11/2019 14:30	1041.679
26/11/2019 13:15	1272.833	27/11/2019 14:45	1033.691

(ii) Volatile Organic Compounds (VOCs)

VOC DATA

Location 1		Location 2		Location 3	
Date/Time		Date/Time		Date/Time	
Tue Nov 26 2019 15:30:00	0.2	Mon Nov 25 2019 11:30:00	0.1	Mon Nov 25 2019 12:30:00	0.2
Tue Nov 26 2019 16:00:00	0.2	Mon Nov 25 2019 12:00:00	0.2	Mon Nov 25 2019 13:00:00	0.0
Tue Nov 26 2019 16:30:00	0.1	Mon Nov 25 2019 12:30:00	0.1	Mon Nov 25 2019 13:30:00	0.2
Tue Nov 26 2019 17:00:00	0.2	Mon Nov 25 2019 13:00:00	0.0	Mon Nov 25 2019 14:00:00	0.0
Tue Nov 26 2019 17:30:00	0.1	Mon Nov 25 2019 13:30:00	0.1	Mon Nov 25 2019 14:30:00	0.0
Tue Nov 26 2019 18:00:00	0.2	Mon Nov 25 2019 14:00:00	0.2	Mon Nov 25 2019 15:00:00	0.0
Tue Nov 26 2019 18:30:00	0.0	Mon Nov 25 2019 14:30:00	0.2	Mon Nov 25 2019 15:30:00	0.1
Tue Nov 26 2019 19:00:00	0.0	Mon Nov 25 2019 15:00:00	0.0	Mon Nov 25 2019 16:00:00	0.1
Tue Nov 26 2019 19:30:00	0.1	Mon Nov 25 2019 15:30:00	0.2	Mon Nov 25 2019 16:30:00	0.1
Tue Nov 26 2019 20:00:00	0.2	Mon Nov 25 2019 16:00:00	0.0	Mon Nov 25 2019 17:00:00	0.2
Tue Nov 26 2019 20:30:00	0.1	Mon Nov 25 2019 16:30:00	0.2	Mon Nov 25 2019 17:30:00	0.1
Tue Nov 26 2019 21:00:00	0.0	Mon Nov 25 2019 17:00:00	0.0	Mon Nov 25 2019 18:00:00	0.1
Tue Nov 26 2019 21:30:00	0.0	Mon Nov 25 2019 17:30:00	0.2	Mon Nov 25 2019 18:30:00	0.2
Tue Nov 26 2019 22:00:00	0.2	Mon Nov 25 2019 18:00:00	0.2	Mon Nov 25 2019 19:00:00	0.1
Tue Nov 26 2019 22:30:00	0.0	Mon Nov 25 2019 18:30:00	0.1	Mon Nov 25 2019 19:30:00	0.1
Tue Nov 26 2019 23:00:00	0.1	Mon Nov 25 2019 19:00:00	0.1	Mon Nov 25 2019 20:00:00	0.2
Tue Nov 26 2019 23:30:00	0.2	Mon Nov 25 2019 19:30:00	0.2	Mon Nov 25 2019 20:30:00	0.1
Wed Nov 27 2019 00:00:00	0.2	Mon Nov 25 2019 20:00:00	0.2	Mon Nov 25 2019 21:00:00	0.1
Wed Nov 27 2019 00:30:00	0.2	Mon Nov 25 2019 20:30:00	0.1	Mon Nov 25 2019 21:30:00	0.1
Wed Nov 27 2019 01:00:00	0.1	Mon Nov 25 2019 21:00:00	0.1	Mon Nov 25 2019 22:00:00	0.0
Wed Nov 27 2019 01:30:00	0.1	Mon Nov 25 2019 21:30:00	0.1	Mon Nov 25 2019 22:30:00	0.1
Wed Nov 27 2019 02:00:00	0.0	Mon Nov 25 2019 22:00:00	0.0	Mon Nov 25 2019 23:00:00	0.0
Wed Nov 27 2019 02:30:00	0.0	Mon Nov 25 2019 22:30:00	0.1	Mon Nov 25 2019 23:30:00	0.1
Wed Nov 27 2019 03:00:00	0.1	Mon Nov 25 2019 23:00:00	0.1	Tue Nov 26 2019 00:00:00	0.2
Wed Nov 27 2019 03:30:00	0.1	Mon Nov 25 2019 23:30:00	0.2	Tue Nov 26 2019 00:30:00	0.0
Wed Nov 27 2019 04:00:00	0.0	Tue Nov 26 2019 00:00:00	0.1	Tue Nov 26 2019 01:00:00	0.0
Wed Nov 27 2019 04:30:00	0.0	Tue Nov 26 2019 00:30:00	0.0	Tue Nov 26 2019 01:29:59	0.0
Wed Nov 27 2019 05:00:00	0.0	Tue Nov 26 2019 01:00:00	0.2	Tue Nov 26 2019 01:59:59	0.1
Wed Nov 27 2019 05:30:00	0.1	Tue Nov 26 2019 01:30:00	0.0	Tue Nov 26 2019 02:29:59	0.0
Wed Nov 27 2019 06:00:00	0.1	Tue Nov 26 2019 02:00:00	0.0	Tue Nov 26 2019 02:59:59	0.2
Wed Nov 27 2019 06:30:00	0.1	Tue Nov 26 2019 02:30:00	0.1	Tue Nov 26 2019 03:29:59	0.2
Wed Nov 27 2019 07:00:00	0.1	Tue Nov 26 2019 03:00:00	0.2	Tue Nov 26 2019 03:59:59	0.1
Wed Nov 27 2019 07:30:00	0.1	Tue Nov 26 2019 03:30:00	0.2	Tue Nov 26 2019 04:29:59	0.1
Wed Nov 27 2019 08:00:00	0.1	Tue Nov 26 2019 04:00:00	0.1	Tue Nov 26 2019 04:59:59	0.1
Wed Nov 27 2019 08:30:00	0.1	Tue Nov 26 2019 04:30:00	0.2	Tue Nov 26 2019 05:29:59	0.1
Wed Nov 27 2019 09:00:00	0.1	Tue Nov 26 2019 05:00:00	0.0	Tue Nov 26 2019 05:59:59	0.1
Wed Nov 27 2019 09:30:00	0.1	Tue Nov 26 2019 05:30:00	0.1	Tue Nov 26 2019 06:29:59	0.2
Wed Nov 27 2019 10:00:00	0.2	Tue Nov 26 2019 06:00:00	0.1	Tue Nov 26 2019 06:59:59	0.2
Wed Nov 27 2019 10:30:00	0.1	Tue Nov 26 2019 06:30:00	0.0	Tue Nov 26 2019 07:29:59	0.0
Wed Nov 27 2019 11:00:00	0.2	Tue Nov 26 2019 07:00:00	0.0	Tue Nov 26 2019 07:59:59	0.1
Wed Nov 27 2019 11:30:00	0.0	Tue Nov 26 2019 07:30:00	0.1	Tue Nov 26 2019 08:29:59	0.0
Wed Nov 27 2019 12:00:00	0.1	Tue Nov 26 2019 08:00:00	0.1	Tue Nov 26 2019 08:59:59	0.1
Wed Nov 27 2019 12:30:00	0.1	Tue Nov 26 2019 08:30:00	0.0	Tue Nov 26 2019 09:29:59	0.1
Wed Nov 27 2019 13:00:00	0.1	Tue Nov 26 2019 09:00:00	0.2	Tue Nov 26 2019 09:59:59	0.2

Wed Nov 27 2019 13:30:00	0.2	Tue Nov 26 2019 09:30:00	0.0	Tue Nov 26 2019 10:29:59	0.1
Wed Nov 27 2019 14:00:00	0.0	Tue Nov 26 2019 10:00:00	0.0	Tue Nov 26 2019 10:59:59	0.2
Wed Nov 27 2019 14:30:00	0.2	Tue Nov 26 2019 10:30:00	0.2	Tue Nov 26 2019 11:29:59	0.0
Wed Nov 27 2019 15:00:00	0.2	Tue Nov 26 2019 11:00:00	0.1	Tue Nov 26 2019 11:59:59	0.0

VOC DATA (Continued)

Location 4		Location 5	
Date/Time		Date/Time	
Mon Nov 25 2019 13:30:00	0.0	Tue Nov 26 2019 15:00:00	0.1
Mon Nov 25 2019 14:00:00	0.1	Tue Nov 26 2019 15:30:00	0.1
Mon Nov 25 2019 14:30:00	0.2	Tue Nov 26 2019 16:00:00	0.2
Mon Nov 25 2019 15:00:00	0.0	Tue Nov 26 2019 16:30:00	0.2
Mon Nov 25 2019 15:30:00	0.1	Tue Nov 26 2019 17:00:00	0.2
Mon Nov 25 2019 16:00:00	0.0	Tue Nov 26 2019 17:30:00	0.0
Mon Nov 25 2019 16:30:00	0.2	Tue Nov 26 2019 18:00:00	0.1
Mon Nov 25 2019 17:00:00	0.0	Tue Nov 26 2019 18:30:00	0.0
Mon Nov 25 2019 17:30:00	0.2	Tue Nov 26 2019 19:00:00	0.2
Mon Nov 25 2019 18:00:00	0.0	Tue Nov 26 2019 19:30:00	0.2
Mon Nov 25 2019 18:30:00	0.0	Tue Nov 26 2019 20:00:00	0.0
Mon Nov 25 2019 19:00:00	0.2	Tue Nov 26 2019 20:30:00	0.2
Mon Nov 25 2019 19:30:00	0.2	Tue Nov 26 2019 21:00:00	0.1
Mon Nov 25 2019 20:00:00	0.0	Tue Nov 26 2019 21:30:00	0.2
Mon Nov 25 2019 20:30:00	0.0	Tue Nov 26 2019 22:00:00	0.0
Mon Nov 25 2019 21:00:00	0.0	Tue Nov 26 2019 22:30:00	0.0
Mon Nov 25 2019 21:30:00	0.0	Tue Nov 26 2019 23:00:00	0.0
Mon Nov 25 2019 22:00:00	0.0	Tue Nov 26 2019 23:30:00	0.1
Mon Nov 25 2019 22:30:00	0.0	Wed Nov 27 2019 00:00:00	0.1
Mon Nov 25 2019 23:00:00	0.0	Wed Nov 27 2019 00:30:00	0.2
Mon Nov 25 2019 23:30:00	0.2	Wed Nov 27 2019 01:00:00	0.2
Tue Nov 26 2019 00:00:00	0.0	Wed Nov 27 2019 01:30:00	0.2
Tue Nov 26 2019 00:30:00	0.1	Wed Nov 27 2019 02:00:00	0.0
Tue Nov 26 2019 01:00:00	0.0	Wed Nov 27 2019 02:30:00	0.0
Tue Nov 26 2019 01:30:00	0.1	Wed Nov 27 2019 03:00:00	0.0
Tue Nov 26 2019 02:00:00	0.2	Wed Nov 27 2019 03:30:00	0.0
Tue Nov 26 2019 02:30:00	0.1	Wed Nov 27 2019 04:00:00	0.1
Tue Nov 26 2019 03:00:00	0.2	Wed Nov 27 2019 04:30:00	0.1
Tue Nov 26 2019 03:30:00	0.0	Wed Nov 27 2019 05:00:00	0.1
Tue Nov 26 2019 04:00:00	0.0	Wed Nov 27 2019 05:30:00	0.1
Tue Nov 26 2019 04:30:00	0.0	Wed Nov 27 2019 06:00:00	0.2
Tue Nov 26 2019 05:00:00	0.2	Wed Nov 27 2019 06:30:00	0.1
Tue Nov 26 2019 05:30:00	0.2	Wed Nov 27 2019 07:00:00	0.1
Tue Nov 26 2019 06:00:00	0.0	Wed Nov 27 2019 07:30:00	0.1
Tue Nov 26 2019 06:30:00	0.0	Wed Nov 27 2019 08:00:00	0.0
Tue Nov 26 2019 07:00:00	0.2	Wed Nov 27 2019 08:30:00	0.1
Tue Nov 26 2019 07:30:00	0.0	Wed Nov 27 2019 09:00:00	0.1
Tue Nov 26 2019 08:00:00	0.2	Wed Nov 27 2019 09:30:00	0.1
Tue Nov 26 2019 08:30:00	0.0	Wed Nov 27 2019 10:00:00	0.1
Tue Nov 26 2019 09:00:00	0.1	Wed Nov 27 2019 10:30:00	0.0
Tue Nov 26 2019 09:30:00	0.0	Wed Nov 27 2019 11:00:00	0.1
Tue Nov 26 2019 10:00:00	0.1	Wed Nov 27 2019 11:30:00	0.1
Tue Nov 26 2019 10:30:00	0.0	Wed Nov 27 2019 12:00:00	0.1
Tue Nov 26 2019 11:00:00	0.2	Wed Nov 27 2019 12:30:00	0.1

Tue Nov 26 2019 11:30:00	0.0	Wed Nov 27 2019 13:00:00	0.0
Tue Nov 26 2019 12:00:00	0.0	Wed Nov 27 2019 13:30:00	0.2
Tue Nov 26 2019 12:30:00	0.2	Wed Nov 27 2019 14:00:00	0.1
Tue Nov 26 2019 13:00:00	0.0	Wed Nov 27 2019 14:30:00	0.1

(iii) Ozone (O_3)

O3 DATA

Location 1		Location 2		Location 3	
Date Time	O3 (µg/m³)	Date Time	O3 (µg/m³)	Date Time	O3 (µg/m³)
26/11/2019 15:30	42.967	25/11/2019 11:30	40.385	25/11/2019 12:30	32.197
26/11/2019 15:45	39.087	25/11/2019 11:45	30.705	25/11/2019 12:45	33.365
26/11/2019 16:00	50.301	25/11/2019 12:00	22.074	25/11/2019 13:00	35.52
26/11/2019 16:15	45.728	25/11/2019 12:15	27.164	25/11/2019 13:15	41.4
26/11/2019 16:30	48.505	25/11/2019 12:30	30.403	25/11/2019 13:30	35.865
26/11/2019 16:45	49.949	25/11/2019 12:45	22.714	25/11/2019 13:45	33.009
26/11/2019 17:00	35.358	25/11/2019 13:00	29.443	25/11/2019 14:00	36.143
26/11/2019 17:15	49.1	25/11/2019 13:15	44.274	25/11/2019 14:15	38.322
26/11/2019 17:30	45.265	25/11/2019 13:30	32.497	25/11/2019 14:30	32.467
26/11/2019 17:45	30.845	25/11/2019 13:45	30.063	25/11/2019 14:45	33.303
26/11/2019 18:00	43.549	25/11/2019 14:00	43.257	25/11/2019 15:00	41.631
26/11/2019 18:15	40.669	25/11/2019 14:15	27.887	25/11/2019 15:15	39.788
26/11/2019 18:30	39.251	25/11/2019 14:30	25.124	25/11/2019 15:30	33.233
26/11/2019 18:45	46.617	25/11/2019 14:45	23.151	25/11/2019 15:45	32.013
26/11/2019 19:00	47.94	25/11/2019 15:00	33.666	25/11/2019 16:00	32.199
26/11/2019 19:15	30.706	25/11/2019 15:15	32.428	25/11/2019 16:15	36.655
26/11/2019 19:30	41.681	25/11/2019 15:30	29.928	25/11/2019 16:30	33.996
26/11/2019 19:45	44.968	25/11/2019 15:45	35.34	25/11/2019 16:45	34.649
26/11/2019 20:00	45.8	25/11/2019 16:00	38.097	25/11/2019 17:00	30.417
26/11/2019 20:15	30.002	25/11/2019 16:15	25.373	25/11/2019 17:15	38.107
26/11/2019 20:30	51.686	25/11/2019 16:30	29.411	25/11/2019 17:30	39.477
26/11/2019 20:45	54.591	25/11/2019 16:45	43.439	25/11/2019 17:45	30.979
26/11/2019 21:00	41.057	25/11/2019 17:00	43.232	25/11/2019 18:00	40.786
26/11/2019 21:15	43.208	25/11/2019 17:15	25.085	25/11/2019 18:15	40.26
26/11/2019 21:30	43.44	25/11/2019 17:30	27.498	25/11/2019 18:30	34.703
26/11/2019 21:45	40.869	25/11/2019 17:45	24.141	25/11/2019 18:45	30.542
26/11/2019 22:00	52.964	25/11/2019 18:00	43.781	25/11/2019 19:00	41.162
26/11/2019 22:15	31.254	25/11/2019 18:15	23.274	25/11/2019 19:15	36.455
26/11/2019 22:30	49.438	25/11/2019 18:30	28.818	25/11/2019 19:30	40.778
26/11/2019 22:45	32.734	25/11/2019 18:45	32.544	25/11/2019 19:45	30.866
26/11/2019 23:00	30.013	25/11/2019 19:00	27.228	25/11/2019 20:00	40.849
26/11/2019 23:15	53.399	25/11/2019 19:15	20.224	25/11/2019 20:15	35.832
26/11/2019 23:30	33.06	25/11/2019 19:30	22.371	25/11/2019 20:30	30.351
26/11/2019 23:45	36.767	25/11/2019 19:45	42.414	25/11/2019 20:45	33.865
27/11/2019 00:00	52.907	25/11/2019 20:00	35.437	25/11/2019 21:00	36.194
27/11/2019 00:15	32.622	25/11/2019 20:15	35.308	25/11/2019 21:15	35.891
27/11/2019 00:30	50.401	25/11/2019 20:30	35.813	25/11/2019 21:30	34.322
27/11/2019 00:45	33.045	25/11/2019 20:45	27.237	25/11/2019 21:45	36.57
27/11/2019 01:00	31.911	25/11/2019 21:00	34.08	25/11/2019 22:00	36.88
27/11/2019 01:15	38.379	25/11/2019 21:15	28.578	25/11/2019 22:15	41.281
27/11/2019 01:30	51.944	25/11/2019 21:30	41.964	25/11/2019 22:30	41.803
27/11/2019 01:45	44.035	25/11/2019 21:45	34.242	25/11/2019 22:45	36.712
27/11/2019 02:00	33.127	25/11/2019 22:00	28.61	25/11/2019 23:00	32.489
27/11/2019 02:15	53.842	25/11/2019 22:15	44.87	25/11/2019 23:15	31.728

27/11/2019 02:30	33.588	25/11/2019 22:30	28.78	25/11/2019 23:30	35.283
27/11/2019 02:45	37.624	25/11/2019 22:45	37.388	25/11/2019 23:45	37.164
27/11/2019 03:00	39.919	25/11/2019 23:00	41.277	26/11/2019 00:00	39.467
27/11/2019 03:15	31.903	25/11/2019 23:15	24.895	26/11/2019 00:15	31.947
27/11/2019 03:30	41.098	25/11/2019 23:30	41.968	26/11/2019 00:30	35.042
27/11/2019 03:45	50.192	25/11/2019 23:45	23.448	26/11/2019 00:45	37.431
27/11/2019 04:00	48.829	26/11/2019 00:00	24.493	26/11/2019 01:00	37.893
27/11/2019 04:15	54.853	26/11/2019 00:15	25.132	26/11/2019 01:15	38.528
27/11/2019 04:30	36.782	26/11/2019 00:30	41.703	26/11/2019 01:30	37.457
27/11/2019 04:45	44.706	26/11/2019 00:45	26.141	26/11/2019 01:45	34.814
27/11/2019 05:00	31.943	26/11/2019 01:00	30.167	26/11/2019 02:00	39.091
27/11/2019 05:15	50.634	26/11/2019 01:15	26.316	26/11/2019 02:15	35.494
27/11/2019 05:30	38.861	26/11/2019 01:30	23.427	26/11/2019 02:30	36.474
27/11/2019 05:45	35.09	26/11/2019 01:45	33.996	26/11/2019 02:45	38.146
27/11/2019 06:00	42.877	26/11/2019 02:00	23.277	26/11/2019 03:00	34.184
27/11/2019 06:15	48.484	26/11/2019 02:15	28.562	26/11/2019 03:15	36.482
27/11/2019 06:30	39.808	26/11/2019 02:30	34.301	26/11/2019 03:30	38.014
27/11/2019 06:45	53.546	26/11/2019 02:45	35.69	26/11/2019 03:45	39.285
27/11/2019 07:00	41.824	26/11/2019 03:00	25.064	26/11/2019 04:00	31.548
27/11/2019 07:15	37.104	26/11/2019 03:15	22.161	26/11/2019 04:15	32.694
27/11/2019 07:30	37.819	26/11/2019 03:30	37.688	26/11/2019 04:30	30.439
27/11/2019 07:45	53.844	26/11/2019 03:45	28.904	26/11/2019 04:45	39.758
27/11/2019 08:00	48.467	26/11/2019 04:00	32.128	26/11/2019 05:00	32.825
27/11/2019 08:15	50.806	26/11/2019 04:15	44.78	26/11/2019 05:15	36.811
27/11/2019 08:30	42.766	26/11/2019 04:30	31.985	26/11/2019 05:30	40.114
27/11/2019 08:45	47.287	26/11/2019 04:45	28.777	26/11/2019 05:45	31.285
27/11/2019 09:00	51.982	26/11/2019 05:00	41.548	26/11/2019 06:00	32.618
27/11/2019 09:15	48.356	26/11/2019 05:15	35.035	26/11/2019 06:15	34.061
27/11/2019 09:30	37.718	26/11/2019 05:30	43.942	26/11/2019 06:30	37.307
27/11/2019 09:45	45.546	26/11/2019 05:45	37.707	26/11/2019 06:45	31.13
27/11/2019 10:00	38.725	26/11/2019 06:00	22.059	26/11/2019 07:00	32.814
27/11/2019 10:15	37.07	26/11/2019 06:15	39.563	26/11/2019 07:15	40.167
27/11/2019 10:30	37.057	26/11/2019 06:30	25.98	26/11/2019 07:30	31.452
27/11/2019 10:45	39.211	26/11/2019 06:45	34.484	26/11/2019 07:45	41.932
27/11/2019 11:00	39.788	26/11/2019 07:00	29.094	26/11/2019 08:00	31.816
27/11/2019 11:15	51.571	26/11/2019 07:15	34.649	26/11/2019 08:15	30.41
27/11/2019 11:30	36.232	26/11/2019 07:30	39.349	26/11/2019 08:30	39.956
27/11/2019 11:45	50.326	26/11/2019 07:45	31.158	26/11/2019 08:45	41.019
27/11/2019 12:00	41.61	26/11/2019 08:00	22.151	26/11/2019 09:00	40.639
27/11/2019 12:15	51.936	26/11/2019 08:15	27.991	26/11/2019 09:15	30.241
27/11/2019 12:30	34.163	26/11/2019 08:30	37.871	26/11/2019 09:30	35.233
27/11/2019 12:45	37.354	26/11/2019 08:45	30.835	26/11/2019 09:45	38.797
27/11/2019 13:00	51.639	26/11/2019 09:00	32.703	26/11/2019 10:00	40.738
27/11/2019 13:15	46.345	26/11/2019 09:15	35.588	26/11/2019 10:15	38.033
27/11/2019 13:30	40.84	26/11/2019 09:30	44.554	26/11/2019 10:30	32.306
27/11/2019 13:45	48.219	26/11/2019 09:45	38.187	26/11/2019 10:45	39.002
27/11/2019 14:00	49.655	26/11/2019 10:00	41.836	26/11/2019 11:00	41.67

27/11/2019 14:15	35.261	26/11/2019 10:15	44.788	26/11/2019 11:15	33.553
27/11/2019 14:30	36.395	26/11/2019 10:30	42.313	26/11/2019 11:30	36.488
27/11/2019 14:45	36.71	26/11/2019 10:45	27.867	26/11/2019 11:45	36.195
27/11/2019 15:00	42.216	26/11/2019 11:00	39.154	26/11/2019 12:00	34.095
27/11/2019 15:15	31.719	26/11/2019 11:15	28.664	26/11/2019 12:15	31.867

O3 DATA

Location 4		Location 5	
Date Time	O3 (µg/m³)	Date Time	O3 (µg/m³)
25/11/2019 13:30	41.643	26/11/2019 15:00	52.588
25/11/2019 13:45	45.36	26/11/2019 15:15	39.448
25/11/2019 14:00	53.282	26/11/2019 15:30	36.01
25/11/2019 14:15	30.832	26/11/2019 15:45	30.671
25/11/2019 14:30	38.207	26/11/2019 16:00	41.546
25/11/2019 14:45	39.296	26/11/2019 16:15	31.883
25/11/2019 15:00	43.366	26/11/2019 16:30	41.261
25/11/2019 15:15	52.514	26/11/2019 16:45	32.743
25/11/2019 15:30	47.799	26/11/2019 17:00	33.413
25/11/2019 15:45	35.781	26/11/2019 17:15	32.292
25/11/2019 16:00	35.329	26/11/2019 17:30	41.718
25/11/2019 16:15	49.802	26/11/2019 17:45	48.805
25/11/2019 16:30	39.537	26/11/2019 18:00	46.68
25/11/2019 16:45	49.306	26/11/2019 18:15	41.915
25/11/2019 17:00	48.871	26/11/2019 18:30	51.189
25/11/2019 17:15	35.726	26/11/2019 18:45	36.698
25/11/2019 17:30	44.71	26/11/2019 19:00	31.143
25/11/2019 17:45	34.931	26/11/2019 19:15	37.527
25/11/2019 18:00	30.678	26/11/2019 19:30	41.951
25/11/2019 18:15	48.237	26/11/2019 19:45	41.879
25/11/2019 18:30	38.363	26/11/2019 20:00	39.367
25/11/2019 18:45	50.723	26/11/2019 20:15	39.398
25/11/2019 19:00	53.034	26/11/2019 20:30	48.542
25/11/2019 19:15	50.242	26/11/2019 20:45	35.554
25/11/2019 19:30	40.318	26/11/2019 21:00	33.626
25/11/2019 19:45	35.163	26/11/2019 21:15	49.059
25/11/2019 20:00	41.513	26/11/2019 21:30	39.995
25/11/2019 20:15	51.477	26/11/2019 21:45	50.248
25/11/2019 20:30	33.505	26/11/2019 22:00	52.944
25/11/2019 20:45	43.27	26/11/2019 22:15	50.448
25/11/2019 21:00	30.777	26/11/2019 22:30	49.693
25/11/2019 21:15	45.447	26/11/2019 22:45	44.552
25/11/2019 21:30	39.399	26/11/2019 23:00	43.416
25/11/2019 21:45	42.982	26/11/2019 23:15	52.37
25/11/2019 22:00	38.762	26/11/2019 23:30	36.647
25/11/2019 22:15	40.111	26/11/2019 23:45	36.022
25/11/2019 22:30	47.888	27/11/2019 00:00	41.136
25/11/2019 22:45	44.075	27/11/2019 00:15	53.3
25/11/2019 23:00	52.716	27/11/2019 00:30	36.851
25/11/2019 23:15	48.598	27/11/2019 00:45	46.718
25/11/2019 23:30	32.162	27/11/2019 01:00	47.16
25/11/2019 23:45	33.745	27/11/2019 01:15	51.767
26/11/2019 00:00	34.256	27/11/2019 01:30	48.913
26/11/2019 00:15	43.934	27/11/2019 01:45	52.293

26/11/2019 00:30	48.11	27/11/2019 02:00	44.125
26/11/2019 00:45	39.058	27/11/2019 02:15	40.017
26/11/2019 01:00	31.965	27/11/2019 02:30	38.313
26/11/2019 01:15	37.215	27/11/2019 02:45	37.357
26/11/2019 01:30	34.321	27/11/2019 03:00	37.168
26/11/2019 01:45	45.417	27/11/2019 03:15	51.763
26/11/2019 02:00	52.743	27/11/2019 03:30	45.809
26/11/2019 02:15	31.263	27/11/2019 03:45	53.119
26/11/2019 02:30	35.225	27/11/2019 04:00	39.851
26/11/2019 02:45	45.725	27/11/2019 04:15	36.506
26/11/2019 03:00	36.923	27/11/2019 04:30	30.083
26/11/2019 03:15	52.719	27/11/2019 04:45	36.866
26/11/2019 03:30	49.824	27/11/2019 05:00	36.74
26/11/2019 03:45	52.432	27/11/2019 05:15	39.443
26/11/2019 04:00	33.848	27/11/2019 05:30	46.83
26/11/2019 04:15	43.995	27/11/2019 05:45	30.921
26/11/2019 04:30	54.356	27/11/2019 06:00	50.027
26/11/2019 04:45	47.864	27/11/2019 06:15	48.493
26/11/2019 05:00	48.777	27/11/2019 06:30	35.092
26/11/2019 05:15	48.397	27/11/2019 06:45	47.369
26/11/2019 05:30	51.315	27/11/2019 07:00	46.106
26/11/2019 05:45	42.195	27/11/2019 07:15	48.88
26/11/2019 06:00	47.592	27/11/2019 07:30	50.945
26/11/2019 06:15	30.001	27/11/2019 07:45	49.008
26/11/2019 06:30	34.885	27/11/2019 08:00	33.019
26/11/2019 06:45	44.555	27/11/2019 08:15	50.837
26/11/2019 07:00	40.226	27/11/2019 08:30	40.081
26/11/2019 07:15	39.393	27/11/2019 08:45	35.421
26/11/2019 07:30	46.974	27/11/2019 09:00	33.722
26/11/2019 07:45	42.78	27/11/2019 09:15	41.639
26/11/2019 08:00	51.511	27/11/2019 09:30	48.902
26/11/2019 08:15	43.364	27/11/2019 09:45	33.212
26/11/2019 08:30	52.62	27/11/2019 10:00	42.404
26/11/2019 08:45	54.978	27/11/2019 10:15	41.776
26/11/2019 09:00	32.326	27/11/2019 10:30	40.423
26/11/2019 09:15	54.578	27/11/2019 10:45	31.761
26/11/2019 09:30	31.554	27/11/2019 11:00	30.47
26/11/2019 09:45	43.684	27/11/2019 11:15	35.86
26/11/2019 10:00	33.441	27/11/2019 11:30	37.162
26/11/2019 10:15	41.754	27/11/2019 11:45	36.928
26/11/2019 10:30	49.662	27/11/2019 12:00	51.081
26/11/2019 10:45	43.345	27/11/2019 12:15	30.476
26/11/2019 11:00	33.316	27/11/2019 12:30	38.994
26/11/2019 11:15	43.141	27/11/2019 12:45	43.891
26/11/2019 11:30	43.453	27/11/2019 13:00	47.049
26/11/2019 11:45	44.453	27/11/2019 13:15	30.644
26/11/2019 12:00	51.588	27/11/2019 13:30	51.449

26/11/2019 12:15	43.405	27/11/2019 13:45	44.423
26/11/2019 12:30	48.858	27/11/2019 14:00	45.559
26/11/2019 12:45	33.825	27/11/2019 14:15	31.094
26/11/2019 13:00	44.868	27/11/2019 14:30	52.352
26/11/2019 13:15	40.255	27/11/2019 14:45	38.87

(iv) Filter Weights

Location	Date 2019	Parameters	Pre-Weight (g)	Post-Weight (g)
1	November 26th – 27th	$PM_{2.5}$	4.4412	4.4593
		PM_{10}	4.3002	4.3485
		TSP	2.6026	2.7060
2	November 25th – 26th	$PM_{2.5}$	4.4858	4.4940
		PM_{10}	4.4634	4.4772
		TSP	3.6532	3.6791
3	November 25th – 26th	$PM_{2.5}$	4.4594	4.4712
		PM_{10}	4.4880	4.5047
		TSP	3.5787	3.6126
4	November 25th – 26th	$PM_{2.5}$	4.4896	4.5053
		PM_{10}	4.4651	4.4906
		TSP	3.6756	3.7219
5	November 26th – 27th	$PM_{2.5}$	4.4702	4.4840
		PM_{10}	4.5096	4.5367
		TSP	3.7896	8.8355

G. Meteorological Data

(i) Raw Meteorological Data

month	day	year	hour	Temp degC	Precip mm	Pressure mb	RH %	Wdir10m deg	Wspeed10m ms-1
11	25	2019	0	27.0	0	766.6	82.0	88	1.7
11	25	2019	100	26.8	0	766.6	83.0	102	1.3
11	25	2019	200	26.7	0	766.6	84.0	102	1.0
11	25	2019	300	26.5	0	766.6	85.0	88	1.4
11	25	2019	400	26.4	0	766.6	86.0	339	0.6
11	25	2019	500	26.2	0	766.6	85.0	339	0.7
11	25	2019	600	26.1	0	766.6	86.0	45	0.4
11	25	2019	700	26.1	0	766.4	86.0		0.9
11	25	2019	800	26.0	0	766.4	87.0	22	0.7
11	25	2019	900	26.0	0	766.4	87.0	45	1.1
11	25	2019	1000	25.9	0	766.4	87.0	22	1.2
11	25	2019	1100	25.8	0	766.4	88.0	270	1.1
11	25	2019	1200	25.8	0	766.1	88.0	113	0.7
11	25	2019	1300	25.8	0	766.1	88.0	88	1.0
11	25	2019	1400	25.8	0	766.1	87.0	102	0.8
11	25	2019	1500	25.7	0	766.1	88.0	102	1.1
11	25	2019	1600	25.8	0	766.1	89.0	113	0.6
11	25	2019	1700	25.8	0	766.1	88.0	45	0.8
11	25	2019	1800	26.0	0	766.1	87.0	68	0.7
11	25	2019	1900	26.0	0	765.9	87.0	45	0.5
11	25	2019	2000	26.0	0	765.9	85.0	68	0.9
11	25	2019	2100	26.4	0	765.9	84.0	102	0.4
11	25	2019	2200	26.7	0	765.9	85.0	88	0.5
11	25	2019	2300	26.6	0	765.9	83.0	113	0.7
11	25	2019	2400	27.0	0	765.6	83.0	100	0.8
11	25	2019	0	27.6	0	765.6	84.0	125	1.1
11	25	2019	100	27.6	0	765.6	85.0	113	1.1
11	25	2019	200	27.4	0	765.6	82.0	88	0.8
11	25	2019	300	27.8	0	765.6	83.0	100	0.5
11	25	2019	400	28.4	0	765.4	81.0	247	0.9
11	25	2019	500	28.5	0	765.4	82.0	125	1.0
11	25	2019	600	28.7	0	765.4	79.0	88	1.9
11	25	2019	700	28.3	0	765.4	80.0	102	1.5
11	25	2019	800	28.6	0	765.4	79.0	102	1.8
11	25	2019	900	28.3	0	765.1	77.0	100	1.7
11	25	2019	1000	28.5	0	765.1	77.0	100	1.8
11	25	2019	1100	28.9	0	765.1	76.0	100	1.2
11	25	2019	1200	27.4	1	764.9	82.0	102	1.1
11	25	2019	1300	26.1	1	764.9	89.0	88	0.1
11	25	2019	1400	26.2	1	764.9	88.0	102	1.0
11	25	2019	1500	26.3	1	765.1	90.0	88	0.5
11	25	2019	1600	26.5	1	765.1	88.0	102	0.6
11	25	2019	1700	27.3	1	765.1	87.0	113	0.6
11	25	2019	1800	27.5	1	765.1	84.0	113	0.5

11	25	2019	1900	27.6	1	764.9	84.0	88	0.6
11	25	2019	2000	27.6	1	764.9	82.0	102	0.9
11	25	2019	2100	27.5	1	764.9	81.0	88	1.5
11	25	2019	2200	27.5	1	764.9	81.0	100	1.2
11	25	2019	2300	27.5	0	764.9	81.0	68	1.2
11	25	2019	2400	27.3	0	764.9	83.0	88	0.9
11	25	2019	0	27.2	0	764.9	82.0	102	0.7
11	25	2019	100	27.2	0	764.9	85.0	270	0.6
11	25	2019	200	26.7	0	764.9	89.0	292	1.1
11	25	2019	300	26.6	0	764.9	88.0	318	0.7
11	25	2019	400	26.5	0	764.9	88.0	339	1.0
11	25	2019	500	26.4	0	764.9	88.0	318	1.1
11	25	2019	600	26.3	0	764.9	89.0	0	1.1
11	25	2019	700	26.1	1	764.9	89.0	0	1.5
11	25	2019	800	25.7	1	764.9	90.0	0	1.6
11	25	2019	900	25.4	1	764.9	90.0	22	1.1
11	25	2019	1000	25.3	1	764.9	90.0	22	1.1
11	25	2019	1100	25.2	1	764.9	89.0	45	0.8
11	25	2019	1200	25.2	1	764.9	87.0	22	0.9
11	25	2019	1300	25.3	1	764.9	86.0	45	1.2
11	25	2019	1400	25.3	1	765.1	85.0	68	1.3
11	25	2019	1500	25.4	1	765.1	86.0	102	1.0
11	25	2019	1600	25.7	1	765.1	83.0	68	1.1
11	25	2019	1700	25.9	1	765.1	81.0	45	1.1
11	25	2019	1800	25.9	1	765.1	82.0	202	0.9
11	25	2019	1900	25.9	1	765.1	82.0	102	0.8
11	25	2019	2000	25.7	0	765.1	82.0	88	1.3
11	25	2019	2100	25.6	0	765.1	82.0	45	1.0
11	25	2019	2200	25.6	0	765.1	82.0	45	0.6
11	25	2019	2300	25.5	0	765.4	84.0	68	0.6
11	25	2019	2400	25.4	0	765.4	84.0	88	0.8
11	25	2019	0	25.2	0	765.4	85.0	88	0.7
11	25	2019	100	25.1	0	765.6	85.0	88	0.8
11	25	2019	200	25.1	0	765.6	85.0	88	0.3
11	25	2019	300	25.0	0	765.4	86.0	68	0.7
11	25	2019	400	24.9	0	765.4	86.0	68	0.5
11	25	2019	500	24.9	0	765.4	87.0	88	0.9
11	25	2019	600	24.8	0	765.4	87.0	102	0.8
11	25	2019	700	24.8	0	765.4	87.0	102	0.5
11	25	2019	800	24.7	0	765.4	88.0	102	0.7
11	25	2019	900	24.6	0	765.4	88.0	68	0.5
11	25	2019	1000	24.6	0	765.4	88.0	0	0.3
11	25	2019	1100	24.5	0	765.4	88.0	88	0.4
11	25	2019	1200	24.5	0	765.6	88.0	102	1.1
11	25	2019	1300	24.6	0	765.6	88.0	88	1.1
11	25	2019	1400	24.6	0	765.6	88.0	102	1.1
11	25	2019	1500	24.6	0	765.9	88.0	102	0.9

11	25	2019	1600	24.6	0	765.9	88.0	102	1.0
11	25	2019	1700	24.6	0	765.9	87.0	102	1.0
11	25	2019	1800	24.6	0	765.9	88.0	102	0.9
11	25	2019	1900	24.5	0	766.1	88.0	102	1.0
11	25	2019	2000	24.5	0	766.1	88.0	102	1.0
11	25	2019	2100	24.5	0	765.9	88.0	102	0.9
11	25	2019	2200	24.5	0	766.1	88.0	102	0.8
11	25	2019	2300	24.5	0	766.1	88.0	68	1.0
11	25	2019	2400	24.5	0	766.1	88.0	88	1.1
11	25	2019	0	24.5	0	766.1	88.0	88	0.9
11	25	2019	100	24.5	0	766.1	88.0	88	0.9
11	25	2019	200	24.6	0	766.1	88.0	102	1.3
11	25	2019	300	24.6	0	766.1	88.0	88	1.5
11	25	2019	400	24.6	0	766.1	87.0	102	1.4
11	25	2019	500	24.6	0	766.1	88.0	102	1.3
11	25	2019	600	24.5	0	766.1	88.0	100	0.9
11	25	2019	700	24.5	0	766.1	88.0	88	1.1
11	25	2019	800	24.5	0	766.1	88.0	68	1.1
11	25	2019	900	24.5	0	766.1	87.0	102	1.2
11	25	2019	1000	24.5	0	766.1	87.0	102	1.1
11	25	2019	1100	24.5	0	766.1	87.0	100	1.4
11	25	2019	1200	24.5	0	766.4	88.0	102	2.4
11	25	2019	1300	24.5	0	766.4	88.0	68	2.0
11	25	2019	1400	24.6	0	766.1	88.0	102	1.9
11	25	2019	1500	24.6	0	766.1	88.0	68	2.1
11	25	2019	1600	24.7	0	766.1	87.0	102	3.0
11	25	2019	1700	24.9	0	766.1	87.0	102	3.3
11	25	2019	1800	24.9	0	766.1	87.0	102	2.1
11	25	2019	1900	24.8	0	766.1	88.0	102	2.1
11	25	2019	2000	24.8	0	766.4	89.0	88	1.0
11	25	2019	2100	24.7	0	766.4	89.0	100	2.0
11	25	2019	2200	24.6	0	766.4	89.0	102	0.6
11	25	2019	2300	24.6	0	766.4	89.0	102	1.0
11	25	2019	2400	24.5	0	766.4	90.0	22	0.8
11	25	2019	0	24.5	0	766.1	90.0		0.9
11	25	2019	100	24.4	0	766.1	90.0		0.7
11	25	2019	200	24.4	0	766.4	90.0	88	2.2
11	25	2019	300	24.4	0	766.4	90.0	88	0.9
11	25	2019	400	24.3	0	766.4	90.0	88	0.0
11	25	2019	500	24.3	0	766.1	90.0	339	1.4
11	25	2019	600	24.3	0	766.1	90.0	318	1.1
11	25	2019	700	24.2	0	766.1	90.0	68	0.8
11	25	2019	800	24.2	0	766.1	90.0	68	0.4
11	25	2019	900	24.2	0	766.1	90.0	22	0.5
11	25	2019	1000	24.2	0	766.1	90.0	339	0.9
11	25	2019	1100	24.2	0	766.1	89.0	88	1.4
11	25	2019	1200	24.3	0	766.1	89.0	102	0.9

11	25	2019	1300	24.3	0	766.1	89.0	88	1.4
11	25	2019	1400	24.4	0	766.1	89.0	88	0.6
11	25	2019	1500	24.4	0	766.1	89.0	88	0.3
11	25	2019	1600	24.4	0	766.1	89.0	100	0.7
11	25	2019	1700	24.4	0	766.1	89.0	100	1.3
11	25	2019	1800	24.4	0	765.9	89.0	102	0.6
11	25	2019	1900	24.4	0	765.9	89.0	102	1.6
11	25	2019	2000	24.4	0	766.1	89.0	0	1.3
11	25	2019	2100	24.4	0	766.1	90.0	88	1.1
11	26	2019	2200	24.4	0	766.1	90.0	45	0.6
11	26	2019	2300	24.4	0	766.1	90.0	68	0.9
11	26	2019	2400	24.3	0	766.1	90.0	88	0.8
11	26	2019	0	24.3	0	766.1	90.0	68	0.8
11	26	2019	100	24.3	0	766.1	89.0	102	0.4
11	26	2019	200	24.3	0	766.1	89.0	68	0.6
11	26	2019	300	24.3	0	766.1	89.0	100	0.8
11	26	2019	400	24.2	0	766.1	89.0	270	0.9
11	26	2019	500	24.2	0	765.9	89.0	225	1.1
11	26	2019	600	24.3	0	765.9	89.0	102	1.1
11	26	2019	700	24.3	0	765.9	88.0	68	0.7
11	26	2019	800	24.3	0	765.9	88.0	68	0.4
11	26	2019	900	24.2	0	765.9	88.0	45	0.4
11	26	2019	1000	24.3	0	765.9	88.0	22	0.8
11	26	2019	1100	24.2	0	765.9	88.0	68	0.7
11	26	2019	1200	24.2	0	765.6	88.0	318	0.4
11	26	2019	1300	24.2	0	765.6	88.0	0	0.6
11	26	2019	1400	24.2	0	765.6	88.0	45	0.5
11	26	2019	1500	24.2	0	765.6	88.0	68	0.8
11	26	2019	1600	24.2	0	765.6	88.0		0.6
11	26	2019	1700	24.2	0	765.6	88.0	68	0.9
11	26	2019	1800	24.3	0	765.4	87.0	88	0.6
11	26	2019	1900	24.3	0	765.4	87.0	0	0.4
11	26	2019	2000	24.3	0	765.6	87.0	100	0.6
11	26	2019	2100	24.1	0	765.1	88.0	68	0.4
11	26	2019	2200	24.1	0	765.4	88.0	22	0.2
11	26	2019	2300	24.1	0	765.4	88.0	22	0.4
11	26	2019	2400	24.1	0	765.6	89.0	88	0.8
11	26	2019	0	24.2	0	765.6	89.0	102	1.4
11	26	2019	100	24.1	0	765.4	89.0	102	1.2
11	26	2019	200	24.0	0	765.4	90.0	100	1.5
11	26	2019	300	23.8	0	765.4	91.0	100	0.4
11	26	2019	400	23.5	0	765.4	93.0	100	0.1
11	26	2019	500	23.5	0	765.4	93.0	100	0.4
11	26	2019	600	23.4	0	765.4	93.0	100	1.1
11	26	2019	700	23.5	0	765.4	93.0	100	0.8
11	26	2019	800	23.5	0	765.4	93.0	125	1.3
11	26	2019	900	23.4	0	765.4	93.0	292	0.8

11	26	2019	1000	23.5	0	765.6	92.0	88	1.6
11	26	2019	1100	23.5	0	765.4	92.0	88	1.4
11	26	2019	1200	23.4	0	765.4	93.0	88	2.4
11	26	2019	1300	23.4	1	765.4	94.0	68	0.7
11	26	2019	1400	23.2	1	765.4	94.0	102	1.0
11	26	2019	1500	23.2	2	765.4	94.0	100	0.8
11	26	2019	1600	23.1	2	765.4	95.0	88	0.9
11	26	2019	1700	23.1	2	765.4	95.0	88	0.6
11	26	2019	1800	23.1	2	765.6	95.0	22	1.0
11	26	2019	1900	23.0	2	765.6	94.0	88	1.3
11	26	2019	2000	23.1	2	765.6	94.0	88	1.1
11	26	2019	2100	23.1	2	765.6	93.0	102	0.9
11	26	2019	2200	23.1	2	765.6	93.0	100	1.3
11	26	2019	2300	23.2	2	765.6	92.0	88	0.9
11	26	2019	2400	23.3	1	765.6	92.0	88	1.2
11	26	2019	0	23.4	0	765.6	92.0	102	1.1
11	26	2019	100	23.4	0	765.6	91.0	102	1.3
11	26	2019	200	23.5	0	765.6	90.0	102	1.3
11	26	2019	300	23.6	0	765.9	90.0	102	1.3
11	26	2019	400	23.6	0	765.9	90.0	270	1.0
11	26	2019	500	23.7	0	765.9	92.0	88	2.2
11	26	2019	600	23.7	0	766.1	92.0	102	2.3
11	26	2019	700	23.6	0	766.1	93.0	88	2.2
11	26	2019	800	23.5	0	766.1	93.0	102	2.1
11	26	2019	900	23.5	0	766.4	93.0	102	3.0
11	26	2019	1000	23.5	0	766.4	93.0	102	4.0
11	26	2019	1100	23.6	0	766.4	91.0	102	2.5
11	26	2019	1200	23.9	0	766.4	90.0	102	3.1
11	26	2019	1300	24.0	0	766.4	90.0	102	3.2
11	26	2019	1400	24.1	0	766.4	90.0	100	2.5
11	26	2019	1500	24.0	0	766.1	90.0	102	3.5
11	26	2019	1600	24.0	0	765.9	90.0	102	2.1
11	26	2019	1700	24.0	0	766.1	90.0	102	2.3
11	26	2019	1800	24.0	0	766.1	90.0	100	1.4
11	26	2019	1900	24.0	0	766.1	89.0	88	2.0
11	26	2019	2000	24.1	0	766.4	89.0	88	1.7
11	26	2019	2100	24.1	0	766.6	89.0	88	1.8
11	26	2019	2200	24.0	0	766.9	90.0	68	1.1
11	26	2019	2300	24.0	0	766.9	91.0	22	0.3
11	26	2019	2400	23.8	0	767.2	92.0	22	0.4
11	26	2019	0	23.7	0	767.2	93.0	22	0.4
11	26	2019	100	23.7	1	767.2	93.0	88	0.5
11	26	2019	200	23.7	1	767.4	93.0	88	0.9
11	26	2019	300	23.7	1	767.4	94.0	68	0.7
11	26	2019	400	23.6	1	767.4	94.0	68	1.1
11	26	2019	500	23.7	1	767.4	93.0	88	3.0
11	26	2019	600	23.9	1	767.4	92.0	88	2.7

11	26	2019	700	23.9	1	767.4	92.0	102	0.9
11	26	2019	800	23.9	0	767.7	92.0	102	1.2
11	26	2019	900	24.4	0	767.7	93.0	125	0.2
11	26	2019	1000	24.8	0	767.7	94.0	88	0.4
11	26	2019	1100	24.8	0	767.7	91.0	102	0.4
11	26	2019	1200	24.9	0	767.7	90.0	102	0.7
11	26	2019	1300	25.4	0	767.7	86.0		1.1
11	26	2019	1400	25.5	0	767.7	84.0	292	0.6
11	26	2019	1500	25.5	0	767.7	84.0	292	0.4
11	26	2019	1600	25.8	0	767.7	85.0		0.4
11	26	2019	1700	26.4	0	767.7	82.0	45	1.3
11	26	2019	1800	26.4	0	767.7	84.0	45	1.3
11	26	2019	1900	26.4	0	767.4	84.0	45	2.7
11	26	2019	2000	26.6	0	767.4	84.0	102	1.4
11	26	2019	2100	26.6	0	767.4	84.0	102	1.5
11	26	2019	2200	26.6	0	767.4	84.0	102	1.5
11	26	2019	2300	26.6	0	767.4	83.0	88	1.6
11	26	2019	2400	26.8	0	767.4	82.0	102	1.8
11	26	2019	0	26.6	0	767.4	80.0	88	1.9
11	26	2019	100	26.4	0	767.4	81.0	102	2.1
11	26	2019	200	26.4	0	767.4	81.0	100	1.4
11	26	2019	300	26.3	0	767.2	82.0	102	0.7
11	26	2019	400	26.3	0	767.2	83.0	22	0.7
11	26	2019	500	26.3	0	767.2	83.0	68	0.5
11	26	2019	600	26.2	0	767.2	86.0	202	0.2
11	26	2019	700	26.2	0	767.2	84.0	339	0.7
11	26	2019	800	26.2	0	766.9	85.0	339	0.7
11	26	2019	900	26.1	0	766.9	87.0	292	0.8
11	26	2019	1000	26.4	0	766.9	84.0	68	1.1
11	26	2019	1100	26.5	0	766.9	82.0	102	1.0
11	26	2019	1200	26.5	0	766.6	83.0	125	0.7
11	26	2019	1300	26.7	0	766.6	81.0	102	1.0
11	26	2019	1400	26.6	0	766.4	83.0	270	0.8
11	26	2019	1500	26.6	0	766.4	82.0	68	1.4
11	26	2019	1600	26.7	0	766.6	84.0	102	0.7
11	26	2019	1700	26.7	0	766.6	83.0	102	1.1
11	26	2019	1800	26.8	0	766.4	83.0	100	0.8
11	26	2019	1900	27.1	0	766.4	84.0	202	0.8
11	26	2019	2000	27.3	0	766.4	83.0	113	0.9
11	26	2019	2100	27.4	0	766.4	81.0	88	1.2
11	26	2019	2200	27.3	0	766.4	82.0	68	0.8
11	26	2019	2300	27.2	0	766.1	81.0	88	1.1
11	26	2019	2400	27.1	0	766.1	80.0	102	2.0
11	26	2019	0	26.9	0	766.1	80.0	88	1.6
11	26	2019	100	27.1	0	766.1	81.0	102	1.1
11	26	2019	200	27.6	0	765.9	80.0	100	1.0
11	26	2019	300	27.9	0	765.6	79.0	100	1.4

11	26	2019	400	28.2	0	765.6	78.0	100	1.7
11	26	2019	500	27.9	0	765.6	78.0	100	1.6
11	26	2019	600	28.1	0	765.4	78.0	88	0.8
11	26	2019	700	28.3	0	765.4	77.0	100	1.0
11	26	2019	800	28.6	0	765.4	76.0	88	1.3
11	26	2019	900	28.2	0	765.4	77.0	88	1.0
11	26	2019	1000	27.9	0	765.4	78.0	68	1.0
11	26	2019	1100	27.6	0	765.4	80.0	100	0.6
11	26	2019	1200	27.6	0	765.4	81.0	88	0.7
11	26	2019	1300	27.7	0	765.4	80.0	68	1.0
11	26	2019	1400	27.8	0	765.4	79.0	102	1.0
11	26	2019	1500	27.8	0	765.1	79.0	102	1.0
11	26	2019	1600	27.9	0	765.1	78.0	88	0.8
11	26	2019	1700	27.7	0	765.4	79.0	88	0.8
11	26	2019	1800	27.7	0	765.4	80.0	102	0.7
11	26	2019	1900	27.6	0	765.4	80.0	45	0.9
11	26	2019	2000	27.3	0	765.1	81.0	88	0.4
11	26	2019	2100	27.4	0	765.4	81.0	68	1.1
11	26	2019	2200	26.6	0	765.4	84.0	102	2.5
11	26	2019	2300	25.6	0	765.4	86.0	102	2.5
11	26	2019	2400	25.1	0	765.4	87.0	45	1.6
11	26	2019	0	24.8	0	765.4	88.0	88	1.9
11	26	2019	100	24.7	0	765.4	88.0	102	1.4
11	26	2019	200	24.6	0	765.4	89.0	88	1.6
11	26	2019	300	24.7	0	765.1	89.0	88	1.4
11	26	2019	400	24.7	0	765.4	89.0	68	1.3
11	26	2019	500	24.8	0	765.4	89.0	68	0.5
11	26	2019	600	24.9	0	765.4	89.0	125	1.0
11	26	2019	700	24.9	0	765.4	89.0	0	0.9
11	26	2019	800	24.8	0	765.4	89.0	22	1.0
11	26	2019	900	24.8	0	765.4	89.0	22	1.1
11	26	2019	1000	24.9	0	765.4	89.0	0	0.6
11	26	2019	1100	24.9	0	765.4	89.0	339	0.2
11	26	2019	1200	25.0	0	765.4	89.0	45	0.5
11	26	2019	1300	25.0	0	765.4	89.0	68	0.6
11	26	2019	1400	24.9	0	765.4	89.0	292	0.6
11	26	2019	1500	24.8	0	765.6	89.0	102	1.1
11	26	2019	1600	24.6	0	765.6	90.0	102	2.0
11	26	2019	1700	24.5	0	765.6	90.0	88	1.7
11	26	2019	1800	24.4	0	765.6	90.0	102	2.0
11	26	2019	1900	24.4	0	765.6	89.0	88	1.9
11	26	2019	2000	24.4	0	765.9	89.0	88	1.4
11	26	2019	2100	24.4	0	765.9	89.0	102	1.8
11	26	2019	2200	24.3	0	765.6	88.0	102	2.5
11	26	2019	2300	24.2	0	765.6	89.0	68	1.3
11	26	2019	2400	24.2	0	765.6	89.0	102	2.8
11	26	2019	0	24.1	0	765.6	89.0	102	2.0

11	26	2019	100	24.0	0	765.6	89.0	88	2.2
11	26	2019	200	24.0	0	765.6	90.0	88	2.1
11	26	2019	300	23.9	0	765.4	90.0	68	2.2
11	26	2019	400	23.8	0	765.4	91.0	0	1.7
11	26	2019	500	23.8	1	765.4	91.0	102	1.5
11	26	2019	600	23.7	1	765.4	91.0	102	2.1
11	26	2019	700	23.7	1	765.4	91.0	88	1.9
11	26	2019	800	23.7	1	765.6	90.0	88	2.1
11	26	2019	900	23.8	1	765.6	89.0	88	2.1
11	26	2019	1000	23.9	1	765.6	89.0	102	2.1
11	26	2019	1100	24.0	1	765.9	89.0	102	1.1
11	26	2019	1200	23.9	0	765.9	89.0	88	1.4
11	26	2019	1300	24.0	0	765.9	89.0	102	1.3
11	26	2019	1400	24.0	0	765.9	88.0	102	0.9
11	26	2019	1500	24.1	0	765.9	89.0	102	0.8
11	26	2019	1600	24.1	0	766.1	89.0	88	0.6
11	26	2019	1700	24.1	0	766.4	89.0	100	0.9
11	26	2019	1800	24.1	0	766.4	89.0	102	1.3
11	26	2019	1900	24.2	0	766.4	89.0	88	1.0
11	26	2019	2000	24.2	0	766.6	89.0	45	0.5
11	26	2019	2100	24.2	0	766.6	89.0	0	0.7
11	26	2019	2200	24.3	0	766.6	90.0	68	0.9
11	26	2019	2300	24.3	0	766.6	91.0	88	1.4
11	26	2019	2400	24.2	0	766.6	92.0	88	1.3
11	26	2019	0	24.2	0	766.6	92.0	88	1.5
11	26	2019	100	24.2	0	766.6	92.0	88	1.5
11	26	2019	200	24.2	0	766.6	92.0	88	1.6
11	26	2019	300	24.1	0	766.4	93.0	88	1.3
11	26	2019	400	23.9	0	766.4	93.0	88	1.6
11	26	2019	500	23.8	0	766.4	94.0	102	1.7
11	26	2019	600	23.8	0	766.4	94.0	88	1.3
11	26	2019	700	23.7	0	766.1	94.0	102	1.2
11	26	2019	800	23.6	0	766.1	94.0	88	0.9
11	26	2019	900	23.6	0	766.1	93.0	22	1.7
11	26	2019	1000	23.6	0	766.4	93.0	22	1.8
11	26	2019	1100	23.6	0	766.4	92.0	22	1.6
11	26	2019	1200	23.6	0	766.4	91.0		1.6
11	26	2019	1300	23.7	0	766.6	89.0	88	0.8
11	26	2019	1400	23.8	0	766.6	89.0	22	0.6
11	26	2019	1500	23.8	0	766.6	88.0	100	0.7
11	26	2019	1600	23.9	0	766.6	87.0	45	0.9
11	26	2019	1700	23.9	0	766.6	86.0	22	0.7
11	26	2019	1800	24.0	0	766.6	87.0	0	0.4
11	26	2019	1900	24.0	0	766.6	88.0	22	0.3
11	26	2019	2000	23.9	0	766.6	88.0	100	0.3
11	26	2019	2100	23.9	0	766.9	88.0	339	0.2
11	26	2019	2200	23.8	0	766.9	86.0	0	0.6

11	26	2019	2300	23.9	0	766.9	85.0	45	0.9
11	26	2019	2400	24.1	0	766.9	85.0	22	0.8
11	26	2019	0	24.4	0	766.9	87.0	22	0.9
11	26	2019	100	24.5	0	766.9	87.0	68	1.7
11	26	2019	200	24.7	0	766.9	87.0	0	1.4
11	26	2019	300	24.8	0	766.9	87.0	113	1.1
11	26	2019	400	24.8	0	766.9	87.0	102	1.4
11	26	2019	500	24.9	0	766.9	86.0	88	2.3
11	26	2019	600	25.0	0	766.9	85.0	68	1.8
11	26	2019	700	25.1	0	766.9	85.0	88	1.7
11	26	2019	800	25.0	0	767.2	86.0	68	1.0
11	26	2019	900	25.0	0	767.2	86.0	88	1.3
11	26	2019	1000	24.9	0	767.2	86.0	45	1.1
11	26	2019	1100	24.9	0	767.2	86.0	113	0.8
11	26	2019	1200	24.9	0	766.9	85.0	88	1.6
11	26	2019	1300	25.0	0	766.9	85.0	68	1.6
11	26	2019	1400	24.9	0	766.9	85.0	102	1.2
11	26	2019	1500	24.9	0	766.9	86.0	88	1.4
11	26	2019	1600	24.9	0	766.6	86.0	102	1.4
11	26	2019	1700	24.9	0	766.6	86.0	45	1.4
11	26	2019	1800	24.8	0	766.4	87.0	22	1.0
11	26	2019	1900	24.8	0	766.4	88.0	270	1.3
11	26	2019	2000	24.8	0	766.4	89.0	88	1.3
11	26	2019	2100	24.8	0	766.4	89.0		1.4
11	26	2019	2200	24.8	0	766.4	89.0	247	2.3
11	26	2019	2300	24.8	0	766.4	89.0	88	1.3
11	26	2019	2400	24.8	0	766.4	89.0	202	1.7
11	26	2019	0	24.8	0	766.4	89.0	88	1.6
11	26	2019	100	24.8	0	766.4	89.0	88	1.7
11	27	2019	200	24.8	0	766.4	90.0	45	2.2
11	27	2019	300	24.8	0	766.4	90.0	22	2.2
11	27	2019	400	24.8	0	766.4	90.0	100	1.6
11	27	2019	500	24.8	0	766.6	90.0	318	1.6
11	27	2019	600	24.8	0	766.6	90.0	0	1.0
11	27	2019	700	24.8	0	766.4	90.0		1.0
11	27	2019	800	24.7	0	766.6	90.0	68	0.9
11	27	2019	900	24.7	0	766.6	90.0	68	1.2
11	27	2019	1000	24.7	0	766.4	90.0	45	0.9
11	27	2019	1100	24.8	0	766.4	90.0	88	1.1
11	27	2019	1200	24.8	0	766.4	90.0	68	0.8
11	27	2019	1300	24.8	0	766.4	90.0	88	1.8
11	27	2019	1400	24.9	0	766.1	90.0	100	1.1
11	27	2019	1500	24.9	0	766.1	90.0	68	1.3
11	27	2019	1600	24.9	0	766.1	90.0	270	0.6
11	27	2019	1700	24.9	0	766.1	90.0	100	0.9
11	27	2019	1800	25.0	0	766.1	90.0	45	1.0
11	27	2019	1900	25.0	0	766.1	90.0	68	1.1

11	27	2019	2000	25.0	0	766.1	90.0	22	1.3
11	27	2019	2100	25.0	0	766.1	91.0	247	1.3
11	27	2019	2200	25.0	0	765.9	91.0	339	1.0
11	27	2019	2300	25.0	0	765.9	90.0	0	1.1
11	27	2019	2400	25.1	0	765.9	90.0	88	1.7
11	27	2019	0	25.1	0	765.6	89.0	22	1.9
11	27	2019	100	25.2	0	765.6	89.0	45	1.2
11	27	2019	200	25.2	0	765.6	89.0	45	1.2
11	27	2019	300	25.1	0	765.6	89.0	45	1.8
11	27	2019	400	25.1	0	765.6	89.0	88	1.6
11	27	2019	500	25.1	0	765.6	89.0	45	1.5
11	27	2019	600	25.1	0	765.6	89.0	22	1.3
11	27	2019	700	25.1	0	765.6	88.0	45	2.0
11	27	2019	800	25.1	0	765.6	88.0	318	1.7
11	27	2019	900	25.2	0	765.6	88.0	0	1.4
11	27	2019	1000	25.1	0	765.6	88.0	22	1.8
11	27	2019	1100	25.2	0	765.6	89.0	102	1.3
11	27	2019	1200	25.1	0	765.9	89.0	318	1.3
11	27	2019	1300	25.1	0	765.9	89.0	113	1.5
11	27	2019	1400	25.1	0	765.6	89.0	125	1.2
11	27	2019	1500	25.0	0	765.6	89.0	0	1.4
11	27	2019	1600	25.0	0	765.6	88.0	45	0.9
11	27	2019	1700	25.0	0	765.6	88.0	22	1.1
11	27	2019	1800	25.1	0	765.6	88.0	68	1.4
11	27	2019	1900	25.1	0	765.6	89.0	68	1.4
11	27	2019	2000	25.1	0	765.6	89.0	0	1.3
11	27	2019	2100	25.1	0	765.6	88.0	45	1.8
11	27	2019	2200	25.1	0	765.6	88.0	22	1.3
11	27	2019	2300	25.1	0	765.6	89.0	22	1.5
11	27	2019	2400	25.1	0	765.9	90.0	68	1.7
11	27	2019	0	25.0	0	765.9	90.0	102	1.3
11	27	2019	100	25.0	0	765.6	89.0	68	1.3
11	27	2019	200	24.9	0	765.6	89.0	88	1.3
11	27	2019	300	25.0	0	765.9	89.0	100	1.3
11	27	2019	400	24.9	0	765.9	89.0	102	1.7
11	27	2019	500	24.9	0	765.9	89.0	88	1.9
11	27	2019	600	24.9	0	765.9	89.0	22	2.0
11	27	2019	700	24.9	0	765.9	89.0	0	1.7
11	27	2019	800	24.9	0	765.9	88.0	68	1.8
11	27	2019	900	24.8	0	765.9	88.0	68	1.2
11	27	2019	1000	24.8	0	765.9	89.0	88	1.7
11	27	2019	1100	24.8	0	765.9	89.0	88	1.6
11	27	2019	1200	24.8	0	765.9	89.0	102	1.6
11	27	2019	1300	24.8	0	765.9	88.0	88	1.0
11	27	2019	1400	24.8	0	765.9	88.0	100	1.7
11	27	2019	1500	24.7	0	765.9	88.0	45	1.4
11	27	2019	1600	24.8	0	765.9	88.0	88	1.4

11	27	2019	1700	24.8	0	766.1	88.0	0	2.1
11	27	2019	1800	24.8	0	766.1	88.0	88	1.8
11	27	2019	1900	24.8	0	766.1	87.0	22	1.3
11	27	2019	2000	24.8	0	766.1	87.0	88	1.7
11	27	2019	2100	24.8	0	766.4	87.0	68	1.3
11	27	2019	2200	24.8	0	766.4	87.0	68	1.1
11	27	2019	2300	24.8	0	766.4	88.0	88	1.1
11	27	2019	2400	24.8	0	766.4	88.0	68	1.6
11	27	2019	0	24.8	0	766.4	87.0	68	1.6
11	27	2019	100	24.8	0	766.4	87.0	339	0.9
11	27	2019	200	24.8	0	766.6	87.0	339	1.8
11	27	2019	300	24.8	0	766.6	87.0	102	1.9
11	27	2019	400	24.8	0	766.6	86.0	102	1.3
11	27	2019	500	24.8	0	766.6	86.0	45	1.3
11	27	2019	600	24.8	0	766.6	86.0	88	1.6
11	27	2019	700	24.8	0	766.9	86.0	68	1.3
11	27	2019	800	24.8	0	766.9	86.0	68	1.3
11	27	2019	900	24.8	0	766.9	86.0	88	1.2
11	27	2019	1000	24.8	0	766.9	86.0	102	1.4
11	27	2019	1100	24.8	0	766.9	86.0	88	1.3
11	27	2019	1200	24.8	0	767.2	85.0	88	1.3
11	27	2019	1300	25.0	0	767.2	85.0	270	1.0
11	27	2019	1400	25.1	0	767.4	85.0	68	1.5
11	27	2019	1500	25.2	0	767.4	85.0	100	1.2
11	27	2019	1600	25.3	0	767.4	85.0	88	1.2
11	27	2019	1700	25.4	0	767.4	85.0	102	0.8
11	27	2019	1800	25.3	0	767.7	85.0	102	0.8
11	27	2019	1900	25.7	0	767.7	85.0	100	0.7
11	27	2019	2000	25.7	0	767.7	84.0	100	0.7
11	27	2019	2100	25.6	0	767.7	85.0	100	0.9
11	27	2019	2200	25.8	0	767.7	84.0	100	0.9
11	27	2019	2300	25.8	0	767.9	85.0	247	0.7
11	27	2019	2400	25.9	0	767.9	84.0	88	0.9
11	27	2019	0	26.0	0	767.9	83.0	100	0.9
11	27	2019	100	26.2	0	767.9	81.0	68	0.9
11	27	2019	200	26.4	0	768.2	80.0	88	0.9
11	27	2019	300	26.6	0	768.2	79.0	88	0.8
11	27	2019	400	26.8	0	768.2	79.0	88	0.9
11	27	2019	500	27.0	0	768.2	78.0	100	1.3
11	27	2019	600	26.7	0	768.2	78.0	88	1.1
11	27	2019	700	26.6	0	768.2	80.0	88	1.3
11	27	2019	800	26.7	0	768.2	78.0	45	1.1
11	27	2019	900	26.7	0	768.2	80.0	102	0.8
11	27	2019	1000	26.6	0	768.4	80.0	225	1.1
11	27	2019	1100	26.7	0	768.4	80.0	22	1.1
11	27	2019	1200	26.6	0	768.4	80.0	22	1.2
11	27	2019	1300	26.6	0	768.4	81.0	0	1.1

11	27	2019	1400	26.8	0	768.4	80.0	100	0.8
11	27	2019	1500	27.0	0	768.4	79.0	68	1.1
11	27	2019	1600	26.9	0	768.7	82.0	125	0.4
11	27	2019	1700	27.0	0	768.7	80.0	102	1.1
11	27	2019	1800	27.1	0	768.7	80.0		0.9
11	27	2019	1900	27.2	0	768.7	79.0	102	0.9
11	27	2019	2000	27.2	0	768.7	80.0	100	0.9
11	27	2019	2100	27.3	0	768.7	80.0	100	1.3
11	27	2019	2200	27.6	0	768.7	79.0	88	0.7
11	27	2019	2300	27.7	0	768.7	78.0	88	1.1
11	27	2019	2400	27.5	0	768.7	79.0	88	0.6
11	27	2019	0	27.4	0	768.7	79.0	88	1.1
11	27	2019	100	27.2	0	768.7	80.0	292	0.8
11	27	2019	200	27.4	0	768.7	79.0	88	1.1
11	27	2019	300	27.6	0	768.7	79.0	45	0.6
11	27	2019	400	27.8	0	768.7	78.0	45	0.6
11	27	2019	500	27.9	0	768.4	78.0	102	0.9
11	27	2019	600	27.8	0	768.4	79.0	0	0.9
11	27	2019	700	28.0	0	768.4	79.0	292	1.2
11	27	2019	800	28.4	0	768.4	75.0	102	1.4
11	27	2019	900	28.5	0	768.4	77.0	102	1.2
11	27	2019	1000	28.6	0	768.2	77.0	88	1.3
11	27	2019	1100	28.2	0	768.2	76.0	102	2.0
11	27	2019	1200	27.8	0	768.4	80.0	68	1.8
11	27	2019	1300	27.6	0	768.4	81.0		1.3
11	27	2019	1400	27.3	0	768.2	82.0	68	1.1
11	27	2019	1500	27.1	0	768.2	83.0	22	1.4
11	27	2019	1600	27.1	0	768.2	84.0	339	1.4
11	27	2019	1700	27.0	0	768.2	85.0	292	1.3
11	27	2019	1800	27.3	0	767.9	85.0		0.9
11	27	2019	1900	27.9	0	767.9	83.0	88	0.8
11	27	2019	2000	27.6	0	767.9	83.0		1.4
11	27	2019	2100	27.7	0	767.9	82.0	125	0.7
11	27	2019	2200	27.9	0	767.9	82.0	292	0.8
11	27	2019	2300	28.2	0	767.7	80.0	113	0.9
11	27	2019	2400	28.2	0	767.7	76.0	102	1.9
11	27	2019	0	28.0	0	767.4	76.0	102	2.0
11	27	2019	100	28.0	0	767.4	79.0	102	1.3
11	27	2019	200	27.6	0	767.4	80.0	102	1.8
11	27	2019	300	27.6	0	767.4	81.0	102	1.7
11	27	2019	400	27.5	0	767.2	81.0	88	1.6
11	27	2019	500	27.2	0	767.2	82.0	100	1.2
11	27	2019	600	27.3	0	767.2	83.0	102	1.2
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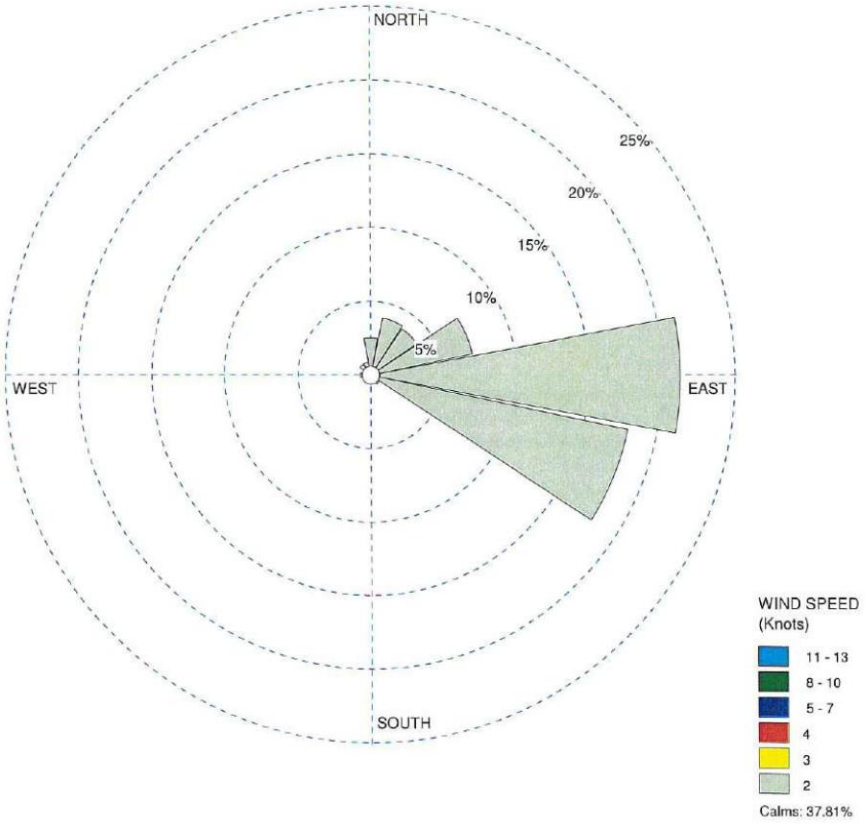
11	27	2019	800	27.4	0	767.2	81.0	88	1.3
11	27	2019	900	27.5	0	767.2	81.0	0	0.8
11	27	2019	1000	27.5	0	767.2	80.0	100	0.5

11	27	2019	1100	27.7	0	766.9	75.0	102	1.5
11	27	2019	1200	27.6	0	766.9	77.0	88	1.2
11	27	2019	1300	27.5	0	766.9	75.0	88	1.6
11	27	2019	1400	27.5	0	766.9	76.0	102	1.2
11	27	2019	1500	27.4	0	766.9	79.0	102	1.1
11	27	2019	1600	27.2	0	766.6	84.0	247	0.5
11	27	2019	1700	27.2	0	766.6	82.0		0.5
11	27	2019	1800	27.4	0	766.6	82.0	202	0.3
11	27	2019	1900	27.2	0	766.6	82.0	202	0.3
11	27	2019	2000	27.3	0	766.6	85.0	113	0.9
11	27	2019	2100	27.1	0	766.6	84.0	113	0.4
11	27	2019	2200	27.2	0	766.6	84.0	68	0.3
11	27	2019	2300	27.0	0	766.6	84.0	125	0.6
11	27	2019	2400	27.2	0	766.6	84.0	100	0.8
11	27	2019	0	27.4	0	766.6	78.0	88	0.9
11	27	2019	100	27.4	0	766.6	78.0	88	1.9
11	27	2019	200	27.4	0	766.6	78.0	88	1.4
11	27	2019	300	27.5	0	766.6	80.0	102	1.0
11	27	2019	400	27.5	0	766.6	80.0	102	0.8
11	27	2019	500	27.2	0	766.6	80.0	113	1.3
11	27	2019	600	27.1	0	766.6	80.0	88	1.3
11	27	2019	700	26.8	0	766.4	81.0	100	0.8
11	27	2019	800	26.9	0	766.4	82.0	88	0.9
11	27	2019	900	26.8	0	766.4	81.0	88	0.9
11	27	2019	1000	26.7	0	766.4	82.0	102	0.9
11	27	2019	1100	26.7	0	766.4	82.0	68	0.8
11	27	2019	1200	26.6	0	766.4	83.0	339	0.7

(ii) Wind Rose Plot

WIND ROSE PLOT:

Ecoengineering Consultants Limited
25th - 27th November, 2019



COMMENTS:		COMPANY NAME: **Ecoengineering Consultants Limited**	
		MODELER: **Kaizen Environmental Service (Trinidad) Limited**	
			PROJECT NO.: **19-9282-3**

WRPLOT View - Lakes Environmental Software

(iii) Calibration Certificate – Davis Met Station

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE #: 040418-A70426N737

DATE: 2019-10-27

ANALYSER TYPE: Davis Meteorological Station

SERIAL #: A70426N737

Sensor	Date Checked	Response
UV	*040418*	**OK**
Rain Gauge	*040418*	**OK**
Wind Monitor	*040418*	**OK**
Wind Direction	*040418*	**OK**
Temp & Humidity	*040418*	**OK**
Pressure	*040418*	**OK**

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with Davis factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by: amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

H. Biographies of Personnel

Anthony Chariah
Environmental Technician | PROJECT Services Division

Mr. Anthony Chariah is presently employed at Kaizen Environmental Services Limited as an Environmental Technician in the Project Services Department where he is responsible for executing the environmental fieldwork component of projects. This includes pre planning, data collection, and management, the operation of equipment, testing and preparation of technical information.

Mr. Chariah has been under the Project Services Division for four years now where he has gained knowledge and training in Environmental and Occupational monitoring and sampling according to US EPA and EMA guidelines. His work experiences include performing Ambient Air Quality monitoring, Indoor Air Quality monitoring, Stack Emission testing (Point Source Testing) and Noise testing.

Mr. Chariah possesses a BSc. Environmental and Natural Resources Management and Geography together with a NEBOSH National General Certificate in Occupational Health and Safety. Past experience includes working as a California Industrial Engineering Services Company Limited.

Deven Hadai
Environmental Technician | PROJECT Services Division

Mr. Deven Hadai is presently employed at Kaizen Environmental Services (Trinidad) Limited as an Environmental Technician in the Project Services Department where he is responsible for executing environmental fieldwork projects, data analysis, and metrology reporting. This includes equipment use, service, calibration, and testing together with data collection, processing, and reporting.

Mr. Hadai possesses a BSc. Physics with minors in Environmental Physics and Material Science together with a Diploma in Mechanical Engineering. Past experience includes working as a Maintenance Technician with Preventative Maintenance Limited at Arcelor Mittal and as a Maintenance Planner at Sammy's Multilift Services Limited. The main role involved as Maintenance Technician included maintenance of all conveyors present on the compound. This included repairs to mechanical parts of conveyors and repairs to conveyor belts by cold splicing. Maintenance planning involved planning and scheduling of reactive, routine and breakdown repairs on equipment.

7 APPENDIX G - DRY SEASON AMBIENT AIR QUALITY MONITORING: CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

National Infrastructure Development Co. Ltd.

CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

(DRY SEASON AIR QUALITY MONITORING)



ECO REPORT No. 02/2020

FEBRUARY 17, 2020

PREPARED BY

Ecoengineering Consultants Limited

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TRINIDAD, WEST INDIES

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ENVIRONMENTALLY APPROPRIATE DEVELOPMENT FOR THE CARIBBEAN

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February 17, 2020 Eco Report No. 2/2020

NATIONAL INFRASTRUCTURE DEVELOPMENT COMPANY LIMITED
The Atrium
Don Miguel Road Extension
SAN JUAN

Attention: Ms. Lynn Cameron
Project Engineer

Dear Ms. Cameron,

Re: CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS: Dry Season Ambient Air Quality Monitoring

Ecoengineering Consultants Limited (Ecoengineering) was contracted by the National Infrastructure Development Company Limited (NIDCO) to conduct Baseline Air Quality Monitoring for the construction of a vehicular overpass in the vicinity of Powder Magazine. This letter report documents the results of ambient air quality monitoring conducted in the dry season of 2020. This follows wet season monitoring conducted in 2019.

These results are summarized under the following headings:

- Background;
- Study Team;
- Regulatory Framework;
- Method Statement;
- Environmental Setting; and
- Results.

A BACKGROUND

The National Infrastructure Development Company (NIDCO) Limited intends to design and build a vehicular overpass in the vicinity of Powder Magazine and related improvements including link roads, ramps and drainage. To this end, NIDCO applied to the Environmental Management Authority (EMA) for a Certificate of Environmental Clearance (CEC) to conduct the works. Based on issues raised by stakeholders at public consultations for the project held in July and September 2019 and to satisfy some of the stakeholders, NIDCO has decided to undertake new testing of air quality to update baseline measurements. This letter report documents dry season ambient air quality monitoring.

B STUDY TEAM

The following are the key staff who worked on this assignment:

Ecoengineering Consultants Limited:

- Ms. Debbie Reyes, Senior Environmental Scientist / Study Manager, and
- Ms. Linda Sammy, Senior Environmental Scientist / Quality Control,

Kaizen Environmental Services (Trinidad) Limited (KESTL)

KESTL was responsible for conducting ambient air quality on this project. The team included:

- Mr. Yasin Khan, Team Leader, and
- Mr. Anthony Chariah.

C REGULATORY FRAMEWORK

This monitoring is guided by the Air Pollution Rules, 2014. The Air Pollution Rules, 2014, define an air pollutant as any of the substances mentioned in the First Schedule of the Rules, at or in excess of the maximum permissible levels prescribed therein. Table 1 below lists the maximum permissible limits for applicable parameters and the durations over which each limit occurs. It must be noted that the Rules contain no limits for VOCs.

TABLE 1: AIR POLLUTION RULES 2014, MAXIMUM PERMISSIBLE LIMITS

PARAMETER		AVERAGING TIME	MAXIMUM PERMISSIBLE LIMIT ($\mu g/m^3$)
Particulates	TSP	24 hours	150
	PM_{10}	24 hours	75
	$PM_{2.5}$	24 hours	65
Non-Metallic Inorganic Pollutants	NO_2	1 hour	200
	CO	8 hours	10 000
	SO_2	24 hours	125
	Ozone	8 hours	120

D METHOD STATEMENT

Monitoring was conducted as follows:

- January 13th – 15th, 2020
- January 20th – 22nd, 2020
- January 23rd – 25th, 2020

Figure 1 shows the locations monitored during the dry season. These locations are very close to the locations monitored during the wet season. Details of the methods and equipment used are included in the Attachment.

E ENVIRONMENTAL SETTING

The main sources of air emissions in the area were exhaust emissions from vehicles along the Western Main Road. Traffic flow at Locations 1 and 5 can be described as high. At Locations 1 and 5, the dispersion characteristics are excellent since these sites are surrounded by wide open spaces. While Locations 2, 3 and 4 are surrounded by houses and buildings so the dispersion characteristics are not as good.

F RESULTS

The results obtained during all three dry season events are included in the Attachment. A comparison of the wet season and dry season results revealed the following:



Ecoengineering Consultants Ltd. 62 EASTERN MAIN ROAD ST. AUGUSTINE PHONE: (868) 645-4420 FAX: (868) 662-7292 e-mail : ecoeng@ecoenggroup.com	ECO REPORT NO. 02/2020 DATE: 17/02/20	CLIENT: NATIONAL INFRASTRUCTURE DEVELOPMENT COMPANY LIMITED (NIDCO) PROJECT: CONSTRUCTION OF VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS DWG. NAME: AIR MONITORING LOCATIONS	FIGURE NUMBER: 1

F.1 $PM_{2.5}$, PM_{10}, and Total Suspended Particulates (TSP)

- In the wet season, $PM_{2.5}$ concentrations ranged between 1 µg/m^3 and 11 µg/m^3. Dry season concentrations were higher as expected and ranged between 7 µg/m^3 and 22 µg/m^3.

- In the wet season, the concentrations for PM_{10} ranged between 3 µg/m^3 and 29 µg/m^3. Dry season concentrations were similar and ranged between 12 µg/m^3 and 25 µg/m^3.

- Wet season TSP concentrations ranged between 8 µg/m^3 and 62 µg/m^3. Dry season concentrations were similar and ranged between 15 µg/m^3 and 49 µg/m^3.

- In both seasons, these three parameters were well below the maximum permissible limits stated in the Air Pollution Rules, 2014:

    - TSP = 150 µg/m^3
    - $PM_{2.5}$ = 65 µg/m^3
    - PM_{10} = 75 µg/m^3 respectively.

- Thus, there were no exceedances of those limits during the three monitoring events in either season.

- These values mayl be used as the baseline for comparison with air quality monitoring conducted during construction of the vehicular overpass.

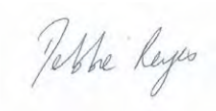
F.2 Non-Metallic Inorganic Pollutants

During the wet season, NO_2, CO, SO_2 and O_3 were detected at each location during all three events at very low concentrations. Dry season concentrations of NO_2 and SO_2 were below the method detection limit during all 3 events. Dry season CO concentrations ranged between 648 µg/m^3 and 1042 µg/m^3 while O_3 concentrations ranged between 9 µg/m^3 and 80 µg/m^3. VOC concentrations ranged between 0.8 µg/m^3 and 1.3 µg/m^3.

There were no exceedances of the maximum permissible limits stated in the Air Pollution Rules, 2014 with NO_2 having a limit of 200 µg/m3, CO having a limit of 10,000 µg/m_3, O_3 with a limit of 120 µg/m_3. There are no guidelines for VOCs in ambient air.

We trust that this Report is sufficiently clear. Please do not hesitate to contact us if there is need for further clarification on any item.

Yours sincerely,



Debbie Reyes,
Study Manager

ATTACHMENT

DRY SEASON

AIR QUALITY

MONITORING REPORTS

Event 1

PROJECTServices
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REPORT

Ambient Air Quality Monitoring

For

Construction of the Diego Martin Vehicular Overpass

January 2020

Phase II

Event 1

Prepared For

Ecoengineering – Consultants Limited
#62 Eastern Main Road, St. Augustine,
Trinidad W.I

Prepared By

Kaizen Environmental Services (Trinidad) Limited
Unit #8 Rajkumar Street, Mission Road,
Freeport,
Trinidad, W.I.

Davie Selal
Davie Selal
Trainee Administrative Technician II,
Reporting and Client Relations

Henry Lue-Fatt
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G. Meteorological Data
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H. Biographies of Personnel

EXECUTIVE SUMMARY

Kaizen Environmental Services (Trinidad) Limited (Kaizen) was commissioned to conduct Ambient Air Quality Monitoring by Ecoengineering – Consultants Limited. Monitoring was conducted for the Construction of the Diego Martin Vehicular Overpass.

The parameters measured were as follows:

1. Particulate Matter 2.5 ($PM_{2.5}$)
2. Particulate Matter 10 (PM_{10})
3. Total Suspended Particulates (TSP)
4. Nitrogen Dioxide (NO_2)
5. Sulphur Dioxide (SO_2)
6. Carbon Monoxide (CO)
7. Ozone (O_3)
8. Volatile Organic Compounds (VOCs)

Fieldwork was conducted during the period January 13th – 15th, 2020.

SUMMARY OF RESULTS

Based on the investigation conducted on January 13th – 15th, 2020, the following conclusions can be made:

- The 24-hour average concentrations obtained for **Particulate Matter ($PM_{2.5}$ and PM_{10})** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's[a] Air Pollution Rules 2014.

- The 24-hour average concentrations obtained for **Total Suspended Particulates (TSP)** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's Air Pollution Rules 2014.

- The 1-hour concentrations obtained for **Nitrogen Dioxide (NO_2)** at all locations sampled were in compliance with the guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: NO_2 was below the detection limit at all locations monitored

- The 24-hour average concentrations obtained for **Sulphur Dioxide (SO_2)** at all locations sampled were in compliance with their respective guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: SO_2 was below the detection limit at all locations monitored

[a] EMA – Environmental Management Authority of Trinidad and Tobago

- The 8-hour average concentrations obtained for **Carbon Monoxide (CO)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

- The 8-hour average concentrations obtained for **Ozone (O_3)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

- The 8-hour average concentrations for **Volatile Organic Compounds (VOCs)** were obtained at all sampling locations. The concentrations obtained were within the range of 0.6 $\mu g/m^3$ to 1.2 $\mu g/m^3$. There are no EMA guidelines for **VOCs.**

1.0 Introduction

Kaizen Environmental Services (Trinidad) Limited (Kaizen) was commissioned to conduct Ambient Air Quality Monitoring by Ecoengineering – Consultants Limited. Monitoring was conducted for the Construction of the Diego Martin Vehicular Overpass.

Fieldwork was conducted during the period January 13th – 15th, 2020.

2.0 Monitoring Locations and Parameters

Five (5) locations were selected by Ecoengineering – Consultants Limited for the ambient air monitoring as follows:

Table 1: Monitoring Locations and Parameters

Location No.	Co-ordinates	Parameters Monitored
1	20P0657831 UTM1180930	Particulate Matter 2.5 ($PM_{2.5}$) Particulate Matter 10 (PM_{10}) Total Suspended Particulates (TSP) Nitrogen Dioxide (NO_2) Sulphur Dioxide (SO_2) Carbon Monoxide (CO) Ozone (O_3) Volatile Organic Compounds (VOCs)
2	20P0657681 UTM1181156	
3	20P0658177 UTM1181216	
4	20P0658383 UTM1181049	
5	20P0658294 UTM1181091	

3.0 Test Methodology

3.1 Particulate Matter ($PM_{2.5}$ and PM_{10}) Monitoring

$PM_{2.5}$ & PM_{10} was measured in accordance with the US EPA's[b] "*Compendium of Methods for the Determination of Inorganic Compounds in Ambient Air - Compendium Method IO 2.1: Sampling of Ambient Air for Total Suspended Particulate Matter (SPM) and PM_{10} Using High Volume (HV) Sampler*".

The $PM_{2.5}$ high volume sampler utilized meets the US EPA's Reference Method: *40 CFR Part 50 Appendix L.*

The PM_{10} high volume sampler utilized meets the US EPA's Reference Method: *40 CFR Part 50 Appendix J.*

The $PM_{2.5}$ & PM_{10} sampler was calibrated prior to use in the field (*Calibration Certificate is appended–Attachment A (i) and (ii) respectively*)

3.2 Total Suspended Particulate Matter (TSP)

TSP was measured in accordance with equipment specified in the USEPA's *Code of Federal regulations (CFR) 40 CFR Chapter 1 Part 50 Appendix B Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method).*
The TSP sampler was calibrated prior to use in the field (*Calibration Certificate is appended–Attachment A (iii)*).

3.3 Nitrogen Dioxide (NO_2)

NO_2 concentrations were determined in accordance with the US EPA Designated Equivalent Method *NO – EQN – 1277 – 026, "Sodium Arsenite Method for the Determination of Nitrogen Dioxide in the Atmosphere".*

A sample of the ambient air is bubbled at a low flow rate through an impinger containing a sodium arsenite and sodium hydroxide solution for the full 24-hour sampling period. The concentration of the nitrite ion produced during sampling is determined colorimetrically by reacting the nitrite ion with phosphoric acid and N – (1-naphthyl)-ethylene diamine di-hydrochloride and measuring the absorbance of the highly colored azo dye at 540 nm. A vacuum pump was used to draw the ambient air through the sampling solution contained in the impinger.
Based on results from a collaborative study conducted by the US EPA, the lower detectable limit of the method is estimated to be 9 $\mu g/m^3$ for a 24-hour period.

[b] US EPA – United States Environmental Protection Agency

Modified Method to monitor the concentration of NO_2 in accordance to the EMA's Air Pollution Rules, 2014: The sampling time was reduced to one (1) hour or sixty (60) minutes with a sample flow rate of 2 L/min which is reflected in the formula for the calculation of volume of air sampled. The new detectable limit of the method is calculated to be 20 $\mu g/m^3$.

The following formulae were used in the determination of NO_2:

Volume of air sampled:
$V = (F_i + F_f / 2) \times t_s \times 10^{-6}$

Where:
V = Volume of air sampled, m^3
F_i = Air flow rate before sampling, cm^3/min
F_f = Air flow rate after sampling, cm^3/min
t_s = Sampling time, 60 minutes
10^{-6} = conversion of cm^3 to m^3

NO_2 Concentration in Air:
(Concentration of NO_2 (mg/L) x 50 / Volume of air sampled x 0.82) x Dilution factor

Where:
Concentration of NO_2 (mg/L) = obtained from lab analysis report
Volume of absorbing reagent used in sampling, ml = 50
Volume of air sampled = obtained from previous calculation
Sampling efficiency = 0.82
Dilution factor = 1

3.4 Sulphur Dioxide (SO_2)

The concentration of SO_2 was determined in accordance with US EPA 40 CFR Part 50 Appendix A: *"Reference Method for the Determination of Sulphur Dioxide in the Atmosphere (Pararosaniline Method).*

With this Method, a measured volume of air was bubbled through a solution of 0.04 M potassium tetrachloromercurate (TCM), which was contained in an impinger train assembly. The SO_2 present in the air stream reacts with the TCM solution to form a stable monochlorosulfanomercurate complex. Once formed, this complex resists air oxidation and is stable in the presence of strong oxidants such as ozone and oxides of nitrogen. During subsequent analysis, the complex is reacted with acid bleached pararosaniline methyl sulfonic acid. The optical density of this species is determined spectrophotometrically at 548 nm and is directly related to the amount of SO_2 collected.

Based on results from a collaborative study conducted by the US EPA, the lower limit of detection of SO_2 in 10 ml of TCM is 0.75 µg. This represents a concentration of 13 µg SO_2/ m^3 (0.005 ppm) for a 24-hour period.

3.5 Carbon Monoxide (CO)

The Thermo Scientific Model 48i Carbon Monoxide Analyzer is an U.S. EPA Reference Method: *RFCA-0981-054.*

The Model 48i Carbon Monoxide (CO) absorbs infrared radiation at a wavelength of 4.6 microns. The instrument electronics transform the basic analyzer signal into a linear output. The 48i uses an exact calibration curve to accurately linearize the instrument output over any range up to a concentration of 10,000ppm. The CO samplers were calibrated prior to use in the field (*Calibration Certificate is appended – Attachment A (iv)*.

3.6 Ozone (O_3)

For this measurement of Ozone, the Aeroqual Series 500-USEPA Tier II & III Indicative method was used; comparable to USEPA studies. *See Attachment D – Ozone Comparative Study*

3.7 Volatile Organic Compounds (VOCs)

For monitoring of VOCs, Crowcon portable emissions analyzer was utilized, and was calibrated prior to use in the field (*Test Certificate is appended –Attachment A (ii)*).

The Crowcon Gas Detective portable emissions analyzer is a microprocessor controlled portable gas detector, which is capable of monitoring up to four (4) gas types simultaneously and providing warning of hazardous levels.

Using electrochemical, catalytic, and thermal conductivity sensors, this instrument was configured to detect any practical combination of oxygen, toxic and flammable gas.

The Crowcon was fitted with electrochemical sensors to measure VOC concentrations. The concentration ranges and resolution/ detection limits of this instrument VOC are as follows:

Sensor/ Parameter	Range (ppm)	Resolution/ Detection Limit (ppm)
VOC	0 – 100	1.0

The Crowcon was configured to log averages at 15-minute intervals.

4.0 Results

4.1 Particulate Matter ($PM_{2.5}$ and PM_{10}), Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2), and Carbon Monoxide (CO), Ozone (O_3), Total Suspended Particulate Matter (TSP) and Volatile Organic Compounds (VOCs) Results

Table 2 presents the results of the Particulate Matter ($PM_{2.5}$ and PM_{10}) and Total Suspended Particulate (TSP) Monitoring. The results in this table have been compared to standards outlined by the EMA in the Air Pollution Rules, 2014.

Table 2: Ambient Air Quality Testing Results Particulate Matter ($PM_{2.5}$ PM_{10} and TSP)

Location No.	Sample Period/ 2020	Parameter Concentration		
		$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	TSP ($\mu g/m^3$)
1	January $14^{th} - 15^{th}$	7	22	33
2	January $13^{th} - 14^{th}$	7	12	15
3		7	21	40
4		7	17	32
5	January $14^{th} - 15^{th}$	13	16	26
EMA[c] STEL[d] (24-hr average)		**65**	**75**	**150**

Note:

a) Results reported to the nearest whole number

[c] EMA – Environmental Management Authority of Trinidad and Tobago
[d] STEL – Short-term Maximum Permissible Level

Table 3 displays the results of the 24 hour monitoring event for SO_2. The results were compared to their respective short term permissible levels as stipulated by the EMA in their Air Pollution Rules, 2014.

Table 3: Ambient Air Quality Testing Results –SO_2 (24-hour)

Location No	Sample Period/ 2020	Parameter Concentration
		SO_2 (µg/m^3)
1	January 14th – 15th	BDL
2	January 13th – 14th	BDL
3		BDL
4		BDL
5	January 14th – 15th	BDL
EMA STEL (24-hr)		**125**

Note:

a) BDL – Below Detection Limit
b) SO_2 Method Detection Limit = 13 µg/Nm^3

Table 4 displays the data for the 1-hour monitoring event for NO_2. The results were compared to the relevant limits as stated by the EMA in the Air Pollution Rules, 2014.

Table 4: Ambient Air Quality Testing Results – NO_2 (1-hour)

Location No	Sample Period/ 2020	Parameter Concentration
		NO_2 (µg/m^3)
1	January 14th	BDL
2	January 13th	BDL
3		BDL
4		BDL
5	January 14th	BDL
EMA[e] STEL[f] (1-hr)		**200**

Note:

a) BDL – Below Detection Limit
b) NO_2 Modified Method Detection Limit = 20 µg/Nm^3

[e] EMA – Environmental Management Authority of Trinidad and Tobago
[f] STEL – Short-term Maximum Permissible Level

Table 5 displays the results of the CO, VOC and O_3 monitoring. The results were compared to the 8-hour limit as stated by the EMA in the Air Pollution Rules, 2014.

Table 5: Ambient Air Quality Testing Results – Carbon Monoxide (CO), Volatile Organic Compounds (VOCs) and Ozone (O_3)

Location	Sampling Date/ 2020	Sampling Period		Avg 8-Hr CO Concentration ($\mu g/m^3$)	Avg 8-Hr VOC Concentration ($\mu g/m^3$)	Avg 8-Hr O_3 Concentration ($\mu g/m^3$)
		Start	End			
1	January 14th	14:27	22:26	1027	1.0	75
	January 14th – 15th	22:27	06:26	942	0.9	80
	January 15th	06:27	14:27	1046	1.0	73
2	January 13th	12:20	20:19	866	0.9	21
	January 13th – 14th	20:20	04:19	824	1.0	23
	January 14th	04:20	12:20	867	1.1	30
3	January 13th	12:58	20:57	879	1.0	59
	January 13th – 14th	20:58	04:57	829	1.1	67
	January 14th	04:58	12:58	860	0.8	64
4	January 13th	13:30	21:29	1018	1.0	10
	January 13th – 14th	21:30	05:29	899	1.0	18
	January 14th	05:30	13:30	985	0.8	9
5	January 14th	13:45	21:44	1042	0.9	70
	January 14th – 15th	21:45	05:44	928	0.8	73
	January 15th	05:45	13:45	1041	0.9	64
EMA STEL (8-hour average)				**10 000**	**N/A**	**120**

Note:

a) Results reported to the nearest whole number
b) There are no guidelines for VOCs in ambient air.

4.2 Meteorological Monitoring

Table 6: Summary of Meteorological Conditions during Monitoring Periods (January 13th – 15th, 2020)

Date/ 2020	Average Wind Speed (m/s)	Average Temperature (°C)	Average Relative Humidity (%)	Average Barometric Pressure (mmHg)	Total Rainfall (mm)
January 13th – 15th	1.0	26.6	76.3	762.7	0

The raw meteorological data is attached as *Appendix F*.

5.0 Conclusion

Based on the investigation conducted on January 13th – 15th, 2020, the following conclusions can be made:

- The 24-hour average concentrations obtained for **Particulate Matter ($PM_{2.5}$ and PM_{10})** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's[g] Air Pollution Rules 2014.

- The 24-hour average concentrations obtained for **Total Suspended Particulates (TSP)** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's Air Pollution Rules 2014.

- The 1-hour concentrations obtained for **Nitrogen Dioxide (NO_2)** at all locations sampled were in compliance with the guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: NO_2 was below the detection limit at all locations monitored

- The 24-hour average concentrations obtained for **Sulphur Dioxide (SO_2)** at all locations sampled were in compliance with their respective guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: SO_2 was below the detection limit at all locations monitored

- The 8-hour average concentrations obtained for **Carbon Monoxide (CO)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

[g] EMA – Environmental Management Authority of Trinidad and Tobago

- The 8-hour average concentrations obtained for **Ozone (O_3)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

- The 8-hour average concentrations for **Volatile Organic Compounds (VOCs)** were obtained at all sampling locations. The concentrations obtained were within the range of 0.6 $\mu g/m^3$ to 1.2 $\mu g/m^3$. There are no EMA guidelines for **VOCs.**

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ATTACHMENTS

A. Calibration Certificates

- (i) $PM_{2.5}$ High Volume Samplers
- (ii) PM_{10} High Volume Samplers
- (iii) TSP Samplers
- (iv) Thermo Scientific (CO)
- (v) Aeroqual (O_3)
- (vi) SKC Pumps (NO_2 and SO_2)
- (vii) Crowncon Gas Detective (VOCs)
- (viii) Analytical Balance

B. Map of Monitoring Location

C. Accreditation Certificate

D. Laboratory Data

- (i) Chain of Custody
- (ii) Analytical Results

E. Ozone Comparative Study

F. Raw Data

- (i) Carbon Monoxide (CO)
- (ii) Volatile Organic Compounds (VOCs)
- (iii) Ozone (O_3)
- (iv) Filter Weights

G. Meteorological Data

- (i) Raw Meteorological Data
- (ii) Wind Rose Plot
- (iii) Calibration Certificate - Davis Met Station

H. Biographies of Personnel

A. Calibration Certificates

(i) $PM_{2.5}$ High Volume Samplers

KAIZEN
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PM2.5 High Volume Sampler Calibration

DATE: December 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-711768
Serial# : 711768
Sampler: Staplex

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

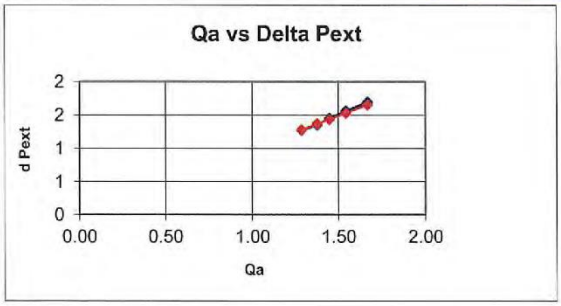
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	27.3	**Ta (°K)**	300.3	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.96	**Pa (mm Hg)**	760.984	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.143603**
6.9	1.669	6.6	1.693	1.6502	**intercept, b2:**	**-0.214450**
5.9	1.544	5.6	1.559	1.5259	**corr. coeff, r2**	**0.998751**
5.2	1.450	4.8	1.443	1.4325		
4.7	1.379	4.2	1.350	1.3619	**SFR**	**1.135**
4.1	1.289	3.7	1.267	1.2720	**SSP**	**2.71**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

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Environmental Services (T'dad) Ltd

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Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

PM2.5 High Volume Sampler Calibration

DATE: December 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-711763
Serial# : 711763
Sampler: Staplex

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

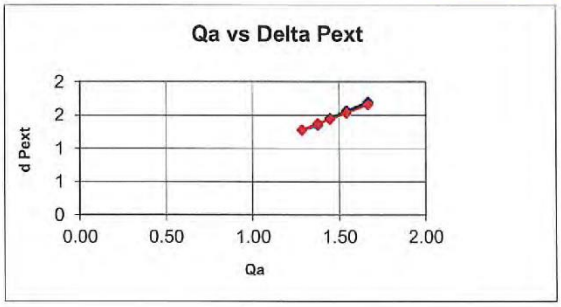
Conditions

Ta:(°C)	27.3	**Ta (°K)**	300.3	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.96	**Pa (mm Hg)**	760.984	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext
6.9	1.669	6.6	1.693	1.6502
5.9	1.544	5.6	1.559	1.5259
5.2	1.450	4.8	1.443	1.4325
4.7	1.379	4.2	1.350	1.3619
4.1	1.289	3.7	1.267	1.2720

slope, m2:	**1.143603**
intercept, b2:	**-0.214450**
corr. coeff, r2	**0.998751**
SFR	**1.135**
SSP	**2.71**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Deodath Maharaj
Instrumentation Team Leader

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PM2.5 High Volume Sampler Calibration

DATE: Dec 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4735
Serial# : 4735
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

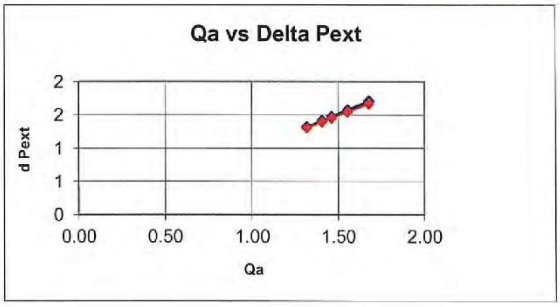
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	27.3	**Ta (°K)**	300.3	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.96	**Pa (mm Hg)**	760.984	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.072916**
7	1.681	6.7	1.705	1.6621	**intercept, b2:**	**-0.097978**
6	1.557	5.7	1.573	1.5388	**corr. coeff, r2**	**0.999998**
5.3	1.464	5	1.473	1.4463		
4.9	1.408	4.6	1.413	1.3906	**SFR**	**1.135**
4.3	1.320	4	1.318	1.3027	**SSP**	**2.89**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

(ii) PM_{10} High Volume Samplers

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Email: inquiries@kaizen-tt.com

PM10 High Volume Sampler Calibration

DATE: Dec 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-711770
Serial# : 711770
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

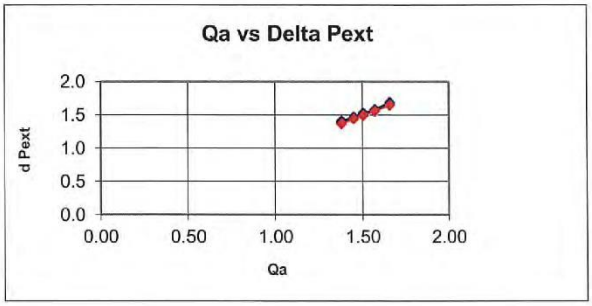
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.009309**
6.8	1.661	6.5	1.683	1.6420	**intercept, b2:**	**-0.001603**
6.1	1.574	5.7	1.576	1.5552	**corr. coeff, r2**	**0.997414**
5.6	1.508	5.3	1.520	1.4901		
5.2	1.454	4.9	1.461	1.4359	**SFR**	**1.141**
4.7	1.383	4.5	1.401	1.3651	**SSP**	**3.03**



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PM10 High Volume Sampler Calibration

DATE: Dec 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4734
Serial# : 4734
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

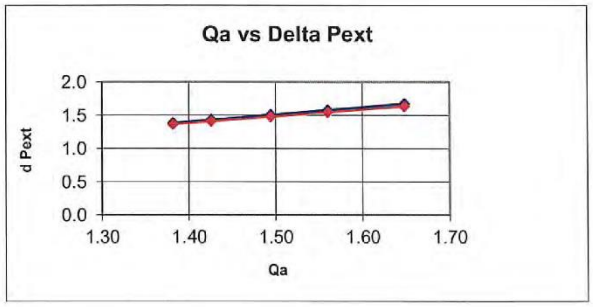
Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext
6.7	1.649	6.4	1.670	1.6299
6	1.561	5.7	1.576	1.5424
5.5	1.495	5.2	1.505	1.4767
5	1.426	4.7	1.431	1.4080
4.7	1.383	4.4	1.385	1.3651

slope, m2:	**1.072142**
intercept, b2:	**-0.097217**
corr. coeff, r2	**0.999999**
SFR	**1.141**
SSP	**2.91**



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PM10 High Volume Sampler Calibration

DATE: Dec 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-1328
Serial# : 1328
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

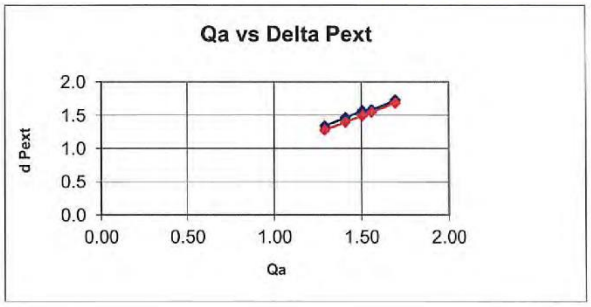
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**0.932154**
7.1	1.697	6.8	1.722	1.6778	**intercept, b2:**	**0.139218**
6	1.561	5.7	1.576	1.5424	**corr. coeff, r2**	**0.995687**
5.6	1.508	5.6	1.562	1.4901		
4.9	1.411	4.9	1.461	1.3938	**SFR**	**1.141**
4.1	1.292	4.1	1.337	1.2750	**SSP**	**3.32**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

(iii) TSP Samplers

KAIZEN
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TSP High Volume Sampler Calibration

DATE: Dec 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-2576
Serial# : 2158
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

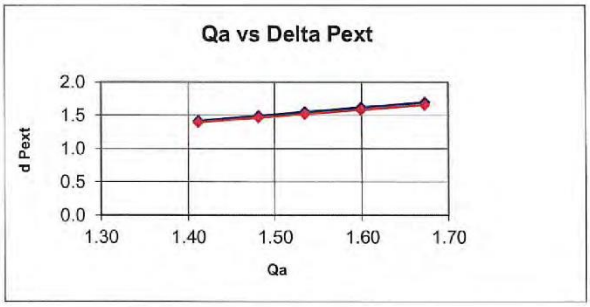
Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

Conditions

Ta:(°C)	28.5	**Ta (°K)**	301.5	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.072053**
6.9	1.673	6.6	1.695	1.6532	**intercept, b2:**	**-0.098219**
6.3	1.599	6	1.616	1.5797	**corr. coeff, r2**	**0.999999**
5.8	1.535	5.5	1.548	1.5157		
5.4	1.482	5.1	1.490	1.4625	**SFR**	**1.139**
4.9	1.412	4.6	1.415	1.3932	**SSP**	**2.90**



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TSP High Volume Sampler Calibration

DATE: Dec 23rd 2019
Techinician : Amrit Persad Maharaj

Certificate #: 010319-4731
Serial# : 4731
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

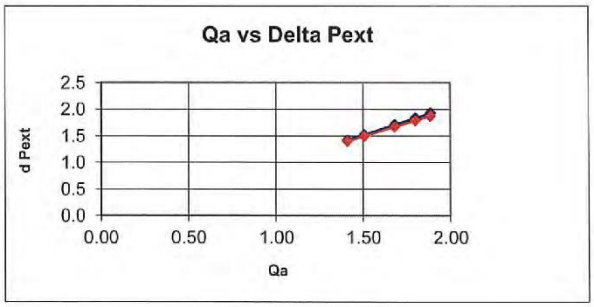
Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	1.068727
8.8	1.889	8.5	1.925	1.8679	intercept, b2:	-0.093403
8	1.801	7.7	1.832	1.7810	corr. coeff, r2	0.999998
7	1.686	6.7	1.709	1.6660		
5.6	1.509	5.3	1.520	1.4901	SFR	1.141
4.9	1.413	4.6	1.416	1.3938	SSP	2.91



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Amrit Persad Maharaj
Instrumentation Technician

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Email: inquiries@kaizen-tt.com

TSP High Volume Sampler Calibration

DATE: Dec 23rd 2019
Techinician : Amrit Persad Maharaj

Certificate #: 010319-4730
Serial# : 4730
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

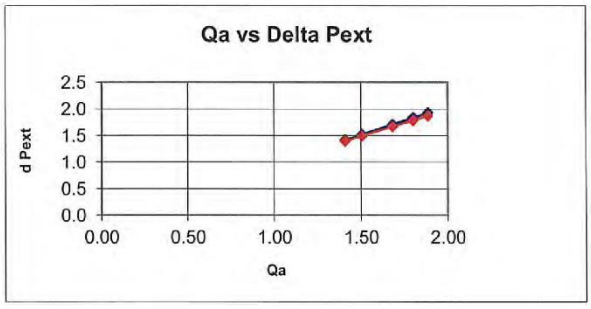
Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext
8.8	1.889	8.5	1.925	1.8679
8	1.801	7.7	1.832	1.7810
7	1.686	6.7	1.709	1.6660
5.6	1.509	5.3	1.520	1.4901
4.9	1.413	4.6	1.416	1.3938

slope, m2:	**1.068727**
intercept, b2:	**-0.093403**
corr. coeff, r2	**0.999998**
SFR	**1.141**
SSP	**2.91**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

(iv) Thermo Scientific (CO)

KAIZEN
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VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-1205951890

DATE: 28/12/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	As Left	Span	Gas Manufacturer	Gas Lot #
0	0	*Air Zero Grade (THC<1ppm)*	CALGAZ	152802
49	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

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Environmental Services (T'dad) Ltd

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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-1108347541

DATE: 28/12/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	As Left	Span	Gas Manufacturer	Gas Lot #
0	0	*Air Zero Grade (THC<1ppm)*	CALGAZ	152802
50	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-1108347540

DATE: 28/12/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	As Left	Span	Gas Manufacturer	Gas Lot #
0	0	*Air Zero Grade (THC<1ppm)*	CALGAZ	152802
50	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

(v) Aeroqual (O_3)

aeroqual

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32159

Calibration Date: 25 Feb 2019 14:51

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1221

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.005	0.110	0.523	0.000
AQL Sensor (Std. Dev) /ppm	0.000	0.001	0.002	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: **Takao Yamasaki**

Date: **25 Feb 2019**

aeroqual

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32151

Calibration Date: 25 Feb 2019 14:50

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1225

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.004	0.109	0.510	0.000
AQL Sensor (Std. Dev) /ppm	0.001	0.001	0.001	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: **Takao Yamasaki**

Date: **25 Feb 2019**

aeroqual

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32142

Calibration Date: 25 Feb 2019 14:50

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1232

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.005	0.113	0.506	0.000
AQL Sensor (Std. Dev) /ppm	0.002	0.001	0.003	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: **Takao Yamasaki**

Date: **25 Feb 2019**

(vi) SKC Pumps (NO_2 and SO_2)

KAIZEN
Environmental Services (T'dad) Ltd

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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-562657

DATE: 27/12/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 562657

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
2.9 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-634661

DATE: 27/12/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 634661

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
3.0 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-634635

DATE: 27/12/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 634635

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
3.1 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

(vii) Crowncon Gas Detective (VOCs)

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-42045
DATE: 2019-12-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 42045

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*
VOC	0	0	10	10	*10 ppm Isobutylene*

TEMPERATURE: 25.9°C

RELATIVE HUMIDITY: 51.4%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport, Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-45704
DATE: 2019-12-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 45704

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*
VOC	0	0	10	10	*10 ppm Isobutylene*

TEMPERATURE: 25.8°C

RELATIVE HUMIDITY: 51.5%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-44094
DATE: 2019-12-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 44094

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*
VOC	0	0	10	10	*10 ppm Isobutylene*

TEMPERATURE: 25.8°C

RELATIVE HUMIDITY: 51.6%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

(viii) Analytical Balance

Location:
University of the West Indies
St. Augustine Campus, Trinidad & Tobago
Mailing Address:
Tunapuna Post Office, Trinidad & Tobago
Tel: (868) 299-0210
Fax: (868) 662-7177
Email: cams@cariri.com
Website: www.cariri.com

CARIRI
Caribbean Industrial Research Institute

IAS ACCREDITED
Calibration Laboratory
LAB NO. CL-134

CALIBRATION CERTIFICATE

Date of Issue: September 06, 2019

Certificate No.: C067119

Project No.: EC03834167/19

CLIENT: Kaizen Environmental Services (Trinidad) Ltd.

ADDRESS: Unit 8 Rajkumar Street, Mission Road, Freeport

CALIBRATION LOCATION: Kaizen Environmental Services (Trinidad) Ltd., Balance Room

EQUIPMENT: Electronic Balance

MANUFACTURER: Sartorius

MODEL NO.: AC 210S 00016

SERIAL NO.: 40305246

EQUIPMENT NO.: ASD-EQ-BAL001

CAPACITY/RESOLUTION: 100g/ 0.0001g

CALIBRATION TYPE: As Found

CALIBRATION DATE: September 4, 2019

1. This report relates solely to the specific sample of the product which has been analysed or calibrated by CARIRI as the basis for preparing the report. It shall not be used for certification, advertising or marketing of products produced by the same manufacturer or the Client without the prior written consent of the Chief Executive Officer of CARIRI.

2. This report may not be reproduced, other than in full, except with the prior written authorization from the Chief Executive Officer / Chairman of CARIRI.

CARIBBEAN INDUSTRIAL RESEARCH INSTITUTE
CALIBRATION CERTIFICATE

Certificate No.: C067119
Project No.: EC03834167/19

PROCEDURE:
The electronic balance was calibrated in accordance with UKAS Lab 14 and CARIRI's SOP: CAMS.M1

TRACEABILITY:
The values and units of measurement of the reference weights are traceable to the SI (International System of Units), through reference standards maintained at the National Physical Laboratory (England), NIST (USA) and other recognized standards laboratories.

OBSERVATIONS:
The Internal, External and Sensitivity calibration functions on the balance are inoperative.
As a result these functions could not be used to adjust the balance readout.

AMBIENT CONDITIONS:
Temperature: 23±2°C, Relative Humidity: 50±5%RH

REFERENCE MASS

Serial No.	Weights Applied (g)	Certificate No.	Laboratory No.	Class	Uncertainty (g)
41950	0.005 to 100	M49398	0438	E2	0.00005

REPEATABILITY
Applied Load (g): 100

Unloaded Reading(A)	Loaded Reading (B)	Difference (B-A)	Readability
0.0000	99.8289	99.8289	0.0001
0.0000	99.8293	99.8293	
0.0000	99.8291	99.8291	
0.0000	99.8290	99.8290	
0.0000	99.8291	99.8291	
0.0000	99.8294	99.8294	
0.0000	99.8290	99.8290	
0.0000	99.8288	99.8288	
0.0000	99.8290	99.8290	
0.0000	99.8289	99.8289	
Standard Deviation (g):	0.00018		

LINEARITY

Applied Load (g)	Indicated Reading (g)	Error (g)
0.005	0.0046	-0.0004
0.02	0.0198	-0.0002
0.1	0.0998	-0.0002
1	0.9986	-0.0014
5	4.9919	-0.0081
20	19.9658	-0.0342
30	29.9490	-0.0510
50	49.9149	-0.0851
70	69.8807	-0.1193
100	99.8290	-0.1710
Maximum Error (g):	0.1710	

Error = Indicated Reading - Applied Load

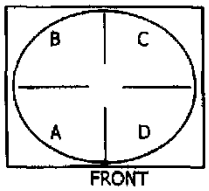
CARIBBEAN INDUSTRIAL RESEARCH INSTITUTE
CALIBRATION CERTIFICATE

Certificate No.: C067119
Project No.: EC03834167/19

ECCENTRICITY
Applied Load (g): 20

Position	Indicated Reading (g)	Error (g)
Front Left (A)	19.9661	-0.0339
Rear Left (B)	19.9660	-0.0340
Rear Right (C)	19.9659	-0.0341
Front Right (D)	19.9659	-0.0341

Maximum deviation across balance pan (g): 0.0002



Uncertainty of Calibration (g): ±0.00032
Manufacturer's Stated Linearity (g): ±0.002
Manufacturer's Stated Repeatability (g): 0.0001

Calibrator: N. Jonas
Signature: .....

Approved Signatory: M. Andrews
Signature: .....

End of Certificate

The uncertainty is for a confidence probability of approximately 95 percent and coverage factor k = 1.984
Error = Indicated Reading - Applied Load

B. Map of Monitoring Location


Location 3
N
Location 2
Location 5
Diego Martin Hwy
Location 4
Main Rd
Location 1
Western Main Rd

C. Accreditation Certificates

TT TABS
TRINIDAD AND TOBAGO
laboratory
Accreditation
Service

CERTIFICATE OF ACCREDITATION

KAIZEN ENVIRONMENTAL SERVICES (TRINIDAD) LTD

Testing Laboratory No.: LAS-005

is an accredited Laboratory which fulfils the requirements of ISO/IEC 17025 and has demonstrated competence to carry out tests as per a defined scope for:

CHEMICAL AND MICROBIOLOGICAL TESTING

as per attached schedule

While this certificate remains valid, the Accredited Laboratory named above is authorized to issue TTLABS-endorsed certificates.

Karlene Carolyn Lewis
Manager, TTLABS

"Recognised as the official national laboratory accrediting body by the Ministry of Trade, Industry, Investment and Communication of the Republic of Trinidad and Tobago"

Initial Accreditation date: 3rd September 2014

This certificate issued on: 21st September 2017

"This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrated technical competence for a defined scope and the operation of a laboratory quality management system. (refer to joint ISO-ILAC-IAF Communiqué dated 18 June 2005)"

Canadian Association for Laboratory Accreditation Inc.

CALA

Certificate of Accreditation

Kaizen Lab
KaizenLAB Inc.
333-50th Ave. S.E.
Calgary, Alberta

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

Accreditation No.: A2925
Issued On: October 17, 2017
Accreditation Date: January 31, 2005
Expiry Date: April 16, 2020

Andrew M. Adams
President & CEO

This certificate is the property of the Canadian Association for Laboratory Accreditation Inc. and must be returned on request; reproduction must follow policy in place at date of issue. For the specific tests to which this accreditation applies, please refer to the laboratory's scope of accreditation at www.cala.ca.

D. Laboratory Data

(i) Chain of Custody

PROJECTServices

A DIVISION OF KAIZEN ENVIRONMENTAL SERVICES LIMITED
Unit # 8, Rajkumar Street, Mission Road, Freeport, Trinidad, W.I.
Tel: (868) 299-0009 Fax: (868) 673-5997

CHAIN OF Kaizen Lab **305021** **CAL REQUEST FORM**
Nº PSD 1740

29 JAN 20

Date Submitted: 15/01/2020 | Date Required: ~~23/01/2020~~

Service Requested:
- Regular (10 days) ☐
- Rush (within 5 days) + 25% ☑
- Priority (3 days) + 50% ☐
- Emergency (next day) + 100% ☐

ANALYSIS REQUESTED

SAMPLE ID	DATE SAMPLED	SAMPLED TYPE	SO4
Eco-Engineering (Diego Martin)			
1 - Loc 1	14/01/2020		✓
2 - Loc 2	13/01/2020	SO4 Absorbing Solution	✓
3 - Loc 3	13/01/2020		✓
4 - Loc 4	13/01/2020		✓
5 - Loc 5	14/01/2020		✓

Client: Henry Lue Tatt Phone: Same As Above
Contact: Fax:
Report Address: P.O.#:
Client Job #:
Billing Address: # Samples Submitted: 5
Preservatives:
Special Requests:

Relinquished By: A. Charran Received By: LM
Date: 15/01/2020 Date: 23 JAN 20
Time: 1700h Time: 10:45 TEMP: 15°C

Sample Condition Upon Receipt:
Frozen ☐ Cold ☐ Ambient ☐ Head Space (yes/no): ____
Other (breakage, leakage, illegible etc.): ____

SAMPLED BY: A. Charran
NAME IN BLOCK LETTERS
A. C
SIGNATURE

DATE: 15/01/2020

Pronto 852-3577

White - File Copy Yellow - Lab Copy

PROJECTServices

A DIVISION OF KAIZEN ENVIRONMENTAL SERVICES LIMITED
Unit # 8, Rajkumar Street, Mission Road, Freeport, Trinidad, W.I.
Tel: (868) 299-0009 Fax: (868) 673-5997

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

Kaizen Lab File #: 427940-1-5 № PSD 1739

Date Submitted: 15/01/2020 | Date Required: 23/01/2020

Service Requested:
- Regular (10 days) ☐
- Rush (within 5 days) + 25% ☑
- Priority (3 days) + 50% ☐
- Emergency (next day) + 100% ☐

ANALYSIS REQUESTED

SAMPLE ID	DATE SAMPLED	SAMPLED TYPE	NOx	
Eco-Engineering				
(Diego Martin)				
-Loc 1	14/01/2020		✓	-1
-Loc 2	13/01/2020	NOx Absorbing	✓	-2
-Loc 3	13/01/2020	Solution	✓	-3
-Loc 4	13/01/2020		✓	-4
-Loc 5	14/01/2020		✓	-5

Client: Henry Lue Fatt | Phone: Same As Above
Contact: | Fax:
Report Address: | P.O.#:
Client Job #:
Billing Address: | # Samples Submitted: 5
Preservatives:
Special Requests:

Relinquished By: A. Chariah | Received By: Steve Dammerson Jr.
Date: 15/01/2020 | Date: 16/01/20
Time: 1700h | Time: 2:50PM

Sample Condition Upon Receipt:
Frozen ☐ Cold ☐ Ambient ☑ Head Space (yes/no):
Other (breakage, leakage, illegible etc.):

SAMPLED BY: A. Chariah
NAME IN BLOCK LETTERS
A. [signature]
SIGNATURE

DATE: 15/01/2020

White - File Copy Yellow - Lab Copy

Promo 652-3577

(ii) Analytical Results

KaizenLAB
Analytical Division of Kaizen Environmental Services (Trinidad) Ltd.

Unit 8 Rajkumar Street,
Mission Road, Freeport.
Email: kaizenlab@kaizen-tt.com
Tel: (868) 299-0009
Fax: (868) 673-6774

ANALYSIS DATA REPORT

Customer:	KESTL- PSD	**Customer Contact:**	Henry Lue-Fatt
Customer's Address:	Unit 8 Rajkumar Street, Mission Road, Freeport.		
Client Project #:	20-002	**Lab File #:**	427940
Item(s) Analyzed:	Liquid Samples		
Date of Sampling:	13-Jan-20 & 14-Jan-20	**Sampling Location:**	Eco Engineering (Diego Martin)
Sampling Condition:	n/a	**Sampled By:**	PSD Staff - A. Chariah
Sampling Plan Used:	n/a		
Date of Receipt:	16-Jan-20	**Date of Testing:**	20-Jan-20
Report Date:	21-Jan-20		

ANALYSIS RESULTS

Analysis: Nitrite-N

Sample ID	Units	Results
		Nitrite-N
427940-1, Loc 1	mg/L	<0.04
427940-2, Loc 2	mg/L	<0.04
427940-3, Loc 3	mg/L	<0.04
427940-4, Loc 4	mg/L	<0.04
427940-5, Loc 5	mg/L	<0.04

** Detailed Test Methodologies and QA/QC data available upon request.*

***Test Methodologies:** Nitrite-N: EPA-EQN-1277-026

Discussion: None

Comments: The results in this test report relate only to the items as received and tested.

Report Authorized by: Devika Rooplal
Devika Rooplal
Laboratory Manager

This test report shall not be reproduced except in full, without written approval of the laboratory.

333 50th Ave. S.E.
Calgary, AB, T2G 2B3
Phone (403) 297-0868
Fax: (403) 297-0869

KaizenLAB

ANALYTICAL REPORT

Client: Kaizen Environmental Services (Trinidad) Ltd.
Unit 8, Rajkumar Street, Mission Road
Freeport, Trinidad, West Indies

Attention: Henry Lue-Fatt

KaizenLAB JOB #:	305021
DATE RECEIVED:	23-Jan-2020
DATE REPORTED:	29-Jan-2020
PROJECT ID:	Eco - Engineering (Diego Martin)
LOCATION:	

KaizenLAB Sample #: 305021_001 **Sample ID:** Loc 1
Date Sampled: 14-Jan-2020 **Matrix:** Water

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 305021_002 **Sample ID:** Loc 2
Date Sampled: 13-Jan-2020 **Matrix:** Water

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 305021_003 **Sample ID:** Loc 3
Date Sampled: 13-Jan-2020 **Matrix:** Water

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 305021_004 **Sample ID:** Loc 4
Date Sampled: 13-Jan-2020 **Matrix:** Water

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 305021_005 **Sample ID:** Loc 5
Date Sampled: 14-Jan-2020 **Matrix:** Water

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

333 50th Ave. S.E.
Calgary, AB, T2G 2B3
Phone (403) 297-0868
Fax: (403) 297-0869

KaizenLAB

Test Methodologies

SO2 in Water - Determination of SO2 Absorbed in Potassium Trichlormercurate

Final Review by:

Shirley Lowe
Client Service Representative / Project Coordinator

Note: The results in this report relate only to the items tested and as received. Information is available for any items in 7.8.2.1 of ISO/IEC 17025:2017 that cannot be put on a test report. The report shall not be reproduced except in full without written approval of KaizenLAB. The validity of results may be affected if the information is provided by the customer.

E. Comparative Study – Ozone (O_3)

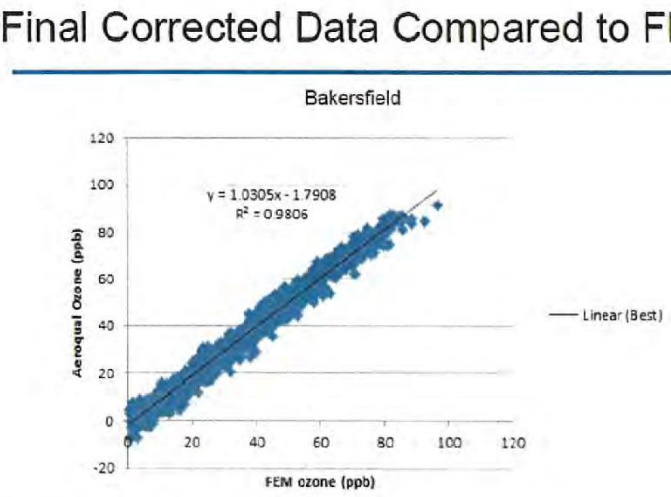
The Aeroqual's Series 500 portable ozone monitors were chosen by an air quality consultancy based in California, USA to better understand the spatial and temporal distribution of ozone in an area.

Twenty three monitors were co-located next to a federal reference method (FEM) monitoring stations to check their precision and accuracy before being distributed across an area of about 100 square miles. The monitors collected and transmitted ozone concentrations every minute for six weeks. Afterwards the monitors were co-located with reference monitoring stations to quantify drift. The data was analyzed and a report was produced.

Co-location of the Series 500 monitors established accuracy to within +/- 3 ppb of the federal reference monitors. See example in figure below.
The study demonstrated that there are strong spatial gradients in ozone over short distances even in rural areas. In addition, the new site at Di Giorgio actually measures higher concentrations than the old Bear Mountain site, and therefore is a good replacement site. In addition, it was determined that the new site was representative of concentrations experienced in the city of Arvin and is therefore useful for real-time warnings regarding poor air quality for citizens in Arvin.
The results of this study provide important supporting evidence for the District's formal attainment request to EPA. In addition the study provides a strong scientific foundation for future decision making about managing the air resources of the San Joaquin Valley.

The final report can be found at:
http://www.valleyair.org/Air_Quality_Plans/docs/2013Attainment/OzoneSaturationStudy.pdf.

Data is courtesy of STI, 2013.



F. Raw Data

(i) Carbon Monoxide (CO)

CO DATA

Location 1		Location 2		Location 3	
Date Time	co	Date Time	co	Date Time	co
14/01/2020 14:27	1007.763	13/01/2020 12:20	938.560	13/01/2020 12:58	968.921
14/01/2020 14:42	1086.168	13/01/2020 12:35	917.474	13/01/2020 13:13	923.992
14/01/2020 14:57	1141.865	13/01/2020 12:50	937.810	13/01/2020 13:28	917.950
14/01/2020 15:12	1072.780	13/01/2020 13:05	902.181	13/01/2020 13:43	948.904
14/01/2020 15:27	1076.863	13/01/2020 13:20	920.809	13/01/2020 13:58	916.494
14/01/2020 15:42	1011.090	13/01/2020 13:35	944.810	13/01/2020 14:13	908.787
14/01/2020 15:57	912.497	13/01/2020 13:50	765.745	13/01/2020 14:28	751.866
14/01/2020 16:12	866.594	13/01/2020 14:05	848.094	13/01/2020 14:43	818.294
14/01/2020 16:27	970.4	13/01/2020 14:20	781.277	13/01/2020 14:58	870.098
14/01/2020 16:42	973.931	13/01/2020 14:35	827.724	13/01/2020 15:13	863.592
14/01/2020 16:57	914.059	13/01/2020 14:50	773.324	13/01/2020 15:28	881.238
14/01/2020 17:12	951.294	13/01/2020 15:05	853.581	13/01/2020 15:43	780.907
14/01/2020 17:27	1196.2	13/01/2020 15:20	778.142	13/01/2020 15:58	836.235
14/01/2020 17:42	1062.778	13/01/2020 15:35	799.624	13/01/2020 16:13	854.254
14/01/2020 17:57	1006.941	13/01/2020 15:50	802.335	13/01/2020 16:28	791.357
14/01/2020 18:12	1059.620	13/01/2020 16:05	914.576	13/01/2020 16:43	929.937
14/01/2020 18:27	1196.459	13/01/2020 16:20	867.686	13/01/2020 16:58	928.434
14/01/2020 18:42	1074.728	13/01/2020 16:35	875.904	13/01/2020 17:13	942.122
14/01/2020 18:57	1202.972	13/01/2020 16:50	934.231	13/01/2020 17:28	858.3
14/01/2020 19:12	1154.290	13/01/2020 17:05	963.447	13/01/2020 17:43	976.03
14/01/2020 19:27	1179.166	13/01/2020 17:20	945.859	13/01/2020 17:58	856.297
14/01/2020 19:42	984.237	13/01/2020 17:35	926.249	13/01/2020 18:13	949.46
14/01/2020 19:57	1038.020	13/01/2020 17:50	877.262	13/01/2020 18:28	939.834
14/01/2020 20:12	1029.076	13/01/2020 18:05	993.289	13/01/2020 18:43	971.17
14/01/2020 20:27	1174.708	13/01/2020 18:20	919.35	13/01/2020 18:58	889.309
14/01/2020 20:42	963.778	13/01/2020 18:35	894.3	13/01/2020 19:13	980.084
14/01/2020 20:57	963.992	13/01/2020 18:50	889.959	13/01/2020 19:28	824.475
14/01/2020 21:12	870.198	13/01/2020 19:05	754.764	13/01/2020 19:43	793.248
14/01/2020 21:27	915.927	13/01/2020 19:20	750.352	13/01/2020 19:58	802.199
14/01/2020 21:42	964.838	13/01/2020 19:35	754.96	13/01/2020 20:13	809.948
14/01/2020 21:57	909.917	13/01/2020 19:50	764.975	13/01/2020 20:28	762.926
14/01/2020 22:12	918.413	13/01/2020 20:05	881.288	13/01/2020 20:43	868.638
14/01/2020 22:27	940.838	13/01/2020 20:20	865.308	13/01/2020 20:58	884.806
14/01/2020 22:42	911.819	13/01/2020 20:35	890.486	13/01/2020 21:13	794.038
14/01/2020 22:57	953.446	13/01/2020 20:50	880.644	13/01/2020 21:28	852.559
14/01/2020 23:12	944.864	13/01/2020 21:05	861.464	13/01/2020 21:43	868.82
14/01/2020 23:27	944.549	13/01/2020 21:20	772.654	13/01/2020 21:58	766.363
14/01/2020 23:42	988.955	13/01/2020 21:35	766.494	13/01/2020 22:13	755.906
14/01/2020 23:57	993.947	13/01/2020 21:50	798.901	13/01/2020 22:28	898.813
15/01/2020 00:12	951.045	13/01/2020 22:05	818.484	13/01/2020 22:43	848.482
15/01/2020 00:27	962.495	13/01/2020 22:20	768.11	13/01/2020 22:58	793.417
15/01/2020 00:42	858.210	13/01/2020 22:35	837.032	13/01/2020 23:13	890.903
15/01/2020 00:57	979.282	13/01/2020 22:50	815.598	13/01/2020 23:28	785.111
15/01/2020 01:12	917.314	13/01/2020 23:05	752.915	13/01/2020 23:43	860.508

15/01/2020 01:27	952.051	13/01/2020 23:20	789.29	13/01/2020 23:58	887.642
15/01/2020 01:42	931.481	13/01/2020 23:35	839.422	14/01/2020 00:13	867.912
15/01/2020 01:57	915.554	13/01/2020 23:50	757.864	14/01/2020 00:28	856.163
15/01/2020 02:12	964.903	14/01/2020 00:05	846.746	14/01/2020 00:43	769.064
15/01/2020 02:27	905.297	14/01/2020 00:20	837.618	14/01/2020 00:58	881.174
15/01/2020 02:42	982.687	14/01/2020 00:35	768.222	14/01/2020 01:13	758.74
15/01/2020 02:57	860.000	14/01/2020 00:50	895.121	14/01/2020 01:28	842.715
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15/01/2020 03:27	861.745	14/01/2020 01:20	842.263	14/01/2020 01:58	771.34
15/01/2020 03:42	961.938	14/01/2020 01:35	770.229	14/01/2020 02:13	770.016
15/01/2020 03:57	947.774	14/01/2020 01:50	809.511	14/01/2020 02:28	891.171
15/01/2020 04:12	941.936	14/01/2020 02:05	839.568	14/01/2020 02:43	826.374
15/01/2020 04:27	992.157	14/01/2020 02:20	889.596	14/01/2020 02:58	853.374
15/01/2020 04:42	958.552	14/01/2020 02:35	820.972	14/01/2020 03:13	887.129
15/01/2020 04:57	894.096	14/01/2020 02:50	804.915	14/01/2020 03:28	813.994
15/01/2020 05:12	983.866	14/01/2020 03:05	834.485	14/01/2020 03:43	840.402
15/01/2020 05:27	983.080	14/01/2020 03:20	759.276	14/01/2020 03:58	776.28
15/01/2020 05:42	966.142	14/01/2020 03:35	863.278	14/01/2020 04:13	786.831
15/01/2020 05:57	996.317	14/01/2020 03:50	860.207	14/01/2020 04:28	796.478
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15/01/2020 06:27	856.252	14/01/2020 04:20	879.291	14/01/2020 04:58	876.321
15/01/2020 06:42	969.759	14/01/2020 04:35	843.383	14/01/2020 05:13	832.282
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15/01/2020 09:12	1144.108	14/01/2020 07:05	996.282	14/01/2020 07:43	923.971
15/01/2020 09:27	998.533	14/01/2020 07:20	928.913	14/01/2020 07:58	878.718
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15/01/2020 10:27	1115.952	14/01/2020 08:20	939.566	14/01/2020 08:58	874.281
15/01/2020 10:42	1133.463	14/01/2020 08:35	979.19	14/01/2020 09:13	952.588
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15/01/2020 11:12	1110.297	14/01/2020 09:05	883.018	14/01/2020 09:43	791.421
15/01/2020 11:27	1046.192	14/01/2020 09:20	777.609	14/01/2020 09:58	779.418
15/01/2020 11:42	972.225	14/01/2020 09:35	801.605	14/01/2020 10:13	894.161
15/01/2020 11:57	871.094	14/01/2020 09:50	864.195	14/01/2020 10:28	817.068
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15/01/2020 13:57	922.113	14/01/2020 11:50	847.249	14/01/2020 12:28	807.489
15/01/2020 14:12	995.176	14/01/2020 12:05	899.382	14/01/2020 12:43	837.327

CO DATA

Location 4		Location 5	
Date Time	co	Date Time	co
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13/01/2020 14:15	1069.166	14/01/2020 14:30	1115.516
13/01/2020 14:30	966.950	14/01/2020 14:45	1036.032
13/01/2020 14:45	1127.151	14/01/2020 15:00	1086.278
13/01/2020 15:00	1134.046	14/01/2020 15:15	919.166
13/01/2020 15:15	1020.819	14/01/2020 15:30	896.432
13/01/2020 15:30	1048.532	14/01/2020 15:45	854.351
13/01/2020 15:45	1054.816	14/01/2020 16:00	928.695
13/01/2020 16:00	1184.752	14/01/2020 16:15	910.46
13/01/2020 16:15	1158.627	14/01/2020 16:30	931.432
13/01/2020 16:30	974.431	14/01/2020 16:45	1104.537
13/01/2020 16:45	989.231	14/01/2020 17:00	1242.585
13/01/2020 17:00	976.224	14/01/2020 17:15	1269.842
13/01/2020 17:15	912.118	14/01/2020 17:30	1129.772
13/01/2020 17:30	1098.531	14/01/2020 17:45	1050.631
13/01/2020 17:45	918.221	14/01/2020 18:00	1090.663
13/01/2020 18:00	1053.036	14/01/2020 18:15	1233.051
13/01/2020 18:15	1031.513	14/01/2020 18:30	1084.279
13/01/2020 18:30	992.641	14/01/2020 18:45	1105.02
13/01/2020 18:45	1099.888	14/01/2020 19:00	1037.671
13/01/2020 19:00	912.895	14/01/2020 19:15	1096.567
13/01/2020 19:15	1113.939	14/01/2020 19:30	1111.252
13/01/2020 19:30	1140.179	14/01/2020 19:45	1277.981
13/01/2020 19:45	1164.822	14/01/2020 20:00	928.376
13/01/2020 20:00	834.89	14/01/2020 20:15	988.78
13/01/2020 20:15	878.895	14/01/2020 20:30	899.431
13/01/2020 20:30	881.819	14/01/2020 20:45	857.718
13/01/2020 20:45	923.828	14/01/2020 21:00	956.79
13/01/2020 21:00	814.478	14/01/2020 21:15	927.682
13/01/2020 21:15	949.174	14/01/2020 21:30	922.347
13/01/2020 21:30	910.883	14/01/2020 21:45	953.782
13/01/2020 21:45	949.563	14/01/2020 22:00	955.467
13/01/2020 22:00	932.333	14/01/2020 22:15	850.743
13/01/2020 22:15	891.265	14/01/2020 22:30	945.681
13/01/2020 22:30	931.804	14/01/2020 22:45	910.431
13/01/2020 22:45	889.015	14/01/2020 23:00	889.828
13/01/2020 23:00	923.341	14/01/2020 23:15	998.518
13/01/2020 23:15	941.99	14/01/2020 23:30	862.439
13/01/2020 23:30	900.734	14/01/2020 23:45	980.787
13/01/2020 23:45	847.397	15/01/2020 00:00	982.206
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14/01/2020 00:15	824.613	15/01/2020 00:30	945.084

14/01/2020 00:30	898.323	15/01/2020 00:45	883.302
14/01/2020 00:45	825.15	15/01/2020 01:00	953.52
14/01/2020 01:00	820.103	15/01/2020 01:15	969.785
14/01/2020 01:15	890.599	15/01/2020 01:30	914.486
14/01/2020 01:30	935.054	15/01/2020 01:45	995.281
14/01/2020 01:45	911.817	15/01/2020 02:00	859.874
14/01/2020 02:00	899.444	15/01/2020 02:15	947.065
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14/01/2020 02:30	880.684	15/01/2020 02:45	917.367
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14/01/2020 03:15	891.921	15/01/2020 03:30	996.994
14/01/2020 03:30	878.249	15/01/2020 03:45	944.354
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14/01/2020 04:00	942.689	15/01/2020 04:15	943.291
14/01/2020 04:15	893.054	15/01/2020 04:30	858.594
14/01/2020 04:30	915.625	15/01/2020 04:45	947.159
14/01/2020 04:45	892.726	15/01/2020 05:00	904.977
14/01/2020 05:00	925.498	15/01/2020 05:15	914.672
14/01/2020 05:15	860.362	15/01/2020 05:30	961.517
14/01/2020 05:30	885.797	15/01/2020 05:45	871.651
14/01/2020 05:45	932.088	15/01/2020 06:00	972.32
14/01/2020 06:00	884.353	15/01/2020 06:15	903.418
14/01/2020 06:15	987.999	15/01/2020 06:30	948.952
14/01/2020 06:30	1013.938	15/01/2020 06:45	984.939
14/01/2020 06:45	1181.447	15/01/2020 07:00	1163.198
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14/01/2020 07:15	1058.338	15/01/2020 07:30	1178.479
14/01/2020 07:30	921.841	15/01/2020 07:45	1161.042
14/01/2020 07:45	976.276	15/01/2020 08:00	988.814
14/01/2020 08:00	1042.972	15/01/2020 08:15	1140.191
14/01/2020 08:15	917.365	15/01/2020 08:30	1079.749
14/01/2020 08:30	1006.34	15/01/2020 08:45	1292.653
14/01/2020 08:45	1096.357	15/01/2020 09:00	1083.332
14/01/2020 09:00	1022.49	15/01/2020 09:15	1186.447
14/01/2020 09:15	883.061	15/01/2020 09:30	1296.435
14/01/2020 09:30	1192.474	15/01/2020 09:45	1281.074
14/01/2020 09:45	919.069	15/01/2020 10:00	1089.277
14/01/2020 10:00	1041.733	15/01/2020 10:15	1023.779
14/01/2020 10:15	943.368	15/01/2020 10:30	1092.227
14/01/2020 10:30	944.892	15/01/2020 10:45	1034.718
14/01/2020 10:45	987.277	15/01/2020 11:00	952.723
14/01/2020 11:00	991.37	15/01/2020 11:15	920.081
14/01/2020 11:15	980.697	15/01/2020 11:30	958.412
14/01/2020 11:30	983.63	15/01/2020 11:45	947.473
14/01/2020 11:45	951.473	15/01/2020 12:00	888.868
14/01/2020 12:00	916.57	15/01/2020 12:15	955.64

14/01/2020 12:15	980.419	15/01/2020 12:30	943.897
14/01/2020 12:30	991.474	15/01/2020 12:45	999.333
14/01/2020 12:45	927.597	15/01/2020 13:00	879.887
14/01/2020 13:00	926.594	15/01/2020 13:15	949.688
14/01/2020 13:15	958.689	15/01/2020 13:30	960.314

(ii) Volatile Organic Compounds (VOCs)

VOC DATA

Location 1		Location 2		Location 3	
Date/Time		Date/Time		Date/Time	
Tue Jan 14 2020 14:27:00	2.0	Mon Jan 13 2020 12:20:00	1.0	Mon Jan 13 2020 12:58:00	2.0
Tue Jan 14 2020 14:42:00	1.0	Mon Jan 13 2020 12:35:00	1.0	Mon Jan 13 2020 13:13:00	1.0
Tue Jan 14 2020 14:57:00	0.0	Mon Jan 13 2020 12:50:00	0.0	Mon Jan 13 2020 13:28:00	0.0
Tue Jan 14 2020 15:12:00	0.0	Mon Jan 13 2020 13:05:00	2.0	Mon Jan 13 2020 13:43:00	1.0
Tue Jan 14 2020 15:27:00	1.0	Mon Jan 13 2020 13:20:00	0.0	Mon Jan 13 2020 13:58:00	1.0
Tue Jan 14 2020 15:42:00	2.0	Mon Jan 13 2020 13:35:00	1.0	Mon Jan 13 2020 14:13:00	2.0
Tue Jan 14 2020 15:57:00	2.0	Mon Jan 13 2020 13:50:00	1.0	Mon Jan 13 2020 14:28:00	0.0
Tue Jan 14 2020 16:12:00	1.0	Mon Jan 13 2020 14:05:00	0.0	Mon Jan 13 2020 14:43:00	2.0
Tue Jan 14 2020 16:27:00	0.0	Mon Jan 13 2020 14:20:00	1.0	Mon Jan 13 2020 14:58:00	1.0
Tue Jan 14 2020 16:42:00	2.0	Mon Jan 13 2020 14:35:00	2.0	Mon Jan 13 2020 15:13:00	0.0
Tue Jan 14 2020 16:57:00	0.0	Mon Jan 13 2020 14:50:00	1.0	Mon Jan 13 2020 15:28:00	0.0
Tue Jan 14 2020 17:12:00	2.0	Mon Jan 13 2020 15:05:00	1.0	Mon Jan 13 2020 15:43:00	2.0
Tue Jan 14 2020 17:27:00	2.0	Mon Jan 13 2020 15:20:00	1.0	Mon Jan 13 2020 15:58:00	1.0
Tue Jan 14 2020 17:42:00	1.0	Mon Jan 13 2020 15:35:00	0.0	Mon Jan 13 2020 16:13:00	1.0
Tue Jan 14 2020 17:57:00	1.0	Mon Jan 13 2020 15:50:00	2.0	Mon Jan 13 2020 16:28:00	2.0
Tue Jan 14 2020 18:12:00	1.0	Mon Jan 13 2020 16:05:00	0.0	Mon Jan 13 2020 16:43:00	1.0
Tue Jan 14 2020 18:27:00	0.0	Mon Jan 13 2020 16:20:00	1.0	Mon Jan 13 2020 16:58:00	0.0
Tue Jan 14 2020 18:42:00	2.0	Mon Jan 13 2020 16:35:00	0.0	Mon Jan 13 2020 17:13:00	2.0
Tue Jan 14 2020 18:57:00	1.0	Mon Jan 13 2020 16:50:00	2.0	Mon Jan 13 2020 17:28:00	2.0
Tue Jan 14 2020 19:12:00	1.0	Mon Jan 13 2020 17:05:00	2.0	Mon Jan 13 2020 17:43:00	2.0
Tue Jan 14 2020 19:27:00	2.0	Mon Jan 13 2020 17:20:00	0.0	Mon Jan 13 2020 17:58:00	2.0
Tue Jan 14 2020 19:42:00	1.0	Mon Jan 13 2020 17:35:00	0.0	Mon Jan 13 2020 18:13:00	2.0
Tue Jan 14 2020 19:57:00	2.0	Mon Jan 13 2020 17:50:00	1.0	Mon Jan 13 2020 18:28:00	0.0
Tue Jan 14 2020 20:12:00	1.0	Mon Jan 13 2020 18:05:00	0.0	Mon Jan 13 2020 18:43:00	2.0
Tue Jan 14 2020 20:27:00	0.0	Mon Jan 13 2020 18:20:00	0.0	Mon Jan 13 2020 18:58:00	0.0
Tue Jan 14 2020 20:42:00	1.0	Mon Jan 13 2020 18:35:00	2.0	Mon Jan 13 2020 19:13:00	0.0
Tue Jan 14 2020 20:57:00	1.0	Mon Jan 13 2020 18:50:00	2.0	Mon Jan 13 2020 19:28:00	0.0
Tue Jan 14 2020 21:12:00	0.0	Mon Jan 13 2020 19:05:00	0.0	Mon Jan 13 2020 19:43:00	1.0
Tue Jan 14 2020 21:27:00	2.0	Mon Jan 13 2020 19:20:00	1.0	Mon Jan 13 2020 19:58:00	0.0
Tue Jan 14 2020 21:42:00	0.0	Mon Jan 13 2020 19:35:00	0.0	Mon Jan 13 2020 20:13:00	2.0
Tue Jan 14 2020 21:57:00	1.0	Mon Jan 13 2020 19:50:00	2.0	Mon Jan 13 2020 20:28:00	1.0
Tue Jan 14 2020 22:12:00	0.0	Mon Jan 13 2020 20:05:00	2.0	Mon Jan 13 2020 20:43:00	0.0
Tue Jan 14 2020 22:27:00	2.0	Mon Jan 13 2020 20:20:00	0.0	Mon Jan 13 2020 20:58:00	0.0
Tue Jan 14 2020 22:42:00	0.0	Mon Jan 13 2020 20:35:00	2.0	Mon Jan 13 2020 21:13:00	1.0
Tue Jan 14 2020 22:57:00	2.0	Mon Jan 13 2020 20:50:00	0.0	Mon Jan 13 2020 21:28:00	0.0
Tue Jan 14 2020 23:12:00	2.0	Mon Jan 13 2020 21:05:00	2.0	Mon Jan 13 2020 21:43:00	2.0
Tue Jan 14 2020 23:27:00	1.0	Mon Jan 13 2020 21:20:00	1.0	Mon Jan 13 2020 21:58:00	2.0
Tue Jan 14 2020 23:42:00	1.0	Mon Jan 13 2020 21:35:00	0.0	Mon Jan 13 2020 22:13:00	0.0
Tue Jan 14 2020 23:57:00	2.0	Mon Jan 13 2020 21:50:00	2.0	Mon Jan 13 2020 22:28:00	2.0
Wed Jan 15 2020 00:12:00	2.0	Mon Jan 13 2020 22:05:00	0.0	Mon Jan 13 2020 22:43:00	2.0
Wed Jan 15 2020 00:27:00	0.0	Mon Jan 13 2020 22:20:00	2.0	Mon Jan 13 2020 22:58:00	1.0
Wed Jan 15 2020 00:42:00	1.0	Mon Jan 13 2020 22:35:00	2.0	Mon Jan 13 2020 23:13:00	2.0
Wed Jan 15 2020 00:57:00	2.0	Mon Jan 13 2020 22:50:00	2.0	Mon Jan 13 2020 23:28:00	1.0
Wed Jan 15 2020 01:12:00	0.0	Mon Jan 13 2020 23:05:00	2.0	Mon Jan 13 2020 23:43:00	0.0

Wed Jan 15 2020 01:27:00	0.0	Mon Jan 13 2020 23:20:00	0.0	Mon Jan 13 2020 23:58:00	2.0
Wed Jan 15 2020 01:42:00	0.0	Mon Jan 13 2020 23:35:00	1.0	Tue Jan 14 2020 00:13:00	1.0
Wed Jan 15 2020 01:57:00	1.0	Mon Jan 13 2020 23:50:00	1.0	Tue Jan 14 2020 00:28:00	2.0
Wed Jan 15 2020 02:12:00	0.0	Tue Jan 14 2020 00:05:00	1.0	Tue Jan 14 2020 00:43:00	2.0
Wed Jan 15 2020 02:27:00	0.0	Tue Jan 14 2020 00:20:00	1.0	Tue Jan 14 2020 00:58:00	1.0
Wed Jan 15 2020 02:42:00	1.0	Tue Jan 14 2020 00:35:00	0.0	Tue Jan 14 2020 01:13:00	0.0
Wed Jan 15 2020 02:57:00	1.0	Tue Jan 14 2020 00:50:00	0.0	Tue Jan 14 2020 01:28:00	0.0
Wed Jan 15 2020 03:12:00	0.0	Tue Jan 14 2020 01:05:00	2.0	Tue Jan 14 2020 01:43:00	1.0
Wed Jan 15 2020 03:27:00	1.0	Tue Jan 14 2020 01:20:00	2.0	Tue Jan 14 2020 01:58:00	2.0
Wed Jan 15 2020 03:42:00	0.0	Tue Jan 14 2020 01:35:00	1.0	Tue Jan 14 2020 02:13:00	1.0
Wed Jan 15 2020 03:57:00	1.0	Tue Jan 14 2020 01:50:00	0.0	Tue Jan 14 2020 02:28:00	1.0
Wed Jan 15 2020 04:12:00	0.0	Tue Jan 14 2020 02:05:00	2.0	Tue Jan 14 2020 02:43:00	1.0
Wed Jan 15 2020 04:27:00	2.0	Tue Jan 14 2020 02:20:00	0.0	Tue Jan 14 2020 02:58:00	0.0
Wed Jan 15 2020 04:42:00	2.0	Tue Jan 14 2020 02:35:00	0.0	Tue Jan 14 2020 03:13:00	0.0
Wed Jan 15 2020 04:57:00	1.0	Tue Jan 14 2020 02:50:00	1.0	Tue Jan 14 2020 03:28:00	1.0
Wed Jan 15 2020 05:12:00	0.0	Tue Jan 14 2020 03:05:00	2.0	Tue Jan 14 2020 03:43:00	2.0
Wed Jan 15 2020 05:27:00	0.0	Tue Jan 14 2020 03:20:00	1.0	Tue Jan 14 2020 03:58:00	2.0
Wed Jan 15 2020 05:42:00	2.0	Tue Jan 14 2020 03:35:00	1.0	Tue Jan 14 2020 04:13:00	1.0
Wed Jan 15 2020 05:57:00	1.0	Tue Jan 14 2020 03:50:00	1.0	Tue Jan 14 2020 04:28:00	2.0
Wed Jan 15 2020 06:12:00	0.0	Tue Jan 14 2020 04:05:00	1.0	Tue Jan 14 2020 04:43:00	1.0
Wed Jan 15 2020 06:27:00	0.0	Tue Jan 14 2020 04:20:00	0.0	Tue Jan 14 2020 04:58:00	0.0
Wed Jan 15 2020 06:42:00	2.0	Tue Jan 14 2020 04:35:00	1.0	Tue Jan 14 2020 05:13:00	0.0
Wed Jan 15 2020 06:57:00	0.0	Tue Jan 14 2020 04:50:00	2.0	Tue Jan 14 2020 05:28:00	1.0
Wed Jan 15 2020 07:12:00	0.0	Tue Jan 14 2020 05:05:00	2.0	Tue Jan 14 2020 05:43:00	1.0
Wed Jan 15 2020 07:27:00	2.0	Tue Jan 14 2020 05:20:00	0.0	Tue Jan 14 2020 05:58:00	1.0
Wed Jan 15 2020 07:42:00	0.0	Tue Jan 14 2020 05:35:00	2.0	Tue Jan 14 2020 06:13:00	2.0
Wed Jan 15 2020 07:57:00	0.0	Tue Jan 14 2020 05:50:00	1.0	Tue Jan 14 2020 06:28:00	0.0
Wed Jan 15 2020 08:12:00	0.0	Tue Jan 14 2020 06:05:00	0.0	Tue Jan 14 2020 06:43:00	1.0
Wed Jan 15 2020 08:27:00	2.0	Tue Jan 14 2020 06:20:00	2.0	Tue Jan 14 2020 06:58:00	0.0
Wed Jan 15 2020 08:42:00	2.0	Tue Jan 14 2020 06:35:00	0.0	Tue Jan 14 2020 07:13:00	0.0
Wed Jan 15 2020 08:57:00	2.0	Tue Jan 14 2020 06:50:00	2.0	Tue Jan 14 2020 07:28:00	2.0
Wed Jan 15 2020 09:12:00	1.0	Tue Jan 14 2020 07:05:00	1.0	Tue Jan 14 2020 07:43:00	0.0
Wed Jan 15 2020 09:27:00	1.0	Tue Jan 14 2020 07:20:00	1.0	Tue Jan 14 2020 07:58:00	0.0
Wed Jan 15 2020 09:42:00	1.0	Tue Jan 14 2020 07:35:00	0.0	Tue Jan 14 2020 08:13:00	0.0
Wed Jan 15 2020 09:57:00	2.0	Tue Jan 14 2020 07:50:00	1.0	Tue Jan 14 2020 08:28:00	0.0
Wed Jan 15 2020 10:12:00	1.0	Tue Jan 14 2020 08:05:00	0.0	Tue Jan 14 2020 08:43:00	1.0
Wed Jan 15 2020 10:27:00	2.0	Tue Jan 14 2020 08:20:00	1.0	Tue Jan 14 2020 08:58:00	2.0
Wed Jan 15 2020 10:42:00	2.0	Tue Jan 14 2020 08:35:00	1.0	Tue Jan 14 2020 09:13:00	2.0
Wed Jan 15 2020 10:57:00	1.0	Tue Jan 14 2020 08:50:00	1.0	Tue Jan 14 2020 09:28:00	0.0
Wed Jan 15 2020 11:12:00	1.0	Tue Jan 14 2020 09:05:00	1.0	Tue Jan 14 2020 09:43:00	1.0
Wed Jan 15 2020 11:27:00	0.0	Tue Jan 14 2020 09:20:00	1.0	Tue Jan 14 2020 09:58:00	0.0
Wed Jan 15 2020 11:42:00	1.0	Tue Jan 14 2020 09:35:00	0.0	Tue Jan 14 2020 10:13:00	1.0
Wed Jan 15 2020 11:57:00	1.0	Tue Jan 14 2020 09:50:00	0.0	Tue Jan 14 2020 10:28:00	1.0
Wed Jan 15 2020 12:12:00	1.0	Tue Jan 14 2020 10:05:00	0.0	Tue Jan 14 2020 10:43:00	1.0
Wed Jan 15 2020 12:27:00	0.0	Tue Jan 14 2020 10:20:00	2.0	Tue Jan 14 2020 10:58:00	0.0
Wed Jan 15 2020 12:42:00	1.0	Tue Jan 14 2020 10:35:00	1.0	Tue Jan 14 2020 11:13:00	1.0
Wed Jan 15 2020 12:57:00	2.0	Tue Jan 14 2020 10:50:00	2.0	Tue Jan 14 2020 11:28:00	1.0

Wed Jan 15 2020 13:12:00	0.0	Tue Jan 14 2020 11:05:00	2.0	Tue Jan 14 2020 11:43:00	2.0
Wed Jan 15 2020 13:27:00	1.0	Tue Jan 14 2020 11:20:00	1.0	Tue Jan 14 2020 11:58:00	1.0
Wed Jan 15 2020 13:42:00	1.0	Tue Jan 14 2020 11:35:00	2.0	Tue Jan 14 2020 12:13:00	1.0
Wed Jan 15 2020 13:57:00	1.0	Tue Jan 14 2020 11:50:00	2.0	Tue Jan 14 2020 12:28:00	2.0
Wed Jan 15 2020 14:12:00	0.0	Tue Jan 14 2020 12:05:00	2.0	Tue Jan 14 2020 12:43:00	1.0

VOC DATA

Location 4		Location 5	
Date/Time		Date/Time	
Mon Jan 13 2020 13:30:00	1.0	Tue Jan 14 2020 13:45:00	0.0
Mon Jan 13 2020 13:45:00	0.0	Tue Jan 14 2020 14:00:00	0.0
Mon Jan 13 2020 14:00:00	2.0	Tue Jan 14 2020 14:15:00	1.0
Mon Jan 13 2020 14:15:00	0.0	Tue Jan 14 2020 14:30:00	2.0
Mon Jan 13 2020 14:30:00	2.0	Tue Jan 14 2020 14:45:00	2.0
Mon Jan 13 2020 14:45:00	1.0	Tue Jan 14 2020 15:00:00	0.0
Mon Jan 13 2020 15:00:00	2.0	Tue Jan 14 2020 15:15:00	0.0
Mon Jan 13 2020 15:15:00	0.0	Tue Jan 14 2020 15:30:00	2.0
Mon Jan 13 2020 15:30:00	1.0	Tue Jan 14 2020 15:45:00	2.0
Mon Jan 13 2020 15:45:00	1.0	Tue Jan 14 2020 16:00:00	0.0
Mon Jan 13 2020 16:00:00	2.0	Tue Jan 14 2020 16:15:00	1.0
Mon Jan 13 2020 16:15:00	0.0	Tue Jan 14 2020 16:30:00	0.0
Mon Jan 13 2020 16:30:00	0.0	Tue Jan 14 2020 16:45:00	1.0
Mon Jan 13 2020 16:45:00	1.0	Tue Jan 14 2020 17:00:00	0.0
Mon Jan 13 2020 17:00:00	0.0	Tue Jan 14 2020 17:15:00	2.0
Mon Jan 13 2020 17:15:00	0.0	Tue Jan 14 2020 17:30:00	2.0
Mon Jan 13 2020 17:30:00	2.0	Tue Jan 14 2020 17:45:00	1.0
Mon Jan 13 2020 17:45:00	1.0	Tue Jan 14 2020 18:00:00	0.0
Mon Jan 13 2020 18:00:00	2.0	Tue Jan 14 2020 18:15:00	0.0
Mon Jan 13 2020 18:15:00	0.0	Tue Jan 14 2020 18:30:00	1.0
Mon Jan 13 2020 18:30:00	0.0	Tue Jan 14 2020 18:45:00	0.0
Mon Jan 13 2020 18:45:00	0.0	Tue Jan 14 2020 19:00:00	2.0
Mon Jan 13 2020 19:00:00	2.0	Tue Jan 14 2020 19:15:00	2.0
Mon Jan 13 2020 19:15:00	1.0	Tue Jan 14 2020 19:30:00	2.0
Mon Jan 13 2020 19:30:00	2.0	Tue Jan 14 2020 19:45:00	2.0
Mon Jan 13 2020 19:45:00	1.0	Tue Jan 14 2020 20:00:00	1.0
Mon Jan 13 2020 20:00:00	1.0	Tue Jan 14 2020 20:15:00	0.0
Mon Jan 13 2020 20:15:00	2.0	Tue Jan 14 2020 20:30:00	0.0
Mon Jan 13 2020 20:30:00	1.0	Tue Jan 14 2020 20:45:00	2.0
Mon Jan 13 2020 20:45:00	1.0	Tue Jan 14 2020 21:00:00	1.0
Mon Jan 13 2020 21:00:00	1.0	Tue Jan 14 2020 21:15:00	0.0
Mon Jan 13 2020 21:15:00	2.0	Tue Jan 14 2020 21:30:00	1.0
Mon Jan 13 2020 21:30:00	0.0	Tue Jan 14 2020 21:45:00	2.0
Mon Jan 13 2020 21:45:00	0.0	Tue Jan 14 2020 22:00:00	0.0
Mon Jan 13 2020 22:00:00	2.0	Tue Jan 14 2020 22:15:00	0.0
Mon Jan 13 2020 22:15:00	2.0	Tue Jan 14 2020 22:30:00	0.0
Mon Jan 13 2020 22:30:00	2.0	Tue Jan 14 2020 22:45:00	1.0
Mon Jan 13 2020 22:45:00	2.0	Tue Jan 14 2020 23:00:00	2.0
Mon Jan 13 2020 23:00:00	0.0	Tue Jan 14 2020 23:15:00	0.0
Mon Jan 13 2020 23:15:00	2.0	Tue Jan 14 2020 23:30:00	0.0
Mon Jan 13 2020 23:30:00	2.0	Tue Jan 14 2020 23:45:00	0.0
Mon Jan 13 2020 23:45:00	0.0	Wed Jan 15 2020 00:00:00	2.0
Tue Jan 14 2020 00:00:00	0.0	Wed Jan 15 2020 00:15:00	2.0
Tue Jan 14 2020 00:15:00	1.0	Wed Jan 15 2020 00:30:00	2.0

Tue Jan 14 2020 00:30:00	0.0	Wed Jan 15 2020 00:45:00	0.0
Tue Jan 14 2020 00:45:00	1.0	Wed Jan 15 2020 01:00:00	1.0
Tue Jan 14 2020 01:00:00	1.0	Wed Jan 15 2020 01:15:00	2.0
Tue Jan 14 2020 01:15:00	0.0	Wed Jan 15 2020 01:30:00	2.0
Tue Jan 14 2020 01:30:00	0.0	Wed Jan 15 2020 01:45:00	0.0
Tue Jan 14 2020 01:45:00	2.0	Wed Jan 15 2020 02:00:00	1.0
Tue Jan 14 2020 02:00:00	0.0	Wed Jan 15 2020 02:15:00	0.0
Tue Jan 14 2020 02:15:00	0.0	Wed Jan 15 2020 02:30:00	1.0
Tue Jan 14 2020 02:30:00	2.0	Wed Jan 15 2020 02:45:00	0.0
Tue Jan 14 2020 02:45:00	1.0	Wed Jan 15 2020 03:00:00	2.0
Tue Jan 14 2020 03:00:00	2.0	Wed Jan 15 2020 03:15:00	2.0
Tue Jan 14 2020 03:15:00	2.0	Wed Jan 15 2020 03:30:00	1.0
Tue Jan 14 2020 03:30:00	2.0	Wed Jan 15 2020 03:45:00	0.0
Tue Jan 14 2020 03:45:00	1.0	Wed Jan 15 2020 04:00:00	2.0
Tue Jan 14 2020 04:00:00	2.0	Wed Jan 15 2020 04:15:00	0.0
Tue Jan 14 2020 04:15:00	2.0	Wed Jan 15 2020 04:30:00	0.0
Tue Jan 14 2020 04:30:00	0.0	Wed Jan 15 2020 04:45:00	0.0
Tue Jan 14 2020 04:45:00	2.0	Wed Jan 15 2020 05:00:00	0.0
Tue Jan 14 2020 05:00:00	0.0	Wed Jan 15 2020 05:15:00	1.0
Tue Jan 14 2020 05:15:00	0.0	Wed Jan 15 2020 05:30:00	0.0
Tue Jan 14 2020 05:30:00	1.0	Wed Jan 15 2020 05:45:00	0.0
Tue Jan 14 2020 05:45:00	0.0	Wed Jan 15 2020 06:00:00	0.0
Tue Jan 14 2020 06:00:00	2.0	Wed Jan 15 2020 06:15:00	0.0
Tue Jan 14 2020 06:15:00	0.0	Wed Jan 15 2020 06:30:00	2.0
Tue Jan 14 2020 06:30:00	1.0	Wed Jan 15 2020 06:45:00	1.0
Tue Jan 14 2020 06:45:00	0.0	Wed Jan 15 2020 07:00:00	1.0
Tue Jan 14 2020 07:00:00	0.0	Wed Jan 15 2020 07:15:00	0.0
Tue Jan 14 2020 07:15:00	0.0	Wed Jan 15 2020 07:30:00	0.0
Tue Jan 14 2020 07:30:00	2.0	Wed Jan 15 2020 07:45:00	1.0
Tue Jan 14 2020 07:45:00	1.0	Wed Jan 15 2020 08:00:00	1.0
Tue Jan 14 2020 08:00:00	2.0	Wed Jan 15 2020 08:15:00	0.0
Tue Jan 14 2020 08:15:00	2.0	Wed Jan 15 2020 08:30:00	1.0
Tue Jan 14 2020 08:30:00	0.0	Wed Jan 15 2020 08:45:00	2.0
Tue Jan 14 2020 08:45:00	1.0	Wed Jan 15 2020 09:00:00	0.0
Tue Jan 14 2020 09:00:00	2.0	Wed Jan 15 2020 09:15:00	2.0
Tue Jan 14 2020 09:15:00	1.0	Wed Jan 15 2020 09:30:00	2.0
Tue Jan 14 2020 09:30:00	0.0	Wed Jan 15 2020 09:45:00	2.0
Tue Jan 14 2020 09:45:00	0.0	Wed Jan 15 2020 10:00:00	0.0
Tue Jan 14 2020 10:00:00	2.0	Wed Jan 15 2020 10:15:00	2.0
Tue Jan 14 2020 10:15:00	0.0	Wed Jan 15 2020 10:30:00	2.0
Tue Jan 14 2020 10:30:00	0.0	Wed Jan 15 2020 10:45:00	1.0
Tue Jan 14 2020 10:45:00	1.0	Wed Jan 15 2020 11:00:00	0.0
Tue Jan 14 2020 11:00:00	1.0	Wed Jan 15 2020 11:15:00	2.0
Tue Jan 14 2020 11:15:00	0.0	Wed Jan 15 2020 11:30:00	0.0
Tue Jan 14 2020 11:30:00	1.0	Wed Jan 15 2020 11:45:00	0.0
Tue Jan 14 2020 11:45:00	0.0	Wed Jan 15 2020 12:00:00	0.0
Tue Jan 14 2020 12:00:00	0.0	Wed Jan 15 2020 12:15:00	1.0

Tue Jan 14 2020 12:15:00	1.0	Wed Jan 15 2020 12:30:00	1.0
Tue Jan 14 2020 12:30:00	0.0	Wed Jan 15 2020 12:45:00	2.0
Tue Jan 14 2020 12:45:00	1.0	Wed Jan 15 2020 13:00:00	0.0
Tue Jan 14 2020 13:00:00	1.0	Wed Jan 15 2020 13:15:00	2.0
Tue Jan 14 2020 13:15:00	2.0	Wed Jan 15 2020 13:30:00	1.0

(iii) Ozone (O_3)

O3 DATA

Location 1		Location 2		Location 3	
Date Time	O3(ppm)	Date Time	O3(ppm)	Date Time	O3(ppm)
14/01/2020 14:27	0.033	13/01/2020 12:20	0.011	13/01/2020 12:58	0.027
14/01/2020 14:42	0.034	13/01/2020 12:35	0.011	13/01/2020 13:13	0.024
14/01/2020 14:57	0.037	13/01/2020 12:50	0.015	13/01/2020 13:28	0.029
14/01/2020 15:12	0.033	13/01/2020 13:05	0.019	13/01/2020 13:43	0.032
14/01/2020 15:27	0.037	13/01/2020 13:20	0.017	13/01/2020 13:58	0.033
14/01/2020 15:42	0.038	13/01/2020 13:35	0.016	13/01/2020 14:13	0.036
14/01/2020 15:57	0.038	13/01/2020 13:50	0.017	13/01/2020 14:28	0.035
14/01/2020 16:12	0.033	13/01/2020 14:05	0.019	13/01/2020 14:43	0.029
14/01/2020 16:27	0.038	13/01/2020 14:20	0.019	13/01/2020 14:58	0.032
14/01/2020 16:42	0.038	13/01/2020 14:35	0.022	13/01/2020 15:13	0.032
14/01/2020 16:57	0.04	13/01/2020 14:50	0.02	13/01/2020 15:28	0.033
14/01/2020 17:12	0.036	13/01/2020 15:05	0.022	13/01/2020 15:43	0.036
14/01/2020 17:27	0.037	13/01/2020 15:20	0.026	13/01/2020 15:58	0.034
14/01/2020 17:42	0.037	13/01/2020 15:35	0.027	13/01/2020 16:13	0.031
14/01/2020 17:57	0.036	13/01/2020 15:50	0.005	13/01/2020 16:28	0.036
14/01/2020 18:12	0.037	13/01/2020 16:05	0.005	13/01/2020 16:43	0.033
14/01/2020 18:27	0.034	13/01/2020 16:20	0.001	13/01/2020 16:58	0.037
14/01/2020 18:42	0.035	13/01/2020 16:35	0	13/01/2020 17:13	0.03
14/01/2020 18:57	0.04	13/01/2020 16:50	0.001	13/01/2020 17:28	0.029
14/01/2020 19:12	0.043	13/01/2020 17:05	0	13/01/2020 17:43	0.03
14/01/2020 19:27	0.036	13/01/2020 17:20	0.008	13/01/2020 17:58	0.029
14/01/2020 19:42	0.037	13/01/2020 17:35	0.008	13/01/2020 18:13	0.027
14/01/2020 19:57	0.039	13/01/2020 17:50	0	13/01/2020 18:28	0.026
14/01/2020 20:12	0.036	13/01/2020 18:05	0.006	13/01/2020 18:43	0.026
14/01/2020 20:27	0.039	13/01/2020 18:20	0.005	13/01/2020 18:58	0.025
14/01/2020 20:42	0.043	13/01/2020 18:35	0.005	13/01/2020 19:13	0.027
14/01/2020 20:57	0.043	13/01/2020 18:50	0.005	13/01/2020 19:28	0.027
14/01/2020 21:12	0.044	13/01/2020 19:05	0.005	13/01/2020 19:43	0.027
14/01/2020 21:27	0.043	13/01/2020 19:20	0.005	13/01/2020 19:58	0.028
14/01/2020 21:42	0.039	13/01/2020 19:35	0.005	13/01/2020 20:13	0.029
14/01/2020 21:57	0.044	13/01/2020 19:50	0.005	13/01/2020 20:28	0.029
14/01/2020 22:12	0.041	13/01/2020 20:05	0.005	13/01/2020 20:43	0.028
14/01/2020 22:27	0.039	13/01/2020 20:20	0.005	13/01/2020 20:58	0.026
14/01/2020 22:42	0.046	13/01/2020 20:35	0.005	13/01/2020 21:13	0.028
14/01/2020 22:57	0.044	13/01/2020 20:50	0.005	13/01/2020 21:28	0.031
14/01/2020 23:12	0.043	13/01/2020 21:05	0.005	13/01/2020 21:43	0.031
14/01/2020 23:27	0.039	13/01/2020 21:20	0.005	13/01/2020 21:58	0.029
14/01/2020 23:42	0.038	13/01/2020 21:35	0.02	13/01/2020 22:13	0.029
14/01/2020 23:57	0.041	13/01/2020 21:50	0.011	13/01/2020 22:28	0.03
15/01/2020 00:12	0.045	13/01/2020 22:05	0.013	13/01/2020 22:43	0.034
15/01/2020 00:27	0.043	13/01/2020 22:20	0.023	13/01/2020 22:58	0.035
15/01/2020 00:42	0.04	13/01/2020 22:35	0.016	13/01/2020 23:13	0.035
15/01/2020 00:57	0.038	13/01/2020 22:50	0.014	13/01/2020 23:28	0.033
15/01/2020 01:12	0.039	13/01/2020 23:05	0.022	13/01/2020 23:43	0.033

15/01/2020 01:27	0.036	13/01/2020 23:20	0.016	13/01/2020 23:58	0.032
15/01/2020 01:42	0.042	13/01/2020 23:35	0.02	14/01/2020 00:13	0.033
15/01/2020 01:57	0.045	13/01/2020 23:50	0.025	14/01/2020 00:28	0.032
15/01/2020 02:12	0.046	14/01/2020 00:05	0.001	14/01/2020 00:43	0.034
15/01/2020 02:27	0.044	14/01/2020 00:20	0.001	14/01/2020 00:58	0.035
15/01/2020 02:42	0.042	14/01/2020 00:35	0.003	14/01/2020 01:13	0.033
15/01/2020 02:57	0.04	14/01/2020 00:50	0.008	14/01/2020 01:28	0.034
15/01/2020 03:12	0.043	14/01/2020 01:05	0.002	14/01/2020 01:43	0.038
15/01/2020 03:27	0.042	14/01/2020 01:20	0.015	14/01/2020 01:58	0.039
15/01/2020 03:42	0.042	14/01/2020 01:35	0.021	14/01/2020 02:13	0.04
15/01/2020 03:57	0.042	14/01/2020 01:50	0.019	14/01/2020 02:28	0.038
15/01/2020 04:12	0.039	14/01/2020 02:05	0.005	14/01/2020 02:43	0.036
15/01/2020 04:27	0.039	14/01/2020 02:20	0.017	14/01/2020 02:58	0.039
15/01/2020 04:42	0.04	14/01/2020 02:35	0.011	14/01/2020 03:13	0.042
15/01/2020 04:57	0.039	14/01/2020 02:50	0.01	14/01/2020 03:28	0.038
15/01/2020 05:12	0.037	14/01/2020 03:05	0.006	14/01/2020 03:43	0.036
15/01/2020 05:27	0.039	14/01/2020 03:20	0.014	14/01/2020 03:58	0.037
15/01/2020 05:42	0.039	14/01/2020 03:35	0.016	14/01/2020 04:13	0.036
15/01/2020 05:57	0.038	14/01/2020 03:50	0.011	14/01/2020 04:28	0.034
15/01/2020 06:12	0.036	14/01/2020 04:05	0.005	14/01/2020 04:43	0.034
15/01/2020 06:27	0.038	14/01/2020 04:20	0.001	14/01/2020 04:58	0.033
15/01/2020 06:42	0.036	14/01/2020 04:35	0.022	14/01/2020 05:13	0.031
15/01/2020 06:57	0.037	14/01/2020 04:50	0.025	14/01/2020 05:28	0.033
15/01/2020 07:12	0.035	14/01/2020 05:05	0.017	14/01/2020 05:43	0.031
15/01/2020 07:27	0.036	14/01/2020 05:20	0.018	14/01/2020 05:58	0.029
15/01/2020 07:42	0.037	14/01/2020 05:35	0.022	14/01/2020 06:13	0.03
15/01/2020 07:57	0.037	14/01/2020 05:50	0.018	14/01/2020 06:28	0.03
15/01/2020 08:12	0.038	14/01/2020 06:05	0.011	14/01/2020 06:43	0.029
15/01/2020 08:27	0.038	14/01/2020 06:20	0.02	14/01/2020 06:58	0.028
15/01/2020 08:42	0.03	14/01/2020 06:35	0.015	14/01/2020 07:13	0.029
15/01/2020 08:57	0.034	14/01/2020 06:50	0.021	14/01/2020 07:28	0.029
15/01/2020 09:12	0.035	14/01/2020 07:05	0.024	14/01/2020 07:43	0.032
15/01/2020 09:27	0.039	14/01/2020 07:20	0.017	14/01/2020 07:58	0.031
15/01/2020 09:42	0.038	14/01/2020 07:35	0.009	14/01/2020 08:13	0.031
15/01/2020 09:57	0.04	14/01/2020 07:50	0.011	14/01/2020 08:28	0.027
15/01/2020 10:12	0.04	14/01/2020 08:05	0.017	14/01/2020 08:43	0.031
15/01/2020 10:27	0.033	14/01/2020 08:20	0.008	14/01/2020 08:58	0.03
15/01/2020 10:42	0.038	14/01/2020 08:35	0.011	14/01/2020 09:13	0.032
15/01/2020 10:57	0.039	14/01/2020 08:50	0.01	14/01/2020 09:28	0.033
15/01/2020 11:12	0.035	14/01/2020 09:05	0.014	14/01/2020 09:43	0.03
15/01/2020 11:27	0.038	14/01/2020 09:20	0.022	14/01/2020 09:58	0.036
15/01/2020 11:42	0.038	14/01/2020 09:35	0.016	14/01/2020 10:13	0.035
15/01/2020 11:57	0.034	14/01/2020 09:50	0.005	14/01/2020 10:28	0.035
15/01/2020 12:12	0.035	14/01/2020 10:05	0.008	14/01/2020 10:43	0.035
15/01/2020 12:27	0.035	14/01/2020 10:20	0.02	14/01/2020 10:58	0.034
15/01/2020 12:42	0.039	14/01/2020 10:35	0.02	14/01/2020 11:13	0.035
15/01/2020 12:57	0.038	14/01/2020 10:50	0.008	14/01/2020 11:28	0.037

15/01/2020 13:12	0.04	14/01/2020 11:05	0.01	14/01/2020 11:43	0.038
15/01/2020 13:27	0.037	14/01/2020 11:20	0.021	14/01/2020 11:58	0.036
15/01/2020 13:42	0.041	14/01/2020 11:35	0.004	14/01/2020 12:13	0.035
15/01/2020 13:57	0.036	14/01/2020 11:50	0.02	14/01/2020 12:28	0.043
15/01/2020 14:12	0.039	14/01/2020 12:05	0.024	14/01/2020 12:43	0.036



O3 DATA

Location 4		Location 5	
Date Time	O3(ppm)	Date Time	O3(ppm)
13/01/2020 13:30	0	14/01/2020 13:45	0.033
13/01/2020 13:45	0	14/01/2020 14:00	0.036
13/01/2020 14:00	0	14/01/2020 14:15	0.034
13/01/2020 14:15	0	14/01/2020 14:30	0.033
13/01/2020 14:30	0	14/01/2020 14:45	0.036
13/01/2020 14:45	0	14/01/2020 15:00	0.034
13/01/2020 15:00	0	14/01/2020 15:15	0.032
13/01/2020 15:15	0.004	14/01/2020 15:30	0.04
13/01/2020 15:30	0.003	14/01/2020 15:45	0.036
13/01/2020 15:45	0.002	14/01/2020 16:00	0.036
13/01/2020 16:00	0.002	14/01/2020 16:15	0.035
13/01/2020 16:15	0	14/01/2020 16:30	0.036
13/01/2020 16:30	0.002	14/01/2020 16:45	0.035
13/01/2020 16:45	0.001	14/01/2020 17:00	0.037
13/01/2020 17:00	0.005	14/01/2020 17:15	0.036
13/01/2020 17:15	0.006	14/01/2020 17:30	0.037
13/01/2020 17:30	0.005	14/01/2020 17:45	0.033
13/01/2020 17:45	0.006	14/01/2020 18:00	0.032
13/01/2020 18:00	0.004	14/01/2020 18:15	0.032
13/01/2020 18:15	0.003	14/01/2020 18:30	0.031
13/01/2020 18:30	0.005	14/01/2020 18:45	0.035
13/01/2020 18:45	0.003	14/01/2020 19:00	0.036
13/01/2020 19:00	0.001	14/01/2020 19:15	0.034
13/01/2020 19:15	0.003	14/01/2020 19:30	0.037
13/01/2020 19:30	0.002	14/01/2020 19:45	0.038
13/01/2020 19:45	0.008	14/01/2020 20:00	0.034
13/01/2020 20:00	0.008	14/01/2020 20:15	0.037
13/01/2020 20:15	0.009	14/01/2020 20:30	0.042
13/01/2020 20:30	0.009	14/01/2020 20:45	0.039
13/01/2020 20:45	0.008	14/01/2020 21:00	0.039
13/01/2020 21:00	0.007	14/01/2020 21:15	0.041
13/01/2020 21:15	0.007	14/01/2020 21:30	0.036
13/01/2020 21:30	0.007	14/01/2020 21:45	0.035
13/01/2020 21:45	0.009	14/01/2020 22:00	0.041
13/01/2020 22:00	0.01	14/01/2020 22:15	0.04
13/01/2020 22:15	0.009	14/01/2020 22:30	0.045
13/01/2020 22:30	0.01	14/01/2020 22:45	0.039
13/01/2020 22:45	0.008	14/01/2020 23:00	0.041
13/01/2020 23:00	0.007	14/01/2020 23:15	0.031
13/01/2020 23:15	0.009	14/01/2020 23:30	0.04
13/01/2020 23:30	0.007	14/01/2020 23:45	0.042
13/01/2020 23:45	0.006	15/01/2020 00:00	0.039
14/01/2020 00:00	0.008	15/01/2020 00:15	0.04
14/01/2020 00:15	0.006	15/01/2020 00:30	0.034

14/01/2020 00:30	0.007	15/01/2020 00:45	0.033
14/01/2020 00:45	0.009	15/01/2020 01:00	0.029
14/01/2020 01:00	0.011	15/01/2020 01:15	0.031
14/01/2020 01:15	0.008	15/01/2020 01:30	0.032
14/01/2020 01:30	0.008	15/01/2020 01:45	0.038
14/01/2020 01:45	0.009	15/01/2020 02:00	0.037
14/01/2020 02:00	0.008	15/01/2020 02:15	0.04
14/01/2020 02:15	0.009	15/01/2020 02:30	0.037
14/01/2020 02:30	0.011	15/01/2020 02:45	0.037
14/01/2020 02:45	0.013	15/01/2020 03:00	0.038
14/01/2020 03:00	0.01	15/01/2020 03:15	0.038
14/01/2020 03:15	0.01	15/01/2020 03:30	0.038
14/01/2020 03:30	0.009	15/01/2020 03:45	0.036
14/01/2020 03:45	0.008	15/01/2020 04:00	0.037
14/01/2020 04:00	0.012	15/01/2020 04:15	0.038
14/01/2020 04:15	0.009	15/01/2020 04:30	0.038
14/01/2020 04:30	0.011	15/01/2020 04:45	0.039
14/01/2020 04:45	0.01	15/01/2020 05:00	0.036
14/01/2020 05:00	0.01	15/01/2020 05:15	0.034
14/01/2020 05:15	0.01	15/01/2020 05:30	0.036
14/01/2020 05:30	0.011	15/01/2020 05:45	0.037
14/01/2020 05:45	0.01	15/01/2020 06:00	0.036
14/01/2020 06:00	0.007	15/01/2020 06:15	0.038
14/01/2020 06:15	0.006	15/01/2020 06:30	0.036
14/01/2020 06:30	0.008	15/01/2020 06:45	0.032
14/01/2020 06:45	0.007	15/01/2020 07:00	0.033
14/01/2020 07:00	0.008	15/01/2020 07:15	0.037
14/01/2020 07:15	0.007	15/01/2020 07:30	0.033
14/01/2020 07:30	0.005	15/01/2020 07:45	0.03
14/01/2020 07:45	0	15/01/2020 08:00	0.03
14/01/2020 08:00	0.001	15/01/2020 08:15	0.029
14/01/2020 08:15	0	15/01/2020 08:30	0.031
14/01/2020 08:30	0.001	15/01/2020 08:45	0.034
14/01/2020 08:45	0	15/01/2020 09:00	0.034
14/01/2020 09:00	0.002	15/01/2020 09:15	0.028
14/01/2020 09:15	0	15/01/2020 09:30	0.03
14/01/2020 09:30	0.004	15/01/2020 09:45	0.031
14/01/2020 09:45	0.001	15/01/2020 10:00	0.029
14/01/2020 10:00	0.001	15/01/2020 10:15	0.031
14/01/2020 10:15	0.002	15/01/2020 10:30	0.029
14/01/2020 10:30	0.006	15/01/2020 10:45	0.03
14/01/2020 10:45	0.006	15/01/2020 11:00	0.029
14/01/2020 11:00	0.004	15/01/2020 11:15	0.035
14/01/2020 11:15	0.002	15/01/2020 11:30	0.034
14/01/2020 11:30	0.007	15/01/2020 11:45	0.031
14/01/2020 11:45	0.004	15/01/2020 12:00	0.033
14/01/2020 12:00	0.006	15/01/2020 12:15	0.033

14/01/2020 12:15	0.01	15/01/2020 12:30	0.028
14/01/2020 12:30	0.006	15/01/2020 12:45	0.031
14/01/2020 12:45	0.006	15/01/2020 13:00	0.037
14/01/2020 13:00	0.007	15/01/2020 13:15	0.037
14/01/2020 13:15	0.007	15/01/2020 13:30	0.038
		15/01/2020 13:45	0.035

(iv) Filter Weights

Location	Date 2020	Parameters	Pre-Weight (g)	Post-Weight (g)
1	January $14^{th} - 15^{th}$	$PM_{2.5}$	4.5087	4.5205
		PM_{10}	4.4251	4.4642
		TSP	2.6740	2.6186
2	January $13^{th} - 14^{th}$	$PM_{2.5}$	4.4931	4.5058
		PM_{10}	4.5301	4.5490
		TSP	2.5659	2.5909
3	January $13^{th} - 14^{th}$	$PM_{2.5}$	4.4690	4.4802
		PM_{10}	4.4132	4.4445
		TSP	3.7038	3.7695
4	January $13^{th} - 14^{th}$	$PM_{2.5}$	4.4856	4.4975
		PM_{10}	4.4294	4.4576
		TSP	2.5680	2.6202
5	January $14^{th} - 15^{th}$	$PM_{2.5}$	4.4936	4.5163
		PM_{10}	4.4333	4.4586
		TSP	2.5420	2.5858

G. Meteorological Data

(i) Raw Meteorological Data

month	day	Temp degC	Precip mm	Pressure mb	RH %	Wdir10m deg	Wspeed10m ms-1
1	13	27.5	0	763.8	72	45	0.9
1	13	29.1	0	763.6	65	22	1.5
1	13	29.4	0	763.3	62	45	2.3
1	13	29.4	0	763.1	61	22	2.4
1	13	29.8	0	763.1	60	22	2.4
1	13	29.4	0	762.8	63	68	2.1
1	13	29.5	0	762.6	62	88	1.4
1	13	29.6	0	762.6	64	68	2.1
1	13	29.8	0	762.6	62	45	1.9
1	13	29.2	0	762.3	63	68	2.3
1	13	29.8	0	762.3	61	88	1.5
1	13	29.4	0	762.1	65	45	2.4
1	13	28.3	0	762.3	67	45	1.9
1	13	28.4	0	762.3	64	68	1.7
1	13	28.2	0	762.3	64	88	1.4
1	13	28.6	0	762.1	63	100	0.6
1	13	28.7	0	762.1	64	22	1.7
1	13	28.6	0	762.1	65	68	1.6
1	13	28.2	0	762.3	65	68	1.7
1	13	27.9	0	762.3	67	22	1.7
1	13	27.5	0	762.6	69	45	1.8
1	13	27.1	0	762.6	71	68	0.8
1	13	26.8	0	762.6	72	68	0.8
1	13	26.5	0	762.3	73	68	1.2
1	13	26.4	0	762.6	73	45	1.2
1	13	26.3	0	762.8	75	88	0.7
1	13	26.3	0	762.8	75	88	0.3
1	13	25.6	0	763.1	78	88	0.4
1	13	25.7	0	763.1	77	68	1.0
1	13	25.9	0	763.1	76	22	1.4
1	13	26.1	0	763.6	75	45	1.0
1	13	25.8	0	763.6	76	68	0.6
1	13	25.6	0	763.8	78	102	0.5
1	13	24.7	0	763.8	81	102	0.5
1	13	24.4	0	763.6	84	102	0.3
1	13	24.4	0	763.6	84	102	0.3
1	13	24.6	0	763.6	83	88	0.6
1	13	25.0	0	763.6	81	88	0.7
1	13	25.5	0	763.6	77	22	1.0
1	13	25.6	0	763.6	78	102	0.6
1	13	25.1	0	763.8	81	102	0.3
1	13	24.4	0	763.8	84	88	0.4
1	13	24.4	0	763.8	85	88	0.8
1	13	24.8	0	763.8	84	88	1.2

1	13	24.6	0	763.6	85	88	0.9
1	13	24.9	0	763.6	83	68	0.8
1	14	24.6	0	763.6	82	88	0.6
1	14	25.1	0	763.6	79	45	1.1
1	14	25.2	0	763.3	80	45	0.8
1	14	25.4	0	763.3	78	45	1.1
1	14	25.2	0	763.3	79	88	0.4
1	14	25.0	0	763.1	81	88	0.6
1	14	24.3	0	762.8	84	102	0.3
1	14	23.9	0	762.8	86	102	0.4
1	14	24.4	0	762.8	83	102	0.4
1	14	24.8	0	762.6	81	45	0.8
1	14	24.7	0	762.3	81	68	0.8
1	14	24.8	0	762.3	80	45	0.9
1	14	24.9	0	762.3	79	22	1.0
1	14	24.8	0	762.1	80	68	0.5
1	14	24.8	0	762.1	80	247	0.8
1	14	24.9	0	762.1	81	102	0.4
1	14	24.3	0	762.1	82	102	0.3
1	14	23.8	0	762.1	86	102	0.3
1	14	23.8	0	762.3	85	102	0.2
1	14	23.7	0	762.3	85	88	0.4
1	14	23.7	0	762.1	86	88	0.4
1	14	23.6	0	762.3	86	102	0.3
1	14	23.6	0	762.3	87	102	0.4
1	14	23.7	0	762.3	86	102	0.6
1	14	23.8	0	762.3	85	102	0.2
1	14	23.9	0	762.6	85	102	0.4
1	14	23.8	0	762.8	86	102	0.1
1	14	23.8	0	762.8	86	100	0.3
1	14	24.1	0	762.8	85	88	0.5
1	14	24.7	0	763.1	83	102	0.4
1	14	25.3	0	763.1	81	102	0.2
1	14	26.6	0	763.1	76	102	0.4
1	14	28.1	0	763.6	69	102	0.3
1	14	28.2	0	763.3	70	88	1.0
1	14	28.2	0	763.8	68	45	1.3
1	14	28.8	0	763.8	67	45	1.5
1	14	28.7	0	763.8	67	68	1.7
1	14	28.7	0	764.1	67	68	1.5
1	14	29.3	0	764.1	64	22	1.2
1	14	29.8	0	764.1	63	68	1.3
1	14	30.2	0	763.8	61	68	1.1
1	14	30.1	0	763.8	61	22	1.7
1	14	31.0	0	763.6	58	45	1.4
1	14	30.9	0	763.6	59	45	1.8
1	14	29.8	0	763.6	64	68	1.5

1	14	29.4	0	763.3	64	45	2.4
1	14	29.6	0	763.3	65	68	1.4
1	14	29.1	0	763.1	69	45	2.4
1	14	28.2	0	763.1	70	68	2.5
1	14	28.7	0	762.8	69	68	2.5
1	14	27.8	0	763.1	71	68	3.4
1	14	27.4	0	763.1	73	68	1.1
1	14	27.7	0	762.8	72	68	1.7
1	14	27.5	0	762.6	71	45	0.9
1	14	27.8	0	762.3	71	45	1.4
1	14	28.4	0	762.3	68	202	0.8
1	14	28.6	0	762.1	68	292	1.1
1	14	28.7	0	762.1	67	68	0.8
1	14	28.9	0	761.8	66	22	1.2
1	14	29.3	0	761.6	65	45	1.8
1	14	29.6	0	761.6	64	45	2.6
1	14	28.7	0	761.6	62	45	2.5
1	14	28.6	0	761.0	63	45	2.3
1	14	28.8	0	761.6	62	45	1.4
1	14	28.7	0	761.3	63	22	1.3
1	14	28.5	0	761.6	65	45	1.4
1	14	28.0	0	761.6	69	45	1.0
1	14	27.9	0	761.6	69	22	0.9
1	14	27.9	0	761.8	71	45	1.1
1	14	27.4	0	761.6	74	22	1.2
1	14	27.2	0	761.6	74	339	0.6
1	14	27.3	0	761.8	73	22	0.8
1	14	27.3	0	761.8	73	45	1.0
1	14	26.2	0	761.8	81	45	1.4
1	14	26.2	0	761.8	78	22	0.9
1	14	26.3	0	761.8	77	100	0.6
1	14	26.4	0	762.1	74	22	0.7
1	14	26.6	0	762.1	75	270	0.9
1	14	26.7	0	762.3	76	45	1.0
1	14	26.8	0	762.3	74	68	0.8
1	14	26.9	0	762.3	73	45	1.3
1	14	26.9	0	762.6	72	0	1.3
1	14	26.8	0	762.6	72	102	0.5
1	14	26.9	0	762.8	70	318	0.7
1	14	27.0	0	762.8	70		0.9
1	14	27.0	0	763.1	70	45	1.2
1	14	26.0	0	763.1	80	45	1.3
1	14	25.7	0	762.8	80	88	0.6
1	14	26.2	0	762.6	74	225	0.6
1	14	26.9	0	762.6	67	22	1.3
1	14	27.1	0	762.8	69	0	1.2
1	14	26.9	0	762.6	69	270	0.7

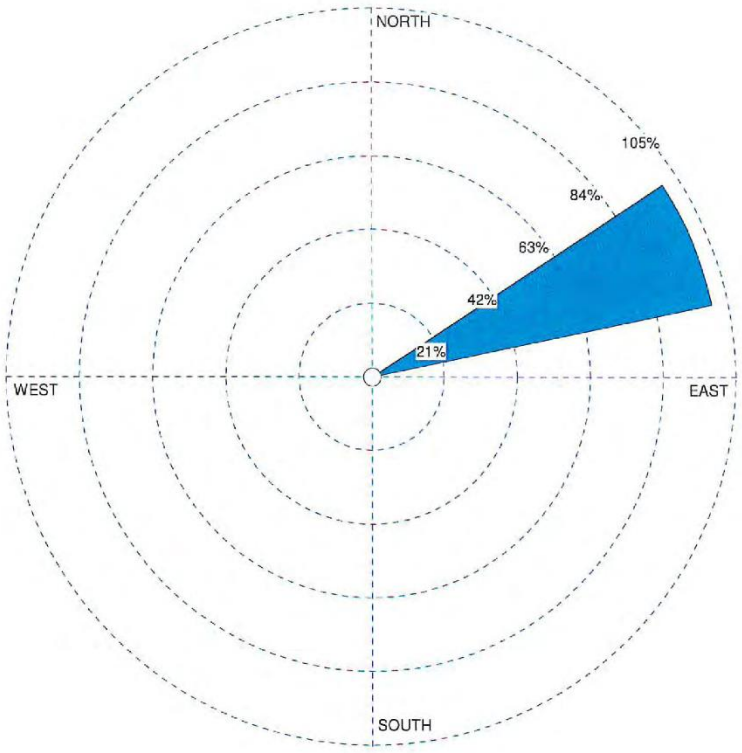
1	14	27.2	0	762.6	67	68	0.7
1	14	26.9	0	762.6	68	45	1.3
1	14	27.2	0	762.3	67	22	1.5
1	14	27.1	0	762.3	68	45	1.4
1	15	27.2	0	762.3	68	339	1.2
1	15	27.2	0	762.3	68	45	1.3
1	15	27.2	0	762.3	68	45	1.4
1	15	27.1	0	762.3	70	22	1.3
1	15	26.8	0	762.1	72	68	0.5
1	15	26.2	0	761.8	75	100	0.2
1	15	25.6	0	762.1	81	113	1.0
1	15	25.5	0	761.8	81	100	0.5
1	15	25.3	0	761.8	83	225	0.7
1	15	25.2	0	761.6	83	102	0.2
1	15	25.1	0	761.6	83	88	0.8
1	15	24.9	0	761.3	84	113	0.8
1	15	24.8	0	761.6	85	125	0.1
1	15	24.8	0	761.6	86	225	0.6
1	15	24.9	0	761.6	86	88	0.5
1	15	24.7	0	761.8	86	102	0.0
1	15	24.6	0	761.8	87	102	0.1
1	15	24.6	0	761.8	87	113	0.0
1	15	24.4	0	761.8	88	125	0.0
1	15	24.5	0	761.8	88	102	0.4
1	15	24.3	0	761.8	89	100	0.1
1	15	24.2	0	761.8	91	100	0.0
1	15	24.0	0	761.8	92	113	0.0
1	15	23.7	0	761.8	94	100	0.3
1	15	23.7	0	761.8	93	88	0.4
1	15	23.8	0	761.8	93	102	0.7
1	15	23.9	0	762.1	92	102	0.8
1	15	24.1	0	762.1	92	88	0.8
1	15	24.2	0	762.3	91	68	0.8
1	15	24.3	0	762.6	90	88	0.7
1	15	24.4	0	762.6	90	88	0.8
1	15	24.6	0	762.8	89	68	0.4
1	15	25.1	0	763.1	87	102	0.1
1	15	25.4	0	763.3	84	88	0.8
1	15	25.7	0	763.6	85	88	0.6
1	15	25.7	0	763.6	86	102	0.8
1	15	25.9	0	763.6	87	100	0.6
1	15	26.9	0	763.6	82	88	1.0
1	15	27.2	0	763.6	80	88	0.8
1	15	27.4	0	763.6	79	102	0.5
1	15	28.4	0	763.6	75	88	0.8
1	15	28.1	0	763.3	76	22	1.7
1	15	28.3	0	763.3	76	68	1.2

1	15	27.3	0	763.3	78	102	0.4
1	15	28.2	0	763.3	74	88	0.4
1	15	27.3	0	763.3	78	102	0.6
1	15	28.2	0	763.3	76	22	0.9
1	15	27.7	0	763.3	79	100	1.0
1	15	26.6	0	763.1	85	125	0.2
1	15	27.6	0	762.8	79	202	0.4
1	15	28.3	0	762.8	77	270	0.8
1	15	28.3	0	762.3	77	247	0.9
1	15	27.7	0	762.3	81	270	1.3
1	15	26.7	0	762.1	83	125	0.7
1	15	26.1	0	761.8	89	68	0.8
1	15	26.2	0	761.8	89	45	1.8
1	15	26.3	0	761.8	88	22	1.3
1	15	26.6	0	761.8	86	45	1.2

(ii) Wind Rose Plot

WIND ROSE PLOT:

Ecoengineering Consultants Limited
13th - 15th January, 2020



WIND SPEED
(m/s)

- 5.5 - 6.9
- 3.9 - 5.4
- 2.4 - 3.8
- 1.9 - 2.3
- 1.4 - 1.8
- < 1.4

Calms: 0.00%

COMMENTS:		COMPANY NAME: **Ecoengineering Consultants Limited**	
		MODELER: **Kaizen Environmental Services (Trinidad) Limited**	
			PROJECT NO.: **20-9010-1**

WRPLOT View - Lakes Environmental Software

(iii) Calibration Certificate – Davis Met Station

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE #: 040418-A70426N737

DATE: 2019-12-25

ANALYSER TYPE: Davis Meteorological Station

SERIAL #: A70426N737

Sensor	Date Checked	Response
UV	*25/12/19*	**OK**
Rain Gauge	*25/12/19*	**OK**
Wind Monitor	*25/12/19*	**OK**
Wind Direction	*25/12/19*	**OK**
Temp & Humidity	*25/12/19*	**OK**
Pressure	*25/12/19*	**OK**

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with Davis factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

Mr. Anthony Chariah
Environmental Technician | PROJECT Services Division

Mr. Anthony Chariah is presently employed at Kaizen Environmental Services Limited as an Environmental Technician in the Project Services Department where he is responsible for executing the environmental fieldwork component of projects. This includes pre planning, data collection, and management, the operation of equipment, testing and preparation of technical information.

Mr. Chariah has been under the Project Services Division for four years now where he has gained knowledge and training in Environmental and Occupational monitoring and sampling according to US EPA and EMA guidelines. His work experiences include performing Ambient Air Quality monitoring, Indoor Air Quality monitoring, Stack Emission testing (Point Source Testing) and Noise testing.

Mr. Chariah possesses a BSc. Environmental and Natural Resources Management and Geography together with a NEBOSH National General Certificate in Occupational Health and Safety. Past experience includes working as a California Industrial Engineering Services Company Limited.

Mr. Troy Glod
Trainee Environmental Technician | PROJECT Services Division

Mr. Troy Glod is presently employed at Kaizen Environmental Services Limited as a Trainee Environmental Technician in the Project Services Department where he is responsible for executing environmental type fieldwork projects and reporting of the environmental type projects. This includes equipment use, service, calibration and testing together with data collection, processing and measurement reporting.

Mr. Glod has been under the Project Services Division where he has gained knowledge and training in Environmental and Occupational monitoring and sampling according to USEPA and EMA guidelines. His work experiences include performing Ambient Air Quality monitoring, Indoor Air Quality monitoring, Stack Emission testing (Point Source Testing), Noise monitoring and light monitoring.

Mr. Glod possesses a BSc. Environmental Science and Sustainable Technology.

Event 2

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REPORT

Ambient Air Quality Monitoring

For

Construction of the Diego Martin Vehicular Overpass

January 2020

Phase II

Event 2

Prepared For

Ecoengineering – Consultants Limited
#62 Eastern Main Road, St. Augustine,
Trinidad W.I

Prepared By

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EXECUTIVE SUMMARY

Kaizen Environmental Services (Trinidad) Limited (Kaizen) was commissioned to conduct Ambient Air Quality Monitoring by Ecoengineering – Consultants Limited. Monitoring was conducted for the Construction of the Diego Martin Vehicular Overpass.

The parameters measured were as follows:

1. Particulate Matter 2.5 ($PM_{2.5}$)
2. Particulate Matter 10 (PM_{10})
3. Total Suspended Particulates (TSP)
4. Nitrogen Dioxide (NO_2)
5. Sulphur Dioxide (SO_2)
6. Carbon Monoxide (CO)
7. Ozone (O_3)
8. Volatile Organic Compounds (VOCs)

Fieldwork was conducted during the period January 20th – 22nd, 2020.

SUMMARY OF RESULTS

Based on the investigation conducted on January 20th – 22nd, 2020, the following conclusions can be made:

- The 24-hour average concentrations obtained for **Particulate Matter ($PM_{2.5}$ and PM_{10})** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's[a] Air Pollution Rules 2014.

- The 24-hour average concentrations obtained for **Total Suspended Particulates (TSP)** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's Air Pollution Rules 2014.

- The 1-hour concentrations obtained for **Nitrogen Dioxide (NO_2)** at all locations sampled were in compliance with the guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: NO_2 was below the detection limit at all locations monitored

- The 24-hour average concentrations obtained for **Sulphur Dioxide (SO_2)** at all locations sampled were in compliance with their respective guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: SO_2 was below the detection limit at all locations monitored

[a] EMA – Environmental Management Authority of Trinidad and Tobago

- The 8-hour average concentrations obtained for **Carbon Monoxide (CO)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

- The 8-hour average concentrations obtained for **Ozone (O_3)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

- The 8-hour average concentrations for **Volatile Organic Compounds (VOCs)** were obtained at all sampling locations. The concentrations obtained were within the range of 0.7 $\mu g/m^3$ to 1.3 $\mu g/m^3$. There are no EMA guidelines for **VOCs.**

1.0 Introduction

Kaizen Environmental Services (Trinidad) Limited (Kaizen) was commissioned to conduct Ambient Air Quality Monitoring by Ecoengineering – Consultants Limited. Monitoring was conducted for the Construction of the Diego Martin Vehicular Overpass.

Fieldwork was conducted during the period January 20th – 22nd, 2020.

2.0 Monitoring Locations and Parameters

Five (5) locations were selected by Ecoengineering – Consultants Limited for the ambient air monitoring as follows:

Table 1: Monitoring Locations and Parameters

Location No.	Co-ordinates	Parameters Monitored
1	20P0657831 UTM1180930	Particulate Matter 2.5 ($PM_{2.5}$) Particulate Matter 10 (PM_{10}) Total Suspended Particulates (TSP) Nitrogen Dioxide (NO_2) Sulphur Dioxide (SO_2) Carbon Monoxide (CO) Ozone (O_3) Volatile Organic Compounds (VOCs)
2	20P0657681 UTM1181156	
3	20P0658177 UTM1181216	
4	20P0658383 UTM1181049	
5	20P0658294 UTM1181091	

3.0 Test Methodology

3.1 Particulate Matter ($PM_{2.5}$ and PM_{10}) Monitoring

$PM_{2.5}$ & PM_{10} was measured in accordance with the US EPA's[b] "*Compendium of Methods for the Determination of Inorganic Compounds in Ambient Air - Compendium Method IO 2.1: Sampling of Ambient Air for Total Suspended Particulate Matter (SPM) and PM_{10} Using High Volume (HV) Sampler*".

The $PM_{2.5}$ high volume sampler utilized meets the US EPA's Reference Method: *40 CFR Part 50 Appendix L.*

The PM_{10} high volume sampler utilized meets the US EPA's Reference Method: *40 CFR Part 50 Appendix J.*

The $PM_{2.5}$ & PM_{10} sampler was calibrated prior to use in the field (*Calibration Certificate is appended–Attachment A (i) and (ii) respectively*)

3.2 Total Suspended Particulate Matter (TSP)

TSP was measured in accordance with equipment specified in the USEPA's *Code of Federal regulations (CFR) 40 CFR Chapter 1 Part 50 Appendix B Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method).*
The TSP sampler was calibrated prior to use in the field (*Calibration Certificate is appended–Attachment A (iii*).

3.3 Nitrogen Dioxide (NO_2)

NO_2 concentrations were determined in accordance with the US EPA Designated Equivalent Method *NO – EQN – 1277 – 026, "Sodium Arsenite Method for the Determination of Nitrogen Dioxide in the Atmosphere".*

A sample of the ambient air is bubbled at a low flow rate through an impinger containing a sodium arsenite and sodium hydroxide solution for the full 24-hour sampling period. The concentration of the nitrite ion produced during sampling is determined colorimetrically by reacting the nitrite ion with phosphoric acid and N – (1-naphthyl)-ethylene diamine di-hydrochloride and measuring the absorbance of the highly colored azo dye at 540 nm. A vacuum pump was used to draw the ambient air through the sampling solution contained in the impinger.
Based on results from a collaborative study conducted by the US EPA, the lower detectable limit of the method is estimated to be 9 $\mu g/m^3$ for a 24-hour period.

[b] US EPA – United States Environmental Protection Agency

Modified Method to monitor the concentration of NO_2 in accordance to the EMA's Air Pollution Rules, 2014: The sampling time was reduced to one (1) hour or sixty (60) minutes with a sample flow rate of 2 L/min which is reflected in the formula for the calculation of volume of air sampled. The new detectable limit of the method is calculated to be 20 $\mu g/m^3$.

The following formulae were used in the determination of NO_2:

Volume of air sampled:
$V = (F_i + F_f / 2) \times t_s \times 10^{-6}$

Where:
V = Volume of air sampled, m^3
F_i = Air flow rate before sampling, cm^3/min
F_f = Air flow rate after sampling, cm^3/min
t_s = Sampling time, 60 minutes
10^{-6} = conversion of cm^3 to m^3

NO_2 Concentration in Air:
(Concentration of NO_2 (mg/L) x 50 / Volume of air sampled x 0.82) x Dilution factor

Where:
Concentration of NO_2 (mg/L) = obtained from lab analysis report
Volume of absorbing reagent used in sampling, ml = 50
Volume of air sampled = obtained from previous calculation
Sampling efficiency = 0.82
Dilution factor = 1

3.4 Sulphur Dioxide (SO_2)

The concentration of SO_2 was determined in accordance with US EPA 40 CFR Part 50 Appendix A: *"Reference Method for the Determination of Sulphur Dioxide in the Atmosphere (Pararosaniline Method).*

With this Method, a measured volume of air was bubbled through a solution of 0.04 M potassium tetrachloromercurate (TCM), which was contained in an impinger train assembly. The SO_2 present in the air stream reacts with the TCM solution to form a stable monochlorosulfanomercurate complex. Once formed, this complex resists air oxidation and is stable in the presence of strong oxidants such as ozone and oxides of nitrogen. During subsequent analysis, the complex is reacted with acid bleached pararosaniline methyl sulfonic acid. The optical density of this species is determined spectrophotometrically at 548 nm and is directly related to the amount of SO_2 collected.

Based on results from a collaborative study conducted by the US EPA, the lower limit of detection of SO_2 in 10 ml of TCM is 0.75 µg. This represents a concentration of 13 µg SO_2/ m^3 (0.005 ppm) for a 24-hour period.

3.5 Carbon Monoxide (CO)

The Thermo Scientific Model 48i Carbon Monoxide Analyzer is an U.S. EPA Reference Method: *RFCA-0981-054.*

The Model 48i Carbon Monoxide (CO) absorbs infrared radiation at a wavelength of 4.6 microns. The instrument electronics transform the basic analyzer signal into a linear output. The 48i uses an exact calibration curve to accurately linearize the instrument output over any range up to a concentration of 10,000ppm. The CO samplers were calibrated prior to use in the field (*Calibration Certificate is appended – Attachment A (iv).*

3.6 Ozone (O_3)

For this measurement of Ozone, the Aeroqual Series 500-USEPA Tier II & III Indicative method was used; comparable to USEPA studies. *See Attachment D – Ozone Comparative Study*

3.7 Volatile Organic Compounds (VOCs)

For monitoring of VOCs, Crowcon portable emissions analyzer was utilized, and was calibrated prior to use in the field (*Test Certificate is appended –Attachment A (ii)*).

The Crowcon Gas Detective portable emissions analyzer is a microprocessor controlled portable gas detector, which is capable of monitoring up to four (4) gas types simultaneously and providing warning of hazardous levels.

Using electrochemical, catalytic, and thermal conductivity sensors, this instrument was configured to detect any practical combination of oxygen, toxic and flammable gas.

The Crowcon was fitted with electrochemical sensors to measure VOC concentrations. The concentration ranges and resolution/ detection limits of this instrument VOC are as follows:

Sensor/ Parameter	Range (ppm)	Resolution/ Detection Limit (ppm)
VOC	0 – 100	1.0

The Crowcon was configured to log averages at 15-minute intervals.

4.0 Results

4.1 Particulate Matter ($PM_{2.5}$ and PM_{10}), Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2), and Carbon Monoxide (CO), Ozone (O_3), Total Suspended Particulate Matter (TSP) and Volatile Organic Compounds (VOCs) Results

Table 2 presents the results of the Particulate Matter ($PM_{2.5}$ and PM_{10}) and Total Suspended Particulate (TSP) Monitoring. The results in this table have been compared to standards outlined by the EMA in the Air Pollution Rules, 2014.

Table 2: Ambient Air Quality Testing Results Particulate Matter ($PM_{2.5}$ PM_{10} and TSP)

Location No.	Sample Period/ 2020	Parameter Concentration		
		$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	TSP ($\mu g/m^3$)
1	January $21^{st} - 22^{nd}$	8	25	33
2	January $20^{th} - 21^{st}$	8	18	26
3		8	18	28
4		9	16	49
5	January $21^{st} - 22^{nd}$	14	23	30
EMA[c] STEL[d] (24-hr average)		**65**	**75**	**150**

Note:

a) Results reported to the nearest whole number

[c] EMA – Environmental Management Authority of Trinidad and Tobago
[d] STEL – Short-term Maximum Permissible Level

Table 3 displays the results of the 24 hour monitoring event for SO_2. The results were compared to their respective short term permissible levels as stipulated by the EMA in their Air Pollution Rules, 2014.

Table 3: Ambient Air Quality Testing Results –SO_2 (24-hour)

Location No	Sample Period/ 2020	Parameter Concentration
		SO_2 (µg/m^3)
1	January 21st – 22nd	BDL
2	January 20th – 21st	BDL
3		BDL
4		BDL
5	January 21st – 22nd	BDL
EMA STEL (24-hr)		**125**

Note:

a) BDL – Below Detection Limit
b) SO_2 Method Detection Limit = 13 µg/Nm^3

Table 4 displays the data for the 1-hour monitoring event for NO_2. The results were compared to the relevant limits as stated by the EMA in the Air Pollution Rules, 2014.

Table 4: Ambient Air Quality Testing Results – NO_2 (1-hour)

Location No	Sample Period/ 2020	Parameter Concentration
		NO_2 (µg/m^3)
1	January 21st	BDL
2	January 20th	BDL
3		BDL
4		BDL
5	January 21st	BDL
EMA[e] STEL[f] (1-hr)		**200**

Note:

a) BDL – Below Detection Limit
b) NO_2 Modified Method Detection Limit = 20 µg/Nm^3

[e] EMA – Environmental Management Authority of Trinidad and Tobago
[f] STEL – Short-term Maximum Permissible Level

Table 5 displays the results of the CO, VOC and O_3 monitoring. The results were compared to the 8-hour limit as stated by the EMA in the Air Pollution Rules, 2014.

Table 5: Ambient Air Quality Testing Results – Carbon Monoxide (CO), Volatile Organic Compounds (VOCs) and Ozone (O_3)

Location	Sampling Date/ 2020	Sampling Period		Avg 8-Hr CO Concentration ($\mu g/m^3$)	Avg 8-Hr VOC Concentration ($\mu g/m^3$)	Avg 8-Hr O_3 Concentration ($\mu g/m^3$)
		Start	End			
1	January 21st	15:00	22:59	953	1.0	68
	January 21st – 22nd	23:00	06:59	848	0.8	72
	January 22nd	07:00	15:00	936	1.2	71
2	January20th	11:45	19:44	737	1.3	48
	January 20th -21st	19:45	03:44	648	1.1	47
	January 21st	03:45	11:45	694	1.0	48
3	January20th	13:30	21:29	898	0.9	61
	January 20th -21st	21:30	05:29	820	1.0	64
	January 21st	05:30	13:30	886	1.1	58
4	January20th	14:00	21:59	984	0.7	61
	January 20th -21st	22:00	05:59	854	0.8	57
	January 21st	06:00	14:00	908	1.1	58
5	January 21st	14:30	22:29	971	1.3	64
	January 21st – 22nd	22:30	06:29	835	0.9	67
	January 22nd	06:30	14:30	938	1.0	61
EMA STEL (8-hour average)				**10 000**	**N/A**	**120**

Note:

a) Results reported to the nearest whole number
b) There are no guidelines for VOCs in ambient air.

4.2 Meteorological Monitoring

Table 6: Summary of Meteorological Conditions during Monitoring Periods (January 20th – 22nd, 2020)

Date/ 2020	Average Wind Speed (m/s)	Average Temperature (°C)	Average Relative Humidity (%)	Average Barometric Pressure (mmHg)	Total Rainfall (mm)
January 20th – 22nd	0.8	25.4	81.5	762.2	0.3

The raw meteorological data is attached as *Appendix F*.

5.0 Conclusion

Based on the investigation conducted on January 20th – 22nd, 2020, the following conclusions can be made:

- The 24-hour average concentrations obtained for **Particulate Matter ($PM_{2.5}$ and PM_{10})** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's[g] Air Pollution Rules 2014.
- The 24-hour average concentrations obtained for **Total Suspended Particulates (TSP)** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's Air Pollution Rules 2014.
- The 1-hour concentrations obtained for **Nitrogen Dioxide (NO_2)** at all locations sampled were in compliance with the guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: NO_2 was below the detection limit at all locations monitored
- The 24-hour average concentrations obtained for **Sulphur Dioxide (SO_2)** at all locations sampled were in compliance with their respective guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: SO_2 was below the detection limit at all locations monitored
- The 8-hour average concentrations obtained for **Carbon Monoxide (CO)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

[g] EMA – Environmental Management Authority of Trinidad and Tobago

- The 8-hour average concentrations obtained for **Ozone (O_3)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

- The 8-hour average concentrations for **Volatile Organic Compounds (VOCs)** were obtained at all sampling locations. The concentrations obtained were within the range of 0.7 $\mu g/m^3$ to 1.3 $\mu g/m^3$. There are no EMA guidelines for **VOCs.**

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ATTACHMENTS

A. Calibration Certificates

- (i) $PM_{2.5}$ High Volume Samplers
- (ii) PM_{10} High Volume Samplers
- (iii) TSP Samplers
- (iv) Thermo Scientific (CO)
- (v) Aeroqual (O_3)
- (vi) SKC Pumps (NO_2 and SO_2)
- (vii) Crowncon Gas Detective (VOCs)
- (viii) Analytical Balance

B. Map of Monitoring Location

C. Accreditation Certificate

D. Laboratory Data

- (i) Chain of Custody
- (ii) Analytical Results

E. Ozone Comparative Study

F. Raw Data

- (i) Carbon Monoxide (CO)
- (ii) Volatile Organic Compounds (VOCs)
- (iii) Ozone (O_3)
- (iv) Filter Weights

G. Meteorological Data

- (i) Raw Meteorological Data
- (ii) Wind Rose Plot
- (iii) Calibration Certificate – Davis Met Station

H. Biographies of Personnel

A. Calibration Certificates

(i) $PM_{2.5}$ High Volume Samplers

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PM2.5 High Volume Sampler Calibration

DATE: December 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-711768
Serial# : 711768
Sampler: Staplex

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

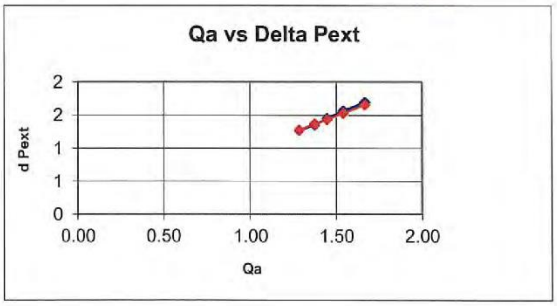
Conditions

Ta:(°C)	27.3	**Ta (°K)**	300.3	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.96	**Pa (mm Hg)**	760.984	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext
6.9	1.669	6.6	1.693	1.6502
5.9	1.544	5.6	1.559	1.5259
5.2	1.450	4.8	1.443	1.4325
4.7	1.379	4.2	1.350	1.3619
4.1	1.289	3.7	1.267	1.2720

slope, m2:	**1.143603**
intercept, b2:	**-0.214450**
corr. coeff, r2	**0.998751**
SFR	**1.135**
SSP	**2.71**



amrit persad maharaj

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PM2.5 High Volume Sampler Calibration

DATE: December 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-711763
Serial# : 711763
Sampler: Staplex

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

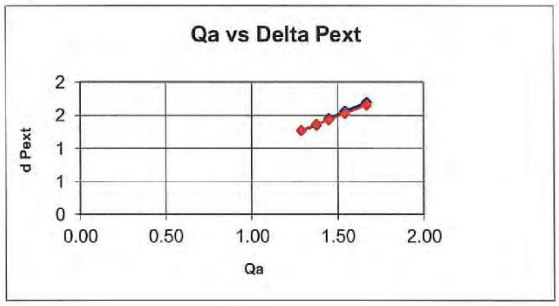
Conditions

Ta:(°C)	27.3	**Ta (°K)**	300.3	**Tstd.**	298	**Ps (mmHg**	761.238
Pa: (" Hg.)	29.96	**Pa (mm Hg)**	760.984	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext
6.9	1.669	6.6	1.693	1.6502
5.9	1.544	5.6	1.559	1.5259
5.2	1.450	4.8	1.443	1.4325
4.7	1.379	4.2	1.350	1.3619
4.1	1.289	3.7	1.267	1.2720

slope, m2:	**1.143603**
intercept, b2:	**-0.214450**
corr. coeff, r2	**0.998751**
SFR	**1.135**
SSP	**2.71**



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Instrumentation Technician

Deodath Maharaj
Instrumentation Team Leader

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PM2.5 High Volume Sampler Calibration

DATE: Dec 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4735
Serial# : 4735
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

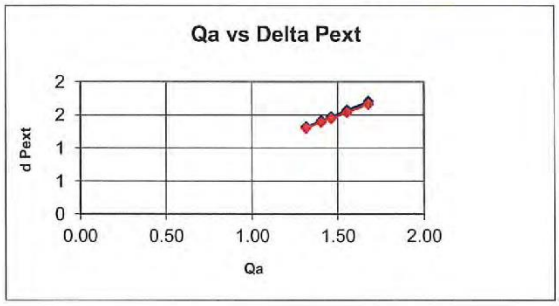
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	27.3	**Ta (°K)**	300.3	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.96	**Pa (mm Hg)**	760.984	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.072916**
7	1.681	6.7	1.705	1.6621	**intercept, b2:**	**-0.097978**
6	1.557	5.7	1.573	1.5388	**corr. coeff, r2**	**0.999998**
5.3	1.464	5	1.473	1.4463		
4.9	1.408	4.6	1.413	1.3906	**SFR**	**1.135**
4.3	1.320	4	1.318	1.3027	**SSP**	**2.89**



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(ii) PM_{10} High Volume Samplers

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PM10 High Volume Sampler Calibration

DATE: Dec 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-711770
Serial# : 711770
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

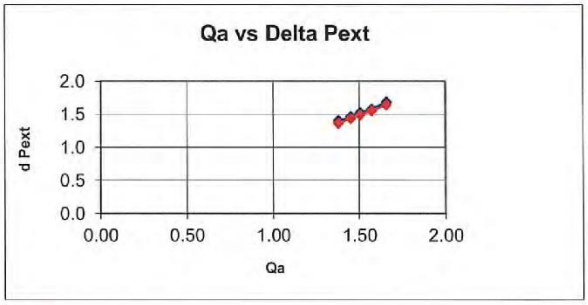
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.009309**
6.8	1.661	6.5	1.683	1.6420	**intercept, b2:**	**-0.001603**
6.1	1.574	5.7	1.576	1.5552	**corr. coeff, r2**	**0.997414**
5.6	1.508	5.3	1.520	1.4901		
5.2	1.454	4.9	1.461	1.4359	**SFR**	**1.141**
4.7	1.383	4.5	1.401	1.3651	**SSP**	**3.03**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

PM10 High Volume Sampler Calibration

DATE: Dec 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4734
Serial# : 4734
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

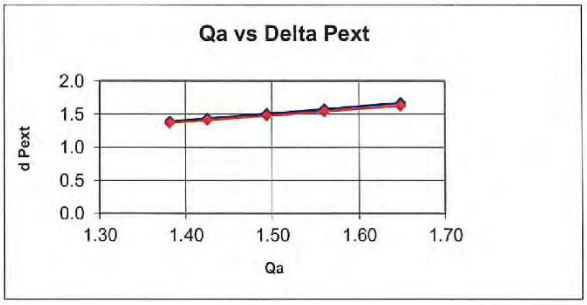
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.072142**
6.7	1.649	6.4	1.670	1.6299	**intercept, b2:**	**-0.097217**
6	1.561	5.7	1.576	1.5424	**corr. coeff, r2**	**0.999999**
5.5	1.495	5.2	1.505	1.4767		
5	1.426	4.7	1.431	1.4080	**SFR**	**1.141**
4.7	1.383	4.4	1.385	1.3651	**SSP**	**2.91**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

KAIZEN
Environmental Services (T'dad) Ltd

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Freeport. Trinidad, W.I.,
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FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

PM10 High Volume Sampler Calibration

DATE: Dec 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-1328
Serial# : 1328
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

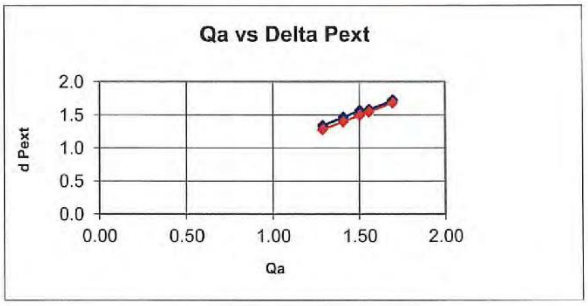
Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext
7.1	1.697	6.8	1.722	1.6778
6	1.561	5.7	1.576	1.5424
5.6	1.508	5.6	1.562	1.4901
4.9	1.411	4.9	1.461	1.3938
4.1	1.292	4.1	1.337	1.2750

slope, m2:	**0.932154**
intercept, b2:	**0.139218**
corr. coeff, r2	**0.995687**
SFR	**1.141**
SSP	**3.32**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

(iii) TSP Samplers

KAIZEN
Environmental Services (T'dad) Ltd

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Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

TSP High Volume Sampler Calibration

DATE: Dec 23th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-2576
Serial# : 2576
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

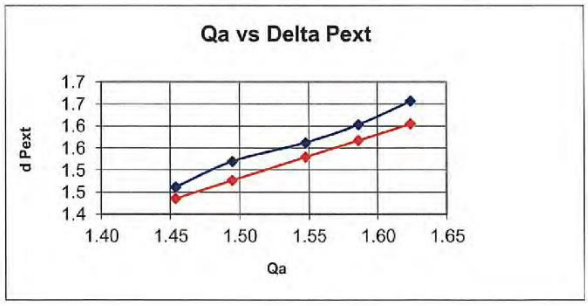
Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

Conditions

Ta:(°C)	28.5	**Ta (°K)**	301.5	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.094582**
6.5	1.624	6.3	1.656	1.6046	**intercept, b2:**	**-0.127347**
6.2	1.587	5.9	1.603	1.5671	**corr. coeff, r2**	**0.995148**
5.9	1.548	5.6	1.562	1.5287		
5.5	1.495	5.3	1.519	1.4760	**SFR**	**1.139**
5.2	1.454	4.9	1.461	1.4352	**SSP**	**2.88**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

KAIZEN
Environmental Services (T'dad) Ltd

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Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

TSP High Volume Sampler Calibration

DATE: Dec 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-2576
Serial# : 2158
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

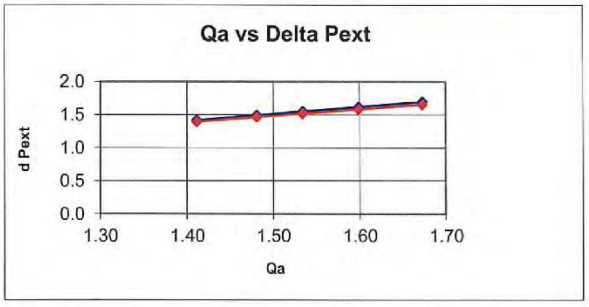
Conditions

Ta:(°C)	28.5	**Ta (°K)**	301.5	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext
6.9	1.673	6.6	1.695	1.6532
6.3	1.599	6	1.616	1.5797
5.8	1.535	5.5	1.548	1.5157
5.4	1.482	5.1	1.490	1.4625
4.9	1.412	4.6	1.415	1.3932

slope, m2:	**1.072053**
intercept, b2:	**-0.098219**
corr. coeff, r2	**0.999999**
SFR	**1.139**
SSP	**2.90**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

KAIZEN
Environmental Services (T'dad) Ltd

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Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

TSP High Volume Sampler Calibration

DATE: Dec 23rd 2019
Techinician : Amrit Persad Maharaj

Certificate #: 010319-4730
Serial# : 4730
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

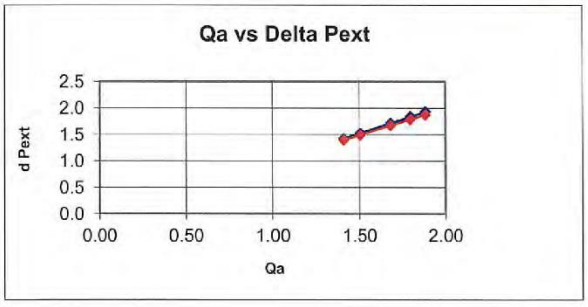
Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.068727**
8.8	1.889	8.5	1.925	1.8679	**intercept, b2:**	**-0.093403**
8	1.801	7.7	1.832	1.7810	**corr. coeff, r2**	**0.999998**
7	1.686	6.7	1.709	1.6660		
5.6	1.509	5.3	1.520	1.4901	**SFR**	**1.141**
4.9	1.413	4.6	1.416	1.3938	**SSP**	**2.91**



amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

(iv) Thermo Scientific (CO)

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
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Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-1108347541

DATE: 28/12/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	As Left	Span	Gas Manufacturer	Gas Lot #
0	0	*Air Zero Grade (THC<1ppm)*	CALGAZ	152802
50	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-1108347540

DATE: 28/12/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	As Left	Span	Gas Manufacturer	Gas Lot #
0	0	*Air Zero Grade (THC<1ppm)*	CALGAZ	152802
50	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-710821552

DATE: 28/12/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	As Left	Span	Gas Manufacturer	Gas Lot #
0	0	*Air Zero Grade (THC<1ppm)*	CALGAZ	152802
50	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj.

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

(v) Aeroqual (O_3)

aeroqual

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32159

Calibration Date: 25 Feb 2019 14:51

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1221

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.005	0.110	0.523	0.000
AQL Sensor (Std. Dev) /ppm	0.000	0.001	0.002	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: **Takao Yamasaki**

Date: **25 Feb 2019**

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32151

Calibration Date: 25 Feb 2019 14:50

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1225

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.004	0.109	0.510	0.000
AQL Sensor (Std. Dev) /ppm	0.001	0.001	0.001	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: **Takao Yamasaki**

Date: **25 Feb 2019**

aeroqual

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32142

Calibration Date: 25 Feb 2019 14:50

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1232

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.005	0.113	0.506	0.000
AQL Sensor (Std. Dev) /ppm	0.002	0.001	0.003	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: **Takao Yamasaki**

Date: **25 Feb 2019**

(vi) SKC Pumps (NO_2 and SO_2)

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-634635

DATE: 27/12/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 634635

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
3.1 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-562657

DATE: 27/12/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 562657

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
2.9 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
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Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-634661

DATE: 27/12/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 634661

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
3.0 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

(vii) Crowncon Gas Detective (VOCs)

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-45704
DATE: 2019-12-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 45704

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*
VOC	0	0	10	10	*10 ppm Isobutylene*

TEMPERATURE: 25.8°C

RELATIVE HUMIDITY: 51.5%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Freeport. Trinidad, W.I.,
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FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-44094
DATE: 2019-12-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 44094

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*
VOC	0	0	10	10	*10 ppm Isobutylene*

TEMPERATURE: 25.8°C

RELATIVE HUMIDITY: 51.6%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

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Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
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Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-42045
DATE: 2019-12-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 42045

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*
VOC	0	0	10	10	*10 ppm Isobutylene*

TEMPERATURE: 25.9°C

RELATIVE HUMIDITY: 51.4%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

(viii) Analytical Balance

Location:
University of the West Indies
St. Augustine Campus, Trinidad & Tobago
Mailing Address:
Tunapuna Post Office, Trinidad & Tobago
Tel: (868) 299-0210
Fax: (868) 662-7177
Email: cams@cariri.com
Website: www.cariri.com

CARIRI
Caribbean Industrial Research Institute

IAS ACCREDITED
Calibration Laboratory
LAB NO. CL-134

CALIBRATION CERTIFICATE

Date of Issue: September 06, 2019

Certificate No.: C067119

Project No.: EC03834167/19

CLIENT: Kaizen Environmental Services (Trinidad) Ltd.

ADDRESS: Unit 8 Rajkumar Street, Mission Road, Freeport

CALIBRATION LOCATION: Kaizen Environmental Services (Trinidad) Ltd., Balance Room

EQUIPMENT: Electronic Balance

MANUFACTURER: Sartorius

MODEL NO.: AC 210S 00016

SERIAL NO.: 40305246

EQUIPMENT NO.: ASD-EQ-BAL001

CAPACITY/RESOLUTION: 100g/ 0.0001g

CALIBRATION TYPE: As Found

CALIBRATION DATE: September 4, 2019

1. This report relates solely to the specific sample of the product which has been analysed or calibrated by CARIRI as the basis for preparing the report. It shall not be used for certification, advertising or marketing of products produced by the same manufacturer or the Client without the prior written consent of the Chief Executive Officer of CARIRI.

2. This report may not be reproduced, other than in full, except with the prior written authorization from the Chief Executive Officer / Chairman of CARIRI.

CARIBBEAN INDUSTRIAL RESEARCH INSTITUTE
CALIBRATION CERTIFICATE

Certificate No.: C067119
Project No.: EC03834167/19

PROCEDURE:
The electronic balance was calibrated in accordance with UKAS Lab 14 and CARIRI's SOP: CAMS.M1

TRACEABILITY:
The values and units of measurement of the reference weights are traceable to the SI (International System of Units), through reference standards maintained at the National Physical Laboratory (England), NIST (USA) and other recognized standards laboratories.

OBSERVATIONS:
The Internal, External and Sensitivity calibration functions on the balance are inoperative.
As a result these functions could not be used to adjust the balance readout.

AMBIENT CONDITIONS:
Temperature: 23±2°C, Relative Humidity: 50±5%RH

REFERENCE MASS

Serial No.	Weights Applied (g)	Certificate No.	Laboratory No.	Class	Uncertainty (g)
41950	0.005 to 100	M49398	0438	E2	0.00005

REPEATABILITY
Applied Load (g): 100

Unloaded Reading(A)	Loaded Reading (B)	Difference (B-A)	Readability
0.0000	99.8289	99.8289	0.0001
0.0000	99.8293	99.8293	
0.0000	99.8291	99.8291	
0.0000	99.8290	99.8290	
0.0000	99.8291	99.8291	
0.0000	99.8294	99.8294	
0.0000	99.8290	99.8290	
0.0000	99.8288	99.8288	
0.0000	99.8290	99.8290	
0.0000	99.8289	99.8289	

Standard Deviation (g): 0.00018

LINEARITY

Applied Load (g)	Indicated Reading (g)	Error (g)
0.005	0.0046	-0.0004
0.02	0.0198	-0.0002
0.1	0.0998	-0.0002
1	0.9986	-0.0014
5	4.9919	-0.0081
20	19.9658	-0.0342
30	29.9490	-0.0510
50	49.9149	-0.0851
70	69.8807	-0.1193
100	99.8290	-0.1710

Maximum Error (g): 0.1710

Error = Indicated Reading - Applied Load

CARIBBEAN INDUSTRIAL RESEARCH INSTITUTE
CALIBRATION CERTIFICATE

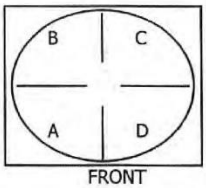
Certificate No.: C067119
Project No.: EC03834167/19

ECCENTRICITY

Applied Load (g): 20

Position	Indicated Reading (g)	Error (g)
Front Left (A)	19.9661	-0.0339
Rear Left (B)	19.9660	-0.0340
Rear Right (C)	19.9659	-0.0341
Front Right (D)	19.9659	-0.0341

Maximum deviation across balance pan (g): 0.0002



Uncertainty of Calibration (g): ±0.00032
Manufacturer's Stated Linearity (g): ±0.002
Manufacturer's Stated Repeatability (g): 0.0001

Calibrator: N. Jonas

Signature: N. Jonas

Approved Signatory: M. Andrews

Signature: M. Andrews

End of Certificate

The uncertainty is for a confidence probability of approximately 95 percent and coverage factor k = 1.984
Error = Indicated Reading - Applied Load

B. Map of Monitoring Location


Location 3
N
Location 2
Location 5
Diego Martin Hwy
Location 4
Main Rd
Location 1
Western Main Rd

C. Accreditation Certificates

TRINIDAD AND TOBAGO
laboratory
Accreditation
Service

CERTIFICATE OF ACCREDITATION

KAIZEN ENVIRONMENTAL SERVICES (TRINIDAD) LTD

Testing Laboratory No.: LAS-005

is an accredited Laboratory which fulfils the requirements of ISO/IEC 17025 and has demonstrated competence to carry out tests as per a defined scope for:

CHEMICAL AND MICROBIOLOGICAL TESTING

as per attached schedule

While this certificate remains valid, the Accredited Laboratory named above is authorized to issue TTLABS-endorsed certificates.

Karlene Carolyn Lewis
Manager, TTLABS

"Recognised as the official national laboratory accrediting body by the Ministry of Trade, Industry, Investment and Communication of the Republic of Trinidad and Tobago"

Initial Accreditation date: 3rd September 2014

This certificate issued on: 21st September 2017

"This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrated technical competence for a defined scope and the operation of a laboratory quality management system. (refer to joint ISO-ILAC-IAF Communiqué dated 18 June 2005)"

Canadian Association for Laboratory Accreditation Inc.

CALA

Certificate of Accreditation

Kaizen Lab
KaizenLAB Inc.
333-50th Ave. S.E.
Calgary, Alberta

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

Accreditation No.: A2925
Issued On: October 17, 2017
Accreditation Date: January 31, 2005
Expiry Date: April 16, 2020

Andrew M. Adams
President & CEO

CALA

This certificate is the property of the Canadian Association for Laboratory Accreditation Inc. and must be returned on request. Reproduction must follow policy in place at date of issue. For the specific tests to which this accreditation applies, please refer to the laboratory's scope of accreditation at www.cala.ca.

D. Laboratory Data

(i) Chain of Custody

PROJECTServices

A DIVISION OF KAIZEN ENVIRONMENTAL SERVICES LIMITED
Unit # 8, Rajkumar Street, Mission Road, Freeport, Trinidad, W.I.
Tel: (868) 299-0009 Fax: (868) 673-5997

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

Kaizen Lab File #: 122972-1-5 **Nº PSD 1743**

Date Submitted: 23/01/2020 Date Required: 31/01/2020

Service Requested:
- Regular (10 days) ☐
- Rush (within 5 days) + 25% ☑
- Priority (3 days) + 50% ☐
- Emergency (next day) + 100% ☐

ANALYSIS REQUESTED

SAMPLE ID	DATE SAMPLED	SAMPLED TYPE	NO_x
Eco-Engineering			
-Loc 1	21/01/2020		☑ 42797 - 1
-Loc 2	20/01/2020	NO_x Absorbing Solution	☑ - 2
-Loc 3	20/01/2020		☑ - 3
-Loc 4	20/01/2020		☑ - 4
-Loc 5	21/01/2020		☑ - 5

Client: Heavy Lue Tatt Phone: Same As Above
Contact: Fax:
Report Address: P.O.#:
Client Job #:
Billing Address: # Samples Submitted: 5
Preservatives:
Special Requests:

Relinquished By: A. Charlah
Date: 23/01/2020
Time: 0800h

Received By: J. Phillip
Date: 23-01-2020
Time: 8:30

Sample Condition Upon Receipt:
Frozen ☐ Cold ☐ Ambient ☑ Head Space (yes/no): Yes
Other (breakage, leakage, illegible etc.):

SAMPLED BY: A. Charlah
NAME IN BLOCK LETTERS
A. Charlah
SIGNATURE

DATE: 23/01/2020

White - File Copy Yellow - Lab Copy

Phone 652-3577

PROJECTServices

A DIVISION OF KAIZEN ENVIRONMENTAL SERVICES LIMITED
Unit # 8, Rajkumar Street, Mission Road, Freeport Trinidad, W.I.
Tel: (868) 299-0009 Fax: (868) 673-5997

CHAIN OF CUSTODY AND REQUEST FORM

Kaizen Lab File # **305119** PSD 1744

05 Feb 20.

Date Submitted: 23/01/2020	Date Required: 31/01/2020 NS

Service Requested:
- Regular (10 days) ☐
- Rush (within 5 days) + 25% ☑
- Priority (3 days) + 50% ☐
- Emergency (next day) + 100% ☐

ANALYSIS REQUESTED

SOX

	SAMPLE ID	DATE SAMPLED	SAMPLED TYPE	
	Eco-Engineering			
1	-Loc 1	21/01/2020		✓
2	-Loc 2	20/01/2020	SO2 Absorbing Solution	✓
3	-Loc 3	20/01/2020		✓
4	-Loc 4	20/01/2020		✓
5	-Loc 5	21/01/2020		✓

Client: Henry Lue Yatt Phone: Same As Above
Contact Fax:
Report Address: P.O.#:
Client Job #:
Billing Address: # Samples Submitted: 5
Preservatives:
Special Requests:

Relinquished By: A. Charlah Received By: NS
Date: 23/01/2020 Date: 30. Jan. 20
Time: 0800h Time: 9:04 am.

Sample Condition Upon Receipt: t° = 15,4°C.
Frozen ☐ Cold ☐ Ambient ☐ Head Space (yes/no):
Other (breakage, leakage, illegible etc.):

SAMPLED BY: A. Charlah
NAME IN BLOCK LETTERS
A. Charlah
SIGNATURE

DATE: 23/01/2020

White - File Copy Yellow - Lab Copy

Pronto 852-3577

(ii) Analytical Results

333 50th Ave. S.E.
Calgary, AB, T2G 2B3
Phone (403) 297-0868
Fax: (403) 297-0869

KaizenLAB

ANALYTICAL REPORT

Client: Kaizen Environmental Services (Trinidad) Ltd.
Unit 8, Rajkumar Street, Mission Road
Freeport, Trinidad, West Indies

Attention: Henry Lue-Fatt

KaizenLAB JOB #:	305119
DATE RECEIVED:	30-Jan-2020
DATE REPORTED:	05-Feb-2020
PROJECT ID:	Eco Engineering
LOCATION:	

KaizenLAB Sample #: 305119_001 **Sample ID:** Loc 1
Date Sampled: 21-Jan-2020 **Matrix:** LIQUID

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 305119_002 **Sample ID:** Loc 2
Date Sampled: 20-Jan-2020 **Matrix:** LIQUID

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 305119_003 **Sample ID:** Loc 3
Date Sampled: 20-Jan-2020 **Matrix:** LIQUID

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 305119_004 **Sample ID:** Loc 4
Date Sampled: 20-Jan-2020 **Matrix:** LIQUID

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 305119_005 **Sample ID:** Loc 5
Date Sampled: 21-Jan-2020 **Matrix:** LIQUID

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

333 50th Ave. S.E.
Calgary, AB, T2G 2B3
Phone (403) 297-0868
Fax: (403) 297-0869

KaizenLAB

Test Methodologies

SO2 in Water - Determination of SO2 Absorbed in Potassium Trichlormercurate

Final Review by:

Shirley Lowe
Client Service Representative / Project Coordinator

Note: The results in this report relate only to the items tested and as received. Information is available for any items in 7.8.2.1 of ISO/IEC 17025:2017 that cannot be put on a test report. The report shall not be reproduced except in full without written approval of KaizenLAB. The validity of results may be affected if the information is provided by the customer.

KaizenLAB
Analytical Division of Kaizen Environmental Services (Trinidad) Ltd.

Unit 8 Rajkumar Street,
Mission Road, Freeport.
Email: kaizenlab@kaizen-tt.com
Tel: (868) 299-0009
Fax: (868) 673-6774

ANALYSIS DATA REPORT

Customer:	KESTL- PSD	**Customer Contact:**	Henry Lue-Fatt
Customer's Address:	Unit 8 Rajkumar Street, Mission Road, Freeport.		
Client Project #:	20-002	**Lab File #:**	427972
Item(s) Analyzed:	Liquid Samples		
Date of Sampling:	20-Jan-20 & 21-Jan-20	**Sampling Location:**	Eco Engineering
Sampling Condition:	n/a	**Sampled By:**	PSD Staff - A. Chariah
Sampling Plan Used:	n/a		
Date of Receipt:	23-Jan-20	**Date of Testing:**	23-Jan-20
Report Date:	27-Jan-20		

ANALYSIS RESULTS

Analysis: Nitrite-N

Sample ID	Units	Results
		Nitrite-N
427972-1, Loc 1	mg/L	<0.04
427972-2, Loc 2	mg/L	<0.04
427972-3, Loc 3	mg/L	<0.04
427972-4, Loc 4	mg/L	<0.04
427972-5, Loc 5	mg/L	<0.04

** Detailed Test Methodologies and QA/QC data available upon request.*

***Test Methodologies:** Nitrite-N: EPA-EQN-1277-026

Discussion: None

Comments: The results in this test report relate only to the items as received and tested.

Report Authorized by: Devika Rooplal

Devika Rooplal
Laboratory Manager

This test report shall not be reproduced except in full, without written approval of the laboratory.

E. Comparative Study – Ozone (O_3)

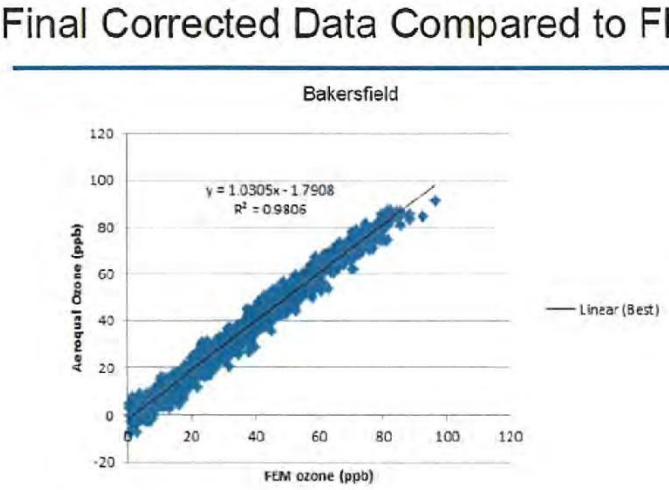
The Aeroqual's Series 500 portable ozone monitors were chosen by an air quality consultancy based in California, USA to better understand the spatial and temporal distribution of ozone in an area.

Twenty three monitors were co-located next to a federal reference method (FEM) monitoring stations to check their precision and accuracy before being distributed across an area of about 100 square miles. The monitors collected and transmitted ozone concentrations every minute for six weeks. Afterwards the monitors were co-located with reference monitoring stations to quantify drift. The data was analyzed and a report was produced.

Co-location of the Series 500 monitors established accuracy to within +/- 3 ppb of the federal reference monitors. See example in figure below.
The study demonstrated that there are strong spatial gradients in ozone over short distances even in rural areas. In addition, the new site at Di Giorgio actually measures higher concentrations than the old Bear Mountain site, and therefore is a good replacement site. In addition, it was determined that the new site was representative of concentrations experienced in the city of Arvin and is therefore useful for real-time warnings regarding poor air quality for citizens in Arvin.
The results of this study provide important supporting evidence for the District's formal attainment request to EPA. In addition the study provides a strong scientific foundation for future decision making about managing the air resources of the San Joaquin Valley.

The final report can be found at:
http://www.valleyair.org/Air_Quality_Plans/docs/2013Attainment/OzoneSaturationStudy.pdf.

Data is courtesy of STI, 2013.



F. Raw Data

(i) Carbon Monoxide (CO)

CO DATA

Location 1		Location 2		Location 3	
Date Time	co	Date Time	co	Date Time	co
21/01/2020 15:00	987.835	20/01/2020 11:45	690.316	20/01/2020 13:30	976.796
21/01/2020 15:15	1167.605	20/01/2020 12:00	892.305	20/01/2020 13:45	832.684
21/01/2020 15:30	1142.842	20/01/2020 12:15	856.624	20/01/2020 14:00	950.470
21/01/2020 15:45	1127.636	20/01/2020 12:30	637.015	20/01/2020 14:15	760.912
21/01/2020 16:00	992.250	20/01/2020 12:45	666.440	20/01/2020 14:30	899.262
21/01/2020 16:15	1040.280	20/01/2020 13:00	731.878	20/01/2020 14:45	873.865
21/01/2020 16:30	1009.978	20/01/2020 13:15	847.819	20/01/2020 15:00	751.827
21/01/2020 16:45	1075.653	20/01/2020 13:30	879.402	20/01/2020 15:15	1109.172
21/01/2020 17:00	969.95	20/01/2020 13:45	718.695	20/01/2020 15:30	920.604
21/01/2020 17:15	900.411	20/01/2020 14:00	888.432	20/01/2020 15:45	767.658
21/01/2020 17:30	945.996	20/01/2020 14:15	715.146	20/01/2020 16:00	1107.604
21/01/2020 17:45	1120.202	20/01/2020 14:30	714.396	20/01/2020 16:15	1021.193
21/01/2020 18:00	1194.224	20/01/2020 14:45	849.552	20/01/2020 16:30	943.529
21/01/2020 18:15	914.06	20/01/2020 15:00	761.975	20/01/2020 16:45	1189.675
21/01/2020 18:30	1131.351	20/01/2020 15:15	804.788	20/01/2020 17:00	716.259
21/01/2020 18:45	1113.460	20/01/2020 15:30	640.381	20/01/2020 17:15	942.513
21/01/2020 19:00	911.378	20/01/2020 15:45	757.453	20/01/2020 17:30	949.41
21/01/2020 19:15	1117.132	20/01/2020 16:00	700.609	20/01/2020 17:45	930.477
21/01/2020 19:30	956.252	20/01/2020 16:15	768.142	20/01/2020 18:00	988.802
21/01/2020 19:45	993.113	20/01/2020 16:30	539.978	20/01/2020 18:15	705.64
21/01/2020 20:00	894.699	20/01/2020 16:45	671.485	20/01/2020 18:30	824.258
21/01/2020 20:15	759.312	20/01/2020 17:00	588.321	20/01/2020 18:45	846.477
21/01/2020 20:30	735.995	20/01/2020 17:15	764.099	20/01/2020 19:00	812.709
21/01/2020 20:45	774.960	20/01/2020 17:30	786.753	20/01/2020 19:15	874.629
21/01/2020 21:00	985.432	20/01/2020 17:45	765.202	20/01/2020 19:30	993.035
21/01/2020 21:15	781.858	20/01/2020 18:00	770.144	20/01/2020 19:45	924.248
21/01/2020 21:30	884.760	20/01/2020 18:15	626.814	20/01/2020 20:00	960.04
21/01/2020 21:45	735.183	20/01/2020 18:30	529.521	20/01/2020 20:15	964.718
21/01/2020 22:00	802.877	20/01/2020 18:45	728.16	20/01/2020 20:30	843.134
21/01/2020 22:15	785.998	20/01/2020 19:00	741.157	20/01/2020 20:45	840.774
21/01/2020 22:30	782.362	20/01/2020 19:15	795.338	20/01/2020 21:00	676.587
21/01/2020 22:45	757.403	20/01/2020 19:30	751.784	20/01/2020 21:15	821.551
21/01/2020 23:00	834.212	20/01/2020 19:45	648.277	20/01/2020 21:30	825.31
21/01/2020 23:15	657.529	20/01/2020 20:00	561.59	20/01/2020 21:45	686.4
21/01/2020 23:30	891.656	20/01/2020 20:15	695.392	20/01/2020 22:00	743.888
21/01/2020 23:45	671.552	20/01/2020 20:30	712.611	20/01/2020 22:15	602.551
22/01/2020 00:00	685.906	20/01/2020 20:45	508.686	20/01/2020 22:30	716.955
22/01/2020 00:15	785.666	20/01/2020 21:00	501.425	20/01/2020 22:45	650.293
22/01/2020 00:30	832.473	20/01/2020 21:15	554.023	20/01/2020 23:00	842.666
22/01/2020 00:45	842.440	20/01/2020 21:30	692.665	20/01/2020 23:15	842.168
22/01/2020 01:00	672.858	20/01/2020 21:45	735.644	20/01/2020 23:30	602.899
22/01/2020 01:15	885.719	20/01/2020 22:00	511.607	20/01/2020 23:45	717.754
22/01/2020 01:30	812.672	20/01/2020 22:15	714.678	21/01/2020 00:00	884.891
22/01/2020 01:45	807.711	20/01/2020 22:30	745.184	21/01/2020 00:15	813.408

22/01/2020 02:00	629.901	20/01/2020 22:45	665.716	21/01/2020 00:30	638.928
22/01/2020 02:15	659.808	20/01/2020 23:00	588.441	21/01/2020 00:45	775.274
22/01/2020 02:30	727.790	20/01/2020 23:15	519.894	21/01/2020 01:00	611.19
22/01/2020 02:45	886.947	20/01/2020 23:30	677.514	21/01/2020 01:15	866.882
22/01/2020 03:00	803.276	20/01/2020 23:45	706.846	21/01/2020 01:30	892.867
22/01/2020 03:15	623.607	21/01/2020 00:00	557.277	21/01/2020 01:45	736.277
22/01/2020 03:30	654.389	21/01/2020 00:15	529.062	21/01/2020 02:00	867.274
22/01/2020 03:45	793.219	21/01/2020 00:30	588.716	21/01/2020 02:15	856.194
22/01/2020 04:00	709.493	21/01/2020 00:45	760.811	21/01/2020 02:30	810.716
22/01/2020 04:15	880.421	21/01/2020 01:00	623.075	21/01/2020 02:45	654.024
22/01/2020 04:30	787.013	21/01/2020 01:15	554.024	21/01/2020 03:00	603.51
22/01/2020 04:45	661.135	21/01/2020 01:30	640.024	21/01/2020 03:15	633.162
22/01/2020 05:00	1173.513	21/01/2020 01:45	699.218	21/01/2020 03:30	1052.882
22/01/2020 05:15	1141.572	21/01/2020 02:00	745.104	21/01/2020 03:45	1133.942
22/01/2020 05:30	1080.535	21/01/2020 02:15	786.871	21/01/2020 04:00	997.349
22/01/2020 05:45	1178.050	21/01/2020 02:30	617.338	21/01/2020 04:15	1161.533
22/01/2020 06:00	1123.805	21/01/2020 02:45	614.699	21/01/2020 04:30	1096.453
22/01/2020 06:15	1104.935	21/01/2020 03:00	785.646	21/01/2020 04:45	1026.039
22/01/2020 06:30	943.622	21/01/2020 03:15	709.801	21/01/2020 05:00	803.688
22/01/2020 06:45	1194.986	21/01/2020 03:30	800.057	21/01/2020 05:15	1093.425
22/01/2020 07:00	942.755	21/01/2020 03:45	687.925	21/01/2020 05:30	755.409
22/01/2020 07:15	985.568	21/01/2020 04:00	857.686	21/01/2020 05:45	993.77
22/01/2020 07:30	1192.674	21/01/2020 04:15	868.884	21/01/2020 06:00	1037.886
22/01/2020 07:45	942.879	21/01/2020 04:30	602.167	21/01/2020 06:15	1156.814
22/01/2020 08:00	1059.537	21/01/2020 04:45	812.064	21/01/2020 06:30	876.268
22/01/2020 08:15	902.347	21/01/2020 05:00	725.04	21/01/2020 06:45	890.202
22/01/2020 08:30	1029.072	21/01/2020 05:15	606.152	21/01/2020 07:00	732.823
22/01/2020 08:45	960.122	21/01/2020 05:30	690.295	21/01/2020 07:15	759.206
22/01/2020 09:00	1117.387	21/01/2020 05:45	752.567	21/01/2020 07:30	1186.694
22/01/2020 09:15	901.691	21/01/2020 06:00	667.187	21/01/2020 07:45	864.852
22/01/2020 09:30	847.447	21/01/2020 06:15	740.152	21/01/2020 08:00	741.993
22/01/2020 09:45	822.511	21/01/2020 06:30	681.099	21/01/2020 08:15	890.918
22/01/2020 10:00	840.055	21/01/2020 06:45	760.932	21/01/2020 08:30	736.383
22/01/2020 10:15	974.785	21/01/2020 07:00	609.844	21/01/2020 08:45	864.009
22/01/2020 10:30	757.064	21/01/2020 07:15	606.843	21/01/2020 09:00	783.808
22/01/2020 10:45	819.781	21/01/2020 07:30	688.415	21/01/2020 09:15	898.451
22/01/2020 11:00	919.166	21/01/2020 07:45	616.889	21/01/2020 09:30	985.111
22/01/2020 11:15	951.986	21/01/2020 08:00	635.622	21/01/2020 09:45	889.61
22/01/2020 11:30	939.393	21/01/2020 08:15	683.275	21/01/2020 10:00	891.123
22/01/2020 11:45	978.840	21/01/2020 08:30	754.392	21/01/2020 10:15	797.458
22/01/2020 12:00	1003.103	21/01/2020 08:45	604.194	21/01/2020 10:30	761.112
22/01/2020 12:15	838.551	21/01/2020 09:00	621.747	21/01/2020 10:45	991.006
22/01/2020 12:30	786.817	21/01/2020 09:15	647.281	21/01/2020 11:00	774.109
22/01/2020 12:45	1066.616	21/01/2020 09:30	676.495	21/01/2020 11:15	1046.263
22/01/2020 13:00	1037.118	21/01/2020 09:45	725.746	21/01/2020 11:30	808.111
22/01/2020 13:15	904.210	21/01/2020 10:00	618.961	21/01/2020 11:45	811.478
22/01/2020 13:30	811.042	21/01/2020 10:15	697.825	21/01/2020 12:00	774.128

22/01/2020 13:45	892.312	21/01/2020 10:30	692.643	21/01/2020 12:15	874.175
22/01/2020 14:00	1081.608	21/01/2020 10:45	615.581	21/01/2020 12:30	1043.78
22/01/2020 14:15	827.517	21/01/2020 11:00	737.254	21/01/2020 12:45	970.282
22/01/2020 14:30	994.116	21/01/2020 11:15	730.73	21/01/2020 13:00	847.883
22/01/2020 14:45	823.938	21/01/2020 11:30	796.368	21/01/2020 13:15	901.775

CO DATA (Continued)

Location 4		Location 5	
Date Time	co	Date Time	co
20/01/2020 14:00	911.456	21/01/2020 14:30	1088.095
20/01/2020 14:15	1178.893	21/01/2020 14:45	1157.832
20/01/2020 14:30	1071.883	21/01/2020 15:00	1130.671
20/01/2020 14:45	1032.502	21/01/2020 15:15	914.165
20/01/2020 15:00	1093.319	21/01/2020 15:30	1128.091
20/01/2020 15:15	1175.802	21/01/2020 15:45	1019.478
20/01/2020 15:30	1010.595	21/01/2020 16:00	1180.418
20/01/2020 15:45	1167.046	21/01/2020 16:15	1010.981
20/01/2020 16:00	1057.721	21/01/2020 16:30	1150.389
20/01/2020 16:15	1059.503	21/01/2020 16:45	1165.971
20/01/2020 16:30	948.792	21/01/2020 17:00	917.871
20/01/2020 16:45	1044.945	21/01/2020 17:15	982.844
20/01/2020 17:00	1048.814	21/01/2020 17:30	1097.321
20/01/2020 17:15	1189.93	21/01/2020 17:45	1173.137
20/01/2020 17:30	1141.079	21/01/2020 18:00	1172.342
20/01/2020 17:45	1143.796	21/01/2020 18:15	905.368
20/01/2020 18:00	1148.916	21/01/2020 18:30	913.397
20/01/2020 18:15	970.459	21/01/2020 18:45	1194.372
20/01/2020 18:30	966.97	21/01/2020 19:00	1039.559
20/01/2020 18:45	1063.04	21/01/2020 19:15	949.406
20/01/2020 19:00	864.092	21/01/2020 19:30	791.817
20/01/2020 19:15	711.623	21/01/2020 19:45	895.207
20/01/2020 19:30	882.53	21/01/2020 20:00	885.847
20/01/2020 19:45	966.053	21/01/2020 20:15	858.92
20/01/2020 20:00	892.629	21/01/2020 20:30	982.03
20/01/2020 20:15	800.57	21/01/2020 20:45	772.426
20/01/2020 20:30	913.68	21/01/2020 21:00	946.61
20/01/2020 20:45	822.278	21/01/2020 21:15	732.089
20/01/2020 21:00	979.706	21/01/2020 21:30	780.8
20/01/2020 21:15	693.773	21/01/2020 21:45	777.055
20/01/2020 21:30	673.729	21/01/2020 22:00	689.342
20/01/2020 21:45	868.294	21/01/2020 22:15	666.303
20/01/2020 22:00	616.525	21/01/2020 22:30	646.709
20/01/2020 22:15	856.046	21/01/2020 22:45	829.867
20/01/2020 22:30	739.97	21/01/2020 23:00	763.564
20/01/2020 22:45	735.517	21/01/2020 23:15	666.945
20/01/2020 23:00	828.361	21/01/2020 23:30	754.573
20/01/2020 23:15	720.667	21/01/2020 23:45	705.803
20/01/2020 23:30	856.355	22/01/2020 00:00	630.662
20/01/2020 23:45	773.624	22/01/2020 00:15	771.072
21/01/2020 00:00	813.115	22/01/2020 00:30	716.273
21/01/2020 00:15	652.097	22/01/2020 00:45	894.832
21/01/2020 00:30	783.9	22/01/2020 01:00	801.564
21/01/2020 00:45	851.023	22/01/2020 01:15	744.009

21/01/2020 01:00	898.513	22/01/2020 01:30	836.592
21/01/2020 01:15	632.518	22/01/2020 01:45	878.594
21/01/2020 01:30	799.992	22/01/2020 02:00	866.886
21/01/2020 01:45	745.199	22/01/2020 02:15	826.668
21/01/2020 02:00	799.121	22/01/2020 02:30	761.51
21/01/2020 02:15	773.444	22/01/2020 02:45	801.306
21/01/2020 02:30	868.607	22/01/2020 03:00	632.464
21/01/2020 02:45	615.863	22/01/2020 03:15	601.517
21/01/2020 03:00	827.094	22/01/2020 03:30	608.553
21/01/2020 03:15	668.838	22/01/2020 03:45	829.572
21/01/2020 03:30	785.785	22/01/2020 04:00	795.183
21/01/2020 03:45	892.24	22/01/2020 04:15	760.716
21/01/2020 04:00	1096.894	22/01/2020 04:30	1134.173
21/01/2020 04:15	1168.403	22/01/2020 04:45	933.742
21/01/2020 04:30	981.651	22/01/2020 05:00	972.198
21/01/2020 04:45	1178.175	22/01/2020 05:15	1178.861
21/01/2020 05:00	930.657	22/01/2020 05:30	920.18
21/01/2020 05:15	1170.991	22/01/2020 05:45	1155.017
21/01/2020 05:30	1119.196	22/01/2020 06:00	1153.281
21/01/2020 05:45	1152.556	22/01/2020 06:15	1148.948
21/01/2020 06:00	1184.983	22/01/2020 06:30	1163.281
21/01/2020 06:15	957.206	22/01/2020 06:45	1098.548
21/01/2020 06:30	1040.186	22/01/2020 07:00	1182.237
21/01/2020 06:45	1004.451	22/01/2020 07:15	1099.796
21/01/2020 07:00	1053.53	22/01/2020 07:30	1006.373
21/01/2020 07:15	947.358	22/01/2020 07:45	1156.37
21/01/2020 07:30	1003.872	22/01/2020 08:00	998.819
21/01/2020 07:45	986.935	22/01/2020 08:15	1033.006
21/01/2020 08:00	906.806	22/01/2020 08:30	1194.214
21/01/2020 08:15	895.032	22/01/2020 08:45	818.695
21/01/2020 08:30	753.745	22/01/2020 09:00	861.794
21/01/2020 08:45	889.745	22/01/2020 09:15	732.357
21/01/2020 09:00	764.776	22/01/2020 09:30	839.76
21/01/2020 09:15	850.914	22/01/2020 09:45	789.058
21/01/2020 09:30	846.823	22/01/2020 10:00	928.885
21/01/2020 09:45	773.423	22/01/2020 10:15	843.135
21/01/2020 10:00	775.21	22/01/2020 10:30	713.785
21/01/2020 10:15	781.965	22/01/2020 10:45	804.305
21/01/2020 10:30	753.864	22/01/2020 11:00	790.564
21/01/2020 10:45	987.727	22/01/2020 11:15	954.834
21/01/2020 11:00	864.065	22/01/2020 11:30	904.428
21/01/2020 11:15	993.701	22/01/2020 11:45	1006.644
21/01/2020 11:30	854.376	22/01/2020 12:00	909.398
21/01/2020 11:45	993.857	22/01/2020 12:15	1019.865
21/01/2020 12:00	981.596	22/01/2020 12:30	1055.845
21/01/2020 12:15	775.854	22/01/2020 12:45	823.841
21/01/2020 12:30	775.75	22/01/2020 13:00	938.343

21/01/2020 12:45	815.004	22/01/2020 13:15	857.644
21/01/2020 13:00	1012.583	22/01/2020 13:30	903.435
21/01/2020 13:15	888.53	22/01/2020 13:45	797.149
21/01/2020 13:30	953.091	22/01/2020 14:00	941.454
21/01/2020 13:45	987.907	22/01/2020 14:15	849.915

(ii) Volatile Organic Compounds (VOCs)

VOC DATA

Location 1		Location 2		Location 3	
Date/Time		Date/Time		Date/Time	
Tue Jan 21 2020 15:00:00	1.0	Mon Jan 20 2020 11:45:00	0.0	Mon Jan 20 2020 13:30:00	1.0
Tue Jan 21 2020 15:15:00	0.0	Mon Jan 20 2020 12:00:00	2.0	Mon Jan 20 2020 13:45:00	0.0
Tue Jan 21 2020 15:30:00	2.0	Mon Jan 20 2020 12:15:00	0.0	Mon Jan 20 2020 14:00:00	0.0
Tue Jan 21 2020 15:45:00	0.0	Mon Jan 20 2020 12:30:00	1.0	Mon Jan 20 2020 14:15:00	0.0
Tue Jan 21 2020 16:00:00	1.0	Mon Jan 20 2020 12:45:00	1.0	Mon Jan 20 2020 14:30:00	1.0
Tue Jan 21 2020 16:15:00	2.0	Mon Jan 20 2020 13:00:00	2.0	Mon Jan 20 2020 14:45:00	2.0
Tue Jan 21 2020 16:30:00	0.0	Mon Jan 20 2020 13:15:00	0.0	Mon Jan 20 2020 15:00:00	2.0
Tue Jan 21 2020 16:45:00	1.0	Mon Jan 20 2020 13:30:00	0.0	Mon Jan 20 2020 15:15:00	2.0
Tue Jan 21 2020 17:00:00	2.0	Mon Jan 20 2020 13:45:00	1.0	Mon Jan 20 2020 15:30:00	0.0
Tue Jan 21 2020 17:15:00	0.0	Mon Jan 20 2020 14:00:00	1.0	Mon Jan 20 2020 15:45:00	0.0
Tue Jan 21 2020 17:30:00	2.0	Mon Jan 20 2020 14:15:00	1.0	Mon Jan 20 2020 16:00:00	1.0
Tue Jan 21 2020 17:45:00	2.0	Mon Jan 20 2020 14:30:00	2.0	Mon Jan 20 2020 16:15:00	2.0
Tue Jan 21 2020 18:00:00	2.0	Mon Jan 20 2020 14:45:00	2.0	Mon Jan 20 2020 16:30:00	2.0
Tue Jan 21 2020 18:15:00	0.0	Mon Jan 20 2020 15:00:00	0.0	Mon Jan 20 2020 16:45:00	1.0
Tue Jan 21 2020 18:30:00	2.0	Mon Jan 20 2020 15:15:00	2.0	Mon Jan 20 2020 17:00:00	1.0
Tue Jan 21 2020 18:45:00	0.0	Mon Jan 20 2020 15:30:00	1.0	Mon Jan 20 2020 17:15:00	1.0
Tue Jan 21 2020 19:00:00	0.0	Mon Jan 20 2020 15:45:00	1.0	Mon Jan 20 2020 17:30:00	1.0
Tue Jan 21 2020 19:15:00	0.0	Mon Jan 20 2020 16:00:00	2.0	Mon Jan 20 2020 17:45:00	1.0
Tue Jan 21 2020 19:30:00	1.0	Mon Jan 20 2020 16:15:00	2.0	Mon Jan 20 2020 18:00:00	0.0
Tue Jan 21 2020 19:45:00	2.0	Mon Jan 20 2020 16:30:00	0.0	Mon Jan 20 2020 18:15:00	2.0
Tue Jan 21 2020 20:00:00	1.0	Mon Jan 20 2020 16:45:00	2.0	Mon Jan 20 2020 18:30:00	1.0
Tue Jan 21 2020 20:15:00	2.0	Mon Jan 20 2020 17:00:00	2.0	Mon Jan 20 2020 18:45:00	0.0
Tue Jan 21 2020 20:30:00	2.0	Mon Jan 20 2020 17:15:00	2.0	Mon Jan 20 2020 19:00:00	0.0
Tue Jan 21 2020 20:45:00	2.0	Mon Jan 20 2020 17:30:00	1.0	Mon Jan 20 2020 19:15:00	1.0
Tue Jan 21 2020 21:00:00	0.0	Mon Jan 20 2020 17:45:00	2.0	Mon Jan 20 2020 19:30:00	1.0
Tue Jan 21 2020 21:15:00	0.0	Mon Jan 20 2020 18:00:00	1.0	Mon Jan 20 2020 19:45:00	0.0
Tue Jan 21 2020 21:30:00	0.0	Mon Jan 20 2020 18:15:00	2.0	Mon Jan 20 2020 20:00:00	1.0
Tue Jan 21 2020 21:45:00	2.0	Mon Jan 20 2020 18:30:00	2.0	Mon Jan 20 2020 20:15:00	2.0
Tue Jan 21 2020 22:00:00	1.0	Mon Jan 20 2020 18:45:00	2.0	Mon Jan 20 2020 20:30:00	2.0
Tue Jan 21 2020 22:15:00	1.0	Mon Jan 20 2020 19:00:00	1.0	Mon Jan 20 2020 20:45:00	2.0
Tue Jan 21 2020 22:30:00	1.0	Mon Jan 20 2020 19:15:00	1.0	Mon Jan 20 2020 21:00:00	2.0
Tue Jan 21 2020 22:45:00	0.0	Mon Jan 20 2020 19:30:00	1.0	Mon Jan 20 2020 21:15:00	0.0
Tue Jan 21 2020 23:00:00	2.0	Mon Jan 20 2020 19:45:00	2.0	Mon Jan 20 2020 21:30:00	0.0
Tue Jan 21 2020 23:15:00	0.0	Mon Jan 20 2020 20:00:00	1.0	Mon Jan 20 2020 21:45:00	2.0
Tue Jan 21 2020 23:30:00	1.0	Mon Jan 20 2020 20:15:00	2.0	Mon Jan 20 2020 22:00:00	0.0
Tue Jan 21 2020 23:45:00	0.0	Mon Jan 20 2020 20:30:00	2.0	Mon Jan 20 2020 22:15:00	2.0
Wed Jan 22 2020 00:00:00	2.0	Mon Jan 20 2020 20:45:00	0.0	Mon Jan 20 2020 22:30:00	2.0
Wed Jan 22 2020 00:15:00	0.0	Mon Jan 20 2020 21:00:00	1.0	Mon Jan 20 2020 22:45:00	0.0
Wed Jan 22 2020 00:30:00	2.0	Mon Jan 20 2020 21:15:00	0.0	Mon Jan 20 2020 23:00:00	0.0
Wed Jan 22 2020 00:45:00	1.0	Mon Jan 20 2020 21:30:00	1.0	Mon Jan 20 2020 23:15:00	2.0
Wed Jan 22 2020 01:00:00	2.0	Mon Jan 20 2020 21:45:00	1.0	Mon Jan 20 2020 23:30:00	1.0
Wed Jan 22 2020 01:15:00	1.0	Mon Jan 20 2020 22:00:00	2.0	Mon Jan 20 2020 23:45:00	2.0
Wed Jan 22 2020 01:30:00	0.0	Mon Jan 20 2020 22:15:00	1.0	Tue Jan 21 2020 00:00:00	0.0
Wed Jan 22 2020 01:45:00	0.0	Mon Jan 20 2020 22:30:00	2.0	Tue Jan 21 2020 00:15:00	0.0

Wed Jan 22 2020 02:00:00	0.0	Mon Jan 20 2020 22:45:00	2.0	Tue Jan 21 2020 00:30:00	2.0
Wed Jan 22 2020 02:15:00	0.0	Mon Jan 20 2020 23:00:00	1.0	Tue Jan 21 2020 00:45:00	1.0
Wed Jan 22 2020 02:30:00	0.0	Mon Jan 20 2020 23:15:00	0.0	Tue Jan 21 2020 01:00:00	0.0
Wed Jan 22 2020 02:45:00	0.0	Mon Jan 20 2020 23:30:00	2.0	Tue Jan 21 2020 01:15:00	1.0
Wed Jan 22 2020 03:00:00	0.0	Mon Jan 20 2020 23:45:00	0.0	Tue Jan 21 2020 01:30:00	2.0
Wed Jan 22 2020 03:15:00	0.0	Tue Jan 21 2020 00:00:00	2.0	Tue Jan 21 2020 01:45:00	0.0
Wed Jan 22 2020 03:30:00	0.0	Tue Jan 21 2020 00:15:00	2.0	Tue Jan 21 2020 02:00:00	0.0
Wed Jan 22 2020 03:45:00	1.0	Tue Jan 21 2020 00:30:00	1.0	Tue Jan 21 2020 02:15:00	1.0
Wed Jan 22 2020 04:00:00	1.0	Tue Jan 21 2020 00:45:00	2.0	Tue Jan 21 2020 02:30:00	1.0
Wed Jan 22 2020 04:15:00	2.0	Tue Jan 21 2020 01:00:00	0.0	Tue Jan 21 2020 02:45:00	1.0
Wed Jan 22 2020 04:30:00	0.0	Tue Jan 21 2020 01:15:00	1.0	Tue Jan 21 2020 03:00:00	1.0
Wed Jan 22 2020 04:45:00	2.0	Tue Jan 21 2020 01:30:00	1.0	Tue Jan 21 2020 03:15:00	2.0
Wed Jan 22 2020 05:00:00	2.0	Tue Jan 21 2020 01:45:00	1.0	Tue Jan 21 2020 03:30:00	0.0
Wed Jan 22 2020 05:15:00	1.0	Tue Jan 21 2020 02:00:00	0.0	Tue Jan 21 2020 03:45:00	2.0
Wed Jan 22 2020 05:30:00	2.0	Tue Jan 21 2020 02:15:00	1.0	Tue Jan 21 2020 04:00:00	1.0
Wed Jan 22 2020 05:45:00	1.0	Tue Jan 21 2020 02:30:00	0.0	Tue Jan 21 2020 04:15:00	0.0
Wed Jan 22 2020 06:00:00	0.0	Tue Jan 21 2020 02:45:00	1.0	Tue Jan 21 2020 04:30:00	0.0
Wed Jan 22 2020 06:15:00	2.0	Tue Jan 21 2020 03:00:00	0.0	Tue Jan 21 2020 04:45:00	2.0
Wed Jan 22 2020 06:30:00	0.0	Tue Jan 21 2020 03:15:00	1.0	Tue Jan 21 2020 05:00:00	2.0
Wed Jan 22 2020 06:45:00	2.0	Tue Jan 21 2020 03:30:00	0.0	Tue Jan 21 2020 05:15:00	1.0
Wed Jan 22 2020 07:00:00	1.0	Tue Jan 21 2020 03:45:00	0.0	Tue Jan 21 2020 05:30:00	2.0
Wed Jan 22 2020 07:15:00	2.0	Tue Jan 21 2020 04:00:00	2.0	Tue Jan 21 2020 05:45:00	1.0
Wed Jan 22 2020 07:30:00	2.0	Tue Jan 21 2020 04:15:00	1.0	Tue Jan 21 2020 06:00:00	2.0
Wed Jan 22 2020 07:45:00	1.0	Tue Jan 21 2020 04:30:00	1.0	Tue Jan 21 2020 06:15:00	0.0
Wed Jan 22 2020 08:00:00	2.0	Tue Jan 21 2020 04:45:00	2.0	Tue Jan 21 2020 06:30:00	2.0
Wed Jan 22 2020 08:15:00	0.0	Tue Jan 21 2020 05:00:00	2.0	Tue Jan 21 2020 06:45:00	0.0
Wed Jan 22 2020 08:30:00	2.0	Tue Jan 21 2020 05:15:00	2.0	Tue Jan 21 2020 07:00:00	0.0
Wed Jan 22 2020 08:45:00	0.0	Tue Jan 21 2020 05:30:00	0.0	Tue Jan 21 2020 07:15:00	2.0
Wed Jan 22 2020 09:00:00	2.0	Tue Jan 21 2020 05:45:00	0.0	Tue Jan 21 2020 07:30:00	2.0
Wed Jan 22 2020 09:15:00	1.0	Tue Jan 21 2020 06:00:00	0.0	Tue Jan 21 2020 07:45:00	2.0
Wed Jan 22 2020 09:30:00	1.0	Tue Jan 21 2020 06:15:00	2.0	Tue Jan 21 2020 08:00:00	2.0
Wed Jan 22 2020 09:45:00	2.0	Tue Jan 21 2020 06:30:00	2.0	Tue Jan 21 2020 08:15:00	0.0
Wed Jan 22 2020 10:00:00	0.0	Tue Jan 21 2020 06:45:00	1.0	Tue Jan 21 2020 08:30:00	2.0
Wed Jan 22 2020 10:15:00	1.0	Tue Jan 21 2020 07:00:00	0.0	Tue Jan 21 2020 08:45:00	2.0
Wed Jan 22 2020 10:30:00	2.0	Tue Jan 21 2020 07:15:00	1.0	Tue Jan 21 2020 09:00:00	2.0
Wed Jan 22 2020 10:45:00	0.0	Tue Jan 21 2020 07:30:00	0.0	Tue Jan 21 2020 09:15:00	2.0
Wed Jan 22 2020 11:00:00	2.0	Tue Jan 21 2020 07:45:00	2.0	Tue Jan 21 2020 09:30:00	0.0
Wed Jan 22 2020 11:15:00	0.0	Tue Jan 21 2020 08:00:00	1.0	Tue Jan 21 2020 09:45:00	1.0
Wed Jan 22 2020 11:30:00	0.0	Tue Jan 21 2020 08:15:00	2.0	Tue Jan 21 2020 10:00:00	0.0
Wed Jan 22 2020 11:45:00	1.0	Tue Jan 21 2020 08:30:00	2.0	Tue Jan 21 2020 10:15:00	0.0
Wed Jan 22 2020 12:00:00	2.0	Tue Jan 21 2020 08:45:00	1.0	Tue Jan 21 2020 10:30:00	1.0
Wed Jan 22 2020 12:15:00	1.0	Tue Jan 21 2020 09:00:00	1.0	Tue Jan 21 2020 10:45:00	1.0
Wed Jan 22 2020 12:30:00	1.0	Tue Jan 21 2020 09:15:00	1.0	Tue Jan 21 2020 11:00:00	0.0
Wed Jan 22 2020 12:45:00	0.0	Tue Jan 21 2020 09:30:00	0.0	Tue Jan 21 2020 11:15:00	2.0
Wed Jan 22 2020 13:00:00	2.0	Tue Jan 21 2020 09:45:00	2.0	Tue Jan 21 2020 11:30:00	0.0
Wed Jan 22 2020 13:15:00	2.0	Tue Jan 21 2020 10:00:00	0.0	Tue Jan 21 2020 11:45:00	0.0
Wed Jan 22 2020 13:30:00	2.0	Tue Jan 21 2020 10:15:00	1.0	Tue Jan 21 2020 12:00:00	1.0

Wed Jan 22 2020 13:45:00	2.0	Tue Jan 21 2020 10:30:00	0.0	Tue Jan 21 2020 12:15:00	1.0
Wed Jan 22 2020 14:00:00	1.0	Tue Jan 21 2020 10:45:00	2.0	Tue Jan 21 2020 12:30:00	0.0
Wed Jan 22 2020 14:15:00	2.0	Tue Jan 21 2020 11:00:00	0.0	Tue Jan 21 2020 12:45:00	2.0
Wed Jan 22 2020 14:30:00	1.0	Tue Jan 21 2020 11:15:00	1.0	Tue Jan 21 2020 13:00:00	1.0
Wed Jan 22 2020 14:45:00	0.0	Tue Jan 21 2020 11:30:00	0.0	Tue Jan 21 2020 13:15:00	1.0

VOC DATA (Continued)

Location 4		Location 5	
Date/Time		Date/Time	
Mon Jan 20 2020 14:00:00	0.0	Tue Jan 21 2020 14:30:00	1.0
Mon Jan 20 2020 14:15:00	2.0	Tue Jan 21 2020 14:45:00	2.0
Mon Jan 20 2020 14:30:00	1.0	Tue Jan 21 2020 15:00:00	0.0
Mon Jan 20 2020 14:45:00	1.0	Tue Jan 21 2020 15:15:00	1.0
Mon Jan 20 2020 15:00:00	0.0	Tue Jan 21 2020 15:30:00	1.0
Mon Jan 20 2020 15:15:00	2.0	Tue Jan 21 2020 15:45:00	1.0
Mon Jan 20 2020 15:30:00	0.0	Tue Jan 21 2020 16:00:00	2.0
Mon Jan 20 2020 15:45:00	1.0	Tue Jan 21 2020 16:15:00	2.0
Mon Jan 20 2020 16:00:00	0.0	Tue Jan 21 2020 16:30:00	2.0
Mon Jan 20 2020 16:15:00	1.0	Tue Jan 21 2020 16:45:00	1.0
Mon Jan 20 2020 16:30:00	0.0	Tue Jan 21 2020 17:00:00	1.0
Mon Jan 20 2020 16:45:00	2.0	Tue Jan 21 2020 17:15:00	0.0
Mon Jan 20 2020 17:00:00	0.0	Tue Jan 21 2020 17:30:00	2.0
Mon Jan 20 2020 17:15:00	0.0	Tue Jan 21 2020 17:45:00	0.0
Mon Jan 20 2020 17:30:00	0.0	Tue Jan 21 2020 18:00:00	2.0
Mon Jan 20 2020 17:45:00	1.0	Tue Jan 21 2020 18:15:00	2.0
Mon Jan 20 2020 18:00:00	0.0	Tue Jan 21 2020 18:30:00	1.0
Mon Jan 20 2020 18:15:00	2.0	Tue Jan 21 2020 18:45:00	0.0
Mon Jan 20 2020 18:30:00	1.0	Tue Jan 21 2020 19:00:00	1.0
Mon Jan 20 2020 18:45:00	0.0	Tue Jan 21 2020 19:15:00	2.0
Mon Jan 20 2020 19:00:00	0.0	Tue Jan 21 2020 19:30:00	1.0
Mon Jan 20 2020 19:15:00	0.0	Tue Jan 21 2020 19:45:00	2.0
Mon Jan 20 2020 19:30:00	0.0	Tue Jan 21 2020 20:00:00	0.0
Mon Jan 20 2020 19:45:00	0.0	Tue Jan 21 2020 20:15:00	2.0
Mon Jan 20 2020 20:00:00	2.0	Tue Jan 21 2020 20:30:00	1.0
Mon Jan 20 2020 20:15:00	1.0	Tue Jan 21 2020 20:45:00	2.0
Mon Jan 20 2020 20:30:00	1.0	Tue Jan 21 2020 21:00:00	2.0
Mon Jan 20 2020 20:45:00	1.0	Tue Jan 21 2020 21:15:00	2.0
Mon Jan 20 2020 21:00:00	2.0	Tue Jan 21 2020 21:30:00	1.0
Mon Jan 20 2020 21:15:00	0.0	Tue Jan 21 2020 21:45:00	1.0
Mon Jan 20 2020 21:30:00	2.0	Tue Jan 21 2020 22:00:00	2.0
Mon Jan 20 2020 21:45:00	1.0	Tue Jan 21 2020 22:15:00	1.0
Mon Jan 20 2020 22:00:00	0.0	Tue Jan 21 2020 22:30:00	2.0
Mon Jan 20 2020 22:15:00	0.0	Tue Jan 21 2020 22:45:00	0.0
Mon Jan 20 2020 22:30:00	2.0	Tue Jan 21 2020 23:00:00	1.0
Mon Jan 20 2020 22:45:00	2.0	Tue Jan 21 2020 23:15:00	0.0
Mon Jan 20 2020 23:00:00	1.0	Tue Jan 21 2020 23:30:00	2.0
Mon Jan 20 2020 23:15:00	2.0	Tue Jan 21 2020 23:45:00	1.0
Mon Jan 20 2020 23:30:00	0.0	Wed Jan 22 2020 00:00:00	2.0
Mon Jan 20 2020 23:45:00	1.0	Wed Jan 22 2020 00:15:00	2.0
Tue Jan 21 2020 00:00:00	2.0	Wed Jan 22 2020 00:30:00	2.0
Tue Jan 21 2020 00:15:00	1.0	Wed Jan 22 2020 00:45:00	0.0
Tue Jan 21 2020 00:30:00	0.0	Wed Jan 22 2020 01:00:00	2.0
Tue Jan 21 2020 00:45:00	1.0	Wed Jan 22 2020 01:15:00	0.0

Tue Jan 21 2020 01:00:00	1.0	Wed Jan 22 2020 01:30:00	0.0
Tue Jan 21 2020 01:15:00	2.0	Wed Jan 22 2020 01:45:00	0.0
Tue Jan 21 2020 01:30:00	1.0	Wed Jan 22 2020 02:00:00	2.0
Tue Jan 21 2020 01:45:00	0.0	Wed Jan 22 2020 02:15:00	2.0
Tue Jan 21 2020 02:00:00	1.0	Wed Jan 22 2020 02:30:00	0.0
Tue Jan 21 2020 02:15:00	1.0	Wed Jan 22 2020 02:45:00	2.0
Tue Jan 21 2020 02:30:00	1.0	Wed Jan 22 2020 03:00:00	1.0
Tue Jan 21 2020 02:45:00	0.0	Wed Jan 22 2020 03:15:00	2.0
Tue Jan 21 2020 03:00:00	0.0	Wed Jan 22 2020 03:30:00	0.0
Tue Jan 21 2020 03:15:00	2.0	Wed Jan 22 2020 03:45:00	1.0
Tue Jan 21 2020 03:30:00	0.0	Wed Jan 22 2020 04:00:00	2.0
Tue Jan 21 2020 03:45:00	0.0	Wed Jan 22 2020 04:15:00	2.0
Tue Jan 21 2020 04:00:00	0.0	Wed Jan 22 2020 04:30:00	0.0
Tue Jan 21 2020 04:15:00	1.0	Wed Jan 22 2020 04:45:00	0.0
Tue Jan 21 2020 04:30:00	2.0	Wed Jan 22 2020 05:00:00	0.0
Tue Jan 21 2020 04:45:00	0.0	Wed Jan 22 2020 05:15:00	0.0
Tue Jan 21 2020 05:00:00	0.0	Wed Jan 22 2020 05:30:00	0.0
Tue Jan 21 2020 05:15:00	0.0	Wed Jan 22 2020 05:45:00	0.0
Tue Jan 21 2020 05:30:00	0.0	Wed Jan 22 2020 06:00:00	1.0
Tue Jan 21 2020 05:45:00	0.0	Wed Jan 22 2020 06:15:00	0.0
Tue Jan 21 2020 06:00:00	1.0	Wed Jan 22 2020 06:30:00	2.0
Tue Jan 21 2020 06:15:00	2.0	Wed Jan 22 2020 06:45:00	2.0
Tue Jan 21 2020 06:30:00	2.0	Wed Jan 22 2020 07:00:00	2.0
Tue Jan 21 2020 06:45:00	1.0	Wed Jan 22 2020 07:15:00	0.0
Tue Jan 21 2020 07:00:00	2.0	Wed Jan 22 2020 07:30:00	1.0
Tue Jan 21 2020 07:15:00	2.0	Wed Jan 22 2020 07:45:00	1.0
Tue Jan 21 2020 07:30:00	1.0	Wed Jan 22 2020 08:00:00	1.0
Tue Jan 21 2020 07:45:00	0.0	Wed Jan 22 2020 08:15:00	0.0
Tue Jan 21 2020 08:00:00	0.0	Wed Jan 22 2020 08:30:00	0.0
Tue Jan 21 2020 08:15:00	1.0	Wed Jan 22 2020 08:45:00	1.0
Tue Jan 21 2020 08:30:00	1.0	Wed Jan 22 2020 09:00:00	0.0
Tue Jan 21 2020 08:45:00	0.0	Wed Jan 22 2020 09:15:00	1.0
Tue Jan 21 2020 09:00:00	1.0	Wed Jan 22 2020 09:30:00	2.0
Tue Jan 21 2020 09:15:00	2.0	Wed Jan 22 2020 09:45:00	2.0
Tue Jan 21 2020 09:30:00	0.0	Wed Jan 22 2020 10:00:00	1.0
Tue Jan 21 2020 09:45:00	2.0	Wed Jan 22 2020 10:15:00	2.0
Tue Jan 21 2020 10:00:00	2.0	Wed Jan 22 2020 10:30:00	0.0
Tue Jan 21 2020 10:15:00	0.0	Wed Jan 22 2020 10:45:00	1.0
Tue Jan 21 2020 10:30:00	0.0	Wed Jan 22 2020 11:00:00	2.0
Tue Jan 21 2020 10:45:00	2.0	Wed Jan 22 2020 11:15:00	0.0
Tue Jan 21 2020 11:00:00	2.0	Wed Jan 22 2020 11:30:00	1.0
Tue Jan 21 2020 11:15:00	1.0	Wed Jan 22 2020 11:45:00	2.0
Tue Jan 21 2020 11:30:00	2.0	Wed Jan 22 2020 12:00:00	0.0
Tue Jan 21 2020 11:45:00	2.0	Wed Jan 22 2020 12:15:00	0.0
Tue Jan 21 2020 12:00:00	0.0	Wed Jan 22 2020 12:30:00	1.0
Tue Jan 21 2020 12:15:00	0.0	Wed Jan 22 2020 12:45:00	1.0
Tue Jan 21 2020 12:30:00	2.0	Wed Jan 22 2020 13:00:00	1.0

Tue Jan 21 2020 12:45:00	0.0	Wed Jan 22 2020 13:15:00	1.0
Tue Jan 21 2020 13:00:00	1.0	Wed Jan 22 2020 13:30:00	2.0
Tue Jan 21 2020 13:15:00	2.0	Wed Jan 22 2020 13:45:00	0.0
Tue Jan 21 2020 13:30:00	0.0	Wed Jan 22 2020 14:00:00	1.0
Tue Jan 21 2020 13:45:00	0.0	Wed Jan 22 2020 14:15:00	0.0

(iii) Ozone (O_3)

O3 DATA

Location 1		Location 2		Location 3	
Date Time	O3(ppm)	Date Time	O3(ppm)	Date Time	O3(ppm)
21/01/2020 15:00	0.029	20/01/2020 11:45	0.020	20/01/2020 13:30	0.033
21/01/2020 15:15	0.033	20/01/2020 12:00	0.027	20/01/2020 13:45	0.029
21/01/2020 15:30	0.029	20/01/2020 12:15	0.033	20/01/2020 14:00	0.027
21/01/2020 15:45	0.033	20/01/2020 12:30	0.015	20/01/2020 14:15	0.030
21/01/2020 16:00	0.031	20/01/2020 12:45	0.021	20/01/2020 14:30	0.038
21/01/2020 16:15	0.038	20/01/2020 13:00	0.016	20/01/2020 14:45	0.030
21/01/2020 16:30	0.043	20/01/2020 13:15	0.017	20/01/2020 15:00	0.031
21/01/2020 16:45	0.042	20/01/2020 13:30	0.035	20/01/2020 15:15	0.032
21/01/2020 17:00	0.035	20/01/2020 13:45	0.026	20/01/2020 15:30	0.032
21/01/2020 17:15	0.031	20/01/2020 14:00	0.026	20/01/2020 15:45	0.029
21/01/2020 17:30	0.029	20/01/2020 14:15	0.035	20/01/2020 16:00	0.028
21/01/2020 17:45	0.032	20/01/2020 14:30	0.034	20/01/2020 16:15	0.030
21/01/2020 18:00	0.029	20/01/2020 14:45	0.028	20/01/2020 16:30	0.034
21/01/2020 18:15	0.029	20/01/2020 15:00	0.030	20/01/2020 16:45	0.036
21/01/2020 18:30	0.037	20/01/2020 15:15	0.016	20/01/2020 17:00	0.033
21/01/2020 18:45	0.040	20/01/2020 15:30	0.018	20/01/2020 17:15	0.029
21/01/2020 19:00	0.032	20/01/2020 15:45	0.029	20/01/2020 17:30	0.030
21/01/2020 19:15	0.041	20/01/2020 16:00	0.015	20/01/2020 17:45	0.030
21/01/2020 19:30	0.032	20/01/2020 16:15	0.018	20/01/2020 18:00	0.030
21/01/2020 19:45	0.043	20/01/2020 16:30	0.021	20/01/2020 18:15	0.030
21/01/2020 20:00	0.029	20/01/2020 16:45	0.035	20/01/2020 18:30	0.031
21/01/2020 20:15	0.031	20/01/2020 17:00	0.016	20/01/2020 18:45	0.033
21/01/2020 20:30	0.030	20/01/2020 17:15	0.025	20/01/2020 19:00	0.028
21/01/2020 20:45	0.034	20/01/2020 17:30	0.022	20/01/2020 19:15	0.029
21/01/2020 21:00	0.043	20/01/2020 17:45	0.020	20/01/2020 19:30	0.031
21/01/2020 21:15	0.029	20/01/2020 18:00	0.032	20/01/2020 19:45	0.032
21/01/2020 21:30	0.036	20/01/2020 18:15	0.020	20/01/2020 20:00	0.029
21/01/2020 21:45	0.043	20/01/2020 18:30	0.029	20/01/2020 20:15	0.030
21/01/2020 22:00	0.034	20/01/2020 18:45	0.026	20/01/2020 20:30	0.032
21/01/2020 22:15	0.036	20/01/2020 19:00	0.032	20/01/2020 20:45	0.031
21/01/2020 22:30	0.041	20/01/2020 19:15	0.015	20/01/2020 21:00	0.030
21/01/2020 22:45	0.030	20/01/2020 19:30	0.033	20/01/2020 21:15	0.033
21/01/2020 23:00	0.038	20/01/2020 19:45	0.030	20/01/2020 21:30	0.030
21/01/2020 23:15	0.042	20/01/2020 20:00	0.020	20/01/2020 21:45	0.031
21/01/2020 23:30	0.035	20/01/2020 20:15	0.015	20/01/2020 22:00	0.030
21/01/2020 23:45	0.043	20/01/2020 20:30	0.025	20/01/2020 22:15	0.030
22/01/2020 00:00	0.038	20/01/2020 20:45	0.030	20/01/2020 22:30	0.030
22/01/2020 00:15	0.036	20/01/2020 21:00	0.021	20/01/2020 22:45	0.031
22/01/2020 00:30	0.040	20/01/2020 21:15	0.017	20/01/2020 23:00	0.031
22/01/2020 00:45	0.037	20/01/2020 21:30	0.018	20/01/2020 23:15	0.030
22/01/2020 01:00	0.038	20/01/2020 21:45	0.027	20/01/2020 23:30	0.032
22/01/2020 01:15	0.036	20/01/2020 22:00	0.029	20/01/2020 23:45	0.034
22/01/2020 01:30	0.032	20/01/2020 22:15	0.033	21/01/2020 00:00	0.035
22/01/2020 01:45	0.041	20/01/2020 22:30	0.020	21/01/2020 00:15	0.033

22/01/2020 02:00	0.031	20/01/2020 22:45	0.022	21/01/2020 00:30	0.032
22/01/2020 02:15	0.034	20/01/2020 23:00	0.034	21/01/2020 00:45	0.034
22/01/2020 02:30	0.043	20/01/2020 23:15	0.015	21/01/2020 01:00	0.033
22/01/2020 02:45	0.034	20/01/2020 23:30	0.025	21/01/2020 01:15	0.034
22/01/2020 03:00	0.034	20/01/2020 23:45	0.030	21/01/2020 01:30	0.030
22/01/2020 03:15	0.040	21/01/2020 00:00	0.021	21/01/2020 01:45	0.033
22/01/2020 03:30	0.044	21/01/2020 00:15	0.019	21/01/2020 02:00	0.036
22/01/2020 03:45	0.042	21/01/2020 00:30	0.021	21/01/2020 02:15	0.034
22/01/2020 04:00	0.034	21/01/2020 00:45	0.018	21/01/2020 02:30	0.033
22/01/2020 04:15	0.035	21/01/2020 01:00	0.026	21/01/2020 02:45	0.030
22/01/2020 04:30	0.029	21/01/2020 01:15	0.031	21/01/2020 03:00	0.030
22/01/2020 04:45	0.040	21/01/2020 01:30	0.017	21/01/2020 03:15	0.033
22/01/2020 05:00	0.038	21/01/2020 01:45	0.028	21/01/2020 03:30	0.032
22/01/2020 05:15	0.036	21/01/2020 02:00	0.027	21/01/2020 03:45	0.037
22/01/2020 05:30	0.031	21/01/2020 02:15	0.024	21/01/2020 04:00	0.033
22/01/2020 05:45	0.033	21/01/2020 02:30	0.022	21/01/2020 04:15	0.034
22/01/2020 06:00	0.029	21/01/2020 02:45	0.027	21/01/2020 04:30	0.032
22/01/2020 06:15	0.036	21/01/2020 03:00	0.022	21/01/2020 04:45	0.036
22/01/2020 06:30	0.031	21/01/2020 03:15	0.017	21/01/2020 05:00	0.030
22/01/2020 06:45	0.043	21/01/2020 03:30	0.032	21/01/2020 05:15	0.033
22/01/2020 07:00	0.030	21/01/2020 03:45	0.016	21/01/2020 05:30	0.030
22/01/2020 07:15	0.031	21/01/2020 04:00	0.033	21/01/2020 05:45	0.027
22/01/2020 07:30	0.039	21/01/2020 04:15	0.022	21/01/2020 06:00	0.029
22/01/2020 07:45	0.035	21/01/2020 04:30	0.025	21/01/2020 06:15	0.033
22/01/2020 08:00	0.035	21/01/2020 04:45	0.020	21/01/2020 06:30	0.031
22/01/2020 08:15	0.035	21/01/2020 05:00	0.026	21/01/2020 06:45	0.030
22/01/2020 08:30	0.037	21/01/2020 05:15	0.028	21/01/2020 07:00	0.030
22/01/2020 08:45	0.044	21/01/2020 05:30	0.018	21/01/2020 07:15	0.030
22/01/2020 09:00	0.032	21/01/2020 05:45	0.020	21/01/2020 07:30	0.028
22/01/2020 09:15	0.037	21/01/2020 06:00	0.015	21/01/2020 07:45	0.031
22/01/2020 09:30	0.044	21/01/2020 06:15	0.033	21/01/2020 08:00	0.030
22/01/2020 09:45	0.035	21/01/2020 06:30	0.025	21/01/2020 08:15	0.027
22/01/2020 10:00	0.037	21/01/2020 06:45	0.016	21/01/2020 08:30	0.028
22/01/2020 10:15	0.031	21/01/2020 07:00	0.025	21/01/2020 08:45	0.029
22/01/2020 10:30	0.038	21/01/2020 07:15	0.021	21/01/2020 09:00	0.028
22/01/2020 10:45	0.044	21/01/2020 07:30	0.019	21/01/2020 09:15	0.029
22/01/2020 11:00	0.044	21/01/2020 07:45	0.034	21/01/2020 09:30	0.025
22/01/2020 11:15	0.036	21/01/2020 08:00	0.030	21/01/2020 09:45	0.032
22/01/2020 11:30	0.036	21/01/2020 08:15	0.017	21/01/2020 10:00	0.030
22/01/2020 11:45	0.033	21/01/2020 08:30	0.017	21/01/2020 10:15	0.031
22/01/2020 12:00	0.037	21/01/2020 08:45	0.032	21/01/2020 10:30	0.031
22/01/2020 12:15	0.037	21/01/2020 09:00	0.028	21/01/2020 10:45	0.035
22/01/2020 12:30	0.032	21/01/2020 09:15	0.019	21/01/2020 11:00	0.025
22/01/2020 12:45	0.037	21/01/2020 09:30	0.024	21/01/2020 11:15	0.038
22/01/2020 13:00	0.036	21/01/2020 09:45	0.031	21/01/2020 11:30	0.032
22/01/2020 13:15	0.032	21/01/2020 10:00	0.015	21/01/2020 11:45	0.030
22/01/2020 13:30	0.037	21/01/2020 10:15	0.027	21/01/2020 12:00	0.027

22/01/2020 13:45	0.035	21/01/2020 10:30	0.032	21/01/2020 12:15	0.031
22/01/2020 14:00	0.039	21/01/2020 10:45	0.030	21/01/2020 12:30	0.032
22/01/2020 14:15	0.037	21/01/2020 11:00	0.027	21/01/2020 12:45	0.025
22/01/2020 14:30	0.029	21/01/2020 11:15	0.030	21/01/2020 13:00	0.032
22/01/2020 14:45	0.035	21/01/2020 11:30	0.030	21/01/2020 13:15	0.026

O3 DATA (Continued)

Location 4		Location 5	
Date Time	O3(ppm)	Date Time	O3(ppm)
20/01/2020 14:00	0.024	21/01/2020 14:30	0.034
20/01/2020 14:15	0.028	21/01/2020 14:45	0.03
20/01/2020 14:30	0.035	21/01/2020 15:00	0.03
20/01/2020 14:45	0.04	21/01/2020 15:15	0.033
20/01/2020 15:00	0.04	21/01/2020 15:30	0.028
20/01/2020 15:15	0.026	21/01/2020 15:45	0.034
20/01/2020 15:30	0.033	21/01/2020 16:00	0.031
20/01/2020 15:45	0.039	21/01/2020 16:15	0.028
20/01/2020 16:00	0.022	21/01/2020 16:30	0.031
20/01/2020 16:15	0.027	21/01/2020 16:45	0.033
20/01/2020 16:30	0.026	21/01/2020 17:00	0.031
20/01/2020 16:45	0.033	21/01/2020 17:15	0.03
20/01/2020 17:00	0.04	21/01/2020 17:30	0.031
20/01/2020 17:15	0.022	21/01/2020 17:45	0.034
20/01/2020 17:30	0.04	21/01/2020 18:00	0.032
20/01/2020 17:45	0.034	21/01/2020 18:15	0.028
20/01/2020 18:00	0.028	21/01/2020 18:30	0.034
20/01/2020 18:15	0.033	21/01/2020 18:45	0.03
20/01/2020 18:30	0.04	21/01/2020 19:00	0.034
20/01/2020 18:45	0.028	21/01/2020 19:15	0.035
20/01/2020 19:00	0.029	21/01/2020 19:30	0.039
20/01/2020 19:15	0.02	21/01/2020 19:45	0.033
20/01/2020 19:30	0.027	21/01/2020 20:00	0.033
20/01/2020 19:45	0.029	21/01/2020 20:15	0.034
20/01/2020 20:00	0.027	21/01/2020 20:30	0.032
20/01/2020 20:15	0.037	21/01/2020 20:45	0.031
20/01/2020 20:30	0.031	21/01/2020 21:00	0.033
20/01/2020 20:45	0.024	21/01/2020 21:15	0.031
20/01/2020 21:00	0.028	21/01/2020 21:30	0.035
20/01/2020 21:15	0.02	21/01/2020 21:45	0.035
20/01/2020 21:30	0.039	21/01/2020 22:00	0.033
20/01/2020 21:45	0.04	21/01/2020 22:15	0.035
20/01/2020 22:00	0.037	21/01/2020 22:30	0.031
20/01/2020 22:15	0.022	21/01/2020 22:45	0.033
20/01/2020 22:30	0.02	21/01/2020 23:00	0.034
20/01/2020 22:45	0.038	21/01/2020 23:15	0.033
20/01/2020 23:00	0.022	21/01/2020 23:30	0.036
20/01/2020 23:15	0.023	21/01/2020 23:45	0.034
20/01/2020 23:30	0.035	22/01/2020 00:00	0.034
20/01/2020 23:45	0.025	22/01/2020 00:15	0.031
21/01/2020 00:00	0.032	22/01/2020 00:30	0.034
21/01/2020 00:15	0.031	22/01/2020 00:45	0.037
21/01/2020 00:30	0.025	22/01/2020 01:00	0.031
21/01/2020 00:45	0.031	22/01/2020 01:15	0.03

21/01/2020 01:00	0.032	22/01/2020 01:30	0.031
21/01/2020 01:15	0.036	22/01/2020 01:45	0.035
21/01/2020 01:30	0.039	22/01/2020 02:00	0.033
21/01/2020 01:45	0.03	22/01/2020 02:15	0.035
21/01/2020 02:00	0.024	22/01/2020 02:30	0.035
21/01/2020 02:15	0.032	22/01/2020 02:45	0.037
21/01/2020 02:30	0.024	22/01/2020 03:00	0.037
21/01/2020 02:45	0.024	22/01/2020 03:15	0.037
21/01/2020 03:00	0.025	22/01/2020 03:30	0.036
21/01/2020 03:15	0.022	22/01/2020 03:45	0.035
21/01/2020 03:30	0.021	22/01/2020 04:00	0.038
21/01/2020 03:45	0.023	22/01/2020 04:15	0.033
21/01/2020 04:00	0.036	22/01/2020 04:30	0.035
21/01/2020 04:15	0.037	22/01/2020 04:45	0.039
21/01/2020 04:30	0.036	22/01/2020 05:00	0.025
21/01/2020 04:45	0.027	22/01/2020 05:15	0.029
21/01/2020 05:00	0.037	22/01/2020 05:30	0.04
21/01/2020 05:15	0.029	22/01/2020 05:45	0.037
21/01/2020 05:30	0.022	22/01/2020 06:00	0.038
21/01/2020 05:45	0.037	22/01/2020 06:15	0.034
21/01/2020 06:00	0.035	22/01/2020 06:30	0.033
21/01/2020 06:15	0.022	22/01/2020 06:45	0.037
21/01/2020 06:30	0.032	22/01/2020 07:00	0.037
21/01/2020 06:45	0.02	22/01/2020 07:15	0.034
21/01/2020 07:00	0.028	22/01/2020 07:30	0.034
21/01/2020 07:15	0.033	22/01/2020 07:45	0.035
21/01/2020 07:30	0.034	22/01/2020 08:00	0.03
21/01/2020 07:45	0.021	22/01/2020 08:15	0.031
21/01/2020 08:00	0.037	22/01/2020 08:30	0.028
21/01/2020 08:15	0.02	22/01/2020 08:45	0.031
21/01/2020 08:30	0.039	22/01/2020 09:00	0.033
21/01/2020 08:45	0.038	22/01/2020 09:15	0.03
21/01/2020 09:00	0.032	22/01/2020 09:30	0.03
21/01/2020 09:15	0.036	22/01/2020 09:45	0.03
21/01/2020 09:30	0.023	22/01/2020 10:00	0.028
21/01/2020 09:45	0.03	22/01/2020 10:15	0.025
21/01/2020 10:00	0.028	22/01/2020 10:30	0.025
21/01/2020 10:15	0.03	22/01/2020 10:45	0.024
21/01/2020 10:30	0.032	22/01/2020 11:00	0.027
21/01/2020 10:45	0.039	22/01/2020 11:15	0.028
21/01/2020 11:00	0.025	22/01/2020 11:30	0.028
21/01/2020 11:15	0.034	22/01/2020 11:45	0.024
21/01/2020 11:30	0.025	22/01/2020 12:00	0.03
21/01/2020 11:45	0.021	22/01/2020 12:15	0.033
21/01/2020 12:00	0.035	22/01/2020 12:30	0.036
21/01/2020 12:15	0.037	22/01/2020 12:45	0.037
21/01/2020 12:30	0.03	22/01/2020 13:00	0.034

21/01/2020 12:45	0.021	22/01/2020 13:15	0.029
21/01/2020 13:00	0.029	22/01/2020 13:30	0.032
21/01/2020 13:15	0.02	22/01/2020 13:45	0.033
21/01/2020 13:30	0.023	22/01/2020 14:00	0.033
21/01/2020 13:45	0.039	22/01/2020 14:15	0.028

(iv) Filter Weights

Location	Date 2020	Parameters	Pre-Weight (g)	Post-Weight (g)
1	January 21st – 22nd	$PM_{2.5}$	4.3880	4.4018
		PM_{10}	4.5001	4.4962
		TSP	3.6818	3.7367
2	January 20th -21st	$PM_{2.5}$	4.4586	4.4726
		PM_{10}	4.3998	4.4295
		TSP	3.8220	3.8652
3	January 20th - 21st	$PM_{2.5}$	4.4066	4.4203
		PM_{10}	4.4208	4.4512
		TSP	2.5688	2.6152
4	January 20th – 21st	$PM_{2.5}$	4.4496	4.4642
		PM_{10}	4.3706	4.3950
		TSP	3.7106	3.7919
5	January 21st – 22nd	$PM_{2.5}$	4.4408	4.4643
		PM_{10}	4.3746	4.4112
		TSP	3.8110	3.8610

G. Meteorological Data

(i) Raw Meteorological Data

month	day	year	minute	Temp degC	Precip mm	Pressure mb	RH %	Wdir10m deg	Wspeed10m ms-1
2	20	2020	0	29.0	0	763.8	73.0	225	0.9
2	20	2020	15	28.3	0	763.6	76.0	225	0.6
2	20	2020	30	26.8	11	763.7	80.0	113	0.9
2	20	2020	45	26.6	5	763.6	83.0	45	1.6
2	20	2020	60	26.4	0	763.4	86.0	0	1.0
2	20	2020	75	28.1	0	763.2	78.0	22	1.1
2	20	2020	90	29.0	0	763.0	74.0		1.1
2	20	2020	105	29.8	0	762.7	71.0	88	0.9
2	20	2020	120	30.2	0	762.6	70.0	247	0.9
2	20	2020	135	29.6	0	762.5	74.0	270	1.3
2	20	2020	150	29.5	0	762.3	74.0	339	1.6
2	20	2020	165	28.8	0	762.1	76.0	339	0.8
2	20	2020	180	29.6	0	761.8	72.0	45	2.0
2	20	2020	195	28.6	0	762.0	74.0	68	1.6
2	20	2020	210	27.5	3	762.0	81.0	88	1.9
2	20	2020	225	25.6	28	762.3	85.0	125	1.6
2	20	2020	240	25.7	1	762.0	89.0	45	1.3
2	20	2020	255	25.7	2	761.8	90.0	68	1.2
2	20	2020	270	26.1	0	761.9	87.0	68	1.0
2	20	2020	285	26.9	0	761.8	84.0	68	0.7
2	20	2020	300	27.3	0	761.6	82.0	68	0.6
2	20	2020	315	27.3	0	761.6	81.0	45	1.1
2	20	2020	330	27.3	0	761.6	83.0	45	1.4
2	20	2020	345	27.1	0	761.6	83.0	88	1.1
2	20	2020	360	27.2	0	761.8	82.0	68	1.0
2	20	2020	375	26.7	0	761.9	85.0	45	0.9
2	20	2020	390	26.6	0	762.0	85.0	68	0.7
2	20	2020	405	26.3	0	761.8	86.0	88	0.9
2	20	2020	420	26.2	0	761.8	87.0	45	0.9
2	20	2020	435	26.0	0	762.0	87.0	88	0.7
2	20	2020	450	25.5	0	762.2	89.0	100	0.6
2	20	2020	465	25.4	0	762.2	89.0	100	0.1
2	20	2020	480	25.6	0	762.3	88.0	125	0.2
2	20	2020	495	25.4	0	762.6	89.0	100	0.1
2	20	2020	510	25.1	0	762.7	91.0	102	0.1
2	20	2020	525	24.9	0	762.7	91.0	102	0.3
2	20	2020	540	24.8	0	762.8	91.0	102	0.3
2	20	2020	555	24.4	0	762.8	92.0	88	0.4
2	20	2020	570	24.2	0	763.0	93.0	88	0.5
2	20	2020	585	24.2	0	763.1	93.0	88	0.9
2	20	2020	600	24.2	0	763.2	93.0	88	0.4
2	20	2020	615	24.2	0	763.3	93.0	68	0.7
2	20	2020	630	24.0	0	763.3	93.0	102	0.7
2	20	2020	645	23.8	0	763.3	93.0	102	0.4

2	20	2020	660	23.8	0	763.4	93.0	102	0.4
2	20	2020	675	23.5	0	763.3	93.0	68	0.7
2	20	2020	690	23.3	0	763.3	93.0	88	0.4
2	20	2020	705	23.2	0	763.3	93.0	88	0.4
2	20	2020	720	23.2	0	763.3	95.0	88	0.5
2	20	2020	735	23.1	0	763.3	94.0	102	0.3
2	20	2020	750	23.1	0	763.3	93.0	102	0.3
2	20	2020	765	23.1	0	763.2	94.0	88	0.4
2	21	2020	0	22.8	0	763.2	94.0	45	0.6
2	21	2020	15	22.6	0	763.0	95.0	88	0.4
2	21	2020	30	22.5	0	763.0	95.0	68	0.5
2	21	2020	45	22.4	0	763.0	95.0	88	0.7
2	21	2020	60	22.4	0	763.0	94.0	68	0.6
2	21	2020	75	22.3	0	762.8	95.0	88	0.5
2	21	2020	90	22.0	0	762.5	96.0	88	0.5
2	21	2020	105	22.1	0	762.4	95.0	88	0.6
2	21	2020	120	22.1	0	762.3	95.0	68	0.8
2	21	2020	135	22.0	0	762.1	95.0	68	0.5
2	21	2020	150	21.8	0	762.2	95.0	45	0.8
2	21	2020	165	22.0	0	762.2	94.0	68	0.6
2	21	2020	180	21.8	0	762.0	95.0	88	0.5
2	21	2020	195	21.6	0	762.0	95.0	102	0.3
2	21	2020	210	21.5	0	762.0	95.0	88	0.6
2	21	2020	225	21.6	0	761.9	95.0	68	0.6
2	21	2020	240	21.5	0	761.9	95.0	88	0.4
2	21	2020	255	21.4	0	762.0	95.0	88	0.8
2	21	2020	270	21.4	0	762.0	95.0	68	0.5
2	21	2020	285	21.4	0	762.0	95.0	45	0.7
2	21	2020	300	21.3	0	762.1	95.0	45	0.5
2	21	2020	315	21.2	0	762.3	96.0	68	0.8
2	21	2020	330	21.2	0	762.3	96.0	102	0.2
2	21	2020	345	21.2	0	762.5	96.0	88	0.3
2	21	2020	360	21.1	0	762.4	96.0	45	0.8
2	21	2020	375	21.1	0	762.6	96.0	68	0.8
2	21	2020	390	21.2	0	762.7	96.0	68	0.7
2	21	2020	405	21.3	0	762.8	96.0	88	0.5
2	21	2020	420	21.4	0	762.9	96.0	68	0.6
2	21	2020	435	21.5	0	763.0	95.0	45	1.0
2	21	2020	450	21.8	0	763.2	94.0	45	1.2
2	21	2020	465	22.5	0	763.3	92.0	68	0.8
2	21	2020	480	23.6	0	763.3	88.0	88	0.8
2	21	2020	495	24.7	0	763.5	84.0	88	0.9
2	21	2020	510	26.5	0	763.5	76.0	102	0.5
2	21	2020	525	26.9	0	763.6	74.0	102	0.5
2	21	2020	540	27.9	0	763.6	71.0	68	0.8
2	21	2020	555	28.6	0	763.7	63.0	45	1.1
2	21	2020	570	29.4	0	763.5	59.0	68	1.2

2	21	2020	585	30.4	0	763.6	62.0	125	0.5
2	21	2020	600	29.7	0	763.5	64.0	125	0.6
2	21	2020	615	30.1	0	763.5	60.0	202	0.4
2	21	2020	630	30.8	0	763.5	57.0	125	0.7
2	21	2020	645	30.9	0	763.4	60.0	125	0.5
2	21	2020	660	30.2	0	763.3	65.0	125	0.6
2	21	2020	675	29.6	0	763.2	66.0	225	0.7
2	21	2020	690	29.2	0	763.1	70.0	88	0.6
2	21	2020	705	28.5	0	763.2	73.0	22	0.6
2	21	2020	720	28.9	0	762.5	71.0	45	1.2
2	21	2020	735	29.4	0	762.3	69.0	68	0.4
2	21	2020	750	29.1	0	762.1	72.0	45	1.6
2	21	2020	765	28.6	0	762.0	75.0	45	1.5
2	21	2020	780	29.2	0	761.8	71.0	45	1.3
2	21	2020	795	29.3	0	761.8	70.0	22	1.3
2	21	2020	810	28.7	0	761.5	73.0	45	1.7
2	21	2020	825	28.9	0	761.5	72.0	68	1.2
2	21	2020	840	28.7	0	761.2	73.0	0	1.1
2	21	2020	855	29.8	0	761.1	70.0	0	1.4
2	21	2020	870	29.5	0	760.8	70.0	45	1.1
2	21	2020	885	29.3	0	760.6	71.0	68	1.5
2	21	2020	900	29.7	0	760.5	68.0	45	1.2
2	21	2020	915	28.3	0	760.6	75.0	22	1.4
2	21	2020	930	29.5	0	760.5	69.0	202	0.8
2	21	2020	945	29.8	0	760.5	65.0	202	1.2
2	21	2020	960	28.5	0	760.5	70.0	225	1.3
2	21	2020	975	27.7	0	760.6	73.0	125	1.2
2	21	2020	990	28.3	0	760.6	71.0	102	1.2
2	21	2020	1005	28.0	0	760.8	73.0	102	1.1
2	21	2020	1020	27.8	0	760.7	73.0	247	0.8
2	21	2020	1035	27.7	0	760.8	72.0	247	1.6
2	21	2020	1050	27.6	0	761.0	72.0	125	0.7
2	21	2020	1065	27.3	0	761.1	73.0	125	1.0
2	21	2020	1080	27.2	0	761.1	71.0	113	1.1
2	21	2020	1095	27.0	0	761.2	72.0	100	0.9
2	21	2020	1110	27.0	0	761.2	73.0	318	0.9
2	21	2020	1125	26.7	0	761.4	73.0	113	0.8
2	21	2020	1140	26.0	0	761.5	77.0	102	0.2
2	21	2020	1155	25.5	0	761.5	80.0	102	0.3
2	21	2020	1170	25.1	0	761.8	81.0	100	0.4
2	21	2020	1185	24.7	0	761.8	82.0	100	0.0
2	21	2020	1200	24.9	0	761.9	82.0	68	0.5
2	21	2020	1215	24.5	0	762.1	84.0	113	0.0
2	21	2020	1230	24.6	0	762.2	84.0	100	0.3
2	21	2020	1245	24.3	0	762.3	85.0	88	0.5
2	21	2020	1260	24.2	0	762.5	85.0	88	0.5
2	21	2020	1275	24.2	0	762.3	85.0	68	0.6

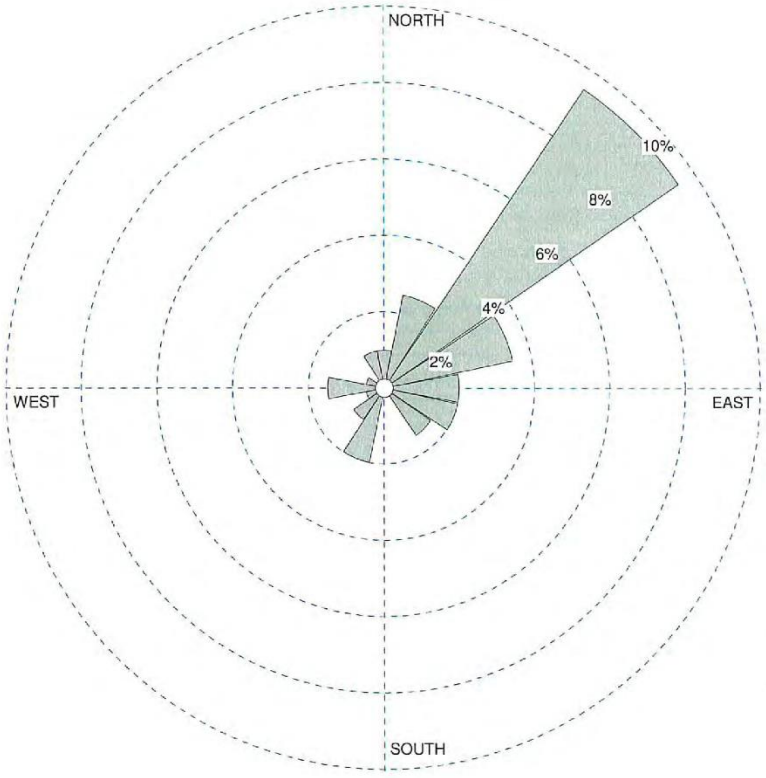
2	21	2020	1290	23.9	0	762.7	87.0	88	0.5
2	21	2020	1305	23.8	0	762.7	86.0	88	0.6
2	21	2020	1320	23.6	0	762.7	87.0	102	0.3
2	21	2020	1335	23.5	0	762.7	88.0	88	0.6
2	21	2020	1350	23.3	0	762.5	89.0	88	0.6
2	21	2020	1365	23.1	0	762.7	89.0	88	0.7
2	21	2020	1380	23.1	0	762.6	89.0	102	0.4
2	21	2020	1395	22.9	0	762.5	90.0	68	0.4
2	21	2020	1410	22.6	0	762.4	89.0	88	0.4
2	21	2020	1425	22.7	0	762.3	87.0	68	0.5
2	22	2020	0	22.4	0	762.4	88.0	88	0.6
2	22	2020	15	22.6	0	762.4	87.0	102	0.5
2	22	2020	30	22.6	0	762.5	85.0	88	0.3
2	22	2020	45	22.0	0	762.3	88.0	68	0.5
2	22	2020	60	21.8	0	762.1	87.0	68	0.8
2	22	2020	75	21.9	0	762.0	87.0	88	0.5
2	22	2020	90	21.4	0	761.9	88.0	88	0.6
2	22	2020	105	21.4	0	761.8	88.0	68	0.6
2	22	2020	120	21.3	0	761.7	87.0	68	0.6
2	22	2020	135	21.7	0	761.5	85.0	45	1.0
2	22	2020	150	21.1	0	761.5	88.0	88	0.5
2	22	2020	165	20.8	0	761.3	89.0	68	0.9
2	22	2020	180	21.2	0	761.0	87.0	68	0.6
2	22	2020	195	21.2	0	760.8	87.0	45	0.9
2	22	2020	210	20.8	0	760.8	89.0	88	0.6
2	22	2020	225	20.7	0	760.8	90.0	45	0.6
2	22	2020	240	20.9	0	760.8	87.0	88	0.3
2	22	2020	255	21.0	0	761.0	89.0	45	0.5
2	22	2020	270	20.7	0	761.0	90.0	68	0.5
2	22	2020	285	20.9	0	761.0	89.0	88	0.9
2	22	2020	300	20.8	0	761.1	89.0	88	0.5
2	22	2020	315	20.8	0	760.8	90.0	45	0.9
2	22	2020	330	20.6	0	761.0	89.0	88	0.9
2	22	2020	345	21.2	0	761.2	86.0	125	0.2
2	22	2020	360	20.5	0	761.2	90.0	88	0.5
2	22	2020	375	20.5	0	761.3	91.0	102	0.4
2	22	2020	390	20.5	0	761.6	91.0	88	0.5
2	22	2020	405	20.8	0	761.8	90.0	68	0.6
2	22	2020	420	20.8	0	762.0	91.0	102	0.5
2	22	2020	435	21.0	0	762.2	91.0	45	0.8
2	22	2020	450	21.2	0	762.3	91.0	88	1.1
2	22	2020	465	21.8	0	762.4	89.0	88	0.3
2	22	2020	480	23.2	0	762.7	84.0	22	0.8
2	22	2020	495	24.6	0	762.8	81.0	102	0.3
2	22	2020	510	25.0	0	762.8	79.0	102	0.3
2	22	2020	525	25.5	0	763.0	77.0	100	0.9
2	22	2020	540	26.3	0	763.0	72.0	100	0.1

2	22	2020	555	27.3	0	762.9	68.0	102	0.5
2	22	2020	570	27.9	0	762.8	66.0	102	0.9
2	22	2020	585	29.2	0	762.8	62.0	100	0.8
2	22	2020	600	29.7	0	762.7	60.0	88	0.5
2	22	2020	615	29.7	0	762.3	60.0	247	0.9
2	22	2020	630	29.2	0	762.3	60.0	113	0.6
2	22	2020	645	28.8	0	762.3	61.0	270	1.0
2	22	2020	660	29.6	0	762.6	60.0	270	1.7
2	22	2020	675	29.4	0	762.4	61.0	45	1.6
2	22	2020	690	30.3	0	762.3	60.0	202	1.1
2	22	2020	705	30.5	0	762.3	60.0	202	1.1
2	22	2020	720	30.6	0	761.8	59.0	125	0.7
2	22	2020	735	30.2	0	761.9	57.0	292	0.9
2	22	2020	750	29.9	0	761.6	59.0	202	0.8
2	22	2020	765	29.9	0	761.7	61.0	202	1.0
2	22	2020	780	29.6	0	761.5	66.0	45	1.0
2	22	2020	795	29.2	0	761.2	68.0	0	1.1
2	22	2020	810	29.2	0	761.2	65.0	125	0.2
2	22	2020	825	30.6	0	760.8	58.0	125	0.6
2	22	2020	840	30.6	0	760.8	57.0	202	0.8
2	22	2020	855	30.7	0	760.5	58.0	202	0.9
2	22	2020	870	29.8	0	760.4	66.0	339	1.5
2	22	2020	885	30.1	0	760.3	67.0	292	1.8
2	22	2020	900	30.0	0	760.3	66.0	22	1.8

(ii) Wind Rose Plot

WIND ROSE PLOT:

Ecoengineering Consultants Limited
20th - 22nd January, 2020



WIND SPEED
(m/s)

- 5.5 - 6.9
- 3.9 - 5.4
- 2.4 - 3.8
- 1.9 - 2.3
- 1.4 - 1.8
- < 1.4

Calms: 71.64%

COMMENTS:	COMPANY NAME: **Ecoengineering Consultants Limited**	
	MODELER: **Kaizen Environmental Services (Trinidad) Limited**	
		PROJECT NO.: **20-9010-2**

WRPLOT View - Lakes Environmental Software

(iii) Calibration Certificate – Davis Met Station

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE #: 040418-A70426N737

DATE: 2019-12-25

ANALYSER TYPE: Davis Meteorological Station

SERIAL #: A70426N737

Sensor	Date Checked	Response
UV	*25/12/19*	**OK**
Rain Gauge	*25/12/19*	**OK**
Wind Monitor	*25/12/19*	**OK**
Wind Direction	*25/12/19*	**OK**
Temp & Humidity	*25/12/19*	**OK**
Pressure	*25/12/19*	**OK**

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with Davis factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

Anthony Chariah
Environmental Technician | PROJECT Services Division

Mr. Anthony Chariah is presently employed at Kaizen Environmental Services Limited as an Environmental Technician in the Project Services Department where he is responsible for executing the environmental fieldwork component of projects. This includes pre planning, data collection, and management, the operation of equipment, testing and preparation of technical information.

Mr. Chariah has been under the Project Services Division for four years now where he has gained knowledge and training in Environmental and Occupational monitoring and sampling according to US EPA and EMA guidelines. His work experiences include performing Ambient Air Quality monitoring, Indoor Air Quality monitoring, Stack Emission testing (Point Source Testing) and Noise testing.

Mr. Chariah possesses a BSc. Environmental and Natural Resources Management and Geography together with a NEBOSH National General Certificate in Occupational Health and Safety. Past experience includes working as a California Industrial Engineering Services Company Limited.

Mr. Troy Glod
Trainee Environmental Technician | PROJECT Services Division

Mr. Troy Glod is presently employed at Kaizen Environmental Services Limited as a Trainee Environmental Technician in the Project Services Department where he is responsible for executing environmental type fieldwork projects and reporting of the environmental type projects. This includes equipment use, service, calibration and testing together with data collection, processing and measurement reporting.

Mr. Glod has been under the Project Services Division where he has gained knowledge and training in Environmental and Occupational monitoring and sampling according to USEPA and EMA guidelines. His work experiences include performing Ambient Air Quality monitoring, Indoor Air Quality monitoring, Stack Emission testing (Point Source Testing), Noise monitoring and light monitoring.

Mr. Glod possesses a BSc. Environmental Science and Sustainable Technology.

Event 3

PROJECTServices
A DIVISION OF KAIZEN ENVIRONMENTAL SERVICES TRINIDAD LIMITED

Rajkumar Street,
Mission Road, .
Freeport Trinidad, W.I.
Tel: (868) 299-0009
Fax: (868) 673-6420

REPORT

Ambient Air Quality Monitoring

For

Construction of the Diego Martin Vehicular Overpass

January 2020

Phase II

Event 3

Prepared For

Ecoengineering – Consultants Limited
#62 Eastern Main Road, St. Augustine,
Trinidad W.I

Prepared By

Kaizen Environmental Services (Trinidad) Limited
Unit #8 Rajkumar Street, Mission Road,
Freeport,
Trinidad, W.I.

Davie Selal
Trainee Administrative Technician II,
Reporting and Client Relations

Henry Lue-Fatt
Quality Control

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   (ii) PM_{10} High Volume Samplers
   (iii) TSP Samplers
   (iv) Thermo Scientific (CO)
   (v) Aeroqual (O_3)
   (vi) SKC Pumps (NO_2 and SO_2)
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H. Biographics of Personnel

EXECUTIVE SUMMARY

Kaizen Environmental Services (Trinidad) Limited (Kaizen) was commissioned to conduct Ambient Air Quality Monitoring by Ecoengineering – Consultants Limited. Monitoring was conducted for the Construction of the Diego Martin Vehicular Overpass.

The parameters measured were as follows:

1. Particulate Matter 2.5 ($PM_{2.5}$)
2. Particulate Matter 10 (PM_{10})
3. Total Suspended Particulates (TSP)
4. Nitrogen Dioxide (NO_2)
5. Sulphur Dioxide (SO_2)
6. Carbon Monoxide (CO)
7. Ozone (O_3)
8. Volatile Organic Compounds (VOCs)

Fieldwork was conducted during the period January 23rd – 25th, 2020.

SUMMARY OF RESULTS

Based on the investigation conducted on January 23rd – 25th, 2020, the following conclusions can be made:

- The 24-hour average concentrations obtained for **Particulate Matter ($PM_{2.5}$ and PM_{10})** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's[a] Air Pollution Rules 2014.

- The 24-hour average concentrations obtained for **Total Suspended Particulates (TSP)** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's Air Pollution Rules 2014.

- The 1-hour concentrations obtained for **Nitrogen Dioxide (NO_2)** at all locations sampled were in compliance with the guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: NO_2 was below the detection limit at all locations monitored

- The 24-hour average concentrations obtained for **Sulphur Dioxide (SO_2)** at all locations sampled were in compliance with their respective guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: SO_2 was below the detection limit at all locations monitored

[a] EMA – Environmental Management Authority of Trinidad and Tobago

- The 8-hour average concentrations obtained for **Carbon Monoxide (CO)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

- The 8-hour average concentrations obtained for **Ozone (O_3)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

- The 8-hour average concentrations for **Volatile Organic Compounds (VOCs)** were obtained at all sampling locations. The concentrations obtained were within the range of 0.7 $\mu g/m^3$ to 1.1 $\mu g/m^3$. There are no EMA guidelines for **VOCs.**

1.0 Introduction

Kaizen Environmental Services (Trinidad) Limited (Kaizen) was commissioned to conduct Ambient Air Quality Monitoring by Ecoengineering – Consultants Limited. Monitoring was conducted for the Construction of the Diego Martin Vehicular Overpass.

Fieldwork was conducted during the period January 23rd – 25th, 2020.

2.0 Monitoring Locations and Parameters

Five (5) locations were selected by Ecoengineering – Consultants Limited for the ambient air monitoring as follows:

Table 1: Monitoring Locations and Parameters

Location No.	Co-ordinates	Parameters Monitored
1	20P0657831 UTM1180930	Particulate Matter 2.5 ($PM_{2.5}$) Particulate Matter 10 (PM_{10}) Total Suspended Particulates (TSP) Nitrogen Dioxide (NO_2) Sulphur Dioxide (SO_2) Carbon Monoxide (CO) Ozone (O_3) Volatile Organic Compounds (VOCs)
2	20P0657681 UTM1181156	
3	20P0658177 UTM1181216	
4	20P0658383 UTM1181049	
5	20P0658294 UTM1181091	

3.0 Test Methodology

3.1 Particulate Matter ($PM_{2.5}$ and PM_{10}) Monitoring

$PM_{2.5}$ & PM_{10} was measured in accordance with the US EPA's[b] "*Compendium of Methods for the Determination of Inorganic Compounds in Ambient Air - Compendium Method IO 2.1: Sampling of Ambient Air for Total Suspended Particulate Matter (SPM) and PM_{10} Using High Volume (HV) Sampler*".

The $PM_{2.5}$ high volume sampler utilized meets the US EPA's Reference Method: *40 CFR Part 50 Appendix L.*

The PM_{10} high volume sampler utilized meets the US EPA's Reference Method: *40 CFR Part 50 Appendix J.*

The $PM_{2.5}$ & PM_{10} sampler was calibrated prior to use in the field (*Calibration Certificate is appended–Attachment A (i) and (ii) respectively*)

3.2 Total Suspended Particulate Matter (TSP)

TSP was measured in accordance with equipment specified in the USEPA's *Code of Federal regulations (CFR) 40 CFR Chapter 1 Part 50 Appendix B Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method).*
The TSP sampler was calibrated prior to use in the field (*Calibration Certificate is appended–Attachment A (iii*).

3.3 Nitrogen Dioxide (NO_2)

NO_2 concentrations were determined in accordance with the US EPA Designated Equivalent Method *NO – EQN – 1277 – 026, "Sodium Arsenite Method for the Determination of Nitrogen Dioxide in the Atmosphere".*

A sample of the ambient air is bubbled at a low flow rate through an impinger containing a sodium arsenite and sodium hydroxide solution for the full 24-hour sampling period. The concentration of the nitrite ion produced during sampling is determined colorimetrically by reacting the nitrite ion with phosphoric acid and N – (1-naphthyl)-ethylene diamine di-hydrochloride and measuring the absorbance of the highly colored azo dye at 540 nm. A vacuum pump was used to draw the ambient air through the sampling solution contained in the impinger.
Based on results from a collaborative study conducted by the US EPA, the lower detectable limit of the method is estimated to be 9 $\mu g/m^3$ for a 24-hour period.

[b] US EPA – United States Environmental Protection Agency

Modified Method to monitor the concentration of NO_2 in accordance to the EMA's Air Pollution Rules, 2014: The sampling time was reduced to one (1) hour or sixty (60) minutes with a sample flow rate of 2 L/min which is reflected in the formula for the calculation of volume of air sampled. The new detectable limit of the method is calculated to be 20 $\mu g/m^3$.

The following formulae were used in the determination of NO_2:

Volume of air sampled:
$V = (F_i + F_f / 2) \times t_s \times 10^{-6}$

Where:
V = Volume of air sampled, m^3
F_i = Air flow rate before sampling, cm^3/min
F_f = Air flow rate after sampling, cm^3/min
t_s = Sampling time, 60 minutes
10^{-6} = conversion of cm^3 to m^3

NO_2 Concentration in Air:
(Concentration of NO_2 (mg/L) x 50 / Volume of air sampled x 0.82) x Dilution factor

Where:
Concentration of NO_2 (mg/L) = obtained from lab analysis report
Volume of absorbing reagent used in sampling, ml = 50
Volume of air sampled = obtained from previous calculation
Sampling efficiency = 0.82
Dilution factor = 1

3.4 Sulphur Dioxide (SO_2)

The concentration of SO_2 was determined in accordance with US EPA 40 CFR Part 50 Appendix A: *"Reference Method for the Determination of Sulphur Dioxide in the Atmosphere (Pararosaniline Method).*

With this Method, a measured volume of air was bubbled through a solution of 0.04 M potassium tetrachloromercurate (TCM), which was contained in an impinger train assembly. The SO_2 present in the air stream reacts with the TCM solution to form a stable monochlorosulfanomercurate complex. Once formed, this complex resists air oxidation and is stable in the presence of strong oxidants such as ozone and oxides of nitrogen. During subsequent analysis, the complex is reacted with acid bleached pararosaniline methyl sulfonic acid. The optical density of this species is determined spectrophotometrically at 548 nm and is directly related to the amount of SO_2 collected.

Based on results from a collaborative study conducted by the US EPA, the lower limit of detection of SO_2 in 10 ml of TCM is 0.75 µg. This represents a concentration of 13 µg SO_2/ m^3 (0.005 ppm) for a 24-hour period.

3.5 Carbon Monoxide (CO)

The Thermo Scientific Model 48i Carbon Monoxide Analyzer is an U.S. EPA Reference Method: *RFCA-0981-054.*

The Model 48i Carbon Monoxide (CO) absorbs infrared radiation at a wavelength of 4.6 microns. The instrument electronics transform the basic analyzer signal into a linear output. The 48i uses an exact calibration curve to accurately linearize the instrument output over any range up to a concentration of 10,000ppm. The CO samplers were calibrated prior to use in the field (*Calibration Certificate is appended – Attachment A (iv)*.

3.6 Ozone (O_3)

For this measurement of Ozone, the Aeroqual Series 500-USEPA Tier II & III Indicative method was used; comparable to USEPA studies. *See Attachment D – Ozone Comparative Study*

3.7 Volatile Organic Compounds (VOCs)

For monitoring of VOCs, Crowcon portable emissions analyzer was utilized, and was calibrated prior to use in the field (*Test Certificate is appended –Attachment A (ii)*).

The Crowcon Gas Detective portable emissions analyzer is a microprocessor controlled portable gas detector, which is capable of monitoring up to four (4) gas types simultaneously and providing warning of hazardous levels.

Using electrochemical, catalytic, and thermal conductivity sensors, this instrument was configured to detect any practical combination of oxygen, toxic and flammable gas.

The Crowcon was fitted with electrochemical sensors to measure VOC concentrations. The concentration ranges and resolution/ detection limits of this instrument VOC are as follows:

Sensor/ Parameter	Range (ppm)	Resolution/ Detection Limit (ppm)
VOC	0 – 100	1.0

The Crowcon was configured to log averages at 15-minute intervals.

4.0 Results

4.1 Particulate Matter ($PM_{2.5}$ and PM_{10}), Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2), and Carbon Monoxide (CO), Ozone (O_3), Total Suspended Particulate Matter (TSP) and Volatile Organic Compounds (VOCs) Results

Table 2 presents the results of the Particulate Matter ($PM_{2.5}$ and PM_{10}) and Total Suspended Particulate (TSP) Monitoring. The results in this table have been compared to standards outlined by the EMA in the Air Pollution Rules, 2014.

Table 2: Ambient Air Quality Testing Results Particulate Matter ($PM_{2.5}$ PM_{10} and TSP)

Location No.	Sample Period/ 2020	Parameter Concentration		
		$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	TSP ($\mu g/m^3$)
1	January $24^{th} - 25^{th}$	22	24	46
2	January $23^{rd} - 24^{th}$	11	19	26
3		16	18	25
4		15	21	30
5	January $24^{th} - 25^{th}$	10	16	24
EMA[c] STEL[d] (24-hr average)		**65**	**75**	**150**

Note:

a) Results reported to the nearest whole number

[c]EMA – Environmental Management Authority of Trinidad and Tobago
[d] STEL – Short-term Maximum Permissible Level

Table 3 displays the results of the 24 hour monitoring event for SO_2. The results were compared to their respective short term permissible levels as stipulated by the EMA in their Air Pollution Rules, 2014.

Table 3: Ambient Air Quality Testing Results –SO_2 (24-hour)

Location No	Sample Period/ 2020	Parameter Concentration
		SO_2 ($\mu g/m^3$)
1	January 24th – 25th	BDL
2	January 23rd – 24th	BDL
3		BDL
4		BDL
5	January 24th – 25th	BDL
EMA STEL (24-hr)		**125**

Note:

a) BDL – Below Detection Limit
b) SO_2 Method Detection Limit = 13 $\mu g/Nm^3$

Table 4 displays the data for the 1-hour monitoring event for NO_2. The results were compared to the relevant limits as stated by the EMA in the Air Pollution Rules, 2014.

Table 4: Ambient Air Quality Testing Results – NO_2 (1-hour)

Location No	Sample Period/ 2020	Parameter Concentration
		NO_2 ($\mu g/m^3$)
1	January 24th	BDL
2	January 23rd	BDL
3		BDL
4		BDL
5	January 24th	BDL
EMA[e] STEL[f] (1-hr)		**200**

Note:

a) BDL – Below Detection Limit
b) NO_2 Modified Method Detection Limit = 20 $\mu g/Nm^3$

[e] EMA – Environmental Management Authority of Trinidad and Tobago
[f] STEL – Short-term Maximum Permissible Level

Table 5 displays the results of the CO, VOC and O_3 monitoring. The results were compared to the 8-hour limit as stated by the EMA in the Air Pollution Rules, 2014.

Table 5: Ambient Air Quality Testing Results – Carbon Monoxide (CO), Volatile Organic Compounds (VOCs) and Ozone (O_3)

Location	Sampling Date/ 2020	Sampling Period		Avg 8-Hr CO Concentration ($\mu g/m^3$)	Avg 8-Hr VOC Concentration ($\mu g/m^3$)	Avg 8-Hr O_3 Concentration ($\mu g/m^3$)
		Start	End			
1	January 24th	14:45	22:44	1004	0.8	74
	January 24th – 25th	22:45	06:44	877	1.0	74
	January 25th	06:45	14:45	1004	0.9	70
2	January 23rd	12:00	19:59	793	1.0	41
	January 23rd – 24th	20:00	03:59	696	0.8	40
	January 24th	04:00	12:00	860	0.7	40
3	January 23rd	13:00	20:59	916	0.9	36
	January 23rd – 24th	21:00	04:59	761	1.0	40
	January 24th	05:00	13:00	949	1.0	40
4	January 23rd	13:50	21:49	1009	0.9	52
	January 23rd – 24th	21:50	05:49	861	0.8	58
	January 24th	05:49	13:50	973	1.1	64
5	January 24th	13:30	21:29	1020	1.0	71
	January 24th – 25th	21:30	05:29	871	0.9	72
	January 25th	05:30	13:30	980	1.0	75
EMA STEL (8-hour average)				**10 000**	**N/A**	**120**

Note:

a) Results reported to the nearest whole number
b) There are no guidelines for VOCs in ambient air.

4.2 Meteorological Monitoring

Table 6: Summary of Meteorological Conditions during Monitoring Periods (January 23rd – 25th, 2020)

Date/ 2020	Average Wind Speed (m/s)	Average Temperature (°C)	Average Relative Humidity (%)	Average Barometric Pressure (mmHg)	Total Rainfall (mm)
January 23rd – 25th	1.0	24.1	81.1	767.2	0.2

The raw meteorological data is attached as *Appendix F*.

5.0 Conclusion

Based on the investigation conducted on January 23rd – 25th, 2020, the following conclusions can be made:

- The 24-hour average concentrations obtained for **Particulate Matter ($PM_{2.5}$ and PM_{10})** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's[g] Air Pollution Rules 2014.

- The 24-hour average concentrations obtained for **Total Suspended Particulates (TSP)** at all locations sampled were in compliance with the respective guidelines, as published by the EMA's Air Pollution Rules 2014.

- The 1-hour concentrations obtained for **Nitrogen Dioxide (NO_2)** at all locations sampled were in compliance with the guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: NO_2 was below the detection limit at all locations monitored

- The 24-hour average concentrations obtained for **Sulphur Dioxide (SO_2)** at all locations sampled were in compliance with their respective guidelines, as published in the EMA's Air Pollution Rules, 2014.
  Note: SO_2 was below the detection limit at all locations monitored

- The 8-hour average concentrations obtained for **Carbon Monoxide (CO)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

[g] EMA – Environmental Management Authority of Trinidad and Tobago

- The 8-hour average concentrations obtained for **Ozone (O_3)** at all locations sampled were in compliance with the limit, as published in the EMA's Air Pollution Rules, 2014.

- The 8-hour average concentrations for **Volatile Organic Compounds (VOCs)** were obtained at all sampling locations. The concentrations obtained were within the range of 0.7 $\mu g/m^3$ to 1.1 $\mu g/m^3$. There are no EMA guidelines for **VOCs.**

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Fax: (868) 673-6420

ATTACHMENTS

A. Calibration Certificates

- (i) $PM_{2.5}$ High Volume Samplers
- (ii) PM_{10} High Volume Samplers
- (iii) TSP Samplers
- (iv) Thermo Scientific (CO)
- (v) Aeroqual (O_3)
- (vi) SKC Pumps (NO_2 and SO_2)
- (vii) Crowncon Gas Detective (VOCs)
- (viii) Analytical Balance

B. Map of Monitoring Location

C. Accreditation Certificate

D. Laboratory Data

- (i) Chain of Custody
- (ii) Analytical Results

E. Ozone Comparative Study

F. Raw Data

- (i) Carbon Monoxide (CO)
- (ii) Volatile Organic Compounds (VOCs)
- (iii) Ozone (O_3)
- (iv) Filter Weights

G. Meteorological Data

- (i) Raw Meteorological Data
- (ii) Wind Rose Plot
- (iii) Calibration Certificate – Davis Met Station

H. Biographies of Personnel

A. Calibration Certificates

(i) $PM_{2.5}$ High Volume Samplers

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PM2.5 High Volume Sampler Calibration

DATE: Dec 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4735
Serial# : 4735
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

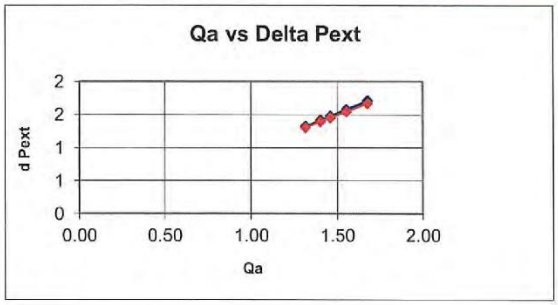
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	27.3	**Ta (°K)**	300.3	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.96	**Pa (mm Hg)**	760.984	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.072916**
7	1.681	6.7	1.705	1.6621	**intercept, b2:**	**-0.097978**
6	1.557	5.7	1.573	1.5388	**corr. coeff, r2**	**0.999998**
5.3	1.464	5	1.473	1.4463		
4.9	1.408	4.6	1.413	1.3906	**SFR**	**1.135**
4.3	1.320	4	1.318	1.3027	**SSP**	**2.89**



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PM2.5 High Volume Sampler Calibration

DATE: December 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-711763
Serial# : 711763
Sampler: Staplex

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

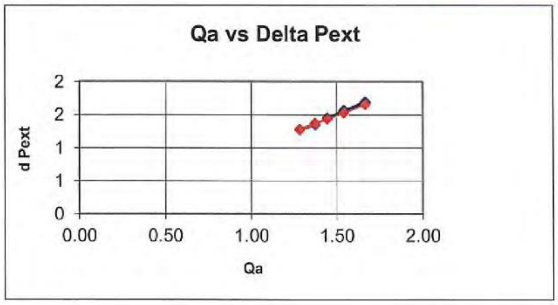
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	27.3	**Ta (°K)**	300.3	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.96	**Pa (mm Hg)**	760.984	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.143603**
6.9	1.669	6.6	1.693	1.6502	**intercept, b2:**	**-0.214450**
5.9	1.544	5.6	1.559	1.5259	**corr. coeff, r2**	**0.998751**
5.2	1.450	4.8	1.443	1.4325		
4.7	1.379	4.2	1.350	1.3619	**SFR**	**1.135**
4.1	1.289	3.7	1.267	1.2720	**SSP**	**2.71**



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Instrumentation Team Leader

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PM2.5 High Volume Sampler Calibration

DATE: December 9th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-711768
Serial# : 711768
Sampler: Staplex

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

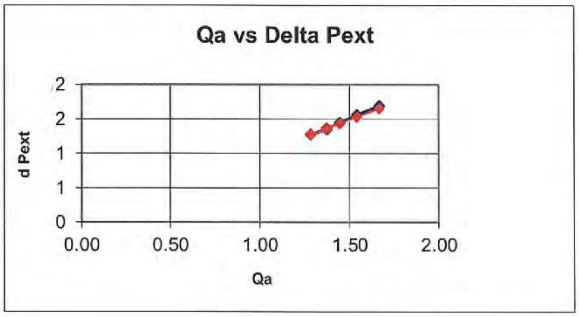
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	27.3	**Ta (°K)**	300.3	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.96	**Pa (mm Hg)**	760.984	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.143603**
6.9	1.669	6.6	1.693	1.6502	**intercept, b2:**	**-0.214450**
5.9	1.544	5.6	1.559	1.5259	**corr. coeff, r2**	**0.998751**
5.2	1.450	4.8	1.443	1.4325		
4.7	1.379	4.2	1.350	1.3619	**SFR**	**1.135**
4.1	1.289	3.7	1.267	1.2720	**SSP**	**2.71**



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(ii) PM_{10} High Volume Samplers

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PM10 High Volume Sampler Calibration

DATE: Dec 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-4734
Serial# : 4734
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

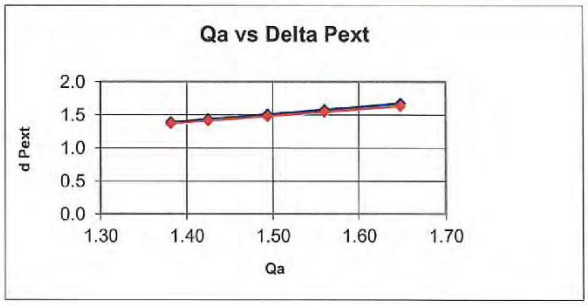
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.072142**
6.7	1.649	6.4	1.670	1.6299	**intercept, b2:**	**-0.097217**
6	1.561	5.7	1.576	1.5424	**corr. coeff, r2**	**0.999999**
5.5	1.495	5.2	1.505	1.4767		
5	1.426	4.7	1.431	1.4080	**SFR**	**1.141**
4.7	1.383	4.4	1.385	1.3651	**SSP**	**2.91**



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PM10 High Volume Sampler Calibration

DATE: Dec 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-2480
Serial# : 2480
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

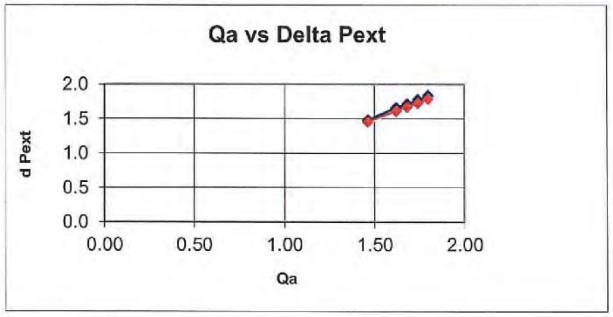
Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext
8	1.801	7.7	1.832	1.7810
7.5	1.744	7.2	1.772	1.7244
7	1.685	6.7	1.709	1.6660
6.5	1.624	6.3	1.657	1.6054
5.3	1.467	5	1.476	1.4496

slope, m2:	**1.060066**
intercept, b2:	**-0.074936**
corr. coeff, r2	**0.999042**
SFR	**1.141**
SSP	**2.95**



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PM10 High Volume Sampler Calibration

DATE: Dec 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-711770
Serial# : 711770
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

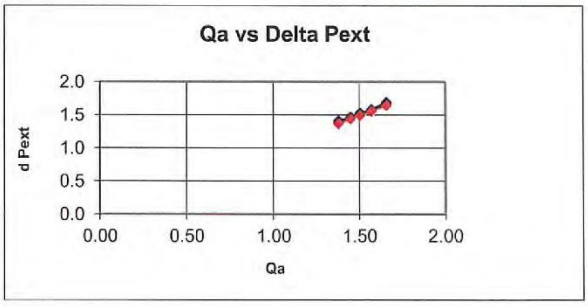
Qactual Intercept, b1 -0.0103
Qactual Slope, m1 0.99482

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.009309**
6.8	1.661	6.5	1.683	1.6420	**intercept, b2:**	**-0.001603**
6.1	1.574	5.7	1.576	1.5552	**corr. coeff, r2**	**0.997414**
5.6	1.508	5.3	1.520	1.4901		
5.2	1.454	4.9	1.461	1.4359	**SFR**	**1.141**
4.7	1.383	4.5	1.401	1.3651	**SSP**	**3.03**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

(iii) TSP Samplers

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

TSP High Volume Sampler Calibration

DATE: Dec 23rd 2019
Techinician : Amrit Persad Maharaj

Certificate #: 010319-4730
Serial# : 4730
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

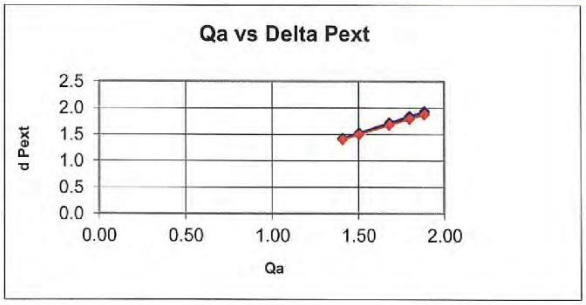
Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

Conditions

Ta:(°C)	28.8	**Ta (°K)**	301.8	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.068727**
8.8	1.889	8.5	1.925	1.8679	**intercept, b2:**	**-0.093403**
8	1.801	7.7	1.832	1.7810	**corr. coeff, r2**	**0.999998**
7	1.686	6.7	1.709	1.6660		
5.6	1.509	5.3	1.520	1.4901	**SFR**	**1.141**
4.9	1.413	4.6	1.416	1.3938	**SSP**	**2.91**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

TSP High Volume Sampler Calibration

DATE: Dec 23rd 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-2576
Serial# : 2158
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

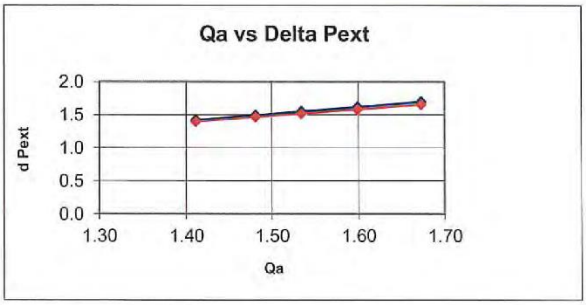
Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

Conditions

Ta:(°C)	28.5	**Ta (°K)**	301.5	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.072053**
6.9	1.673	6.6	1.695	1.6532	**intercept, b2:**	**-0.098219**
6.3	1.599	6	1.616	1.5797	**corr. coeff, r2**	**0.999999**
5.8	1.535	5.5	1.548	1.5157		
5.4	1.482	5.1	1.490	1.4625	**SFR**	**1.139**
4.9	1.412	4.6	1.415	1.3932	**SSP**	**2.90**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
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Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

TSP High Volume Sampler Calibration

DATE: Dec 23th 2019
Technician: Amrit Persad Maharaj

Certificate #: 010319-2576
Serial# : 2576
Sampler: Tisch

Calibration Orifice

Make: Tisch
Model: TE-5028A
Serial #: 674

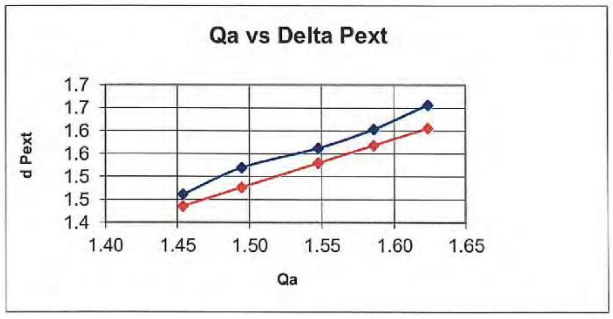
Qactual Intercept, b1 -0.01284
Qactual Slope, m1 0.99571

Conditions

Ta:(°C)	28.5	**Ta (°K)**	301.5	**Tstd.**	298	**Ps (mmHg)**	761.238
Pa: (" Hg.)	29.97	**Pa (mm Hg)**	761.238	**Pstd.**	760	**Ts (K)**	299

Calibrations

Manometer (H_2O)	Qactual (M^3/min)	delta Pex	delta Pext*	delta Pext		
					slope, m2:	**1.094582**
6.5	1.624	6.3	1.656	1.6046	**intercept, b2:**	**-0.127347**
6.2	1.587	5.9	1.603	1.5671	**corr. coeff, r2**	**0.995148**
5.9	1.548	5.6	1.562	1.5287		
5.5	1.495	5.3	1.519	1.4760	**SFR**	**1.139**
5.2	1.454	4.9	1.461	1.4352	**SSP**	**2.88**



amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

(iv) Thermo Scientific (CO)

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-1108347541

DATE: 28/12/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	As Left	Span	Gas Manufacturer	Gas Lot #
0	0	*Air Zero Grade (THC<1ppm)*	CALGAZ	152802
50	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-1108347540

DATE: 28/12/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	As Left	Span	Gas Manufacturer	Gas Lot #
0	0	*Air Zero Grade (THC<1ppm)*	CALGAZ	152802
50	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-1205951890

DATE: 28/12/2019

ANALYSER TYPE: Thermo 48i CO Analyzer

Span		Calibration Gas Used		
As Found	As Left	Span	Gas Manufacturer	Gas Lot #
0	0	*Air Zero Grade (THC<1ppm)*	CALGAZ	152802
49	50	*50 ppm CO*	GASCO	JAO-50-50-2

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with THERMO factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

(v) Aeroqual (O_3)

aeroqual

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32159

Calibration Date: 25 Feb 2019 14:51

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1221

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.005	0.110	0.523	0.000
AQL Sensor (Std. Dev) /ppm	0.000	0.001	0.002	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: **Takao Yamasaki**

Date: **25 Feb 2019**

aeroqual

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32151

Calibration Date: 25 Feb 2019 14:50

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1225

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.004	0.109	0.510	0.000
AQL Sensor (Std. Dev) /ppm	0.001	0.001	0.001	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: **Takao Yamasaki**

Date: **25 Feb 2019**

aeroqual

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland, New Zealand
Phone: +64-9-623 3013 Fax: +64-9-623 3012
www.aeroqual.com

Calibration Certificate No. 32142

Calibration Date: 25 Feb 2019 14:50

Model: Ozone Low 0-0.5 ppm

Serial No: OZLC1709300-1232

Environmental Conditions

Temperature 29.3 °C

Relative Humidity 30.5 %

Measurements

Calibration Standard /ppm	0.006	0.111	0.508	0.000
AQL Sensor (Mean) /ppm	0.005	0.113	0.506	0.000
AQL Sensor (Std. Dev) /ppm	0.002	0.001	0.003	0.000

*The Mean and Standard Deviation are calculated from three consecutive readings.

Calibration Standard

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA certified ozone UV photometer whose traceability is maintained with international standards organisations. *NATA is Australia's national body for accreditation of producers of certified reference materials.

QC Approval: **Takao Yamasaki**

Date: **25 Feb 2019**

(vi) SKC Pumps (NO_2 and SO_2)

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-634661

DATE: 27/12/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 634661

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
3.0 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-634635

DATE: 27/12/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 634635

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
3.1 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE # : 030418-562657

DATE: 27/12/2019

ANALYSER TYPE: SKC Sampling Pump

MODEL #: PCXR4

SERIAL #: 562657

CALIBRATOR TYPE: Gilian Lab & Field Manual Flow Calibration System

MODEL #: 800573-3

SERIAL #: 0702001

Gilian Manual Flow Calibrator	SKC Pump
1.0 l/min +/- 5%	1.0 l/min
2.0 l/min +/- 5%	2.0 l/min
2.9 l/min +/- 5%	3.0 l/min

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

(vii) Crowncon Gas Detective (VOCs)

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-42045
DATE: 2019-12-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 42045

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*
VOC	0	0	10	10	*10 ppm Isobutylene*

TEMPERATURE: 25.9°C

RELATIVE HUMIDITY: 51.4%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-45704
DATE: 2019-12-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 45704

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*
VOC	0	0	10	10	*10 ppm Isobutylene*

TEMPERATURE: 25.8°C

RELATIVE HUMIDITY: 51.5%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

CALIBRATION REPORT

CERTIFICATE #: 030418-44094
DATE: 2019-12-27
ANALYSER TYPE: CROWCON Detective Multi-Gas Monitor
SERIAL NUMBER: 44094

Sensor	Zero		Span		Calibration Gas Used
	As Found	As Left	As Found	As Left	Span
NO	0	0	25	25	*25 ppm NO*
VOC	0	0	10	10	*10 ppm Isobutylene*

TEMPERATURE: 25.8°C

RELATIVE HUMIDITY: 51.6%

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with CROWCON factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested By:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified By:

Deodath Maharaj
Instrumentation Team Leader

(viii) Analytical Balance

Location:
University of the West Indies
St. Augustine Campus, Trinidad & Tobago
Mailing Address:
Tunapuna Post Office, Trinidad & Tobago
Tel: (868) 299-0210
Fax: (868) 662-7177
Email: cams@cariri.com
Website: www.cariri.com

CARIRI
Caribbean Industrial Research Institute

IAS ACCREDITED
Calibration Laboratory
LAB NO. CL-134

CALIBRATION CERTIFICATE

Date of Issue: September 06, 2019

Certificate No.: C067119

Project No.: EC03834167/19

CLIENT: Kaizen Environmental Services (Trinidad) Ltd.

ADDRESS: Unit 8 Rajkumar Street, Mission Road, Freeport

CALIBRATION LOCATION: Kaizen Environmental Services (Trinidad) Ltd., Balance Room

EQUIPMENT: Electronic Balance

MANUFACTURER: Sartorius

MODEL NO.: AC 210S 00016

SERIAL NO.: 40305246

EQUIPMENT NO.: ASD-EQ-BAL001

CAPACITY/RESOLUTION: 100g/ 0.0001g

CALIBRATION TYPE: As Found

CALIBRATION DATE: September 4, 2019

1. This report relates solely to the specific sample of the product which has been analysed or calibrated by CARIRI as the basis for preparing the report. It shall not be used for certification, advertising or marketing of products produced by the same manufacturer or the Client without the prior written consent of the Chief Executive Officer of CARIRI.

2. This report may not be reproduced, other than in full, except with the prior written authorization from the Chief Executive Officer / Chairman of CARIRI.

CARIBBEAN INDUSTRIAL RESEARCH INSTITUTE
CALIBRATION CERTIFICATE

Certificate No.: C067119
Project No.: EC03834167/19

PROCEDURE:
The electronic balance was calibrated in accordance with UKAS Lab 14 and CARIRI's SOP: CAMS.M1

TRACEABILITY:
The values and units of measurement of the reference weights are traceable to the SI (International System of Units), through reference standards maintained at the National Physical Laboratory (England), NIST (USA) and other recognized standards laboratories.

OBSERVATIONS:
The Internal, External and Sensitivity calibration functions on the balance are inoperative.
As a result these functions could not be used to adjust the balance readout.

AMBIENT CONDITIONS:
Temperature: 23±2°C, Relative Humidity: 50±5%RH

REFERENCE MASS

Serial No.	Weights Applied (g)	Certificate No.	Laboratory No.	Class	Uncertainty (g)
41950	0.005 to 100	M49398	0438	E2	0.00005

REPEATABILITY
Applied Load (g): 100

Unloaded Reading(A)	Loaded Reading (B)	Difference (B-A)	Readability
0.0000	99.8289	99.8289	0.0001
0.0000	99.8293	99.8293	
0.0000	99.8291	99.8291	
0.0000	99.8290	99.8290	
0.0000	99.8291	99.8291	
0.0000	99.8294	99.8294	
0.0000	99.8290	99.8290	
0.0000	99.8288	99.8288	
0.0000	99.8290	99.8290	
0.0000	99.8289	99.8289	

Standard Deviation (g): 0.00018

LINEARITY

Applied Load (g)	Indicated Reading (g)	Error (g)
0.005	0.0046	-0.0004
0.02	0.0198	-0.0002
0.1	0.0998	-0.0002
1	0.9986	-0.0014
5	4.9919	-0.0081
20	19.9658	-0.0342
30	29.9490	-0.0510
50	49.9149	-0.0851
70	69.8807	-0.1193
100	99.8290	-0.1710

Maximum Error (g): 0.1710

Error = Indicated Reading - Applied Load

CARIBBEAN INDUSTRIAL RESEARCH INSTITUTE
CALIBRATION CERTIFICATE

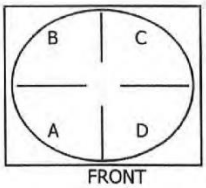
Certificate No.: C067119
Project No.: EC03834167/19

ECCENTRICITY

Applied Load (g): 20

Position	Indicated Reading (g)	Error (g)
Front Left (A)	19.9661	-0.0339
Rear Left (B)	19.9660	-0.0340
Rear Right (C)	19.9659	-0.0341
Front Right (D)	19.9659	-0.0341

Maximum deviation across balance pan (g): 0.0002



Uncertainty of Calibration (g): ±0.00032
Manufacturer's Stated Linearity (g): ±0.002
Manufacturer's Stated Repeatability (g): 0.0001

Calibrator: N. Jonas

Signature: N. Jonas

Approved Signatory: M. Andrews

Signature: M. Andrews

End of Certificate

The uncertainty is for a confidence probability of approximately 95 percent and coverage factor k = 1.984
Error = Indicated Reading - Applied Load

B. Map of Monitoring Location


Location 3
N
Location 2
Location 5
Diego Martin Hwy
Location 4
Main Rd
Location 1
Western Main Rd

C. Accreditation Certificates

TT LABS
TRINIDAD AND TOBAGO
laboratory
Accreditation
Service

CERTIFICATE OF ACCREDITATION

KAIZEN ENVIRONMENTAL SERVICES (TRINIDAD) LTD

Testing Laboratory No.: LAS-005

is an accredited Laboratory which fulfils the requirements of ISO/IEC 17025 and has demonstrated competence to carry out tests as per a defined scope for:

CHEMICAL AND MICROBIOLOGICAL TESTING

as per attached schedule

While this certificate remains valid, the Accredited Laboratory named above is authorized to issue TTLABS-endorsed certificates.

Karlene Carolyn Lewis
Manager, TTLABS

"Recognised as the official national laboratory accrediting body by the Ministry of Trade, Industry, Investment and Communication of the Republic of Trinidad and Tobago"

Initial Accreditation date: 3rd September 2014

This certificate issued on: 21st September 2017

"This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrated technical competence for a defined scope and the operation of a laboratory quality management system. (refer to joint ISO-ILAC-IAF Communiqué dated 18 June 2005)"

Canadian Association
for Laboratory Accreditation Inc.

CALA

Certificate of Accreditation

Kaizen Lab
KaizenLAB Inc.
333-50th Ave. S.E.
Calgary, Alberta

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

Accreditation No.: A2925
Issued On: October 17, 2017
Accreditation Date: January 31, 2005
Expiry Date: April 16, 2020

Andrew M. Adams
President & CEO

CALA

This certificate is the property of the Canadian Association for Laboratory Accreditation Inc. and must be returned on request. Reproduction must follow policy in place at date of issue. For the specific tests to which this accreditation applies, please refer to the laboratory's scope of accreditation at www.cala.ca.

D. Laboratory Data

(i) Chain of Custody

PROJECTServices

A DIVISION OF KAIZEN ENVIRONMENTAL SERVICES LIMITED
Unit # 8, Rajkumar Street, Mission Road, Freeport. Trinidad, W.I.
Tel: (868) 299-0009 Fax (868) 673-5997

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

Kaizen Lab File # 305118 PSD 1746

05. Feb. 20 NS

Date Submitted: 27/01/2020 Date Required: 04/02/2020

Service Requested:
- Regular (10 days) ☐
- Rush (within 5 days) + 25% ☑
- Priority (3 days) + 50% ☐
- Emergency (next day) + 100% ☐

ANALYSIS REQUESTED

	SAMPLE ID	DATE SAMPLED	SAMPLED TYPE	SOx
	Eco-Engineering			
1	-Loc 1	24/01/2020	SOx Absorbing Solution	✓
2	-Loc 2	23/01/2020		✓
3	-Loc 3	23/01/2020		✓
4	-Loc 4	23/01/2020		✓
5	-Loc 5	24/01/2020		✓

Client: Henry Lue Tatt Phone: Same As Above
Contact Fax:
Report Address: P.O.#:
Client Job #:
Billing Address: # Samples Submitted: 5
Preservatives:
Special Requests:

Relinquished By: A. Ghariah	Received By: NS
Date: 27/01/2020	Date: 30. Jan. 20.
Time: 0800h	Time: 9:04 am

Sample Condition Upon Receipt: t° = 15.4°C
Frozen ☐ Cold ☐ Ambient ☐ Head Space (yes/no): _____
Other (breakage, leakage, illegible etc.): _____

SAMPLED BY: A. Ghariah
NAME IN BLOCK LETTERS
A. Ghariah
SIGNATURE

DATE: 27/01/2020

White - File Copy Yellow - Lab Copy

Pronto 652-3577

PROJECTServices

A DIVISION OF KAIZEN ENVIRONMENTAL SERVICES LIMITED

Unit # 8, Rajkumar Street, Mission Road, Freeport, Trinidad, W.I.
Tel: (868) 299-0009 Fax: (868) 673-5997

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

Kaizen Lab File # 427988 - 1-5 | № PSD 1745

Date Submitted: 27/01/2020 | Date Required: 4/02/2020

Service Requested:
- Regular (10 days) ☐
- Rush (within 5 days) + 25% ☑
- Priority (3 days) + 50% ☐
- Emergency (next day) + 100% ☐

ANALYSIS REQUESTED

SAMPLE ID	DATE SAMPLED	SAMPLED TYPE	NO2											
Eco-Engineering														
- Loc 1	24/01/2020		/					4	2	7	9	8	8	- 1
- Loc 2	23/01/2020	NO2 Absorbing	/											2
- Loc 3	23/01/2020	Solution	/											3
- Loc 4	23/01/2020		/											4
- Loc 5	24/01/2020		/											5

Client: Henry Lui Fatt | Phone: Same As Above
Contact: | Fax:
Report Address: | P.O.#:
Client Job #:
Billing Address: | # Samples Submitted: 5
Preservatives:
Special Requests:

Relinquished By: A. Chariah | Received By: [illegible]
Date: 27/01/2020 | Date: [illegible]
Time: 0800h | Time: [illegible]

Sample Condition Upon Receipt:
Frozen ☐ Cold ☐ Ambient ☑ Head Space (yes/no):
Other (breakage, leakage, illegible etc.):

SAMPLED BY: A. Chariah
NAME IN BLOCK LETTERS

A. Chariah
SIGNATURE

DATE: 27/01/2020

White - File Copy Yellow - Lab Copy

Pronto 852-3577

(ii) Analytical Results

333 50th Ave. S.E.
Calgary, AB, T2G 2B3
Phone (403) 297-0868
Fax: (403) 297-0869

KaizenLAB

ANALYTICAL REPORT

Client: Kaizen Environmental Services (Trinidad) Ltd.
Unit 8, Rajkumar Street, Mission Road
Freeport, Trinidad, West Indies

Attention: Henry Lue-Fatt

KaizenLAB JOB #:	305118
DATE RECEIVED:	30-Jan-2020
DATE REPORTED:	05-Feb-2020
PROJECT ID:	Eco Engineering
LOCATION:	

KaizenLAB Sample #: 305118_001 **Sample ID:** Loc 1
Date Sampled: 24-Jan-2020 **Matrix:** LIQUID

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 305118_002 **Sample ID:** Loc 2
Date Sampled: 23-Jan-2020 **Matrix:** LIQUID

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 305118_003 **Sample ID:** Loc 3
Date Sampled: 23-Jan-2020 **Matrix:** LIQUID

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 305118_004 **Sample ID:** Loc 4
Date Sampled: 23-Jan-2020 **Matrix:** LIQUID

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

KaizenLAB Sample #: 305118_005 **Sample ID:** Loc 5
Date Sampled: 24-Jan-2020 **Matrix:** LIQUID

Parameter Description	Units	Result	Detection Limit
SO2	mg/l	<0.1	0.1

333 50th Ave. S.E.
Calgary, AB, T2G 2B3
Phone (403) 297-0868
Fax: (403) 297-0869

KaizenLAB

Test Methodologies

SO2 in Water - Determination of SO2 Absorbed in Potassium Trichlormercurate

Final Review by:

Shirley Lowe
Client Service Representative / Project Coordinator

Note: The results in this report relate only to the items tested and as received. Information is available for any items in 7.8.2.1 of ISO/IEC 17025:2017 that cannot be put on a test report. The report shall not be reproduced except in full without written approval of KaizenLAB. The validity of results may be affected if the information is provided by the customer.

KaizenLAB
Analytical Division of Kaizen Environmental Services (Trinidad) Ltd.

Unit 8 Rajkumar Street,
Mission Road, Freeport.
Email: kaizenlab@kaizen-tt.com
Tel: (868) 299-0009
Fax: (868) 673-6774

ANALYSIS DATA REPORT

Customer:	KESTL- PSD	**Customer Contact:**	Henry Lue-Fatt
Customer's Address:	Unit 8 Rajkumar Street, Mission Road, Freeport.		
Client Project #:	20-002	**Lab File #:**	427988
Item(s) Analyzed:	Liquid Samples		
Date of Sampling:	23-Jan-20 & 24-Jan-20	**Sampling Location:**	Eco Engineering
Sampling Condition:	n/a	**Sampled By:**	PSD Staff - A. Chariah
Sampling Plan Used:	n/a		
Date of Receipt:	27-Jan-20	**Date of Testing:**	27-Jan-20
Report Date:	27-Jan-20		

ANALYSIS RESULTS

Analysis: Nitrite-N

Sample ID	Units	Results
		Nitrite-N
427988-1, Loc 1	mg/L	<0.04
427988-2, Loc 2	mg/L	<0.04
427988-3, Loc 3	mg/L	<0.04
427988-4, Loc 4	mg/L	<0.04
427988-5, Loc 5	mg/L	<0.04

** Detailed Test Methodologies and QA/QC data available upon request.*

***Test Methodologies:** Nitrite-N: EPA-EQN-1277-026

Discussion: None

Comments: The results in this test report relate only to the items as received and tested.

Report Authorized by: Devika Rooplal

Devika Rooplal
Laboratory Manager

This test report shall not be reproduced except in full, without written approval of the laboratory.

E. Comparative Study – Ozone (O_3)

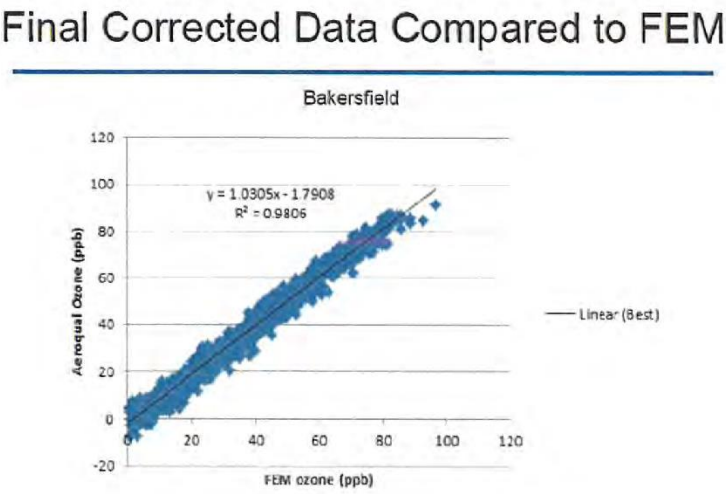
The Aeroqual's Series 500 portable ozone monitors were chosen by an air quality consultancy based in California, USA to better understand the spatial and temporal distribution of ozone in an area.

Twenty three monitors were co-located next to a federal reference method (FEM) monitoring stations to check their precision and accuracy before being distributed across an area of about 100 square miles. The monitors collected and transmitted ozone concentrations every minute for six weeks. Afterwards the monitors were co-located with reference monitoring stations to quantify drift. The data was analyzed and a report was produced.

Co-location of the Series 500 monitors established accuracy to within +/- 3 ppb of the federal reference monitors. See example in figure below.
The study demonstrated that there are strong spatial gradients in ozone over short distances even in rural areas. In addition, the new site at Di Giorgio actually measures higher concentrations than the old Bear Mountain site, and therefore is a good replacement site. In addition, it was determined that the new site was representative of concentrations experienced in the city of Arvin and is therefore useful for real-time warnings regarding poor air quality for citizens in Arvin.
The results of this study provide important supporting evidence for the District's formal attainment request to EPA. In addition the study provides a strong scientific foundation for future decision making about managing the air resources of the San Joaquin Valley.

The final report can be found at:
http://www.valleyair.org/Air_Quality_Plans/docs/2013Attainment/OzoneSaturationStudy.pdf.

Data is courtesy of STI, 2013.



F. Raw Data

(i) Carbon Monoxide (CO)

CO DATA

Location 1		Location 2		Location 3	
Date Time	co	Date Time	co	Date Time	co
24/01/2020 14:45	1172.897	23/01/2020 12:00	841.162	23/01/2020 13:00	1050.698
24/01/2020 15:00	957.524	23/01/2020 12:15	790.858	23/01/2020 13:15	1012.070
24/01/2020 15:15	995.070	23/01/2020 12:30	820.843	23/01/2020 13:30	907.606
24/01/2020 15:30	1046.471	23/01/2020 12:45	894.673	23/01/2020 13:45	877.869
24/01/2020 15:45	1054.142	23/01/2020 13:00	861.707	23/01/2020 14:00	1035.864
24/01/2020 16:00	1132.766	23/01/2020 13:15	968.044	23/01/2020 14:15	857.098
24/01/2020 16:15	970.188	23/01/2020 13:30	861.474	23/01/2020 14:30	909.806
24/01/2020 16:30	995.508	23/01/2020 13:45	899.049	23/01/2020 14:45	1087.289
24/01/2020 16:45	1087.447	23/01/2020 14:00	989.72	23/01/2020 15:00	890.226
24/01/2020 17:00	1104.252	23/01/2020 14:15	961.841	23/01/2020 15:15	1010.863
24/01/2020 17:15	962.828	23/01/2020 14:30	990.603	23/01/2020 15:30	896.738
24/01/2020 17:30	1181.022	23/01/2020 14:45	855.951	23/01/2020 15:45	853.397
24/01/2020 17:45	1068.499	23/01/2020 15:00	979.52	23/01/2020 16:00	888.022
24/01/2020 18:00	1008.438	23/01/2020 15:15	765.19	23/01/2020 16:15	986.217
24/01/2020 18:15	986.356	23/01/2020 15:30	751.698	23/01/2020 16:30	829.29
24/01/2020 18:30	1079.570	23/01/2020 15:45	915.635	23/01/2020 16:45	832.239
24/01/2020 18:45	919.643	23/01/2020 16:00	725.491	23/01/2020 17:00	990.436
24/01/2020 19:00	1007.483	23/01/2020 16:15	690.491	23/01/2020 17:15	883.52
24/01/2020 19:15	1034.997	23/01/2020 16:30	691.534	23/01/2020 17:30	860.517
24/01/2020 19:30	988.458	23/01/2020 16:45	724.846	23/01/2020 17:45	905.767
24/01/2020 19:45	883.350	23/01/2020 17:00	728.539	23/01/2020 18:00	948.41
24/01/2020 20:00	1024.698	23/01/2020 17:15	618.345	23/01/2020 18:15	908.488
24/01/2020 20:15	884.120	23/01/2020 17:30	639.74	23/01/2020 18:30	800.643
24/01/2020 20:30	991.267	23/01/2020 17:45	670.208	23/01/2020 18:45	878.538
24/01/2020 20:45	1084.553	23/01/2020 18:00	763.844	23/01/2020 19:00	990.844
24/01/2020 21:00	894.769	23/01/2020 18:15	783.45	23/01/2020 19:15	936.659
24/01/2020 21:15	1002.581	23/01/2020 18:30	641.319	23/01/2020 19:30	888.985
24/01/2020 21:30	931.025	23/01/2020 18:45	662.375	23/01/2020 19:45	715.404
24/01/2020 21:45	1083.394	23/01/2020 19:00	769.709	23/01/2020 20:00	977.048
24/01/2020 22:00	1005.914	23/01/2020 19:15	719.247	23/01/2020 20:15	903.793
24/01/2020 22:15	808.016	23/01/2020 19:30	725.931	23/01/2020 20:30	938.705
24/01/2020 22:30	767.680	23/01/2020 19:45	677.38	23/01/2020 20:45	866.279
24/01/2020 22:45	828.145	23/01/2020 20:00	600.94	23/01/2020 21:00	741.795
24/01/2020 23:00	839.494	23/01/2020 20:15	563.788	23/01/2020 21:15	910.62
24/01/2020 23:15	830.820	23/01/2020 20:30	616.334	23/01/2020 21:30	967.879
24/01/2020 23:30	858.168	23/01/2020 20:45	747.763	23/01/2020 21:45	733.767
24/01/2020 23:45	817.846	23/01/2020 21:00	735.882	23/01/2020 22:00	630.997
25/01/2020 00:00	834.189	23/01/2020 21:15	608.985	23/01/2020 22:15	738.191
25/01/2020 00:15	755.330	23/01/2020 21:30	767.614	23/01/2020 22:30	698.248
25/01/2020 00:30	854.948	23/01/2020 21:45	756.283	23/01/2020 22:45	688.534
25/01/2020 00:45	785.912	23/01/2020 22:00	551.143	23/01/2020 23:00	644.779
25/01/2020 01:00	768.312	23/01/2020 22:15	647.604	23/01/2020 23:15	673.462
25/01/2020 01:15	856.678	23/01/2020 22:30	662.725	23/01/2020 23:30	620.886
25/01/2020 01:30	845.262	23/01/2020 22:45	766.402	23/01/2020 23:45	708.021

25/01/2020 01:45	816.780	23/01/2020 23:00	743.091	24/01/2020 00:00	786.004
25/01/2020 02:00	831.959	23/01/2020 23:15	727.878	24/01/2020 00:15	835.177
25/01/2020 02:15	857.279	23/01/2020 23:30	766.031	24/01/2020 00:30	832.401
25/01/2020 02:30	898.047	23/01/2020 23:45	676.478	24/01/2020 00:45	727.732
25/01/2020 02:45	819.229	24/01/2020 00:00	610.242	24/01/2020 01:00	742.482
25/01/2020 03:00	869.433	24/01/2020 00:15	647.942	24/01/2020 01:15	657.442
25/01/2020 03:15	874.712	24/01/2020 00:30	735.698	24/01/2020 01:30	628.807
25/01/2020 03:30	778.673	24/01/2020 00:45	657.751	24/01/2020 01:45	848.009
25/01/2020 03:45	792.038	24/01/2020 01:00	778.869	24/01/2020 02:00	700.191
25/01/2020 04:00	850.516	24/01/2020 01:15	624.42	24/01/2020 02:15	671.239
25/01/2020 04:15	883.348	24/01/2020 01:30	733.955	24/01/2020 02:30	732.326
25/01/2020 04:30	962.633	24/01/2020 01:45	729.746	24/01/2020 02:45	754.344
25/01/2020 04:45	869.022	24/01/2020 02:00	606.72	24/01/2020 03:00	811.378
25/01/2020 05:00	948.882	24/01/2020 02:15	795.676	24/01/2020 03:15	659.705
25/01/2020 05:15	952.677	24/01/2020 02:30	779.623	24/01/2020 03:30	642.928
25/01/2020 05:30	945.510	24/01/2020 02:45	660.655	24/01/2020 03:45	928.013
25/01/2020 05:45	998.066	24/01/2020 03:00	660.436	24/01/2020 04:00	907.084
25/01/2020 06:00	1161.284	24/01/2020 03:15	783.083	24/01/2020 04:15	927.767
25/01/2020 06:15	1122.148	24/01/2020 03:30	758.427	24/01/2020 04:30	952.872
25/01/2020 06:30	956.647	24/01/2020 03:45	765.509	24/01/2020 04:45	856.605
25/01/2020 06:45	923.436	24/01/2020 04:00	655.193	24/01/2020 05:00	969.044
25/01/2020 07:00	1196.786	24/01/2020 04:15	885.842	24/01/2020 05:15	924.648
25/01/2020 07:15	1102.163	24/01/2020 04:30	778.082	24/01/2020 05:30	1033.011
25/01/2020 07:30	981.094	24/01/2020 04:45	865.078	24/01/2020 05:45	1165.262
25/01/2020 07:45	1130.784	24/01/2020 05:00	851.483	24/01/2020 06:00	1029.537
25/01/2020 08:00	1132.906	24/01/2020 05:15	662.855	24/01/2020 06:15	1006.231
25/01/2020 08:15	1096.441	24/01/2020 05:30	890.394	24/01/2020 06:30	1069.495
25/01/2020 08:30	1000.019	24/01/2020 05:45	854.25	24/01/2020 06:45	1024.249
25/01/2020 08:45	1193.351	24/01/2020 06:00	805.873	24/01/2020 07:00	1126.877
25/01/2020 09:00	1028.166	24/01/2020 06:15	845.575	24/01/2020 07:15	961.441
25/01/2020 09:15	1194.830	24/01/2020 06:30	877.942	24/01/2020 07:30	1152.274
25/01/2020 09:30	1133.625	24/01/2020 06:45	887.936	24/01/2020 07:45	1071.724
25/01/2020 09:45	926.010	24/01/2020 07:00	898.731	24/01/2020 08:00	930.729
25/01/2020 10:00	880.696	24/01/2020 07:15	947.888	24/01/2020 08:15	912.718
25/01/2020 10:15	950.962	24/01/2020 07:30	866.592	24/01/2020 08:30	863.189
25/01/2020 10:30	928.982	24/01/2020 07:45	930.009	24/01/2020 08:45	930.695
25/01/2020 10:45	850.206	24/01/2020 08:00	850.504	24/01/2020 09:00	872.024
25/01/2020 11:00	905.382	24/01/2020 08:15	938.287	24/01/2020 09:15	918.004
25/01/2020 11:15	864.164	24/01/2020 08:30	918.927	24/01/2020 09:30	898.846
25/01/2020 11:30	911.265	24/01/2020 08:45	997.459	24/01/2020 09:45	924.101
25/01/2020 11:45	902.262	24/01/2020 09:00	910.142	24/01/2020 10:00	855.639
25/01/2020 12:00	961.920	24/01/2020 09:15	760.15	24/01/2020 10:15	907.541
25/01/2020 12:15	888.409	24/01/2020 09:30	833.289	24/01/2020 10:30	856.343
25/01/2020 12:30	828.374	24/01/2020 09:45	870.574	24/01/2020 10:45	834.681
25/01/2020 12:45	978.559	24/01/2020 10:00	776.114	24/01/2020 11:00	985.948
25/01/2020 13:00	997.864	24/01/2020 10:15	829.637	24/01/2020 11:15	975.747
25/01/2020 13:15	890.542	24/01/2020 10:30	939.266	24/01/2020 11:30	801.95

25/01/2020 13:30	869.586	24/01/2020 10:45	895.766	24/01/2020 11:45	856.364
25/01/2020 13:45	1193.658	24/01/2020 11:00	881.87	24/01/2020 12:00	955.704
25/01/2020 14:00	905.460	24/01/2020 11:15	867.222	24/01/2020 12:15	854.877
25/01/2020 14:15	1194.570	24/01/2020 11:30	809.06	24/01/2020 12:30	884.519
25/01/2020 14:30	1172.034	24/01/2020 11:45	952.033	24/01/2020 12:45	810.424

CO DATA (Continued)

Location 4		Location 5	
Date Time	CO	Date Time	CO
23/01/2020 13:50	978.051	24/01/2020 13:30	1010.061
23/01/2020 14:05	1095.760	24/01/2020 13:45	1077.067
23/01/2020 14:20	997.281	24/01/2020 14:00	1104.225
23/01/2020 14:35	1029.989	24/01/2020 14:15	963.743
23/01/2020 14:50	1071.068	24/01/2020 14:30	1001.112
23/01/2020 15:05	1112.133	24/01/2020 14:45	1196.617
23/01/2020 15:20	1137.105	24/01/2020 15:00	992.187
23/01/2020 15:35	972.471	24/01/2020 15:15	1168.71
23/01/2020 15:50	1110.299	24/01/2020 15:30	1012.695
23/01/2020 16:05	1023.406	24/01/2020 15:45	1144.18
23/01/2020 16:20	916.414	24/01/2020 16:00	1186.347
23/01/2020 16:35	1100.988	24/01/2020 16:15	1060.101
23/01/2020 16:50	1062.573	24/01/2020 16:30	1172.83
23/01/2020 17:05	902.439	24/01/2020 16:45	1045.33
23/01/2020 17:20	1110.089	24/01/2020 17:00	1004.646
23/01/2020 17:35	1002.486	24/01/2020 17:15	964.995
23/01/2020 17:50	1069.408	24/01/2020 17:30	976.912
23/01/2020 18:05	1032.555	24/01/2020 17:45	1037.61
23/01/2020 18:20	1086.078	24/01/2020 18:00	908.379
23/01/2020 18:35	1164.949	24/01/2020 18:15	1188.596
23/01/2020 18:50	1028.02	24/01/2020 18:30	856.128
23/01/2020 19:05	920.841	24/01/2020 18:45	970.142
23/01/2020 19:20	1092.84	24/01/2020 19:00	1072.555
23/01/2020 19:35	1075.62	24/01/2020 19:15	917.151
23/01/2020 19:50	848.762	24/01/2020 19:30	1056.512
23/01/2020 20:05	1000.788	24/01/2020 19:45	902.435
23/01/2020 20:20	1046.136	24/01/2020 20:00	1068.585
23/01/2020 20:35	932.536	24/01/2020 20:15	1024.925
23/01/2020 20:50	840.724	24/01/2020 20:30	1026.885
23/01/2020 21:05	937.717	24/01/2020 20:45	915.091
23/01/2020 21:20	834.686	24/01/2020 21:00	751.137
23/01/2020 21:35	768.917	24/01/2020 21:15	851.3
23/01/2020 21:50	793.378	24/01/2020 21:30	755.679
23/01/2020 22:05	893.599	24/01/2020 21:45	810.842
23/01/2020 22:20	870.012	24/01/2020 22:00	839.06
23/01/2020 22:35	819.018	24/01/2020 22:15	776.101
23/01/2020 22:50	752.313	24/01/2020 22:30	860.992
23/01/2020 23:05	773.506	24/01/2020 22:45	844.007
23/01/2020 23:20	754.044	24/01/2020 23:00	792.68
23/01/2020 23:35	775.528	24/01/2020 23:15	819.825
23/01/2020 23:50	787.406	24/01/2020 23:30	868.235
24/01/2020 00:05	888.698	24/01/2020 23:45	877.689
24/01/2020 00:20	854.719	25/01/2020 00:00	861.273
24/01/2020 00:35	790.633	25/01/2020 00:15	892.68

24/01/2020 00:50	814.897	25/01/2020 00:30	897.141
24/01/2020 01:05	758.573	25/01/2020 00:45	896.248
24/01/2020 01:20	809.771	25/01/2020 01:00	829.45
24/01/2020 01:35	879.114	25/01/2020 01:15	766.733
24/01/2020 01:50	751.444	25/01/2020 01:30	838.91
24/01/2020 02:05	893.376	25/01/2020 01:45	899.694
24/01/2020 02:20	864.037	25/01/2020 02:00	751.063
24/01/2020 02:35	879.452	25/01/2020 02:15	756.077
24/01/2020 02:50	753.731	25/01/2020 02:30	809.794
24/01/2020 03:05	826.94	25/01/2020 02:45	852.19
24/01/2020 03:20	767.248	25/01/2020 03:00	881.642
24/01/2020 03:35	984.19	25/01/2020 03:15	918.99
24/01/2020 03:50	871.701	25/01/2020 03:30	964.056
24/01/2020 04:05	900.85	25/01/2020 03:45	900.993
24/01/2020 04:20	977.532	25/01/2020 04:00	869.894
24/01/2020 04:35	879.09	25/01/2020 04:15	979.748
24/01/2020 04:50	976.89	25/01/2020 04:30	857.656
24/01/2020 05:05	968.291	25/01/2020 04:45	1024.039
24/01/2020 05:20	1128.916	25/01/2020 05:00	1190.89
24/01/2020 05:35	1101.677	25/01/2020 05:15	972.005
24/01/2020 05:50	1076.913	25/01/2020 05:30	1137.761
24/01/2020 06:05	929.084	25/01/2020 05:45	956.895
24/01/2020 06:20	1189.797	25/01/2020 06:00	1076.526
24/01/2020 06:35	910.934	25/01/2020 06:15	1096.991
24/01/2020 06:50	1074.454	25/01/2020 06:30	965.733
24/01/2020 07:05	1096.487	25/01/2020 06:45	1031.472
24/01/2020 07:20	1100.874	25/01/2020 07:00	1090.806
24/01/2020 07:35	1061.826	25/01/2020 07:15	1106.818
24/01/2020 07:50	993.253	25/01/2020 07:30	974.45
24/01/2020 08:05	1177.587	25/01/2020 07:45	971.568
24/01/2020 08:20	1061.889	25/01/2020 08:00	1068.616
24/01/2020 08:35	1123.646	25/01/2020 08:15	1019.406
24/01/2020 08:50	925.247	25/01/2020 08:30	1148.651
24/01/2020 09:05	955.847	25/01/2020 08:45	811.481
24/01/2020 09:20	846.254	25/01/2020 09:00	934.9
24/01/2020 09:35	994.715	25/01/2020 09:15	962.529
24/01/2020 09:50	861.511	25/01/2020 09:30	990.73
24/01/2020 10:05	918.744	25/01/2020 09:45	801.675
24/01/2020 10:20	929.596	25/01/2020 10:00	815.561
24/01/2020 10:35	966.706	25/01/2020 10:15	945.655
24/01/2020 10:50	823.126	25/01/2020 10:30	877.811
24/01/2020 11:05	894.609	25/01/2020 10:45	920.17
24/01/2020 11:20	852.86	25/01/2020 11:00	915.583
24/01/2020 11:35	804.947	25/01/2020 11:15	984.643
24/01/2020 11:50	944.894	25/01/2020 11:30	911.01
24/01/2020 12:05	821.746	25/01/2020 11:45	874.563
24/01/2020 12:20	919.191	25/01/2020 12:00	902.932

24/01/2020 12:35	800.222	25/01/2020 12:15	991.252
24/01/2020 12:50	1012.596	25/01/2020 12:30	1069.9
24/01/2020 13:05	1189.568	25/01/2020 12:45	957.593
24/01/2020 13:20	932.593	25/01/2020 13:00	981.554
24/01/2020 13:35	946.472	25/01/2020 13:15	1052.771

(ii) Volatile Organic Compounds (VOCs)

VOC DATA

Location 1		Location 2		Location 3	
Date/Time		Date/Time		Date/Time	
Fri Jan 24 2020 14:45:00	1.0	Thu Jan 23 2020 12:00:00	0.0	Thu Jan 23 2020 13:00:00	2.0
Fri Jan 24 2020 15:00:00	1.0	Thu Jan 23 2020 12:15:00	1.0	Thu Jan 23 2020 13:15:00	0.0
Fri Jan 24 2020 15:15:00	0.0	Thu Jan 23 2020 12:30:00	1.0	Thu Jan 23 2020 13:30:00	2.0
Fri Jan 24 2020 15:30:00	2.0	Thu Jan 23 2020 12:45:00	0.0	Thu Jan 23 2020 13:45:00	2.0
Fri Jan 24 2020 15:45:00	0.0	Thu Jan 23 2020 13:00:00	2.0	Thu Jan 23 2020 14:00:00	2.0
Fri Jan 24 2020 16:00:00	2.0	Thu Jan 23 2020 13:15:00	0.0	Thu Jan 23 2020 14:15:00	1.0
Fri Jan 24 2020 16:15:00	0.0	Thu Jan 23 2020 13:30:00	2.0	Thu Jan 23 2020 14:30:00	0.0
Fri Jan 24 2020 16:30:00	0.0	Thu Jan 23 2020 13:45:00	2.0	Thu Jan 23 2020 14:45:00	1.0
Fri Jan 24 2020 16:45:00	0.0	Thu Jan 23 2020 14:00:00	2.0	Thu Jan 23 2020 15:00:00	1.0
Fri Jan 24 2020 17:00:00	1.0	Thu Jan 23 2020 14:15:00	0.0	Thu Jan 23 2020 15:15:00	0.0
Fri Jan 24 2020 17:15:00	1.0	Thu Jan 23 2020 14:30:00	1.0	Thu Jan 23 2020 15:30:00	2.0
Fri Jan 24 2020 17:30:00	1.0	Thu Jan 23 2020 14:45:00	1.0	Thu Jan 23 2020 15:45:00	0.0
Fri Jan 24 2020 17:45:00	0.0	Thu Jan 23 2020 15:00:00	2.0	Thu Jan 23 2020 16:00:00	0.0
Fri Jan 24 2020 18:00:00	0.0	Thu Jan 23 2020 15:15:00	2.0	Thu Jan 23 2020 16:15:00	0.0
Fri Jan 24 2020 18:15:00	0.0	Thu Jan 23 2020 15:30:00	0.0	Thu Jan 23 2020 16:30:00	2.0
Fri Jan 24 2020 18:30:00	2.0	Thu Jan 23 2020 15:45:00	1.0	Thu Jan 23 2020 16:45:00	2.0
Fri Jan 24 2020 18:45:00	2.0	Thu Jan 23 2020 16:00:00	0.0	Thu Jan 23 2020 17:00:00	1.0
Fri Jan 24 2020 19:00:00	1.0	Thu Jan 23 2020 16:15:00	1.0	Thu Jan 23 2020 17:15:00	0.0
Fri Jan 24 2020 19:15:00	1.0	Thu Jan 23 2020 16:30:00	2.0	Thu Jan 23 2020 17:30:00	0.0
Fri Jan 24 2020 19:30:00	0.0	Thu Jan 23 2020 16:45:00	2.0	Thu Jan 23 2020 17:45:00	1.0
Fri Jan 24 2020 19:45:00	1.0	Thu Jan 23 2020 17:00:00	0.0	Thu Jan 23 2020 18:00:00	0.0
Fri Jan 24 2020 20:00:00	1.0	Thu Jan 23 2020 17:15:00	1.0	Thu Jan 23 2020 18:15:00	2.0
Fri Jan 24 2020 20:15:00	1.0	Thu Jan 23 2020 17:30:00	1.0	Thu Jan 23 2020 18:30:00	1.0
Fri Jan 24 2020 20:30:00	1.0	Thu Jan 23 2020 17:45:00	1.0	Thu Jan 23 2020 18:45:00	0.0
Fri Jan 24 2020 20:45:00	0.0	Thu Jan 23 2020 18:00:00	1.0	Thu Jan 23 2020 19:00:00	1.0
Fri Jan 24 2020 21:00:00	2.0	Thu Jan 23 2020 18:15:00	0.0	Thu Jan 23 2020 19:15:00	1.0
Fri Jan 24 2020 21:15:00	2.0	Thu Jan 23 2020 18:30:00	0.0	Thu Jan 23 2020 19:30:00	2.0
Fri Jan 24 2020 21:30:00	1.0	Thu Jan 23 2020 18:45:00	1.0	Thu Jan 23 2020 19:45:00	0.0
Fri Jan 24 2020 21:45:00	1.0	Thu Jan 23 2020 19:00:00	0.0	Thu Jan 23 2020 20:00:00	2.0
Fri Jan 24 2020 22:00:00	2.0	Thu Jan 23 2020 19:15:00	1.0	Thu Jan 23 2020 20:15:00	0.0
Fri Jan 24 2020 22:15:00	0.0	Thu Jan 23 2020 19:30:00	2.0	Thu Jan 23 2020 20:30:00	1.0
Fri Jan 24 2020 22:30:00	0.0	Thu Jan 23 2020 19:45:00	1.0	Thu Jan 23 2020 20:45:00	0.0
Fri Jan 24 2020 22:45:00	0.0	Thu Jan 23 2020 20:00:00	2.0	Thu Jan 23 2020 21:00:00	2.0
Fri Jan 24 2020 23:00:00	2.0	Thu Jan 23 2020 20:15:00	0.0	Thu Jan 23 2020 21:15:00	0.0
Fri Jan 24 2020 23:15:00	1.0	Thu Jan 23 2020 20:30:00	0.0	Thu Jan 23 2020 21:30:00	0.0
Fri Jan 24 2020 23:30:00	0.0	Thu Jan 23 2020 20:45:00	1.0	Thu Jan 23 2020 21:45:00	0.0
Fri Jan 24 2020 23:45:00	0.0	Thu Jan 23 2020 21:00:00	1.0	Thu Jan 23 2020 22:00:00	2.0
Sat Jan 25 2020 00:00:00	0.0	Thu Jan 23 2020 21:15:00	0.0	Thu Jan 23 2020 22:15:00	1.0
Sat Jan 25 2020 00:15:00	2.0	Thu Jan 23 2020 21:30:00	2.0	Thu Jan 23 2020 22:30:00	2.0
Sat Jan 25 2020 00:30:00	1.0	Thu Jan 23 2020 21:45:00	1.0	Thu Jan 23 2020 22:45:00	2.0
Sat Jan 25 2020 00:45:00	2.0	Thu Jan 23 2020 22:00:00	0.0	Thu Jan 23 2020 23:00:00	0.0
Sat Jan 25 2020 01:00:00	0.0	Thu Jan 23 2020 22:15:00	1.0	Thu Jan 23 2020 23:15:00	1.0
Sat Jan 25 2020 01:15:00	2.0	Thu Jan 23 2020 22:30:00	0.0	Thu Jan 23 2020 23:30:00	0.0
Sat Jan 25 2020 01:30:00	1.0	Thu Jan 23 2020 22:45:00	1.0	Thu Jan 23 2020 23:45:00	0.0

Sat Jan 25 2020 01:45:00	0.0	Thu Jan 23 2020 23:00:00	1.0	Fri Jan 24 2020 00:00:00	2.0
Sat Jan 25 2020 02:00:00	1.0	Thu Jan 23 2020 23:15:00	2.0	Fri Jan 24 2020 00:15:00	2.0
Sat Jan 25 2020 02:15:00	0.0	Thu Jan 23 2020 23:30:00	1.0	Fri Jan 24 2020 00:30:00	1.0
Sat Jan 25 2020 02:30:00	0.0	Thu Jan 23 2020 23:45:00	1.0	Fri Jan 24 2020 00:45:00	2.0
Sat Jan 25 2020 02:45:00	1.0	Fri Jan 24 2020 00:00:00	0.0	Fri Jan 24 2020 01:00:00	2.0
Sat Jan 25 2020 03:00:00	2.0	Fri Jan 24 2020 00:15:00	0.0	Fri Jan 24 2020 01:15:00	0.0
Sat Jan 25 2020 03:15:00	0.0	Fri Jan 24 2020 00:30:00	0.0	Fri Jan 24 2020 01:30:00	0.0
Sat Jan 25 2020 03:30:00	2.0	Fri Jan 24 2020 00:45:00	0.0	Fri Jan 24 2020 01:45:00	0.0
Sat Jan 25 2020 03:45:00	0.0	Fri Jan 24 2020 01:00:00	0.0	Fri Jan 24 2020 02:00:00	1.0
Sat Jan 25 2020 04:00:00	2.0	Fri Jan 24 2020 01:15:00	2.0	Fri Jan 24 2020 02:15:00	1.0
Sat Jan 25 2020 04:15:00	0.0	Fri Jan 24 2020 01:30:00	0.0	Fri Jan 24 2020 02:30:00	0.0
Sat Jan 25 2020 04:30:00	2.0	Fri Jan 24 2020 01:45:00	0.0	Fri Jan 24 2020 02:45:00	2.0
Sat Jan 25 2020 04:45:00	2.0	Fri Jan 24 2020 02:00:00	2.0	Fri Jan 24 2020 03:00:00	2.0
Sat Jan 25 2020 05:00:00	1.0	Fri Jan 24 2020 02:15:00	2.0	Fri Jan 24 2020 03:15:00	0.0
Sat Jan 25 2020 05:15:00	2.0	Fri Jan 24 2020 02:30:00	1.0	Fri Jan 24 2020 03:30:00	2.0
Sat Jan 25 2020 05:30:00	2.0	Fri Jan 24 2020 02:45:00	2.0	Fri Jan 24 2020 03:45:00	2.0
Sat Jan 25 2020 05:45:00	1.0	Fri Jan 24 2020 03:00:00	0.0	Fri Jan 24 2020 04:00:00	0.0
Sat Jan 25 2020 06:00:00	0.0	Fri Jan 24 2020 03:15:00	1.0	Fri Jan 24 2020 04:15:00	2.0
Sat Jan 25 2020 06:15:00	1.0	Fri Jan 24 2020 03:30:00	0.0	Fri Jan 24 2020 04:30:00	0.0
Sat Jan 25 2020 06:30:00	2.0	Fri Jan 24 2020 03:45:00	0.0	Fri Jan 24 2020 04:45:00	1.0
Sat Jan 25 2020 06:45:00	2.0	Fri Jan 24 2020 04:00:00	0.0	Fri Jan 24 2020 05:00:00	1.0
Sat Jan 25 2020 07:00:00	2.0	Fri Jan 24 2020 04:15:00	1.0	Fri Jan 24 2020 05:15:00	2.0
Sat Jan 25 2020 07:15:00	1.0	Fri Jan 24 2020 04:30:00	1.0	Fri Jan 24 2020 05:30:00	0.0
Sat Jan 25 2020 07:30:00	1.0	Fri Jan 24 2020 04:45:00	0.0	Fri Jan 24 2020 05:45:00	2.0
Sat Jan 25 2020 07:45:00	0.0	Fri Jan 24 2020 05:00:00	1.0	Fri Jan 24 2020 06:00:00	1.0
Sat Jan 25 2020 08:00:00	1.0	Fri Jan 24 2020 05:15:00	0.0	Fri Jan 24 2020 06:15:00	0.0
Sat Jan 25 2020 08:15:00	0.0	Fri Jan 24 2020 05:30:00	1.0	Fri Jan 24 2020 06:30:00	0.0
Sat Jan 25 2020 08:30:00	2.0	Fri Jan 24 2020 05:45:00	0.0	Fri Jan 24 2020 06:45:00	2.0
Sat Jan 25 2020 08:45:00	2.0	Fri Jan 24 2020 06:00:00	0.0	Fri Jan 24 2020 07:00:00	2.0
Sat Jan 25 2020 09:00:00	0.0	Fri Jan 24 2020 06:15:00	1.0	Fri Jan 24 2020 07:15:00	0.0
Sat Jan 25 2020 09:15:00	0.0	Fri Jan 24 2020 06:30:00	0.0	Fri Jan 24 2020 07:30:00	0.0
Sat Jan 25 2020 09:30:00	1.0	Fri Jan 24 2020 06:45:00	1.0	Fri Jan 24 2020 07:45:00	2.0
Sat Jan 25 2020 09:45:00	0.0	Fri Jan 24 2020 07:00:00	1.0	Fri Jan 24 2020 08:00:00	1.0
Sat Jan 25 2020 10:00:00	0.0	Fri Jan 24 2020 07:15:00	2.0	Fri Jan 24 2020 08:15:00	1.0
Sat Jan 25 2020 10:15:00	0.0	Fri Jan 24 2020 07:30:00	1.0	Fri Jan 24 2020 08:30:00	0.0
Sat Jan 25 2020 10:30:00	0.0	Fri Jan 24 2020 07:45:00	1.0	Fri Jan 24 2020 08:45:00	1.0
Sat Jan 25 2020 10:45:00	2.0	Fri Jan 24 2020 08:00:00	0.0	Fri Jan 24 2020 09:00:00	1.0
Sat Jan 25 2020 11:00:00	0.0	Fri Jan 24 2020 08:15:00	1.0	Fri Jan 24 2020 09:15:00	1.0
Sat Jan 25 2020 11:15:00	1.0	Fri Jan 24 2020 08:30:00	2.0	Fri Jan 24 2020 09:30:00	1.0
Sat Jan 25 2020 11:30:00	2.0	Fri Jan 24 2020 08:45:00	2.0	Fri Jan 24 2020 09:45:00	1.0
Sat Jan 25 2020 11:45:00	0.0	Fri Jan 24 2020 09:00:00	0.0	Fri Jan 24 2020 10:00:00	0.0
Sat Jan 25 2020 12:00:00	2.0	Fri Jan 24 2020 09:15:00	0.0	Fri Jan 24 2020 10:15:00	2.0
Sat Jan 25 2020 12:15:00	2.0	Fri Jan 24 2020 09:30:00	0.0	Fri Jan 24 2020 10:30:00	0.0
Sat Jan 25 2020 12:30:00	2.0	Fri Jan 24 2020 09:45:00	1.0	Fri Jan 24 2020 10:45:00	1.0
Sat Jan 25 2020 12:45:00	1.0	Fri Jan 24 2020 10:00:00	0.0	Fri Jan 24 2020 11:00:00	1.0
Sat Jan 25 2020 13:00:00	0.0	Fri Jan 24 2020 10:15:00	1.0	Fri Jan 24 2020 11:15:00	2.0
Sat Jan 25 2020 13:15:00	0.0	Fri Jan 24 2020 10:30:00	0.0	Fri Jan 24 2020 11:30:00	1.0

Sat Jan 25 2020 13:30:00	1.0	Fri Jan 24 2020 10:45:00	0.0	Fri Jan 24 2020 11:45:00	0.0
Sat Jan 25 2020 13:45:00	0.0	Fri Jan 24 2020 11:00:00	1.0	Fri Jan 24 2020 12:00:00	1.0
Sat Jan 25 2020 14:00:00	2.0	Fri Jan 24 2020 11:15:00	1.0	Fri Jan 24 2020 12:15:00	0.0
Sat Jan 25 2020 14:15:00	1.0	Fri Jan 24 2020 11:30:00	2.0	Fri Jan 24 2020 12:30:00	2.0
Sat Jan 25 2020 14:30:00	1.0	Fri Jan 24 2020 11:45:00	0.0	Fri Jan 24 2020 12:45:00	2.0

VOC DATA (Continued)

Location 4		Location 5	
Date/Time		Date/Time	
Thu Jan 23 2020 13:50:00	0.0	Fri Jan 24 2020 13:30:00	0.0
Thu Jan 23 2020 14:05:00	0.0	Fri Jan 24 2020 13:45:00	2.0
Thu Jan 23 2020 14:20:00	1.0	Fri Jan 24 2020 14:00:00	0.0
Thu Jan 23 2020 14:35:00	2.0	Fri Jan 24 2020 14:15:00	1.0
Thu Jan 23 2020 14:50:00	1.0	Fri Jan 24 2020 14:30:00	2.0
Thu Jan 23 2020 15:05:00	1.0	Fri Jan 24 2020 14:45:00	2.0
Thu Jan 23 2020 15:20:00	1.0	Fri Jan 24 2020 15:00:00	0.0
Thu Jan 23 2020 15:35:00	1.0	Fri Jan 24 2020 15:15:00	1.0
Thu Jan 23 2020 15:50:00	0.0	Fri Jan 24 2020 15:30:00	0.0
Thu Jan 23 2020 16:05:00	2.0	Fri Jan 24 2020 15:45:00	2.0
Thu Jan 23 2020 16:20:00	0.0	Fri Jan 24 2020 16:00:00	1.0
Thu Jan 23 2020 16:35:00	0.0	Fri Jan 24 2020 16:15:00	0.0
Thu Jan 23 2020 16:50:00	0.0	Fri Jan 24 2020 16:30:00	1.0
Thu Jan 23 2020 17:05:00	1.0	Fri Jan 24 2020 16:45:00	1.0
Thu Jan 23 2020 17:20:00	0.0	Fri Jan 24 2020 17:00:00	1.0
Thu Jan 23 2020 17:35:00	2.0	Fri Jan 24 2020 17:15:00	2.0
Thu Jan 23 2020 17:50:00	2.0	Fri Jan 24 2020 17:30:00	2.0
Thu Jan 23 2020 18:05:00	1.0	Fri Jan 24 2020 17:45:00	2.0
Thu Jan 23 2020 18:20:00	2.0	Fri Jan 24 2020 18:00:00	1.0
Thu Jan 23 2020 18:35:00	1.0	Fri Jan 24 2020 18:15:00	1.0
Thu Jan 23 2020 18:50:00	0.0	Fri Jan 24 2020 18:30:00	2.0
Thu Jan 23 2020 19:05:00	0.0	Fri Jan 24 2020 18:45:00	0.0
Thu Jan 23 2020 19:20:00	0.0	Fri Jan 24 2020 19:00:00	0.0
Thu Jan 23 2020 19:35:00	2.0	Fri Jan 24 2020 19:15:00	1.0
Thu Jan 23 2020 19:50:00	1.0	Fri Jan 24 2020 19:30:00	0.0
Thu Jan 23 2020 20:05:00	1.0	Fri Jan 24 2020 19:45:00	0.0
Thu Jan 23 2020 20:20:00	1.0	Fri Jan 24 2020 20:00:00	2.0
Thu Jan 23 2020 20:35:00	0.0	Fri Jan 24 2020 20:15:00	1.0
Thu Jan 23 2020 20:50:00	2.0	Fri Jan 24 2020 20:30:00	1.0
Thu Jan 23 2020 21:05:00	2.0	Fri Jan 24 2020 20:45:00	1.0
Thu Jan 23 2020 21:20:00	0.0	Fri Jan 24 2020 21:00:00	0.0
Thu Jan 23 2020 21:35:00	1.0	Fri Jan 24 2020 21:15:00	2.0
Thu Jan 23 2020 21:50:00	2.0	Fri Jan 24 2020 21:30:00	1.0
Thu Jan 23 2020 22:05:00	0.0	Fri Jan 24 2020 21:45:00	2.0
Thu Jan 23 2020 22:20:00	0.0	Fri Jan 24 2020 22:00:00	2.0
Thu Jan 23 2020 22:35:00	0.0	Fri Jan 24 2020 22:15:00	2.0
Thu Jan 23 2020 22:50:00	2.0	Fri Jan 24 2020 22:30:00	2.0
Thu Jan 23 2020 23:05:00	1.0	Fri Jan 24 2020 22:45:00	0.0
Thu Jan 23 2020 23:20:00	0.0	Fri Jan 24 2020 23:00:00	1.0
Thu Jan 23 2020 23:35:00	0.0	Fri Jan 24 2020 23:15:00	0.0
Thu Jan 23 2020 23:50:00	1.0	Fri Jan 24 2020 23:30:00	1.0
Fri Jan 24 2020 00:05:00	0.0	Fri Jan 24 2020 23:45:00	2.0
Fri Jan 24 2020 00:20:00	0.0	Sat Jan 25 2020 00:00:00	2.0
Fri Jan 24 2020 00:35:00	0.0	Sat Jan 25 2020 00:15:00	0.0

Fri Jan 24 2020 00:50:00	0.0	Sat Jan 25 2020 00:30:00	1.0
Fri Jan 24 2020 01:05:00	0.0	Sat Jan 25 2020 00:45:00	1.0
Fri Jan 24 2020 01:20:00	2.0	Sat Jan 25 2020 01:00:00	0.0
Fri Jan 24 2020 01:35:00	2.0	Sat Jan 25 2020 01:15:00	0.0
Fri Jan 24 2020 01:50:00	2.0	Sat Jan 25 2020 01:30:00	1.0
Fri Jan 24 2020 02:05:00	2.0	Sat Jan 25 2020 01:45:00	1.0
Fri Jan 24 2020 02:20:00	1.0	Sat Jan 25 2020 02:00:00	0.0
Fri Jan 24 2020 02:35:00	1.0	Sat Jan 25 2020 02:15:00	0.0
Fri Jan 24 2020 02:50:00	0.0	Sat Jan 25 2020 02:30:00	0.0
Fri Jan 24 2020 03:05:00	1.0	Sat Jan 25 2020 02:45:00	2.0
Fri Jan 24 2020 03:20:00	2.0	Sat Jan 25 2020 03:00:00	2.0
Fri Jan 24 2020 03:35:00	1.0	Sat Jan 25 2020 03:15:00	2.0
Fri Jan 24 2020 03:50:00	0.0	Sat Jan 25 2020 03:30:00	1.0
Fri Jan 24 2020 04:05:00	1.0	Sat Jan 25 2020 03:45:00	0.0
Fri Jan 24 2020 04:20:00	1.0	Sat Jan 25 2020 04:00:00	0.0
Fri Jan 24 2020 04:35:00	1.0	Sat Jan 25 2020 04:15:00	0.0
Fri Jan 24 2020 04:50:00	0.0	Sat Jan 25 2020 04:30:00	1.0
Fri Jan 24 2020 05:05:00	1.0	Sat Jan 25 2020 04:45:00	1.0
Fri Jan 24 2020 05:20:00	0.0	Sat Jan 25 2020 05:00:00	1.0
Fri Jan 24 2020 05:35:00	0.0	Sat Jan 25 2020 05:15:00	0.0
Fri Jan 24 2020 05:50:00	1.0	Sat Jan 25 2020 05:30:00	1.0
Fri Jan 24 2020 06:05:00	0.0	Sat Jan 25 2020 05:45:00	1.0
Fri Jan 24 2020 06:20:00	0.0	Sat Jan 25 2020 06:00:00	0.0
Fri Jan 24 2020 06:35:00	0.0	Sat Jan 25 2020 06:15:00	1.0
Fri Jan 24 2020 06:50:00	0.0	Sat Jan 25 2020 06:30:00	2.0
Fri Jan 24 2020 07:05:00	1.0	Sat Jan 25 2020 06:45:00	1.0
Fri Jan 24 2020 07:20:00	2.0	Sat Jan 25 2020 07:00:00	1.0
Fri Jan 24 2020 07:35:00	2.0	Sat Jan 25 2020 07:15:00	1.0
Fri Jan 24 2020 07:50:00	2.0	Sat Jan 25 2020 07:30:00	2.0
Fri Jan 24 2020 08:05:00	1.0	Sat Jan 25 2020 07:45:00	1.0
Fri Jan 24 2020 08:20:00	1.0	Sat Jan 25 2020 08:00:00	1.0
Fri Jan 24 2020 08:35:00	0.0	Sat Jan 25 2020 08:15:00	2.0
Fri Jan 24 2020 08:50:00	1.0	Sat Jan 25 2020 08:30:00	1.0
Fri Jan 24 2020 09:05:00	1.0	Sat Jan 25 2020 08:45:00	1.0
Fri Jan 24 2020 09:20:00	2.0	Sat Jan 25 2020 09:00:00	0.0
Fri Jan 24 2020 09:35:00	0.0	Sat Jan 25 2020 09:15:00	1.0
Fri Jan 24 2020 09:50:00	2.0	Sat Jan 25 2020 09:30:00	1.0
Fri Jan 24 2020 10:05:00	2.0	Sat Jan 25 2020 09:45:00	2.0
Fri Jan 24 2020 10:20:00	0.0	Sat Jan 25 2020 10:00:00	0.0
Fri Jan 24 2020 10:35:00	2.0	Sat Jan 25 2020 10:15:00	0.0
Fri Jan 24 2020 10:50:00	0.0	Sat Jan 25 2020 10:30:00	1.0
Fri Jan 24 2020 11:05:00	2.0	Sat Jan 25 2020 10:45:00	0.0
Fri Jan 24 2020 11:20:00	2.0	Sat Jan 25 2020 11:00:00	1.0
Fri Jan 24 2020 11:35:00	0.0	Sat Jan 25 2020 11:15:00	0.0
Fri Jan 24 2020 11:50:00	0.0	Sat Jan 25 2020 11:30:00	2.0
Fri Jan 24 2020 12:05:00	0.0	Sat Jan 25 2020 11:45:00	0.0
Fri Jan 24 2020 12:20:00	2.0	Sat Jan 25 2020 12:00:00	1.0

Fri Jan 24 2020 12:35:00	2.0	Sat Jan 25 2020 12:15:00	1.0
Fri Jan 24 2020 12:50:00	2.0	Sat Jan 25 2020 12:30:00	0.0
Fri Jan 24 2020 13:05:00	1.0	Sat Jan 25 2020 12:45:00	2.0
Fri Jan 24 2020 13:20:00	2.0	Sat Jan 25 2020 13:00:00	2.0
Fri Jan 24 2020 13:35:00	1.0	Sat Jan 25 2020 13:15:00	1.0

(iii) Ozone (O_3)

O3 DATA

Location 1		Location 2		Location 3	
Date Time	O3(ppm)	Date Time	O3(ppm)	Date Time	O3(ppm)
24/01/2020 14:45	0.03	23/01/2020 12:00	0.01	23/01/2020 13:00	0
24/01/2020 15:00	0.041	23/01/2020 12:15	0.014	23/01/2020 13:15	0.01
24/01/2020 15:15	0.038	23/01/2020 12:30	0.026	23/01/2020 13:30	0
24/01/2020 15:30	0.034	23/01/2020 12:45	0.016	23/01/2020 13:45	0.014
24/01/2020 15:45	0.045	23/01/2020 13:00	0.016	23/01/2020 14:00	0
24/01/2020 16:00	0.036	23/01/2020 13:15	0.016	23/01/2020 14:15	0.026
24/01/2020 16:15	0.039	23/01/2020 13:30	0.021	23/01/2020 14:30	0
24/01/2020 16:30	0.043	23/01/2020 13:45	0.019	23/01/2020 14:45	0.016
24/01/2020 16:45	0.039	23/01/2020 14:00	0.022	23/01/2020 15:00	0.016
24/01/2020 17:00	0.039	23/01/2020 14:15	0.023	23/01/2020 15:15	0.016
24/01/2020 17:15	0.045	23/01/2020 14:30	0.015	23/01/2020 15:30	0.021
24/01/2020 17:30	0.036	23/01/2020 14:45	0.018	23/01/2020 15:45	0.019
24/01/2020 17:45	0.045	23/01/2020 15:00	0.022	23/01/2020 16:00	0.022
24/01/2020 18:00	0.037	23/01/2020 15:15	0.018	23/01/2020 16:15	0.023
24/01/2020 18:15	0.042	23/01/2020 15:30	0.024	23/01/2020 16:30	0.015
24/01/2020 18:30	0.03	23/01/2020 15:45	0.026	23/01/2020 16:45	0.018
24/01/2020 18:45	0.032	23/01/2020 16:00	0.02	23/01/2020 17:00	0.022
24/01/2020 19:00	0.044	23/01/2020 16:15	0.022	23/01/2020 17:15	0.018
24/01/2020 19:15	0.04	23/01/2020 16:30	0.025	23/01/2020 17:30	0.024
24/01/2020 19:30	0.039	23/01/2020 16:45	0.022	23/01/2020 17:45	0.026
24/01/2020 19:45	0.038	23/01/2020 17:00	0.023	23/01/2020 18:00	0.02
24/01/2020 20:00	0.033	23/01/2020 17:15	0.028	23/01/2020 18:15	0.022
24/01/2020 20:15	0.029	23/01/2020 17:30	0.022	23/01/2020 18:30	0.025
24/01/2020 20:30	0.044	23/01/2020 17:45	0.027	23/01/2020 18:45	0.022
24/01/2020 20:45	0.034	23/01/2020 18:00	0.021	23/01/2020 19:00	0.023
24/01/2020 21:00	0.044	23/01/2020 18:15	0.024	23/01/2020 19:15	0.028
24/01/2020 21:15	0.04	23/01/2020 18:30	0.024	23/01/2020 19:30	0.022
24/01/2020 21:30	0.032	23/01/2020 18:45	0.022	23/01/2020 19:45	0.027
24/01/2020 21:45	0.038	23/01/2020 19:00	0.02	23/01/2020 20:00	0.021
24/01/2020 22:00	0.037	23/01/2020 19:15	0.025	23/01/2020 20:15	0.024
24/01/2020 22:15	0.035	23/01/2020 19:30	0.022	23/01/2020 20:30	0.024
24/01/2020 22:30	0.034	23/01/2020 19:45	0.023	23/01/2020 20:45	0.022
24/01/2020 22:45	0.03	23/01/2020 20:00	0.022	23/01/2020 21:00	0.02
24/01/2020 23:00	0.037	23/01/2020 20:15	0.018	23/01/2020 21:15	0.025
24/01/2020 23:15	0.041	23/01/2020 20:30	0.022	23/01/2020 21:30	0.022
24/01/2020 23:30	0.034	23/01/2020 20:45	0.02	23/01/2020 21:45	0.023
24/01/2020 23:45	0.039	23/01/2020 21:00	0.018	23/01/2020 22:00	0.022
25/01/2020 00:00	0.039	23/01/2020 21:15	0.015	23/01/2020 22:15	0.018
25/01/2020 00:15	0.044	23/01/2020 21:30	0.019	23/01/2020 22:30	0.022
25/01/2020 00:30	0.035	23/01/2020 21:45	0.019	23/01/2020 22:45	0.02
25/01/2020 00:45	0.03	23/01/2020 22:00	0.02	23/01/2020 23:00	0.018
25/01/2020 01:00	0.04	23/01/2020 22:15	0.019	23/01/2020 23:15	0.015
25/01/2020 01:15	0.043	23/01/2020 22:30	0.021	23/01/2020 23:30	0.019
25/01/2020 01:30	0.033	23/01/2020 22:45	0.018	23/01/2020 23:45	0.019

25/01/2020 01:45	0.039	23/01/2020 23:00	0.02	24/01/2020 00:00	0.02
25/01/2020 02:00	0.039	23/01/2020 23:15	0.02	24/01/2020 00:15	0.019
25/01/2020 02:15	0.041	23/01/2020 23:30	0.021	24/01/2020 00:30	0.021
25/01/2020 02:30	0.029	23/01/2020 23:45	0.023	24/01/2020 00:45	0.018
25/01/2020 02:45	0.043	24/01/2020 00:00	0.02	24/01/2020 01:00	0.02
25/01/2020 03:00	0.038	24/01/2020 00:15	0.02	24/01/2020 01:15	0.02
25/01/2020 03:15	0.037	24/01/2020 00:30	0.022	24/01/2020 01:30	0.021
25/01/2020 03:30	0.044	24/01/2020 00:45	0.019	24/01/2020 01:45	0.023
25/01/2020 03:45	0.029	24/01/2020 01:00	0.02	24/01/2020 02:00	0.02
25/01/2020 04:00	0.041	24/01/2020 01:15	0.023	24/01/2020 02:15	0.02
25/01/2020 04:15	0.034	24/01/2020 01:30	0.02	24/01/2020 02:30	0.022
25/01/2020 04:30	0.044	24/01/2020 01:45	0.021	24/01/2020 02:45	0.019
25/01/2020 04:45	0.033	24/01/2020 02:00	0.021	24/01/2020 03:00	0.02
25/01/2020 05:00	0.039	24/01/2020 02:15	0.022	24/01/2020 03:15	0.023
25/01/2020 05:15	0.041	24/01/2020 02:30	0.021	24/01/2020 03:30	0.02
25/01/2020 05:30	0.041	24/01/2020 02:45	0.022	24/01/2020 03:45	0.021
25/01/2020 05:45	0.036	24/01/2020 03:00	0.02	24/01/2020 04:00	0.021
25/01/2020 06:00	0.034	24/01/2020 03:15	0.021	24/01/2020 04:15	0.022
25/01/2020 06:15	0.037	24/01/2020 03:30	0.024	24/01/2020 04:30	0.021
25/01/2020 06:30	0.043	24/01/2020 03:45	0.022	24/01/2020 04:45	0.022
25/01/2020 06:45	0.034	24/01/2020 04:00	0.02	24/01/2020 05:00	0.02
25/01/2020 07:00	0.035	24/01/2020 04:15	0.023	24/01/2020 05:15	0.021
25/01/2020 07:15	0.03	24/01/2020 04:30	0.023	24/01/2020 05:30	0.024
25/01/2020 07:30	0.03	24/01/2020 04:45	0.022	24/01/2020 05:45	0.022
25/01/2020 07:45	0.041	24/01/2020 05:00	0.023	24/01/2020 06:00	0.02
25/01/2020 08:00	0.044	24/01/2020 05:15	0.022	24/01/2020 06:15	0.023
25/01/2020 08:15	0.035	24/01/2020 05:30	0.021	24/01/2020 06:30	0.023
25/01/2020 08:30	0.036	24/01/2020 05:45	0.022	24/01/2020 06:45	0.022
25/01/2020 08:45	0.037	24/01/2020 06:00	0.02	24/01/2020 07:00	0.023
25/01/2020 09:00	0.044	24/01/2020 06:15	0.02	24/01/2020 07:15	0.022
25/01/2020 09:15	0.035	24/01/2020 06:30	0.02	24/01/2020 07:30	0.021
25/01/2020 09:30	0.037	24/01/2020 06:45	0.021	24/01/2020 07:45	0.022
25/01/2020 09:45	0.038	24/01/2020 07:00	0.021	24/01/2020 08:00	0.02
25/01/2020 10:00	0.034	24/01/2020 07:15	0.02	24/01/2020 08:15	0.02
25/01/2020 10:15	0.03	24/01/2020 07:30	0.019	24/01/2020 08:30	0.02
25/01/2020 10:30	0.029	24/01/2020 07:45	0.017	24/01/2020 08:45	0.021
25/01/2020 10:45	0.038	24/01/2020 08:00	0.019	24/01/2020 09:00	0.021
25/01/2020 11:00	0.029	24/01/2020 08:15	0.018	24/01/2020 09:15	0.02
25/01/2020 11:15	0.032	24/01/2020 08:30	0.022	24/01/2020 09:30	0.019
25/01/2020 11:30	0.041	24/01/2020 08:45	0.016	24/01/2020 09:45	0.017
25/01/2020 11:45	0.036	24/01/2020 09:00	0.018	24/01/2020 10:00	0.019
25/01/2020 12:00	0.041	24/01/2020 09:15	0.019	24/01/2020 10:15	0.018
25/01/2020 12:15	0.034	24/01/2020 09:30	0.019	24/01/2020 10:30	0.022
25/01/2020 12:30	0.029	24/01/2020 09:45	0.021	24/01/2020 10:45	0.016
25/01/2020 12:45	0.033	24/01/2020 10:00	0.02	24/01/2020 11:00	0.018
25/01/2020 13:00	0.043	24/01/2020 10:15	0.019	24/01/2020 11:15	0.019
25/01/2020 13:15	0.032	24/01/2020 10:30	0.022	24/01/2020 11:30	0.019

25/01/2020 13:30	0.035	24/01/2020 10:45	0.022	24/01/2020 11:45	0.021
25/01/2020 13:45	0.041	24/01/2020 11:00	0.021	24/01/2020 12:00	0.02
25/01/2020 14:00	0.042	24/01/2020 11:15	0.024	24/01/2020 12:15	0.019
25/01/2020 14:15	0.029	24/01/2020 11:30	0.022	24/01/2020 12:30	0.022
25/01/2020 14:30	0.041	24/01/2020 11:45	0.02	24/01/2020 12:45	0.022

O3 DATA (Continued)

Location 4		Location 5	
Date Time	O3(ppm)	Date Time	O3(ppm)
23/01/2020 13:50	0.025	24/01/2020 13:30	0.033
23/01/2020 14:05	0.023	24/01/2020 13:45	0.035
23/01/2020 14:20	0.026	24/01/2020 14:00	0.037
23/01/2020 14:35	0.022	24/01/2020 14:15	0.033
23/01/2020 14:50	0.024	24/01/2020 14:30	0.029
23/01/2020 15:05	0.025	24/01/2020 14:45	0.029
23/01/2020 15:20	0.027	24/01/2020 15:00	0.038
23/01/2020 15:35	0.028	24/01/2020 15:15	0.029
23/01/2020 15:50	0.025	24/01/2020 15:30	0.03
23/01/2020 16:05	0.022	24/01/2020 15:45	0.045
23/01/2020 16:20	0.023	24/01/2020 16:00	0.044
23/01/2020 16:35	0.024	24/01/2020 16:15	0.032
23/01/2020 16:50	0.027	24/01/2020 16:30	0.032
23/01/2020 17:05	0.023	24/01/2020 16:45	0.036
23/01/2020 17:20	0.028	24/01/2020 17:00	0.039
23/01/2020 17:35	0.028	24/01/2020 17:15	0.034
23/01/2020 17:50	0.031	24/01/2020 17:30	0.03
23/01/2020 18:05	0.027	24/01/2020 17:45	0.029
23/01/2020 18:20	0.028	24/01/2020 18:00	0.042
23/01/2020 18:35	0.03	24/01/2020 18:15	0.035
23/01/2020 18:50	0.03	24/01/2020 18:30	0.045
23/01/2020 19:05	0.028	24/01/2020 18:45	0.032
23/01/2020 19:20	0.027	24/01/2020 19:00	0.033
23/01/2020 19:35	0.028	24/01/2020 19:15	0.04
23/01/2020 19:50	0.028	24/01/2020 19:30	0.035
23/01/2020 20:05	0.026	24/01/2020 19:45	0.034
23/01/2020 20:20	0.028	24/01/2020 20:00	0.043
23/01/2020 20:35	0.028	24/01/2020 20:15	0.044
23/01/2020 20:50	0.028	24/01/2020 20:30	0.044
23/01/2020 21:05	0.027	24/01/2020 20:45	0.04
23/01/2020 21:20	0.027	24/01/2020 21:00	0.045
23/01/2020 21:35	0.027	24/01/2020 21:15	0.032
23/01/2020 21:50	0.027	24/01/2020 21:30	0.031
23/01/2020 22:05	0.029	24/01/2020 21:45	0.043
23/01/2020 22:20	0.026	24/01/2020 22:00	0.033
23/01/2020 22:35	0.028	24/01/2020 22:15	0.04
23/01/2020 22:50	0.026	24/01/2020 22:30	0.039
23/01/2020 23:05	0.028	24/01/2020 22:45	0.037
23/01/2020 23:20	0.025	24/01/2020 23:00	0.036
23/01/2020 23:35	0.027	24/01/2020 23:15	0.029
23/01/2020 23:50	0.025	24/01/2020 23:30	0.041
24/01/2020 00:05	0.024	24/01/2020 23:45	0.036
24/01/2020 00:20	0.028	25/01/2020 00:00	0.03
24/01/2020 00:35	0.026	25/01/2020 00:15	0.039

24/01/2020 00:50	0.03	25/01/2020 00:30	0.045
24/01/2020 01:05	0.031	25/01/2020 00:45	0.035
24/01/2020 01:20	0.026	25/01/2020 01:00	0.038
24/01/2020 01:35	0.029	25/01/2020 01:15	0.029
24/01/2020 01:50	0.028	25/01/2020 01:30	0.045
24/01/2020 02:05	0.029	25/01/2020 01:45	0.04
24/01/2020 02:20	0.033	25/01/2020 02:00	0.029
24/01/2020 02:35	0.028	25/01/2020 02:15	0.042
24/01/2020 02:50	0.028	25/01/2020 02:30	0.037
24/01/2020 03:05	0.033	25/01/2020 02:45	0.036
24/01/2020 03:20	0.032	25/01/2020 03:00	0.039
24/01/2020 03:35	0.034	25/01/2020 03:15	0.031
24/01/2020 03:50	0.035	25/01/2020 03:30	0.03
24/01/2020 04:05	0.032	25/01/2020 03:45	0.035
24/01/2020 04:20	0.032	25/01/2020 04:00	0.044
24/01/2020 04:35	0.034	25/01/2020 04:15	0.041
24/01/2020 04:50	0.031	25/01/2020 04:30	0.032
24/01/2020 05:05	0.033	25/01/2020 04:45	0.036
24/01/2020 05:20	0.034	25/01/2020 05:00	0.036
24/01/2020 05:35	0.031	25/01/2020 05:15	0.037
24/01/2020 05:50	0.029	25/01/2020 05:30	0.042
24/01/2020 06:05	0.035	25/01/2020 05:45	0.03
24/01/2020 06:20	0.031	25/01/2020 06:00	0.039
24/01/2020 06:35	0.03	25/01/2020 06:15	0.041
24/01/2020 06:50	0.033	25/01/2020 06:30	0.038
24/01/2020 07:05	0.03	25/01/2020 06:45	0.036
24/01/2020 07:20	0.031	25/01/2020 07:00	0.038
24/01/2020 07:35	0.03	25/01/2020 07:15	0.033
24/01/2020 07:50	0.03	25/01/2020 07:30	0.038
24/01/2020 08:05	0.029	25/01/2020 07:45	0.044
24/01/2020 08:20	0.029	25/01/2020 08:00	0.03
24/01/2020 08:35	0.027	25/01/2020 08:15	0.041
24/01/2020 08:50	0.03	25/01/2020 08:30	0.041
24/01/2020 09:05	0.027	25/01/2020 08:45	0.037
24/01/2020 09:20	0.03	25/01/2020 09:00	0.04
24/01/2020 09:35	0.033	25/01/2020 09:15	0.039
24/01/2020 09:50	0.031	25/01/2020 09:30	0.034
24/01/2020 10:05	0.037	25/01/2020 09:45	0.035
24/01/2020 10:20	0.037	25/01/2020 10:00	0.045
24/01/2020 10:35	0.034	25/01/2020 10:15	0.044
24/01/2020 10:50	0.034	25/01/2020 10:30	0.029
24/01/2020 11:05	0.036	25/01/2020 10:45	0.044
24/01/2020 11:20	0.038	25/01/2020 11:00	0.045
24/01/2020 11:35	0.039	25/01/2020 11:15	0.043
24/01/2020 11:50	0.032	25/01/2020 11:30	0.041
24/01/2020 12:05	0.026	25/01/2020 11:45	0.044
24/01/2020 12:20	0.037	25/01/2020 12:00	0.04

24/01/2020 12:35	0.037	25/01/2020 12:15	0.036
24/01/2020 12:50	0.034	25/01/2020 12:30	0.035
24/01/2020 13:05	0.038	25/01/2020 12:45	0.039
24/01/2020 13:20	0.037	25/01/2020 13:00	0.031
24/01/2020 13:35	0.033	25/01/2020 13:15	0.033

(iv) Filter Weights

Location	Date 2020	Parameters	Pre-Weight (g)	Post-Weight (g)
1	January 24th – 25th	$PM_{2.5}$	4.3923	4.4294
		PM_{10}	4.4416	4.4811
		TSP	3.6799	3.7570
2	January 23rd – 24th	$PM_{2.5}$	4.4515	4.4690
		PM_{10}	4.3457	4.3771
		TSP	3.8196	3.8625
3	January 23rd – 24th	$PM_{2.5}$	4.3682	4.3942
		PM_{10}	4.3184	4.3470
		TSP	3.8055	3.8470
4	January 23rd – 24th	$PM_{2.5}$	4.3881	4.4133
		PM_{10}	4.3091	4.3437
		TSP	3.7976	3.8466
5	January 24th – 25th	$PM_{2.5}$	4.174	4.4344
		PM_{10}	4.4067	4.4329
		TSP	3.6153	3.6545

G. Meteorological Data

(i) Raw Meteorological Data

month	day	year	minute	Temp degC	Precip mm	Pressure mb	RH %	Wdir10m deg	Wspeed10m ms-1
1	23	2020	0	26.8	0	767.4	69.0	125	2.0
1	23	2020	15	26.8	0	767.2	68.0	125	2.7
1	23	2020	30	27.5	0	767.2	68.0	113	1.4
1	23	2020	45	27.5	0	766.9	68.0	125	1.7
1	23	2020	60	26.2	0	766.9	75.0	247	1.5
1	23	2020	75	26.5	0	766.6	76.0	125	1.8
1	23	2020	90	26.4	0	766.4	77.0	292	1.2
1	23	2020	105	27.2	0	766.1	73.0	247	0.9
1	23	2020	120	27.0	0	765.9	77.0	318	0.9
1	23	2020	135	27.0	0	765.6	77.0	270	1.5
1	23	2020	150	26.0	0	765.6	81.0	292	1.2
1	23	2020	165	26.2	0	765.4	80.0	270	1.1
1	23	2020	180	25.8	0	765.1	82.0	202	0.8
1	23	2020	195	26.9	0	765.1	76.0	125	1.4
1	23	2020	210	27.5	0	765.1	72.0	202	1.7
1	23	2020	225	27.3	0	765.1	69.0	100	1.3
1	23	2020	240	27.3	0	764.9	73.0	125	1.7
1	23	2020	255	26.6	0	765.1	74.0	100	1.1
1	23	2020	270	26.2	0	765.1	73.0	102	1.8
1	23	2020	285	26.0	0	765.1	73.0	100	1.5
1	23	2020	300	26.3	0	765.4	71.0	100	1.7
1	23	2020	315	25.7	0	765.4	73.0	102	1.8
1	23	2020	330	25.2	0	765.4	75.0	102	1.1
1	23	2020	345	24.9	0	765.6	74.0	102	1.5
1	23	2020	360	24.8	0	765.6	75.0	102	0.6
1	23	2020	375	24.3	0	765.6	78.0	88	1.1
1	23	2020	390	24.0	0	765.9	79.0	88	1.0
1	23	2020	405	23.9	0	765.9	79.0	88	1.2
1	23	2020	420	23.7	0	765.9	80.0	68	1.1
1	23	2020	435	23.5	0	766.1	80.0	88	0.9
1	23	2020	450	23.5	0	766.1	79.0	68	1.1
1	23	2020	465	23.4	0	766.4	78.0	88	1.3
1	23	2020	480	23.3	0	766.4	78.0	68	1.1
1	23	2020	495	23.1	0	766.6	78.0	68	0.9
1	23	2020	510	23.0	0	766.6	79.0	45	1.1
1	23	2020	525	22.9	0	766.9	78.0	45	0.9
1	23	2020	540	22.7	0	767.2	77.0	45	1.0
1	23	2020	555	22.7	0	767.2	76.0	68	0.9
1	23	2020	570	22.7	0	767.2	77.0	45	0.7
1	23	2020	585	22.6	0	767.2	78.0	68	0.5
1	23	2020	600	22.5	0	767.2	78.0	125	0.6
1	23	2020	615	22.4	0	767.2	76.0	100	0.6
1	23	2020	630	22.5	0	767.2	74.0	292	0.3
1	23	2020	645	22.8	0	767.2	75.0	68	1.1

1	23	2020	660	22.8	0	766.9	72.0	68	1.1
1	23	2020	675	22.8	0	766.9	71.0	45	0.9
1	23	2020	690	22.9	0	766.9	71.0	68	1.1
1	23	2020	705	22.9	0	766.9	74.0	68	1.1
1	23	2020	720	22.7	0	766.9	78.0	68	1.3
1	24	2020	0	22.6	0	766.6	77.0	45	0.8
1	24	2020	15	22.4	0	766.6	75.0	45	0.9
1	24	2020	30	22.4	0	766.6	76.0	68	1.0
1	24	2020	45	22.4	0	766.4	76.0	88	0.9
1	24	2020	60	22.5	0	766.1	74.0	68	0.9
1	24	2020	75	22.4	0	766.1	72.0	45	0.9
1	24	2020	90	22.4	0	766.1	70.0	45	0.8
1	24	2020	105	22.6	0	765.9	74.0	68	1.1
1	24	2020	120	22.3	0	765.6	74.0	68	1.0
1	24	2020	135	22.3	0	765.6	74.0	68	0.8
1	24	2020	150	22.1	0	765.6	74.0	45	0.4
1	24	2020	165	22.1	0	765.6	77.0	88	0.6
1	24	2020	180	21.9	0	765.6	75.0	22	0.6
1	24	2020	195	22.2	0	765.4	75.0	68	0.8
1	24	2020	210	22.4	0	765.4	73.0	45	0.9
1	24	2020	225	22.4	0	765.6	73.0	45	0.8
1	24	2020	240	22.4	0	765.6	77.0	68	0.6
1	24	2020	255	22.1	0	765.9	78.0	113	0.6
1	24	2020	270	22.0	0	765.9	79.0	88	0.7
1	24	2020	285	22.0	0	765.9	78.0	88	0.9
1	24	2020	300	22.2	0	766.1	75.0	88	0.9
1	24	2020	315	22.2	0	766.1	77.0	88	0.9
1	24	2020	330	22.3	0	766.1	76.0	88	1.0
1	24	2020	345	22.2	0	766.4	78.0	88	0.8
1	24	2020	360	22.0	0	766.6	78.0	68	0.7
1	24	2020	375	21.9	0	766.6	80.0	45	0.5
1	24	2020	390	22.2	0	766.9	85.0	88	0.9
1	24	2020	405	22.2	0	766.9	87.0	68	1.1
1	24	2020	420	22.4	0	767.2	87.0	88	1.0
1	24	2020	435	22.7	0	767.4	87.0	88	1.4
1	24	2020	450	22.8	0	767.4	88.0	88	2.0
1	24	2020	465	23.0	0	767.7	88.0	102	1.5
1	24	2020	480	23.5	0	767.9	87.0	102	1.8
1	24	2020	495	23.7	0	767.9	87.0	102	1.0
1	24	2020	510	23.8	0	767.9	87.0	102	1.3
1	24	2020	525	23.9	0	768.2	87.0	100	1.1
1	24	2020	540	24.2	0	768.4	88.0	102	1.3
1	24	2020	555	24.7	0	768.4	86.0	100	1.2
1	24	2020	570	24.6	0	768.7	86.0	102	1.3
1	24	2020	585	24.9	0	768.7	84.0	22	0.6
1	24	2020	600	25.6	0	768.7	82.0	88	1.1
1	24	2020	615	26.1	0	768.4	81.0	113	0.8

1	24	2020	630	25.5	0	768.7	82.0	202	0.3
1	24	2020	645	25.5	0	768.7	82.0	202	1.2
1	24	2020	660	25.0	0	768.4	83.0	339	0.5
1	24	2020	675	25.2	0	768.4	85.0	125	1.4
1	24	2020	690	25.9	0	768.2	81.0	202	0.9
1	24	2020	705	25.2	0	767.9	83.0	318	1.3
1	24	2020	720	25.0	0	767.9	84.0	318	1.1
1	24	2020	735	24.6	0	767.7	84.0	318	1.1
1	24	2020	750	24.2	0	767.7	86.0	318	1.0
1	24	2020	765	23.7	0	767.7	87.0	318	1.5
1	24	2020	780	23.7	0	767.4	87.0	318	1.9
1	24	2020	795	23.7	0	767.2	87.0	339	1.5
1	24	2020	810	23.4	0	767.2	90.0		1.2
1	24	2020	825	23.4	3	766.9	92.0	22	0.9
1	24	2020	840	23.3	4	766.9	94.0	22	0.6
1	24	2020	855	23.3	6	766.6	94.0	0	1.1
1	24	2020	870	23.1	8	766.6	95.0		0.8
1	24	2020	885	23.2	7	766.4	95.0	45	0.6
1	24	2020	900	23.2	6	766.4	95.0	68	0.5
1	24	2020	915	23.4	6	766.1	95.0	45	0.6
1	24	2020	930	23.8	2	765.9	93.0	102	1.1
1	24	2020	945	23.7	2	765.9	96.0	88	0.9
1	24	2020	960	24.4	0	765.9	93.0	88	1.0
1	24	2020	975	24.5	0	765.9	94.0	88	0.6
1	24	2020	990	24.6	0	765.9	89.0	102	1.1
1	24	2020	1005	24.4	0	765.9	89.0	102	1.1
1	24	2020	1020	24.2	0	766.1	90.0	88	0.8
1	24	2020	1035	24.3	0	766.1	91.0	45	0.2
1	24	2020	1050	24.1	0	766.4	90.0	22	0.6
1	24	2020	1065	24.0	0	766.4	91.0	45	0.4
1	24	2020	1080	23.7	0	766.4	91.0	68	0.2
1	24	2020	1095	23.7	0	766.6	93.0	88	0.4
1	24	2020	1110	23.2	0	766.6	94.0	88	0.4
1	24	2020	1125	23.0	0	766.6	94.0	102	0.5
1	24	2020	1140	22.9	0	766.9	94.0	102	0.2
1	24	2020	1155	22.7	0	767.2	94.0	68	0.4
1	24	2020	1170	22.7	0	767.2	94.0	88	0.5
1	24	2020	1185	22.9	0	767.2	94.0	88	0.8
1	24	2020	1200	22.7	0	767.4	93.0	22	0.2
1	24	2020	1215	22.6	0	767.4	93.0	68	0.6
1	24	2020	1230	22.7	0	767.7	93.0	68	0.6
1	24	2020	1245	22.6	0	767.7	93.0	22	0.8
1	24	2020	1260	22.6	0	767.7	93.0	45	0.4
1	24	2020	1275	22.6	0	767.9	93.0	22	0.4
1	24	2020	1290	22.7	0	767.9	92.0	22	0.6
1	24	2020	1305	22.8	0	768.2	92.0	45	0.6
1	24	2020	1320	22.9	0	768.2	91.0	88	0.4

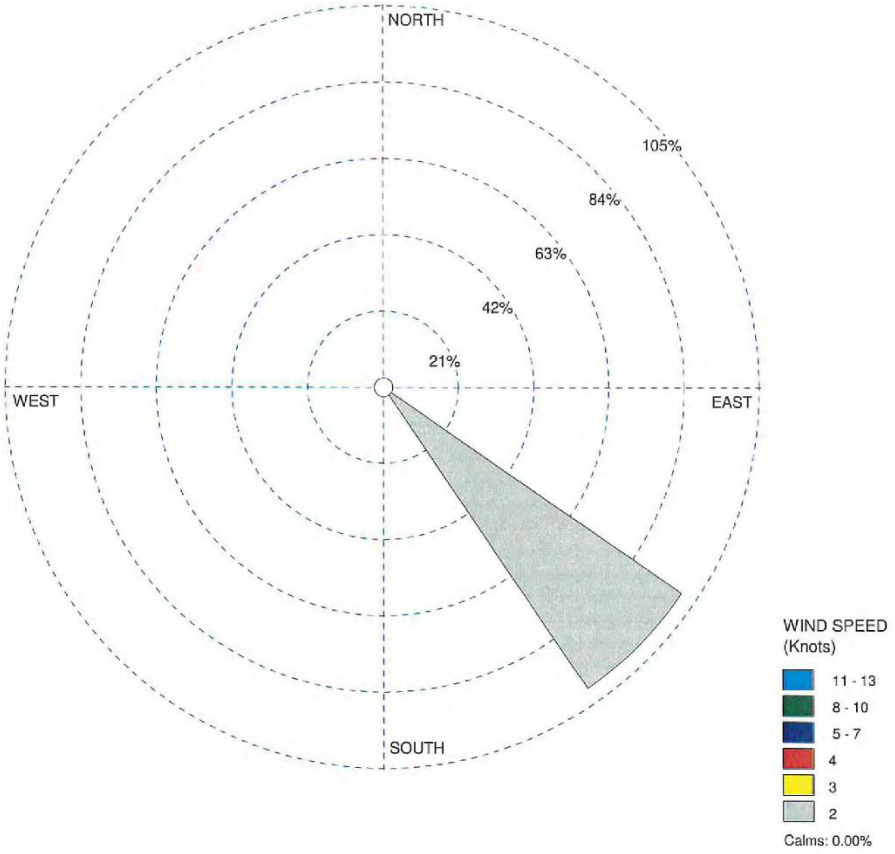
1	24	2020	1335	22.9	0	768.2	91.0	270	0.2
1	24	2020	1350	22.8	0	768.2	92.0	88	0.0
1	24	2020	1365	22.7	0	768.2	93.0	88	0.1
1	24	2020	1380	22.7	0	768.2	94.0	68	0.6
1	24	2020	1395	22.6	0	768.2	94.0	45	0.0
1	24	2020	1410	22.5	0	768.2	93.0	68	0.5
1	25	2020	0	22.6	0	768.2	89.0	88	0.8
1	25	2020	15	22.8	0	768.2	87.0	68	0.5
1	25	2020	30	22.9	0	767.9	86.0	88	0.3
1	25	2020	45	22.9	0	767.7	87.0	68	0.4
1	25	2020	60	22.8	0	767.7	87.0	45	0.2
1	25	2020	75	22.7	0	767.7	87.0	68	0.5
1	25	2020	90	22.8	0	767.7	87.0	45	0.4
1	25	2020	105	22.9	0	767.4	88.0	88	0.7
1	25	2020	120	22.9	0	767.4	88.0	22	0.6
1	25	2020	135	22.8	0	767.4	87.0	22	0.6
1	25	2020	150	22.7	0	767.4	86.0	68	0.5
1	25	2020	165	22.9	0	767.2	84.0	68	0.6
1	25	2020	180	22.9	0	767.2	84.0	45	0.8
1	25	2020	195	22.6	0	767.2	85.0	45	0.2
1	25	2020	210	22.5	0	767.2	86.0	68	0.7
1	25	2020	225	22.5	0	766.9	87.0	45	0.8
1	25	2020	240	22.5	0	766.9	87.0	68	0.8
1	25	2020	255	22.4	0	766.9	88.0	68	0.6
1	25	2020	270	22.5	0	766.9	89.0	45	0.9
1	25	2020	285	22.5	0	767.2	88.0	22	0.9
1	25	2020	300	22.5	0	767.2	87.0	45	0.6
1	25	2020	315	22.5	0	767.2	86.0	45	0.7
1	25	2020	330	22.6	0	767.2	86.0	68	0.6
1	25	2020	345	22.6	0	767.2	87.0	68	0.6
1	25	2020	360	22.5	0	767.4	88.0	45	0.5
1	25	2020	375	22.4	0	767.7	88.0	68	0.8
1	25	2020	390	22.5	0	767.9	88.0	88	0.4
1	25	2020	405	22.4	0	767.9	88.0	68	0.1
1	25	2020	420	22.5	0	768.2	89.0	68	0.3
1	25	2020	435	22.9	0	768.4	88.0	102	0.6
1	25	2020	450	23.2	0	768.4	86.0	88	0.8
1	25	2020	465	24.0	0	768.7	83.0	102	0.9
1	25	2020	480	23.9	0	768.9	83.0	68	0.7
1	25	2020	495	23.9	0	769.2	82.0	102	1.0
1	25	2020	510	24.0	0	769.5	82.0	88	0.9
1	25	2020	525	24.1	0	769.5	86.0	125	0.4
1	25	2020	540	24.2	0	769.7	85.0	113	0.8
1	25	2020	555	24.3	0	769.7	84.0	113	0.9
1	25	2020	570	24.9	0	769.7	82.0	100	0.9
1	25	2020	585	24.9	0	769.7	80.0	102	1.5
1	25	2020	600	24.9	0	769.7	82.0	88	0.9

1	25	2020	615	25.1	0	769.7	81.0	88	0.9
1	25	2020	630	25.5	0	769.7	81.0	88	0.8
1	25	2020	645	25.4	0	769.7	79.0	100	1.4
1	25	2020	660	25.6	0	769.7	80.0	100	1.5
1	25	2020	675	26.2	0	769.5	80.0	202	1.1
1	25	2020	690	26.2	0	769.5	75.0	88	1.5
1	25	2020	705	26.4	0	769.2	77.0	100	0.8
1	25	2020	720	26.6	0	769.2	75.0	100	1.7
1	25	2020	735	26.8	0	768.9	75.0	113	1.7
1	25	2020	750	26.7	0	768.9	71.0	102	1.7
1	25	2020	765	26.5	0	768.7	71.0	102	2.3
1	25	2020	780	27.2	0	768.4	71.0	102	1.1
1	25	2020	795	26.6	0	768.4	71.0	100	1.7
1	25	2020	810	27.0	0	768.2	72.0	100	1.5
1	25	2020	825	27.2	0	767.9	66.0	88	2.8
1	25	2020	840	26.3	0	767.7	66.0	100	1.8
1	25	2020	855	26.9	0	767.7	65.0	88	1.2
1	25	2020	870	27.4	0	767.4	67.0	102	1.2
1	25	2020	885	27.0	0	767.2	68.0	102	1.3

(ii) Wind Rose Plot

WIND ROSE PLOT:

Ecoengineering Consultants Limited
23rd - 25th January, 2020



COMMENTS:		COMPANY NAME: **Ecoengineering Consultants Limited**	
		MODELER: **Kaizen Environmental Services (Trinidad) Limited**	
			PROJECT NO.: **20-9010-3**

WRPLOT View - Lakes Environmental Software

(iii) Calibration Certificate - Davis Met Station

KAIZEN
Environmental Services (T'dad) Ltd

Rajkumar Street,
Mission Road,
Freeport. Trinidad, W.I.,
Tel.: (868) 299-0009,
FAX: (868) 673-6420;
Email: inquiries@kaizen-tt.com

VERIFICATION CERTIFICATE

CERTIFICATE #: 040418-A70426N737

DATE: 2019-12-25

ANALYSER TYPE: Davis Meteorological Station

SERIAL #: A70426N737

Sensor	Date Checked	Response
UV	*25/12/19*	**OK**
Rain Gauge	*25/12/19*	**OK**
Wind Monitor	*25/12/19*	**OK**
Wind Direction	*25/12/19*	**OK**
Temp & Humidity	*25/12/19*	**OK**
Pressure	*25/12/19*	**OK**

This document is to certify that the instrument listed has been inspected, by KAIZEN Environmental Services (Trinidad) Limited and tested in accordance with Davis factory standards, and specifications as outlined in the factory instruction manual and test procedures.

Tested by:

amrit persad maharaj

Amrit Persad Maharaj
Instrumentation Technician

Verified by:

Deodath Maharaj
Instrumentation Team Leader

H. Biographies of Personnel

Anthony Chariah
Environmental Technician | PROJECT Services Division

Mr. Anthony Chariah is presently employed at Kaizen Environmental Services Limited as an Environmental Technician in the Project Services Department where he is responsible for executing the environmental fieldwork component of projects. This includes pre planning, data collection, and management, the operation of equipment, testing and preparation of technical information.

Mr. Chariah has been under the Project Services Division for four years now where he has gained knowledge and training in Environmental and Occupational monitoring and sampling according to US EPA and EMA guidelines. His work experiences include performing Ambient Air Quality monitoring, Indoor Air Quality monitoring, Stack Emission testing (Point Source Testing) and Noise testing.

Mr. Chariah possesses a BSc. Environmental and Natural Resources Management and Geography together with a NEBOSH National General Certificate in Occupational Health and Safety. Past experience includes working as a California Industrial Engineering Services Company Limited.

Mr. Troy Glod
Trainee Environmental Technician | PROJECT Services Division

Mr. Troy Glod is presently employed at Kaizen Environmental Services Limited as a Trainee Environmental Technician in the Project Services Department where he is responsible for executing environmental type fieldwork projects and reporting of the environmental type projects. This includes equipment use, service, calibration and testing together with data collection, processing and measurement reporting.

Mr. Glod has been under the Project Services Division where he has gained knowledge and training in Environmental and Occupational monitoring and sampling according to USEPA and EMA guidelines. His work experiences include performing Ambient Air Quality monitoring, Indoor Air Quality monitoring, Stack Emission testing (Point Source Testing), Noise monitoring and light monitoring.

Mr. Glod possesses a BSc. Environmental Science and Sustainable Technology.

8 APPENDIX H - NATIONAL AIR QUALITY INDEX

The air quality index (AQI) is a number used by government agencies to communicate to the public how polluted the air currently is or how polluted it is forecasted to become. As the AQI increases, an increasingly large percentage of the population is likely to experience increasingly severe adverse health effects. Table 8.1 and Table 8.2 highlight Air Pollutants recorded from March 1st, 2016 – September 30, 2019 at Monitor Station: Port of Spain Tri5432015-Tri5452015 and Monitor Station: Chaguanas TRI5422015-TRI5442015 respectively. The AQI can be viewed on the Air Quality Management Information System (AQMIS) website using the following link:

AQI Dashboard | AQMIS Cloud
http://ei.weblakes.com/RTTPublic/DshBrdAQI

8.1 AIR POLLUTANTS RECORDED AT MONITOR STATION: PORT OF SPAIN TRI5432015-TRI5452015 (MARCH 1ST, 2016 – SEPTEMBER 30, 2019)



Figure 8.1: Location of Monitor Station: Port of Spain TRI5432015-TRI5452015 (March 1st 2016 – October 09 2019)

Table 8.1: Air Pollutants Recorded at Monitor Station: Port of Spain TRI5432015-TRI5452015 (March 1st 2016 – October 09 2019)

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
1-Mar-16			16			
2-Mar-16			21			
3-Mar-16			21			
4-Mar-16			17			
5-Mar-16			26			
6-Mar-16			11			
7-Mar-16			10			
8-Mar-16			14			
9-Mar-16			14			
10-Mar-16			14			
11-Mar-16			29			
12-Mar-16			26			
13-Mar-16			16			
14-Mar-16			13			
15-Mar-16			14			
16-Mar-16			16			
17-Mar-16						
18-Mar-16			23			
19-Mar-16			17			
20-Mar-16			16			
21-Mar-16			17			
22-Mar-16			13			
23-Mar-16			16			
24-Mar-16			22		32	
25-Mar-16			30		15	
26-Mar-16			33		32	
27-Mar-16			25		34	

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
28-Mar-16			22		25	
29-Mar-16			8		23	
30-Mar-16			25		19	
31-Mar-16			15		48	
1-Apr-16			13		103	
2-Apr-16			19		36	
3-Apr-16			22		26	
4-Apr-16			10		26	
5-Apr-16			16		25	
6-Apr-16			16		83	
7-Apr-16			15		25	
8-Apr-16			18		22	
9-Apr-16			25		11	
10-Apr-16					20	
11-Apr-16			18		12	
12-Apr-16			21		96	
13-Apr-16			25		57	
14-Apr-16			29		43	
15-Apr-16			20		40	
16-Apr-16			15		31	
17-Apr-16						
18-Apr-16			16		36	
19-Apr-16			13		20	
20-Apr-16			14		52	
21-Apr-16			12		55	
22-Apr-16			4		53	
23-Apr-16			16		61	
24-Apr-16			14		58	
25-Apr-16			15		56	
26-Apr-16			9		53	

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
27-Apr-16			11			
28-Apr-16			12			
29-Apr-16			10			
30-Apr-16			12			
1-May-16			15		41	
2-May-16			10		47	
3-May-16			12		36	
4-May-16			13		20	
5-May-16			14		27	
6-May-16			11		36	
7-May-16			11			
8-May-16			15		44	
9-May-16			14		40	
10-May-16			18		18	
11-May-16			18		24	
12-May-16			13		21	
13-May-16			15			
14-May-16			34			
15-May-16					13	
16-May-16					17	
17-May-16					33	
18-May-16					31	
19-May-16					43	
20-May-16					34	
21-May-16					30	
22-May-16					29	
23-May-16					20	
24-May-16						
25-May-16						
26-May-16						

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
27-May-16						
28-May-16						
29-May-16						
30-May-16						
31-May-16						
1-Jul-16						
2-Jul-16						
3-Jul-16					25	
4-Jul-16					33	
5-Jul-16					47	
6-Jul-16					50	
7-Jul-16					43	
8-Jul-16						
9-Jul-16						
10-Jul-16					15	
11-Jul-16					28	
12-Jul-16						
13-Jul-16					19	
14-Jul-16					34	
15-Jul-16					31	
16-Jul-16					40	
17-Jul-16					30	
18-Jul-16					27	
19-Jul-16					25	
20-Jul-16					27	
21-Jul-16					31	
22-Jul-16						
23-Jul-16						
24-Jul-16						
25-Jul-16						

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
26-Jul-16					36	
27-Jul-16					159	
28-Jul-16					57	
29-Jul-16					34	
30-Jul-16					37	
31-Jul-16						
1-Aug-16						
2-Aug-16						
3-Aug-16						
4-Aug-16						
5-Aug-16						
6-Aug-16					128	
7-Aug-16					252	
8-Aug-16						
9-Aug-16						
10-Aug-16						
11-Aug-16						
12-Aug-16						
13-Aug-16						
14-Aug-16						
15-Aug-16						
16-Aug-16						
17-Aug-16						
18-Aug-16						
19-Aug-16						
20-Aug-16					160	
21-Aug-16						
22-Aug-16						
23-Aug-16						
24-Aug-16						

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
25-Aug-16					20	
26-Aug-16						
27-Aug-16						
28-Aug-16						
29-Aug-16					32	
30-Aug-16					43	
31-Aug-16					21	
1-Sep-16					20	
2-Sep-16					30	
3-Sep-16					58	
4-Sep-16					63	
5-Sep-16					27	
6-Sep-16					20	
7-Sep-16					49	
8-Sep-16					37	
9-Sep-16					30	
10-Sep-16						
11-Sep-16						
12-Sep-16						
13-Sep-16						
14-Sep-16						
15-Sep-16						
16-Sep-16					36	
17-Sep-16						
18-Sep-16						
19-Sep-16						
20-Sep-16						
21-Sep-16						
22-Sep-16						
23-Sep-16						

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
24-Sep-16						
25-Sep-16					21	
26-Sep-16					28	
27-Sep-16					25	
28-Sep-16					84	
29-Sep-16				17	17	0
30-Sep-16				32	51	
1-Oct-16				49	54	
2-Oct-16				24	25	
3-Oct-16				17	23	
4-Oct-16				19	26	
5-Oct-16				13	18	
6-Oct-16				11		
7-Oct-16				11	168	
8-Oct-16				40	50	
9-Oct-16				13	23	
10-Oct-16				18		
11-Oct-16				14	23	
12-Oct-16				8	14	
13-Oct-16				10	13	
14-Oct-16				15	84	
15-Oct-16			25	18	24	
16-Oct-16			20	13		
17-Oct-16			17	15	21	
18-Oct-16			23	18	16	
19-Oct-16				18		
20-Oct-16			9	14	20	
21-Oct-16			16	18		
22-Oct-16			13	16	21	
23-Oct-16			18	13	25	

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
24-Oct-16			17	18		
25-Oct-16			15	13		
26-Oct-16			18	14		
27-Oct-16				12	205	
28-Oct-16			15	12	13	
29-Oct-16			13	9	476	
30-Oct-16			14	9	338	
31-Oct-16			21	12	360	
31-Oct-16			21	12	360	
1-Nov-16			19	17		
2-Nov-16			13	18		
3-Nov-16			18			
4-Nov-16			10			
5-Nov-16			15			
6-Nov-16			24		22	
7-Nov-16			16		13	
8-Nov-16			11			
9-Nov-16			12		25	
10-Nov-16			8		15	
11-Nov-16			15	8	19	
12-Nov-16			8	7	15	
13-Nov-16			13	10	15	
14-Nov-16			17	10	10	
15-Nov-16			16	7	12	
16-Nov-16			22	9	26	
17-Nov-16				10	22	
18-Nov-16			15	12	25	2
19-Nov-16			10	14	28	
20-Nov-16			21	12	14	
21-Nov-16				8	15	

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
22-Nov-16			9	9	18	
23-Nov-16			13	13	25	
24-Nov-16			10	10	23	
25-Nov-16			3	5		
26-Nov-16			10	8	17	2
27-Nov-16			13	13	15	
28-Nov-16			14	18	29	0
29-Nov-16			9	20	28	0
30-Nov-16				15	19	
1-Dec-16				16	15	
2-Dec-16			18	14	21	
3-Dec-16				11	18	
4-Dec-16			15	11		2
5-Dec-16				10	21	5
6-Dec-16			13	9	15	
7-Dec-16			13	9	33	2
8-Dec-16			13	11	30	2
9-Dec-16			13	17	46	3
10-Dec-16			17	22	30	3
11-Dec-16			23	25	48	0
12-Dec-16			10	12	27	
13-Dec-16				18	34	3
14-Dec-16			16	18		3
15-Dec-16				14	47	5
16-Dec-16			15	15	20	3
17-Dec-16			17	18	32	3
18-Dec-16			25	28	75	0
19-Dec-16				23	34	2
20-Dec-16			23	19	52	
21-Dec-16			17	18	26	6

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
22-Dec-16			22	7	28	2
23-Dec-16			24	8	27	
24-Dec-16			16	9	18	
25-Dec-16			23	13	18	3
26-Dec-16				11	13	0
27-Dec-16			25	13	13	
28-Dec-16			18	8	15	2
29-Dec-16			15	9	18	2
30-Dec-16			13	7	11	3
31-Dec-16			22	12	20	2
1-Jan-17			29	15	15	
2-Jan-17			22	13	14	2
3-Jan-17			27	15	21	2
4-Jan-17				13	25	2
5-Jan-17			17	15	272	3
6-Jan-17			17	15		2
7-Jan-17			24	44		2
8-Jan-17			25	22		
9-Jan-17				13		
10-Jan-17			24	8		0
11-Jan-17			18	4	273	3
12-Jan-17			24	9	25	2
13-Jan-17				8	13	2
14-Jan-17			36	8	18	2
15-Jan-17			31		12	2
16-Jan-17			25			
17-Jan-17			15	9	13	
18-Jan-17			24	7	19	
19-Jan-17			18	11	41	
20-Jan-17			13	10	23	2

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
21-Jan-17			11	7	10	2
22-Jan-17				7		2
23-Jan-17			13	10	90	2
24-Jan-17			19	19	40	2
25-Jan-17				19	25	
26-Jan-17			19	14	14	
27-Jan-17				15	30	
28-Jan-17			18	16	17	2
29-Jan-17			22	18	23	2
30-Jan-17			28	22	21	2
31-Jan-17			20	14	18	2
29-Jan-17			22	18	23	2
30-Jan-17			28	22	21	2
31-Jan-17			20	14	18	2
1-Feb-17			26	20	26	
2-Feb-17				24	29	0
3-Feb-17			25	24	18	2
4-Feb-17			25	22	29	0
5-Feb-17				17	25	
6-Feb-17			21	18	26	
7-Feb-17			26	21	28	2
8-Feb-17			27	38	49	2
9-Feb-17			28	34	40	0
10-Feb-17			22	21	16	
11-Feb-17			25	19		2
12-Feb-17			28	13		0
13-Feb-17			21	10	9	2
14-Feb-17			24	11	20	0
15-Feb-17			22	13	19	
16-Feb-17			17	13	21	0

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
17-Feb-17			20	14		2
18-Feb-17			21	13	13	0
19-Feb-17			15	11	18	0
20-Feb-17			20	11	18	2
21-Feb-17			35	15	25	3
22-Feb-17				13	20	0
23-Feb-17			36	17	24	
24-Feb-17			20	16	25	
25-Feb-17			18	19	137	
26-Feb-17			16	19	31	2
27-Feb-17			17	11	23	2
28-Feb-17			20	8	20	
1-Mar-17			25	15	11	
2-Mar-17			27	19	25	0
3-Mar-17			24	18	18	0
4-Mar-17			21	20	26	0
5-Mar-17			25	18	28	0
6-Mar-17				18	31	0
7-Mar-17			20	17	84	
8-Mar-17			25	16	23	0
9-Mar-17			21	15	27	
10-Mar-17			21	27		0
11-Mar-17			28	39		0
12-Mar-17			32	28	37	0
13-Mar-17			25	14	20	0
14-Mar-17			25	16	20	0
15-Mar-17			28	13	14	2
16-Mar-17				18	23	
17-Mar-17			25	26	33	0
18-Mar-17			29	24		0

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
19-Mar-17			39	20		0
20-Mar-17			22	17	403	0
21-Mar-17			19	25		2
22-Mar-17			15	16		0
23-Mar-17			21		491	0
24-Mar-17						
25-Mar-17						
26-Mar-17						
27-Mar-17			20		338	
28-Mar-17			20		406	
29-Mar-17			23		22	
30-Mar-17			20		17	2
31-Mar-17					18	2
31-Mar-17					18	2
1-Apr-17			21		60	
2-Apr-17			23		68	2
3-Apr-17			18		67	
4-Apr-17			16		66	2
5-Apr-17			17			2
6-Apr-17			19		53	2
7-Apr-17			21	32	39	2
8-Apr-17			23	38	52	3
9-Apr-17			26	38	52	2
10-Apr-17			26	19	25	2
11-Apr-17			26	18	31	
12-Apr-17			27	17	33	2
13-Apr-17			14	23	89	
14-Apr-17			20	42	55	0
15-Apr-17			25	48	56	2
16-Apr-17			23	59	65	

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
17-Apr-17			25	55	63	0
18-Apr-17			20	50	58	2
19-Apr-17			21	54	62	2
20-Apr-17				52		0
21-Apr-17			25	42		
22-Apr-17				29		0
23-Apr-17			21	33		2
24-Apr-17			18	36	37	2
25-Apr-17			19	52	61	2
26-Apr-17			21	60	64	
27-Apr-17			19	44	50	0
28-Apr-17			21	44	54	2
29-Apr-17			20	34	42	2
30-Apr-17			24	33	48	0
1-May-17			18	32	36	2
2-May-17			14	27	40	2
3-May-17			19	31	45	0
4-May-17			21	38	53	
5-May-17			20	35	47	
6-May-17			16	23	41	0
7-May-17			18	29	42	2
8-May-17			14	28	40	2
9-May-17			16	21	35	
10-May-17			14	21	36	2
11-May-17			15	17	28	2
12-May-17			13	5	17	2
13-May-17			12	51	59	0
14-May-17			13	25	41	0
15-May-17			15	68	63	2
16-May-17			16	75	56	2

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
17-May-17			21	39	48	2
18-May-17			13	53	58	2
19-May-17			19	46	55	2
20-May-17			21	50	55	0
21-May-17			17	64	43	0
22-May-17			14	73	66	0
23-May-17			17	24	38	
24-May-17			18	50		2
25-May-17			11	63	63	0
26-May-17			11	52	60	0
27-May-17			17	24	36	0
28-May-17			13	12	22	0
29-May-17			10	31	42	0
30-May-17			13	40	49	2
31-May-17			14	31	53	
1-Jun-17				41	41	
2-Jun-17			9	11	132	0
3-Jun-17			14	7	338	2
4-Jun-17			12	13		0
5-Jun-17				13	403	2
6-Jun-17			10	25		2
7-Jun-17			12	32		2
8-Jun-17			12	26		
9-Jun-17			13	19	476	2
10-Jun-17			13		338	
11-Jun-17			15			0
12-Jun-17			14		447	0
13-Jun-17			10		382	2
14-Jun-17			12			0
15-Jun-17			13			2

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
16-Jun-17						2
17-Jun-17			10			2
18-Jun-17			13		338	
19-Jun-17			10			2
20-Jun-17			13		360	2
21-Jun-17			11			2
22-Jun-17			13		476	2
23-Jun-17			8		382	2
24-Jun-17			12			2
25-Jun-17			10			
26-Jun-17			12			2
27-Jun-17			13			2
28-Jun-17			10		382	
29-Jun-17			13			
30-Jun-17						
1-Jul-17						2
2-Jul-17			14			2
3-Jul-17			11			
4-Jul-17			11			0
5-Jul-17			11			0
6-Jul-17			14			2
7-Jul-17			9			2
8-Jul-17			12			
9-Jul-17			12			2
10-Jul-17			9		346	2
11-Jul-17			13	33	161	
12-Jul-17			7	22	296	0
13-Jul-17			8	20		0
14-Jul-17			10	16		2
15-Jul-17			17	10		

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
16-Jul-17			17	15		2
17-Jul-17			17	17		2
18-Jul-17			6	13		2
19-Jul-17			13	11		2
20-Jul-17				25		2
21-Jul-17			8	17		2
22-Jul-17			12	9		2
23-Jul-17				9		2
24-Jul-17				11	462	2
25-Jul-17			9	9		
26-Jul-17				9		
27-Jul-17			16	9		2
28-Jul-17			12	11		
29-Jul-17			16	16		2
30-Jul-17			14	13		2
31-Jul-17			13	11		2
1-Aug-17			17	25		2
2-Aug-17			13	16		2
3-Aug-17				8	338	2
4-Aug-17			29	8		
5-Aug-17			12	11	360	2
6-Aug-17			16	12	418	2
7-Aug-17			16	6	360	2
8-Aug-17			7	14		3
9-Aug-17			6	11		2
10-Aug-17			12	11		
11-Aug-17			5	23	384	2
12-Aug-17			8	20	34	
13-Aug-17			8	10	21	2
14-Aug-17			19	11	20	

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
15-Aug-17			10	37		2
16-Aug-17			10	33	53	2
17-Aug-17				12	30	
18-Aug-17				24	43	2
19-Aug-17				11	23	
20-Aug-17			11	6	20	2
21-Aug-17				8	24	
22-Aug-17			16	12		2
23-Aug-17			16	11		3
24-Aug-17			12	19	31	2
25-Aug-17			11	29	45	3
26-Aug-17			12	16	89	33
27-Aug-17			16	8	18	2
28-Aug-17				13	30	2
29-Aug-17			8	14	31	2
30-Aug-17			6	14	35	2
31-Aug-17			9	10	28	
1-Sep-17			12	14	20	
2-Sep-17			11	15	33	2
3-Sep-17			13	8	23	2
4-Sep-17			15	9	28	3
5-Sep-17			17	9	27	2
6-Sep-17			20	7	18	2
7-Sep-17			20		28	2
8-Sep-17			8	12	18	2
9-Sep-17			14	11	26	
10-Sep-17			16		25	
11-Sep-17			10			
12-Sep-17			15		13	0
13-Sep-17			21		18	

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
14-Sep-17			25		20	2
15-Sep-17			14		9	2
16-Sep-17			12			2
17-Sep-17			11		22	2
18-Sep-17					31	2
19-Sep-17			16		25	2
20-Sep-17			13		20	2
21-Sep-17			9		15	2
22-Sep-17			6		16	
23-Sep-17			8		8	
24-Sep-17			11		10	
25-Sep-17					38	
26-Sep-17					72	
27-Sep-17					41	
28-Sep-17			10		126	
29-Sep-17			6	20	18	
30-Sep-17			10	18	126	
1-Oct-17			11	13		
2-Oct-17			5	13		
3-Oct-17				13		0
4-Oct-17			8	17	270	0
5-Oct-17			11	15	11	
6-Oct-17			13	13	10	
7-Oct-17			5	8	6	
8-Oct-17			19	12	12	
9-Oct-17			13	13	12	
10-Oct-17				12	18	
11-Oct-17			13	13	17	
12-Oct-17				40	42	
13-Oct-17				37	37	

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
14-Oct-17				13	12	0
15-Oct-17			6	13	417	0
16-Oct-17				12	360	0
17-Oct-17			4	10		0
18-Oct-17			6	8		0
19-Oct-17			13	10		
20-Oct-17			6	25		0
21-Oct-17			5	24		
22-Oct-17			8	11		2
23-Oct-17			4	11		0
24-Oct-17			6	12		
25-Oct-17			8	16	382	2
26-Oct-17			13	13		0
27-Oct-17			8	12		0
28-Oct-17			3	11		2
29-Oct-17			4	19		0
30-Oct-17			2	11		
31-Oct-17				11		2
1-Nov-17				15	403	0
2-Nov-17				13	10	0
3-Nov-17				10	8	2
4-Nov-17			8	11	8	0
5-Nov-17				9		
6-Nov-17				11	10	2
7-Nov-17				24	22	0
8-Nov-17			8	52	52	0
9-Nov-17			8	41	45	0
10-Nov-17				21	24	
11-Nov-17				21	23	2
12-Nov-17			6	19	21	0

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
13-Nov-17				16	17	0
14-Nov-17				11	9	
15-Nov-17				10	12	0
16-Nov-17				13	10	0
17-Nov-17			3	13	12	0
18-Nov-17				13	15	0
19-Nov-17			7	30	35	
20-Nov-17				23	28	
21-Nov-17				11	18	0
22-Nov-17				22	23	0
23-Nov-17					20	0
24-Nov-17					15	0
25-Nov-17				12	15	
26-Nov-17				12	11	
27-Nov-17				15	11	
28-Nov-17				18	16	0
29-Nov-17			6	13	20	
30-Nov-17				10	10	
1-Dec-17				24	26	
2-Dec-17				38	44	
3-Dec-17				19	28	
4-Dec-17			7		15	
5-Dec-17					25	
6-Dec-17			7		49	
7-Dec-17			8		34	
8-Dec-17					27	
9-Dec-17					20	
10-Dec-17			13		8	
11-Dec-17			16		17	
12-Dec-17					8	

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
13-Dec-17					29	0
14-Dec-17						0
15-Dec-17			9		23	0
16-Dec-17			6		13	
17-Dec-17					17	0
18-Dec-17					157	5
19-Dec-17			4		14	3
20-Dec-17					6	2
21-Dec-17					20	2
22-Dec-17			5		82	0
23-Dec-17			6		13	0
24-Dec-17			10		14	
25-Dec-17			8		10	
26-Dec-17					14	0
27-Dec-17			8			0
28-Dec-17					16	0
29-Dec-17					11	0
30-Dec-17			3			
1-Jan-18			19		65	0
2-Jan-18			13		40	2
3-Jan-18			10		33	0
4-Jan-18			10		33	0
5-Jan-18			8		20	0
6-Jan-18					43	
7-Jan-18			12		38	0
8-Jan-18			9		28	2
9-Jan-18					33	0
10-Jan-18			9		18	0
11-Jan-18					12	
12-Jan-18					19	2

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
13-Jan-18			7		17	0
14-Jan-18			15		20	0
15-Jan-18			3		24	2
16-Jan-18					27	0
17-Jan-18			6			5
18-Jan-18			7			2
19-Jan-18			8			2
20-Jan-18			8			0
21-Jan-18			12		403	0
22-Jan-18						2
23-Jan-18			6			
24-Jan-18					18	2
25-Jan-18			3		17	2
26-Jan-18			13		360	2
27-Jan-18			8			0
28-Jan-18			12			
29-Jan-18			11			
30-Jan-18			8		302	0
31-Jan-18					28	0
1-Feb-18					18	0
2-Feb-18			8		15	0
3-Feb-18			16		14	0
4-Feb-18			20		17	
5-Feb-18			9		22	0
6-Feb-18			13		25	0
7-Feb-18			13			0
8-Feb-18			13		23	
9-Feb-18			13		85	
10-Feb-18			13		13	
11-Feb-18			16		27	

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
12-Feb-18			15			
13-Feb-18			16		22	
14-Feb-18			14		21	
15-Feb-18					25	
16-Feb-18			17		24	
17-Feb-18			13			
18-Feb-18					23	
19-Feb-18					20	
20-Feb-18					12	0
21-Feb-18					18	0
22-Feb-18			9		12	0
23-Feb-18			7			0
24-Feb-18			5			
25-Feb-18			16			
26-Feb-18			14		17	0
27-Feb-18			5		20	2
28-Feb-18			12		11	
1-Mar-18			10		18	
2-Mar-18			4			2
3-Mar-18			13		20	0
4-Mar-18					25	0
5-Mar-18					20	
6-Mar-18					25	
7-Mar-18			5		42	0
8-Mar-18			6		38	0
9-Mar-18			8		30	0
10-Mar-18			13		29	0
11-Mar-18						0
12-Mar-18			12		34	0
13-Mar-18			14		31	0

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
14-Mar-18			12		33	0
15-Mar-18			13		32	0
16-Mar-18			12		18	0
17-Mar-18			14		44	0
18-Mar-18					35	0
19-Mar-18			13		28	0
20-Mar-18			10		26	
21-Mar-18			3		86	
22-Mar-18			13		35	
23-Mar-18			10		32	
24-Mar-18			12		29	
25-Mar-18			6		27	
26-Mar-18					38	
27-Mar-18			10		43	
28-Mar-18			12		68	
29-Mar-18			14		60	
30-Mar-18			15		52	
31-Mar-18			12		25	
1-Apr-18					43	0
2-Apr-18			10		40	0
3-Apr-18			2		37	0
4-Apr-18			5		33	0
5-Apr-18			6		38	0
6-Apr-18					40	
7-Apr-18					42	0
8-Apr-18						0
9-Apr-18			12		20	0
10-Apr-18			5		16	0
11-Apr-18			10		26	0
12-Apr-18					27	108

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
13-Apr-18			6		296	
14-Apr-18			5			
15-Apr-18						
16-Apr-18					382	
17-Apr-18			2		476	
18-Apr-18			1			
19-Apr-18						
20-Apr-18						
21-Apr-18					338	
22-Apr-18						
23-Apr-18					297	
24-Apr-18					13	0
25-Apr-18					27	
26-Apr-18						
27-Apr-18					18	
28-Apr-18					29	
29-Apr-18					33	
30-Apr-18					48	
1-May-18					43	
2-May-18			16		45	
3-May-18			17		43	
4-May-18			15		40	
5-May-18			17		39	
6-May-18			16		29	
7-May-18			18		32	
8-May-18			14		30	
9-May-18			11		15	
10-May-18					28	
11-May-18			17			
12-May-18			16			

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
13-May-18			17			
14-May-18			15		21	
15-May-18					33	
16-May-18			15		35	
17-May-18			21			
18-May-18			19			
19-May-18			12			
20-May-18			11			
21-May-18			15		30	
22-May-18					86	
23-May-18			14		30	
24-May-18			14		28	
25-May-18			13		27	
26-May-18			11			
27-May-18			16			
28-May-18			15			
29-May-18			22		32	
30-May-18			19		42	
31-May-18			20		28	
1-Jun-18			11			
2-Jun-18			16		50	
3-Jun-18			19		40	
4-Jun-18			13		28	
5-Jun-18			13		52	
6-Jun-18			13		57	
7-Jun-18			11		53	
8-Jun-18			13		114	
9-Jun-18			15		52	
10-Jun-18					26	
11-Jun-18			12		43	

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
12-Jun-18			12		65	
13-Jun-18			12		40	
14-Jun-18					42	
15-Jun-18			11		29	
16-Jun-18			8			
17-Jun-18			13			
18-Jun-18			6		81	
19-Jun-18			13		22	
20-Jun-18					33	
21-Jun-18			5		30	
22-Jun-18			10		31	
23-Jun-18			12		50	
24-Jun-18			13			
25-Jun-18			11		31	
26-Jun-18			10		49	
27-Jun-18			14			
28-Jun-18			15		19	
29-Jun-18			6		104	
30-Jun-18			7		28	
1-Jul-18			9		25	
2-Jul-18			9		44	
3-Jul-18			9		37	
4-Jul-18			8			
5-Jul-18			12		43	
6-Jul-18					128	
7-Jul-18					85	
8-Jul-18					83	
9-Jul-18						
10-Jul-18						
11-Jul-18						

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
12-Jul-18						
13-Jul-18						
14-Jul-18						
15-Jul-18						
16-Jul-18						
17-Jul-18						
18-Jul-18				12		
19-Jul-18				27		
20-Jul-18				37		
21-Jul-18				27		
22-Jul-18				18		
23-Jul-18				13		
24-Jul-18				10		
25-Jul-18				53		
26-Jul-18				41		
27-Jul-18				13		
28-Jul-18				18		
29-Jul-18				22		
30-Jul-18				16		
31-Jul-18				12		
1-Aug-18				13		
2-Aug-18				19		
3-Aug-18				21	209	
4-Aug-18		7		13		8
5-Aug-18		7		12	418	8
6-Aug-18		6	8	36	194	
7-Aug-18		4	9	50	28	8
8-Aug-18		6	6	33		8
9-Aug-18		5		21	32	8
10-Aug-18		6	10	19	32	8

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
11-Aug-18		6		13	26	8
12-Aug-18		6	13	47	54	8
13-Aug-18		5	6	23	32	8
14-Aug-18		4		14	15	8
15-Aug-18		8	18	31		9
16-Aug-18		5	12	17	28	8
17-Aug-18		6	9	16	29	8
18-Aug-18		5	19	8		8
19-Aug-18		5	13	13	26	8
20-Aug-18		5	8	12	22	9
21-Aug-18		6	2	11	135	9
22-Aug-18		4	8	13	21	6
23-Aug-18		4	5	12	12	
24-Aug-18		6	9	20	29	
25-Aug-18		7	15	12	24	
26-Aug-18		5	18	12	25	8
27-Aug-18		4	20	11	15	8
28-Aug-18		4	5	11	24	
29-Aug-18		4	9	15	27	8
30-Aug-18		4	13	49	23	8
31-Aug-18		5	7	20	35	
1-Sep-18		4	15	18	30	8
2-Sep-18		4	23	13	24	8
3-Sep-18		4		14	21	8
4-Sep-18		3		17	18	8
5-Sep-18		4	11	31	35	9
6-Sep-18		4	10	15	28	8
7-Sep-18		4	7	14	25	8
8-Sep-18		4		8	13	
9-Sep-18		6	9		16	9

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
10-Sep-18		6			24	9
11-Sep-18		8	11		33	9
12-Sep-18		3	8	4	13	171
13-Sep-18		5	13	9	13	8
14-Sep-18		3	11	14	28	8
15-Sep-18		4	12	10	23	8
16-Sep-18		3	8	15		8
17-Sep-18		4	9	15	27	
18-Sep-18		4		11	20	
19-Sep-18		3	12	10	134	114
20-Sep-18		7	11	59	68	8
21-Sep-18		5		29	43	
22-Sep-18		3	10	14		
23-Sep-18		4	33	13	20	8
24-Sep-18		4		10	23	
25-Sep-18		5	6	12	25	8
26-Sep-18		5	6	34	40	8
27-Sep-18		5	12	14	15	
28-Sep-18		4	9	17	31	8
29-Sep-18		4		35	45	8
30-Sep-18		6	8		26	8
1-Oct-18		3	9		27	8
2-Oct-18		6	7		33	8
3-Oct-18		5	4		27	8
4-Oct-18		2	12		28	8
5-Oct-18		7	10		25	8
6-Oct-18		5	10		15	8
7-Oct-18		6	12		20	
8-Oct-18		4			15	8
9-Oct-18		3	3			8

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
10-Oct-18		6	5		25	9
11-Oct-18		7	10		25	8
12-Oct-18		8	10		25	8
13-Oct-18		8	14		25	
14-Oct-18		5	13			8
15-Oct-18		3	5		403	8
16-Oct-18		4	4		336	
17-Oct-18		5		7	13	8
18-Oct-18		4		8	18	9
19-Oct-18		9		12		9
20-Oct-18		9	9	9	19	8
21-Oct-18		4	12	10	19	
22-Oct-18		4		11	19	8
23-Oct-18		4	11	11	23	
24-Oct-18		4	11	13	382	8
25-Oct-18		5	12	10		8
26-Oct-18		5	12	13		
27-Oct-18		4	11	9		8
28-Oct-18		4	13	4	403	8
29-Oct-18		4	13	9	476	
30-Oct-18		6	9	8		8
31-Oct-18		5		11	336	
1-Nov-18		7	9	21	30	9
2-Nov-18		4	6	11	19	8
3-Nov-18		5	10	13	80	8
4-Nov-18		5	13	11	18	9
5-Nov-18		5	4	11		8
6-Nov-18		2		7	15	8
7-Nov-18		3	6	9	13	
8-Nov-18		3	8	11	11	8

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
9-Nov-18		3	5	11	19	8
10-Nov-18		5	8	9	19	8
11-Nov-18			15	4	16	8
12-Nov-18		3	4	8	9	8
13-Nov-18		4	6	8	18	8
14-Nov-18		5	8	13	23	8
15-Nov-18		5	13	11	23	8
16-Nov-18		5		19	30	8
17-Nov-18		4	13	14	15	8
18-Nov-18		4	13	13		
19-Nov-18		5	11	11	18	12
20-Nov-18		4	12	9	13	8
21-Nov-18		4	15	13	11	8
22-Nov-18		4		12	20	8
23-Nov-18		6	13	12	17	8
24-Nov-18		4	13	12		8
25-Nov-18		5		13	21	
26-Nov-18		4		13	20	
27-Nov-18		4	11	8	14	
28-Nov-18		4	14	11	19	8
29-Nov-18		5	13	19	31	8
30-Nov-18		5	11	18	18	9
1-Dec-18		8	13	8	22	8
2-Dec-18		5		8	20	8
3-Dec-18		5	12	13		8
4-Dec-18		5	12	22	31	8
5-Dec-18		6	13	22	29	
6-Dec-18		4	16	12	20	8
7-Dec-18		7	12	9	19	9
8-Dec-18		6	15	15	22	8

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
9-Dec-18		4		12	18	8
10-Dec-18		6		16	15	8
11-Dec-18		5	13	10	10	
12-Dec-18		4	12	17	14	
13-Dec-18		7	18	16	26	8
14-Dec-18		6	14	15	28	8
15-Dec-18		5	20	14	13	8
16-Dec-18		5	20	13	12	8
17-Dec-18		6		12	15	
18-Dec-18		5	19	13	15	8
19-Dec-18		8	6	10	19	
20-Dec-18		3		13	14	9
21-Dec-18		4	13	22	86	78
22-Dec-18		7	13	12	20	
23-Dec-18		4	23	11	18	8
24-Dec-18		5	20	14	20	8
25-Dec-18		5	21	12	15	8
26-Dec-18		4		15	14	10
27-Dec-18		3		20	24	
28-Dec-18		4	24	13	17	8
29-Dec-18		3	20	11	18	8
30-Dec-18		3	26	15	18	
31-Dec-18		5	20	13	19	8
1-Jan-19		7	26	8	17	8
2-Jan-19		4	16		14	8
3-Jan-19			15		77	
4-Jan-19		7		11	13	
5-Jan-19		7		10	18	
6-Jan-19		4		19		8
7-Jan-19		6	16	33	38	

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
8-Jan-19		7	13	25	38	9
9-Jan-19		5	13	22	22	12
10-Jan-19		3	16	25	39	
11-Jan-19		7	15	35	44	8
12-Jan-19		6	17	19	33	
13-Jan-19		5	16	12		10
14-Jan-19		5	17	9		8
15-Jan-19		5	14	15	18	9
16-Jan-19		6	8	17	27	10
17-Jan-19		5	12	14	447	8
18-Jan-19		13	13	15		9
19-Jan-19		8	14	11		
20-Jan-19		10	20	16		9
21-Jan-19			19	21		8
22-Jan-19		11		18	297	
23-Jan-19	0	13	15	13	16	8
24-Jan-19	0	11	18	13	19	
25-Jan-19	0	16	21	13	18	9
26-Jan-19	0	12	18	8	14	8
27-Jan-19	0	10	24	9	19	8
28-Jan-19	0	9	18	9	14	9
29-Jan-19	0	16	21	10	15	9
30-Jan-19	0	12	26	9	20	9
31-Jan-19	0	12	25	10	19	
1-Feb-19	0	16	27	11	16	9
2-Feb-19	0	15	28	9	17	8
3-Feb-19	0	10	32	8	10	
4-Feb-19	0	12		11	23	
5-Feb-19	0	9	13	13	18	9
6-Feb-19	0	10	18	13	23	9

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
7-Feb-19	0	12	19	15	22	9
8-Feb-19	0	11	11	14	79	
9-Feb-19				7	18	8
10-Feb-19			22	6	16	8
11-Feb-19			19	14	28	
12-Feb-19			16		47	9
13-Feb-19						
14-Feb-19						
15-Feb-19						
16-Feb-19						
17-Feb-19						
18-Feb-19						
19-Feb-19						
20-Feb-19						
21-Feb-19						
22-Feb-19			9		15	13
23-Feb-19			9		18	10
24-Feb-19			19		19	10
25-Feb-19			12			45
26-Feb-19			13			
27-Feb-19			14		31	10
28-Feb-19			14		24	
1-Mar-19			11		36	10
2-Mar-19					40	
3-Mar-19			16		38	10
4-Mar-19			16		43	10
5-Mar-19			17		34	10
6-Mar-19			18		35	10
7-Mar-19			18		53	10
8-Mar-19			13		30	10

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
9-Mar-19			16		25	10
10-Mar-19			14		15	
11-Mar-19			13		26	10
12-Mar-19			10		18	10
13-Mar-19			11		27	10
14-Mar-19			15		20	10
15-Mar-19			13			
16-Mar-19			14		45	
17-Mar-19			22		87	10
18-Mar-19			16		69	10
19-Mar-19			14		62	10
20-Mar-19			15		44	13
21-Mar-19					50	10
22-Mar-19			17		35	
23-Mar-19			20		35	
24-Mar-19			25			
25-Mar-19			21		32	12
26-Mar-19			22		25	10
27-Mar-19			13		15	10
28-Mar-19			15		16	12
29-Mar-19			13		13	10
30-Mar-19					23	
31-Mar-19			16		25	
1-Apr-19			17		26	12
2-Apr-19			16		11	12
3-Apr-19			13		14	12
4-Apr-19			21		13	
5-Apr-19			17		20	12
6-Apr-19			22		18	
7-Apr-19			33			

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
8-Apr-19			25			
9-Apr-19			25		15	12
10-Apr-19			26		23	12
11-Apr-19			24		27	12
12-Apr-19			21		28	13
13-Apr-19			15		292	12
14-Apr-19			17		382	12
15-Apr-19			18			12
16-Apr-19			16			13
17-Apr-19			13		359	12
18-Apr-19			13			13
19-Apr-19			18		26	13
20-Apr-19			16		32	13
21-Apr-19			16		30	13
22-Apr-19			16		25	13
23-Apr-19			16		25	
24-Apr-19			13		20	
25-Apr-19					30	
26-Apr-19			13		40	13
27-Apr-19			16		33	13
28-Apr-19			16		33	13
29-Apr-19			13		28	
30-Apr-19			12		18	
1-May-19			13		30	
2-May-19			13		23	
3-May-19			13		29	13
4-May-19			13		31	13
5-May-19			16		34	13
6-May-19			15		35	13
7-May-19			14		28	13

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
8-May-19			13		29	
9-May-19			15		41	
10-May-19			12			13
11-May-19			16		48	
12-May-19			19		41	13
13-May-19			15		40	13
14-May-19			12		40	13
15-May-19			15		89	13
16-May-19			13		34	13
17-May-19			13	29	163	13
18-May-19		9	16	46	33	2
19-May-19		18	18	47	41	0
20-May-19			11	44	89	
21-May-19						
22-May-19						
23-May-19			10	72	47	
24-May-19		8	8	82	365	
25-May-19		5	5	42		
26-May-19		9		28		
27-May-19		14		53		
28-May-19	0	8		52	25	
29-May-19	0	8	4	76	44	
30-May-19		14	5	69	46	
31-May-19		8		95	97	
1-Jun-19		14		38	33	
2-Jun-19		7		27	18	
3-Jun-19		6		54	30	
4-Jun-19		7	5	89	54	
5-Jun-19		6	4	70	32	
6-Jun-19		9		92	43	

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
7-Jun-19		8		82	49	
8-Jun-19	0	7		81	73	
9-Jun-19		6	1	40	33	
10-Jun-19		8	5	72	40	
11-Jun-19	0	8		71	45	
12-Jun-19	0	9		74	42	
13-Jun-19	0	10		54	34	
14-Jun-19	0	6		74	43	
15-Jun-19	0	6		40	27	
16-Jun-19	0	6		71	38	
17-Jun-19	0	11		18	22	
18-Jun-19	0	9		25	25	
19-Jun-19	0	9	3	25	21	
20-Jun-19	0	7		61	33	
21-Jun-19	0	5		95	57	
22-Jun-19	0	9		49	28	
23-Jun-19	0	10		26	26	0
24-Jun-19	0	7		59	34	2
25-Jun-19	0	10		73	41	0
26-Jun-19	0	9	9	69		2
27-Jun-19	0	11	15	61	21	0
28-Jun-19	0	9	7	34	24	2
29-Jun-19	0	8	7	81	48	2
30-Jun-19	0	10	7	66	40	0
1-Jul-19	0	15	6	53	30	0
2-Jul-19	0	10		55	32	2
3-Jul-19	0	9	8	64	37	0
4-Jul-19	0	15	11	25	20	0
5-Jul-19	0	14		52	28	2
6-Jul-19	0	9		68	39	2

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
7-Jul-19	0	11		53	30	0
8-Jul-19	0	9		58	28	0
9-Jul-19	0	8	8	26	17	2
10-Jul-19	0	8		76	43	2
11-Jul-19	0	11		68		
12-Jul-19	0	10	16	40		0
13-Jul-19	0	7	13	16		2
14-Jul-19	0	15		50		2
15-Jul-19	0	8	13	36	18	0
16-Jul-19	0	10	18	34	22	
17-Jul-19	0	39	13	36	25	0
18-Jul-19	0	7	12	36	23	0
19-Jul-19	0	11	13	65	39	2
20-Jul-19	0	9	16	47		0
21-Jul-19	0	8	13	29		0
22-Jul-19	0	9		35		0
23-Jul-19	0	6	9	75	29	0
24-Jul-19	0	8		52	35	2
25-Jul-19	0	8	16	42	30	2
26-Jul-19	0	11	15	57	37	0
27-Jul-19	0	57	13	50	34	0
28-Jul-19	0	8	19	20	24	0
29-Jul-19				23	21	0
30-Jul-19				23	21	2
31-Jul-19			14	59	37	0
1-Aug-19			17	53	40	0
2-Aug-19				44	35	0
3-Aug-19			13	26	26	2
4-Aug-19			13	16	21	0
5-Aug-19			18		18	0

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
6-Aug-19					24	0
7-Aug-19			14		20	0
8-Aug-19	0	15	24	23	25	0
9-Aug-19	0	13	13	39	26	2
10-Aug-19	0	7		46	35	2
11-Aug-19	0	9		29	29	2
12-Aug-19	0	7		31	490	3
13-Aug-19	0	9		38		2
14-Aug-19	0	11	6	30		2
15-Aug-19	0	7		33		2
16-Aug-19	0	10		86		0
17-Aug-19	0	11		38		2
18-Aug-19	0	11	8	17		0
19-Aug-19	0	11	23	21		0
20-Aug-19	0	9		54		0
21-Aug-19	0	12	9	54		2
22-Aug-19	0	9		45		2
23-Aug-19	0	10	10	49		2
24-Aug-19	0	10	10	37		2
25-Aug-19	0	15	12	62		2
26-Aug-19			12	75	382	2
27-Aug-19			18	38		0
28-Aug-19			14	28		2
29-Aug-19			12	38		2
30-Aug-19					319	
31-Aug-19						
1-Sep-19						
2-Sep-19						
3-Sep-19						
4-Sep-19						

Date:	CO	NO2	O3	PM-10	PM-2.5	SO2
5-Sep-19						
6-Sep-19						
7-Sep-19						
8-Sep-19						
9-Sep-19						
10-Sep-19						
11-Sep-19						
12-Sep-19						
13-Sep-19						
14-Sep-19						
15-Sep-19						
16-Sep-19						
17-Sep-19						
18-Sep-19						
19-Sep-19				16		
20-Sep-19	0	9		30		
21-Sep-19	0	12		25		
22-Sep-19	0	8		7		
23-Sep-19	0	6		16		
24-Sep-19	0	9		16		
25-Sep-19	0	8		55		
26-Sep-19	0	7		55		
27-Sep-19	0	8		33		
28-Sep-19	0	6		35		
29-Sep-19	0	5		43		
30-Sep-19	0	10		34		

8.2 AIR POLLUTANTS RECORDED AT MONITOR STATION: CHAGUANAS TRI5422015-TRI5442015 (MARCH 1ST, 2016 – SEPTEMBER 30, 2019)



Figure 8.2: Location of Monitor Station: Chaguanas TRI5422015-TRI5442015

Table 8.2: Air Pollutants Recorded at Monitor Station: Chaguanas TRI5422015-TRI5442015 (MARCH 1ST 2016 – SEPTEMBER 30 2019)

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
2-Mar-16	N/A	12	13	N/A	N/A	N/A
3-Mar-16	N/A	12	11	N/A	N/A	N/A
4-Mar-16	N/A	13	12	N/A	N/A	N/A
5-Mar-16	N/A	12	13	N/A	N/A	N/A
6-Mar-16	N/A	6	10	N/A	N/A	N/A
7-Mar-16	N/A	11	8	N/A	N/A	N/A
8-Mar-16	N/A	N/A	10	N/A	N/A	N/A
9-Mar-16	N/A	13	13	N/A	N/A	N/A
10-Mar-16	N/A	12	8	N/A	N/A	N/A
11-Mar-16	N/A	18	19	N/A	N/A	N/A
12-Mar-16	N/A	13	30	N/A	N/A	N/A
13-Mar-16	N/A	8	9	N/A	N/A	N/A
14-Mar-16	N/A	9	5	N/A	N/A	N/A
15-Mar-16	N/A	N/A	8	N/A	N/A	N/A
16-Mar-16	N/A	N/A	8	N/A	N/A	N/A
17-Mar-16	N/A	11	11	21	N/A	N/A
18-Mar-16	N/A	N/A	10	N/A	N/A	N/A
19-Mar-16	N/A	10	12	46	N/A	N/A
20-Mar-16	N/A	N/A	18	97	N/A	N/A
21-Mar-16	N/A	N/A	10	38	N/A	N/A
22-Mar-16	N/A	9	7	45	N/A	N/A
23-Mar-16	N/A	10	N/A	54	N/A	N/A
24-Mar-16	N/A	16	14	99	N/A	N/A
25-Mar-16	N/A	14	N/A	35	29	N/A
26-Mar-16	N/A	16	25	56	29	N/A
27-Mar-16	N/A	14	22	54	35	N/A
28-Mar-16	N/A	15	N/A	53	45	N/A
29-Mar-16	N/A	14	13	53	28	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
30-Mar-16	N/A	N/A	15	25	10	N/A
31-Mar-16	N/A	12	11	56	24	N/A
1-Apr-16	N/A	11	10	66	39	N/A
2-Apr-16	N/A	12	13	55	20	N/A
3-Apr-16	N/A	11	16	39	16	N/A
4-Apr-16	N/A	14	13	N/A	17	N/A
5-Apr-16	N/A	12	13	N/A	N/A	N/A
6-Apr-16	N/A	11	10	N/A	N/A	N/A
7-Apr-16	N/A	14	12	N/A	8	N/A
8-Apr-16	N/A	11	12	13	7	N/A
9-Apr-16	N/A	9	18	21	11	N/A
10-Apr-16	N/A	10	N/A	24	14	N/A
11-Apr-16	N/A	12	17	33	21	N/A
12-Apr-16	N/A	12	13	93	93	N/A
13-Apr-16	N/A	15	29	36	46	N/A
14-Apr-16	N/A	N/A	25	57	55	N/A
15-Apr-16	N/A	11	11	37	31	N/A
16-Apr-16	N/A	9	8	40	20	N/A
17-Apr-16	N/A	12	18	60	57	N/A
18-Apr-16	N/A	13	17	67	58	N/A
19-Apr-16	N/A	14	12	73	49	N/A
20-Apr-16	N/A	19	9	60	57	N/A
21-Apr-16	N/A	16	7	67	50	N/A
22-Apr-16	N/A	N/A	7	N/A	40	N/A
23-Apr-16	N/A	16	11	97	58	N/A
24-Apr-16	N/A	14	10	N/A	57	N/A
25-Apr-16	N/A	16	9	84	52	N/A
26-Apr-16	N/A	N/A	7	61	40	N/A
27-Apr-16	N/A	N/A	6	N/A	30	N/A
28-Apr-16	N/A	14	8	55	35	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
29-Apr-16	N/A	15	6	67	43	N/A
30-Apr-16	N/A	10	7	66	46	N/A
1-May-16	N/A	13	14	40	38	N/A
2-May-16	N/A	14	7	56	44	N/A
3-May-16	N/A	N/A	7	57	34	N/A
4-May-16	N/A	12	8	30	18	N/A
5-May-16	N/A	10	8	47	30	N/A
6-May-16	N/A	12	6	55	33	N/A
7-May-16	N/A	N/A	7	51	31	N/A
8-May-16	N/A	13	11	67	40	N/A
9-May-16	N/A	11	N/A	52	25	N/A
10-May-16	N/A	14	16	36	23	N/A
11-May-16	N/A	N/A	11	153	165	N/A
12-May-16	N/A	14	9	44	17	N/A
13-May-16	N/A	19	13	39	30	N/A
14-May-16	N/A	N/A	4	11	8	N/A
15-May-16	N/A	12	7	13	157	N/A
16-May-16	N/A	16	6	22	418	N/A
17-May-16	N/A	16	10	55	476	N/A
18-May-16	N/A	17	13	59	419	N/A
19-May-16	N/A	17	13	65	27	N/A
20-May-16	N/A	15	N/A	90	90	N/A
21-May-16	N/A	10	8	21	20	N/A
22-May-16	N/A	8	10	38	N/A	N/A
23-May-16	N/A	8	9	62	35	N/A
24-May-16	N/A	11	11	61	35	N/A
25-May-16	N/A	16	N/A	51	17	N/A
26-May-16	N/A	13	14	37	18	N/A
27-May-16	N/A	11	13	23	14	N/A
28-May-16	N/A	7	7	27	10	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
29-May-16	N/A	10	10	19	11	N/A
30-May-16	N/A	13	N/A	N/A	18	N/A
31-May-16	N/A	17	7	57	88	N/A
1-Jun-16	N/A	13	7	28	19	N/A
2-Jun-16	N/A	12	11	69	42	N/A
3-Jun-16	N/A	17	7	62	21	N/A
4-Jun-16	N/A	15	9	39	27	N/A
5-Jun-16	N/A	14	13	41	20	N/A
6-Jun-16	N/A	17	13	15	6	N/A
7-Jun-16	N/A	17	13	77	30	N/A
8-Jun-16	N/A	17	9	59	29	N/A
9-Jun-16	N/A	16	10	N/A	32	N/A
10-Jun-16	N/A	17	10	N/A	29	N/A
11-Jun-16	N/A	15	7	48	18	N/A
12-Jun-16	N/A	11	7	388	10	N/A
13-Jun-16	N/A	12	12	N/A	84	N/A
14-Jun-16	N/A	13	12	N/A	18	N/A
15-Jun-16	N/A	15	14	N/A	14	N/A
16-Jun-16	N/A	17	10	N/A	7	N/A
17-Jun-16	N/A	12	10	N/A	14	N/A
18-Jun-16	N/A	12	6	N/A	25	N/A
19-Jun-16	N/A	10	6	N/A	13	N/A
20-Jun-16	N/A	12	8	N/A	9	N/A
21-Jun-16	N/A	12	6	N/A	39	N/A
22-Jun-16	N/A	14	9	N/A	30	N/A
23-Jun-16	N/A	13	8	N/A	22	N/A
24-Jun-16	N/A	15	8	N/A	25	N/A
25-Jun-16	N/A	16	7	N/A	32	N/A
26-Jun-16	N/A	15	15	N/A	13	N/A
27-Jun-16	N/A	17	11	N/A	9	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
28-Jun-16	N/A	N/A	6	N/A	5	N/A
29-Jun-16	N/A	N/A	8	N/A	15	N/A
30-Jun-16	N/A	N/A	9	N/A	27	N/A
1-Jul-16	N/A	56	8	N/A	20	N/A
2-Jul-16	N/A	N/A	11	N/A	19	N/A
3-Jul-16	N/A	24	12	N/A	13	N/A
4-Jul-16	N/A	26	7	N/A	N/A	N/A
5-Jul-16	N/A	N/A	12	N/A	23	N/A
6-Jul-16	N/A	6	11	N/A	33	N/A
7-Jul-16	N/A	16	6	N/A	24	N/A
8-Jul-16	N/A	7	9	N/A	N/A	N/A
9-Jul-16	N/A	7	9	N/A	9	N/A
10-Jul-16	N/A	6	10	N/A	N/A	N/A
11-Jul-16	N/A	6	9	N/A	15	N/A
12-Jul-16	N/A	N/A	17	N/A	3	N/A
13-Jul-16	N/A	N/A	9	N/A	13	N/A
14-Jul-16	N/A	12	9	N/A	8	N/A
15-Jul-16	N/A	N/A	N/A	N/A	9	N/A
16-Jul-16	N/A	N/A	9	N/A	19	N/A
17-Jul-16	N/A	8	22	N/A	16	N/A
18-Jul-16	N/A	15	19	N/A	17	N/A
19-Jul-16	N/A	9	12	N/A	13	N/A
20-Jul-16	N/A	7	6	N/A	12	N/A
21-Jul-16	N/A	16	6	N/A	9	N/A
22-Jul-16	N/A	10	9	N/A	34	N/A
23-Jul-16	N/A	15	5	N/A	417	N/A
24-Jul-16	N/A	26	15	N/A	N/A	N/A
25-Jul-16	N/A	N/A	19	N/A	N/A	N/A
26-Jul-16	N/A	N/A	9	N/A	N/A	N/A
27-Jul-16	N/A	N/A	7	N/A	409	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
28-Jul-16	N/A	N/A	7	N/A	72	N/A
29-Jul-16	N/A	46	6	N/A	62	N/A
30-Jul-16	N/A	20	13	N/A	34	N/A
31-Jul-16	N/A	N/A	7	N/A	31	N/A
1-Aug-16	N/A	5	9	N/A	36	N/A
2-Aug-16	N/A	6	N/A	N/A	N/A	N/A
3-Aug-16	N/A	7	7	N/A	30	N/A
4-Aug-16	N/A	9	14	N/A	75	N/A
5-Aug-16	N/A	9	10	N/A	35	N/A
6-Aug-16	N/A	11	16	N/A	17	N/A
7-Aug-16	N/A	5	8	N/A	6	N/A
8-Aug-16	N/A	7	8	N/A	20	N/A
9-Aug-16	N/A	7	6	N/A	13	N/A
10-Aug-16	N/A	N/A	8	N/A	7	N/A
11-Aug-16	N/A	N/A	7	N/A	10	N/A
12-Aug-16	N/A	N/A	9	N/A	16	N/A
13-Aug-16	N/A	N/A	8	N/A	N/A	N/A
14-Aug-16	N/A	N/A	9	N/A	27	N/A
15-Aug-16	N/A	61	10	N/A	N/A	N/A
16-Aug-16	N/A	61	12	N/A	19	N/A
17-Aug-16	N/A	25	4	N/A	14	N/A
18-Aug-16	N/A	N/A	10	N/A	24	N/A
19-Aug-16	N/A	10	9	N/A	48	N/A
20-Aug-16	N/A	37	11	27	15	N/A
21-Aug-16	N/A	83	9	39	22	N/A
22-Aug-16	N/A	20	N/A	34	22	N/A
23-Aug-16	N/A	20	N/A	45	24	N/A
24-Aug-16	N/A	15	6	56	18	N/A
25-Aug-16	N/A	N/A	8	39	18	N/A
26-Aug-16	N/A	14	9	32	31	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
27-Aug-16	N/A	13	6	17	23	N/A
28-Aug-16	N/A	13	5	39	22	N/A
29-Aug-16	N/A	12	10	39	14	N/A
30-Aug-16	N/A	16	7	59	27	N/A
31-Aug-16	N/A	15	15	25	4	N/A
1-Sep-16	N/A	17	9	15	N/A	N/A
1-Sep-16	N/A	17	9	15	N/A	N/A
2-Sep-16	N/A	17	10	45	17	N/A
3-Sep-16	N/A	N/A	N/A	66	43	N/A
4-Sep-16	N/A	20	17	76	43	N/A
5-Sep-16	N/A	21	11	33	15	N/A
6-Sep-16	N/A	18	9	24	17	N/A
7-Sep-16	N/A	18	7	54	31	N/A
8-Sep-16	N/A	29	10	32	24	N/A
9-Sep-16	N/A	19	9	N/A	20	N/A
10-Sep-16	N/A	17	6	N/A	35	N/A
11-Sep-16	N/A	N/A	10	57	N/A	N/A
12-Sep-16	N/A	N/A	8	54	N/A	N/A
13-Sep-16	N/A	18	5	43	20	N/A
14-Sep-16	N/A	N/A	8	35	18	N/A
15-Sep-16	N/A	15	6	45	31	N/A
16-Sep-16	N/A	15	5	64	40	N/A
17-Sep-16	N/A	12	N/A	41	31	N/A
18-Sep-16	N/A	N/A	14	25	27	N/A
19-Sep-16	N/A	N/A	7	33	20	N/A
20-Sep-16	N/A	N/A	8	41	26	N/A
21-Sep-16	N/A	13	9	25	26	N/A
22-Sep-16	N/A	N/A	8	38	28	N/A
23-Sep-16	N/A	14	7	32	31	N/A
24-Sep-16	N/A	N/A	6	29	29	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
25-Sep-16	N/A	15	7	28	28	N/A
26-Sep-16	N/A	19	8	26	30	N/A
27-Sep-16	N/A	N/A	11	39	32	N/A
28-Sep-16	N/A	13	14	36	27	N/A
29-Sep-16	N/A	N/A	6	32	36	N/A
30-Sep-16	N/A	17	7	67	193	N/A
1-Oct-16	N/A	19	7	64	N/A	N/A
2-Oct-16	N/A	17	8	33	N/A	N/A
3-Oct-16	N/A	18	8	38	N/A	N/A
4-Oct-16	N/A	18	11	41	N/A	N/A
5-Oct-16	N/A	N/A	17	N/A	N/A	N/A
6-Oct-16	N/A	22	9	32	340	N/A
7-Oct-16	N/A	19	3	38	15	N/A
8-Oct-16	N/A	8	2	N/A	37	N/A
9-Oct-16	N/A	7	N/A	29	13	N/A
10-Oct-16	N/A	9	5	43	20	N/A
11-Oct-16	N/A	10	4	32	19	N/A
12-Oct-16	N/A	N/A	3	24	15	N/A
13-Oct-16	N/A	N/A	4	26	15	N/A
14-Oct-16	N/A	11	5	40	14	N/A
15-Oct-16	N/A	N/A	7	36	28	N/A
16-Oct-16	N/A	N/A	8	28	19	N/A
17-Oct-16	N/A	12	5	38	21	N/A
18-Oct-16	N/A	15	8	46	24	N/A
19-Oct-16	N/A	14	5	38	N/A	N/A
20-Oct-16	N/A	9	2	32	20	N/A
21-Oct-16	N/A	14	5	N/A	18	N/A
22-Oct-16	N/A	15	3	36	24	N/A
23-Oct-16	N/A	N/A	7	32	16	N/A
24-Oct-16	N/A	19	10	163	20	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
25-Oct-16	N/A	18	3	N/A	15	N/A
26-Oct-16	N/A	13	4	N/A	9	N/A
27-Oct-16	N/A	11	N/A	N/A	N/A	N/A
28-Oct-16	N/A	8	N/A	25	N/A	N/A
29-Oct-16	N/A	12	N/A	32	N/A	N/A
30-Oct-16	N/A	12	N/A	28	N/A	N/A
31-Oct-16	N/A	11	4	33	N/A	N/A
1-Nov-16	N/A	17	4	N/A	N/A	N/A
1-Nov-16	N/A	17	4	N/A	N/A	N/A
2-Nov-16	N/A	37	3	50	N/A	N/A
3-Nov-16	N/A	18	7	29	N/A	N/A
4-Nov-16	N/A	17	10	30	N/A	N/A
5-Nov-16	N/A	10	N/A	22	N/A	N/A
6-Nov-16	N/A	N/A	N/A	N/A	491	N/A
7-Nov-16	N/A	N/A	N/A	31	360	N/A
8-Nov-16	N/A	13	N/A	39	447	N/A
9-Nov-16	N/A	13	N/A	85	N/A	N/A
10-Nov-16	N/A	N/A	N/A	31	N/A	N/A
11-Nov-16	N/A	16	N/A	24	382	N/A
12-Nov-16	N/A	16	N/A	25	491	N/A
13-Nov-16	N/A	11	N/A	38	N/A	N/A
14-Nov-16	N/A	13	N/A	45	N/A	N/A
15-Nov-16	N/A	18	N/A	36	N/A	N/A
16-Nov-16	N/A	11	14	28	N/A	N/A
17-Nov-16	N/A	N/A	N/A	31	N/A	N/A
18-Nov-16	N/A	9	N/A	33	476	N/A
19-Nov-16	N/A	7	N/A	27	476	N/A
20-Nov-16	N/A	9	N/A	36	N/A	N/A
21-Nov-16	N/A	10	N/A	34	415	N/A
22-Nov-16	N/A	9	N/A	27	N/A	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
23-Nov-16	N/A	14	N/A	30	N/A	N/A
24-Nov-16	N/A	N/A	N/A	N/A	N/A	N/A
25-Nov-16	N/A	N/A	N/A	N/A	N/A	N/A
26-Nov-16	N/A	N/A	N/A	N/A	N/A	N/A
27-Nov-16	N/A	N/A	N/A	N/A	N/A	N/A
28-Nov-16	N/A	N/A	N/A	330	183	N/A
29-Nov-16	N/A	N/A	N/A	273	113	N/A
30-Nov-16	N/A	N/A	N/A	N/A	239	N/A
1-Dec-16	N/A	N/A	N/A	N/A	429	N/A
2-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
3-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
4-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
5-Dec-16	N/A	N/A	N/A	N/A	418	N/A
6-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
7-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
8-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
9-Dec-16	N/A	N/A	N/A	N/A	360	N/A
10-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
11-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
12-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
13-Dec-16	N/A	N/A	N/A	N/A	491	N/A
14-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
15-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
16-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
17-Dec-16	N/A	N/A	N/A	N/A	360	N/A
18-Dec-16	N/A	N/A	N/A	N/A	476	N/A
19-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
20-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
21-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
22-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
23-Dec-16	N/A	N/A	N/A	N/A	462	N/A
24-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
25-Dec-16	N/A	N/A	N/A	N/A	462	N/A
26-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
27-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
28-Dec-16	N/A	N/A	N/A	N/A	360	N/A
29-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
30-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
31-Dec-16	N/A	N/A	N/A	N/A	N/A	N/A
1-Jan-17	N/A	N/A	N/A	N/A	N/A	N/A
2-Jan-17	N/A	N/A	N/A	N/A	338	N/A
3-Jan-17	N/A	N/A	N/A	N/A	N/A	N/A
4-Jan-17	N/A	N/A	N/A	N/A	N/A	N/A
5-Jan-17	N/A	N/A	N/A	N/A	N/A	N/A
6-Jan-17	N/A	N/A	N/A	149	343	N/A
7-Jan-17	N/A	N/A	N/A	69	24	N/A
8-Jan-17	N/A	N/A	N/A	50	12	N/A
9-Jan-17	N/A	N/A	N/A	479	169	N/A
10-Jan-17	N/A	N/A	N/A	129	219	N/A
11-Jan-17	0	N/A	18	N/A	127	N/A
12-Jan-17	0	13	204	N/A	172	N/A
13-Jan-17	0	16	74	53	N/A	N/A
14-Jan-17	N/A	16	27	43	23	N/A
15-Jan-17	0	9	24	31	38	N/A
16-Jan-17	N/A	11	17	44	24	N/A
17-Jan-17	N/A	10	10	34	17	N/A
18-Jan-17	N/A	10	9	78	19	N/A
19-Jan-17	N/A	9	13	33	31	N/A
20-Jan-17	N/A	N/A	10	189	11	N/A
21-Jan-17	0	N/A	9	22	N/A	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
22-Jan-17	0	N/A	11	21	N/A	N/A
23-Jan-17	0	N/A	8	24	N/A	N/A
24-Jan-17	0	N/A	10	88	14	N/A
25-Jan-17	0	N/A	9	132	29	N/A
26-Jan-17	N/A	N/A	13	329	27	N/A
27-Jan-17	0	N/A	13	214	26	N/A
28-Jan-17	0	N/A	11	320	20	N/A
29-Jan-17	0	N/A	19	468	17	N/A
30-Jan-17	0	N/A	16	N/A	41	N/A
31-Jan-17	0	10	17	207	30	N/A
1-Feb-17	0	N/A	18	434	139	N/A
2-Feb-17	0	10	21	N/A	74	N/A
3-Feb-17	0	10	20	N/A	44	N/A
4-Feb-17	0	8	18	163	14	N/A
5-Feb-17	N/A	7	21	493	18	N/A
6-Feb-17	N/A	12	20	500	15	N/A
7-Feb-17	N/A	N/A	18	N/A	22	N/A
8-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A
9-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A
10-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A
11-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A
12-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A
13-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A
14-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A
15-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A
16-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A
17-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A
18-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A
19-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A
20-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
21-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A
22-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A
23-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A
24-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A
25-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A
26-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A
27-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A
28-Feb-17	N/A	N/A	N/A	N/A	N/A	N/A
1-Mar-17	N/A	N/A	N/A	N/A	N/A	N/A
2-Mar-17	N/A	N/A	N/A	N/A	N/A	N/A
3-Mar-17	N/A	N/A	N/A	N/A	N/A	N/A
4-Mar-17	N/A	N/A	N/A	N/A	N/A	N/A
5-Mar-17	N/A	N/A	N/A	N/A	N/A	N/A
6-Mar-17	N/A	N/A	N/A	N/A	N/A	N/A
7-Mar-17	N/A	N/A	N/A	N/A	N/A	N/A
8-Mar-17	N/A	N/A	N/A	N/A	N/A	N/A
9-Mar-17	N/A	N/A	N/A	N/A	N/A	N/A
10-Mar-17	N/A	N/A	N/A	N/A	N/A	N/A
11-Mar-17	N/A	7	N/A	N/A	N/A	N/A
12-Mar-17	N/A	N/A	N/A	N/A	N/A	N/A
13-Mar-17	0	N/A	N/A	N/A	N/A	N/A
14-Mar-17	0	9	N/A	N/A	N/A	N/A
15-Mar-17	N/A	10	N/A	N/A	N/A	N/A
16-Mar-17	0	8	N/A	N/A	N/A	N/A
17-Mar-17	0	N/A	N/A	N/A	N/A	N/A
18-Mar-17	N/A	9	N/A	38	N/A	N/A
19-Mar-17	0	7	N/A	50	N/A	N/A
20-Mar-17	0	9	N/A	49	N/A	N/A
21-Mar-17	0	7	N/A	47	N/A	N/A
22-Mar-17	0	6	N/A	N/A	N/A	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
23-Mar-17	0	6	N/A	84	N/A	N/A
24-Mar-17	0	10	N/A	31	N/A	N/A
25-Mar-17	0	N/A	N/A	30	N/A	N/A
26-Mar-17	0	13	N/A	25	N/A	N/A
27-Mar-17	N/A	13	N/A	48	N/A	N/A
28-Mar-17	0	14	N/A	40	N/A	N/A
29-Mar-17	0	14	N/A	42	N/A	N/A
30-Mar-17	N/A	12	N/A	29	N/A	N/A
31-Mar-17	0	12	N/A	41	N/A	N/A
1-Apr-17	N/A	12	N/A	102	N/A	N/A
2-Apr-17	0	11	N/A	115	N/A	N/A
3-Apr-17	0	20	N/A	144	N/A	N/A
4-Apr-17	0	14	N/A	N/A	N/A	N/A
5-Apr-17	N/A	N/A	N/A	127	N/A	N/A
6-Apr-17	0	13	N/A	85	N/A	N/A
7-Apr-17	0	12	N/A	63	N/A	N/A
8-Apr-17	0	16	N/A	54	N/A	N/A
9-Apr-17	0	14	N/A	74	N/A	N/A
10-Apr-17	0	16	N/A	55	N/A	N/A
11-Apr-17	0	N/A	N/A	30	N/A	N/A
12-Apr-17	0	15	N/A	39	N/A	N/A
13-Apr-17	0	7	N/A	N/A	N/A	N/A
14-Apr-17	N/A	2	N/A	72	N/A	N/A
15-Apr-17	N/A	6	N/A	80	N/A	N/A
16-Apr-17	N/A	6	N/A	99	N/A	N/A
17-Apr-17	0	10	N/A	92	N/A	N/A
18-Apr-17	0	9	11	121	N/A	N/A
19-Apr-17	0	11	13	80	56	N/A
20-Apr-17	0	11	14	80	59	N/A
21-Apr-17	0	12	13	50	46	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
22-Apr-17	0	10	15	N/A	40	N/A
23-Apr-17	0	10	14	N/A	25	N/A
24-Apr-17	N/A	10	N/A	68	24	N/A
25-Apr-17	0	12	N/A	95	49	N/A
26-Apr-17	0	12	N/A	100	N/A	N/A
27-Apr-17	0	11	N/A	77	N/A	N/A
28-Apr-17	0	12	N/A	79	N/A	N/A
29-Apr-17	0	10	N/A	65	N/A	N/A
30-Apr-17	0	7	N/A	N/A	N/A	N/A
1-May-17	0	10	N/A	61	338	N/A
2-May-17	N/A	9	N/A	N/A	N/A	N/A
3-May-17	0	6	N/A	66	N/A	N/A
4-May-17	0	N/A	N/A	72	N/A	N/A
5-May-17	N/A	5	N/A	N/A	N/A	N/A
6-May-17	0	3	N/A	61	N/A	N/A
7-May-17	N/A	3	N/A	62	N/A	N/A
8-May-17	0	5	N/A	35	N/A	N/A
9-May-17	0	4	N/A	50	N/A	N/A
10-May-17	0	N/A	N/A	49	N/A	N/A
11-May-17	0	6	N/A	50	N/A	N/A
12-May-17	0	6	N/A	21	N/A	N/A
13-May-17	0	4	N/A	83	N/A	N/A
14-May-17	0	5	N/A	38	N/A	N/A
15-May-17	0	9	N/A	125	N/A	N/A
16-May-17	0	10	N/A	132	N/A	N/A
17-May-17	0	9	N/A	65	N/A	N/A
18-May-17	0	8	N/A	N/A	N/A	N/A
19-May-17	0	9	N/A	60	N/A	N/A
20-May-17	0	N/A	N/A	88	N/A	N/A
21-May-17	0	6	N/A	105	N/A	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
22-May-17	0	6	N/A	N/A	N/A	N/A
23-May-17	0	7	N/A	N/A	N/A	N/A
24-May-17	0	6	N/A	N/A	N/A	N/A
25-May-17	0	N/A	N/A	N/A	N/A	N/A
26-May-17	N/A	N/A	N/A	N/A	N/A	N/A
27-May-17	0	9	N/A	N/A	N/A	N/A
28-May-17	0	7	N/A	N/A	N/A	N/A
29-May-17	0	5	N/A	N/A	N/A	N/A
30-May-17	0	N/A	N/A	N/A	N/A	N/A
31-May-17	0	7	N/A	N/A	N/A	N/A
1-Jun-17	0	7	N/A	N/A	N/A	N/A
2-Jun-17	0	10	N/A	N/A	N/A	N/A
3-Jun-17	N/A	9	N/A	N/A	N/A	N/A
4-Jun-17	0	6	N/A	N/A	N/A	N/A
5-Jun-17	0	8	N/A	N/A	N/A	N/A
6-Jun-17	0	6	N/A	N/A	N/A	N/A
7-Jun-17	N/A	N/A	N/A	N/A	N/A	N/A
8-Jun-17	0	N/A	N/A	N/A	N/A	N/A
9-Jun-17	0	N/A	N/A	N/A	N/A	N/A
10-Jun-17	0	14	N/A	N/A	N/A	N/A
11-Jun-17	0	3	N/A	N/A	N/A	N/A
12-Jun-17	N/A	6	N/A	N/A	N/A	N/A
13-Jun-17	0	10	N/A	N/A	N/A	N/A
14-Jun-17	0	23	N/A	207	N/A	N/A
15-Jun-17	0	3	N/A	36	N/A	N/A
16-Jun-17	0	16	N/A	41	N/A	N/A
17-Jun-17	0	15	N/A	68	N/A	N/A
18-Jun-17	N/A	10	N/A	N/A	N/A	N/A
19-Jun-17	0	N/A	N/A	N/A	N/A	N/A
20-Jun-17	N/A	N/A	N/A	16	N/A	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
21-Jun-17	0	3	N/A	63	N/A	N/A
22-Jun-17	0	4	N/A	57	N/A	N/A
23-Jun-17	0	6	N/A	19	N/A	N/A
24-Jun-17	0	4	N/A	68	N/A	N/A
25-Jun-17	0	N/A	N/A	30	N/A	N/A
26-Jun-17	0	N/A	N/A	95	N/A	N/A
27-Jun-17	0	9	N/A	80	N/A	N/A
28-Jun-17	N/A	5	N/A	28	N/A	N/A
29-Jun-17	0	7	N/A	27	N/A	N/A
30-Jun-17	0	7	N/A	26	N/A	N/A
1-Jul-17	N/A	N/A	N/A	49	N/A	N/A
2-Jul-17	0	5	N/A	23	N/A	N/A
3-Jul-17	N/A	6	N/A	60	N/A	N/A
4-Jul-17	0	7	N/A	68	N/A	N/A
5-Jul-17	0	9	N/A	55	N/A	N/A
6-Jul-17	0	7	N/A	27	N/A	N/A
7-Jul-17	0	5	N/A	29	N/A	N/A
8-Jul-17	0	7	N/A	31	N/A	N/A
9-Jul-17	0	N/A	N/A	38	N/A	N/A
10-Jul-17	0	4	N/A	85	N/A	N/A
11-Jul-17	N/A	N/A	N/A	74	N/A	N/A
12-Jul-17	0	6	N/A	36	N/A	N/A
13-Jul-17	0	8	N/A	39	N/A	N/A
14-Jul-17	0	6	N/A	50	N/A	N/A
15-Jul-17	0	4	N/A	31	N/A	N/A
16-Jul-17	0	5	N/A	43	N/A	N/A
17-Jul-17	N/A	5	N/A	40	N/A	N/A
18-Jul-17	N/A	7	N/A	34	N/A	N/A
19-Jul-17	N/A	N/A	N/A	39	N/A	N/A
20-Jul-17	N/A	N/A	N/A	57	N/A	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
21-Jul-17	0	8	N/A	45	N/A	N/A
22-Jul-17	0	9	N/A	32	N/A	N/A
23-Jul-17	0	N/A	N/A	25	N/A	N/A
24-Jul-17	0	8	N/A	30	N/A	N/A
25-Jul-17	0	6	N/A	29	N/A	N/A
26-Jul-17	0	N/A	N/A	30	N/A	N/A
27-Jul-17	0	6	N/A	25	N/A	N/A
28-Jul-17	0	8	N/A	27	N/A	N/A
29-Jul-17	0	N/A	N/A	N/A	N/A	N/A
30-Jul-17	0	N/A	N/A	16	N/A	N/A
1-Aug-17	0	5	N/A	59	N/A	N/A
2-Aug-17	0	10	N/A	53	N/A	N/A
3-Aug-17	0	6	N/A	37	N/A	N/A
4-Aug-17	0	10	N/A	70	N/A	N/A
5-Aug-17	0	6	N/A	53	N/A	N/A
6-Aug-17	0	2	N/A	39	N/A	N/A
7-Aug-17	0	2	N/A	29	N/A	N/A
8-Aug-17	0	8	N/A	51	N/A	N/A
9-Aug-17	0	5	N/A	31	N/A	N/A
10-Aug-17	N/A	5	N/A	29	N/A	N/A
11-Aug-17	0	5	N/A	53	N/A	N/A
12-Aug-17	N/A	N/A	N/A	N/A	N/A	N/A
13-Aug-17	0	N/A	N/A	24	N/A	N/A
14-Aug-17	0	N/A	N/A	29	N/A	N/A
15-Aug-17	0	N/A	N/A	75	N/A	N/A
16-Aug-17	0	9	N/A	63	N/A	N/A
17-Aug-17	0	N/A	N/A	35	N/A	N/A
18-Aug-17	0	N/A	N/A	58	N/A	N/A
19-Aug-17	0	N/A	N/A	N/A	N/A	N/A
20-Aug-17	0	N/A	N/A	N/A	N/A	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
21-Aug-17	0	6	N/A	N/A	N/A	N/A
22-Aug-17	0	6	N/A	N/A	N/A	N/A
23-Aug-17	0	4	N/A	N/A	N/A	N/A
24-Aug-17	N/A	N/A	N/A	N/A	382	N/A
25-Aug-17	N/A	N/A	N/A	N/A	N/A	N/A
26-Aug-17	0	11	N/A	N/A	22	N/A
27-Aug-17	N/A	7	N/A	N/A	N/A	N/A
28-Aug-17	0	9	N/A	N/A	13	N/A
29-Aug-17	0	9	N/A	N/A	117	N/A
30-Aug-17	N/A	6	N/A	N/A	N/A	N/A
31-Aug-17	0	N/A	N/A	32	N/A	N/A
1-Sep-17	N/A	7	N/A	24	N/A	N/A
2-Sep-17	N/A	9	N/A	N/A	N/A	N/A
3-Sep-17	0	7	N/A	25	N/A	N/A
4-Sep-17	0	8	N/A	29	N/A	N/A
5-Sep-17	N/A	12	N/A	33	N/A	N/A
6-Sep-17	0	N/A	N/A	13	N/A	N/A
7-Sep-17	0	13	N/A	N/A	N/A	N/A
8-Sep-17	0	11	N/A	39	N/A	N/A
9-Sep-17	0	11	N/A	38	N/A	N/A
10-Sep-17	0	9	N/A	31	N/A	N/A
11-Sep-17	0	N/A	N/A	104	N/A	N/A
12-Sep-17	0	5	N/A	31	N/A	N/A
13-Sep-17	0	N/A	6	31	196	N/A
14-Sep-17	N/A	8	7	43	15	N/A
15-Sep-17	0	7	9	36	33	N/A
16-Sep-17	N/A	5	5	43	28	N/A
17-Sep-17	0	6	7	61	N/A	N/A
18-Sep-17	N/A	N/A	8	61	22	N/A
19-Sep-17	0	9	N/A	37	31	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
20-Sep-17	0	N/A	7	38	13	N/A
21-Sep-17	0	7	5	37	12	N/A
22-Sep-17	0	5	5	43	10	N/A
23-Sep-17	N/A	9	7	24	10	N/A
24-Sep-17	0	7	N/A	N/A	16	N/A
25-Sep-17	0	5	7	N/A	38	N/A
26-Sep-17	0	N/A	4	N/A	73	N/A
27-Sep-17	0	8	6	60	19	N/A
28-Sep-17	0	7	6	38	N/A	N/A
29-Sep-17	0	9	6	47	N/A	N/A
30-Sep-17	N/A	6	6	37	N/A	N/A
1-Oct-17	N/A	5	5	28	N/A	N/A
2-Oct-17	0	8	6	39	12	N/A
3-Oct-17	0	8	10	30	476	N/A
4-Oct-17	0	6	7	47	283	N/A
5-Oct-17	N/A	6	8	N/A	289	N/A
6-Oct-17	0	N/A	13	38	433	N/A
7-Oct-17	0	9	7	32	31	N/A
8-Oct-17	0	8	11	30	23	N/A
9-Oct-17	0	10	N/A	40	25	N/A
10-Oct-17	0	7	6	38	26	N/A
11-Oct-17	0	7	6	22	24	N/A
12-Oct-17	0	9	6	75	57	N/A
13-Oct-17	N/A	8	N/A	68	52	N/A
14-Oct-17	0	8	N/A	29	33	N/A
15-Oct-17	0	6	7	24	23	N/A
16-Oct-17	0	7	6	33	N/A	N/A
17-Oct-17	0	5	N/A	83	24	N/A
18-Oct-17	0	N/A	8	18	25	N/A
19-Oct-17	0	7	10	25	25	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
20-Oct-17	0	8	8	48	40	N/A
21-Oct-17	0	8	9	51	33	N/A
22-Oct-17	0	5	11	105	8	N/A
23-Oct-17	N/A	N/A	N/A	36	14	N/A
24-Oct-17	0	10	8	27	N/A	N/A
25-Oct-17	N/A	8	9	32	26	N/A
26-Oct-17	N/A	8	N/A	32	22	N/A
27-Oct-17	0	N/A	8	78	23	N/A
28-Oct-17	0	7	6	74	15	N/A
29-Oct-17	0	N/A	7	44	29	N/A
30-Oct-17	0	6	N/A	N/A	18	N/A
31-Oct-17	N/A	N/A	7	25	17	N/A
1-Oct-17	N/A	5	5	28	N/A	N/A
2-Oct-17	0	8	6	39	12	N/A
3-Oct-17	0	8	10	30	476	N/A
4-Oct-17	0	6	7	47	283	N/A
5-Oct-17	N/A	6	8	N/A	289	N/A
6-Oct-17	0	N/A	13	38	433	N/A
7-Oct-17	0	9	7	32	31	N/A
8-Oct-17	0	8	11	30	23	N/A
9-Oct-17	0	10	N/A	40	25	N/A
10-Oct-17	0	7	6	38	26	N/A
11-Oct-17	0	7	6	22	24	N/A
12-Oct-17	0	9	6	75	57	N/A
13-Oct-17	N/A	8	N/A	68	52	N/A
14-Oct-17	0	8	N/A	29	33	N/A
15-Oct-17	0	6	7	24	23	N/A
16-Oct-17	0	7	6	33	N/A	N/A
17-Oct-17	0	5	N/A	83	24	N/A
18-Oct-17	0	N/A	8	18	25	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
19-Oct-17	0	7	10	25	25	N/A
20-Oct-17	0	8	8	48	40	N/A
21-Oct-17	0	8	9	51	33	N/A
22-Oct-17	0	5	11	105	8	N/A
23-Oct-17	N/A	N/A	N/A	36	14	N/A
24-Oct-17	0	10	8	27	N/A	N/A
25-Oct-17	N/A	8	9	32	26	N/A
26-Oct-17	N/A	8	N/A	32	22	N/A
27-Oct-17	0	N/A	8	78	23	N/A
28-Oct-17	0	7	6	74	15	N/A
29-Oct-17	0	N/A	7	44	29	N/A
30-Oct-17	0	6	N/A	N/A	18	N/A
31-Oct-17	N/A	N/A	7	25	17	N/A
1-Dec-17	0	8	N/A	94	38	N/A
2-Dec-17	0	9	N/A	114	54	N/A
3-Dec-17	N/A	7	N/A	127	30	N/A
4-Dec-17	0	8	N/A	79	21	N/A
5-Dec-17	N/A	N/A	N/A	195	76	N/A
6-Dec-17	N/A	8	N/A	105	52	N/A
7-Dec-17	0	9	N/A	36	39	N/A
8-Dec-17	0	9	N/A	92	30	N/A
9-Dec-17	N/A	8	N/A	82	41	N/A
10-Dec-17	N/A	N/A	N/A	108	N/A	N/A
11-Dec-17	0	13	N/A	91	20	N/A
12-Dec-17	N/A	N/A	N/A	414	309	N/A
13-Dec-17	N/A	8	N/A	91	403	3
14-Dec-17	N/A	7	N/A	115	284	0
15-Dec-17	0	10	N/A	104	32	N/A
16-Dec-17	0	11	N/A	90	33	N/A
17-Dec-17	N/A	8	N/A	78	156	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
18-Dec-17	0	7	N/A	123	476	N/A
19-Dec-17	0	7	N/A	140	N/A	N/A
20-Dec-17	0	8	N/A	24	N/A	N/A
21-Dec-17	N/A	8	N/A	82	159	N/A
22-Dec-17	N/A	N/A	N/A	N/A	40	N/A
23-Dec-17	0	N/A	N/A	N/A	25	N/A
24-Dec-17	0	9	N/A	129	24	N/A
25-Dec-17	N/A	6	N/A	N/A	12	N/A
26-Dec-17	0	5	N/A	86	30	N/A
27-Dec-17	0	7	N/A	410	18	N/A
28-Dec-17	0	6	N/A	195	21	N/A
29-Dec-17	0	N/A	N/A	139	14	N/A
30-Dec-17	0	N/A	N/A	257	18	N/A
31-Dec-17	0	7	N/A	207	44	N/A
1-Jan-18	0	8	N/A	160	63	N/A
2-Jan-18	N/A	8	N/A	144	50	N/A
3-Jan-18	0	9	N/A	98	36	N/A
4-Jan-18	0	7	N/A	N/A	38	N/A
5-Jan-18	N/A	N/A	8	303	142	N/A
6-Jan-18	N/A	N/A	12	N/A	32	N/A
7-Jan-18	N/A	N/A	22	N/A	46	N/A
8-Jan-18	N/A	N/A	19	N/A	N/A	N/A
9-Jan-18	N/A	N/A	9	N/A	46	N/A
10-Jan-18	0	9	13	N/A	23	2
11-Jan-18	0	N/A	15	N/A	81	0
12-Jan-18	N/A	N/A	12	33	22	0
13-Jan-18	0	9	14	37	26	3
14-Jan-18	N/A	N/A	15	N/A	25	0
15-Jan-18	N/A	N/A	10	42	33	2
16-Jan-18	0	N/A	12	86	28	0

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
17-Jan-18	0	N/A	N/A	89	39	0
18-Jan-18	0	N/A	13	56	32	2
19-Jan-18	0	N/A	11	55	35	N/A
20-Jan-18	0	N/A	12	N/A	26	N/A
21-Jan-18	N/A	N/A	13	27	15	N/A
22-Jan-18	0	N/A	15	N/A	N/A	N/A
23-Jan-18	0	N/A	N/A	37	32	2
24-Jan-18	0	N/A	N/A	118	165	2
25-Jan-18	0	N/A	3	N/A	27	2
26-Jan-18	N/A	N/A	14	N/A	34	2
27-Jan-18	0	N/A	13	29	30	2
28-Jan-18	0	N/A	19	N/A	30	0
29-Jan-18	N/A	N/A	16	37	23	0
30-Jan-18	0	N/A	16	462	57	2
31-Jan-18	0	25	12	41	27	0
1-Feb-18	0	N/A	18	42	29	2
2-Feb-18	0	N/A	13	37	N/A	3
3-Feb-18	0	N/A	14	44	28	2
4-Feb-18	0	N/A	16	39	31	2
5-Feb-18	0	N/A	14	37	25	2
6-Feb-18	0	N/A	N/A	50	27	2
7-Feb-18	0	N/A	17	31	23	2
8-Feb-18	0	N/A	21	38	23	2
9-Feb-18	0	N/A	N/A	N/A	26	2
10-Feb-18	N/A	N/A	19	42	14	0
11-Feb-18	N/A	N/A	25	N/A	27	0
12-Feb-18	0	N/A	N/A	N/A	30	2
13-Feb-18	0	N/A	N/A	N/A	29	0
14-Feb-18	0	N/A	21	36	21	0
15-Feb-18	N/A	N/A	21	40	N/A	0

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
16-Feb-18	0	N/A	25	320	25	2
17-Feb-18	0	N/A	22	45	27	2
18-Feb-18	0	N/A	23	34	26	0
19-Feb-18	0	N/A	14	N/A	23	2
20-Feb-18	N/A	N/A	N/A	88	88	2
21-Feb-18	N/A	N/A	19	45	27	2
22-Feb-18	N/A	N/A	17	N/A	28	5
23-Feb-18	N/A	N/A	N/A	132	32	3
24-Feb-18	0	16	23	29	27	2
25-Feb-18	0	10	18	26	25	2
26-Feb-18	0	12	N/A	38	27	3
27-Feb-18	0	10	13	32	26	2
28-Feb-18	0	6	16	31	N/A	3
1-Mar-18	0	13	13	32	23	3
2-Mar-18	0	5	10	161	17	3
3-Mar-18	0	4	15	35	403	2
4-Mar-18	0	N/A	N/A	13	N/A	N/A
5-Mar-18	0	N/A	N/A	119	317	2
6-Mar-18	N/A	N/A	N/A	35	29	2
7-Mar-18	0	N/A	N/A	48	37	2
8-Mar-18	N/A	N/A	N/A	96	36	2
9-Mar-18	0	7	14	43	30	2
10-Mar-18	0	4	N/A	44	32	2
11-Mar-18	0	3	17	55	26	2
12-Mar-18	0	8	16	60	20	2
13-Mar-18	0	4	21	N/A	35	2
14-Mar-18	0	N/A	18	42	33	2
15-Mar-18	0	4	22	55	32	2
16-Mar-18	0	4	18	58	36	2
17-Mar-18	0	6	19	N/A	48	2

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
18-Mar-18	N/A	N/A	N/A	38	35	2
19-Mar-18	0	5	18	50	33	2
20-Mar-18	0	N/A	16	62	39	2
21-Mar-18	0	N/A	12	52	N/A	2
22-Mar-18	0	N/A	18	60	35	2
23-Mar-18	0	N/A	16	54	34	2
24-Mar-18	0	5	17	47	32	2
25-Mar-18	0	3	N/A	N/A	25	0
26-Mar-18	0	4	12	400	22	2
27-Mar-18	0	2	13	330	42	2
28-Mar-18	0	4	N/A	105	68	2
29-Mar-18	N/A	N/A	16	84	N/A	2
30-Mar-18	0	4	18	N/A	48	0
31-Mar-18	0	3	17	N/A	30	2
1-Apr-18	0	N/A	17	38	21	0
2-Apr-18	0	N/A	15	N/A	39	0
3-Apr-18	0	2	13	N/A	N/A	2
4-Apr-18	0	N/A	14	29	33	2
5-Apr-18	0	5	14	65	50	2
6-Apr-18	N/A	N/A	N/A	77	58	3
7-Apr-18	0	N/A	12	66	49	2
8-Apr-18	0	3	17	25	19	0
9-Apr-18	N/A	3	18	25	22	2
10-Apr-18	0	3	13	28	89	2
11-Apr-18	N/A	3	13	66	26	2
12-Apr-18	0	4	15	87	87	2
13-Apr-18	0	5	22	44	26	2
14-Apr-18	0	N/A	24	N/A	17	2
15-Apr-18	N/A	N/A	17	N/A	88	0
16-Apr-18	N/A	N/A	11	83	56	2

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
17-Apr-18	0	N/A	13	66	49	2
18-Apr-18	0	3	13	38	36	2
19-Apr-18	N/A	N/A	13	93	87	2
20-Apr-18	N/A	N/A	13	32	23	2
21-Apr-18	N/A	N/A	N/A	15	20	2
22-Apr-18	N/A	2	13	83	85	2
23-Apr-18	0	2	10	85	84	2
24-Apr-18	0	3	12	28	8	N/A
25-Apr-18	0	2	11	36	22	2
26-Apr-18	0	N/A	17	38	26	2
27-Apr-18	0	N/A	13	49	34	3
28-Apr-18	0	2	14	N/A	N/A	2
29-Apr-18	N/A	2	15	44	18	2
30-Apr-18	0	2	15	74	45	2
30-Apr-18	0	2	15	74	45	2
1-May-18	N/A	N/A	N/A	98	92	2
2-May-18	N/A	2	14	62	42	2
3-May-18	N/A	2	15	48	40	2
4-May-18	N/A	3	16	N/A	38	N/A
5-May-18	0	2	16	60	92	2
6-May-18	0	2	17	44	28	0
7-May-18	0	4	17	55	33	N/A
8-May-18	0	N/A	15	25	N/A	2
9-May-18	0	N/A	15	50	28	2
10-May-18	0	10	N/A	91	87	2
11-May-18	0	N/A	15	41	36	2
12-May-18	0	3	16	53	22	N/A
13-May-18	0	2	16	N/A	16	0
14-May-18	N/A	3	16	37	30	N/A
15-May-18	0	2	15	52	29	2

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
16-May-18	0	3	18	52	30	2
17-May-18	0	4	20	27	32	2
18-May-18	0	2	14	24	31	3
19-May-18	0	2	12	N/A	26	2
20-May-18	0	1	12	N/A	29	N/A
21-May-18	0	N/A	13	62	20	2
22-May-18	N/A	N/A	17	52	189	2
23-May-18	0	3	17	41	N/A	2
24-May-18	0	2	14	46	N/A	2
25-May-18	0	2	17	N/A	N/A	N/A
26-May-18	0	2	14	49	N/A	2
27-May-18	0	3	15	81	N/A	0
28-May-18	0	N/A	14	55	N/A	2
29-May-18	N/A	3	N/A	50	N/A	N/A
30-May-18	N/A	3	N/A	62	N/A	2
31-May-18	0	2	N/A	53	N/A	0
1-Jun-18	N/A	2	N/A	85	N/A	N/A
2-Jun-18	0	2	N/A	84	N/A	2
3-Jun-18	0	3	N/A	42	382	2
4-Jun-18	0	2	N/A	56	N/A	2
5-Jun-18	N/A	1	N/A	105	288	2
6-Jun-18	N/A	10	N/A	153	55	2
7-Jun-18	0	1	13	110	N/A	2
8-Jun-18	0	3	12	188	62	3
9-Jun-18	0	3	14	114	93	2
10-Jun-18	0	2	9	38	22	2
11-Jun-18	N/A	2	13	72	44	2
12-Jun-18	0	2	13	N/A	70	2
13-Jun-18	0	N/A	11	N/A	32	N/A
14-Jun-18	0	3	13	61	42	2

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
15-Jun-18	0	3	14	44	25	2
16-Jun-18	N/A	N/A	10	30	14	2
17-Jun-18	0	2	11	58	25	2
18-Jun-18	0	5	9	22	13	2
19-Jun-18	0	2	10	N/A	N/A	N/A
20-Jun-18	0	N/A	7	36	26	2
21-Jun-18	0	N/A	6	52	25	3
22-Jun-18	0	2	11	53	30	2
23-Jun-18	0	2	13	68	34	2
24-Jun-18	0	3	15	66	28	2
25-Jun-18	0	2	13	78	38	2
26-Jun-18	0	2	13	59	53	2
27-Jun-18	0	N/A	15	80	45	2
28-Jun-18	0	3	11	60	25	2
29-Jun-18	0	2	9	102	N/A	2
30-Jun-18	0	3	12	44	14	2
1-Jul-18	0	N/A	9	32	10	2
2-Jul-18	0	3	10	74	43	2
3-Jul-18	N/A	3	9	32	25	2
4-Jul-18	0	2	10	78	160	2
5-Jul-18	N/A	3	13	45	38	2
6-Jul-18	0	2	10	50	25	2
7-Jul-18	0	N/A	13	N/A	45	2
8-Jul-18	0	4	13	N/A	17	2
9-Jul-18	0	3	12	23	19	2
10-Jul-18	0	4	13	N/A	37	2
11-Jul-18	0	2	11	75	44	2
12-Jul-18	0	3	8	110	49	2
13-Jul-18	0	4	8	100	114	28
14-Jul-18	0	2	12	91	28	2

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
15-Jul-18	0	N/A	9	42	24	2
16-Jul-18	0	N/A	7	36	16	2
17-Jul-18	0	2	11	N/A	37	2
18-Jul-18	0	1	8	31	20	2
19-Jul-18	0	N/A	8	58	31	2
20-Jul-18	N/A	3	14	114	90	2
21-Jul-18	0	3	14	58	27	2
22-Jul-18	0	3	17	49	N/A	2
23-Jul-18	0	N/A	13	78	107	2
24-Jul-18	0	N/A	N/A	N/A	12	2
25-Jul-18	N/A	N/A	12	91	56	2
26-Jul-18	0	2	9	70	49	2
27-Jul-18	0	2	7	38	15	8
28-Jul-18	0	2	12	45	N/A	2
29-Jul-18	0	N/A	8	50	22	2
30-Jul-18	0	N/A	8	44	27	2
1-Aug-18	0	2	11	29	N/A	N/A
2-Aug-18	0	2	7	56	22	2
3-Aug-18	0	2	9	108	89	5
4-Aug-18	N/A	2	9	27	19	2
5-Aug-18	0	1	12	29	16	2
6-Aug-18	0	N/A	9	70	52	3
7-Aug-18	N/A	N/A	9	86	56	3
8-Aug-18	N/A	N/A	N/A	60	40	2
9-Aug-18	0	N/A	7	52	166	3
10-Aug-18	0	N/A	10	51	382	3
11-Aug-18	0	N/A	11	N/A	N/A	2
12-Aug-18	0	3	16	65	N/A	N/A
13-Aug-18	N/A	8	13	42	N/A	2
14-Aug-18	N/A	3	12	30	403	2

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
15-Aug-18	0	2	12	61	395	3
16-Aug-18	0	1	N/A	44	N/A	N/A
17-Aug-18	N/A	4	N/A	154	160	N/A
18-Aug-18	N/A	7	N/A	N/A	N/A	N/A
19-Aug-18	N/A	1	N/A	N/A	N/A	N/A
20-Aug-18	0	2	N/A	492	N/A	N/A
21-Aug-18	0	1	N/A	N/A	N/A	N/A
22-Aug-18	0	N/A	N/A	35	N/A	N/A
23-Aug-18	0	N/A	N/A	N/A	N/A	N/A
24-Aug-18	0	2	N/A	N/A	N/A	N/A
25-Aug-18	N/A	2	N/A	38	N/A	N/A
26-Aug-18	0	2	N/A	38	N/A	N/A
27-Aug-18	0	3	N/A	39	N/A	N/A
28-Aug-18	N/A	N/A	N/A	44	N/A	N/A
29-Aug-18	0	N/A	N/A	50	N/A	N/A
30-Aug-18	0	N/A	N/A	47	N/A	N/A
31-Aug-18	0	3	N/A	50	N/A	N/A
1-Sep-18	0	N/A	N/A	50	N/A	N/A
2-Sep-18	0	3	N/A	38	N/A	N/A
3-Sep-18	0	2	N/A	39	N/A	N/A
4-Sep-18	N/A	N/A	N/A	53	N/A	N/A
5-Sep-18	0	2	N/A	70	N/A	N/A
6-Sep-18	N/A	3	N/A	46	N/A	N/A
7-Sep-18	0	N/A	N/A	46	N/A	N/A
8-Sep-18	0	N/A	N/A	40	N/A	N/A
9-Sep-18	0	N/A	N/A	33	N/A	N/A
10-Sep-18	0	N/A	N/A	38	N/A	N/A
11-Sep-18	N/A	2	N/A	59	N/A	N/A
12-Sep-18	N/A	N/A	N/A	92	N/A	N/A
13-Sep-18	N/A	3	N/A	43	N/A	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
14-Sep-18	0	2	N/A	47	N/A	N/A
15-Sep-18	0	2	N/A	38	N/A	N/A
16-Sep-18	0	2	N/A	44	N/A	N/A
17-Sep-18	0	N/A	N/A	33	N/A	N/A
18-Sep-18	0	N/A	5	38	153	N/A
19-Sep-18	0	N/A	7	41	13	8
20-Sep-18	0	N/A	12	95	59	8
21-Sep-18	0	N/A	N/A	93	84	N/A
22-Sep-18	N/A	3	N/A	45	15	6
23-Sep-18	N/A	N/A	17	42	14	N/A
24-Sep-18	0	N/A	14	33	12	6
25-Sep-18	0	2	9	42	13	6
26-Sep-18	N/A	N/A	N/A	49	25	N/A
27-Sep-18	0	N/A	13	36	N/A	N/A
28-Sep-18	N/A	N/A	N/A	32	18	N/A
29-Sep-18	0	N/A	10	69	30	6
30-Sep-18	0	4	12	41	6	6
1-Oct-18	0	N/A	9	33	17	8
2-Oct-18	0	N/A	9	N/A	18	8
3-Oct-18	0	N/A	10	33	20	N/A
4-Oct-18	0	6	13	N/A	19	N/A
5-Oct-18	0	4	12	24	42	8
6-Oct-18	N/A	4	9	42	7	8
7-Oct-18	N/A	5	12	34	10	8
8-Oct-18	0	5	9	39	11	8
9-Oct-18	0	4	8	40	13	N/A
10-Oct-18	N/A	N/A	7	36	12	N/A
11-Oct-18	0	5	11	37	13	8
12-Oct-18	0	3	11	86	105	N/A
13-Oct-18	N/A	5	N/A	43	15	8

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
14-Oct-18	N/A	4	13	33	9	8
15-Oct-18	0	N/A	7	47	15	8
16-Oct-18	N/A	N/A	8	40	13	N/A
17-Oct-18	0	6	9	20	5	8
18-Oct-18	N/A	4	9	25	6	N/A
19-Oct-18	N/A	5	6	32	13	8
20-Oct-18	0	N/A	9	25	3	8
21-Oct-18	0	N/A	12	27	5	8
22-Oct-18	0	7	9	31	7	8
23-Oct-18	0	4	N/A	35	6	N/A
24-Oct-18	0	3	10	38	10	8
25-Oct-18	0	4	115	89	102	46
26-Oct-18	0	3	10	23	8	8
27-Oct-18	0	N/A	12	38	13	8
28-Oct-18	0	5	13	81	78	8
29-Oct-18	0	N/A	9	36	12	N/A
30-Oct-18	0	6	13	34	10	8
31-Oct-18	0	N/A	10	39	6	8
1-Nov-18	0	N/A	8	56	21	8
2-Nov-18	0	N/A	8	52	13	8
3-Nov-18	0	N/A	12	33	14	8
4-Nov-18	0	N/A	5	35	17	8
5-Nov-18	N/A	N/A	8	N/A	23	8
6-Nov-18	0	6	10	46	19	8
7-Nov-18	0	N/A	6	41	81	8
8-Nov-18	0	N/A	7	38	7	8
9-Nov-18	0	N/A	7	41	48	8
10-Nov-18	0	N/A	8	36	382	8
11-Nov-18	0	6	16	28	N/A	8
12-Nov-18	0	N/A	8	27	N/A	8

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
13-Nov-18	0	N/A	12	29	N/A	8
14-Nov-18	N/A	5	13	37	294	8
15-Nov-18	0	8	15	32	7	8
16-Nov-18	0	6	14	49	10	8
17-Nov-18	0	5	N/A	40	11	8
18-Nov-18	0	5	17	35	7	8
19-Nov-18	N/A	N/A	13	37	8	8
20-Nov-18	0	5	14	22	8	8
21-Nov-18	0	6	17	38	10	8
22-Nov-18	0	5	12	19	11	8
23-Nov-18	0	N/A	13	28	10	8
24-Nov-18	N/A	N/A	13	42	11	N/A
25-Nov-18	0	5	16	48	15	8
26-Nov-18	0	7	15	46	17	8
27-Nov-18	0	5	N/A	30	9	8
28-Nov-18	N/A	N/A	6	N/A	265	N/A
29-Nov-18	N/A	N/A	N/A	N/A	360	9
30-Nov-18	N/A	N/A	5	N/A	360	N/A
1-Dec-18	N/A	N/A	4	N/A	N/A	N/A
2-Dec-18	N/A	N/A	6	N/A	N/A	N/A
3-Dec-18	N/A	N/A	4	N/A	N/A	0
4-Dec-18	N/A	N/A	5	N/A	338	N/A
5-Dec-18	N/A	N/A	5	N/A	N/A	N/A
6-Dec-18	N/A	N/A	N/A	N/A	N/A	0
7-Dec-18	N/A	N/A	5	N/A	N/A	N/A
8-Dec-18	N/A	N/A	5	N/A	N/A	0
9-Dec-18	N/A	N/A	9	N/A	N/A	N/A
10-Dec-18	N/A	N/A	129	N/A	N/A	0
11-Dec-18	N/A	N/A	N/A	N/A	N/A	N/A
12-Dec-18	N/A	N/A	5	N/A	N/A	0

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
13-Dec-18	N/A	N/A	5	N/A	N/A	0
14-Dec-18	N/A	N/A	6	N/A	N/A	0
15-Dec-18	N/A	N/A	6	N/A	N/A	0
16-Dec-18	N/A	N/A	7	N/A	N/A	N/A
17-Dec-18	N/A	N/A	5	N/A	N/A	N/A
18-Dec-18	N/A	N/A	27	N/A	360	0
19-Dec-18	N/A	N/A	2	N/A	N/A	0
20-Dec-18	N/A	N/A	N/A	N/A	240	0
21-Dec-18	N/A	N/A	6	N/A	N/A	N/A
22-Dec-18	N/A	N/A	5	N/A	N/A	0
23-Dec-18	N/A	N/A	6	N/A	N/A	0
24-Dec-18	N/A	N/A	6	N/A	N/A	0
25-Dec-18	N/A	N/A	9	N/A	N/A	N/A
26-Dec-18	N/A	N/A	8	N/A	N/A	0
27-Dec-18	N/A	N/A	8	N/A	N/A	0
28-Dec-18	N/A	N/A	10	N/A	462	N/A
29-Dec-18	N/A	N/A	6	N/A	382	0
30-Dec-18	N/A	N/A	10	N/A	382	N/A
31-Dec-18	N/A	N/A	6	N/A	N/A	0
1-Jan-19	N/A	N/A	9	N/A	N/A	N/A
2-Jan-19	N/A	N/A	6	N/A	N/A	0
3-Jan-19	N/A	N/A	6	N/A	N/A	0
4-Jan-19	N/A	N/A	6	N/A	N/A	0
5-Jan-19	N/A	N/A	7	N/A	N/A	0
6-Jan-19	N/A	N/A	7	N/A	N/A	N/A
7-Jan-19	N/A	N/A	6	N/A	413	N/A
8-Jan-19	N/A	N/A	N/A	N/A	30	N/A
9-Jan-19	N/A	N/A	5	N/A	33	0
10-Jan-19	N/A	N/A	5	N/A	34	N/A
11-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
12-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A
13-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A
14-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A
15-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A
16-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A
17-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A
18-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A
19-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A
20-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A
21-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A
22-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A
23-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A
24-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A
25-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A
26-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A
27-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A
28-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A
29-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A
30-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A
31-Jan-19	N/A	N/A	N/A	N/A	N/A	N/A
1-Feb-19	N/A	N/A	N/A	N/A	N/A	N/A
2-Feb-19	N/A	N/A	N/A	N/A	N/A	N/A
3-Feb-19	N/A	N/A	N/A	N/A	N/A	N/A
4-Feb-19	N/A	N/A	N/A	N/A	N/A	N/A
5-Feb-19	N/A	N/A	N/A	N/A	N/A	N/A
6-Feb-19	N/A	N/A	N/A	N/A	N/A	N/A
7-Feb-19	N/A	N/A	N/A	N/A	N/A	N/A
8-Feb-19	N/A	N/A	N/A	N/A	N/A	N/A
9-Feb-19	N/A	N/A	N/A	N/A	N/A	N/A
10-Feb-19	N/A	N/A	N/A	N/A	N/A	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
11-Feb-19	N/A	N/A	N/A	N/A	N/A	N/A
12-Feb-19	N/A	N/A	3	N/A	N/A	N/A
13-Feb-19	0	12	5	54	24	8
14-Feb-19	N/A	N/A	5	56	28	8
15-Feb-19	0	N/A	4	60	33	N/A
16-Feb-19	0	N/A	6	74	46	8
17-Feb-19	0	13	8	64	33	8
18-Feb-19	N/A	11	6	54	81	N/A
19-Feb-19	N/A	10	7	83	83	N/A
20-Feb-19	N/A	N/A	7	27	23	N/A
21-Feb-19	N/A	8	9	92	127	8
22-Feb-19	N/A	N/A	7	92	14	N/A
23-Feb-19	N/A	N/A	6	N/A	6	N/A
24-Feb-19	N/A	8	10	N/A	12	8
25-Feb-19	N/A	9	6	76	76	8
26-Feb-19	0	8	6	487	17	8
27-Feb-19	0	7	7	N/A	N/A	8
28-Feb-19	N/A	13	6	98	29	N/A
1-Mar-19	N/A	8	8	69	48	N/A
2-Mar-19	N/A	9	8	60	33	8
3-Mar-19	N/A	10	8	60	18	8
4-Mar-19	N/A	8	10	N/A	33	N/A
5-Mar-19	N/A	7	11	N/A	28	8
6-Mar-19	N/A	6	7	86	30	8
7-Mar-19	N/A	N/A	6	72	46	N/A
8-Mar-19	N/A	N/A	N/A	135	104	N/A
9-Mar-19	N/A	N/A	N/A	48	N/A	N/A
10-Mar-19	N/A	N/A	5	42	N/A	N/A
11-Mar-19	N/A	N/A	6	N/A	17	12
12-Mar-19	N/A	N/A	4	N/A	20	12

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
13-Mar-19	N/A	N/A	5	N/A	22	12
14-Mar-19	N/A	N/A	6	N/A	25	N/A
15-Mar-19	N/A	N/A	5	N/A	21	12
16-Mar-19	N/A	N/A	8	N/A	35	12
17-Mar-19	N/A	N/A	6	N/A	N/A	12
18-Mar-19	N/A	N/A	7	150	65	12
19-Mar-19	N/A	N/A	8	109	61	12
20-Mar-19	N/A	N/A	6	84	189	12
21-Mar-19	N/A	N/A	5	119	97	12
22-Mar-19	N/A	N/A	7	56	33	12
23-Mar-19	N/A	N/A	8	52	38	12
24-Mar-19	N/A	N/A	N/A	46	29	12
25-Mar-19	N/A	N/A	8	52	23	12
26-Mar-19	N/A	N/A	N/A	43	83	12
27-Mar-19	N/A	N/A	5	41	11	N/A
28-Mar-19	N/A	N/A	5	49	17	12
29-Mar-19	N/A	N/A	5	N/A	16	12
30-Mar-19	N/A	N/A	7	N/A	10	12
31-Mar-19	N/A	N/A	7	N/A	18	12
1-Apr-19	N/A	N/A	7	N/A	23	12
2-Apr-19	N/A	N/A	11	72	55	13
3-Apr-19	N/A	N/A	7	38	81	12
4-Apr-19	N/A	N/A	9	50	18	12
5-Apr-19	N/A	N/A	8	119	83	12
6-Apr-19	N/A	N/A	11	N/A	11	12
7-Apr-19	N/A	N/A	15	N/A	15	12
8-Apr-19	N/A	N/A	10	34	13	12
9-Apr-19	N/A	N/A	10	N/A	15	12
10-Apr-19	N/A	N/A	8	N/A	N/A	12
11-Apr-19	N/A	N/A	7	N/A	19	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
12-Apr-19	N/A	N/A	7	113	85	N/A
13-Apr-19	N/A	N/A	5	47	29	12
14-Apr-19	N/A	N/A	N/A	N/A	25	12
15-Apr-19	N/A	N/A	N/A	N/A	31	N/A
16-Apr-19	N/A	N/A	8	23	10	12
17-Apr-19	N/A	N/A	50	N/A	128	12
18-Apr-19	N/A	N/A	7	N/A	18	12
19-Apr-19	N/A	N/A	9	N/A	16	12
20-Apr-19	N/A	N/A	N/A	N/A	28	12
21-Apr-19	N/A	N/A	8	N/A	23	12
22-Apr-19	N/A	N/A	8	N/A	14	12
23-Apr-19	N/A	N/A	5	N/A	23	N/A
24-Apr-19	N/A	N/A	4	N/A	17	N/A
25-Apr-19	N/A	N/A	3	N/A	N/A	N/A
26-Apr-19	N/A	N/A	4	176	40	12
27-Apr-19	N/A	N/A	6	N/A	N/A	12
28-Apr-19	N/A	N/A	6	N/A	N/A	12
29-Apr-19	N/A	N/A	4	N/A	N/A	12
1-May-19	N/A	N/A	6	56	447	N/A
2-May-19	N/A	N/A	8	77	292	32
3-May-19	N/A	N/A	5	54	17	N/A
4-May-19	N/A	N/A	7	N/A	20	9
5-May-19	N/A	N/A	9	55	22	6
6-May-19	N/A	N/A	6	58	92	N/A
7-May-19	N/A	N/A	5	50	21	N/A
8-May-19	N/A	N/A	4	53	25	49
9-May-19	N/A	N/A	5	65	36	N/A
10-May-19	N/A	N/A	5	75	41	63
11-May-19	N/A	N/A	6	58	40	63
12-May-19	N/A	N/A	8	N/A	31	64

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
13-May-19	N/A	N/A	5	N/A	34	N/A
14-May-19	N/A	N/A	14	240	94	65
15-May-19	N/A	11	4	100	90	64
16-May-19	0	9	3	36	26	64
17-May-19	0	10	4	N/A	28	64
18-May-19	0	6	4	N/A	25	64
19-May-19	0	9	6	N/A	23	65
20-May-19	0	7	7	N/A	25	65
21-May-19	N/A	7	6	N/A	35	64
22-May-19	0	6	5	N/A	28	65
23-May-19	N/A	9	4	N/A	29	N/A
24-May-19	N/A	N/A	4	N/A	130	65
25-May-19	N/A	N/A	2	N/A	20	N/A
26-May-19	N/A	N/A	3	N/A	18	N/A
27-May-19	N/A	N/A	3	N/A	19	N/A
28-May-19	N/A	N/A	2	N/A	16	N/A
29-May-19	N/A	N/A	4	N/A	89	63
30-May-19	N/A	15	5	N/A	42	N/A
31-May-19	N/A	12	3	38	23	N/A
1-Jun-19	N/A	13	3	43	21	N/A
2-Jun-19	N/A	6	11	76	81	N/A
3-Jun-19	N/A	12	7	N/A	83	N/A
4-Jun-19	N/A	10	3	69	39	N/A
5-Jun-19	N/A	7	5	N/A	30	62
6-Jun-19	N/A	7	3	N/A	40	N/A
7-Jun-19	N/A	8	3	57	34	N/A
8-Jun-19	N/A	7	3	64	34	N/A
9-Jun-19	N/A	11	5	55	23	N/A
10-Jun-19	N/A	22	4	58	116	N/A
11-Jun-19	N/A	16	3	70	35	9

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
12-Jun-19	N/A	14	2	N/A	33	9
13-Jun-19	N/A	16	3	37	27	8
14-Jun-19	N/A	17	3	66	36	8
15-Jun-19	N/A	19	3	N/A	21	8
16-Jun-19	N/A	20	4	N/A	34	6
17-Jun-19	N/A	23	3	24	13	8
18-Jun-19	N/A	19	3	45	21	8
19-Jun-19	N/A	14	5	37	14	6
20-Jun-19	N/A	15	4	65	31	6
21-Jun-19	N/A	12	2	95	54	8
22-Jun-19	N/A	18	3	44	26	6
23-Jun-19	N/A	17	3	N/A	15	8
24-Jun-19	N/A	30	N/A	52	26	N/A
25-Jun-19	0	15	5	78	36	6
26-Jun-19	0	23	6	N/A	30	8
27-Jun-19	0	29	10	N/A	21	8
28-Jun-19	0	17	5	N/A	20	N/A
29-Jun-19	0	15	21	144	91	6
30-Jun-19	0	16	8	N/A	35	6
1-Jul-19	0	17	6	N/A	29	8
2-Jul-19	0	20	6	N/A	25	8
3-Jul-19	0	14	7	N/A	31	8
4-Jul-19	0	20	7	39	14	6
5-Jul-19	N/A	18	5	60	27	N/A
6-Jul-19	N/A	18	7	N/A	88	6
7-Jul-19	0	16	7	N/A	25	N/A
8-Jul-19	0	12	4	N/A	22	N/A
9-Jul-19	0	15	4	N/A	16	6
10-Jul-19	0	12	6	N/A	37	8
11-Jul-19	0	14	6	N/A	36	8

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
12-Jul-19	0	14	6	47	19	8
13-Jul-19	N/A	15	4	33	15	6
14-Jul-19	N/A	14	7	N/A	24	8
15-Jul-19	N/A	19	5	38	22	8
16-Jul-19	0	23	10	48	16	6
17-Jul-19	0	16	5	39	16	6
18-Jul-19	N/A	14	4	36	17	8
19-Jul-19	0	15	6	64	425	8
20-Jul-19	0	15	7	N/A	N/A	N/A
21-Jul-19	0	13	7	N/A	N/A	N/A
22-Jul-19	0	13	4	19	N/A	N/A
23-Jul-19	0	13	4	74	N/A	N/A
24-Jul-19	0	14	5	45	N/A	N/A
25-Jul-19	0	12	6	84	N/A	N/A
26-Jul-19	0	18	8	N/A	311	N/A
27-Jul-19	0	14	4	N/A	27	8
28-Jul-19	0	18	10	N/A	15	8
29-Jul-19	0	17	4	N/A	12	8
30-Jul-19	0	19	5	N/A	15	8
31-Jul-19	0	16	6	N/A	28	8
1-Aug-19	0	17	9	N/A	29	8
2-Aug-19	0	11	4	N/A	19	10
3-Aug-19	0	11	6	N/A	20	N/A
4-Aug-19	0	N/A	9	N/A	14	N/A
5-Aug-19	0	N/A	9	N/A	13	8
6-Aug-19	0	14	9	N/A	13	N/A
7-Aug-19	0	N/A	5	N/A	18	8
8-Aug-19	0	N/A	10	N/A	16	8
9-Aug-19	0	N/A	4	50	22	8
10-Aug-19	0	N/A	4	56	30	39

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
11-Aug-19	0	34	7	39	19	8
12-Aug-19	0	32	2	33	18	8
13-Aug-19	0	34	7	48	82	8
14-Aug-19	0	31	4	38	17	8
15-Aug-19	0	31	2	39	22	8
16-Aug-19	0	30	4	95	52	12
17-Aug-19	0	29	7	45	23	8
18-Aug-19	N/A	N/A	10	14	11	141
19-Aug-19	N/A	N/A	6	N/A	19	9
20-Aug-19	N/A	N/A	5	N/A	30	8
21-Aug-19	N/A	N/A	5	N/A	29	10
22-Aug-19	N/A	N/A	4	N/A	27	8
23-Aug-19	N/A	N/A	4	N/A	28	N/A
24-Aug-19	N/A	N/A	5	N/A	24	8
25-Aug-19	N/A	N/A	6	N/A	40	8
26-Aug-19	N/A	N/A	8	N/A	46	10
27-Aug-19	N/A	N/A	6	N/A	28	9
28-Aug-19	N/A	N/A	7	N/A	28	N/A
29-Aug-19	N/A	N/A	6	N/A	25	8
30-Aug-19	N/A	N/A	N/A	N/A	172	N/A
31-Aug-19	N/A	N/A	N/A	N/A	78	N/A
1-Sep-19	N/A	N/A	N/A	N/A	99	N/A
2-Sep-19	N/A	N/A	N/A	N/A	91	N/A
3-Sep-19	N/A	N/A	N/A	N/A	N/A	N/A
4-Sep-19	N/A	N/A	N/A	N/A	N/A	N/A
5-Sep-19	N/A	N/A	N/A	N/A	80	N/A
6-Sep-19	N/A	N/A	N/A	N/A	28	N/A
7-Sep-19	N/A	N/A	N/A	N/A	28	N/A
8-Sep-19	N/A	N/A	N/A	N/A	25	N/A
9-Sep-19	N/A	N/A	N/A	N/A	18	N/A

Date	CO	NO2	O3	PM-10	PM-2.5	SO2
10-Sep-19	N/A	N/A	N/A	N/A	20	N/A
11-Sep-19	N/A	N/A	N/A	N/A	16	N/A
12-Sep-19	N/A	N/A	N/A	N/A	18	N/A
13-Sep-19	N/A	N/A	N/A	N/A	24	N/A
14-Sep-19	N/A	N/A	N/A	N/A	26	N/A
15-Sep-19	N/A	N/A	N/A	N/A	24	N/A
16-Sep-19	N/A	N/A	N/A	N/A	34	N/A
17-Sep-19	N/A	N/A	N/A	N/A	18	N/A
18-Sep-19	N/A	N/A	N/A	N/A	19	N/A
19-Sep-19	N/A	N/A	N/A	N/A	15	N/A
20-Sep-19	N/A	N/A	N/A	N/A	16	N/A
21-Sep-19	N/A	N/A	N/A	N/A	17	N/A
22-Sep-19	N/A	N/A	N/A	N/A	18	N/A
23-Sep-19	N/A	N/A	N/A	N/A	N/A	N/A
24-Sep-19	N/A	N/A	N/A	N/A	N/A	N/A
25-Sep-19	N/A	N/A	N/A	N/A	N/A	N/A
26-Sep-19	N/A	N/A	N/A	N/A	N/A	N/A
27-Sep-19	N/A	N/A	N/A	N/A	N/A	N/A
28-Sep-19	N/A	N/A	N/A	N/A	N/A	N/A
29-Sep-19	N/A	N/A	N/A	N/A	N/A	N/A
30-Sep-19	N/A	N/A	N/A	N/A	N/A	N/A

9 APPENDIX I – STAKEHOLDER FEEDBACK ON DRAFT SOCIAL IMPACT ASSESSMENT REPORT

In keeping with the Stakeholder Engagement Plan, the Draft Social Impact Assessment (SIA) Report and Appendices for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements were lodged at the Diego Martin Regional Corporation from February 5th 2020 to March 6th 2020. Letters were sent to stakeholders consulted during the SIA process to inform them about the 30-day review period and of the availability of the SIA report at the DMRC. For the purpose of collecting responses from regional stakeholders, a special purpose e-mail address was created:

Comments on Draft Social Impact Assessment (SIA) Report and Appendices for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements

comments.dmvo.sia@gmail.com

The system was designed such that once comments were received, they would be automatically acknowledged and archived. As at March 6th 2020 (the end of the period for comments), no comments were received. The following subsection provides the letters sent to stakeholders.

9.1 LETTERS SENT

KAIRI CONSULTANTS LTD.

An integrated approach to development.

February 4, 2020

Dear Participants

Re: Invitation to view and comment on Social Impact Assessment Report for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements Project

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As a key stakeholder, this letter serves to invite you to view the Draft Social Impact Assessment Report completed by Kairi Consultants Ltd which will be available for public viewing from **Wednesday February 5th, 2020 to Thursday March 6th, 2020** at the **Diego Martin Regional Corporation Administration Building, 17-18 Diego Martin Main Road, Diego Martin**. We would welcome your comments and feedback on the Draft Social Impact Assessment Report. Comments on the Social Impact Assessment Report can be submitted at the following e-mail address:

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Sincerely

Lystra-Ann Johnson
Executive Director

14 Cochrane Street, Tunapuna, Trinidad and Tobago
Website: www.kairi.com
Tel: (868) 663-2677/1442 Fax: (868) 663-2677 E-mail: mail@kairi.com

KAIRI CONSULTANTS LTD.

An integrated approach to development.

February 4, 2020

Mr. Brent Lyons
Managing Director
Housing Development Corporation
44-46 South Quay
Port-of-Spain

Dear Mr. Lyons

Re: Invitation to view and comment on Social Impact Assessment Report for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements Project

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February 4, 2020

Mrs. Alicia Laurent-Wing
Environmental Management Authority
#8 Elizabeth Street
St. Clair
Port of Spain

Dear Mrs. Laurent-Wing

Re: Invitation to view and comment on Social Impact Assessment Report for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements Project

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KAIRI CONSULTANTS LTD.

An integrated approach to development.

February 4, 2020

Mr. Noel Garcia
Chairman
Trinidad and Tobago Housing Development Corporation (HDC)
44-46 South Quay
Port-of-Spain

Dear Mr. Garcia

Re: Invitation to view and comment on Social Impact Assessment Report for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements Project

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KAIRI CONSULTANTS LTD.

An integrated approach to development.

February 4, 2020

Ms. Annette Seaforth
Chief Executive Officer
Port of Spain City Corporation
2-4 Knox Street

Dear Ms. Seaforth

Re: Invitation to view and comment on Social Impact Assessment Report for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements Project

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KAIRI CONSULTANTS LTD.

An integrated approach to development.

February 4, 2020

Ms. Petricie Cain
Chief Executive Officer
Diego Martin Regional Corporation
17-18 Diego Martin Main Road
Diego Martin

Dear Ms. Cain

Re: Invitation to view and comment on Social Impact Assessment Report for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements Project

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KAIRI CONSULTANTS LTD.

An integrated approach to development.

February 4, 2020

His Worship the Mayor Alderman Joel Martinez
Port of Spain City Corporation
2-4 Knox Street
Port-of-Spain

Dear Mr. Martinez

Re: Invitation to view and comment on Social Impact Assessment Report for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements Project

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KAIRI CONSULTANTS LTD.

An integrated approach to development.

February 4, 2020

Susan Hong
Chairman
Diego Martin Regional Corporation
17-18 Diego Martin Main Road
Diego Martin

Dear Ms. Hong

Re: Invitation to view and comment on Social Impact Assessment Report for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements Project

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KAIRI CONSULTANTS LTD.

An integrated approach to development.

February 4, 2020

Senator the Honouable Mr. Rohan Sinanan
Ministry of Works and Transport
Corner of Richmond and London Streets
Port of Spain

Dear Mr. Sinanan

Re: Invitation to view and comment on Social Impact Assessment Report for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements Project

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KAIRI CONSULTANTS LTD.

An integrated approach to development.

February 4, 2020

Ms. Desdra Bascombe
Permanent Secretary
Ministry of Rural Development and Local Government
Kent House
Long Circular Road
Maraval

Dear Ms. Daniel

Re: Invitation to view and comment on Social Impact Assessment Report for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements Project

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An integrated approach to development.

February 4, 2020

Mr. Darryl Smith
MP Diego Martin Central
#1 Orchid Drive
Morne Coco Road
Petit Valley

Dear Mr. Darryl Smith

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An integrated approach to development.

February 4, 2020

Mr. Colm Imbert
Member of Parliament Diego Martin North East
1B Morne Coco Road
Maraval

Dear Mr. Imbert

Re: Invitation to view and comment on Social Impact Assessment Report for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements Project

The Ministry of Works and Transport (MOWT) through the National Infrastructure Development Company Ltd (NIDCO) has embarked on a project to improve the intersection of the Diego Martin Highway and the Western Main Road for improved access, safety, mobility, and connectivity.

MOWT applied to the Environmental Management Authority (EMA) for a Certificate of Environmental Clearance (CEC 5500/2018) for the Construction of a Vehicular Overpass in the vicinity of Powder Magazine and Related Improvement Works. As an integral part of the CEC process, a Social Impact Assessment (SIA) was conducted. Kairi Consultants Ltd was engaged by NIDCO in February 2019 to complete the SIA. The EMA requested that the MOWT hold public consultation meetings with neighbouring communities, including residents, businesses, institutions and other stakeholders, and have the draft Social Impact Assessment Report made available to stakeholders.

As a key stakeholder, this letter serves to invite you to view the Draft Social Impact Assessment Report completed by Kairi Consultants Ltd which will be available for public viewing from **Wednesday February 5th, 2020 to Thursday March 6th, 2020** at the **Diego Martin Regional Corporation Administration Building, 17-18 Diego Martin Main Road, Diego Martin**. We would welcome your comments and feedback on the Draft Social Impact Assessment Report. Comments on the Social Impact Assessment Report can be submitted at the following e-mail address:

Comments on Social Impact Assessment Report
comments.dmvo.sia@gmail.com

Sincerely

Lystra-Ann Johnson
Executive Director

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February 4, 2020

Dr. Keith Rowley
Member of Parliament
Diego Martin West
Constituency Office
1 La Horquetta Valley Road
Diego Martin

Dear Dr. Rowley

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February 4, 2020

Mr. Jameel Chadee Ameeral
Deputy Permanent Secretary (Ag.)
Ministry of Rural Development and Local Government
Kent House
Maraval

Dear Mr. Chadee Ameeral

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Comments on Social Impact Assessment Report
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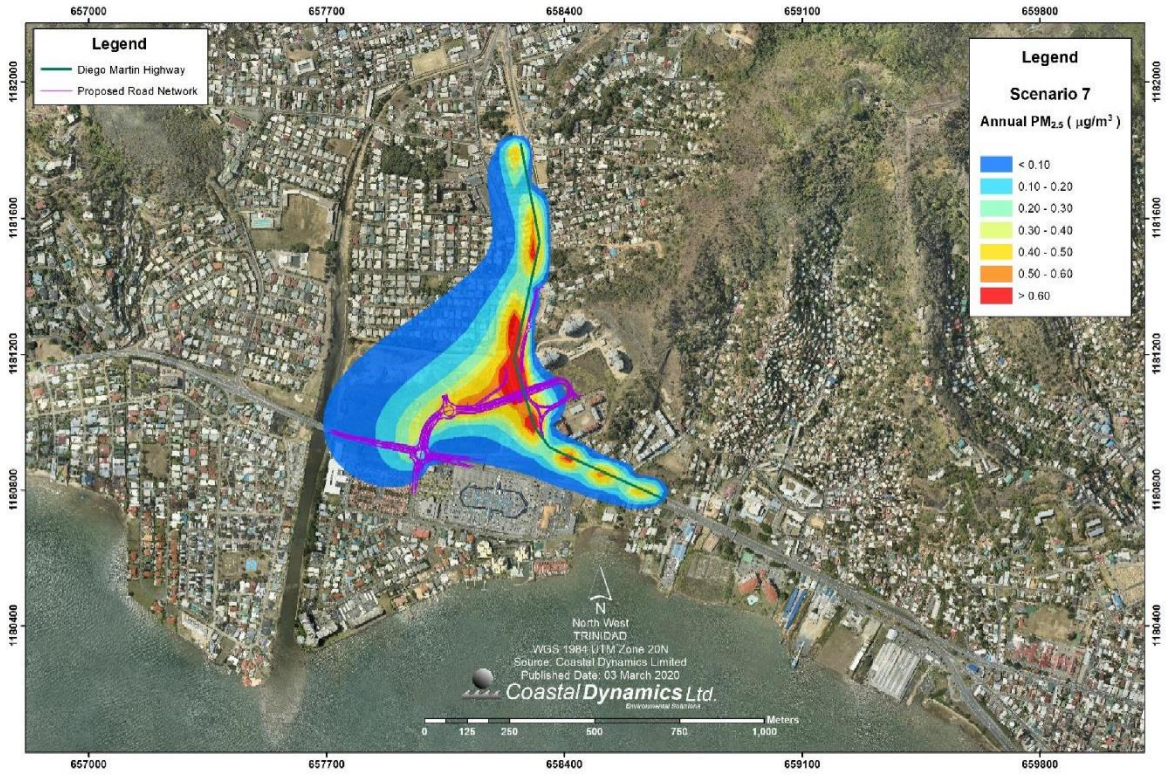
10 APPENDIX J - AIR DISPERSION MODELLING FOR THE CONSTRUCTION OF A VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED ROAD IMPROVEMENTS

National Infrastructure Development Company Limited

Air Quality Dispersion Modelling for Construction of Vehicular Overpass

REPORT



Original Date: March 4th 2020

Revised Date: May 1st 2020

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CLIENT: National Infrastructure Development Company (NIDCO)

CDL PROJECT NUMBER: E025-19

DOCUMENT TITLE: Air Quality Dispersion Modelling for Construction of a Vehicular Overpass

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REVISON RECORD

Revision	Date	Responsible Person	Description of Change
1	01/05/2020	Salomi Seeram	Graph titles updated for Figure 54, Figure 56, Figure 84, Figure 86, Figure 92, Figure 94 and Figure 101. Figure caption updated for Figure 15

DISTRIBUTION

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1 Introduction

National Infrastructure Development Company Limited (NIDCO) is proposing to construct a 4-lane vehicular overpass including link roads, ramps and drainage in Diego Martin, Trinidad. The approximate boundaries of the project area are the Powder Magazine Road (east), the eastern end of the Diego Martin River Bridge on Western Main Road (west), in the vicinity of Victoria Gardens (north) and southern boundary of the existing Western Main Road (south). The purpose of the air quality dispersion modelling is to satisfy the requirements of the Certificate of Environmental Clearance (CEC), request for 2nd Clarification of Further Information as required by the Environmental Management Authority (EMA).

EMA requires that air dispersion modelling be conducted within the defined project area using a model to predict the concentration levels and dispersion of temporal variability of traffic-related air pollutants in order to ascertain the defined zone(s) of impact.

Coastal Dynamics Limited (CDL) conducted the air dispersion modelling for the NIDCO Vehicular Overpass using AERMOD. The modelling methodology utilized was the U.S Environmental Protection Agency (US EPA) AERMOD dispersion modelling system. The model will consider both the Construction and Operational Phases of the project. Pollutant emissions modelled include typical mobile source emissions for vehicles and construction equipment: carbon monoxide (CO), oxides of nitrogen (NOx), particulate matter ($PM_{2.5}$, PM_{10}), total hydrocarbons (HC) and sulphur dioxide (SO_2).

Vehicular emissions from the proposed overpass were simulated to understand the distribution, spread and impact of emissions on the ambient air quality of the surrounding Diego Martin area. Sensitive receptors, such as but not limited to schools, health facilities, government infrastructure, religious institutions, recreational facilities and residential areas that are situated within the study area will also be identified and the concentration of emissions at each receptor will be analysed. Model results will be compared to Schedule 1 of the EMA Air Pollution Rules (2014) as well as modelled baseline conditions.

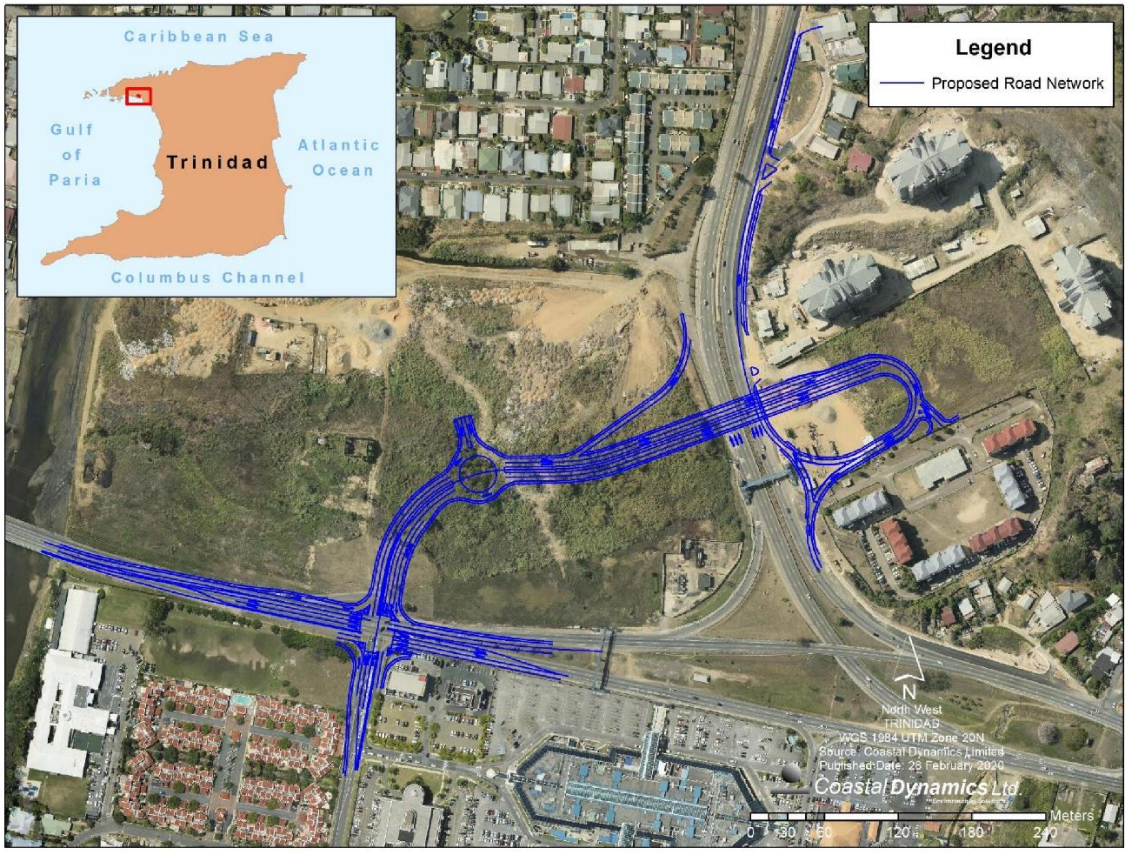


Figure 1: Map showing location of Proposed Overpass Project

2 Background

2.1 Literature Review for Traffic-related Air Pollution (TRAP)

Traffic-related air pollution (TRAP) is one of the major sources of exposure in urban areas and has been associated with a wide range of adverse human health effects. The mixture of vehicle exhausts, secondary pollutants formed in the atmosphere, evaporative emissions from vehicles, and non-combustion emissions (e.g., road dust, tire wear) is referred to as traffic-related air pollution (TRAP). Exposure to this complex and variable mixture of gasses and particles has been linked to a range of health effects from adverse birth outcomes to dementia (Stieb et al. 2016) and (Chen et al. 2017). Health Effects Institute (2010) published a critical review of the literature on emissions, exposure, and health effects of TRAP, identifying associations between TRAP exposure and adverse cardiorespiratory effects including exacerbation of asthma, incident asthma, reduced lung function, myocardial infarction, progression of atherosclerosis, and cardiovascular mortality (Health Effects Institute 2010). Studies have shown that traffic-related emissions affect ambient air quality on a wide range of spatial scales, from local roadsides and urban scales to broadly regional background scales. Based on a synthesis of the best available evidence, the Health Effects Institute identified an exposure zone within a range of up to 300 m to 500 m from a major road as the area most highly affected by traffic emissions (the range reflects the variable influence of background pollution concentrations, meteorological conditions, and season).

The Health Effects Institute concluded that the evidence is sufficient to support a causal relationship between exposure to traffic-related air pollution and exacerbation of asthma. It also found suggestive evidence of a causal relationship with onset of childhood asthma, non-asthma respiratory symptoms, impaired lung function, total and cardiovascular mortality, and cardiovascular morbidity, although the data are not sufficient to fully support causality. For a number of other health outcomes, there was limited evidence of associations, but the data were either inadequate or insufficient to draw firmer conclusions. The Panel's conclusions have to be considered in the context of the progress made to reduce emissions from motor vehicles. Since the epidemiology studies are based on past estimates of exposure from older vehicles, they may

not provide an accurate guide to estimating health associations in the future (Health Effects Institute 2010).

Atkinson et al. (2016) assembled a database of >100 daily, measured and modelled pollutant concentrations characterizing air pollution in London, UK between 2011 and 2012. Based on the analyses of temporal patterns and correlations between the metrics, knowledge of local emission sources and reference to the existing literature, they selected, *a priori*, markers of traffic pollution: oxides of nitrogen (general traffic); elemental and black carbon (EC/BC) (diesel exhaust); carbon monoxide (petrol exhaust); copper (tyre), zinc (brake) and aluminium (mineral dust). Poisson regression accounting for seasonality and meteorology was used to estimate the percentage change in risk of death associated with an interquartile increment of each pollutant. Associations were generally small with confidence intervals that spanned 0% and tended to be negative for cardiovascular mortality and positive for respiratory mortality. The strongest positive associations were for EC and BC adjusted for particle mass and respiratory mortality, 2.66% (95% confidence interval: 0.11, 5.28) and 2.72% (0.09, 5.42) per 0.8 and 1.0 $\mu g/m^3$, respectively. These associations were robust to adjustment for other traffic metrics and regional pollutants, suggesting a degree of specificity with respiratory mortality and diesel exhaust containing EC/BC.

Current evidence concerning the impact of exposure to traffic-related air pollution (TRAP) on adult respiratory morbidity mainly comes from cross-sectional studies. Bowatte et al. (2017) sought to establish more robust measures of this association and potential gene–environment interactions using longitudinal data from an established cohort study. Associations between measures of TRAP (nitrogen dioxide (NO_2) and distance to major roads) and wheeze, asthma prevalence and lung function were investigated in participants of the Tasmanian Longitudinal Health Study at 45- and 50-year follow-ups. Generalised estimating equations were used to quantify associations and the potential modifying effect of glutathione *S*-transferase gene variants. Living <200 m from a major road was associated with increased prevalence of current asthma and wheeze, and lower lung function. The association between living <200 m from a major road and current asthma and wheeze was more marked for carriers of the *GSTT1* null and *GSTP1 val/val* or *ile/val* genotypes. Over the 5-year period, higher NO_2 exposures were

associated with increased current asthma prevalence. Higher NO_2 exposure was associated with lower forced vital capacity for carriers of the *GSTT1* null genotype. TRAP exposures were associated with increased risk of asthma, wheeze and lower lung function in middle-aged adults. The interaction with the *GSTT1* genotype suggests that deficient antioxidant mechanisms may play a role in these adverse health effects.

2.2 Literature Review on Noise Barrier Mitigation Measure

Noise barriers have been added into urban environments to try to reduce the amount of air pollution in cities with a large number of highways, and studies have shown that they are quite effective. Studies consistently show that roads with the noise barriers have lower air pollution around them than that of other roads (Hagler et al. 2012). A field study showed that even a barrier that is only two meters high significantly decreased the pollutants on a boardwalk right next to the barrier (Oltean-Dumbrava and Miah 2016). This shows the close range effects the noise barrier has on the environment. A tracer gas study showed that a solid barrier reduced pollutant concentrations, as much as eighty percent next to the barrier relative to an open area (Venkatram et al. 2016). A numerical modelling study has showed that ground level concentration decreases as barrier height increases (Gong and Wang 2018).

A conducted a field study which quantified the impact of roadside barriers under real-world conditions in Phoenix, Arizona (Baldauf et al. 2016). Public health concerns regarding adverse health effects for populations spending significant amounts of time near high traffic roadways has increased substantially in recent years. Roadside features, including solid noise barriers, have been investigated as potential methods that can be implemented in a relatively short time period to reduce air pollution exposures from nearby traffic. A field study was conducted to determine the influence of noise barriers on both on-road and downwind pollutant concentrations near a large highway in Phoenix, Arizona, USA. Concentrations of nitrogen dioxide, carbon monoxide, ultrafine particles, and black carbon were measured using a mobile platform and fixed sites along two limited-access stretches of highway that contained a section of noise barrier and a section with no noise barrier at-grade with the surrounding terrain. Results of the study showed that pollutant concentrations behind the roadside barriers were significantly lower relative to those

measured in the absence of barriers. The reductions ranged from 50% within 50 m from the barrier to about 30% as far as 300 m from the barrier. Reductions in pollutant concentrations generally began within the first 50 meters of the barrier edge; however, concentrations were highly variable due to vehicle activity behind the barrier and along nearby urban arterial roadways. The concentrations on the highway, upwind of the barrier, varied depending on wind direction. Overall, the on-road concentrations in front of the noise barrier were similar to those measured in the absence of the barrier, contradicting previous modeling results that suggested roadside barriers increase pollutant levels on the road. Thus, this study suggests that noise barriers do reduce potential pollutant exposures for populations downwind of the road, and do not likely increase exposures to traffic-related pollutants for vehicle passengers on the highway.

2.3 Emission Parameters

Increasing air pollution levels due to rapid urbanization and growth in industrial emissions, vehicular emission and transportation activity are now causes of major concern in many large cities of the world. Air pollutants from cars, trucks and other motor vehicles are found in higher concentrations near major roads. Exhaust emissions from road transport arise from the combustion of fuels such as petrol, diesel, liquefied petroleum gas (LPG), and natural gas in internal combustion engines. The air/fuel charge may be ignited by a spark ('spark-ignition' or 'positive-ignition' engines), or it may ignite spontaneously when compressed ('compression-ignition' engines) (Ntziachristos and Samaras 2019). The criteria pollutant emissions generated from fuel combustion by internal combustion engines (ICE) include nitrogen oxides (NO and NO_2, together called NOx), hydrocarbons (HC)—also known as volatile organic compounds (VOCs) or non-methane hydrocarbons (NMHC), carbon monoxide (CO), and particulate matter of size <10 microns (PM10) and <2.5 microns (PM2.5) (Winkler et al. 2018). Many of these emissions also contribute to the formation of secondary pollutants such as ozone (O_3) and secondary particulate matter. Traffic-related air pollution has a profound impact on human health especially for communities located in close proximity to highways.

Diesel and gasoline engines are the major sources of power used in motor vehicles. Both are internal combustion engines but differ fundamentally in terms of their fuel–air mixture

preparation and ignition, and the fuels they use: diesel fuel is composed of petroleum fractions with a higher boiling range than those of gasoline. Based on research and more importantly the availability of emission factors the following critical air pollutants were selected for air dispersion modelling:

For Construction – CO, NOx, PM_{10} and SO_2

For Operation – CO, NOx, $PM_{2.5}$ and HC

The primary factors influencing dilution and dispersion of pollutants are wind and stability. The higher the wind speeds, the lower the pollutant concentration. Land based areas bordered by complex topography thus experience relatively higher concentrations or significant levels of air pollutants because of the presence of barriers that tend to interrupt dispersion of pollutants.

2.4 Modelling Objectives

Air dispersion modelling was conducted within the defined project area of the proposed overpass to determine the impact of project emissions from the vehicle overpass on the surrounding Diego Martin area. This impact will be determined by obtaining the following information from the model output:

1. The distribution and spread of vehicular emissions from the proposed overpass via the use of BREEZE AERMOD Software during the Construction and Operational Phases.
2. The concentration of the emissions at receptors including sensitive receptors within and along the boundaries of the study area.
3. The concentration of pollutants at different heights for the high-rise apartment buildings (sensitive receptors) in the immediate vicinity of the proposed overpass.
4. The maximum ground level concentrations of the pollutants on a daily (24 hours) and average annual basis (over two years).

2.5 AERMOD Dispersion Modelling Overview

Air pollution modelling is a numerical tool used to describe and predict the fate of pollutant emissions based on meteorology and geophysical data (Daly and Zannetti 2007). CDL uses BREEZE AERMOD Software (version 18081), an Environmental Protection Agency (US EPA)

approved steady-state Gaussian Air Dispersion model. BREEZE AERMOD software is widely used for assessing the level of atmospheric air pollution and for simulating the dispersion of air pollutants in a certain atmospheric area (Stefanova and Chuturkova 2017). The model simulates the response of the modelled plumes to atmospheric characteristics in order to understand the impact of project emissions on the ambient air quality of the surrounding area and to estimate the cumulative effect of emissions at long distances as well as in higher layers of the atmosphere (Stefanova and Chuturkova 2017).

AERMOD handles flat or complex, rural or urban terrain within a 50 km distance from the source emitter and includes algorithms for building effects and plume penetration of inversions aloft. Algorithms for plume depletion by wet and dry deposition are also included in the model. AERMOD also allows for the ground level concentrations at each receptor to be calculated, as well as flagpole receptors for concentrations at specified heights.

The AERMOD RLINEXT source algorithm was used to model the near-surface releases from mobile sources and was used to represent a travelled roadway with multiple lanes of traffic. The AERMOD model simulates mobile source emissions using Romberg numerical integration of point sources, with the number of points included in the integration determined by error analysis. As such, for this proposed overpass project, a non-buoyant line RLINEXT source was used and information as such the offset distance from road centerline, number of lanes, width per lane and initial vertical dispersion for each specified road was inputted.

The AERMOD System consists of the following three main components (USEPA 2018):

1. **AERMET** – the meteorological pre-processor needed by AERMOD which uses meteorological data and surface characteristics to calculate atmospheric boundary layer parameters. Meteorological data is used to estimate vertical profiles of wind speed, wind direction, turbulence, temperature and temperature gradient while upper air sounding (rawinsonde) data is used to estimate convective mixing height throughout the day.
2. **AERMAP** – the terrain pre-processor which characterizes the topography of the area, calculates terrain height and generates receptor grids for AERMOD. For each receptor

on this grid, AERMAP provides the location, height above sea level and the receptor specific terrain height scale.

3. **AERMOD** – the main model which performs the dispersion calculations using input data from AERMET and AERMAP, as well as (physical) source data and emission data (chemical). AERMOD uses this information to calculate concentrations while taking into account changes in dispersion rate with height. It also allows for a non-Gaussian plume in convective conditions and accounts for a dispersion rate that is a continuous function of meteorology.

The following diagram (**Figure 2**) summarises the main input data for AERMET and AERMAP that is required for modelling a roadway (as a line source) in AERMOD.

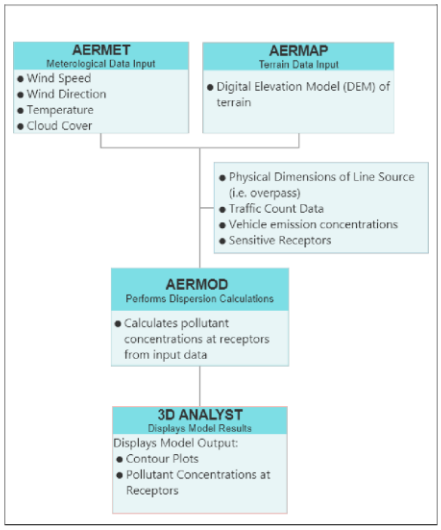


Figure 2: Summary of Line Source Input Data required for AERMOD

3 Method and Model Input

The methodology and input data used for each of the three model components are outlined below.

3.1 AERMET

The meteorological data required by AERMET was wind speed, wind direction, temperature and cloud cover. Modelled wind speed, wind direction and temperature were extracted from the National Oceanographic and Atmospheric Administration's (NOAA) National Centers for Environmental Prediction (NCEP) Global Forecast System (GFS) database for an approximate three-year period (April 2017 – February 2020). The default wind speed threshold for the model was set at 0.5 m/s. The location of the NIDCO overpass was overlayed on the dataset and the nearest grid cell was chosen. The resolution of the model grid was 0.25°. Cloud cover data was extracted from NCEP Climate Forecast System (CFS) also for the same one-year period, and the overlay method was used to extract cloud cover for the site location. The resolution of this grid was 0.2 °.

Upper Air Sounding Data from the NOAA Earth System Research Laboratory (NOAA/ESRL) Radiosonde Database was obtained from the Piarco, Trinidad and Tobago station for the period April 2017 – February 2020.

Surface characteristics for the Diego Martin area in the form of surface roughness (i.e. mechanical turbulence due to land obstacles to the wind flow), albedo (i.e. reflection of solar radiation by the earth's surface to space without absorption), and Bowen ratio (i.e. indicator of moisture in the atmosphere) were also required for the model. These surface characteristic values were determined using the Land Cover Classification System (USEPA 2008). Tables A-1, A-2 and A-3 (Land Cover Classification System) of the US EPA AERSURFACE User Guide 2008 were used to determine albedo, bowen ratio and surface roughness respectively. Satellite imagery of the Diego Martin area surrounding the proposed vehicular overpass (within a 1 km and 5 km radius) was used to determine the different land uses of the Diego Martin area (e.g. residential, forest, etc.) according to the Land Cover Classification Tables. After the different land uses were

determined, a weighted average was then calculated using the "summer" column of the tables i.e. column 1. The weighted averages were then input into AERMET for generation of the meteorological data files for subsequent input into AERMOD.

AERMET generates two output files, a surface meteorological data file and a profile met data file, which were input into AERMOD for the dispersion calculation component.

3.2 AERMAP

The AERMOD model contains the terrain preprocessor, AERMAP, which analyzes the topographical data of the site and is used to account for surface variations such as mountains that affect ground level concentrations. AERMAP determines the height of all receptors and sources as well as the altitude scale of any receptor that has the greatest effect on the dispersion of pollutants in that receptor. A Digital Terrain Model (DTM) was used to represent elevations within the study area. The coordinates for the location of the proposed overpass were overlayed on the DTM to obtain an elevation of 2.3 m. Elevations of the emissions sources and their emission heights, which are calculated from the model, were relative to this 2.3 m terrain elevation for Diego Martin.

Terrain data used for input into AERMAP was a 1m resolution Digital Terrain Model (DTM) obtained from NIDCO for the Diego Martin area (**Figure 3**). The DTM represents the bare earth surface with buildings, vegetation and other features removed. It was derived from an aerial LiDAR survey conducted by the Surveys and Mapping Division, Ministry of Agriculture, Land and Fisheries in 2014 and has a spatial resolution of 1 m. Additionally, CDL conducted a UAV (drone) survey over the study area to measure the heights of specific key receptors within the immediate vicinity of the study area. These included Victoria Keyes and Powder Magazine (**Figure 4**).

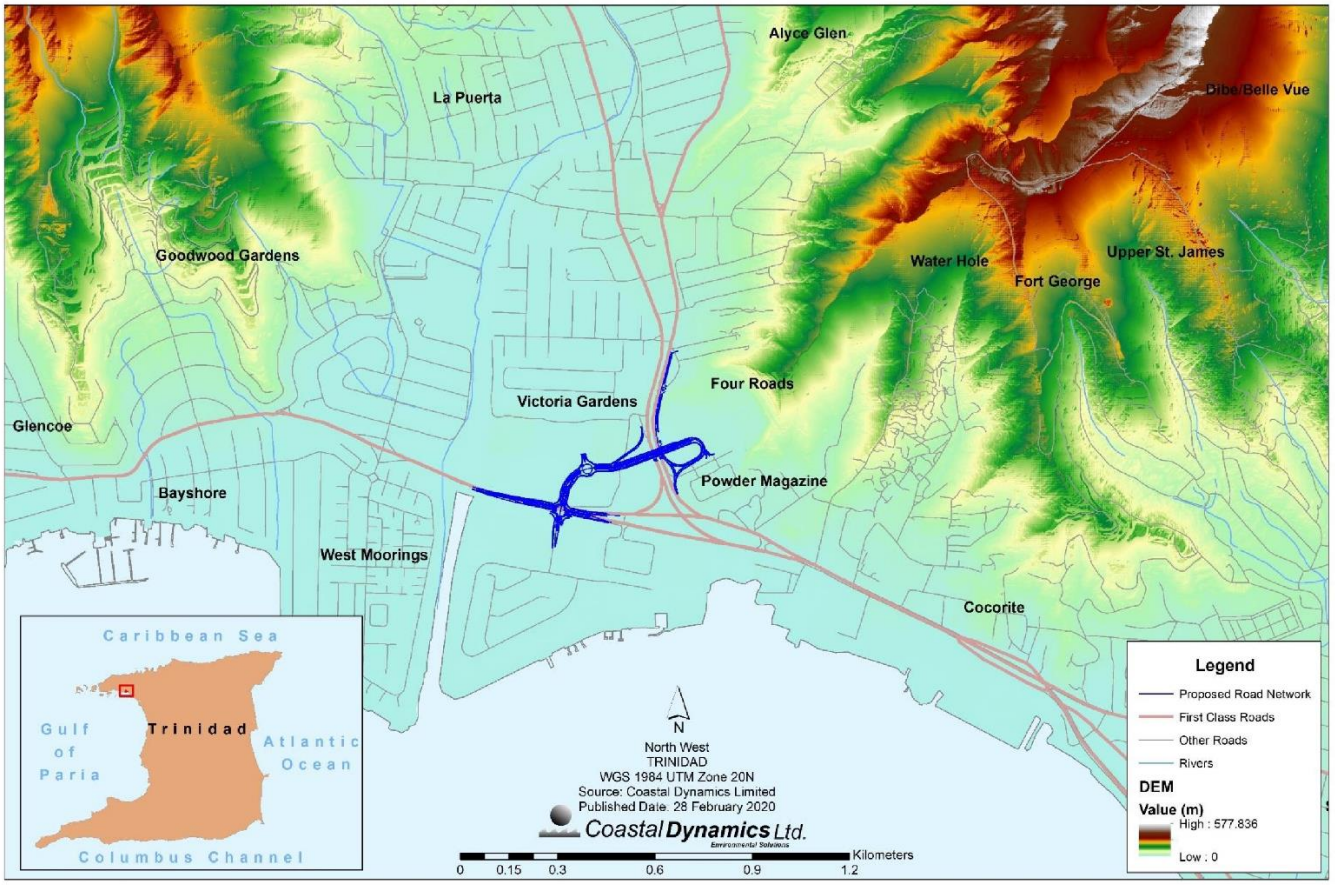


Figure 3: DTM Hillshade of the Proposed Overpass Project area

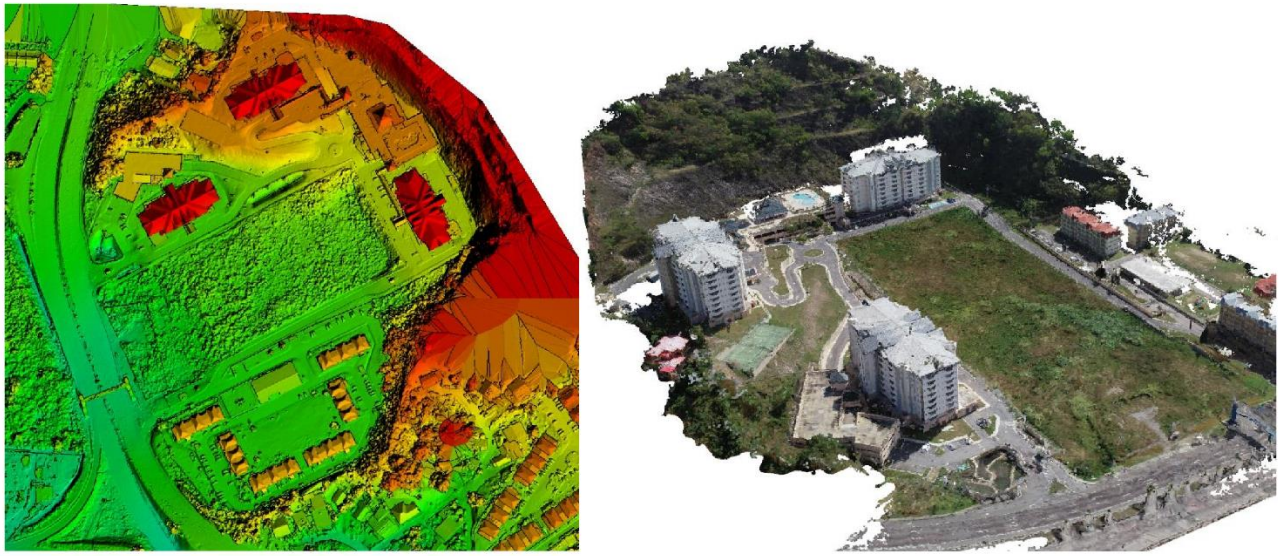


Figure 4: Digital Surface Model (DSM) (left) and 3D model (right) generated from the UAV survey

3.3 AERMOD

Model runs were performed using the World Geodetic System 1984 (WGS84) coordinate system with UTM Projection, Zone 20N. The model was run using the BREEZE AERMOD Executable option (version 18081), which enabled multiple pollutants to be run at the same time. Maximum modelled concentrations of four criteria pollutant were then compared against ambient standards (First Schedule of the EMA Air Pollution Rules, 2014). **Section 3.31: Air Quality Parameter (Model Pollutants)** lists the pollutants that were modelled for the Construction and Operational Phases.

3.3.1 Air Quality Parameters (Model Pollutants)

Modelling was conducted for the Construction Phase and Operational Phase of the proposed project. The emission factors were taken from literature. The emission factors for the Operational Phase were sourced from (USEPA 2019) and for the Construction Phase from (Reşitoğlu, Altinişik, and Keskin 2015). When formulating emission factors certain assumptions and quality criteria are used. CDL preferred to use one source for the emission factors per project phase rather than multiple sources with different assumptions. The US EPA 2019 (Table 4-43) did not have PM_{10} and SO_2 emissions from their listed vehicles and their report did not have construction equipment. (Reşitoğlu, Altinişik, and Keskin 2015) did not have $PM_{2.5}$ and HC, and only calculated emission factors for construction equipment.

For the Construction Phase, the following four critical air quality pollutants were modelled for which emission data was available for the different types of construction equipment provided by NIDCO:

- Particulate Matter less than 10 microns (PM_{10})
- Oxides of Nitrogen (NO_x)
- Carbon Monoxide (CO)
- Sulphur Dioxide (SO_2)

Refer to **Section 6.4: Construction Equipment Calculations** for the calculation methods used to generate the emission rates for the model input.

For the Operational Phase, based on research and availability of data, the following four critical air quality pollutants were selected to be modelled for the roadways and overpass:

- Particulate Matter less than 2.5 microns ($PM_{2.5}$)
- Oxides of Nitrogen (NO_x)
- Carbon Monoxide (CO)
- Total Hydrocarbons (HC) as a measure of Volatile Organic Compounds (VOCs)

Pollutant emissions were calculated based on Traffic data for the area and US EPA emission factors where available. Refer to **Section 6.3: Vehicle Emission Calculation (Operational Phase)** for the calculation methods used.

3.3.2 Sources

AERMOD models roadways as straight-line area sources. Since the Diego Martin Highway and Overpass are not exact straight lines, the highway was subdivided into 6 straight-line segments (between the Morne Coco and Western Main Road intersections) for input into the model. Similarly, the overpass was broken down into 13 different straight-line segments and the emissions per line segment were calculated. See **Section 6.3: Vehicle Emission Calculation (Operational Phase)**. **Figure 5** shows the line segments for the Diego Martin Highway and Overpass that were input in the model.

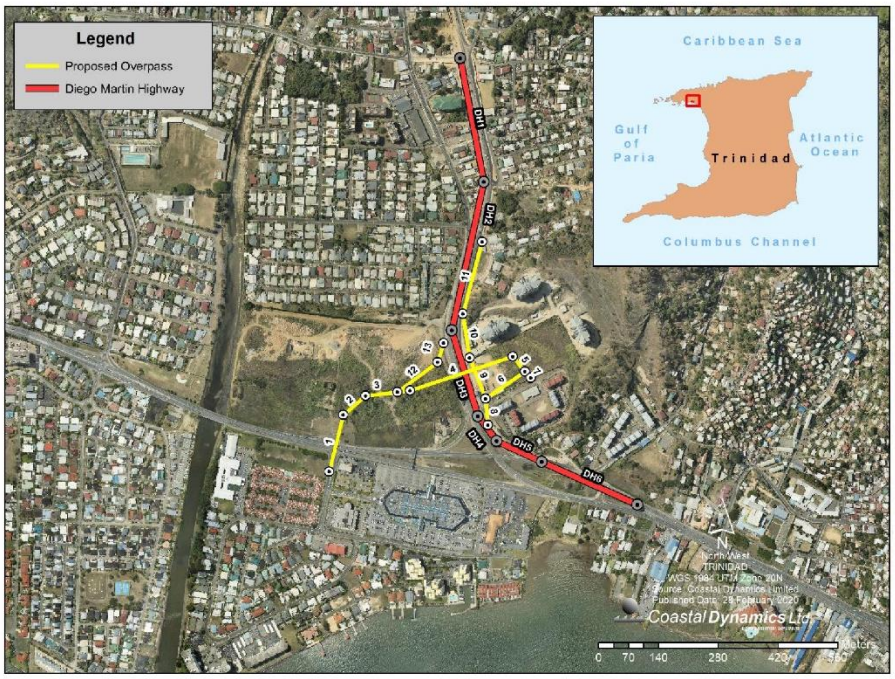


Figure 5: Lines segments for the Diego Martin Highway and Overpass that were input in the model

Sources input into the model for the Baseline and Operational Phases were the Diego Martin Highway and the proposed overpass, which was broken up into 13 different line segments for input into the model. The Baseline is the current traffic modelled data, the present situation prior to construction.

The following source data characteristics for each of the 13 line segments (overpass) and 6 line segments (highway) was input into the model:

- Start and End coordinates for each line segment (UTM)

  UTM coordinates for the overpass were obtained from the AUTOCAD Drawing of the Overpass supplied by NIDCO.

  UTM coordinates for the existing roadways were obtained from Google Earth.

- Release height (m)

  The source release height is used to account for the height at which wind begins to affect the concentration plume and is estimated from the midpoint of the initial vertical dispersion (USEPA 2016, Chavez 2019). The release height was therefore computed as half of the weighted vehicle height (USEPA 2016). The average vehicle height of light duty vehicles was used as 1.53 m and the average vehicle height for heavy duty vehicles was 4 m (USEPA 2016). The Traffic Count Survey (MMM Group Limited 2015a) for Diego Martin was used to calculate the weighted vehicle height for the 2 categories of vehicles (Cars and Other) on the Diego Martin Highway and overpass.

- Initial vertical dimension (m)

  Initial Vertical dimension is used to account for vehicle induced turbulence and is estimated to be 1.7 times the average vehicle height (Chavez 2019; USEPA 2016). The Initial vertical dimension was calculated according to Table 3-2 of the USEPA AERMOD User Guide (2019). For the Diego Martin Highway, the weighted average height of the vehicles (based on the Traffic Count Data for Diego Martin) was found, then multiplied by 1.7 (USEPA 2016) and divided by the dimension factor (2.15) for surface-based sources provided by the USEPA (2019). For the vehicles on the overpass, the average height of the overpass was added to the weighted average vehicle height and then divided by the dimension factor (4.3) for elevated sources (USEPA 2019).

- Width of line segment (m)

  Widths of each line segment for the overpass were obtained from the AUTOCAD Drawing of the Overpass supplied by NIDCO.

  Widths of each major roadway were obtained from Google Earth.

- Pollutant emission rates ($g/s\text{-}m^2$)

  Pollutant emission rates in g/s were calculated using USEPA generated emission factors and the traffic count for Diego Martin per roadway and length of each roadway segment

as described in **Section 6.3: Vehicular Emission Calculations.** These were then divided by the area of each roadway line segment to get the rate in g/(s-m^2).

For the Construction Phase, an area source was used to represent emissions from construction across an approximate average area of 188 881 m^2. This defined polygon area covered the areas east and west of the overpass in which main construction is expected to occur. Additionally, the size of the area selected was large enough to account for any other areas outside of the polygon that construction work may also be carried out i.e. a large area was selected to account for the worst-case construction emissions. Based on brand and model of equipment specifications researched, emission rates for the equipment list provided by NIDCO were calculated where available. See **Section 6.4 Construction Equipment Calculations**. Inputs required for a polygon area source in AERMOD were similar to that of a line source described above. **Figure 6** shows the area selected for the Construction Phase in which construction emissions are expected to occur for approximately 1-year.



Figure 6. Location of expected Construction Works (defined as an area source in the model)

See **Appendix I - Summary of Input Data for AERMOD** for the input data used for each scenario.

3.3.3 Receptors

Receptors are locations at which the concentration or deposition are calculated for a specific pollutant. Ground-level concentrations are generally calculated using receptor grids that vary in spacing (Trinity Consultants 2019). A polygon grid was used for the model with a constant 50 m x 50 m spacing throughout the proposed project area. The boundaries of the receptor grid extended south to the waterfront (500 m) and north, west and east a maximum of 1800 m, taking the populated mountainous regions into consideration. This grid allowed all receptors to be located at varying distances from the emissions sources such that pollutant concentrations for the entire area surrounding the overpass were well represented.

A sensitive receptor is any living organism that is more susceptible than its general population to the adverse effects of exposure to air pollutants (Environmental Management Authority (EMA) 2014). It typically includes sensitive groups such as children, the elderly and people with illnesses. A total of 63 sensitive receptors within the vicinity of the proposed overpass. The sensitive receptors were divided into the following six main categories:

- Schools
- Health Centres
- Residential Areas
- Government Infrastructure (including Police Stations, TTEC Substations, WASA Pump Stations etc.)
- Recreational Facilities
- Religious Institutions

A drone survey was conducted to determine the heights of the sensitive receptors within the immediate vicinity of the overpass (east of the proposed overpass). Victoria Keyes and Powder Magazine are located less than 3 m from the proposed overpass and as such the pollutant concentrations at these particular sensitive receptors were investigated not only at ground level, but also at the mid-point of the building height and at the overall height of the buildings (i.e. mid and high levels).

The overall height of each of the Victoria Keyes buildings was 28 m; pollutant concentrations were therefore measured at ground level (0 m) as well as at 14 m and 28 m heights above ground level. The height of each Powder Magazine building was 14 m; pollutant concentrations were therefore measured at ground level (0 m) as well as at 7 m and 14 m heights above ground level. (A map of the drone survey for this sensitive area was presented in **Figure 4, Section: 3.2 AERMAP**).

Table 1 lists the 63 sensitive receptors that were modelled within the vicinity of the proposed overpass project area along with their respective UTM coordinates and distance from the overpass. **Figure 7** shows a map of the locations of the Sensitive Receptors.

Table 1: List of Sensitive Receptors within and surrounding the defined Project Area			
Sensitive Groups	**Eastings**	**Northings**	**Distance from Overpass (m)**
EDUCATION			
Auntie Ashley's Swimming School	657556.86	1182010.47	1151.2
Cocorite Government Primary School	658883.34	1180783.85	730.8
Dunross Preparatory School	657602.72	1181465.72	727.6
International School of Port of Spain	657721.54	1180841.78	532.3
Kindercare Nursery & Preschool	657382.44	1180706.17	897.3
La Puerta Government Primary School	657631.02	1182049.56	1144.6
Saint Anthony's College	657654.78	1181577.78	756.7
GOVERNMENT			
Four Roads Fire Station	658183.04	1181795.35	735.4
Four Roads Police Station	658203.69	1181757.93	697.6
T&TEC Westmoorings Substation	658227.47	1180952.74	109.6
Trinidad & Tobago Chamber of Industry & Commerce	657961.29	1180687.53	446.5
WASA Diego Martin Pump Station	657591.76	1180983.04	620
WASA Four Roads Waterworks & Pumping Station	657951.27	1181954.22	929.7
HEALTH FACILITIES			
National Radiotherapy Centre	659723.35	1180319.31	1687.8
St. James Medical Complex	659804.39	1180304.49	1767.3
Sunnyview Vetcare Service	658315.56	1181341.69	301.6
Victoria Medical Laboratory	658765.12	1180673.64	679.1
Vitas House Hospice	659719.74	1180365.18	1664.9
West Shore Medical Private Hospital	658730.13	1180621.91	682.6
RECREATIONAL FACILITIES			
C3 Marina	659023.64	1180449.95	1019.6
Cocorite Fishing Facility	659485.44	1180300.41	1487.3
Cocorite Savannah	659137.51	1180706.62	995.6
Dolphin Commodore Park	657309.89	1180573.85	1020.4
First Trinidad Sea Scouts' Boathouse	659297.51	1180302.68	1328.1
Life Fitness Club	658240.6	1181537.5	478.3
Liquid Adrenalin Water Sports of Trinidad and Tobago	659078.08	1180539.27	1015.1
Marlin's Swim Club	657495.67	1181598.25	891.7
Paragon Sports Grounds	658517.84	1180739.78	446.6
Regents Park	657188.67	1180880.48	1034.1
Riverside Park	657564.87	1181074.22	642.2
Starlite Shopping Plaza	658166.65	1181664.86	605.8
The Falls at Westmall	658187.53	1180770.13	209.9

Table 1: List of Sensitive Receptors within and surrounding the defined Project Area			
The Fitness Center Limited	658094.75	1181763.22	711.7
Windsurf Park	657408.6	1180587.4	927.9
Windsurf Tennis Courts	657470.46	1180580.39	879.1
Windsurf West Park	657276.48	1180383.17	1150.8
RELIGIOUS INSTITUTIONS			
Community Hospital of Seventh-day Adventists	658949.07	1180718.37	817.2
Kingdom Hall of Jehovah's Witnesses	658368.88	1181550.02	515.7
St Dominic's Pastoral Centre	657421.3	1181835.59	1103.7
St Finbars RC Church	657438.61	1181885.9	1127.7
The Gathering Place	657977.88	1180674.38	448.8
RESIDENTIAL			
Acton Court	658192.39	1181998	937.7
Bayside Towers	658976.92	1180554.73	921.2
Bayside Towers Tennis Court	658931.9	1180604.78	856.2
Goodwood Heights	657393.95	1181724.62	1049.8
Highpoint Townhouses	657203.68	1181241.81	1019.5
l Harding Place	659079.91	1180655.38	962.4
La Fontaine Towers	657983.56	1180601.5	510.3
La Riviera	657671.02	1180388.75	859.2
Powder Magazine Phase 1 – Ground level	658692.97	1180998.87	490.1
Powder Magazine Phase 1 – Mid Level	658614.03	1180932.36	426.7
Powder Magazine Phase 1 – High Level	658642.66	1180977.97	443.5
Powder Magazine Phase 2 - Building 1	658487.03	1181065	280.2
Powder Magazine Phase 2 - Building 2	658486.43	1181026.41	281.6
Powder Magazine Phase 2 - Building 3	658473.23	1180985.26	276.2
Regents Tower	657245.69	1181129.54	963.7
Spanish Court	657849.05	1180790.15	448.4
The Towers	658219.01	1180611.85	448.7
Victoria Keyes – Ground Level	658358.61	1181190.29	199.7
Victoria Keyes – Mid Level	658429	1181285.34	316.1
Victoria Keyes – High Level	658550.35	1181190.12	367.1
Victoria Villas	658199.5	1181313.49	253.2
West Park Villas	657455.33	1181452.27	847.6

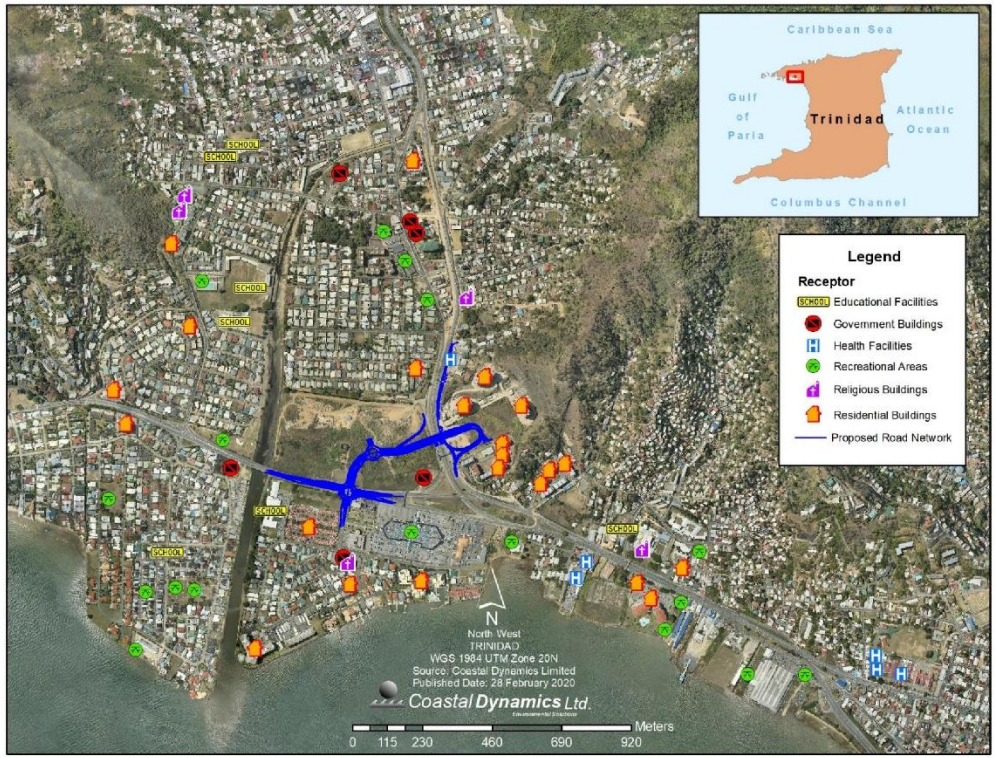


Figure 7: Map showing 63 Receptor Locations within a 5 km radius of the Proposed Overpass Project

4 Modelling Scenarios

Analysing different scenarios enabled examination and evaluation of possible events by considering various feasible results and outcomes. CDL created eight different scenarios to be modelled for the proposed overpass in Diego Martin, using the data supplied by NIDCO. Different Scenarios were modelled to represent the different phases of the proposed overpass i.e. Construction and Operational Phases. Scenarios were also modelled to represent conditions with and without the overpass, taking into account projected traffic increases for 2020 and 2040 estimated by MMM Group Limited during the 2015 Traffic Survey of the proposed project area (MMM Group Limited 2015).

Scenario 1 was selected to represent current conditions i.e. current emissions for the study area before initiation of construction. Current conditions provide a baseline for which to compare potential impacts.

Scenario 2 represented the emissions from the construction equipment during the construction phase alone, without considering the baseline conditions. This was to determine whether any exceedances in pollutant limits were due to construction emissions alone.

Scenario 3 modelled the construction phase alongside current baseline conditions to determine whether emissions from the Construction Phase of the overpass made any significant impact to current conditions. Construction is expected to last approximately 1 year, and as such, this time frame was considered in the modelling.

The Operational Phase was simulated for Scenarios 4 to 6, which considered peak traffic (Scenario 4), off-peak traffic (Scenario 5) and both peak and off-peak cumulatively (Scenario 6). According to MMM Group Limited (2015), peak traffic conditions occur for approximately 3 hours a day (morning and evening) on any given weekday. Emissions were calculated for peak and off-peak separately so that their respective time frames were accounted for in the model. The Operational Phase was modelled for approximately 2 years and 10 months (April 2017 – February 2020). In the absence of 1 year measured data, model data was used to represent the

meteorological conditions in the study area. To fully represent the conditions that may be experienced, 2 years and 10 months of modelled data was used that was readily available from CDL's model from April 2017 – February 2020. In this way seasonal variability would have been captured and included conditions under which Trinidad and Tobago was under El Nino watch (November 2018) (TTMS 2020). This is consistent with the objective put forward by the US EPA's Guideline on Air Quality Models (USEPA 2019) which suggested that in the absence of measured data, modelled data can be used.

A mitigation measure in the form of a noise barrier was included to determine whether proposed mitigation measures would reduce air pollution exposures from nearby traffic on sensitive receptors within the immediate vicinity of the overpass (Scenario 7).

Scenario 8 was modelled as the No-Build option which considered emissions for a projected traffic increase for the year 2040 if no overpass were to be constructed.

Table 2 outlines the summary details of each scenario that was modelled.

Table 2: Scenarios to be modelled for Vehicular Overpass	
Scenario 1	Normal (baseline) Operations (Prior to Construction) – Vehicular emissions from the Diego Martin Highway under current conditions i.e. before any changes
Scenario 2	Construction Phase – Vehicular emissions from construction equipment alone
Scenario 3	Construction Phase – Vehicular emissions from construction equipment and normal (baseline) operating conditions (i.e. Scenario 1 and 2 combined)
Scenario 4	Operational Phase – Vehicular emissions from the proposed overpass at peak traffic times only (based on Traffic Report supplied by NIDCO)
Scenario 5	Operational Phase – Vehicular emissions from the proposed overpass at non-peak traffic times only (based on Traffic Report supplied by NIDCO)
Scenario 6	Operational Phase – Vehicular emissions from proposed overpass at both peak and non-peak traffic times
Scenario 7	Operational Phase – Vehicular emissions from proposed overpass with suggested mitigation measures (e.g. noise barrier included in the model to determine its effectiveness)
Scenario 8	'No Build Option' – Vehicular emissions from the Diego Martin Highway with projected increase in traffic (Increased traffic projects to be supplied by NIDCO)

5 Modelling Assumptions

- Traffic conditions and resulting emissions occur for all 365 days of the year
- MMM Group Limited conducted a Traffic Survey for the proposed project area during 2015; from this data, projected 2020 and 2040 traffic counts were estimated. The model was inputted with these projected traffic counts
- Emission rates based on USEPA Emission Factors 18-year period average to represent current composition of vehicle types in the study area. The MMM Group Limited 2015 Traffic Survey did not include vehicle models (and/or vehicle ages) as such CDL used the 18-year average to assume the current conditions of vehicles. This takes into consideration different vehicle ages and resulting changes in emissions as vehicle control emission technology improves.
- Emission rates (calculated from the number of vehicles on the roadway and overpass) are being continuously emitted for 8 hours a day (during the hours of 6:00 a.m. to 6:00 p.m.), based on MMM Group Limited 2015 Traffic Survey counts
- 100% of vehicles travelling on Morne Coco Road and 50% of vehicles travelling on Diego Martin Highway are expected to use the overpass (Source data: MMM Group Limited 2015 Traffic Survey)
- MMM Group Limited 2015 Traffic Survey did not breakdown the 'Other' category and as such CDL used an average of the light duty trucks and heavy duty vehicles USEPA emission factors (from 2000 – 2018) to estimate the emissions for this category
- For the Construction Phase, a list of equipment was provided by NIDCO. Each type of construction equipment from each category was inputted into the model, resulting in 26 pieces of equipment (list provided in **Appendix I**) working at the same time (six pieces of equipment working in four different areas of the 188 881 m^2 construction area)
- The meteorological data used for this study was an hourly modelled dataset from April 2017 – February 2020 (2 years 10 months), the AERMOD model outputted an annual emissions value averaged over a two year model run time
- It is noted that the EMA Air Pollution Rules (2014) Schedule 1 provide emissions for NO_2, however NOx was modelled according to the USEPA emission factors used. CDL has used the NO_2 as a guide to compare against the NOx levels

6 Vehicular Emission Estimations

Emissions from vehicles for Diego Martin were calculated via the use of hourly traffic survey data for the project area along with vehicle emission factors obtained from the USEPA. In absence of vehicle-specific data and corresponding emission rates, generic emission factors (g/mile[1]) per vehicle category were taken and applied to the traffic data for Diego Martin to determine emission rates per roadway.

6.1 Traffic Count Data for Diego Martin

A Traffic Count Report was conducted in 2015 for the Diego Martin area as part of a Feasibility Study for the Diego Martin Highway (MMM Group Limited 2015). This report conducted manual and automatic traffic counts in 2015 from 6:00 a.m. to 6:00 p.m. between the hours of 6:00 a.m. to 9:00 a.m., 11:00 a.m. to 1:00 p.m. and 3:00 p.m. to 6:00 p.m. For the purpose of this air dispersion modelling report, the traffic survey conducted at the Diego Martin/ Morne Coco Intersection was used to determine the number of vehicles using the Diego Martin Highway and proposed overpass.

From the Traffic Survey conducted in 2015, the number of vehicles using the Diego Martin Highway were determined for two major categories of vehicles: Cars and Other Vehicles. The Car category included passenger cars, SUVs and car-towing trailers while Other Vehicles included trucks, maxis and heavy duty vehicles. Based on this dataset, projections in traffic increase were then computed for 2020 and 2040 by MMM Group Limited. Traffic volumes were estimated to increase annually by approximately 2.2%, equating to a 12% increase by 2020 and 61% by 2040 over the 2015 traffic volumes (MMM Group Limited). The projected increases were applied to the automatic counts to obtain the number of Cars and Other vehicles on the Diego Martin Highway and proposed Overpass. **Figure 8** and **Figure 9** show the projected increase in traffic volume for 2020 and 2040 for the two categories of vehicles measured.

[1] Please note that g/mile was converted to g/s as the latter was required by the AERMOD model

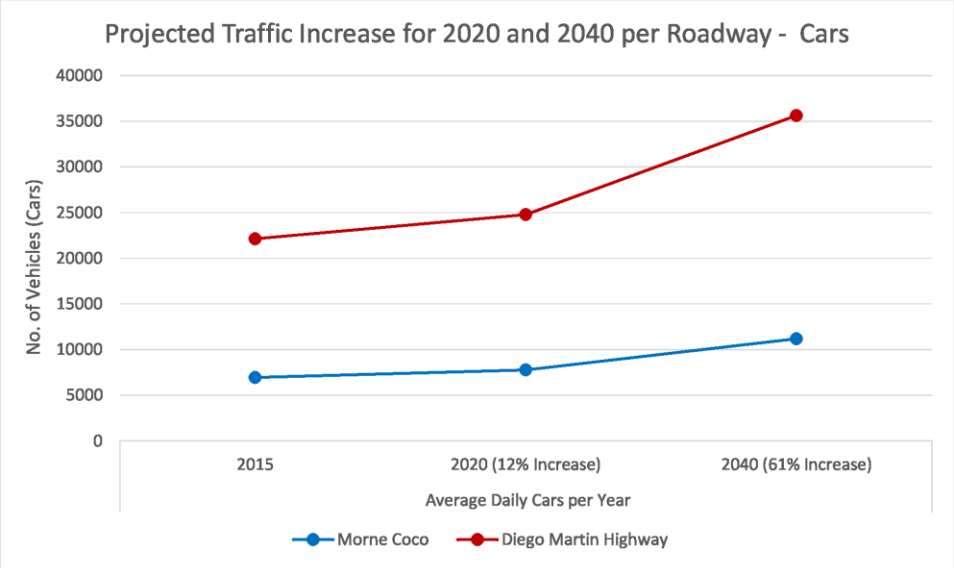


Figure 8: Projected Number of Cars for 2020 and 2040 for the Diego Martin area

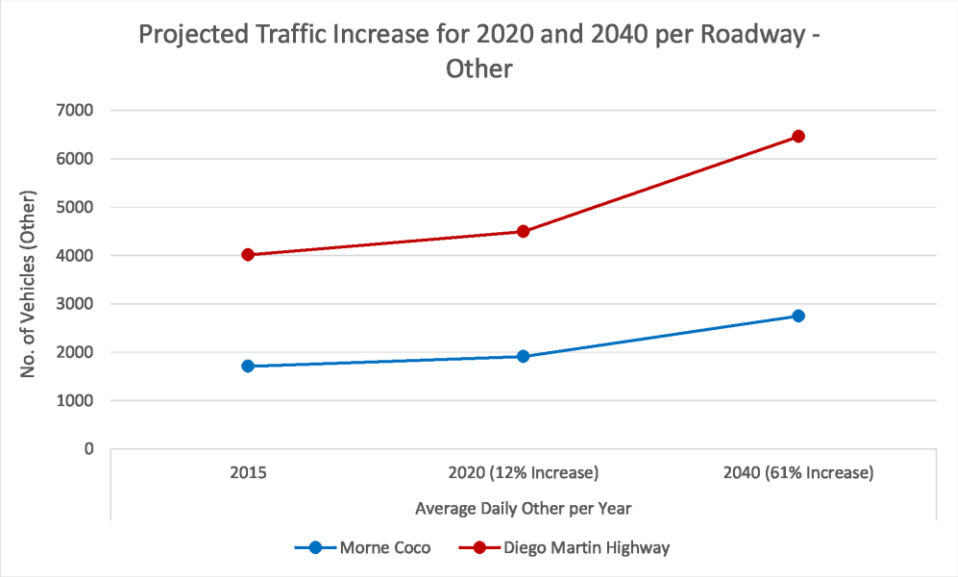


Figure 9: Projected Number of Other for 2020 and 2040 for the Diego Martin area

6.2 Emission Factors from USEPA

The AERMOD Software required input of emission rates for each pollutant to be modelled, taking the different vehicle categories into account. Emission rates were calculated based on USEPA emission factors generated for each pollutant. An emission factor relates the quantity of pollutants released to the atmosphere from a process to a specific activity associated with generating those emissions (in this case vehicles). It represents the average emissions for all emitting processes of similar design and characteristics (USEPA 2013). Vehicle emission factors computed from the USEPA Office of Transportation and Air Quality (USEPA 2018) were used (along with the traffic data for Diego Martin) to calculate vehicular emission rates in grams per second for the Diego Martin Highway and the projected overpass.

Appendix II provides USEPA Table 4-43 which shows estimated National Average Vehicle Emissions Factors per vehicle by Vehicle Type using Gasoline and Diesel compiled by the USEPA for the years 2000 to 2018. Emission factors were provided for exhaust CO, exhaust NOx, exhaust $PM_{2.5}$ and total HC (USEPA 2018). An average of each emission factor for the 18-year period (2000 – 2018) (Table 4-43 **Appendix II**) was taken in order to calculate emission rates per vehicle category for both diesel and gasoline vehicles. **Table 3** shows the average of emission factors used.

Table 3: Average of the 2000 – 2018 USEPA Exhaust Emission Factors

Vehicle Type		Emission Factor CO (g/mile)	Emission Factor $PM_{2.5}$ (g/mile)	Emission Factor NOx (g/mile)	Emission Factor Total HC (g/mile)
Vehicle Category 1 - Cars (Passenger Cars)					
GASOLINE	Light Duty Vehicles	8.310	0.019	0.927	0.866
DIESEL	Light Duty Vehicles	18.992	0.032	1.204	1.269
Average Emission Factor for Cars		**13.651**	**0.0257**	**1.065**	**1.067**
Vehicle Category 2 - Other (2 axle, 4 axle trucks, vehicles)					
GASOLINE	Light Duty Trucks	11.084	0.017	1.392	0.952
DIESEL	Light Duty Trucks	6.173	0.146	3.023	3.023
GASOLINE	Heavy Duty Vehicles	41.596	0.064	4.198	2.202
DIESEL	Heavy Duty Vehicles	3.730	0.611	13.844	1.006
Average Emission Factor for Other		**15.646**	**0.209**	**5.614**	**1.202**
Approximate Difference in Emission Factors between Cars and Other Categories		2.0	0.2	4.5	0.1

Source: Table 4-43, USEPA Bureau of Transportation Statistics (2018) – See **Appendix II**

Table 3 indicates that CO is typically the highest concentration pollutant emitted from vehicles, and $PM_{2.5}$ the lowest.

A comparison of the average emission factors in **Table 3** for the two categories, of MMM Group Limited 2015 Traffic Survey, Cars and Other show that the difference in emission factors between both categories for CO, $PM_{2.5}$ and total HC ranged 0.2 g/mile – 2.0 g/mile while that of NOx was 4.5 g/mile. Due to the larger difference for NOx, this indicated that the heavy duty vehicles (especial diesel vehicles) generate higher NOx when compared to the cars. A single emission rate value per pollutant was required for the model input, therefore an overall weighted average of Cars and Other emission rates was calculated using the Cook et al. (2008) equation below. As a result of taking an overall average, the NOx emission rates calculated were greatly influenced by the Other vehicle category, thereby raising the overall average of NOx emissions per roadway; i.e. the average NOx emission rate value was more reflective of heavy duty vehicles than car emissions. It is therefore expected that the model result would show an overestimate of NOx concentrations.

6.3 Vehicle Emissions Calculation (Operational Phase)

The average emission factors for each pollutant (**Table 3**) were applied to the number of vehicles using the Diego Martin Highway per vehicle category and roadway/overpass length. The following formula was used to calculate emission rates (USEPA 2016, Cook et al. 2008).

$$\mathbf{E_i\,(s) = EF_i\,(s) \times A\,(s)}$$

where $E_i\,(s)$ is the emission rate in mass per unit time (g/hr) for pollutant *i,* from source *s;*

$EF_i\,(s)$ is the emission factor in mass per unit of activity (g/mile) for pollutant *i,* from source *s*;

A (s) is the activity level for source, *s,* (i.e. vehicle miles travelled [VMT]) over a given time). VMT = No. of vehicles x length of roadway (miles)

The resulting weighted average hourly rates for each pollutant and roadway in g/hr were then converted to g/s and entered in the model. Emission rates corresponded to the hourly Traffic Data Count conducted by MMM Group Ltd (2015).

It is noted that because emission factors essentially represent an average of a range of emission rates, approximately half of the subject sources will have emission rates greater than the emission factor and the other half will have emission rates less than the factor.

Emissions were calculated for the 6 straight-line segments of the Diego Martin Highway and 13 straight-line segments for the overpass (since the roadways are not exact straight lines). A weighted average of each vehicle category per segment was used to generate the emissions for each road segment (using the 2015 Diego Martin Traffic Count). The length (and width) of each line segment were taken into account. To estimate the number of vehicles using the overpass, it was assumed that 100% of cars travelling on Morne Coco would use the overpass in addition to 50% of the vehicles using the Diego Martin Highway. This was based on the understanding of typical traffic flow in the area and the proposed aim of the construction of the overpass infrastructure. Therefore, for the Scenarios for which the overpass was modelled (i.e. Scenarios 4 – 6), emissions entered for the roadway in the model reflected 50% of vehicle flow on Diego Martin Highway.

To accurately represent peak and off-peak times in the model, the number of vehicles on the Diego Marin Highway (and overpass) during peak and off-peak were reflected by corresponding increase / decrease in calculated emissions respectively. According to the Traffic Count Survey, peak and off-peak times were from 6:00 a.m. – 9:00 a.m. and 3:00 p.m. – 6:00 p.m. (MMM Group Limited 2015). The resulting emission rates in g/s were then divided by the area of each (roadway) line segment to get the emission rate per square meter [g/(s-m^2)].

6.4 Construction Equipment Calculations

Emission rates for CO, NO2, PM10, and SO_2 were calculated using the equation below (Heidari and Marr 2015):

$$ER = Y \times MW \times D \times \frac{RPM}{2} \times \frac{1}{60} \times \frac{P}{R \times T} \times \frac{1}{1000}$$

where ER = emission rate (g sec^{-1})

Y - volumetric concentration of the pollutant of interest in the exhaust (unitless)

MW - molecular weight of pollutant (g mol^{-1})

D - engine displacement (L)

RPM - engine speed in revolution per minute (min^{-1})

P - standard ambient pressure (atm)

R - ideal gas constant (82.05 x 10^{-6} m^2 atm mol^{-1} K^{-1})

T - temperature inside tailpipe (K)

2 – accounting for the fact that exhaust emissions are vented during every other revolution in a 4-stroke engine

60 – conversion factor between minutes and seconds

1000 – conversion factor between cubic metres and litres

It was assumed that the construction equipment utilised diesel fuel based on the type and model. Diesel fuel is composed of carbon and hydrogen and under ideal conditions, the complete combustion of this fuel would produce CO_2 and H_2O. However, in reality, incomplete combustion occurs and generates pollutants such as CO, HC, NO_x and PM. In addition to these, SO_2 may also be generated depending on the engine specifications and fuel quality. These pollutant emissions compose of ~1% in diesel exhaust gas, of which 50% is NO_x followed by PM and minimal concentrations of CO, HC and SO_2 ((Reşitoğlu, Altinişik, and Keskin 2015)). These volumetric concentrations were used for the Y parameter in the Heidari & Marr (2015) equation above. Specifically, 0.005, 0.00125 and 0.00125 were used for Y parameter for NO_x, CO and SO_2 respectively.

The molecular weight of NO_2 (46 g mol^{-1}) was used for NO_x while the values of 28 g mol^{-1} and 64 g mol^{-1} were used for CO and SO_2 respectively. PM and HC were not calculated as the composition is dependent on various processes that are engine and fuel specific.

A standard atmospheric pressure of 1 atm was used for the pressure parameter (P) as it was assumed the pressure just inside the tailpipe would be equal to the ambient environment. For the temperature parameter (T), an average temperature of 788 K was used for the exhaust temperature as this is an average value for diesel exhaust (Nolan 2017).

An average value for RPM and D were used based on the category of construction equipment. This average was based on the equipment brand and model. See **Appendix I** for the categories of construction equipment used.

7 Meteorological Data

The climate of Trinidad and Tobago is described as tropical and experiences two distinct climate types: dry and wet. The dry season extends from January to May and wet season from June to December. May and December are considered transition periods between the dry and wet seasons respectively as they exhibit both dry and wet season conditions (Trinidad and Tobago Meterological Service (TTMS) 2020). A short break in the wet season frequently occurs during September to October whereby the period is characterised by dry season-like weather and is locally referred to as the 'Petit Careme'. The occurrence of the wet season coincides with the overhead passage of the Inter Tropical Convergence Zone (ITCZ). The ITCZ is a region of low pressure that exists between the subtropical pressure maxima in the Northern and Southern Hemispheres (Landsea and Gray 1992). The seasonality of Trinidad and Tobago's climatic conditions is primarily controlled by the annual north-south oscillation of this pressure system.

Measured meteorological datasets were collected at the location shown in **Figure 10** (WGS 84 UTM 20N: 0657831 1180930) by Kaizen Environmental Services Trinidad Limited (Kaizen Environmental) using a portable Davis Meteorological Station. Kaizen Environmental collected this data on behalf of Ecoengineering Consultants Limited, one of the consultants hired by the National Infrastructure Development Company Limited (NIDCO) for the proposed construction of a 4-lane vehicular overpass including link roads, ramps and drainage in Diego Martin, Trinidad. Meteorological Data was recorded on the following dates:

- 13th – 15th November 2019 (Event 1)
- 18th – 20th November 2019 (Event 2)
- 25th – 27th November 2019 (Event 3)
- 22nd January – 21st February 2020



Figure 10: Location of Meteorological Station in Diego Martin

7.1 Measured Winds

The 10 m wind speeds at Diego Martin over the nine (discontinuous) days in November 2019 showed that during wind speeds ranged from 0.1 m/s – 2.9 m/s with an average wind speed of 1 m/s while wind speeds from late January – February were between 0.0 m/s – 6.3 m/s with an average wind speed of 2.2 m/s. Wind directions were predominately from the NNE with significant contributions from the ENE and E (**Figure 11** – **Figure 16**). Joint frequency analysis of the measured January – February 2020 dataset (**Table 4**) showed that wind speeds between 1 m/s and 3 m/s occurred 59% of the time. Wind directions from the NNE, occurred 40.9% of the time while winds from the ENE and E occurred 30.6% of the time in total.

Despite the short sampling period of meteorological data wind speeds fall within the expected range when compared to longer-term data for Piarco where the long-term average wind speed was 3.15 m/s and had a mean wind speed of 3.35 m/s during the dry season and a mean of 2.61 m/s in the wet season. At Piarco, the winds were primarily from the east (46 %) and east-north-east (40 %), with a much smaller contribution due to northeasterly winds (6 %) (Government of the Republic of Trinidad and Tobago (GORTT) 2013). Piarco's wind speeds were expected to be slightly higher compared to Diego Martin due to less topographical interference experienced at Piarco. The measured wind speed and directions were supplemented with 2 years and 10 months (April 2017 – February 2020) of hindcast data for the Air Dispersion modelling study.

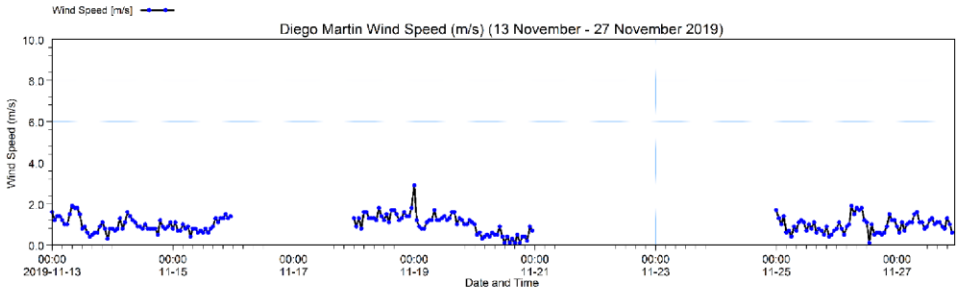


Figure 11: Wind Speed Measured at Diego Martin for Events 1 – 3 in November 2019

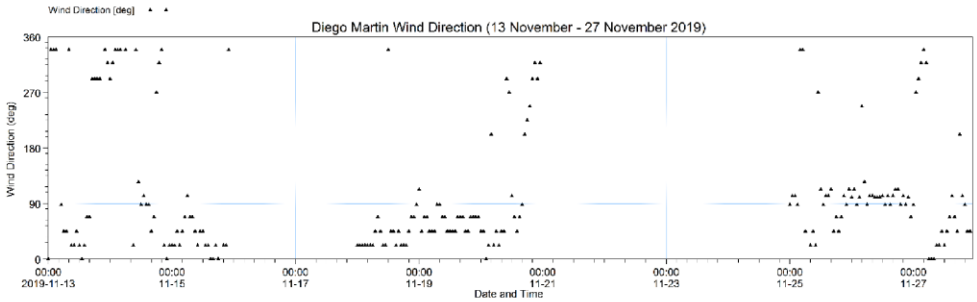


Figure 12: Wind Direction Measured at Diego Martin for Events 1 – 3 in November 2019

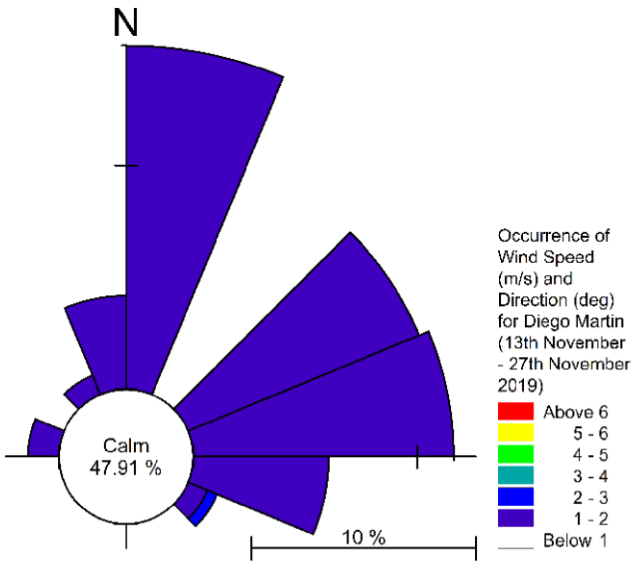


Figure 13: Occurrence of Wind Speed and Direction Measured at Diego Martin for Events 1 – 3 in November 2019

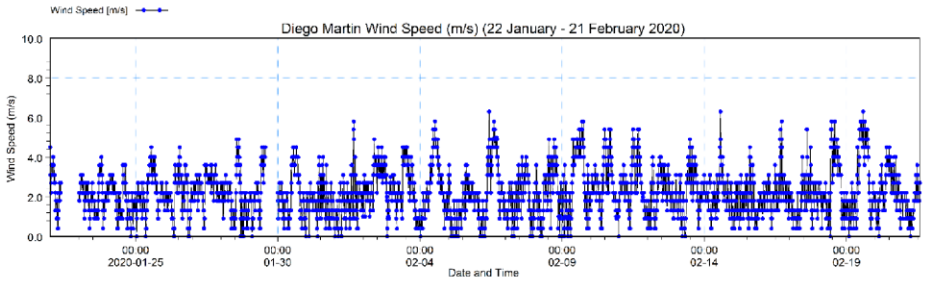


Figure 14: Wind Speed Measured at Diego Martin (22 January – 21 February 2020)

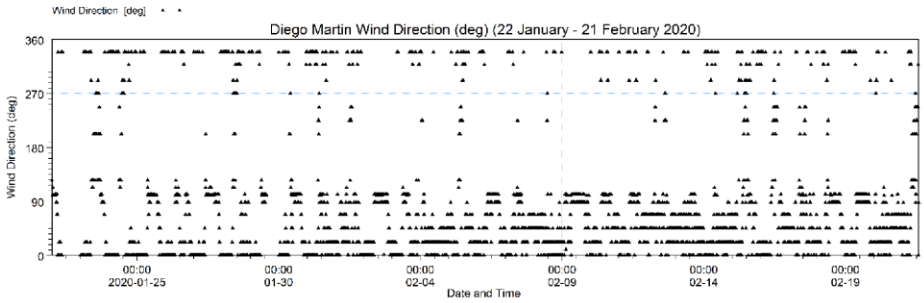


Figure 15: Wind Direction Measured at Diego Martin (22 January – 21 February 2020)

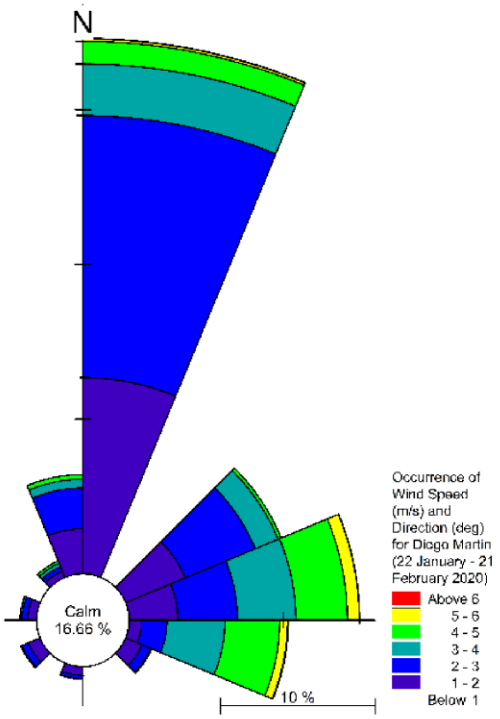


Figure 16: Occurrence of Wind Speed and Direction Measured at Diego Martin (22 January – 21 February 2020)

Table 4:Wind Speed and Direction Joint Frequency Distribution										
Wind Direction From (deg)		Occurrences	Wind Speed (m/s)							
		Percentage	0-<1	1-<2	2-<3	3-<4	4-<5	5-<6	6-<7	Total Occurrence
0-<22.5	NNE	n	256	532	718	140	62	7	1	1716
		%	6.1	12.7	17.1	3.3	1.5	0.2	0.0	40.9
22.5-<45	NE	n								
		%								
45-<67.5	ENE	n	106	174	206	68	9			563
		%	2.5	4.1	4.9	1.6	0.2			13.4
67.5-<90	E	n	100	131	161	158	141	31	1	723
		%	2.4	3.1	3.8	3.8	3.4	0.7	0.0	17.2
90-<112.5	ESE	n	20	34	70	154	148	22	2	450
		%	0.5	0.8	1.7	3.7	3.5	0.5	0.0	10.7
112.5-<135	SE	n	35	48	26	2	1			112
		%	0.8	1.1	0.6	0.0	0.0			2.7
135-<157.5	SSE	n								
		%								
157.5-<180	S	n								
		%								
180-<202.5	SSW	n	9	24	10	1				44
		%	0.2	0.6	0.2	0.0				1.0
202.5-<225	SW	n								
		%								
225-<247.5	WSW	n	16	35	19	3				73
		%	0.4	0.8	0.5	0.1				1.7
247.5-<270	W	n								
		%								
270-<292.5	WNW	n	40	24	16	5				85
		%	1.0	0.6	0.4	0.1				2.0
292.5-<315	NW	n								
		%								
315-<337.5	NNW	n	26	19	13	10	7			75
		%	0.6	0.5	0.3	0.2	0.2			1.8
337.5-<360	N	n	85	124	112	24	13			358
		%	2.0	3.0	2.7	0.6	0.3			8.5
Total Occurrence		n	693	1145	1351	565	381	60	4	4199
		%	17	27	32	13	9	1	0	100
Total Exceedance		%	100	83	56	24	11	2	0	0

7.2 Air Temperature

The Trinidad and Tobago Meteorological Service (TTMS) noted that Trinidad and Tobago's daily temperature cycle is more pronounced than its seasonal cycle. Air temperature at Diego Martin ranged from 24.8 °C – 30.8 °C during the November 2019 sampling events while the ranged was 20 °C – 32.4 °C from January 22nd – February 21st 2020 (**Figure 17** and **Figure 18**). The average temperatures were 27.2 °C and 26.4 °C for the respective periods which are comparable to the average air temperatures recorded at Piarco which had a mean daily temperature of 26.5 °C (GORTT 2013).

Analysis of the daily temperature cycle with wind direction for the January – February 2020 period showed that generally from approximately 9 AM – 6 PM the winds were mainly from the East and corresponded with higher temperatures, while winds from the North occurred at lower daily temperatures (**Figure 19**).

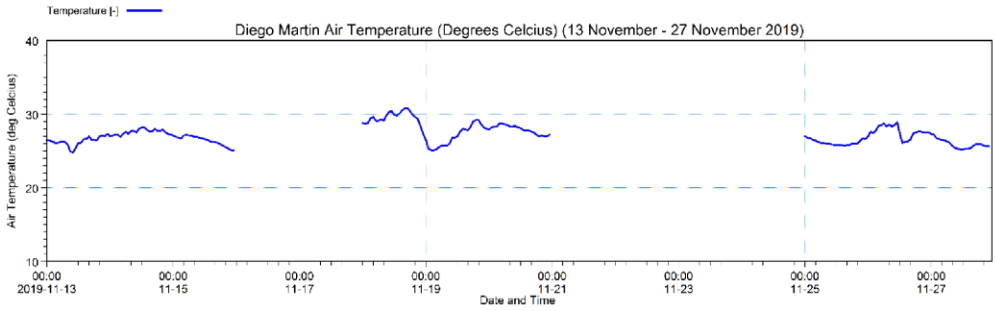


Figure 17: Air temperature Measured at Diego Martin for Events 1 – 3 in November 2019

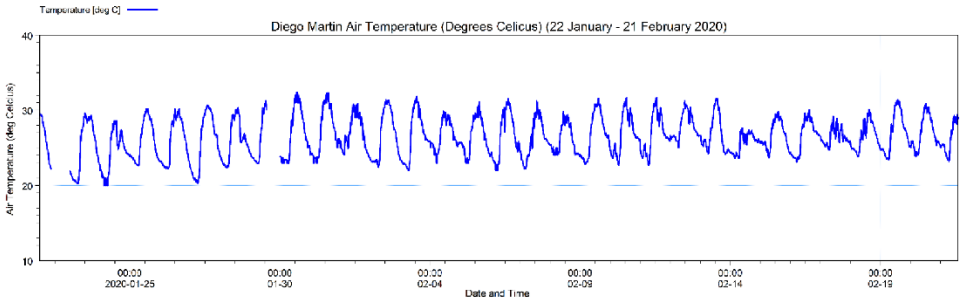


Figure 18: Air Temperature Measured at Diego Martin (22 January – 21 February 2020)

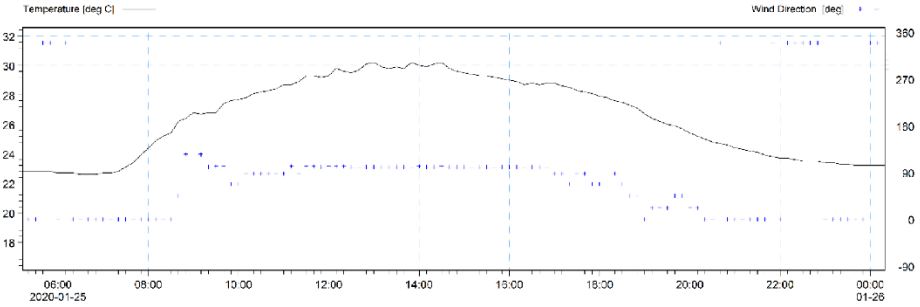


Figure 19: Daily Air Temperature and Wind Direction Measured at Diego Martin

7.3 Rainfall

Orographic (mountain) effects contribute to the greatest rainfall occurring in highland areas in both islands; specifically, the north eastern highland areas in Trinidad and the main ridge in central Tobago (Office of Disaster Preparedness and Management (ODPM) 2014). **Figure 20** and **Figure 21** illustrate the rainfall experienced in Diego martin in November 2019 and January – February 2020 respectively. During the November 2019 sampling events, the maximum amount of precipitation recorded was 84 mm on the 19th November 2019. The maximum recorded precipitation during January – February 2020 was 94 mm (24th January 2020).

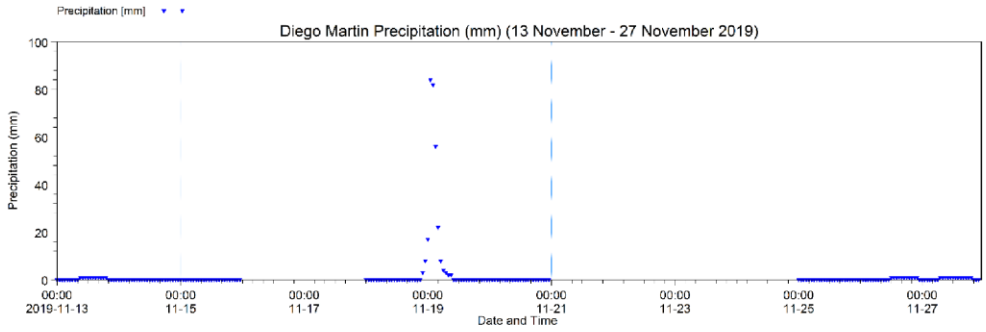


Figure 20: Rainfall Measured at Diego Martin for Events 1 – 3 in November 2019

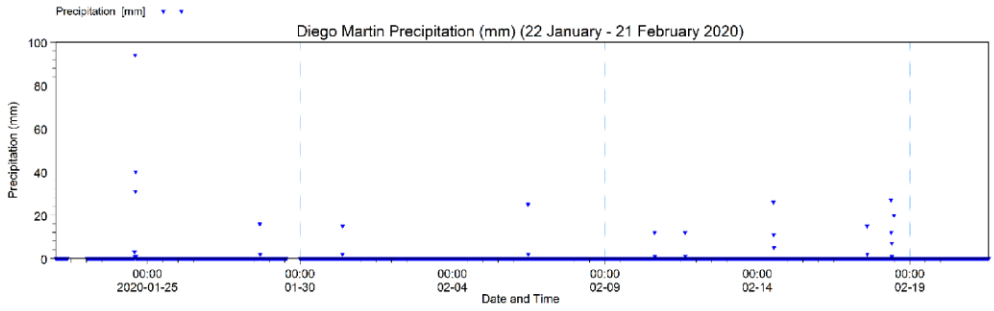


Figure 21: Rainfall Measured at Diego Martin (22 January – 21 February 2020)

7.4 Relative Humidity

Figure 22 and **Figure 23** show the relative humidity measured at Diego Martin for the respective periods of November 2019 and January – February 2020. Generally, the humidity ranged from 70% – 96% for Events 1 – 3 and ranged from 44% – 90% for the January – February 2020 period.

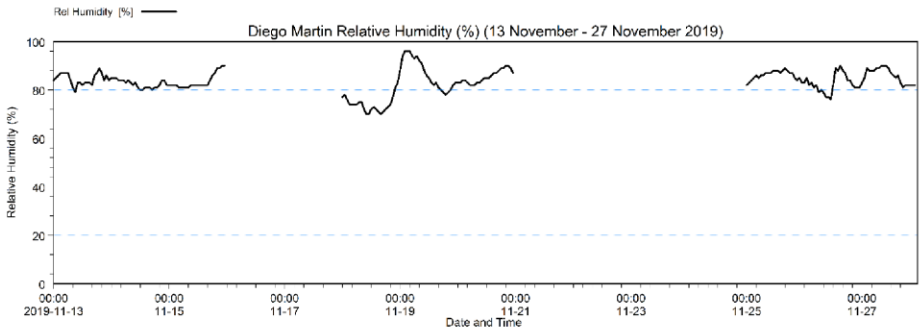


Figure 22: Relative Humidity Measured at Diego Martin for Events 1 – 3 in November 2019

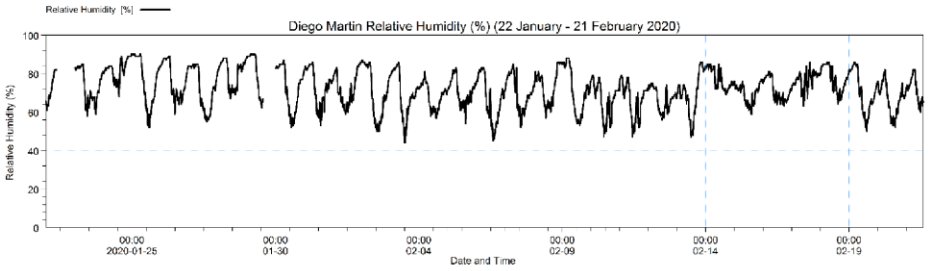


Figure 23: Relative Humidity Measured at Diego Martin (22 January – 21 February 2020)

7.5 Validation

The meteorological data inputted into the model is an important part of dispersion modelling. The data should sufficiently represent the environmental conditions within the model, as discussed in Section 8.4 of the proposed version of USEPA's Guideline on Air Quality Models (USEPA 2016). Specifically, Section 8.4.b states:

"The meteorological data used as input to a dispersion model should be selected on the basis of spatial and climatological (temporal) representativeness as well as the ability of the individual parameters selected to characterize the transport and dispersion conditions in the area of concern. The representativeness of the measured data is dependent on numerous factors including but not limited to: (1) The proximity of the meteorological monitoring site to the area under consideration; (2) the complexity of the terrain; (3) the exposure of the meteorological monitoring site; and (4) the period of time during which data are collected. The spatial representativeness of the data can be adversely affected by large distances between the source and receptors of interest and the complex topographic characteristics of the area. Temporal representativeness is a function of the year-to-year variations in weather conditions. Where appropriate, data representativeness should be viewed in terms of the appropriateness of the data for constructing realistic boundary layer profiles."

Meteorological datasets were obtained from the Global Forecast System (GFS) weather forecast model produced by the National Centers for Environmental Prediction (NCEP). The GFS model is a coupled model, composed of four separate models (an atmosphere model, an ocean model, a land/soil model, and a sea ice model), which work together to provide an accurate picture of weather conditions. Changes are regularly made to the GFS model to improve its performance and forecast accuracy. It is a constantly evolving and improving weather model. This data was used as an input into AERMET as discussed in **Section 3.1: AERMET** above.

The data used for this study were hourly from April 2017 – February 2020 and incorporated the periods of measured data (November 2019 and January – February 2020). The choice of using GFS was based on the fact that GFS covered an extended period of time and can be used to represent a range of wind speeds over the entire study area in lieu of long-term, site specific measured data. Coastal Dynamics Limited (CDL) has previously used GFS to represent

conditions around Trinidad and Tobago and generally showed a very good performance. The spatial resolution was 0.25°.

Figure 24 shows the comparison of the data measured at Diego Martin to the GFS winds for that area. As expected, the GFS winds speeds slightly overestimated the measured wind speeds. These discrepancies between the model and measured data may be a result of the meteorological station being located close to obstructions such as buildings and trees which are not necessarily reflected within the GFS grid resolution. Generally, the GFS dataset represented wind speeds within a similar envelope of values experienced in the area. **Table 5** It should be noted that the wind speeds used for this comparison is referenced to the standard 10 m, however, the vehicular overpass will be at a height of approximately 20 m and therefore experience the slightly overestimated speeds predicted by the GFS dataset.

Figure 24 also shows the measured versus modelled wind direction from 22 January – 21 February 2020. The winds from the east were generally captured by the GFS data as well as some of the components from the north. However, generally the winds from the north was not sufficiently reflected in the GFS dataset. To compensate for this, the measured data (for November, January and February) was assimilated into the datasets used as the model input. As the AERMOD model is a steady - state model, the site-specific data was considered as well as the variability of the GFS data to provide dispersion results.

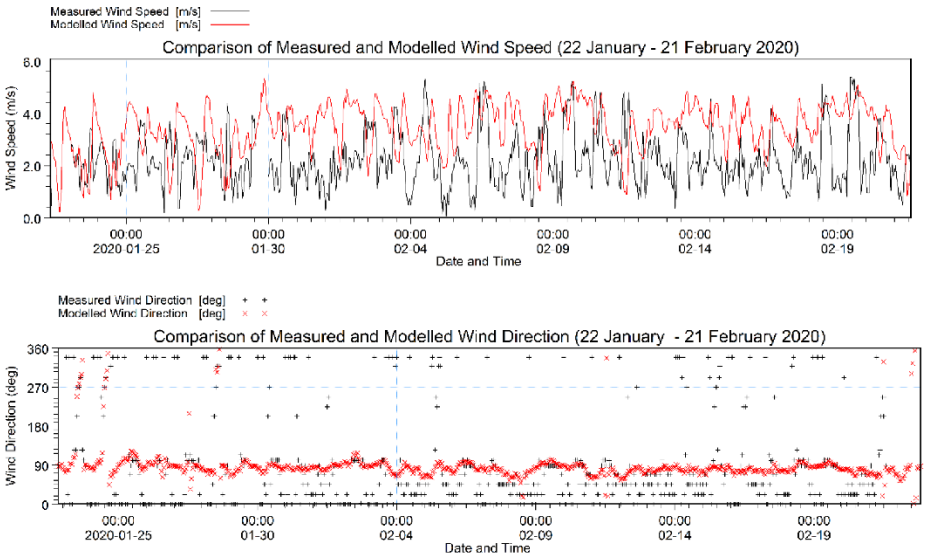


Figure 24: Comparison of Measured and Modelled Wind Speeds and Directions (22 January – 21February 2020)

Table 5: Performance Measures between Modelled and Measured data (22 January – 21 February 2019)	
Mean Error (m/s)	-1.28
Mean Absolute Error (m/s)	1.66
Root Mean Square Error (m/s)	1.97
Standard Deviation of Residuals(m/s)	1.50

8 Modelling of Scenarios Results

The results of each of the eight modelled scenarios are presented below for the highest 1-day (24-hour), and annual average over the approximate 2 year run time (April 2017 – February 2020). This simulated the Operational Phase of the overpass with meteorological conditions over this time period. Projected 12% traffic increases for 2020 (from 2015) according to MMM Group Ltd (2015) were used for Scenarios 1 – 7 emissions while projected 61% traffic increases for 2040 were used for Scenario 8 input emissions.

The results are separated into Sources and Receptors for each Scenario. For the Sources, the modelled results presented the highest average concentration of each pollutant emitted from each source (roadway or overpass) within each time period. The Diego Martin Highway was one roadway source and the proposed overpass was the second roadway. A separate grouping for 'All' Sources (per scenario) was created to model the cumulative emission of both the roadway and overpass for the applicable Scenarios. The Ambient Air Limits in Schedule 1 (EMA Air Pollution Rules 2014) are also included for comparison where applicable. AERMOD treats the generated source emission concentrations as initial concentrations that are then dispersed via the wind flow (and topography).

Additionally, at each receptor, AERMOD selected the highest-concentration for each day (24-hour), and similarly the highest annual average concentrations over 2 years. The receptor concentrations at ground level are shown for each of the 63 sensitive receptors within the vicinity of the proposed overpass. The sensitive receptors within the immediate vicinity of the overpass (Victoria Keyes and Powder Magazine high-rise apartment buildings) also measured concentrations at mid-level and top-level building heights. Stacked bar graphs were used to visually represent the impact of the "All-Sources" grouping on the Sensitive Receptors. Air quality at each Sensitive Receptor were also compared with the relevant Ambient Air Limits in Schedule 1 of the EMA Air Pollution Rules (2014) where applicable.

8.1 Scenario 1

8.1.1 Sources

Scenario 1 simulated baseline conditions for the Diego Martin highway, as the roadway passing under the vehicular overpass. The pollutants modelled were NOx, CO, $PM_{2.5}$, and total HC. **Table 6** presents the highest average pollutant concentrations emitted after 24-hour and annual average concentration over 2 years (for the run period April 2017 – February 2020). **Figure 25** presents the Scenario 1 data graphically for each time period. A trend in the data can be seen where emissions for the 24-hour time period showed the highest concentrations which then decreased significantly to the highest annual average. For this scenario, the highest pollutant concentration emitted after 24-hour and annual average was CO (1384.56 $\mu g/m^3$ and 482.80 $\mu g/m^3$ respectively) followed by NOx (174.93 $\mu g/m^3$ and 64.01 $\mu g/m^3$) and total HC (107.94 $\mu g/m^3$ and 37.64 $\mu g/m^3$). The lowest pollutant emitted was $PM_{2.5}$ (5.35 $\mu g/m^3$ and 1.87 $\mu g/m^3$).

The 24-hour $PM_{2.5}$ ambient air limit (EMA Air Pollution Rules 2014) is 65 $\mu g/m^3$ and the 24-hour $PM_{2.5}$ concentrations emitted from vehicles on the Diego Martin Highway were significantly less (5.35 $\mu g/m^3$). The 1-year $PM_{2.5}$ limit of 15 $\mu g/m^3$ was also not exceeded as the concentration obtained was 1.87 $\mu g/m^3$. No 24-hour nor 1-year limit was declared for CO in the EMA Air Pollution Rules (2014) however the ambient 1-hour limit is 30 000 $\mu g/m^3$ and 8-hour limit is 10 000 $\mu g/m^3$. Since the 24-hour limit was as low as 1384.56 $\mu g/m^3$, it is not expected that the 1-hour and 8-hour limits would have been exceeded.

The highest annual average NOx value measured over a 2-year dataset was found to be approximately 24 $\mu g/m^3$ over the annual 1-year NO_2 limit. This was the worst-case value as it was the highest value recorded, indicating that on average, concentrations are expected to be less than 64 $\mu g/m^3$. As discussed in **Section 6.2 Emission Factors from USEPA**, the model overestimated NOx conditions due to the higher emission factor used for the vehicle category 'Other' that would have influenced the overall emissions calculated for NOx. The model also represented worse case conditions in which emissions were assumed to be continuously emitted from 6:00 a.m. to 6:00 p.m. for 365 days of the year. In reality, this is not the case. Additionally, when compared to NOx monitoring levels measured by the EMA Port of Spain Air Quality station, located in the Beetham area (of the Churchill Roosevelt Highway) on 5th February 2020

the 24-hour time period measured 206 µg/m^3 (to 174.93 µg/m^3 of the Diego Martin modelled result), however for the month of February 2020 the average was 77 µg/m^3 (Environmental Management Authority (EMA) 2020) **Figure 26**).

It is also noted that these emissions will be dispersed by the wind flow in the area as AERMOD treats these source concentrations as initial concentrations to then be dispersed by the model. This results in a decrease in pollutant concentrations as they are dispersed by a combination of the meteorology and topography of the area.

Table 6: Highest average pollutant concentrations for Scenario 1 (Baseline)

Period	Source	CO (µg/m^3)	$PM_{2.5}$ (µg/m^3)	NOx (µg/m^3)	HC (µg/m^3)
24-hour (highest)	**Diego Martin Highway**	1384.56	5.35	174.93	107.94
Highest Annual Average	**Diego Martin Highway**	482.80	1.87	64.01	37.64
Ambient Air Limit (First Schedule, EMA Air Pollution Rules 2014)		nd	65 (24-hour) 15 (1-year)	40 (1-year)	nd

nd – none declared for 24-hour or Annual

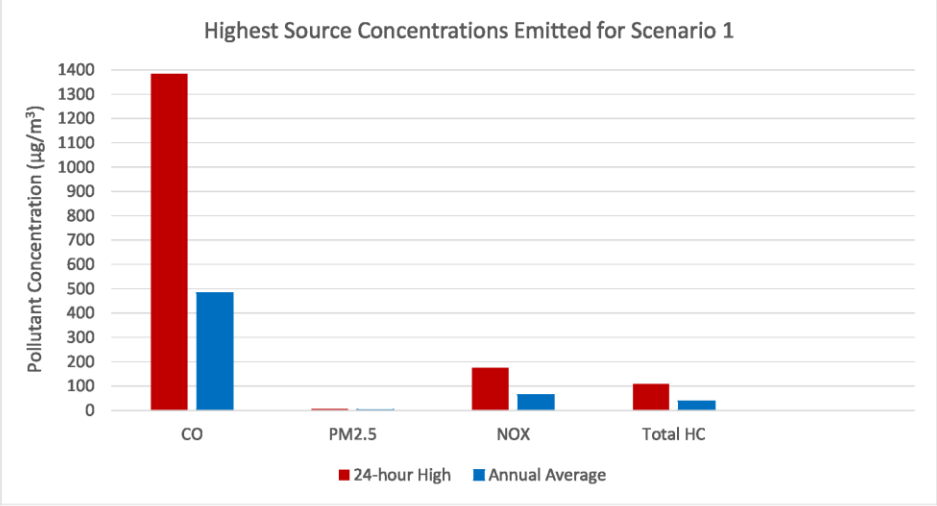
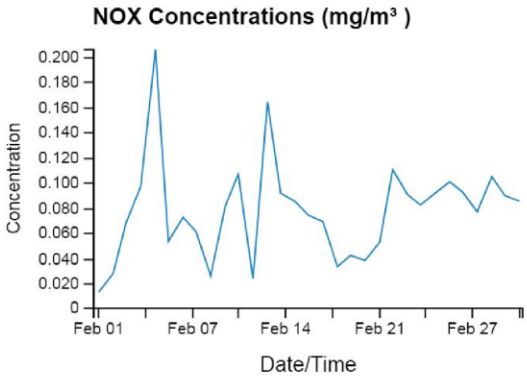


Figure 25: Highest Average pollutants emitted for Baseline Conditions

EMA POS Station NOx levels		
Date	**mg/m3**	**ug/m3**
01-Feb-20	0.013	13
02-Feb-20	0.028	28
03-Feb-20	0.068	68
04-Feb-20	0.097	97
05-Feb-20	0.206	206
06-Feb-20	0.053	53
07-Feb-20	0.073	73
08-Feb-20	0.061	61
09-Feb-20	0.026	26
10-Feb-20	0.082	82
11-Feb-20	0.107	107
12-Feb-20	0.023	23
13-Feb-20	0.164	164
14-Feb-20	0.092	92
15-Feb-20	0.085	85
17-Feb-20*	0.069	69
18-Feb-20	0.033	33
19-Feb-20	0.042	42
20-Feb-20	0.038	38
21-Feb-20	0.053	53
22-Feb-20	0.11	110
23-Feb-20	0.091	91
24-Feb-20	0.082	82
25-Feb-20	0.092	92
26-Feb-20	0.101	101
27-Feb-20	0.093	93
28-Feb-20	0.077	77
29-Feb-20	0.105	105
Mean	0.077	77.3

*16-Feb-20 was omitted



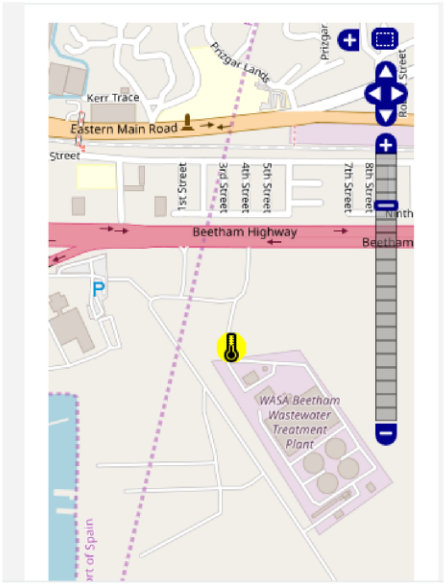


Figure 26: NOx levels at the EMA Port of Spain Air Quality station, located in the Beetham area

8.1.2 Receptors

Concentrations of pollutants at the sensitive receptors for Scenario 1 were compared to Schedule 1, Ambient Air Quality Standards (EMA Air Pollution Rules 2014) according to 24-hour or 1-year limit provided. **Figure 27** – **Figure 32** show each pollutant concentration at the 63 sensitive receptors for Scenario 1, followed by the air quality dispersion plots..

CO concentrations ranged 3 $\mu g/m^3$ – 330 $\mu g/m^3$ for the 24-hour average while that for the annual ranged 0.01 $\mu g/m^3$ – 65 $\mu g/m^3$. Even though no 24-hour nor 1-year limit was declared for CO in the EMA Air Pollution Rules (2014), 1-hour and 8-hour limits were declared at 30 000 $\mu g/m^3$ and 10 000 $\mu g/m^3$. Based on the concentration ranges obtained for CO, it is not expected that the 1-hour and 8-hour limits would have been exceeded.

NOx annual average concentrations range 0.001 $\mu g/m^3$ – 8 $\mu g/m^3$, which was under the ambient air limit of 40 $\mu g/m^3$ for NO_2. The NOx 24-hour concentrations ranged 0.3 $\mu g/m^3$ – 45 $\mu g/m^3$. Concentrations measured for total HC ranged 0.001 $\mu g/m^3$ – 26 $\mu g/m^3$ (24-hour) and 0.001 $\mu g/m^3$ – 5 $\mu g/m^3$ (annual).

$PM_{2.5}$ concentrations which had short term and long-term permissible limits of 65 $\mu g/m^3$ (24-hours) and 15 $\mu g/m^3$ (1-year) respectively, were not exceeded for any of the 63 receptors. The annual $PM_{2.5}$ concentrations at the receptors ranged 0.001 $\mu g/m^3$ – 0.25 $\mu g/m^3$ while the 24-hour ranged 0.01 $\mu g/m^3$ – 1.3 $\mu g/m^3$ for the modelling period April 2017 – February 2020.

With respect to Victoria Keyes and Powder Magazine which are located less than 3 m from the proposed overpass, varying receptor heights made no significant difference to pollutant concentrations. Receptor heights were modelled at ground, middle and top of the buildings.

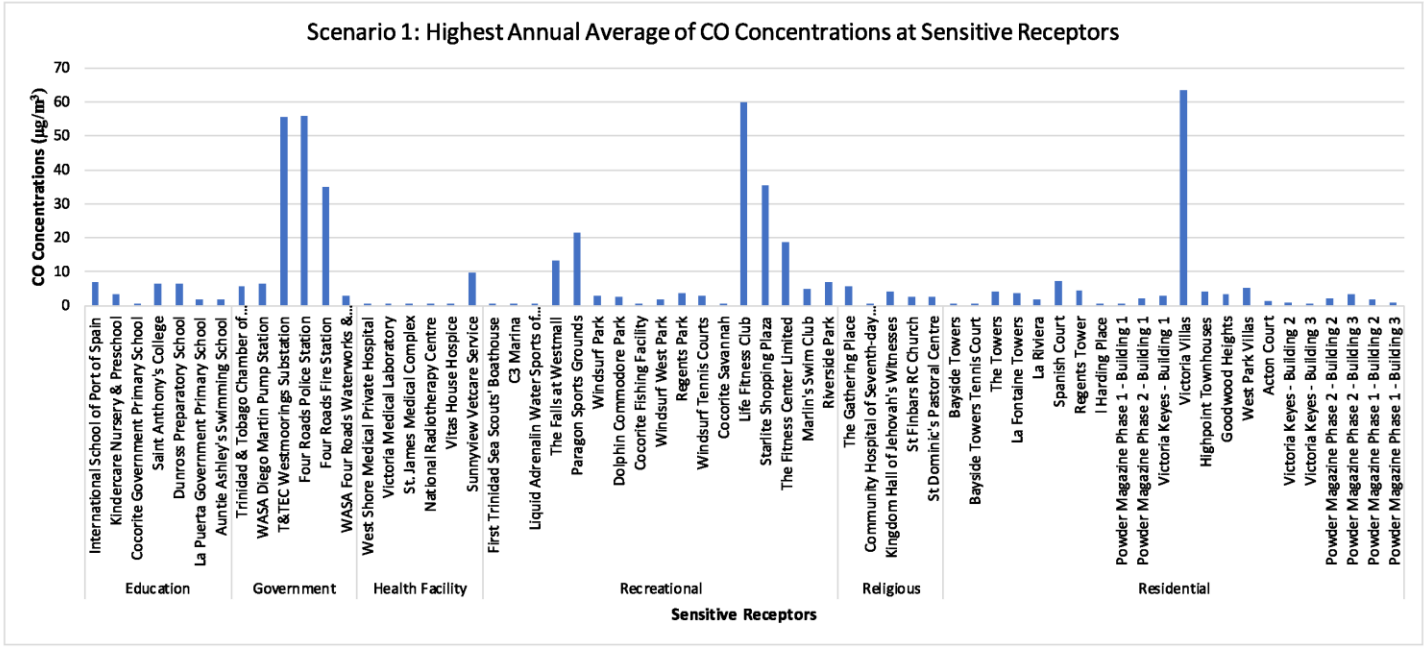


Figure 27: Highest Annual Average CO pollutant concentrations at Sensitive Receptors for Scenario 1

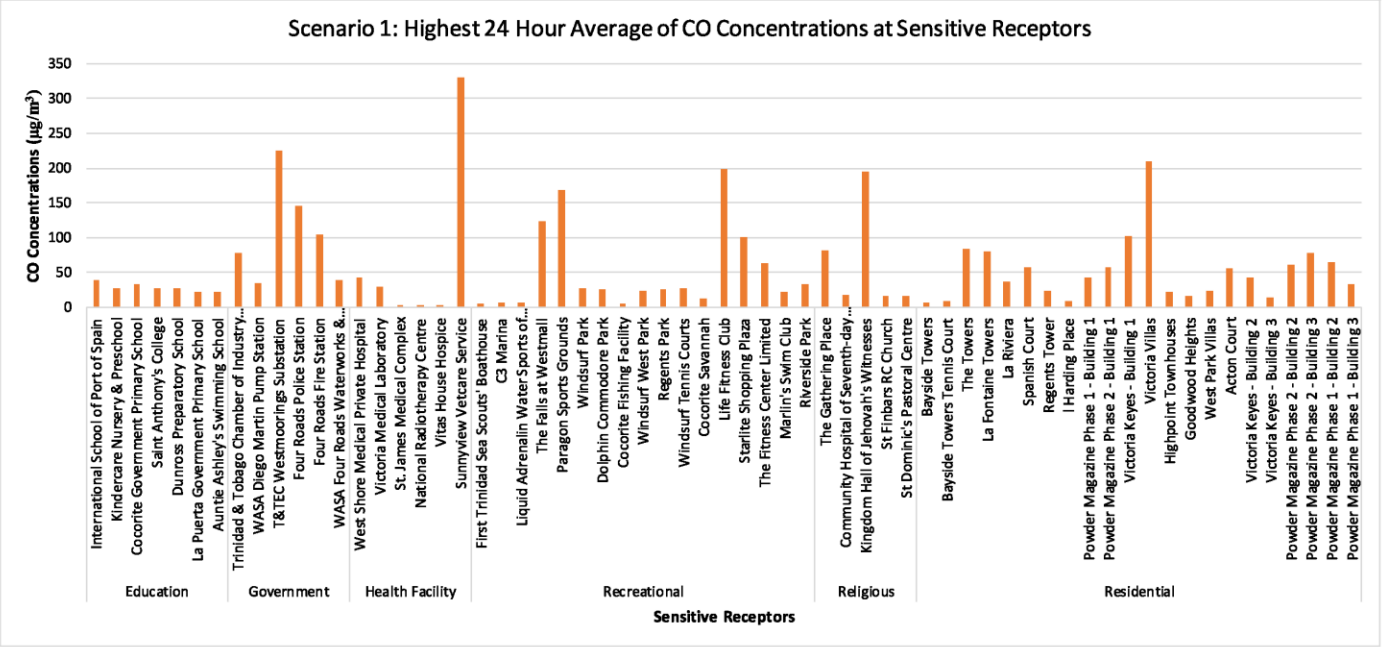


Figure 28: Highest 24-hour Average CO pollutant concentrations at Sensitive Receptors for Scenario 1

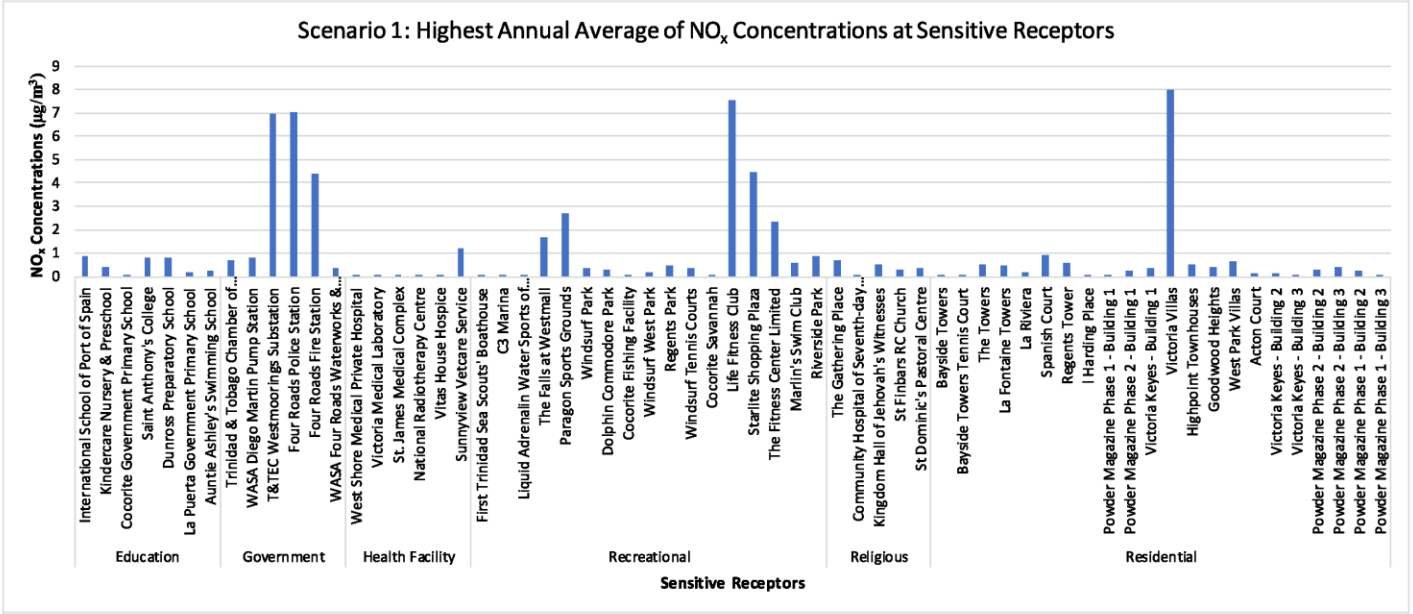


Figure 29: Highest Annual Average NOx pollutant concentrations at Sensitive Receptors for Scenario 1

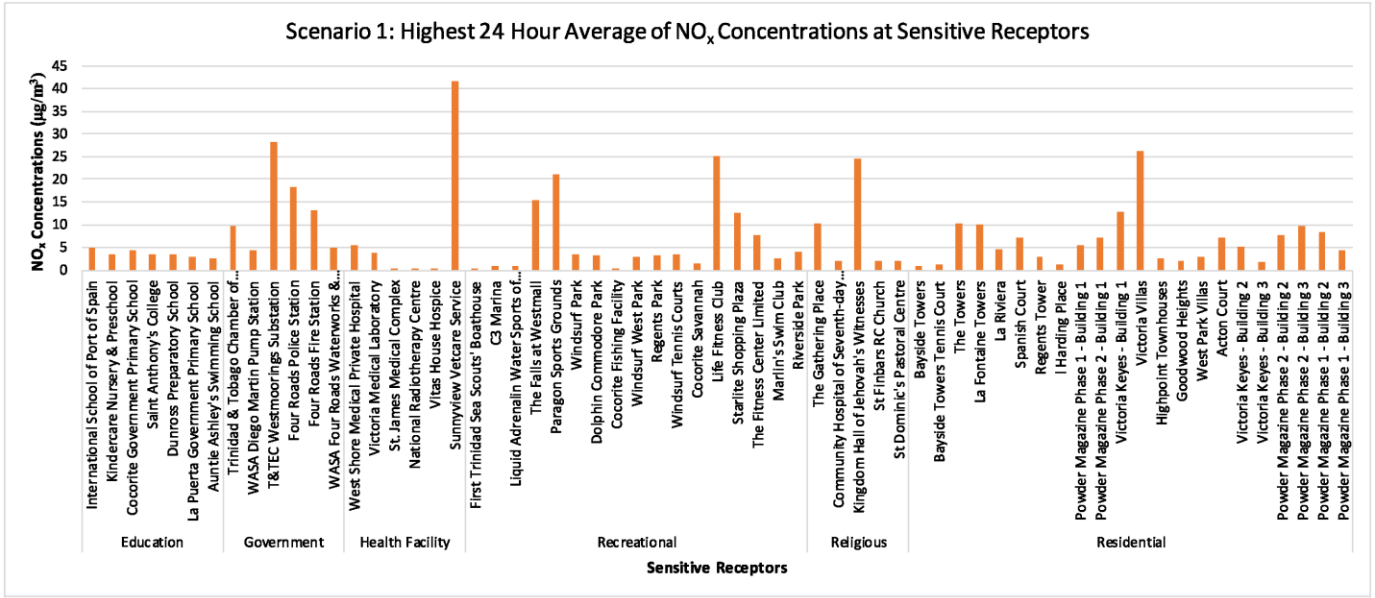


Figure 30: Highest 24-hour Average NOx pollutant concentrations at Sensitive Receptors for Scenario 1

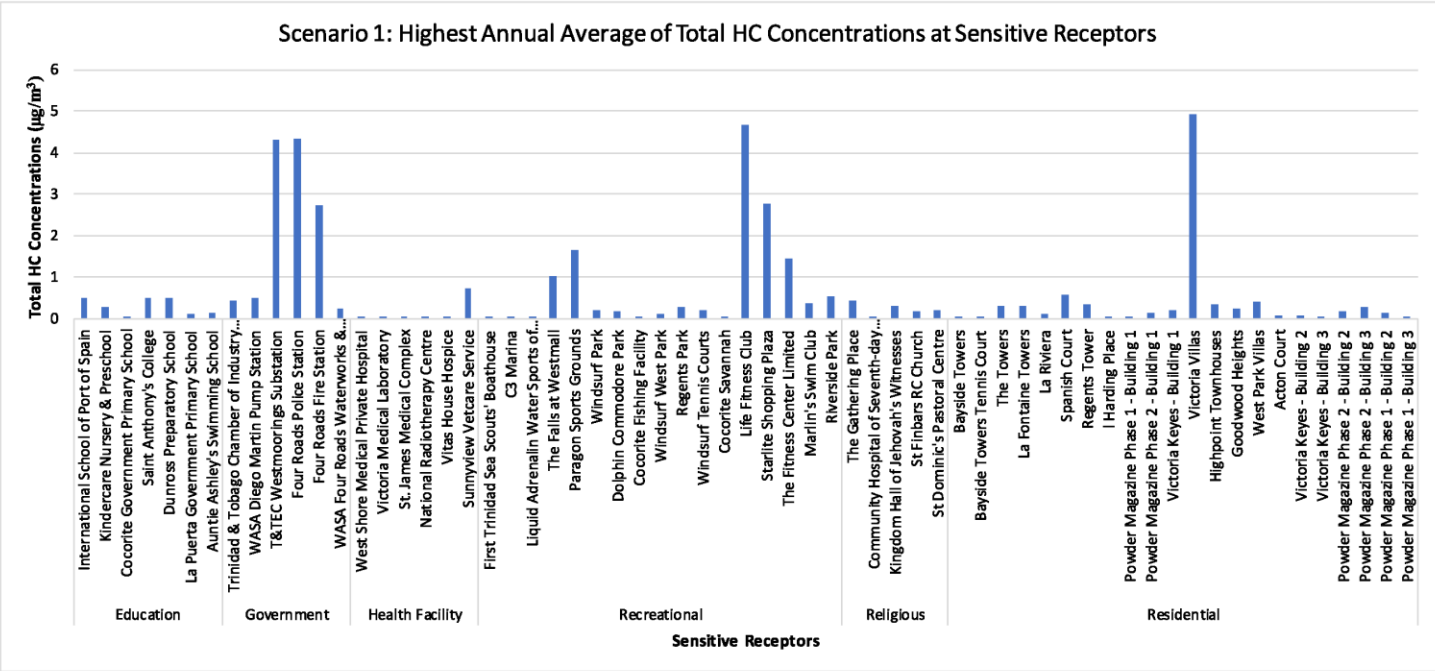


Figure 31: Highest Annual Average Total HC pollutant concentrations at Sensitive Receptors for Scenario 1

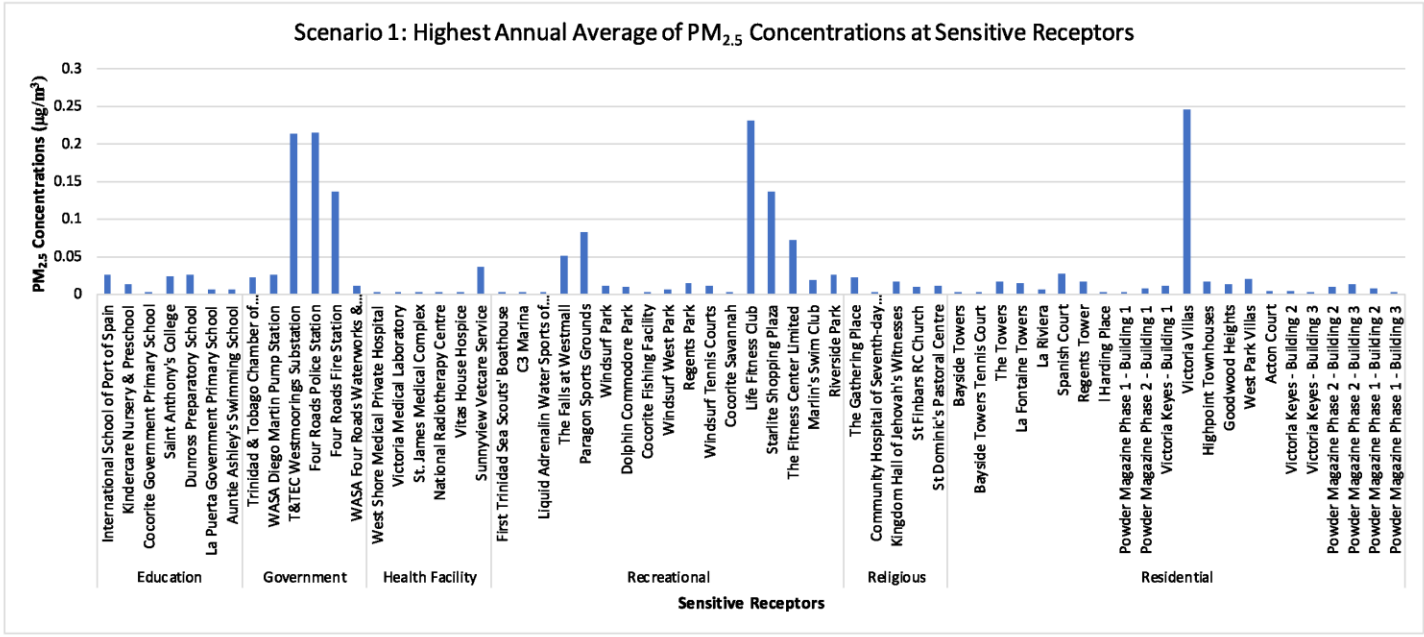


Figure 32: Highest Annual Average $PM_{2.5}$ pollutant concentrations at Sensitive Receptors for Scenario 1

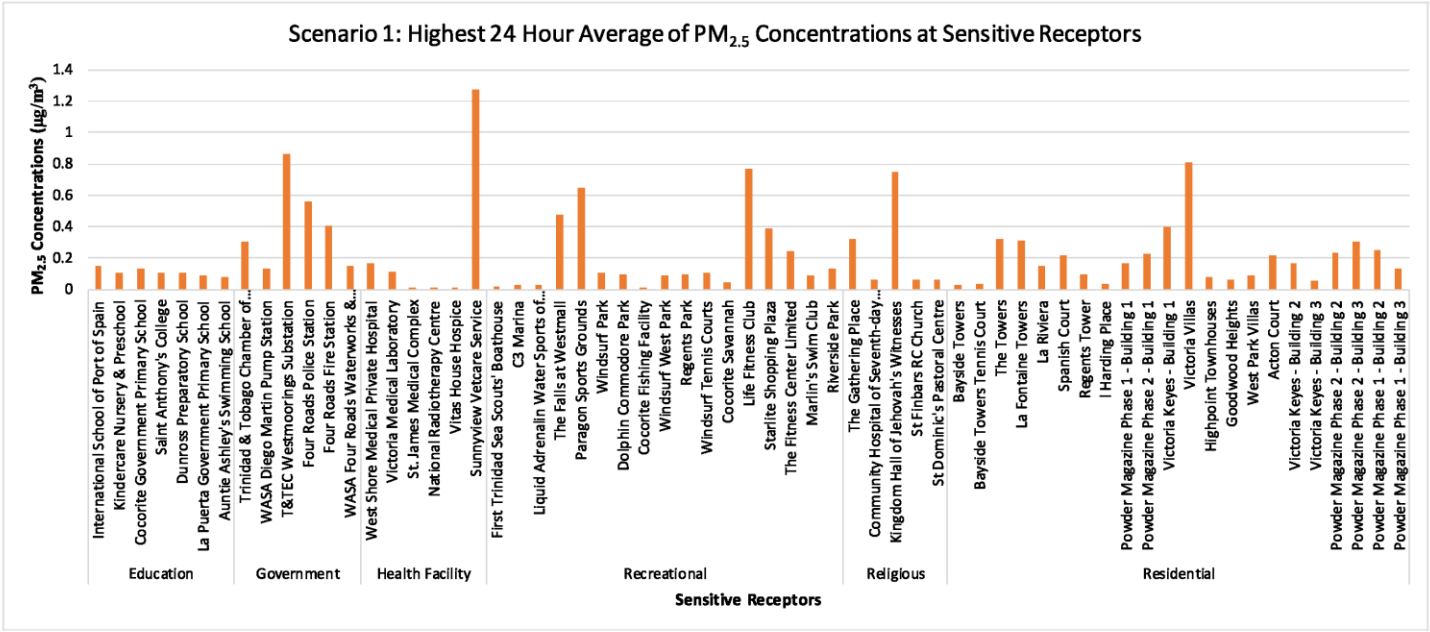
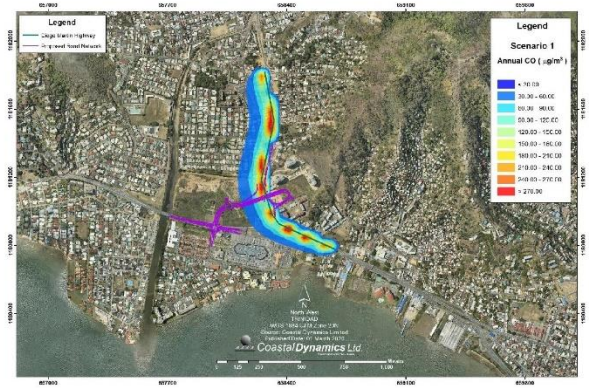
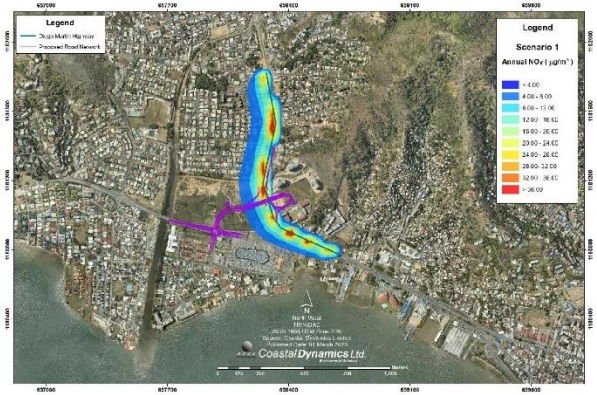
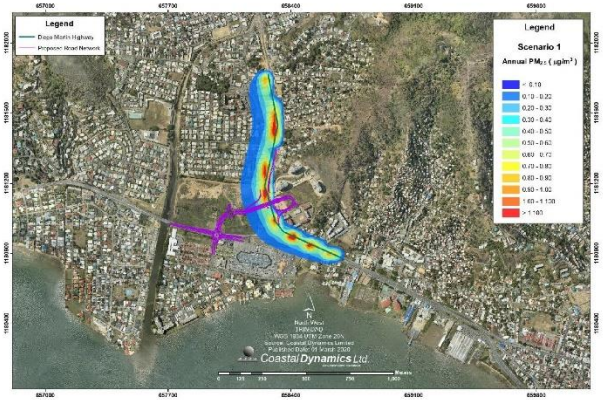


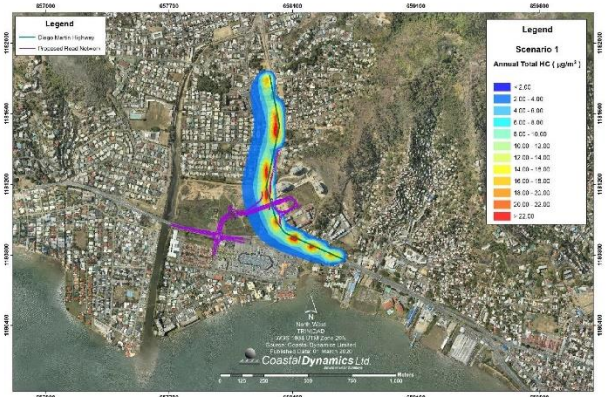
Figure 33: Highest 24-hour Average $PM_{2.5}$ pollutant concentrations at Sensitive Receptors for Scenario 1

Air Dispersion Plot for Scenario 1









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8.2 Scenario 2

8.2.1 Sources

Scenario 2 simulated the Construction Phase for an approximate area of 188 881 m^2 in the immediate vicinity of the proposed overpass. The pollutants modelled were NOx, CO, PM_{10} and SO_2. **Table 7** presents the highest average pollutant concentrations emitted after 1-day and an annual highest average over a 2-year period. **Figure 34** presents the Scenario 2 data graphically for each time period. A trend in the data can be seen where emissions for the 24-hour time period showed the highest concentrations which then decreased significantly to the annual average taken over a 2-year period. For this scenario, the highest pollutant concentration emitted from construction equipment after 24-hour and annual 2-year average was NOx (353.56 $\mu g/m^3$ and 110.52 $\mu g/m^3$ respectively) followed by SO_2 (25.01 $\mu g/m^3$ and 7.82 $\mu g/m^3$) and PM_{10} (21.94 $\mu g/m^3$ and 6.86 $\mu g/m^3$). The lowest pollutant emitted was CO (10.94 $\mu g/m^3$ and 3.42 $\mu g/m^3$).

The 24-hour PM_{10} ambient air limit (EMA Air Pollution Rules 2014) is 75 $\mu g/m^3$ and the 24-hour $PM_{2.5}$ concentrations emitted from the defined construction area were significantly less (6.86 $\mu g/m^3$). The 1-year PM_{10} limit of 50 $\mu g/m^3$ was also not exceeded as the concentration obtained was 6.8 $\mu g/m^3$. Similarly, the highest SO_2 concentration after 24-hour (25.01 $\mu g/m^3$) was significantly less than the corresponding 24-hour EMA Ambient Air Limit of 125 $\mu g/m^3$. No 24-hour nor 1-year limit was declared for CO in the EMA Air Pollution Rules (2014) however the ambient 1-hour limit is 30 000 $\mu g/m^3$ and 8-hour limit is 10 000 $\mu g/m^3$. Since the 24-hour limit was as low as 10.94 $\mu g/m^3$, it is not expected that the 1-hour and 8-hour limits would have been exceeded.

The highest annual average NOx value measured over a 2-year dataset (110 $\mu g/m^3$) was found to exceed the annual 1-year NO_2 limit. This was the worst case value as it was highest value recorded, indicating that on average, concentrations are expected to be less than this value. For this Scenario, worst-case conditions were modelled by assuming that a large area (approximately 188 881 m^2) will be used for construction, and that all categories of equipment are on and in operation at the same time across the entire area. This is an overestimate as not all categories of equipment are expected to be in operation at the same time nor will they be continuously emitting for a 12-hour period (6:00 a.m. to 6:00 p.m.) every day for 365 days of the year.

However worst-case was modelled to determine the effects of such a case on the surrounding Diego Martin area.

Additionally, the construction phase is expected to take approximately 1-year; after this phase is completed, no construction emissions will be experienced within the overpass area. It is also noted that these emissions will be dispersed by the wind flow in the area as AERMOD treats these source concentrations as initial concentrations to then be dispersed by the model. This will result in a decrease in the pollutant concentrations shown in **Table 7** as they are dispersed by a combination of the meteorology and topography of the area.

Table 7: Highest average pollutant concentrations for Scenario 2 (Construction)

Period	Source	CO ($\mu g/m^3$)	NOx ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)
24-hour (highest)	**Construction Equipment**	10.94	353.56	25.01	21.94
Highest Annual Average	**Construction Equipment**	3.42	110.52	7.82	6.86
Ambient Air Limits (First Schedule, EMA Air Pollution Rules 2014)		nd	40 (1-year)	125 (24-hour)	75 (24-hour) 50 (1-year)

nd – none declared for 24-hour or Annual

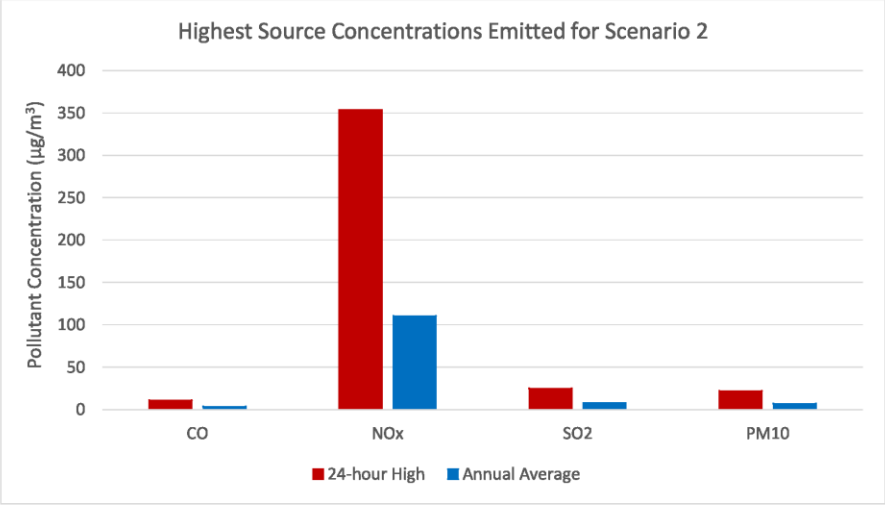

Figure 34: Highest Average pollutants emitted for Construction Equipment alone

8.2.2 Receptors

Concentrations of pollutants at the sensitive receptors for Scenario 2 were compared to Schedule 1, Ambient Air Quality Standards (EMA Air Pollution Rules 2014) according to 24-hour or 1-year limit provided. **Figure 35– Figure 42** show each pollutant concentration at the 63 sensitive receptors for Scenario 2, followed by the air quality dispersion plots.

CO concentrations ranged 0.083 $\mu g/m^3$ – 6.53 $\mu g/m^3$ for the 24-hour average while that for the annual ranged 0.0003 $\mu g/m^3$ – 0.73 $\mu g/m^3$. Even though no 24-hour nor 1-year limit was declared for CO in the EMA Air Pollution Rules (2014), 1-hour and 8-hour limits were declared at 30 000 $\mu g/m^3$ and 10 000 $\mu g/m^3$. Based on the concentration ranges obtained for CO, it is not expected that the 1-hour and 8-hour limits would have been exceeded.

NOx annual 2-year average concentrations range 0.009 µg/m3 – 23.68 µg/m3, which was under the ambient air limit of 40 µg/m3 for NO_2 and 2.70 µg/m3 – 211 µg/m3 for 24-hour average. Similarly, PM_{10} concentrations which had short term and long-term permissible limits of 75 µg/m3 (24-hours) and 50 µg/m3 (1-year) respectively, were not exceeded for any of the 63 receptors (Figure 28 and Figure 29). The PM_{10} concentrations at the receptors ranged 0.167 $\mu g/m^3$ – 13.09 $\mu g/m^3$ for 24-hour average and ranged 0.00059 $\mu g/m^3$ – 1.46 $\mu g/m^3$ for annual 2-year average for the modelling period April 2017 – February 2020.

SO_2 concentrations which had short term and long-term permissible limits of 125 $\mu g/m^3$ (24-hours) and 50 µg/m3 (1-year) respectively, were not exceeded for any of the 63 receptors The SO_2 concentrations at the receptors ranged 0.190 $\mu g/m^3$ – 14.92 $\mu g/m^3$ for 24-hour average and ranged 0.0006 $\mu g/m^3$ – 1.67 $\mu g/m^3$ for annual 2-year average.

With respect to Victoria Keyes and Powder Magazine which are located less than 3 m from the proposed overpass, varying receptor heights made no significant difference to pollutant concentrations. Receptor heights were modelled at ground, middle and top of the buildings.

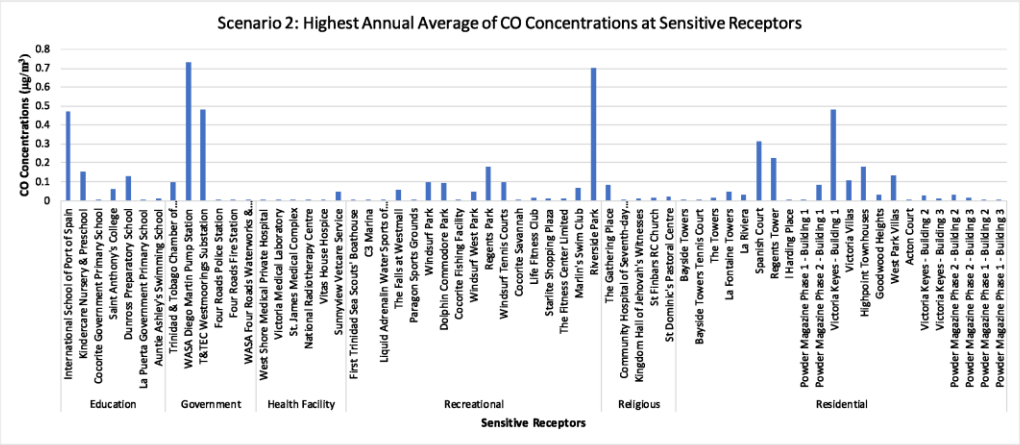

Figure 35: Highest Annual Average CO pollutant concentrations at Sensitive Receptors for Scenario 2

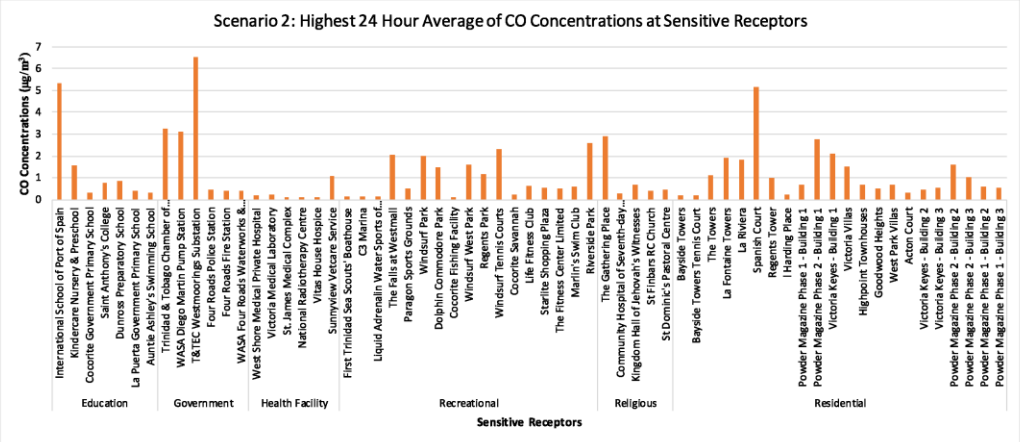

Figure 36: Highest 24-hour Average CO pollutant concentrations at Sensitive Receptors for Scenario 2

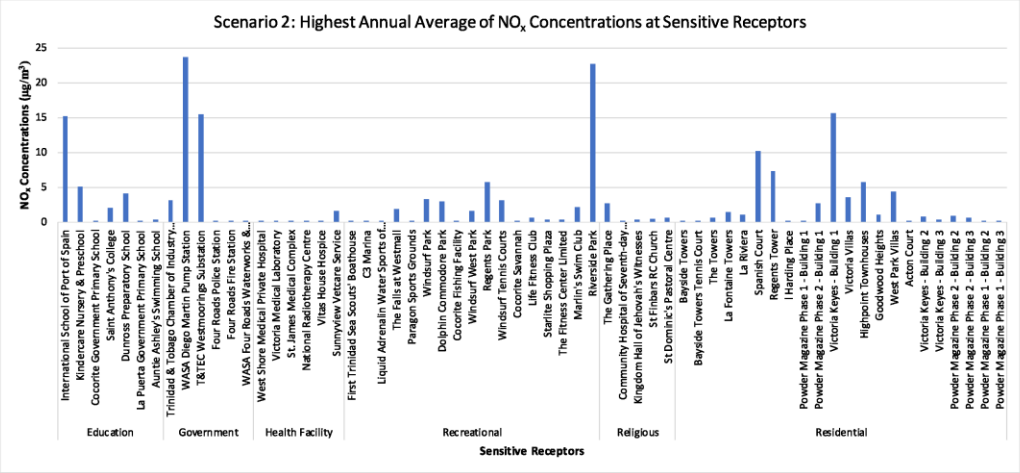

Figure 37: Highest Annual Average NOx pollutant concentrations at Sensitive Receptors for Scenario 2

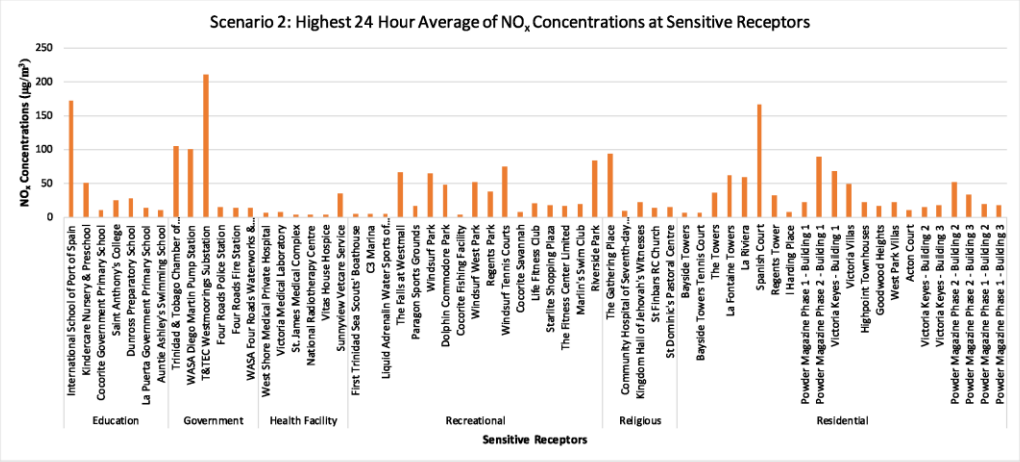

Figure 38: Highest 24-hour Average NOx pollutant concentrations at Sensitive Receptors for Scenario 2

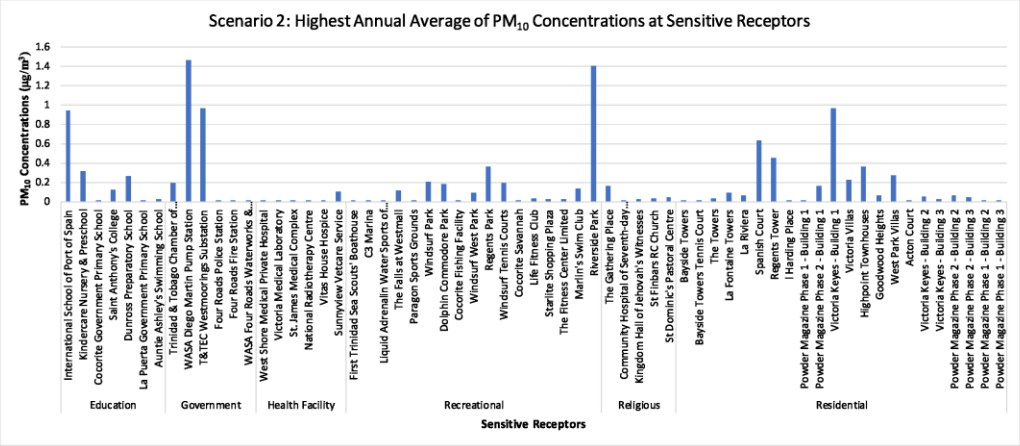

Figure 39: Highest Annual Average PM_{10} pollutant concentrations at Sensitive Receptors for Scenario 2

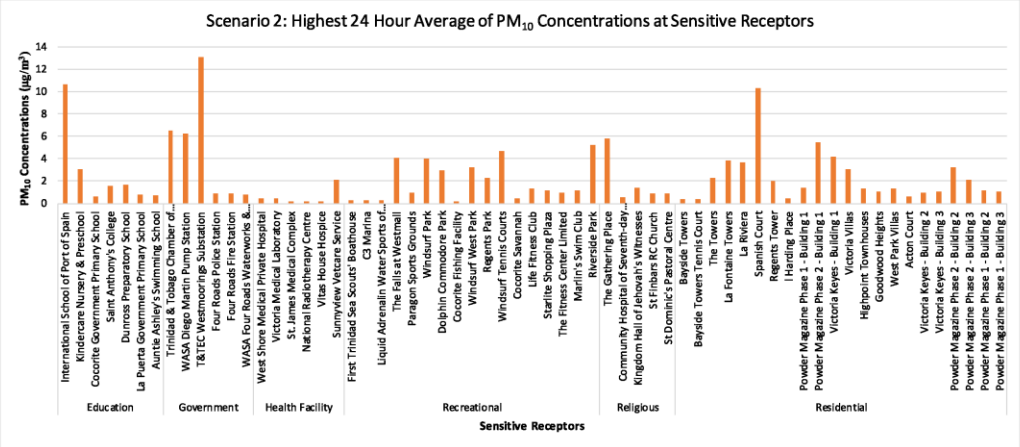

Figure 40: Highest 24-hour Average NOx pollutant concentrations at Sensitive Receptors for Scenario 2

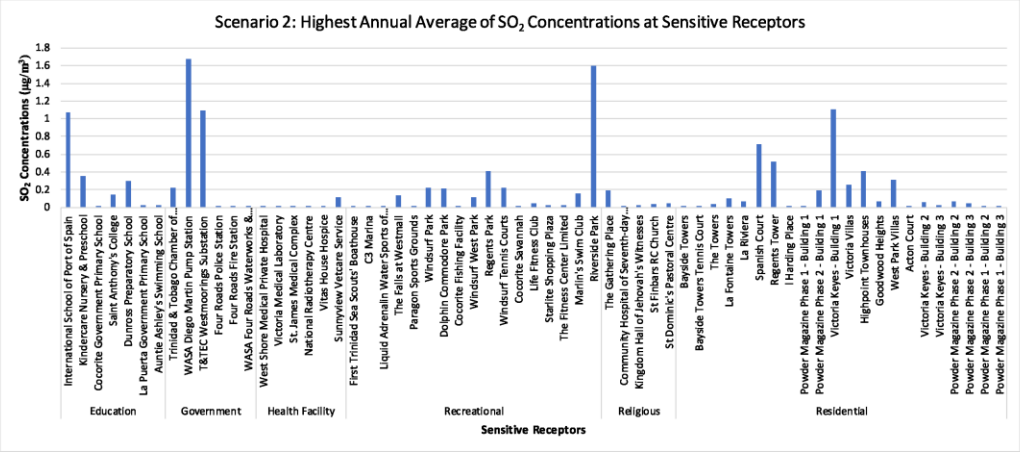

Figure 41: Highest Annual Average SO_2 pollutant concentrations at Sensitive Receptors for Scenario 2

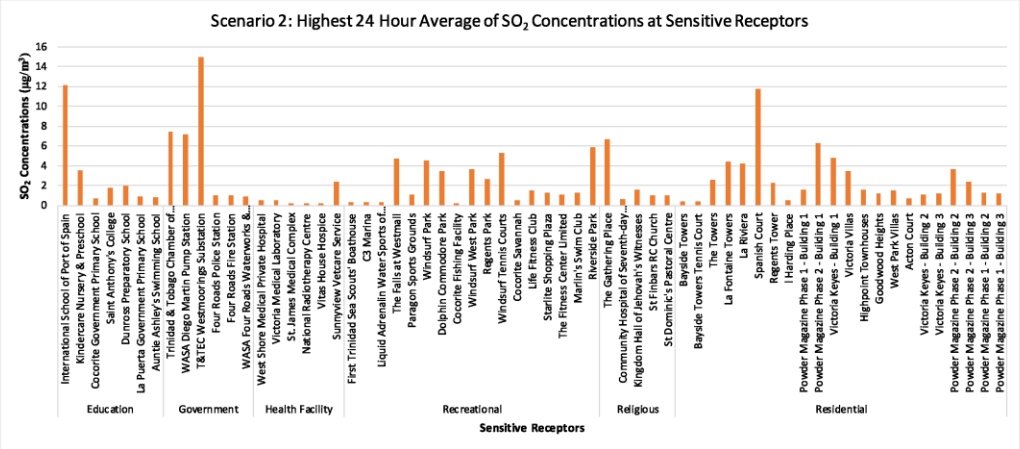

Figure 42: Highest 24-hour Average SO_2 pollutant concentrations at Sensitive Receptors for Scenario 2

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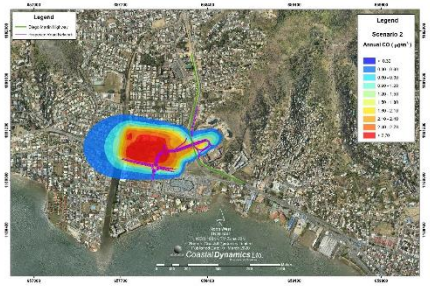
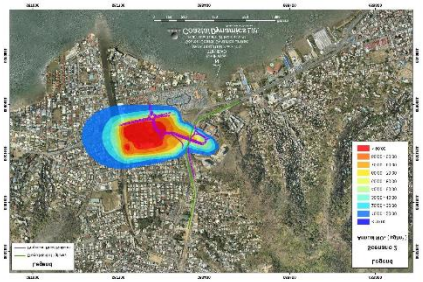
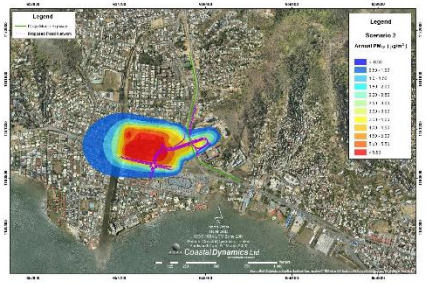
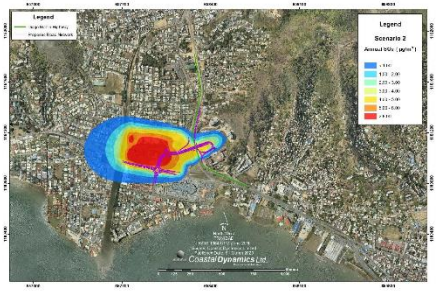
Air Dispersion Plot for Scenario 2









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8.3 Scenario 3

8.3.1 Sources

Scenario 3 simulated the Construction and Baseline Phases cumulatively, taking into account both the construction emissions (modelled in Scenario 2) and the Diego Martin Highway emissions (modelled in Scenario 1). The construction area measured 188 881 m^2 in the immediate vicinity of the proposed overpass. The pollutants modelled were CO, NOx, $PM_{2.5}$ and total HC for the highway (baseline) and NOx, CO, PM_{10} and SO_2 for the construction equipment emissions. As CO and NOx were the only overlap in pollutants for Scenarios 1 and 2 i.e. since only these two pollutants were the same in both scenarios, the results for only these two pollutants are presented. **Table 8** shows the highest average pollutant concentrations emitted after 24-hour and an annual highest average over a 2-year period. **Figure 43** presents the Scenario 2 data graphically for each time period.

A trend in the data can be seen where emissions for the 24-hour time period showed the highest concentrations which then decreased significantly to the annual average taken over a 2-year period. For this scenario, the highest cumulative pollutant concentrations emitted from both construction equipment and baseline after 1-day and annual 2-year average was CO (1385.51 $\mu g/m^3$ and 482.82 $\mu g/m^3$ respectively) followed by NOx (365.73 $\mu g/m^3$ and 112.02 $\mu g/m^3$). Individually, NOx was the higher pollutant concentration emitted from the construction emissions while CO was the higher pollutant emitted for the roadway emissions.

No 24-hour nor 1-year limit was declared for CO in the EMA Air Pollution Rules (2014) however the ambient 1-hour limit is 30 000 $\mu g/m^3$ and 8-hour limit is 10 000 $\mu g/m^3$. Since the 24-hour limit for the All Source grouping was as low as 1384.51 $\mu g/m^3$, it is not expected that the 1-hour and 8-hour limits would have been exceeded.

The highest (cumulative) annual average NOx value measured over a 2-year dataset (112.02 $\mu g/m^3$) was found to exceed the annual 1-year NO_2 limit. This was the worst-case value as it was the highest value recorded, indicating that on average, concentrations are expected to be less than 112.02 $\mu g/m^3$. For this Scenario, worst-case conditions were modelled by assuming that a large area (approximately 188 881 m^2) will be used for construction, and that all categories of

equipment are on and in operation at the same time across the entire area. This is an overestimate as not all categories of equipment are expected to be in operation at the same time nor will they be continuously emitting for a 12-hour period (6:00 a.m. to 6:00 p.m.) every day for 365 days of the year. However worst-case was modelled to determine the effects of such a case on the surrounding Diego Martin area. Additionally, the construction phase is expected to take approximately 1-year; after this phase is completed, no construction emissions will be experienced within the overpass area. It is also noted that these emissions will be dispersed by the wind flow in the area as AERMOD treats these source concentrations as initial concentrations to then be dispersed by the model. This will result in a decrease in the pollutant concentrations shown in **Table 8** as they are dispersed by a combination of the meteorology and topography of the area.

Table 8: Highest average pollutant concentrations for Scenario 3 (Construction & Baseline)

Source	CO		NOx	
	24hr (highest)	Annual Average	24hr (highest)	Annual Average
Construction	10.94	3.42	353.56	110.52
Roadway	1384.58	482.80	174.93	61.00
ALL Sources	1385.51	482.82	365.73	112.02
Ambient Air Limits (First Schedule, EMA Air Pollution Rules 2014)	nd	nd	nd	40

nd – none declared for 24-hour or Annual

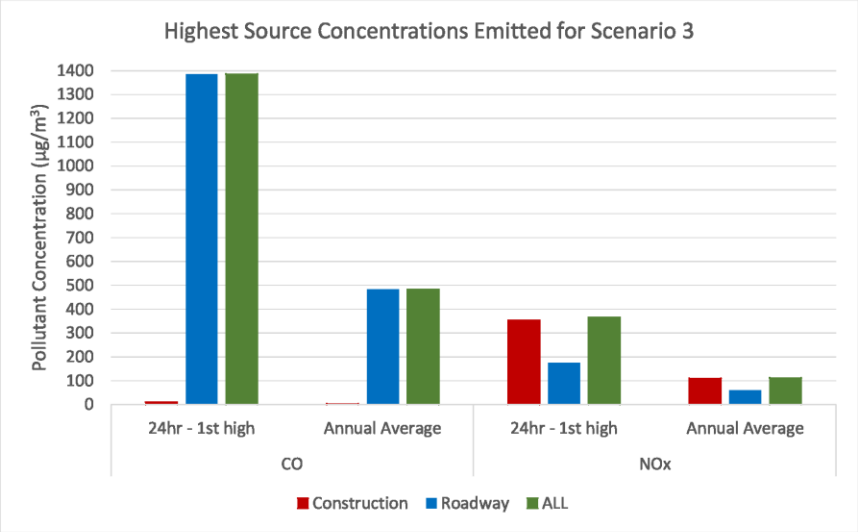


Figure 43: Highest Average pollutants emitted cumulatively for baseline and construction emissions

8.3.2 Receptors

Scenario 3 (simulated the Construction and Baseline Phases cumulatively) were compared to Schedule 1, Ambient Air Quality Standards (EMA Air Pollution Rules 2014) according to 24-hour or 1-year limit provided. **Figure 44 – Figure 47** show each pollutant concentration at the 63 sensitive receptors for Scenario 3, followed by the air quality dispersion plots.

CO concentrations ranged 2.47 µg/m^3 – 330.18 µg/m^3 for the 24-hour average while that for the annual ranged 0.0007 µg/m^3 – 63.52 µg/m^3. Even though no 24-hour nor 1-year limit was declared for CO in the EMA Air Pollution Rules (2014), 1-hour and 8-hour limits were declared at 30 000 µg/m^3 and 10 000 µg/m^3. Based on the concentration ranges obtained for CO, it is not expected that the 1-hour and 8-hour limits would have been exceeded.

NOx annual 2-year average concentrations range 0.010 µg/m3 – 24.50 µg/m3, which was under the ambient air limit of 40 µg/m3 for NO_2 and 2.70 µg/m3 – 239.28 µg/m3 for 24-hour average. As explained under Section 8.3.1 Sources for this Scenario, this was the worst case value as it

was highest value recorded, indicating that on average, concentrations are expected to be less than this value. For this Scenario, worst-case conditions were modelled by assuming that a large area (approximately 188 881 m^2) will be used for construction, and that all categories of equipment are on and in operation at the same time across the entire area. This is an overestimate as not all categories of equipment are expected to be in operation at the same time nor will they be continuously emitting for a 12-hour period (6:00 a.m. to 6:00 p.m.) every day for 365 days of the year. However worst-case was modelled to determine the effects of such a case on the surrounding Diego Martin area.

With respect to Victoria Keyes and Powder Magazine which are located less than 3 m from the proposed overpass, varying receptor heights made no significant difference to pollutant concentrations. Receptor heights were modelled at ground, middle and top of the buildings.

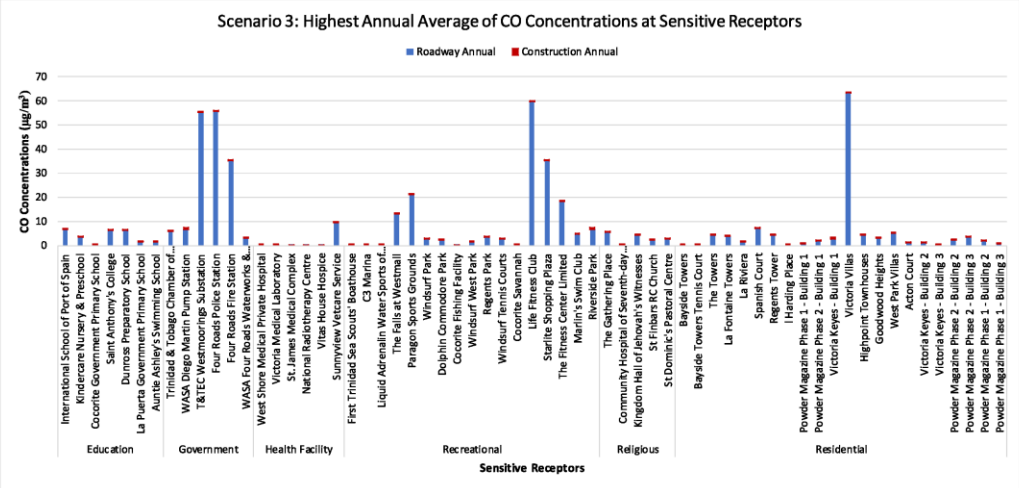


Figure 44: Highest Annual Average CO pollutant concentrations at Sensitive Receptors for Scenario 3

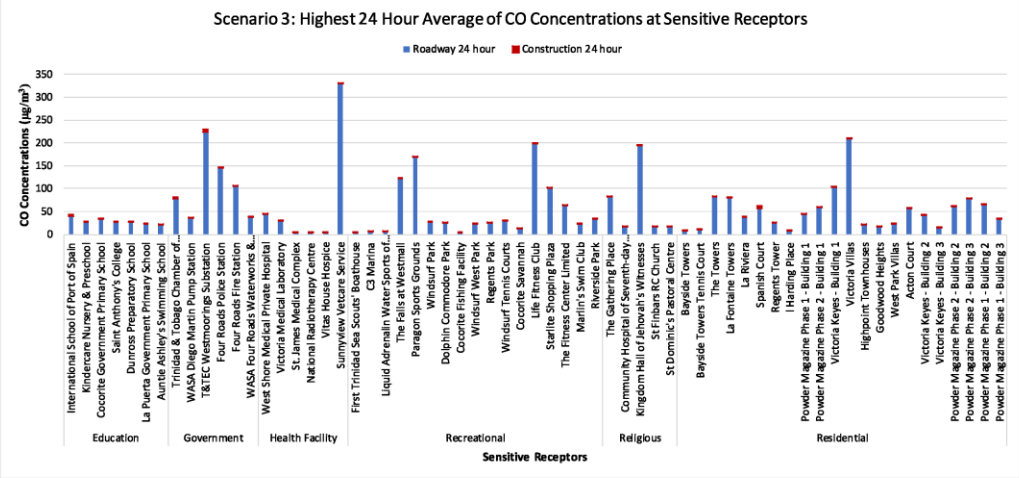


Figure 45: Highest 24-hour Average CO pollutant concentrations at Sensitive Receptors for Scenario 3

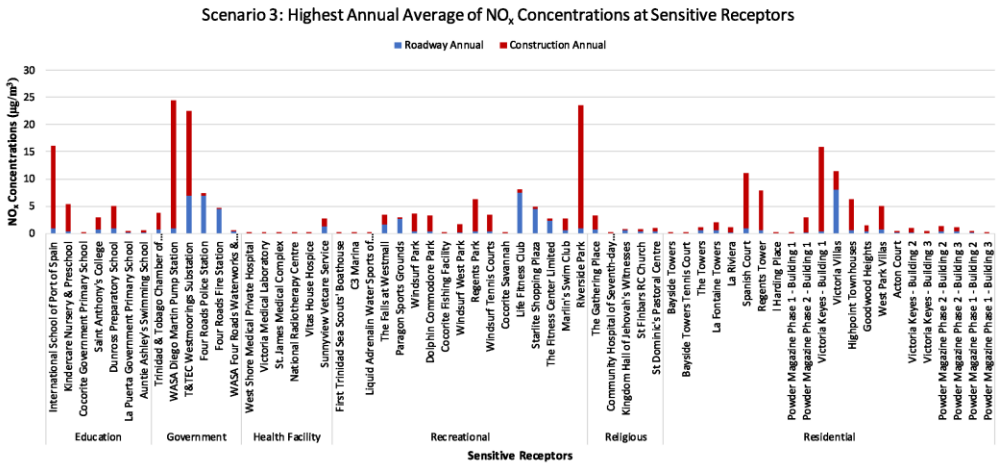


Figure 46: Highest Annual Average NOx pollutant concentrations at Sensitive Receptors for Scenario 3

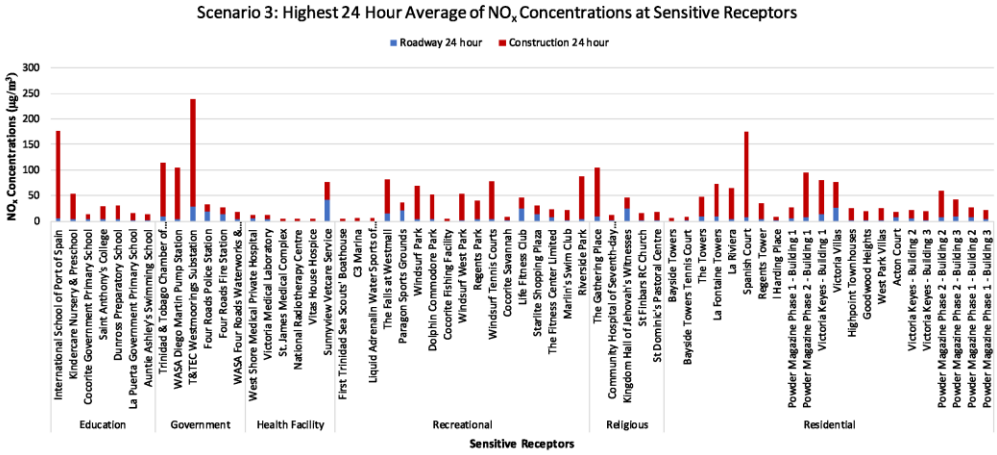
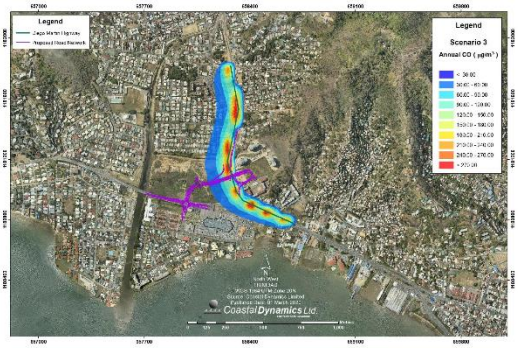
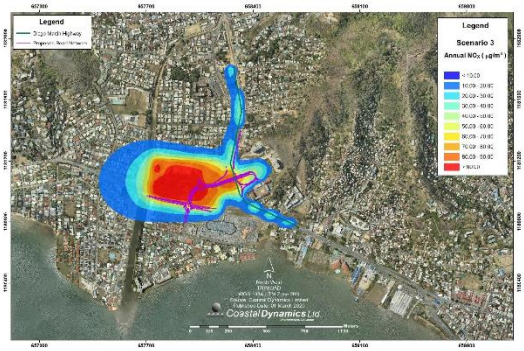


Figure 47: Highest 24-hour Average NOx pollutant concentrations at Sensitive Receptors for Scenario 3

Air Dispersion Plot for Scenario 3





*(Note that **Figure 42** above shows the levels of CO significantly lower for construction than the roadway)*

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8.4 Scenario 4

8.4.1 Sources

Scenario 4 simulated the Operational Phase in which peak traffic is occurring on the overpass alongside 50% of traffic occurring on the Diego Martin Highway. The pollutants modelled were NOx, CO, $PM_{2.5}$ and total HC. **Table 9** presents the highest average pollutant concentrations emitted after 1-day and an annual highest average measured over a 2-year period. **Figure 48** presents the Scenario 4 data graphically for each time period. A trend in the data can be seen where emissions for the 24-hour time period showed the highest concentrations which then decreased significantly to the annual average. For this scenario, the highest cumulative pollutant concentration emitted from peak overpass traffic after 24-hour and annual 2-year average was CO (864 $\mu g/m^3$ and 270 $\mu g/m^3$ respectively) followed by NOx (109 $\mu g/m^3$ and 34 $\mu g/m^3$) and total HC (67 $\mu g/m^3$ and 21 $\mu g/m^3$). The lowest pollutant emitted was $PM_{2.5}$ (3.37 $\mu g/m^3$ and 1.06 $\mu g/m^3$). The All Source grouping concentrations were mainly due to the Diego Martin Highway influence as seen in **Figure 48**.

The 24-hour $PM_{2.5}$ ambient air limit (EMA Air Pollution Rules 2014) is 65 $\mu g/m^3$ and the 24-hour $PM_{2.5}$ concentrations emitted were significantly less (3.37 $\mu g/m^3$). The 1-year $PM_{2.5}$ limit of 15 $\mu g/m^3$ was also not exceeded as the concentration obtained was 1.06 $\mu g/m^3$. Similarly, the highest NOx concentrations for the annual 2-year average (34.43 $\mu g/m^3$) was notably less than the corresponding 1-year EMA Ambient Air Limit of 40 $\mu g/m^3$. No 24-hour nor 1-year limit was declared for CO in the EMA Air Pollution Rules (2014) however the ambient 1-hour limit is 30 000 $\mu g/m^3$ and 8-hour limit is 10 000 $\mu g/m^3$. Since the 24-hour limit was as low as 864 $\mu g/m^3$, it is not expected that the 1-hour and 8-hour limits would have been exceeded.

Table 9: Highest average pollutant concentrations for Scenario 4 (Operational – Peak Traffic)								
Sources	CO		PM2.5		NOx		HC	
	24hr (highest)	Annual Average	24hr (highest)	Annual Average	24hr (highest)	Annual Average	24hr (highest)	Annual Average
Roadway	692.27	241.40	2.68	0.93	87.47	30.49	53.97	16.82
Overpass	336.57	127.54	1.36	0.51	43.87	16.62	26.23	9.94
All	864.26	270.48	3.37	1.06	109.88	34.43	67.38	21.09
Ambient Air Limits (First Schedule, EMA Air Pollution Rules 2014)	nd	nd	65	15	nd	40	nd	nd

nd – none declared for 24-hour or Annual

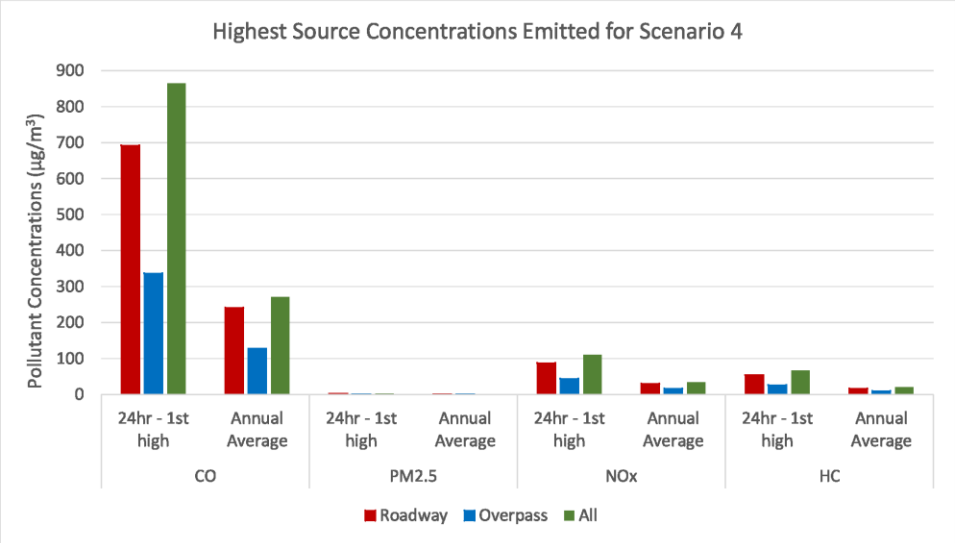

Figure 48: Highest Average Concentrations emitted at peak traffic times for the Roadway and Overpass

8.4.2 Receptors

Total concentrations of pollutants (both roadway and overpass) at the sensitive receptors for Scenario 4 were compared to Schedule 1, Ambient Air Quality Standards (EMA Air Pollution Rules 2014) according to 24-hour or 1-year limit provided. **Figure 49** – **Figure 56** show each pollutant concentration at the 63 sensitive receptors for Scenario 4, followed by the air quality dispersion plots.

CO concentrations ranged 2.43 $\mu g/m^3$ – 285.64 $\mu g/m^3$ for the 24-hour average while that for the annual 2-year average ranged 0.009 $\mu g/m^3$ – 54.52 $\mu g/m^3$. Even though no 24-hour nor 1-year limit was declared for CO in the EMA Air Pollution Rules (2014), 1-hour and 8-hour limits were declared at 30 000 $\mu g/m^3$ and 10 000 $\mu g/m^3$. Based on the concentration ranges obtained for CO, it is not expected that the 1-hour and 8-hour limits would have been exceeded.

NOx annual 2-year average concentrations range 0.001 $\mu g/m^3$ – 22.65 $\mu g/m^3$, which was under the ambient air limit of 40 $\mu g/m^3$ for NO_2 and 0.31 $\mu g/m^3$ – 36.78 $\mu g/m^3$ for 24-hour average. Similarly, $PM_{2.5}$ concentrations which had short term and long-term permissible limits of 65 $\mu g/m^3$ (24-hours) and 15 $\mu g/m^3$ (1-year) respectively, were not exceeded for any of the 63 receptors. The $PM_{2.5}$ concentrations at the receptors ranged 0.005 $\mu g/m^3$ – 0.70 $\mu g/m3$ for 24-hour average and ranged 0.00002 $\mu g/m^3$ – 0.09 $\mu g/m^3$ for annual 2-year average for the modelling period April 2017 – February 2020.

Total HC concentrations at the receptors ranged 0.19 $\mu g/m^3$ – 22.27 $\mu g/m^3$ for 24-hour average and ranged 0.0007 $\mu g/m^3$ – 4.25 $\mu g/m^3$ for annual 2-year average. There are no declared standards for HC.

With respect to Victoria Keyes and Powder Magazine which are located less than 3 m from the proposed overpass, varying receptor heights made no significant difference to pollutant concentrations. Receptor heights were modelled at ground, middle and top of the buildings.

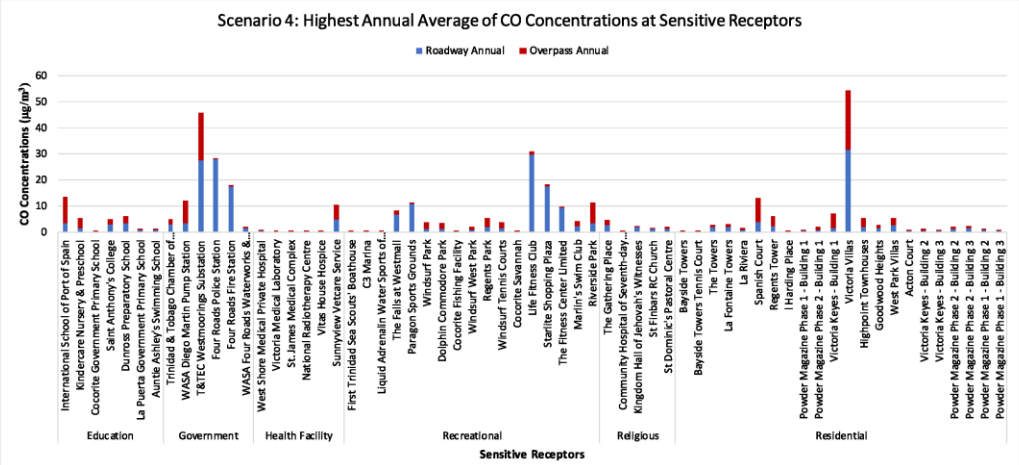

Figure 49: Highest Annual Average CO pollutant concentrations at Sensitive Receptors for Scenario 4

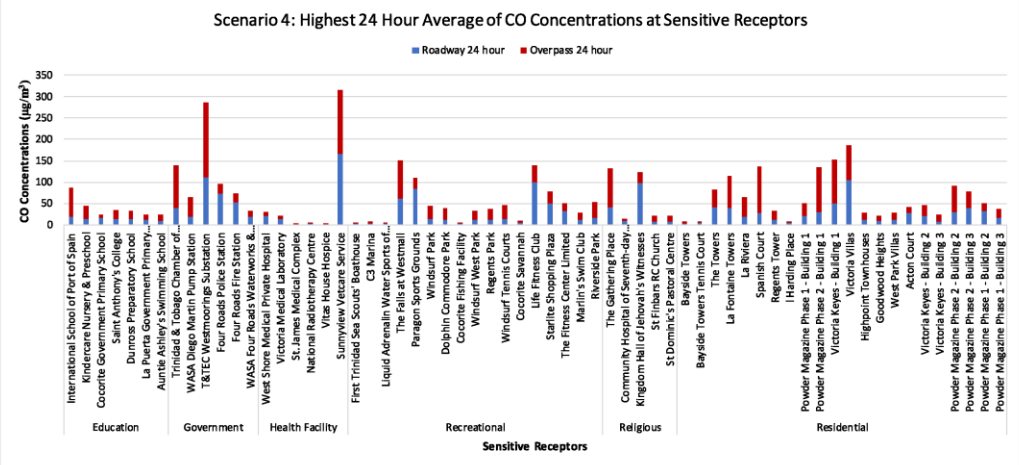

Figure 50: Highest 24-hour Average CO pollutant concentrations at Sensitive Receptors for Scenario 4

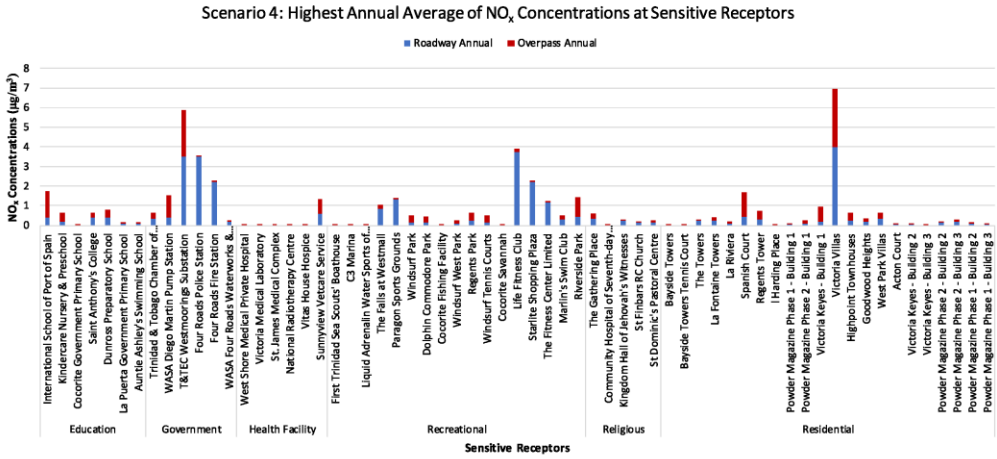

Figure 51: Highest Annual Average NOx pollutant concentrations at Sensitive Receptors for Scenario 4

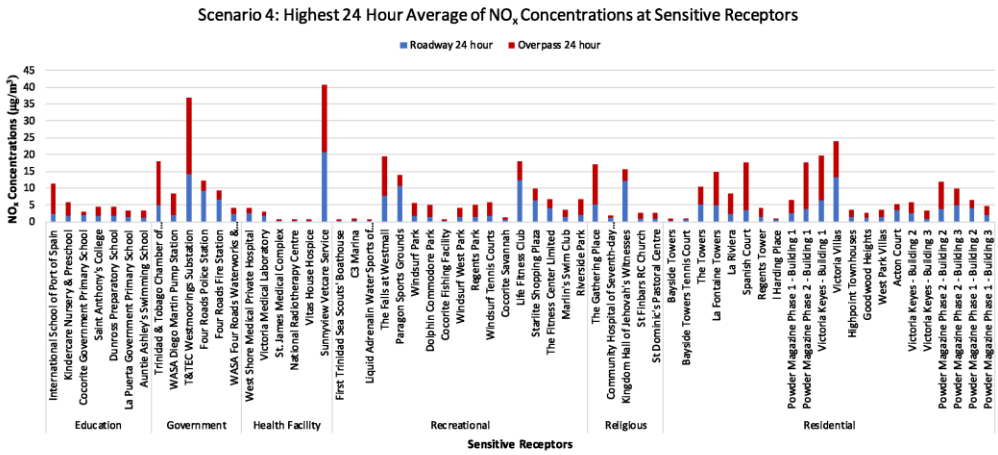

Figure 52: Highest 24-hour Average NOx pollutant concentrations at Sensitive Receptors for Scenario 4

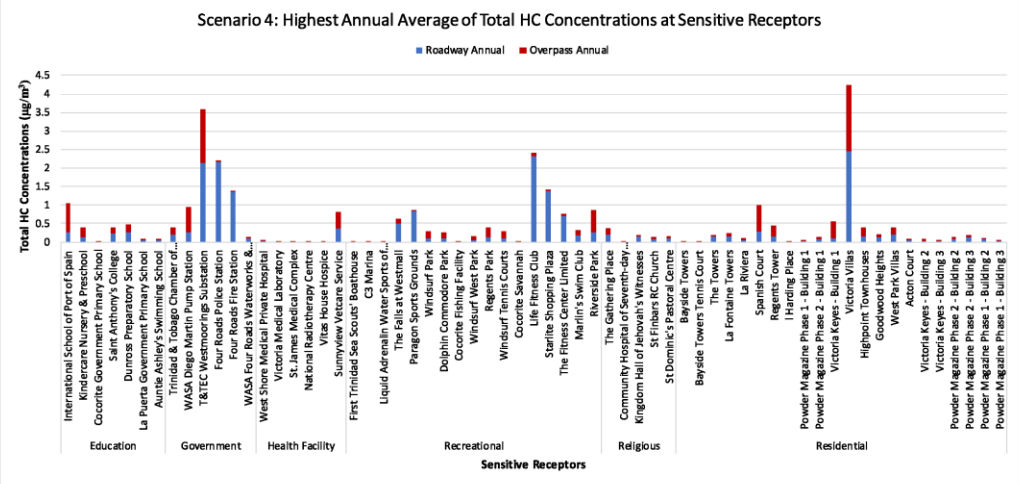

Figure 53: Highest Annual Average Total HC pollutant concentrations at Sensitive Receptors for Scenario 4

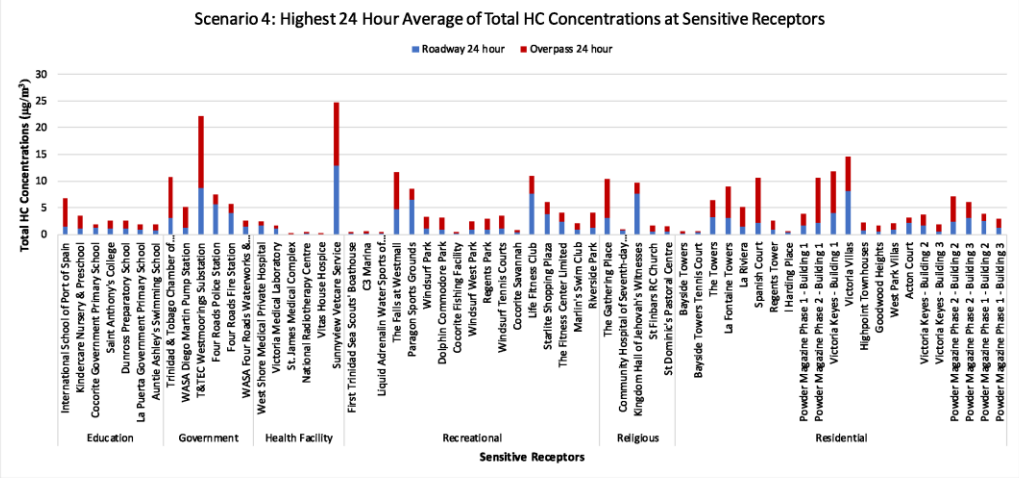

Figure 54: Highest 24-hour Average Total HC pollutant concentrations at Sensitive Receptors for Scenario 4

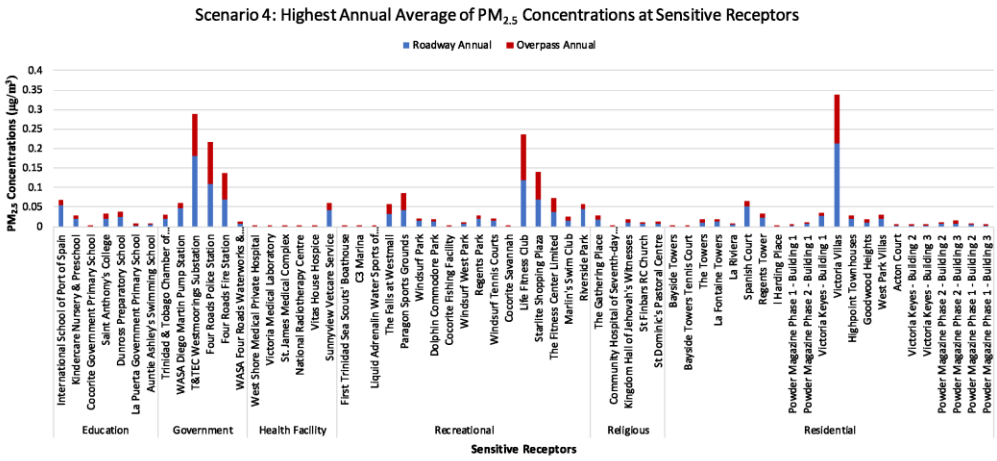

Figure 55: Highest Annual Average $PM_{2.5}$ pollutant concentrations at Sensitive Receptors for Scenario 4

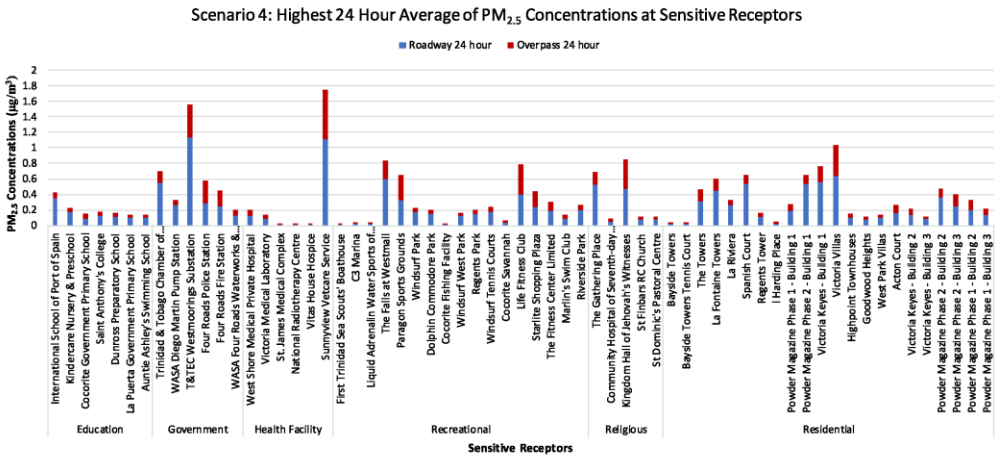

Figure 56: Highest 24-hour Average $PM_{2.5}$ pollutant concentrations at Sensitive Receptors for Scenario 4

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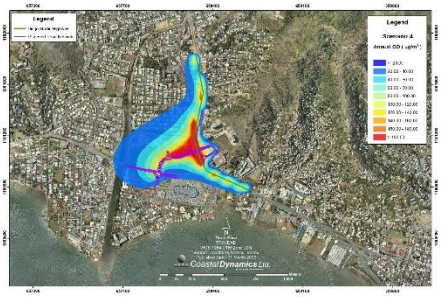
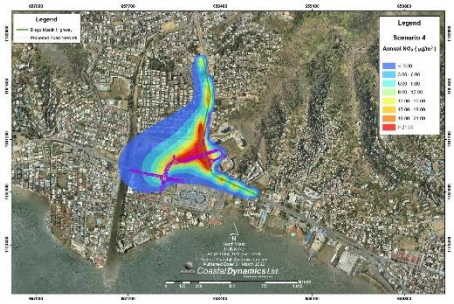
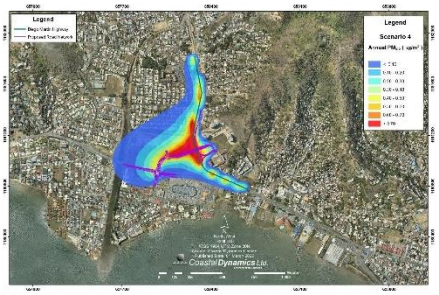
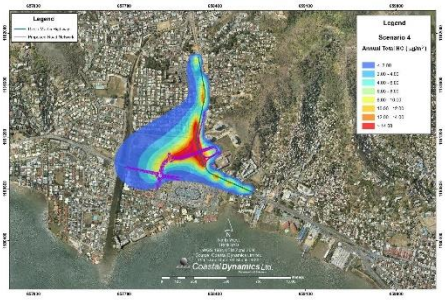
Air Dispersion Plot for Scenario 4









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8.5 Scenario 5

8.5.1 Sources

Scenario 5 simulated the Operational Phase in which off-peak traffic is occurring on the overpass alongside 50% of traffic occurring on the Diego Martin Highway. The pollutants modelled were NOx, CO, $PM_{2.5}$ and total HC. **Table 10** presents the highest average pollutant concentrations emitted after 1-day and an annual highest average measured over a 2-year period. **Figure 57** presents the Scenario 5 data graphically for each time period. A trend in the data can be seen where emissions for the 24-hour time period showed the highest concentrations which then decreased significantly to the annual average. For this scenario, the highest cumulative pollutant concentration emitted from off-peak overpass traffic after 24-hour and annual 2-year average was CO (744 $\mu g/m^3$ and 241 $\mu g/m^3$ respectively) followed by NOx (95 $\mu g/m^3$ and 30 $\mu g/m^3$) and total HC (58 $\mu g/m^3$ and 18 $\mu g/m^3$). The lowest pollutant emitted was $PM_{2.5}$ (2.9 $\mu g/m^3$ and 0.9 $\mu g/m^3$). The All Source grouping concentrations were mainly due to the Diego Martin Highway influence as seen in **Figure 57**.

The 24-hour $PM_{2.5}$ ambient air limit (EMA Air Pollution Rules 2014) is 65 $\mu g/m^3$ and the cumulative 24-hour $PM_{2.5}$ concentrations emitted were significantly less (2.92 $\mu g/m^3$). The 1-year $PM_{2.5}$ limit of 15 $\mu g/m^3$ was also not exceeded as the concentration obtained was 0.9 $\mu g/m^3$. Similarly, the highest NOx concentrations after 1-year (30.5 $\mu g/m^3$) was notably less than the corresponding 1-year EMA Ambient Air Limit of 40 $\mu g/m^3$. No 24-hour nor 1-year limit was declared for CO in the EMA Air Pollution Rules (2014) however the ambient 1-hour limit is 30 000 $\mu g/m^3$ and 8-hour limit is 10 000 $\mu g/m^3$. Since the 24-hour limit was as low as 744 $\mu g/m^3$, it is not expected that the 1-hour and 8-hour limits would have been exceeded.

Table 10: Highest average pollutant concentrations for Scenario 5 (Operational - Off-Peake Traffic)								
Sources	**CO**		**PM2.5**		**NOx**		**HC**	
	24hr (highest)	**Annual Average**	**24hr (highest)**	**Annual Average**	**24hr (highest)**	**Annual Average**	**24hr (highest)**	**Annual Average**
Roadway	692.27	241.40	2.676	0.933	87.465	30.499	53.97	18.819
Overpass	100.82	38.097	0.472	0.178	14.753	5.575	7.85	2.966
ALL	744.38	241.686	2.919	0.934	95.091	30.542	58.028	18.842
Ambient Air Limits (First Schedule, EMA Air Pollution Rules 2014)	nd	nd	65	15	nd	40	nd	nd

nd – none declared for 24-hour or Annual

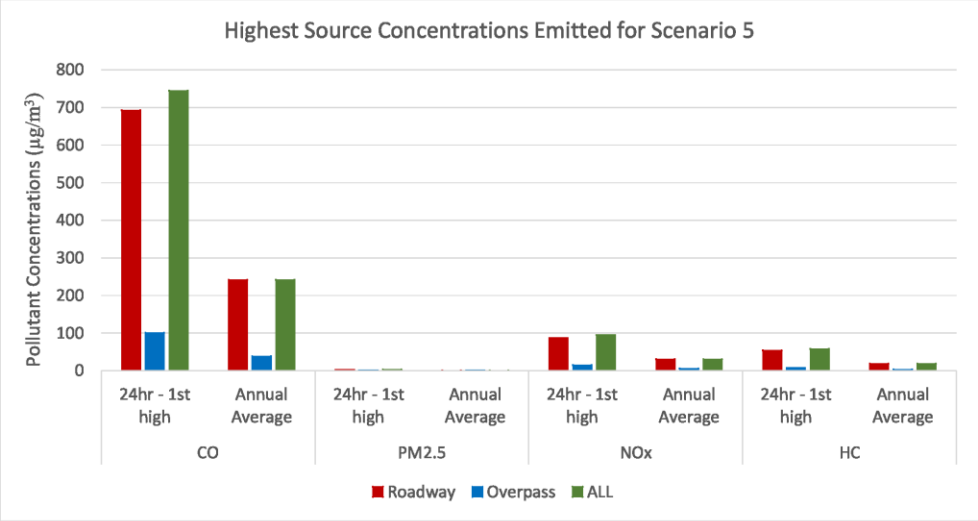

Figure 57: Highest Average Concentrations emitted at off-peak traffic times for the Roadway and Overpass

8.5.2 Receptors

Total concentrations of pollutants (both roadway and overpass) at the sensitive receptors for Scenario 5 were compared to Schedule 1, Ambient Air Quality Standards (EMA Air Pollution Rules 2014) according to 24-hour or 1-year limit provided. **Figure 58** – **Figure 65** show each pollutant concentration at the 63 sensitive receptors for Scenario 5, followed by the air quality dispersion plots.

CO concentrations ranged 1.58 $\mu g/m^3$ – 193.48 $\mu g/m^3$ for the 24-hour average while that for the annual 2-year average ranged 0.005 $\mu g/m^3$ – 38.49 $\mu g/m^3$. Even though no 24-hour nor 1-year limit was declared for CO in the EMA Air Pollution Rules (2014), 1-hour and 8-hour limits were declared at 30 000 $\mu g/m^3$ and 10 000 $\mu g/m^3$. Based on the concentration ranges obtained for CO, it is not expected that the 1-hour and 8-hour limits would have been exceeded.

NOx annual 2-year average concentrations range 0.0007 $\mu g/m^3$ – 5.00 $\mu g/m^3$, which was under the ambient air limit of 40 $\mu g/m^3$ for NO_2 and 0.21 $\mu g/m^3$ – 25.02 $\mu g/m^3$ for 24-hour average. Similarly, $PM_{2.5}$ concentrations which had short term and long-term permissible limits of 65 $\mu g/m^3$ (24-hours) and 15 $\mu g/m^3$ (1-year) respectively, were not exceeded for any of the 63 receptors. The $PM_{2.5}$ concentrations at the receptors ranged 0.006 $\mu g/m^3$ – 0.77 $\mu g/m3$ for 24-hour average and ranged 0.00002 $\mu g/m^3$ – 0.15 $\mu g/m^3$ for annual 2-year average for the modelling period April 2017 – February 2020.

Total HC concentrations at the receptors ranged 0.12 $\mu g/m^3$ – 15.08 $\mu g/m^3$ for 24-hour average and ranged 0.0004 $\mu g/m^3$ – 3.00 $\mu g/m^3$ for annual 2-year average. There are no declared standards for HC.

With respect to Victoria Keyes and Powder Magazine which are located less than 3 m from the proposed overpass, varying receptor heights made no significant difference to pollutant concentrations. Receptor heights were modelled at ground, middle and top of the buildings.

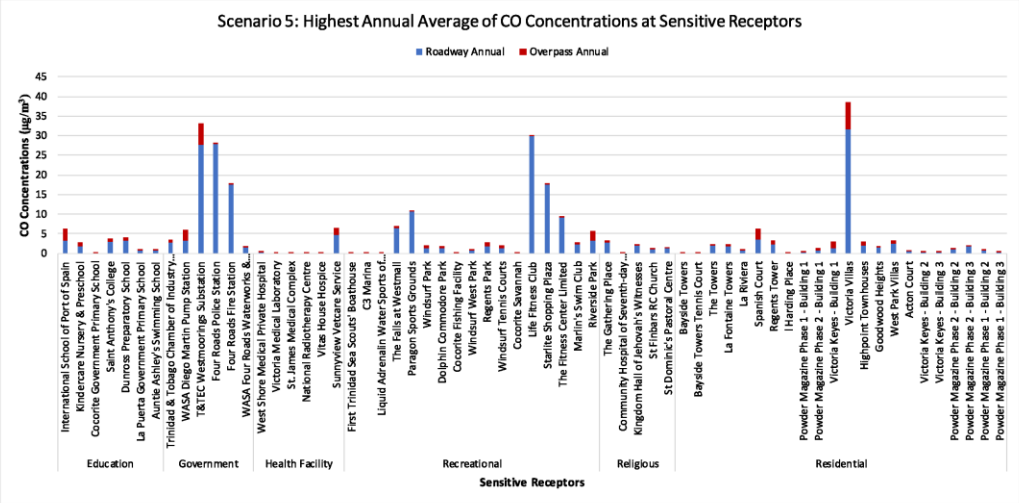

Figure 58: Highest Annual Average CO pollutant concentrations at Sensitive Receptors for Scenario 5

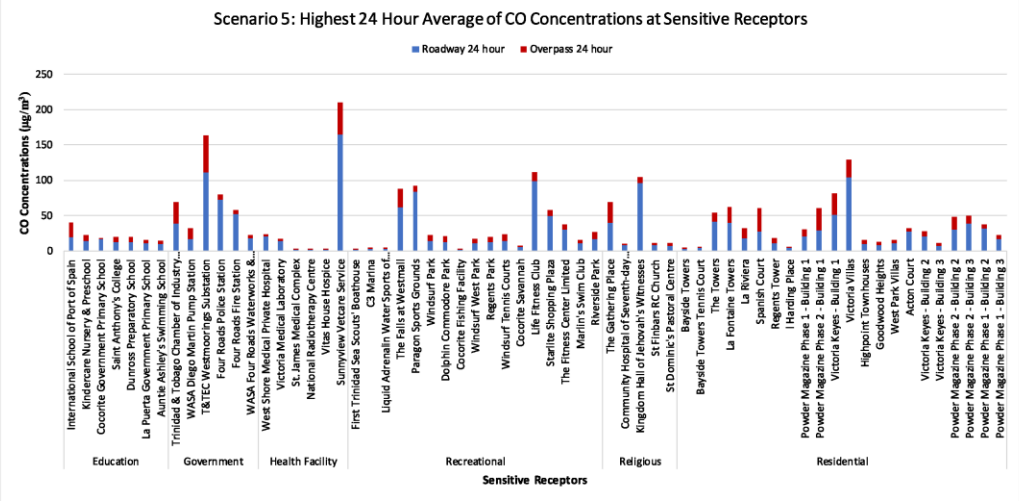

Figure 59: Highest 24-hour Average CO pollutant concentrations at Sensitive Receptors for Scenario 5

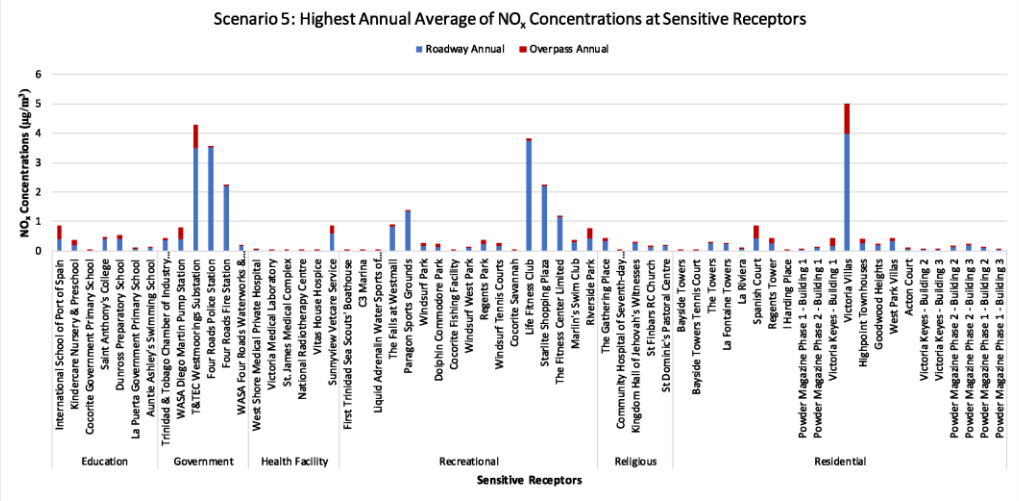

Figure 60: Highest Annual Average NOx pollutant concentrations at Sensitive Receptors for Scenario 5

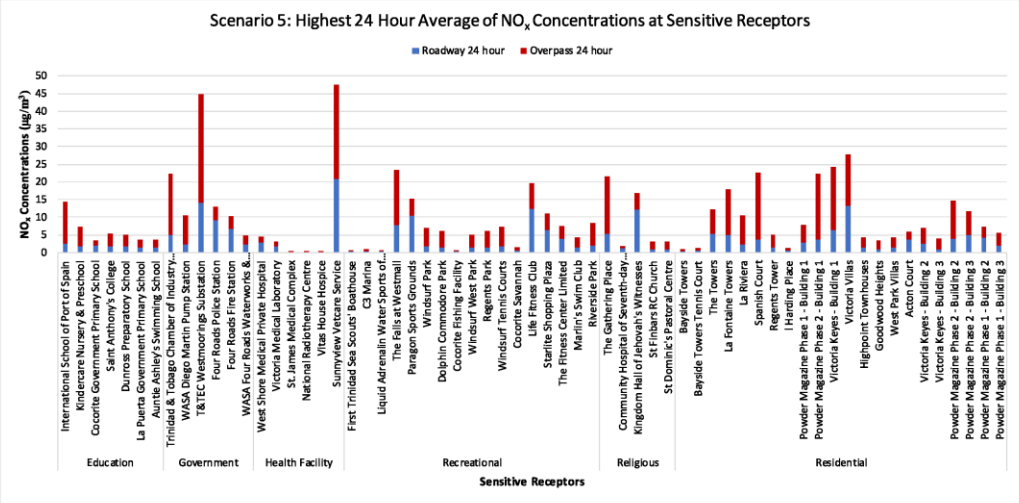

Figure 61: Highest 24-hour Average NOx pollutant concentrations at Sensitive Receptors for Scenario 5

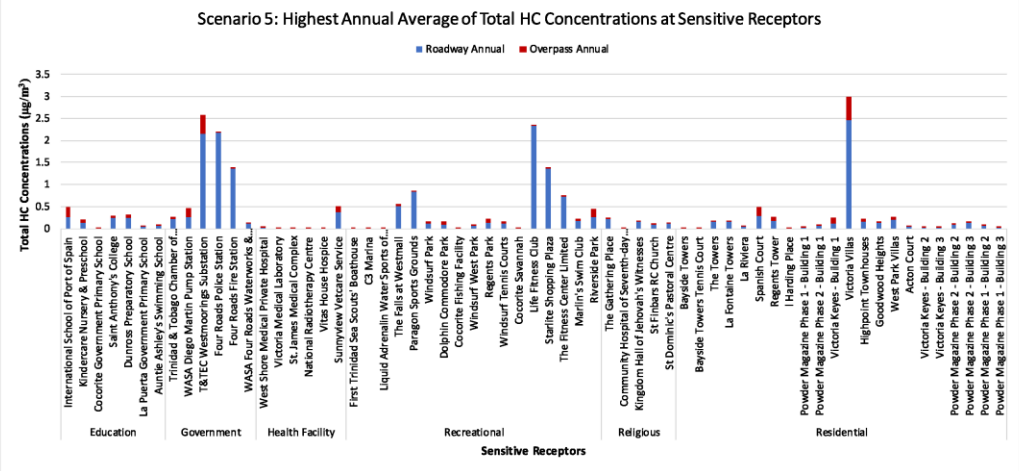

Figure 62: Highest Annual Average Total HC pollutant concentrations at Sensitive Receptors for Scenario 5

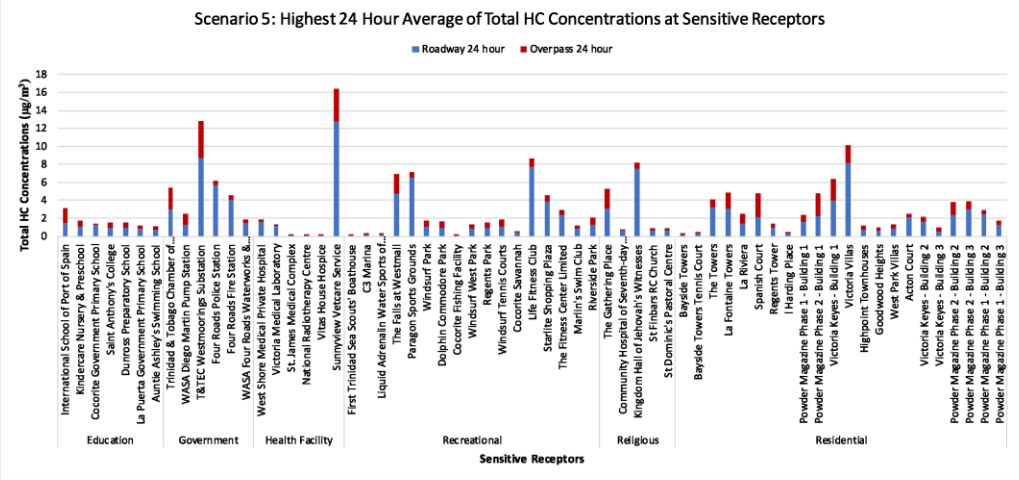

Figure 63: Highest 24-hour Average Total HC pollutant concentrations at Sensitive Receptors for Scenario 5

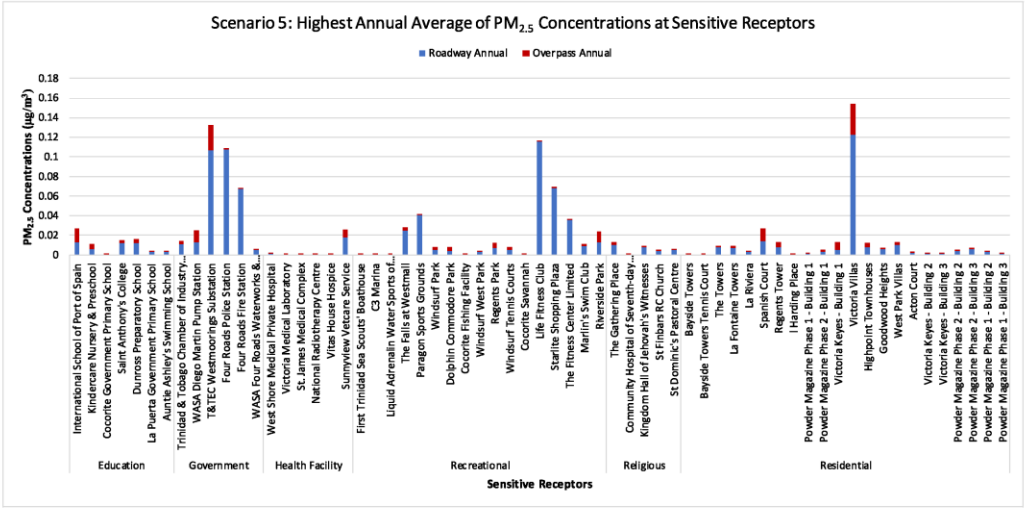

Figure 64: Highest Annual Average $PM_{2.5}$ pollutant concentrations at Sensitive Receptors for Scenario 5

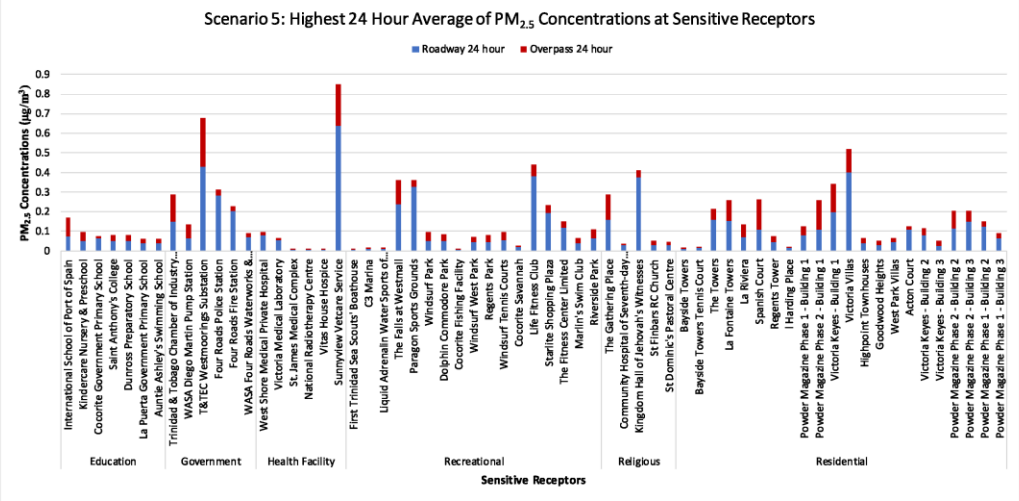

Figure 65: Highest 24-hour Average $PM_{2.5}$ pollutant concentrations at Sensitive Receptors for Scenario 5

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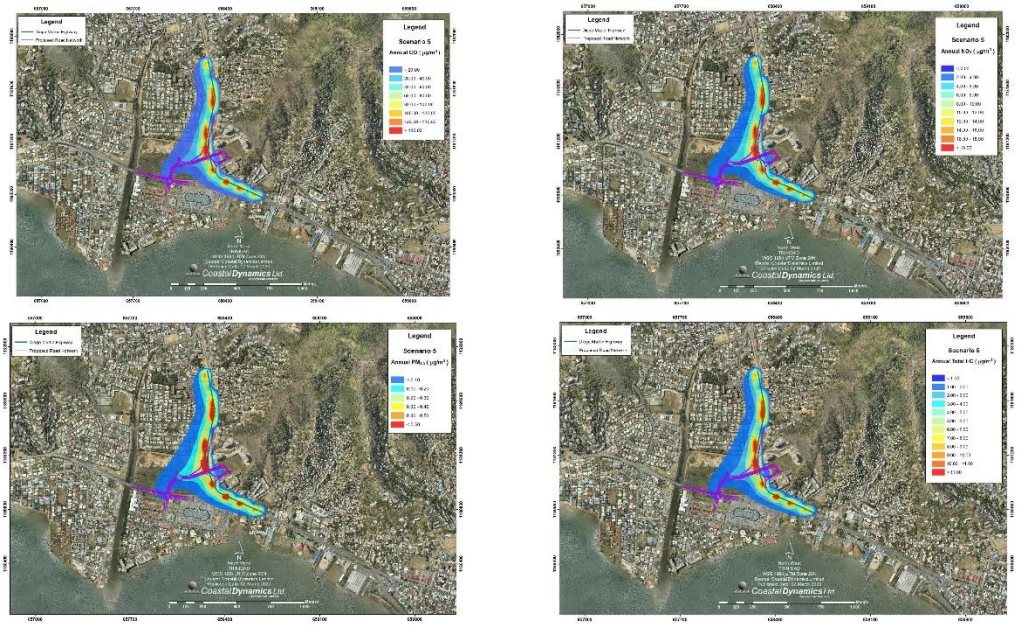
Air Dispersion Plot for Scenario 5



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8.6 Scenario 6

8.6.1 Sources

Scenario 6 simulated the Operational Phase in which both peak and off-peak traffic is occurring simultaneously on the overpass alongside 50% of traffic occurring on the Diego Martin Highway. This scenario simulated worst case emissions. The pollutants modelled were NOx, CO, $PM_{2.5}$ and total HC. **Table 11** presents the highest average pollutant concentrations emitted after 1-day and an annual highest average measured over a 2-year period. **Figure 66** presents the Scenario 6 data graphically for each time period. A trend in the data can be seen where emissions for the 24-hour time period showed the highest concentrations which then decreased significantly to the annual average. For this scenario, the highest cumulative pollutant concentration emitted from peak and off-peak overpass traffic after 24-hour and annual 2-year average was CO (920 $\mu g/m^3$ and 289 $\mu g/m^3$ respectively) followed by NOx (118 $\mu g/m^3$ and 37 $\mu g/m^3$) and total HC (71 $\mu g/m^3$ and 37 $\mu g/m^3$). The lowest pollutant emitted was $PM_{2.5}$ (3.6 $\mu g/m^3$ and 1.15 $\mu g/m^3$). The All Source grouping concentrations were mainly due to the Diego Martin Highway influence as seen in **Figure 66**.

The 24-hour $PM_{2.5}$ ambient air limit (EMA Air Pollution Rules 2014) is 65 $\mu g/m^3$ and the cumulative 24-hour $PM_{2.5}$ concentrations were significantly less (3.6 $\mu g/m^3$). The 1-year $PM_{2.5}$ limit of 15 $\mu g/m^3$ was also not exceeded as the concentration obtained was 1.15 $\mu g/m^3$. Similarly, the highest NOx concentrations after 1-year (37 $\mu g/m^3$) was notably less than the corresponding 1-year EMA Ambient Air Limit of 40 $\mu g/m^3$. No 24-hour nor 1-year limit was declared for CO in the EMA Air Pollution Rules (2014) however the ambient 1-hour limit is 30 000 $\mu g/m^3$ and 8-hour limit is 10 000 $\mu g/m^3$. Since the 24-hour limit was as low as 920 $\mu g/m^3$, it is not expected that the 1-hour and 8-hour limits would have been exceeded.

Table 11: Highest average pollutant concentrations for Scenario 6 (Operational – Peak & Off-Peake Traffic)								
Sources	**CO**		**PM2.5**		**NOx**		**HC**	
	24hr (highest)	**Annual Average**	**24hr (highest)**	**Annual Average**	**24hr (highest)**	**Annual Average**	**24hr (highest)**	**Annual Average**
Overpass	441.06	166.66	1.84	0.69	59.10	22.33	34.37	22.33
Roadway	692.27	241.40	2.68	0.93	87.47	30.49	53.97	30.49
All	920.25	289.76	3.63	1.15	118.01	37.25	71.74	37.25
Ambient Air Limits (First Schedule, EMA Air Pollution Rules 2014)	nd	nd	65	15	nd	40	nd	nd

nd – none declared for 24-hour or Annual

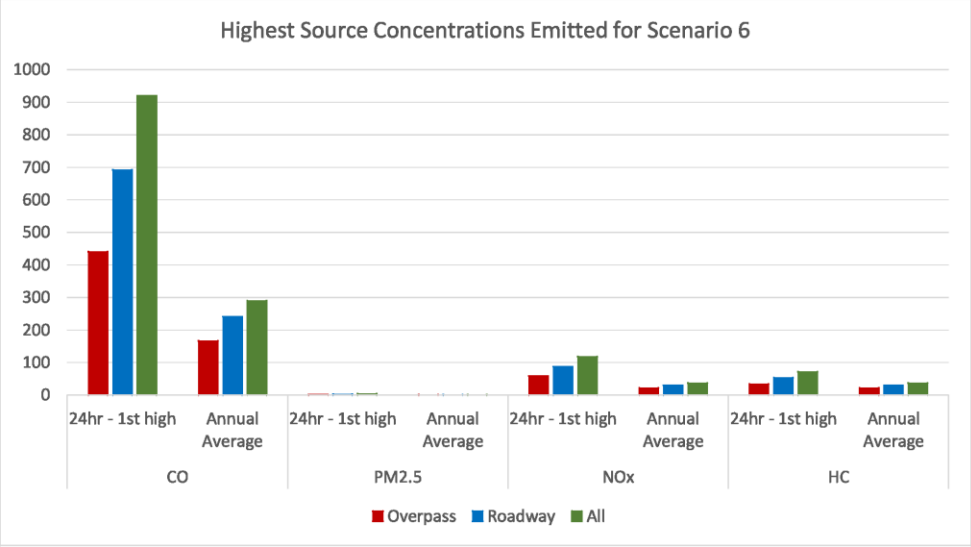

Figure 66: Highest Average pollutants emitted at peak and off-peak traffic times for the Roadway and Overpass

8.6.2 Receptors

Total concentrations of pollutants (both roadway and overpass) at the sensitive receptors for Scenario 5 were compared to Schedule 1, Ambient Air Quality Standards (EMA Air Pollution Rules 2014) according to 24-hour or 1-year limit provided. **Figure 67** – **Figure 74** show each pollutant concentration at the 63 sensitive receptors for Scenario 6.

CO concentrations ranged 2.82 $\mu g/m^3$ – 339.55 $\mu g/m^3$ for the 24-hour average while that for the annual 2-year average ranged 0.01 $\mu g/m^3$ – 61.36 $\mu g/m^3$. Even though no 24-hour nor 1-year limit was declared for CO in the EMA Air Pollution Rules (2014), 1-hour and 8-hour limits were declared at 30 000 $\mu g/m^3$ and 10 000 $\mu g/m^3$. Based on the concentration ranges obtained for CO, it is not expected that the 1-hour and 8-hour limits would have been exceeded.

NOx annual 2-year average concentrations range 0.001 $\mu g/m^3$ – 8.00 $\mu g/m^3$, which was under the ambient air limit of 40 $\mu g/m^3$ for NO_2 and 0.37 $\mu g/m^3$ – 44.64 $\mu g/m^3$ for 24-hour average. Similarly, $PM_{2.5}$ concentrations which had short term and long-term permissible limits of 65 $\mu g/m^3$ (24-hours) and 15 $\mu g/m^3$ (1-year) respectively, were not exceeded for any of the 63 receptors. The $PM_{2.5}$ concentrations at the receptors ranged 0.01 $\mu g/m^3$ – 1.38 $\mu g/m3$ for 24-hour average and ranged 0.00004 $\mu g/m^3$ – 0.25 $\mu g/m^3$ for annual 2-year average for the modelling period April 2017 – February 2020.

Total HC concentrations at the receptors ranged 0.22 $\mu g/m^3$ – 26.46 $\mu g/m^3$ for 24-hour average and ranged 0.0008 $\mu g/m^3$ – 4.78 $\mu g/m^3$ for annual 2-year average. There are no declared standards for HC.

With respect to Victoria Keyes and Powder Magazine which are located less than 3 m from the proposed overpass, varying receptor heights made no significant difference to pollutant concentrations. Receptor heights were modelled at ground, middle and top of the buildings.

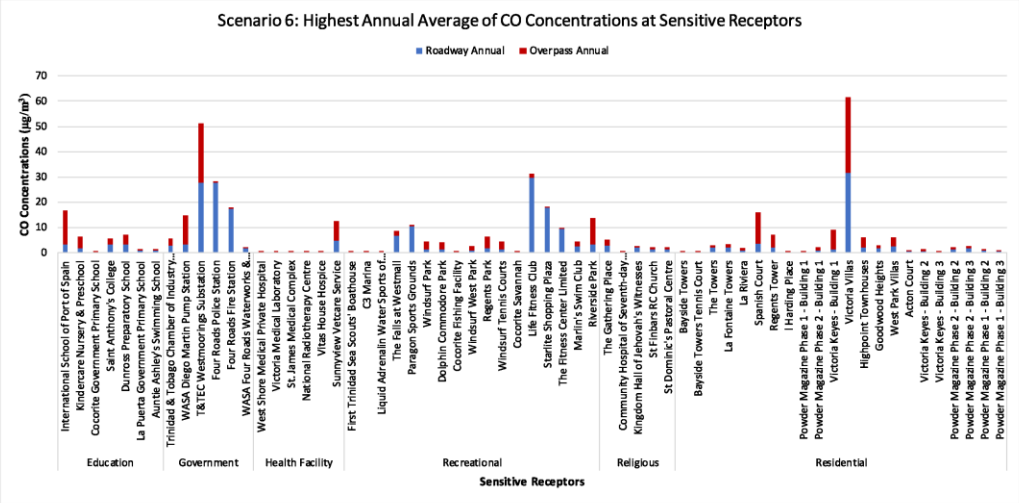

Figure 67: Highest Annual Average CO pollutant concentrations at Sensitive Receptors for Scenario 6

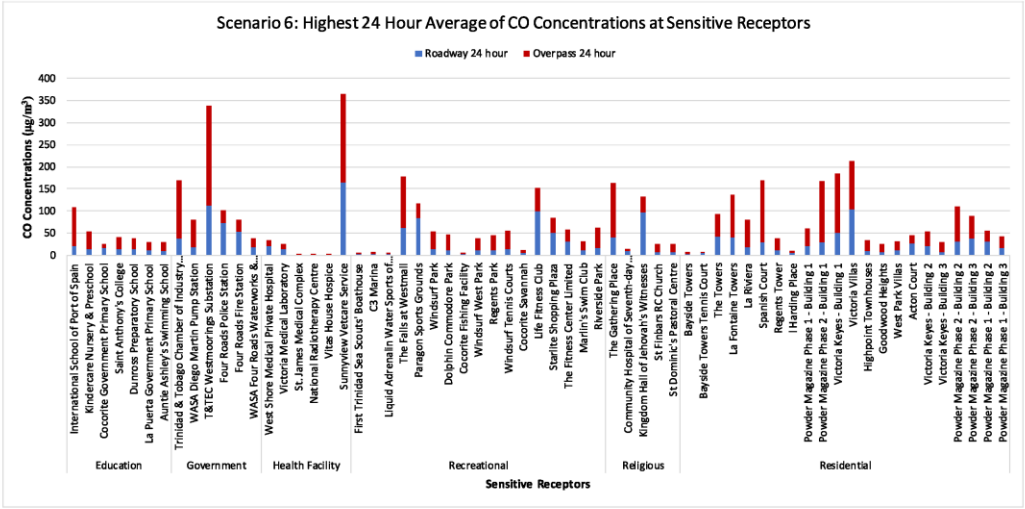

Figure 68: Highest 24-hour Average CO pollutant concentrations at Sensitive Receptors for Scenario 6

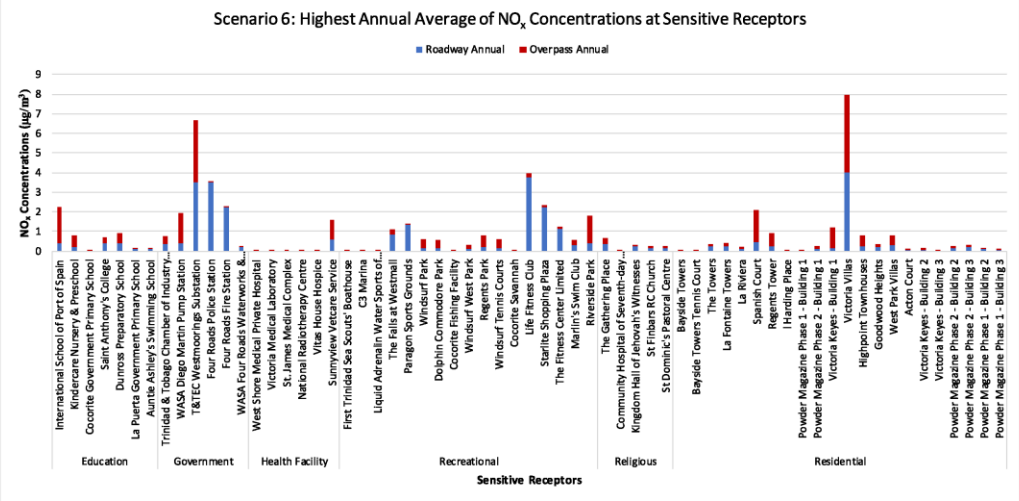

Figure 69: Highest Annual Average NOx pollutant concentrations at Sensitive Receptors for Scenario 6

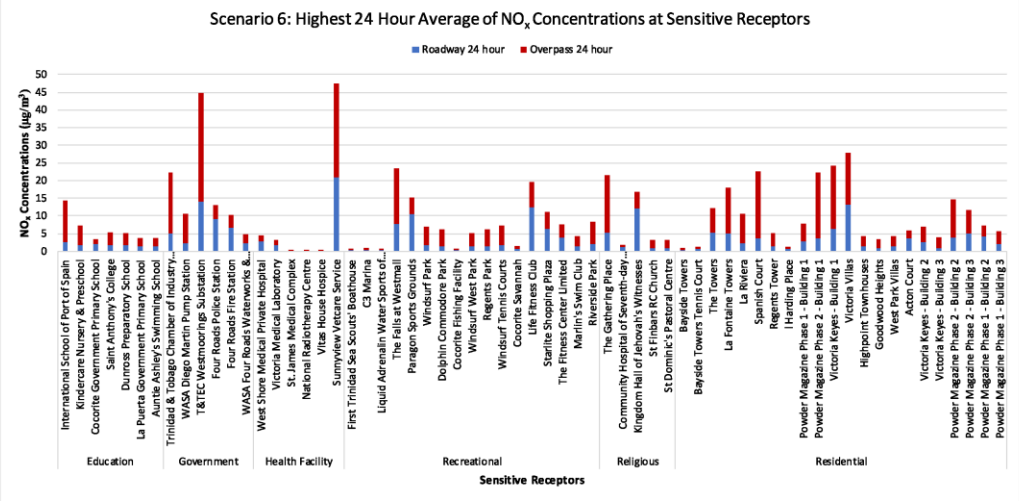

Figure 70: Highest 24-hour Average NOx pollutant concentrations at Sensitive Receptors for Scenario 6

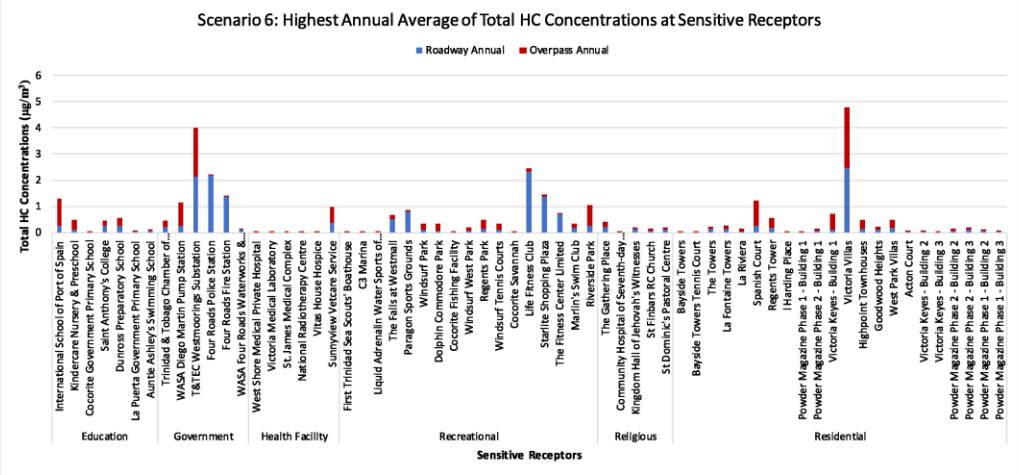

Figure 71: Highest Annual Average Total HC pollutant concentrations at Sensitive Receptors for Scenario 6

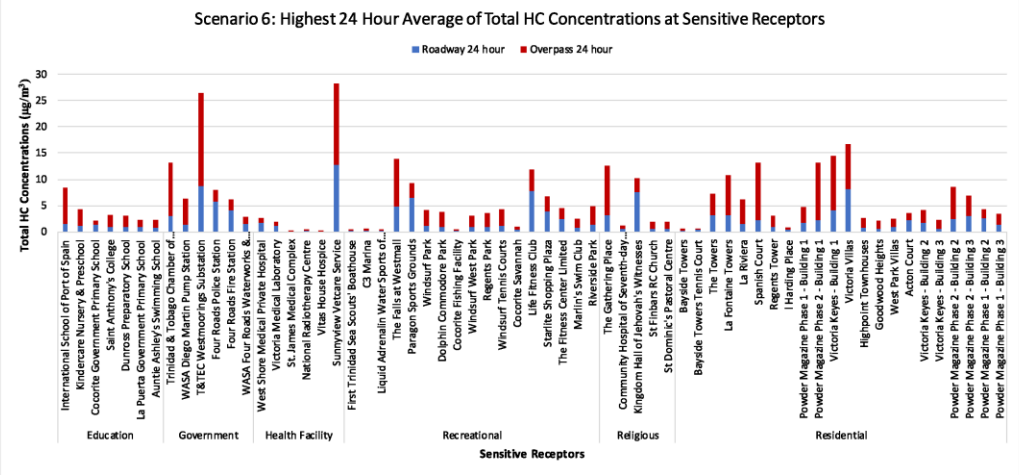

Figure 72: Highest 24-hour Average Total HC pollutant concentrations at Sensitive Receptors for Scenario 6

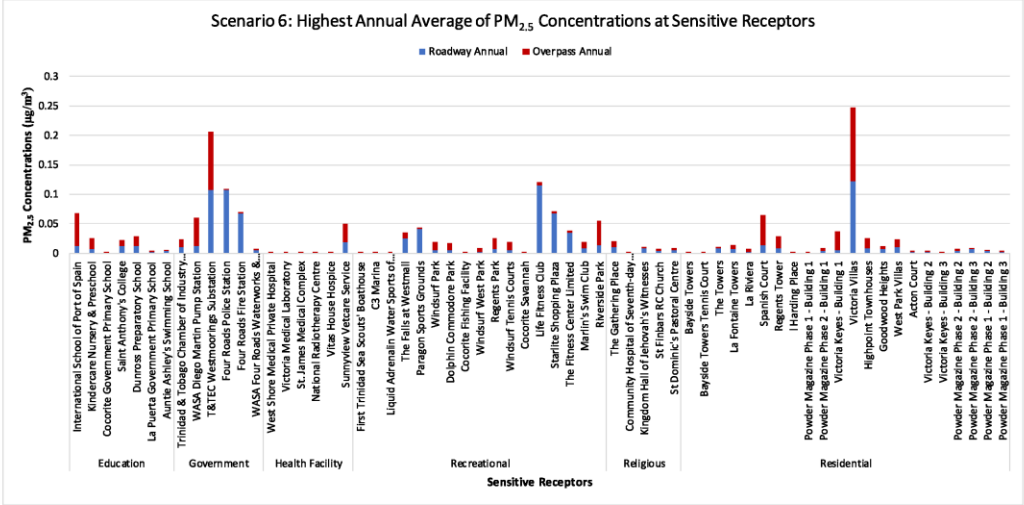

Figure 73: Highest Annual Average $PM_{2.5}$ pollutant concentrations at Sensitive Receptors for Scenario 6

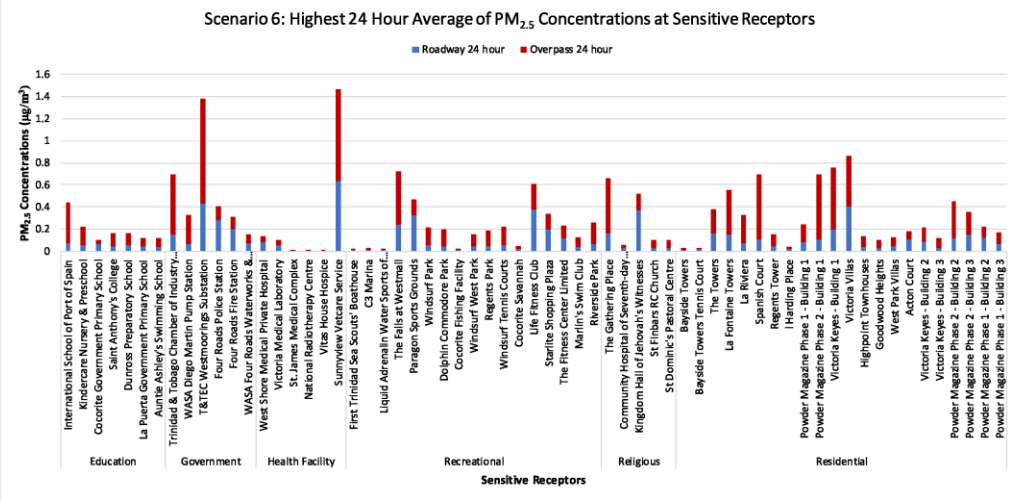

Figure 74: Highest 24-hour Average $PM_{2.5}$ pollutant concentrations at Sensitive Receptors for Scenario 6

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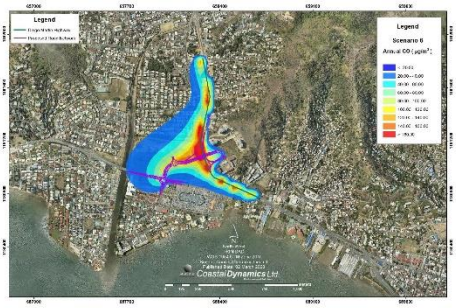
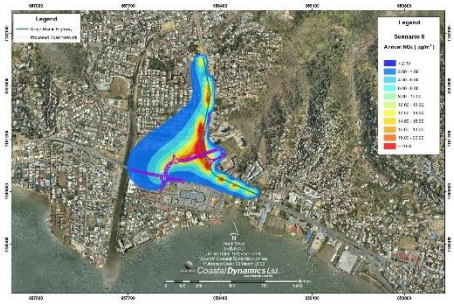
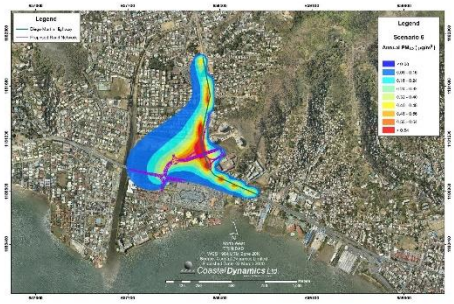
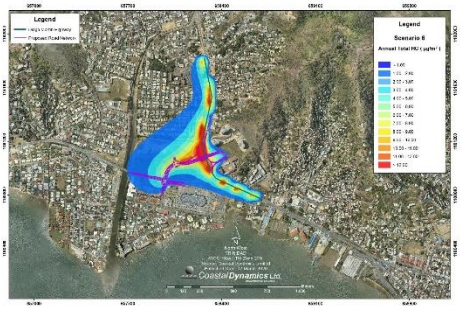
Air Dispersion Plot for Scenario 6









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8.7 Scenario 7

8.7.1 Sources

Scenario 7 simulated the Operational Phase in which both peak and off-peak traffic is occurring simultaneously on the overpass alongside 50% of traffic occurring on the Diego Martin Highway with the addition of a wall barrier at segments 4 – 6 on the overpass (version 1 - v1) and at segments 5 – 6 (version 2 - v2). In other words, this scenario simulated Scenario 6 with the addition of a 3 m height noise barrier (made of aluminium with a transparent shutter type appearance **Figure 75** as an example) at the above defined segments of the overpass (refer to **Figure 5** in **Section 3.3.2: Sources**). **Figure 76** presents the location of proposed noise barrier on the segments.



Figure 75:Examples of Proposed Noise Barrier

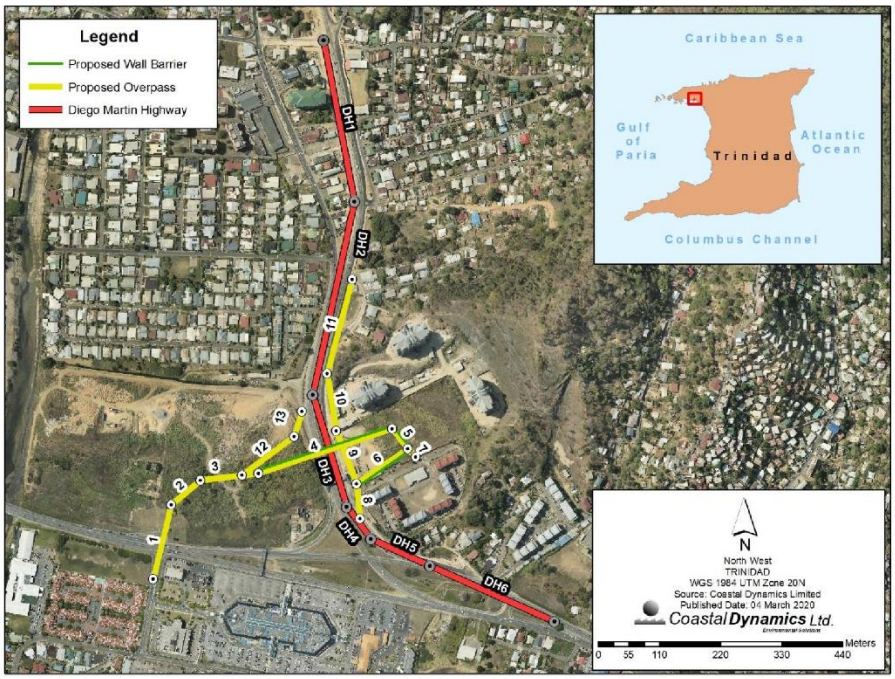


Figure 76: Location of Proposed Noise Barrier (green line on segment 4, 5 and 6)

The pollutants modelled were NOx, CO, $PM_{2.5}$ and total HC. **Table 12** presents the highest average pollutant concentrations emitted after 24-hour and an annual highest average measured over a 2-year period for v1 while **Table 13** shows the same for v2. Two versions are presented since segment 4 extends across the Diego Martin Highway, and not just to the east of the highway alone. Similar to Scenario 6, a trend in the data can be seen where emissions for the 24-hour time period showed the highest concentrations which then decreased significantly to the annual average.

The difference between v1 and v2 of Scenario 7 was the addition / exclusion of the noise barrier at segment 4 (refer to **Figure 5** in **Section 3.32: Sources**). The addition of the wall slightly lowered the source concentrations compared to Scenario 6, though to a greater extent when

segment 4 was included. Heist, Perry, and Brixey (2009) assumes that a barrier has two main effects: 1) it creates a recirculation zone behind the barrier that sweeps the emissions from the highway back towards the wall, and 2) it enhances vertical dispersion and initial mixing. This reduces air pollution exposures from nearby traffic. This may also be due to absorption and/or deposition of pollutants on the 3 m height noise barrier. For v1 of Scenario 7, the highest cumulative pollutant concentration emitted from peak and off-peak overpass traffic after 24-hour and annual 2-year average was CO (889 $\mu g/m^3$ and 266 $\mu g/m^3$ respectively) followed by NOx (113 $\mu g/m^3$ and 34 $\mu g/m^3$) and total HC (69 $\mu g/m^3$ and 20 $\mu g/m^3$). The lowest pollutant emitted was $PM_{2.5}$ (3.4 $\mu g/m^3$ and 1.04 $\mu g/m^3$). The All Source grouping concentrations were mainly due to the Diego Martin Highway influence as seen in **Figure 77**. For v2 of Scenario 7, the highest cumulative pollutant concentration emitted from peak and off-peak overpass traffic after 24-hour and annual 2-year average was CO (920 $\mu g/m^3$ and 284 $\mu g/m^3$ respectively) followed by NOx (118 $\mu g/m^3$ and 36 $\mu g/m^3$) and total HC (71 $\mu g/m^3$ and 22 $\mu g/m^3$). The lowest pollutant emitted was $PM_{2.5}$ (3.6 $\mu g/m^3$ and 1.12 $\mu g/m^3$). The All Source grouping concentrations were mainly due to the Diego Martin Highway influence as seen in **Figure 78**. Pollutant concentrations adhered to the ambient air limits where applicable, similar to Scenario 6.

Table 12: Highest average pollutant concentrations for Scenario 7 (Operational – Peak & Off-Peake Traffic with Mitigation) v1								
Sources	CO		PM2.5		NOx		HC	
	24hr (highest)	Annual Average	24hr (highest)	Annual Average	24hr (highest)	Annual Average	24hr (highest)	Annual Average
Overpass	344.296	127.962	1.43	0.53	46.134	17.146	26.829	9.97
Roadway	692.267	241.4	2.675	0.933	87.465	30.499	53.97	18.819
All	889	266.002	3.499	1.046	113.888	34.064	69.336	20.735
Ambient Air Limits (First Schedule, EMA Air Pollution Rules 2014)	nd	nd	65	15	nd	40	nd	nd

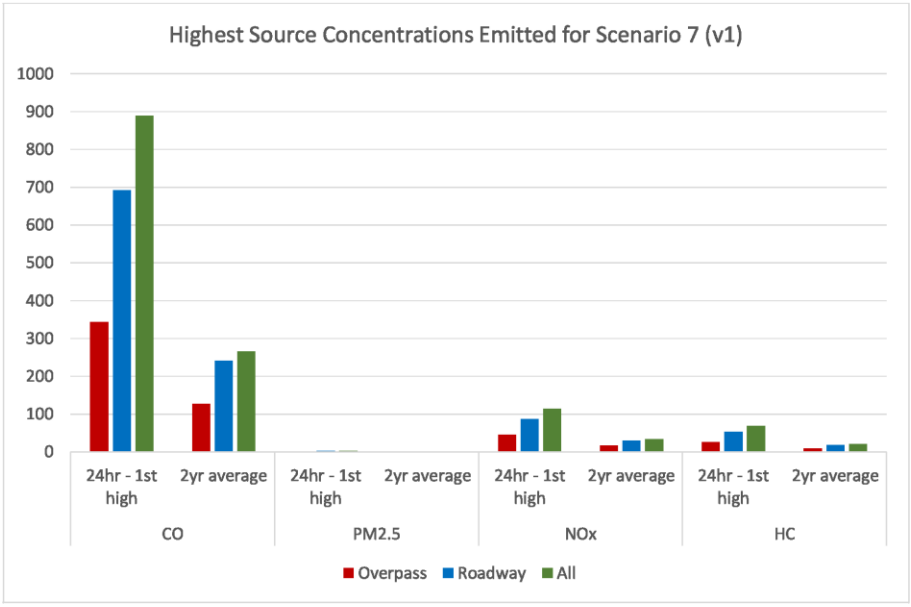


Figure 77: Highest Average pollutants emitted for the overpass with the addition of a wall at segments 4, 5, 6 (v1)

Table 13: Highest average pollutant concentrations for Scenario 7 (Operational – Peak & Off-Peake Traffic with Mitigation) v2								
Sources	**CO**		**PM2.5**		**NOX**		**HC**	
	24hr - 1st high	**2yr average**	**24hr - 1st high**	**2yr average**	**24hr - 1st high**	**2yr average**	**24hr - 1st high**	**2yr average**
Overpass	433	164.774	1.809	0.6885	58.028	22.079	33.746	12.84
Roadway	692.268	241.4	2.675	0.9323	87.4665	30.5	53.97	18.82
All	920	284.392	3.627	1.123	118.0298	36.529	71.744	22.169
Ambient Air Limits (First Schedule, EMA Air Pollution Rules 2014)	nd	nd	65	nd	nd	40	nd	nd

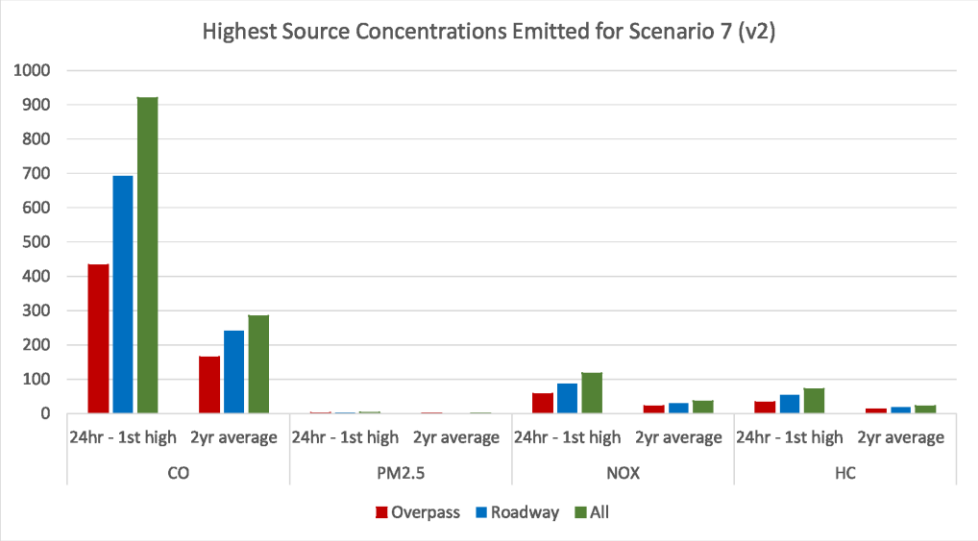


Figure 78: Highest Average pollutants emitted for the overpass with the addition of a wall at segments 5 and 6 (v2)

8.7.2 Receptors

Concentrations of pollutants at the sensitive receptors for Scenario 7 were compared to Schedule 1, Ambient Air Quality Standards (EMA Air Pollution Rules 2014) according to 24-hour or 1-year limit provided. **Figure 79** – **Figure 86** show each pollutant concentration at the 63 sensitive receptors for Scenario 7 (v1) **Figure 87** – **Figure 94** for Scenario 7 (v2), followed by the air quality dispersion plots. The addition of a wall was added to Segments 4 – 6 of the overpass (version 1) while versions 2 contained the wall only in segments 5 and 6. The was done due to the length and orientation of segment 4 used to set up the model (refer to **Figure 5, Section 3:32**).

CO concentrations ranged 4 $\mu g/m^3$ – 350 $\mu g/m^3$ for the 24-hour average while that for the annual 2-year average ranged 0.02 $\mu g/m^3$ – 60 $\mu g/m^3$. Even though no 24-hour nor 1-year limit was declared for CO in the EMA Air Pollution Rules (2014), 1-hour and 8-hour limits were declared at 30 000 $\mu g/m^3$ and 10 000 $\mu g/m^3$. Based on the concentration ranges obtained for CO, it is not expected that the 1-hour and 8-hour limits would have been exceeded.

NOx annual average concentrations range 0.003 $\mu g/m^3$ – 8 $\mu g/m^3$, which was under the ambient air limit of 40 $\mu g/m^3$ for NO_2. The NOx 24-hour concentrations ranged 0.5 $\mu g/m^3$ – 46 $\mu g/m^3$. Concentrations measured for total HC ranged 0.3 $\mu g/m^3$ – 27 $\mu g/m^3$ (24-hour) and 0.001 $\mu g/m^3$ – 4.5 $\mu g/m^3$ (annual).

$PM_{2.5}$ concentrations which had short term and long-term permissible limits of 65 $\mu g/m^3$ (24-hours) and 15 $\mu g/m^3$ (1-year) respectively, were not exceeded for any of the 63 receptors. The annual $PM_{2.5}$ concentrations at the receptors ranged 0.0002 $\mu g/m^3$ – 0.25 $\mu g/m^3$ while the 24-hour ranged 0.02 $\mu g/m^3$ – 1.4 $\mu g/m^3$ for the modelling period April 2017 – February 2020.

With respect to Victoria Keyes and Powder Magazine which are located less than 3 m from the proposed overpass, varying receptor heights made no significant difference to pollutant concentrations.

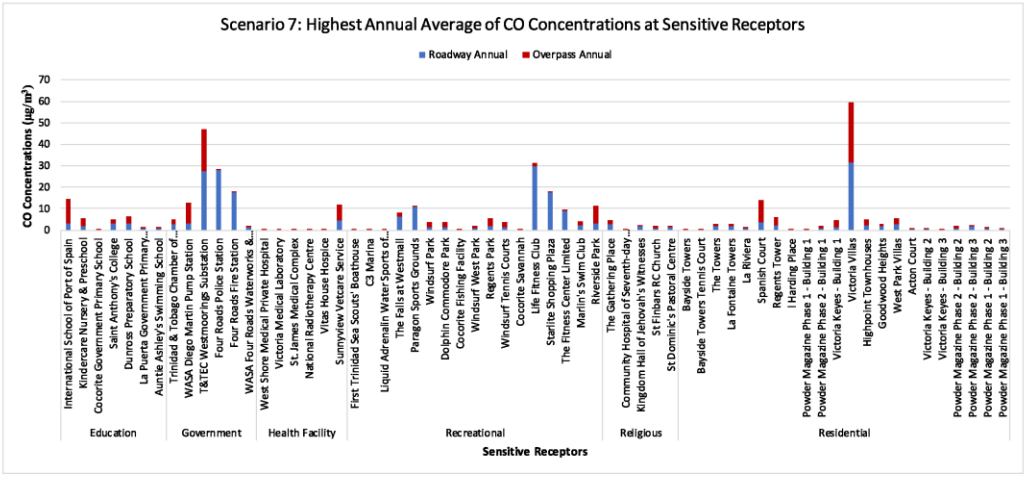


Figure 79: Highest Annual Average CO pollutant concentrations at Sensitive Receptors for Scenario 7 (v1)

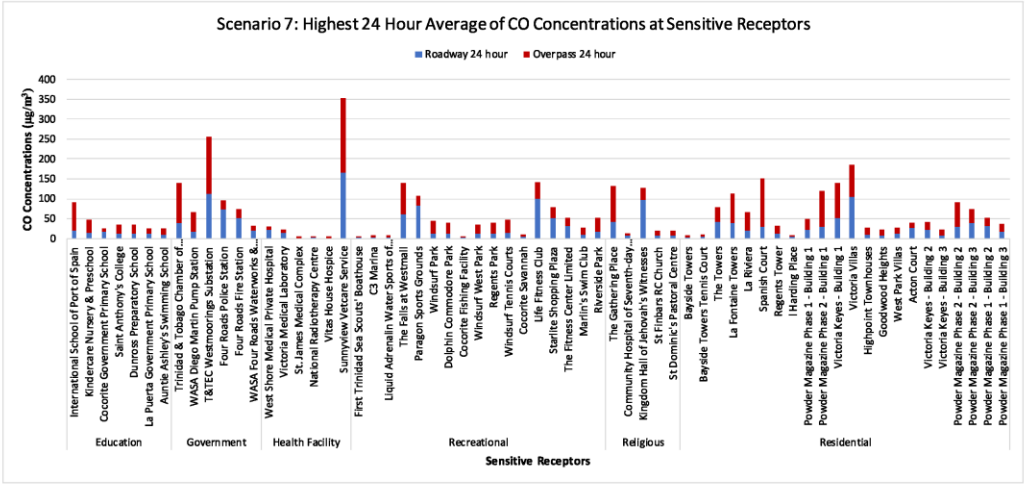


Figure 80: Highest 24-hour Average CO pollutant concentrations at Sensitive Receptors for Scenario 7 (v1)

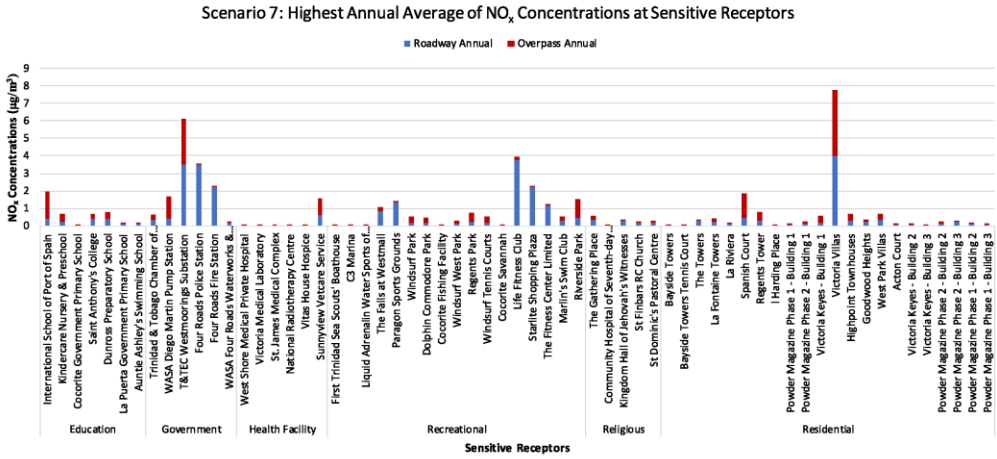


Figure 81: Highest Annual Average NOx pollutant concentrations at Sensitive Receptors for Scenario 7 (v1)

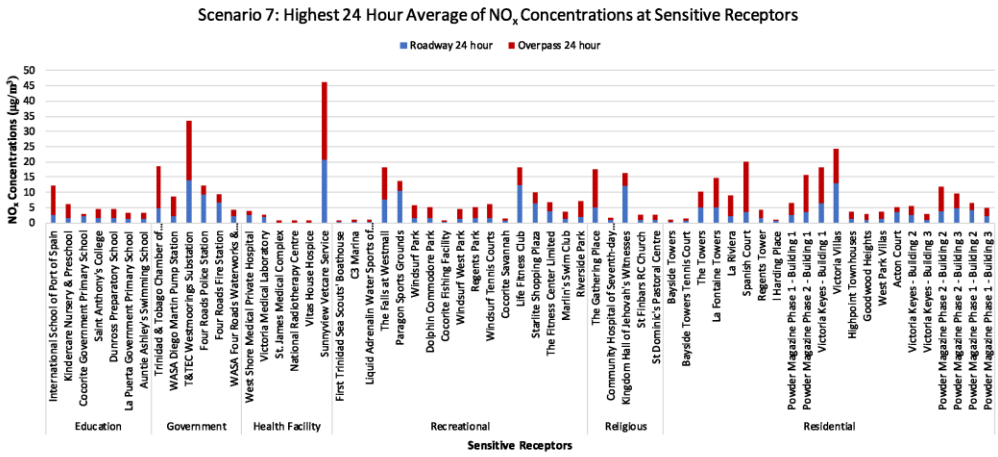


Figure 82: Highest 24-hour Average NOx pollutant concentrations at Sensitive Receptors for Scenario 7 (v1)

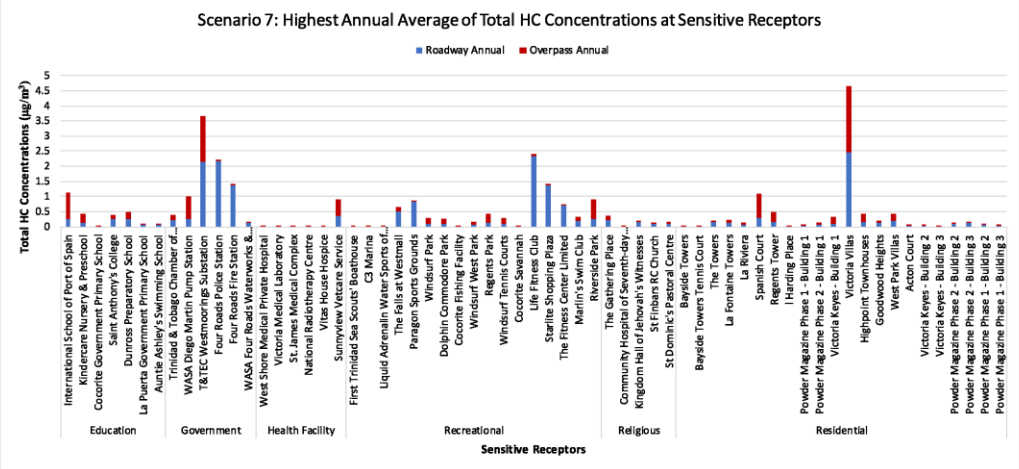


Figure 83: Highest Annual Average Total HC pollutant concentrations at Sensitive Receptors for Scenario 7 (v1)

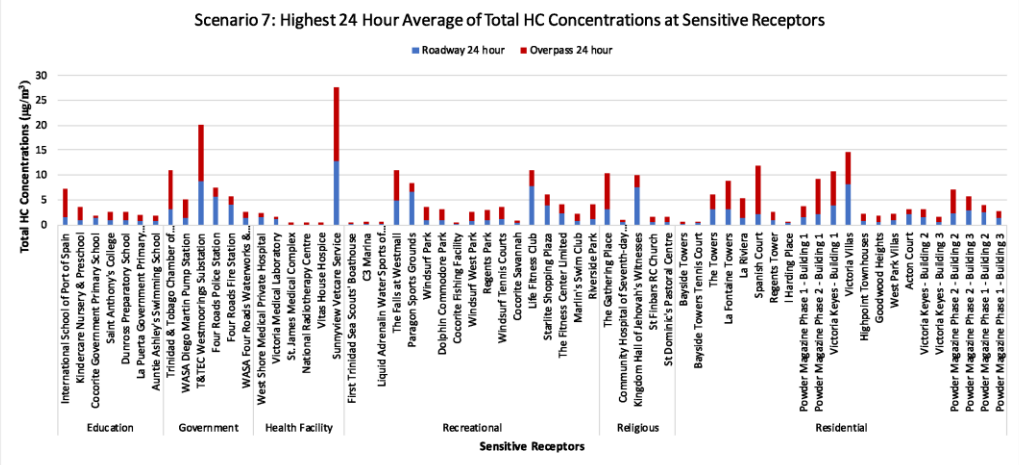


Figure 84: Highest 24-hour Average Total HC pollutant concentrations at Sensitive Receptors for Scenario 7 (v1)

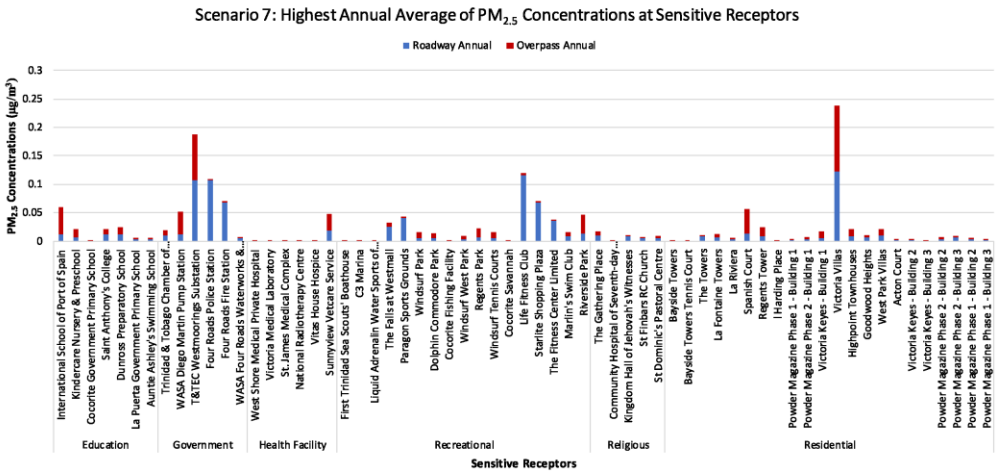


Figure 85: Highest Annual Average $PM_{2.5}$ pollutant concentrations at Sensitive Receptors for Scenario 7 (v1)

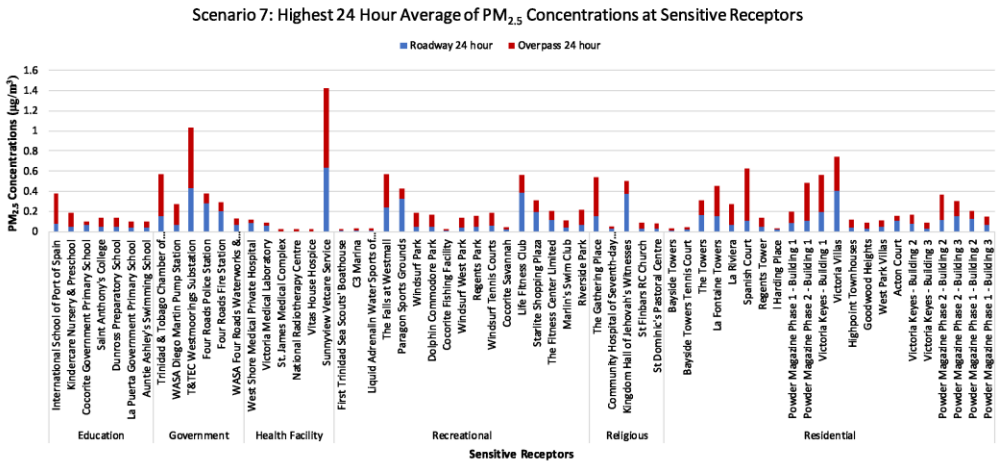


Figure 86: Highest 24-hour Average $PM_{2.5}$ pollutant concentrations at Sensitive Receptors for Scenario 7 (v1)

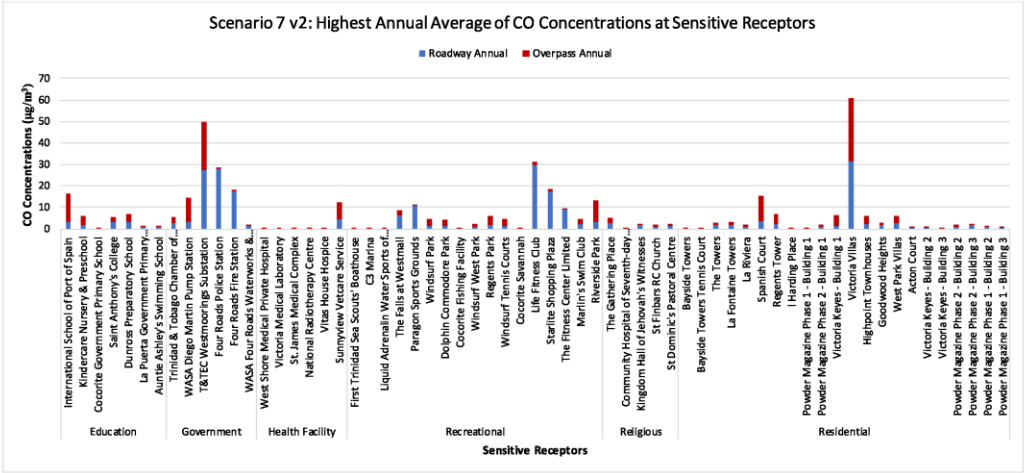


Figure 87: Highest Annual Average CO pollutant concentrations at Sensitive Receptors for Scenario 7 (v2)

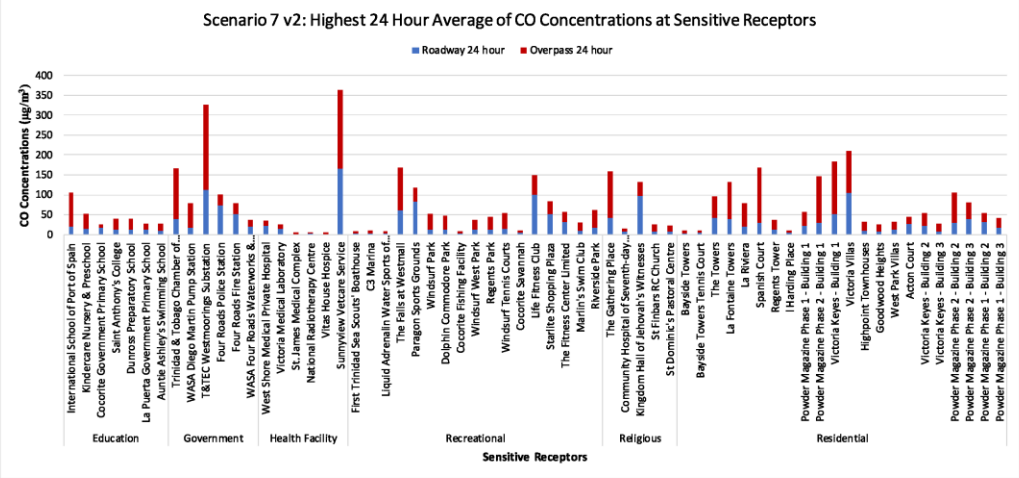


Figure 88: Highest 24-hour Average CO pollutant concentrations at Sensitive Receptors for Scenario 7 (v2)

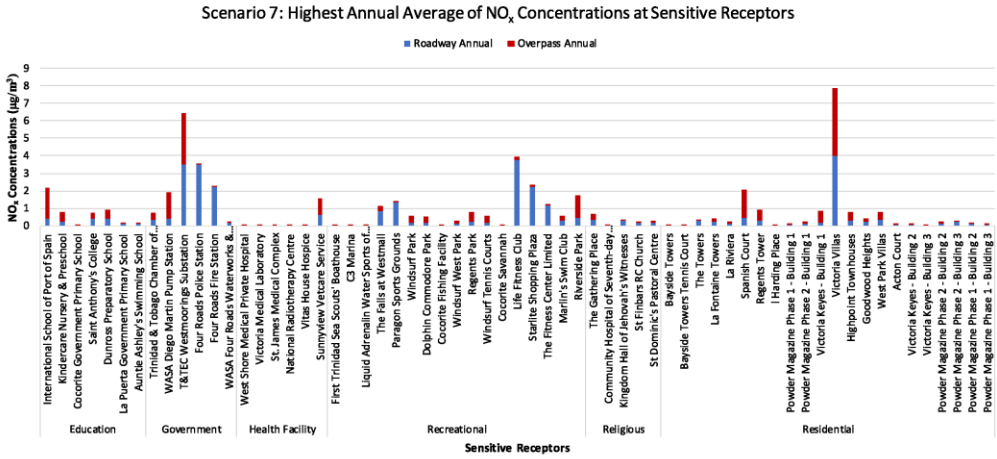


Figure 89: Highest Annual Average NOx pollutant concentrations at Sensitive Receptors for Scenario 7 (v2)

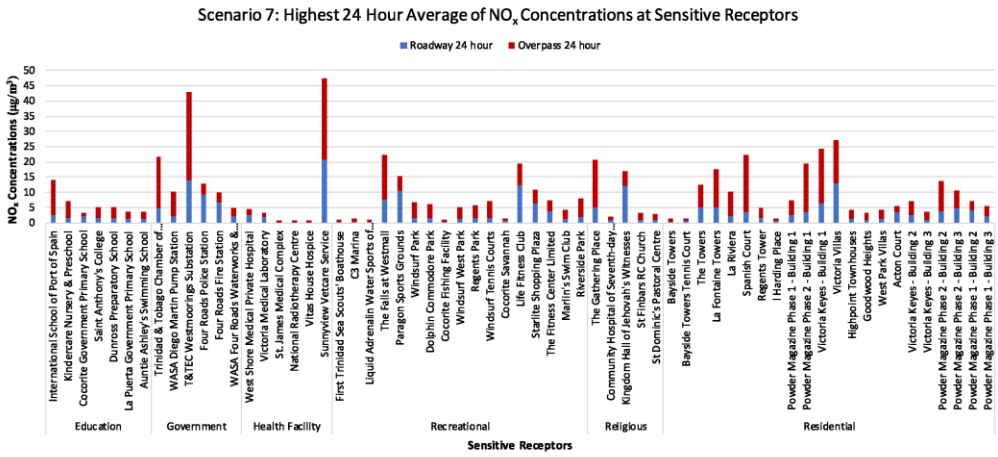


Figure 90: Highest 24-hour Average NOx pollutant concentrations at Sensitive Receptors for Scenario 7 (v2)

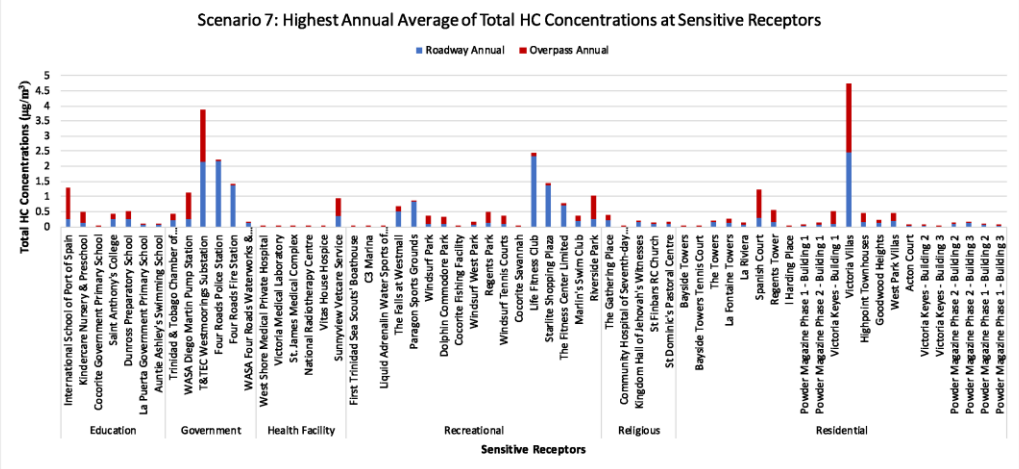


Figure 91: Highest Annual Average Total HC pollutant concentrations at Sensitive Receptors for Scenario 7 (v2)

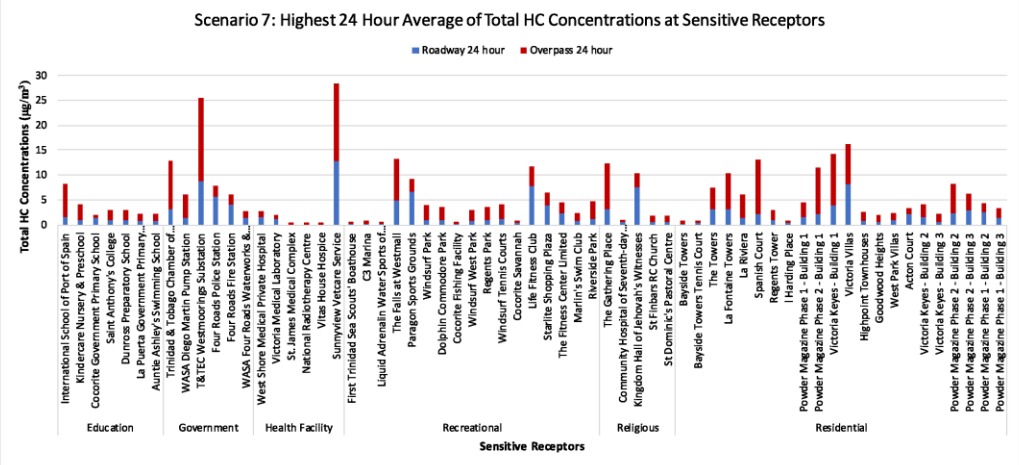


Figure 92: Highest 24-hour Average Total HC pollutant concentrations at Sensitive Receptors for Scenario 7 (v2)

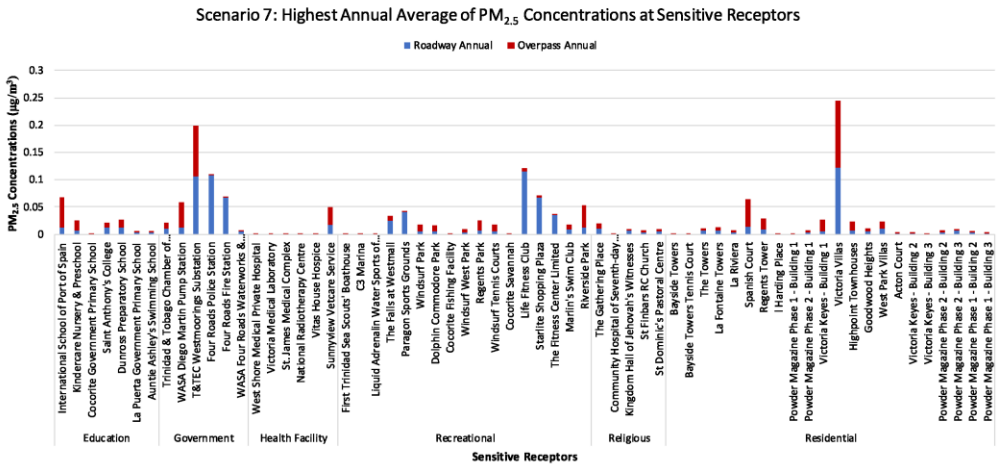


Figure 93: Highest Annual Average $PM_{2.5}$ pollutant concentrations at Sensitive Receptors for Scenario 7 (v2)

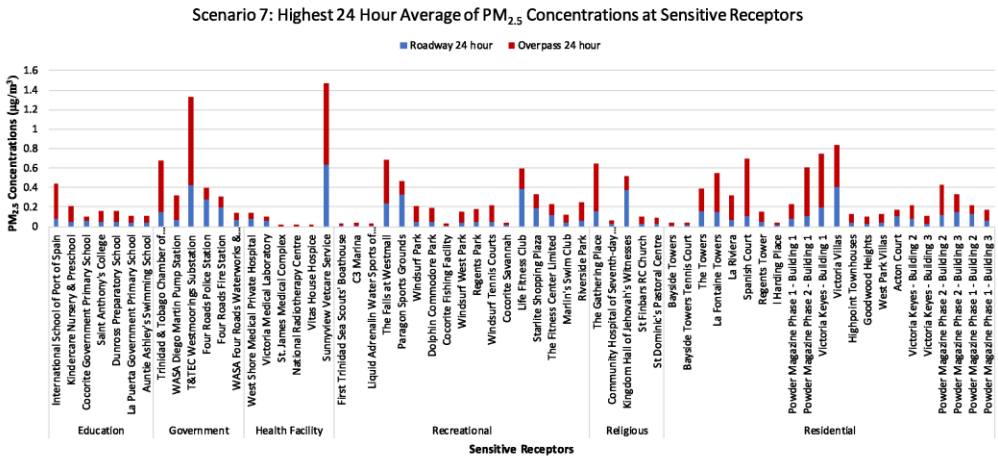
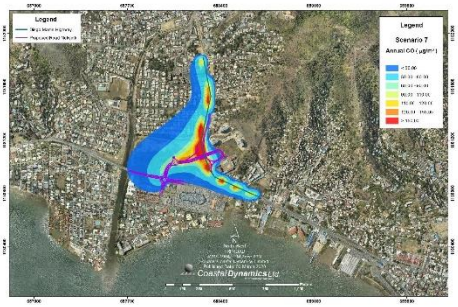
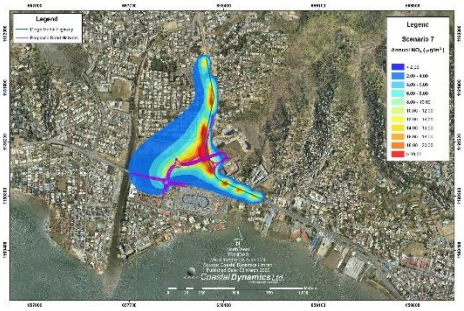
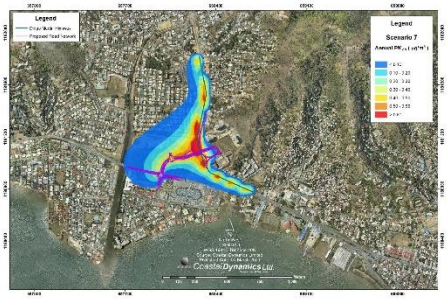


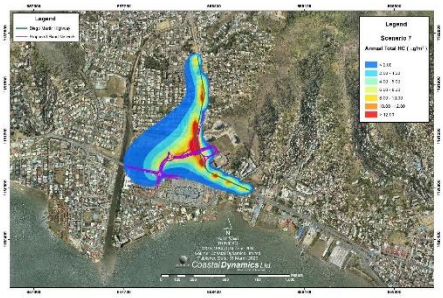
Figure 94: Highest 24-hour Average $PM_{2.5}$ pollutant concentrations at Sensitive Receptors for Scenario 7 (v2)

Air Dispersion Plot for Scenario 7









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8.8 Scenario 8

8.8.1 Sources

Scenario 8 simulated the no-build option in which projected vehicle emissions for 2040 (61% increase from 2015) for the Diego Martin Highway were modelled. The pollutants modelled were NOx, CO, $PM_{2.5}$, and total HC. **Table 14** presents the highest average pollutant concentrations emitted after 24-hour and annual average concentration measured over 2 years (for the run period April 2017 – February 2020). **Figure 95** presents the Scenario 8 data graphically for each time period. A trend in the data can be seen where emissions for the 24-hour time period showed the highest concentrations which then decreased significantly to the highest annual average. For this scenario, the highest pollutant concentration emitted after 24-hour and annual average was CO (1990 $\mu g/m^3$ and 694 $\mu g/m^3$ respectively) followed by NOx (251 $\mu g/m^3$ and 87 $\mu g/m^3$) and total HC (155 $\mu g/m^3$ and 54 $\mu g/m^3$). The lowest pollutant emitted was $PM_{2.5}$ (7.7 $\mu g/m^3$ and 2.7 $\mu g/m^3$).

The 24-hour $PM_{2.5}$ ambient air limit (EMA Air Pollution Rules 2014) is 65 $\mu g/m^3$ and the 24-hour $PM_{2.5}$ concentrations emitted from vehicles on the Diego Martin Highway were significantly less (7.7 $\mu g/m^3$). Similarly, the 1-year $PM_{2.5}$ limit of 15 $\mu g/m^3$ was also not exceeded as the concentration obtained was 2.6 $\mu g/m^3$. No 24-hour nor 1-year limit was declared for CO in the EMA Air Pollution Rules (2014) however the ambient 1-hour limit is 30 000 $\mu g/m^3$ and 8-hour limit is 10 000 $\mu g/m^3$. Since the 24-hour limit was as low as 1990 $\mu g/m^3$, it is not expected that the 1-hour and 8-hour limits would have been exceeded.

The highest annual average NOx value measured over a 2-year dataset was found to be approximately 87 $\mu g/m^3$ over the annual 1-year NO_2 limit. This was the worst-case value as it was highest value recorded, indicating that on average, concentrations are expected to be less than 87 $\mu g/m^3$. As discussed in **Section 6.2 Emission Factors from USEPA**, the model overestimated NOx conditions due to the higher emission factor used for the vehicle category 'Other' that wold have influenced the overall emissions calculated for NOx. Additionally the model represented worse case conditions in which emissions were assumed to be continuously emitted from 6:00 a.m. to 6:00 p.m. for 365 days of the year. In reality, this is not the case. It is also noted that these emissions will be dispersed by the wind flow in the area as AERMOD treats

these source concentrations as initial concentrations to then be dispersed by the model. This results in a decrease in pollutant concentrations as they are dispersed by a combination of the meteorology and topography of the area.

Table 14: Highest average pollutant concentrations for Scenario 8 (No-Build Option)					
Period	**Source**	**CO ($\mu g/m^3$)**	**$PM_{2.5}$ ($\mu g/m^3$)**	**NOx ($\mu g/m^3$)**	**HC ($\mu g/m^3$)**
24-hour (highest)	**Diego Martin Highway**	1990.272	7.692	251.467	155.168
Highest Annual Average	**Diego Martin Highway**	694.261	2.682	87.689	54.109
Ambient Air Limit (First Schedule, EMA Air Pollution Rules 2014)		nd	65 (24-hour) 15 (1-year)	40 (1-year)	nd

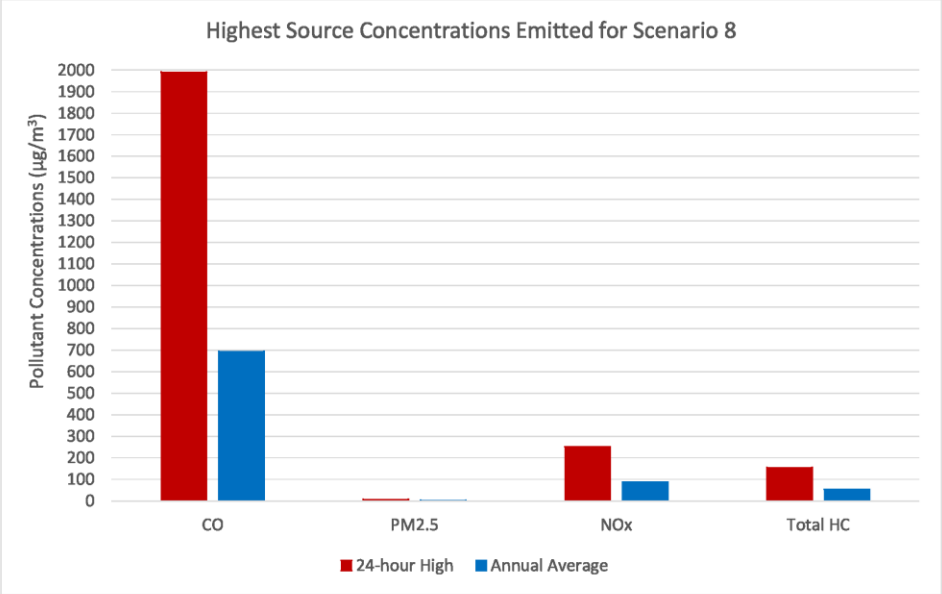

Figure 95: Highest Average pollutants emitted for the No-Build Option

8.8.2 Receptors

Concentrations of pollutants at the sensitive receptors for Scenario 8 were compared to Schedule 1, Ambient Air Quality Standards (EMA Air Pollution Rules 2014) according to 24-hour or 1-year limit provided. **Figure 96** – **Figure 103** show each pollutant concentration at the 63 sensitive receptors for Scenario 8, followed by the air quality dispersion plots.

CO concentrations ranged 3 $\mu g/m^3$ – 500 $\mu g/m^3$ for the 24-hour average while that for the annual ranged 0.01 $\mu g/m^3$ – 90 $\mu g/m^3$. Even though no 24-hour nor 1-year limit was declared for CO in the EMA Air Pollution Rules (2014), 1-hour and 8-hour limits were declared at 30 000 $\mu g/m^3$ and 10 000 $\mu g/m^3$. Based on the concentration ranges obtained for CO, it is not expected that the 1-hour and 8-hour limits would have been exceeded.

NOx annual average concentrations range 0.001 $\mu g/m^3$ – 12 $\mu g/m^3$, which was under the ambient air limit of 40 $\mu g/m^3$ for NO_2. The NOx 24-hour concentrations ranged 0.4 $\mu g/m^3$ – 60 $\mu g/m^3$. Concentrations measured for total HC ranged 0.2 $\mu g/m^3$ – 37 $\mu g/m^3$ (24-hour) and 0.04 $\mu g/m^3$ – 7 $\mu g/m^3$ (annual).

$PM_{2.5}$ concentrations which had short term and long-term permissible limits of 65 $\mu g/m^3$ (24-hours) and 15 $\mu g/m^3$ (1-year) respectively, were not exceeded for any of the 63 receptors. The annual $PM_{2.5}$ concentrations at the receptors ranged 0.0009 $\mu g/m^3$ – 0.35 $\mu g/m^3$ while the 24-hour ranged 0.03 $\mu g/m^3$ – 2 $\mu g/m^3$ for the modelling period April 2017 – February 2020.

With respect to Victoria Keyes and Powder Magazine which are located less than 3 m from the proposed overpass, varying receptor heights made no significant difference to pollutant concentrations. Receptor heights were modelled at ground, middle and top of the buildings.

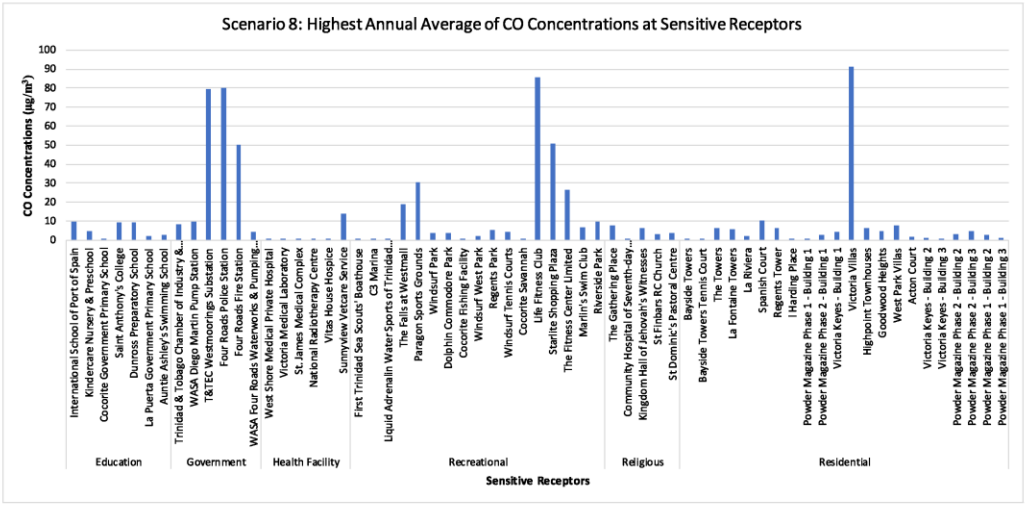

Figure 96: Highest Annual Average CO pollutant concentrations at Sensitive Receptors for Scenario 8

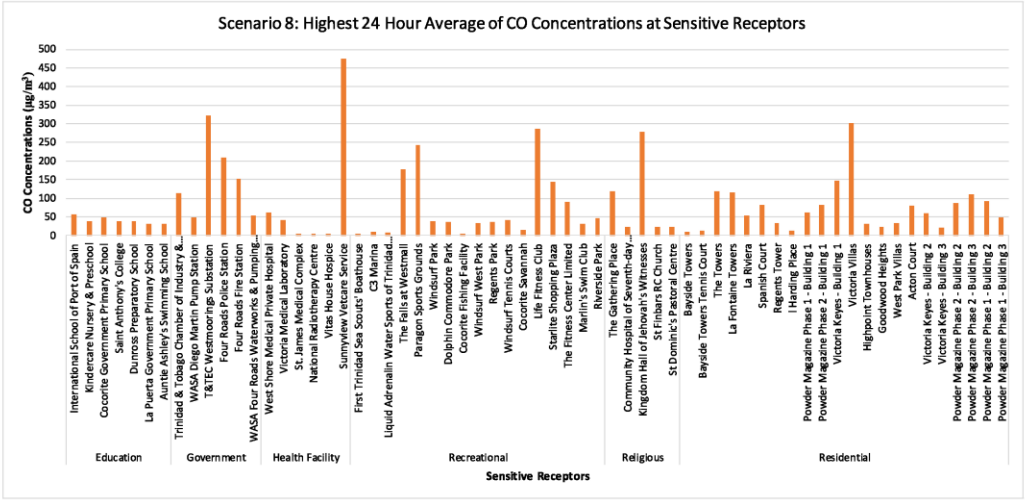

Figure 97: Highest 24-hour Average CO pollutant concentrations at Sensitive Receptors for Scenario 8

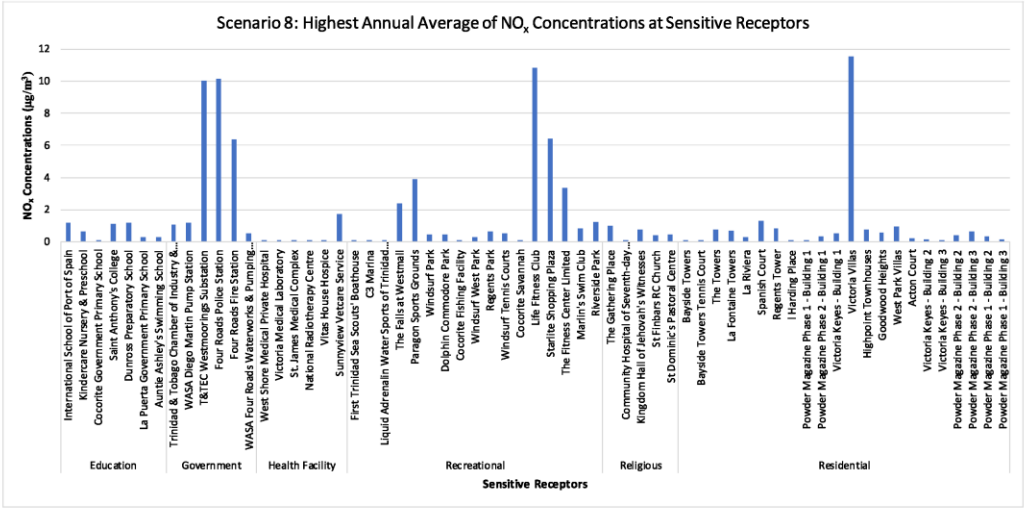

Figure 98: Highest Annual Average NOx pollutant concentrations at Sensitive Receptors for Scenario 8

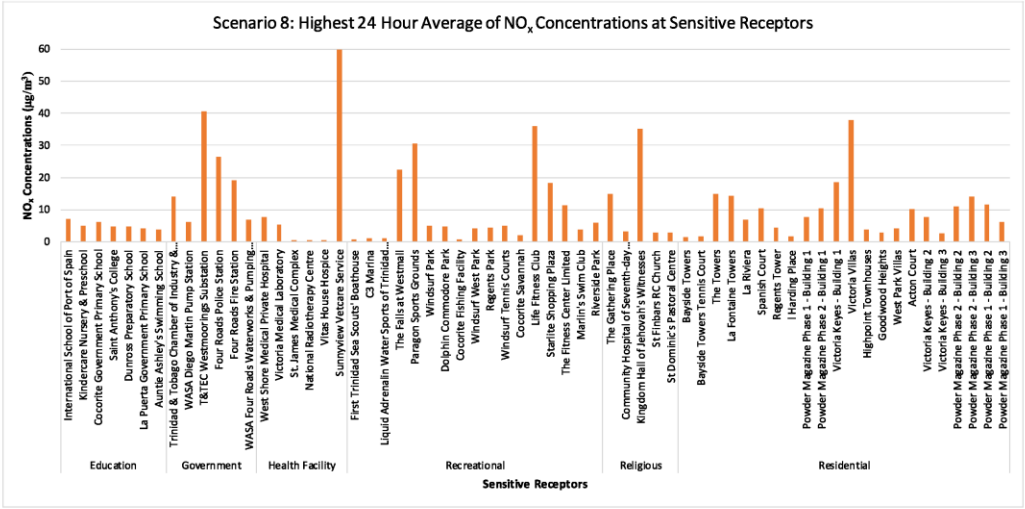

Figure 99: Highest 24-hour Average NOx pollutant concentrations at Sensitive Receptors for Scenario 8

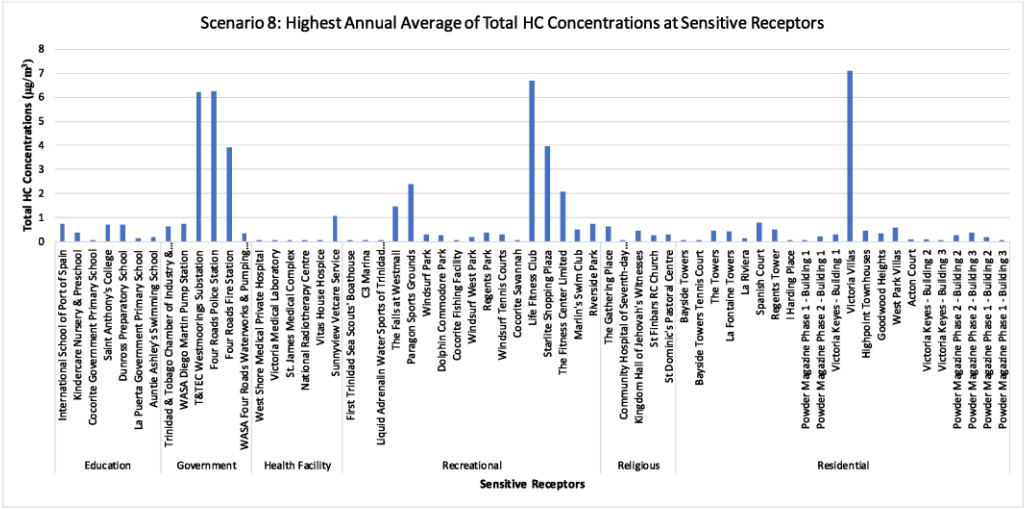

Figure 100: Highest Annual Average Total HC pollutant concentrations at Sensitive Receptors for Scenario 8

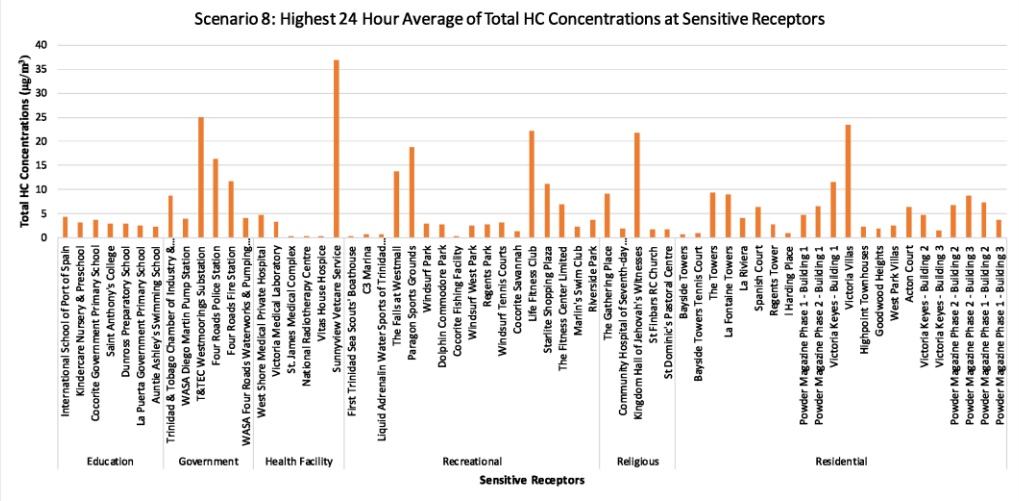

Figure 101: Highest 24-hour Average Total HC pollutant concentrations at Sensitive Receptors for Scenario 8

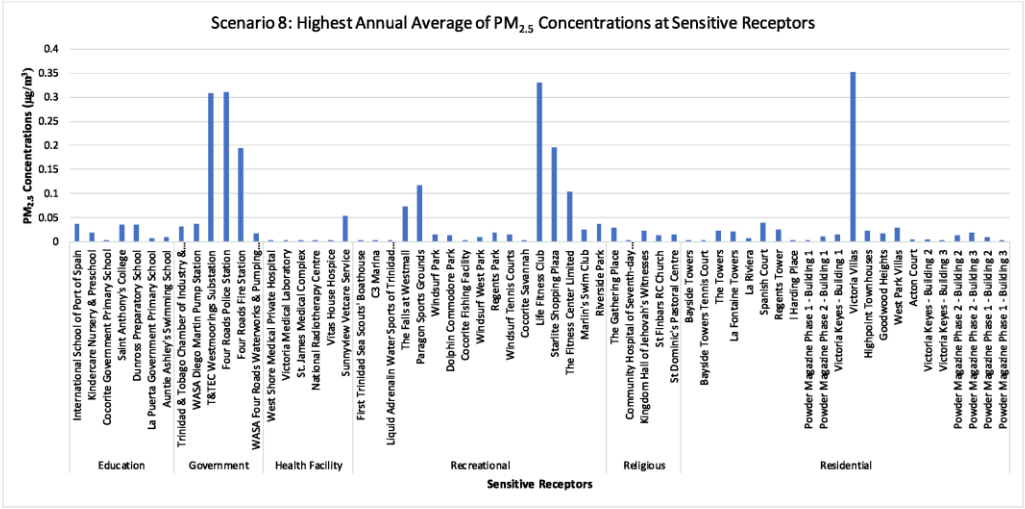

Figure 102: Highest Annual Average $PM_{2.5}$ pollutant concentrations at Sensitive Receptors for Scenario 8

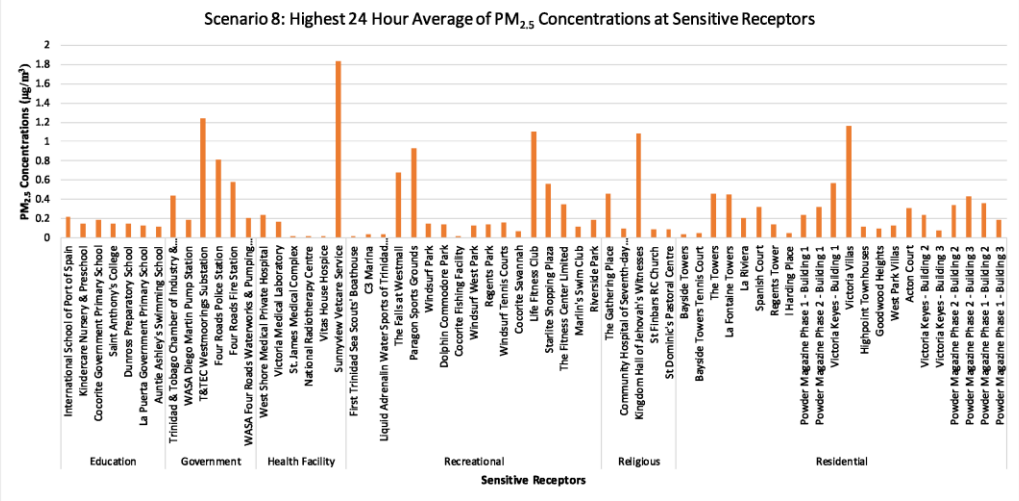

Figure 103: Highest 24-hour Average $PM_{2.5}$ pollutant concentrations at Sensitive Receptors for Scenario 8

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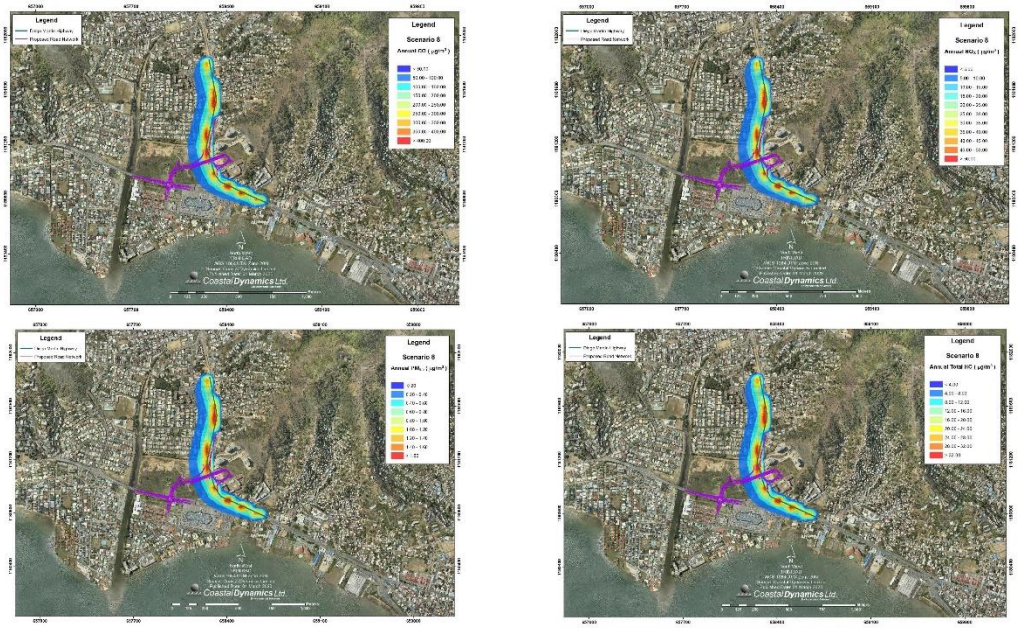
Air Dispersion Plot for Scenario 8



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9 Summary

Modelled meteorological data for the Diego Martin area and projected vehicle emissions for 2020 and 2040 were used to model and assess the ambient air quality impact of four criteria pollutants associated with the proposed vehicular overpass. Meteorological impacts, mainly wind influence on dispersion, resulted in a reduction of the pollutant concentrations for all scenarios in the order of the shortest time frame (i.e.24-hour) to the longest time frame modelled (i.e. annual average over a 2-year period). Each roadway was entered as a Line Source in AERMOD, which treat the source as an area source in which emissions were continuously emitted for 8 hours a day for 365 days for the period April 2017 – February 2020.

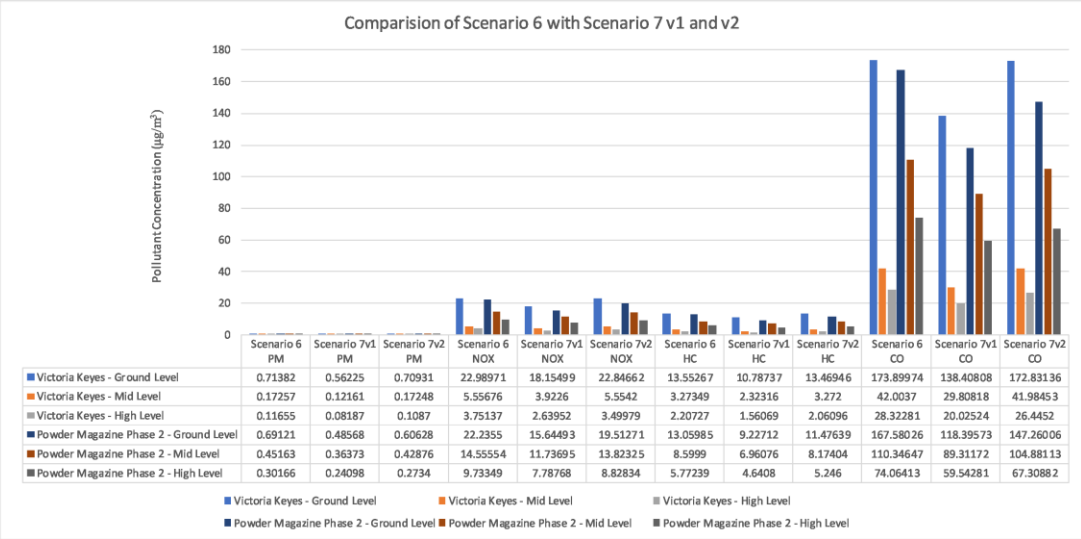
Baseline conditions (Diego Martin Highway between Morne Coco and Western Main Road) indicated annual average NOx concentrations were over the annual NO_2 limit of 40 $\mu g/m^3$. This is not expected to occur in reality as input NOx emission rates calculated were more reflective of the Other Vehicle category due to the weighted average used, and according to the Traffic data count, more cars used the Diego Martin Highway than heavier vehicles such as trucks, vans, etc. Generally heavy duty vehicles (especial diesel vehicles) generate higher NOx levels compared to cars. Additionally, NOx monitoring levels over a 24-hour time period measured by the EMA Port of Spain Air Quality station, (located in Beetham) recorded an average of 77 $\mu g/m^3$. This also indicated that near roadways, NOx concentrations tend to be higher. All other pollutant concentrations were below the Ambient Air Limits in the EMA Air Pollution Rules (2014) for baseline conditions for 2020, where limits were available. A projected 61% increase in traffic also resulted in NOx concentrations that exceeded the annual NO_2 limit.

Construction emissions modelled in Scenarios 2 and 3 also resulted in exceedances in NOx values with the NO_2 Ambient Air Limits in the EMA Air Pollution Rules (2014). Due to the large construction area of 188 881 m^2 selected for the occurrence of construction works, this accounted for worst case conditions. Additionally, it was assumed that all main categories of equipment were on at the same time for 12 hours a day for 365 days. In reality this is not expected to be the case and the Construction Phase is expected to last for 1-year.

Scenarios 4 to 6 (peak, off-peak and peak and off-peak combined) modelled the proposed overpass together with emissions from the Diego Martin Highway i.e. together with baseline conditions. All pollutant concentrations (for both the Highway and Overpass cumulatively), including NOx, were below the Ambient Air Limits in the EMA Air Pollution Rules (2014) for 2020, where limits were available. Emissions from the overpass itself accounted for less of the cumulative emissions when compared to the Diego Martin Highway. It was assumed that 100% of vehicles using Morne Coco and 50% of vehicles using the Diego Martin Highway would use the overpass. Results for Scenarios 4 – 6 indicate that the use of the overpass is not likely to worsen the current baseline conditions in Diego Martin, based on the vehicle traffic count supplied by MMM Group Ltd (2015).

Receptor heights were modelled at ground, middle and top (high) level of the buildings. Generally, pollutant concentrations decreased as the building heights increased for Victoria Keyes and Powder Magazine Phase 2 buildings. Scenario 7 included the addition of a 3 m noise barrier to Scenario 6 at segments 4 – 6 of the proposed overpass. Scenario 7 was divided into two versions; v1 included segments 4 – 6 and v2 included segments 5 – 6. This was done due to length and location of segment 4 (refer to **Figure 5, Section 3.3.2** above) which crosses the Diego Martin Highway and a portion of the underdeveloped plot of land. Scenario 7v1 indicated that the addition of the noise barrier at segment 4 reduced receptor concentrations at Victoria Keyes and Powder Magazine slightly whereas the exclusion of segment 4 of the overpass resulted in similar values to that obtained in Scenario 6. **Figure 104** below shows a comparison of the sensitive receptor concentrations at Victoria Keyes and Powder Magazine for versions 1 and 2. Results of Scenario 6 at these receptors were also included for comparison.

Even though the source NOx concentrations were exceeded for Scenarios 1,2,3,8, it is noted that all receptor concentrations, even those < 3m from the overpass, were below ambient air limits of NO_2 (EMA Air Pollution Rules 2014).



	Scenario 6 PM	Scenario 7v1 PM	Scenario 7v2 PM	Scenario 6 NOX	Scenario 7v1 NOX	Scenario 7v2 NOX	Scenario 6 HC	Scenario 7v1 HC	Scenario 7v2 HC	Scenario 6 CO	Scenario 7v1 CO	Scenario 7v2 CO
Victoria Keyes - Ground Level	0.71382	0.56225	0.70931	22.98971	18.15499	22.84662	13.55267	10.78737	13.46946	173.89974	138.40808	172.83136
Victoria Keyes - Mid Level	0.17257	0.12161	0.17248	5.55676	3.9226	5.5542	3.27349	2.32316	3.272	42.0037	29.80818	41.98453
Victoria Keyes - High Level	0.11655	0.08187	0.1087	3.75137	2.63952	3.49979	2.20727	1.56069	2.06096	28.32281	20.02524	26.4452
Powder Magazine Phase 2 - Ground Level	0.69121	0.48568	0.60628	22.2355	15.64493	19.51271	13.05985	9.22712	11.47639	167.58026	118.39573	147.26006
Powder Magazine Phase 2 - Mid Level	0.45163	0.36373	0.42876	14.55554	11.73695	13.82325	8.5999	6.96076	8.17404	110.34647	89.31172	104.88113
Powder Magazine Phase 2 - High Level	0.30166	0.24098	0.2734	9.73349	7.78768	8.82834	5.77239	4.6408	5.246	74.06413	59.54281	67.30882

Figure 104: A comparison of the sensitive receptor concentrations at Victoria Keyes and Powder Magazine for versions 1 and 2

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APPENDIX 1

SUMMARY OF INPUT DATA FOR AERMOD

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Scenario 1 Input Data - Baseline												
ID		Coordinates		Release height (m)	Coordinates		Width (m)	Initial Vertical Dimension (m)	CO (g/s/m²)	NOx (g/s/m²)	PM2.5 (g/s/m²)	HC (g/s/m²)
		X	Y		End Pt X	End Pt Y						
Baseline	DH1	658271	1181821	0.95	658327	1181531	24	1.51	3.67E-04	4.64E-05	1.42E-06	2.86E-05
	DH2	658327	1181531	0.95	658251	1181183	24	1.51	3.67E-04	4.64E-05	1.42E-06	2.86E-05
	DH3	658251	1181183	0.95	658313	1180983	24	1.51	3.67E-04	4.64E-05	1.42E-06	2.86E-05
	DH4	658313	1180983	0.95	658357	1180925	24	1.51	3.67E-04	4.64E-05	1.42E-06	2.86E-05
	DH5	658357	1180925	0.95	658463	1180876	24	1.51	3.67E-04	4.64E-05	1.42E-06	2.86E-05
	DH6	658463	1180876	0.95	658687	1180776	24	1.51	3.67E-04	4.64E-05	1.42E-06	2.86E-05

Scenario 2 Input Data - Construction Equipment									
ID	Coordinate		Release height (m)	Initial Vertical Dimension (m)	AREA (m²)	SO2 (g/s/m²)	CO (g/s/m²)	PM10 (g/s/m²)	NOX (g/s/m²)
	X	Y							
Construction	657759	1181240	2.89	4.57	188881.2	4.61E-06	2.02E-06	4.05E-06	6.52E-05

Categories of Construction Equipment	
1	Box Truck
2	Compacter/Tamper
3	Concrete Truck
4	Crane
5	Dump Truck
6	Excavator
7	Flat Bed Truck
8	Forklift
9	Former
10	Generator
11	Generator/Pump

Categories of Construction Equipment	
12	Grader
13	Loader
14	Manlift
15	Oil Truck
16	Pick Up Van
17	Piling/drilling rig
18	Pipe handler
19	Reclaimer
20	Roller
21	Spreader
22	Stabilizer
23	Sweeper
24	Tractor
25	Truck
26	Water Truck

Scenario 3 Input Data - Baseline and Construction Equipment															
ID		Coordinate		Release height (m)	Coordinate		Width (m)	Initial Vertical Dimension (m)	AREA (m^2)	SO2 ($g/s/m^2$)	CO ($g/s/m^2$)	PM10 ($g/s/m^2$)	NOX ($g/s/m^2$)	PM2.5 ($g/s/m^2$)	HC ($g/s/m^2$)
		X	Y		End Pt X	End Pt Y									
Construction Equipment		657759	1181240	2.89	n/a	n/a	n/a	4.57	188881.2	4.61E-06	2.02E-06	4.05E-06	6.52E-05	n/a	n/a
Baseline	DH1	658271	1181821	0.95	658327	1181531	24	1.51	n/a	n/a	3.67E-04	n/a	4.64E-05	1.42E-06	2.86E-05
	DH2	658327	1181531	0.95	658251	1181183	24	1.51	n/a	n/a	3.67E-04	n/a	4.64E-05	1.42E-06	2.86E-05
	DH3	658251	1181183	0.95	658313	1180983	24	1.51	n/a	n/a	3.67E-04	n/a	4.64E-05	1.42E-06	2.86E-05
	DH4	658313	1180983	0.95	658357	1180925	24	1.51	n/a	n/a	3.67E-04	n/a	4.64E-05	1.42E-06	2.86E-05
	DH5	658357	1180925	0.95	658463	1180876	24	1.51	n/a	n/a	3.67E-04	n/a	4.64E-05	1.42E-06	2.86E-05
	DH6	658463	1180876	0.95	658687	1180776	24	1.51	n/a	n/a	3.67E-04	n/a	4.64E-05	1.42E-06	2.86E-05

Scenario 4 Input Data - Baseline and Overpass (Peak Times)												
ID		Coordinate		Release height (m)	Coordinate		Width (m)	Initial Vertical Dimension (m)	CO (g/s/m2)	NOx (g/s/m2)	PM2.5 (g/s/m2)	Total HC (g/s/m2)
		X	Y		End Pt X	End Pt Y						
Overpass (Peak Times)	1	657964	1180853	10.99	657997	1180986	26	8.69	2.03E-04	2.65E-05	8.19E-07	1.59E-05
	2	657997	1180986	10.99	658050	1181030	26	8.69	2.03E-04	2.65E-05	8.19E-07	1.59E-05
	3	658050	1181030	10.99	658154	1181043	26	8.69	2.03E-04	2.65E-05	8.19E-07	1.59E-05
	4	658154	1181043	10.99	658395	1181123	26	8.69	2.03E-04	2.65E-05	8.19E-07	1.59E-05
	5	658395	1181123	10.99	658423	1181087	11	8.69	4.81E-04	6.27E-05	1.94E-06	3.75E-05
	6	658423	1181087	10.99	658437	1181073	11	8.69	4.81E-04	6.27E-05	1.94E-06	3.75E-05
	7	658423	1181087	10.99	658331	1181024	11	8.69	4.81E-04	6.27E-05	1.94E-06	3.75E-05
	8	658331	1181024	10.99	658337	1180962	11	8.69	4.81E-04	6.27E-05	1.94E-06	3.75E-05
	9	658331	1181024	10.99	658294	1181119	9	8.69	5.88E-04	7.66E-05	2.37E-06	4.58E-05
	10	658294	1181119	10.99	658278	1181222	8	8.69	6.61E-04	8.62E-05	2.66E-06	5.15E-05
	11	658278	1181222	10.99	658322	1181391	8	8.69	6.61E-04	8.62E-05	2.66E-06	5.15E-05
	12	658124	1181039	10.99	658218	1181109	6	8.69	8.81E-04	1.15E-04	3.55E-06	6.87E-05
	13	658218	1181109	10.99	658233	1181154	6	8.69	8.81E-04	1.15E-04	3.55E-06	6.87E-05
Baseline	DH 1	658271	1181821	0.95	658327	1181531	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05
	DH 2	658327	1181531	0.95	658251	1181183	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05
	DH 3	658251	1181183	0.95	658313	1180983	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05
	DH 4	658313	1180983	0.95	658357	1180925	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05
	DH 5	658357	1180925	0.95	658463	1180876	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05
	DH 6	658463	1180876	0.95	658687	1180776	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05

Scenario 5 Input Data - Baseline and Overpass (Off Peak Traffic)												
ID		Coordinate		Release height (m)	Coordinate		Width (m)	Initial Vertical Dimension (m)	CO (g/s/m2)	NOx (g/s/m2)	PM2.5 (g/s/m2)	Total HC (g/s/m2)
		X	Y		End Pt X	End Pt Y						
Overpass (Peak Times)	1	657964	1180853	10.99	657997	1180986	26	8.69	6.03E-05	8.82E-06	2.82E-07	4.69E-06
	2	657997	1180986	10.99	658050	1181030	26	8.69	6.03E-05	8.82E-06	2.82E-07	4.69E-06
	3	658050	1181030	10.99	658154	1181043	26	8.69	6.03E-05	8.82E-06	2.82E-07	4.69E-06
	4	658154	1181043	10.99	658395	1181123	26	8.69	6.03E-05	8.82E-06	2.82E-07	4.69E-06
	5	658395	1181123	10.99	658423	1181087	11	8.69	1.42E-04	2.08E-05	6.67E-07	1.11E-05
	6	658423	1181087	10.99	658437	1181073	11	8.69	1.42E-04	2.08E-05	6.67E-07	1.11E-05
	7	658423	1181087	10.99	658331	1181024	11	8.69	1.42E-04	2.08E-05	6.67E-07	1.11E-05
	8	658331	1181024	10.99	658337	1180962	11	8.69	1.42E-04	2.08E-05	6.67E-07	1.11E-05
	9	658331	1181024	10.99	658294	1181119	8	8.69	1.74E-04	2.55E-05	8.15E-07	1.36E-05
	10	658294	1181119	10.99	658278	1181222	8	8.69	1.96E-04	2.87E-05	9.17E-07	1.53E-05
	11	658278	1181222	10.99	658322	1181391	8	8.69	1.96E-04	2.87E-05	9.17E-07	1.53E-05
	12	658124	1181039	10.99	658218	1181109	6	8.69	2.61E-04	3.82E-05	1.22E-06	2.03E-05
	13	658218	1181109	10.99	658233	1181154	6	8.69	3.66E-04	5.36E-05	1.72E-06	2.85E-05
Baseline	DH1	658271	1181821	0.95	658327	1181531	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05
	DH2	658327	1181531	0.95	658251	1181183	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05
	DH3	658251	1181183	0.95	658313	1180983	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05
	DH4	658313	1180983	0.95	658357	1180925	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05
	DH5	658357	1180925	0.95	658463	1180876	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05
	DH6	658463	1180876	0.95	658687	1180776	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05

Scenario 6 Input Data - Baseline and Peak and Off-Peak Traffic												
ID		Coordinate		Release height (m)	Coordinate		Width (m)	Initial Vertical Dimension (m)	CO (g/s/m2)	NOx (g/s/m2)	PM2.5 (g/s/m2)	Total HC (g/s/m2)
		X	Y		End Pt X	End Pt Y						
Overpass (Peak Times)	1	657964	1180853	10.99	657997	1180986	26	8.69	2.64E-04	3.53E-05	1.10E-06	2.05E-05
	2	657997	1180986	10.99	658050	1181030	26	8.69	2.64E-04	3.53E-05	1.10E-06	2.05E-05
	3	658050	1181030	10.99	658154	1181043	26	8.69	2.64E-04	3.53E-05	1.10E-06	2.05E-05
	4	658154	1181043	10.99	658395	1181123	26	8.69	2.64E-04	3.53E-05	1.10E-06	2.05E-05
	5	658395	1181123	10.99	658423	1181087	11	8.69	6.23E-04	8.35E-05	2.60E-06	4.86E-05
	6	658423	1181087	10.99	658437	1181073	11	8.69	6.23E-04	8.35E-05	2.60E-06	4.86E-05
	7	658423	1181087	10.99	658331	1181024	11	8.69	6.23E-04	8.35E-05	2.60E-06	4.86E-05
	8	658331	1181024	10.99	658337	1180962	11	8.69	6.23E-04	8.35E-05	2.60E-06	4.86E-05
	9	658331	1181024	10.99	658294	1181119	8	8.69	7.62E-04	1.02E-04	3.18E-06	5.94E-05
	10	658294	1181119	10.99	658278	1181222	8	8.69	8.57E-04	1.15E-04	3.58E-06	6.68E-05
	11	658278	1181222	10.99	658322	1181391	8	8.69	8.57E-04	1.15E-04	3.58E-06	6.68E-05
	12	658124	1181039	10.99	658218	1181109	6	8.69	1.14E-03	1.53E-04	4.77E-06	8.90E-05
	13	658218	1181109	10.99	658233	1181154	6	8.69	1.60E-03	2.15E-04	6.70E-06	1.25E-04
Baseline	DH1	658271	1181821	0.95	658327	1181531	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05
	DH2	658327	1181531	0.95	658251	1181183	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05
	DH3	658251	1181183	0.95	658313	1180983	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05
	DH4	658313	1180983	0.95	658357	1180925	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05
	DH5	658357	1180925	0.95	658463	1180876	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05
	DH6	658463	1180876	0.95	658687	1180776	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05

Scenario 7 Input Data - Baseline and Mitigation												
ID		Coordinate		Release height (m)	Coordinate		Width (m)	Initial Vertical Dimension (m)	CO (g/s/m2)	NOx (g/s/m2)	PM2.5 (g/s/m2)	Total HC (g/s/m2)
		X	Y		End Pt X	End Pt Y						
Overpass (Peak Times)	1	657964	1180853	10.99	657997	1180986	26	8.69	2.64E-04	3.53E-05	1.10E-06	2.05E-05
	2	657997	1180986	10.99	658050	1181030	26	8.69	2.64E-04	3.53E-05	1.10E-06	2.05E-05
	3	658050	1181030	10.99	658154	1181043	26	8.69	2.64E-04	3.53E-05	1.10E-06	2.05E-05
	4	658154	1181043	10.99	658395	1181123	26	8.69	2.64E-04	3.53E-05	1.10E-06	2.05E-05
	5	658395	1181123	10.99	658423	1181087	11	8.69	6.23E-04	8.35E-05	2.60E-06	4.86E-05
	6	658423	1181087	10.99	658437	1181073	11	8.69	6.23E-04	8.35E-05	2.60E-06	4.86E-05
	7	658423	1181087	10.99	658331	1181024	11	8.69	6.23E-04	8.35E-05	2.60E-06	4.86E-05
	8	658331	1181024	10.99	658337	1180962	11	8.69	6.23E-04	8.35E-05	2.60E-06	4.86E-05
	9	658331	1181024	10.99	658294	1181119	8	8.69	7.62E-04	1.02E-04	3.18E-06	5.94E-05
	10	658294	1181119	10.99	658278	1181222	8	8.69	8.57E-04	1.15E-04	3.58E-06	6.68E-05
	11	658278	1181222	10.99	658322	1181391	8	8.69	8.57E-04	1.15E-04	3.58E-06	6.68E-05
	12	658124	1181039	10.99	658218	1181109	6	8.69	1.14E-03	1.53E-04	4.77E-06	8.90E-05
	13	658218	1181109	10.99	658233	1181154	6	8.69	1.60E-03	2.15E-04	6.70E-06	1.25E-04
Baseline	DH1	658271	1181821	0.95	658327	1181531	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05
	DH2	658327	1181531	0.95	658251	1181183	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05
	DH3	658251	1181183	0.95	658313	1180983	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05
	DH4	658313	1180983	0.95	658357	1180925	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05
	DH5	658357	1180925	0.95	658463	1180876	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05
	DH6	658463	1180876	0.95	658687	1180776	24	1.51	1.84E-04	2.32E-05	7.10E-07	1.43E-05

Barrier Height: 3m

Road centreline to source: 564.63 (segment 4); Distance from source: 13

Road centreline to source: 44.55 (segment 5); Distance from source: 5.5

Road centreline to source: 20.32 (segment 6); Distance from source: 5.5

Scenario 8 Input Data - No Build Option with 20 Year Projection											
ID	Coordinate		Release height (m)	Coordinate		Width (m)	Initial Vertical Dimension (m)	CO (g/s/m2)	Nox (g/s/m2)	PM2.5 (g/s/m2)	HC (g/s/m2)
	X	Y		End Pt X	End Pt Y						
DH1	658271	1181821	0.95	658327	1181531	24	1.51	5.28E-04	6.67E-05	2.04E-06	4.12E-05
DH2	658327	1181531	0.95	658251	1181183	24	1.51	5.28E-04	6.67E-05	2.04E-06	4.12E-05
DH3	658251	1181183	0.95	658313	1180983	24	1.51	5.28E-04	6.67E-05	2.04E-06	4.12E-05
DH4	658313	1180983	0.95	658357	1180925	24	1.51	5.28E-04	6.67E-05	2.04E-06	4.12E-05
DH5	658357	1180925	0.95	658463	1180876	24	1.51	5.28E-04	6.67E-05	2.04E-06	4.12E-05
DH6	658463	1180876	0.95	658687	1180776	24	1.51	5.28E-04	6.67E-05	2.04E-06	4.12E-05

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APPENDIX II

US EPA EMISSION FACTORS

Table 4-43: Estimated National Average Vehicle Emissions Rates per Vehicle by Vehicle Type using Gasoline and Diesel (Grams per mile)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
GASOLINE																			
Light-duty vehicles																			
Total HC	1.617	1.506	1.338	1.231	1.116	1.020	0.949	0.881	0.862	0.827	0.786	0.770	0.686	0.624	0.557	0.499	0.447	0.389	0.350
Exhaust CO	16.028	14.672	12.975	11.866	10.714	9.759	9.116	8.457	7.954	7.480	7.121	6.839	6.228	5.775	5.314	4.898	4.563	4.183	3.941
Exhaust NOx	1.681	1.600	1.448	1.342	1.202	1.079	1.034	0.947	0.936	0.917	0.901	0.870	0.772	0.668	0.597	0.518	0.448	0.337	0.289
Exhaust PM2.5	0.037	0.034	0.031	0.028	0.025	0.023	0.021	0.019	0.019	0.018	0.017	0.017	0.015	0.014	0.012	0.011	0.010	0.009	0.008
Brakewear PM2.5	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Tirewear PM2.5	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Light-duty trucks																			
Total HC	1.427	1.378	1.293	1.257	1.161	1.094	1.057	1.026	1.011	0.999	0.979	0.972	0.870	0.791	0.706	0.626	0.553	0.471	0.421
Exhaust CO	16.871	16.043	14.885	14.317	13.273	12.689	12.431	12.168	11.551	11.207	11.007	10.896	9.877	9.090	8.266	7.463	6.779	6.124	5.655
Exhaust NOx	2.268	2.173	2.001	1.923	1.732	1.585	1.542	1.450	1.438	1.440	1.434	1.399	1.260	1.135	1.000	0.872	0.760	0.552	0.478
Exhaust PM2.5	0.025	0.024	0.022	0.022	0.020	0.019	0.019	0.018	0.017	0.017	0.017	0.017	0.016	0.015	0.013	0.012	0.011	0.010	0.010
Brakewear PM2.5	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Tirewear PM2.5	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Heavy-duty vehicles																			
Total HC	3.144	3.167	2.956	2.875	2.597	2.450	2.290	2.264	2.173	2.198	2.248	2.119	2.054	1.937	1.780	1.639	1.494	1.291	1.160
Exhaust CO	58.607	59.991	57.598	57.756	52.132	48.874	45.729	44.489	41.031	40.302	40.808	38.522	36.938	34.737	31.964	29.338	26.902	23.246	21.352
Exhaust NOx	6.233	6.130	5.908	5.781	5.342	4.988	4.835	4.559	4.410	4.341	4.321	4.035	3.794	3.498	3.154	2.837	2.554	1.628	1.416
Exhaust PM2.5	0.108	0.102	0.090	0.084	0.078	0.074	0.068	0.067	0.063	0.062	0.062	0.057	0.054	0.050	0.046	0.042	0.038	0.034	0.030
Brakewear PM2.5	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
Tirewear PM2.5	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Motorcycles																			
Total HC	4.749	5.069	4.942	4.916	4.024	3.825	3.280	2.954	2.844	2.707	2.763	2.754	2.696	2.675	2.642	2.613	2.586	2.565	2.544
Exhaust CO	32.643	36.777	38.409	39.643	33.031	28.261	25.750	22.586	19.337	18.034	17.810	16.522	15.873	15.387	14.940	14.565	14.239	13.792	13.580
Exhaust NOx	1.010	1.114	1.174	1.218	1.071	0.944	0.901	0.803	0.786	0.775	0.789	0.752	0.749	0.743	0.738	0.733	0.729	0.722	0.719
Exhaust PM2.5	0.041	0.041	0.039	0.038	0.033	0.030	0.027	0.026	0.026	0.025	0.026	0.025	0.025	0.025	0.025	0.025	0.025	0.024	0.024
Brakewear PM2.5	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Tirewear PM2.5	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
DIESEL																			
Light-duty vehicles																			
Total HC	2.919	2.812	2.504	2.288	2.126	1.915	1.649	1.567	1.513	1.282	0.939	0.666	0.497	0.361	0.270	0.232	0.202	0.192	0.183
Exhaust CO	47.204	44.202	38.235	34.422	31.587	28.016	23.926	22.682	21.712	18.418	13.604	9.512	7.052	4.998	3.770	3.205	2.876	2.761	2.663
Exhaust NOx	2.906	2.644	2.224	2.020	1.876	1.691	1.484	1.449	1.421	1.256	1.008	0.763	0.580	0.439	0.320	0.248	0.199	0.174	0.153
Exhaust PM2.5	0.066	0.067	0.065	0.062	0.058	0.052	0.043	0.041	0.039	0.032	0.023	0.016	0.012	0.009	0.006	0.005	0.004	0.004	0.004
Brakewear PM2.5	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Tirewear PM2.5	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Light-duty trucks																			
Total HC	0.800	0.761	0.725	0.756	0.747	0.784	0.776	0.760	0.734	0.746	0.754	0.726	0.652	0.583	0.504	0.448	0.399	0.358	0.324
Exhaust CO	9.780	8.526	7.923	7.724	7.419	7.435	7.145	7.003	6.631	6.656	6.633	6.456	5.753	5.024	4.287	3.763	3.344	3.018	2.754
Exhaust NOx	4.503	4.537	4.391	4.096	3.863	3.695	3.587	3.391	3.202	3.129	3.011	2.851	2.564	2.303	2.061	1.834	1.640	1.473	1.321
Exhaust PM2.5	0.235	0.228	0.210	0.204	0.194	0.193	0.187	0.172	0.157	0.154	0.153	0.142	0.123	0.107	0.088	0.075	0.063	0.053	0.045
Brakewear PM2.5	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Tirewear PM2.5	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Heavy-duty vehicles																			
Total HC	1.172	1.166	1.159	1.170	1.201	1.193	1.171	1.092	1.064	1.059	1.070	1.031	0.973	0.917	0.835	0.781	0.732	0.687	0.645
Exhaust CO	4.754	4.746	4.735	4.735	4.850	4.735	4.534	4.085	3.908	3.848	3.851	3.651	3.392	3.151	2.904	2.570	2.361	2.171	1.994
Exhaust NOx	23.945	22.919	21.851	20.221	18.909	17.419	15.931	14.417	13.585	12.956	12.461	11.535	10.532	9.665	8.812	8.008	7.287	6.612	5.971
Exhaust PM2.5	1.068	1.010	0.946	0.898	0.869	0.826	0.772	0.660	0.614	0.583	0.564	0.512	0.462	0.418	0.357	0.317	0.280	0.246	0.213
Brakewear PM2.5	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.013	0.013	0.014	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Tirewear PM2.5	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Average Emissions Per Vehicle, Gasoline and Diesel Fleet																			
Total HC	1.544	1.464	1.340	1.271	1.174	1.094	1.044	0.989	0.970	0.945	0.918	0.905	0.815	0.745	0.669	0.603	0.542	0.474	0.430
Exhaust CO	16.106	15.057	13.710	12.921	11.869	11.058	10.619	10.081	9.496	9.114	8.844	8.714	7.947	7.340	6.699	6.105	5.604	5.084	4.729
Exhaust NOx	3.898	3.774	3.515	3.331	3.020	2.770	2.661	2.461	2.415	2.268	2.212	2.053	1.827	1.678	1.519	1.375	1.244	1.040	0.929
Exhaust PM2.5	0.124	0.119	0.110	0.106	0.099	0.094	0.091	0.080	0.077	0.070	0.068	0.061	0.053	0.049	0.044	0.040	0.036	0.032	0.029
Brakewear PM2.5	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Tirewear PM2.5	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.002	0.002	0.002	0.002	0.002

KEY: CO = carbon monoxide; HC = hydrocarbons; NOx = nitrogen oxides; PM2.5 = particulate matter with diameter <= 2.5 micrometers.

NOTES

Estimates are by calendar year. Vehicles types are defined as follows: light-duty vehicles (passenger cars); light-duty trucks (two axle, four tire); heavy-duty vehicles (trucks with more than two axles or four tires); motorcycle (highway only).

Emissions factors are averages based on the national average age distributions, vehicle activity (speeds, operating modes, vehicle-miles traveled fractions, starts and idling), temperatures, inspection/maintenance and antitampering programs, and average gasoline fuel properties in that calender year. Total HC includes exhaust and evaporative emissions.

Average emissions per vehicle rates assume a fleet comprised exclusively of gasoline and diesel vehicles. Gasoline-electric hybrids are accounted for in the values for gasoline vehicles.

This table was generated using MOVES2014a, the U.S. Environmental Protection Agency's (EPA) mobile source emissions factor model. More information on MOVES is available at /www.epa.gov/moves.

Data for this update are based on new categories and are not comparable to previous releases. Changes retroactively applied to the data for previous years to provide consistent comparisons over time.

SOURCE

U.S. Environmental Protection Agency, Office of Transportation and Air Quality, personal communication, Apr. 6, 2018.