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

February 2020

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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

Submitted to:

Secretary, Tenders Committee
National Infrastructure Development Company Limited
The Atrium, Don Miguel Road Extension, San Juan
Trinidad and Tobago

REVISIONS TO THE DRAFT SIA REPORT BASED ON THE 2ND REQUEST FOR CLARIFICATION OF FURTHER INFORMATION BY THE ENVIRONMENTAL MANAGEMENT AUTHORITY (DEC 11, 2019)

No.	Question (EMA's 2nd request for Clarification- Appendix 1 SIA)	Section and Page No. (Revised SIA Report)	Revised Text/Fig. (Revised SIA Report)
	Executive Summary		
1)	At Page vii, it states that the area of study consists of an alignment of several communities on the Diego Martin and Western Main Road, and the wider municipality of Diego Martin with the limits defined as follows: • The northern limit is the Morne Coco Road and the Four Roads Intersection; The southern limit is the coastline from Westmoorings to Cocorite; • The eastern limit is the Cocorite section of the Western Main Road, outside of Peake's Marine and communities of Fort George; • The western limit is the Western Main Road at the Diego Martin River. Please note that Peake's Marine is located in Carenage. Therefore, please clarify the limits of the proposed project.	**Executive Summary, Pg. ix**	The area of study consists of an alignment of several communities on the Diego Martin and Western Main Road in the immediate study area, and the wider Municipality of Diego Martin with the limits defined as follows: • The northern limit of the immediate study area is the Morne Coco Road and the Four Roads Intersection. • The southern limit is the coastline from Westmoorings to Cocorite. • The eastern limit is the Cocorite section of the Western Main Road, outside of West Shore Medical Private Hospital. • The western limit is the Western Main Road at the Diego Martin River.
	Section 1 Introduction		
1)	At Page 1, it states that the project is fourfold, however, in the Executive Summary it states that the project is fivefold. Please clarify.	Section 1 Introduction, Pg. 1	The purpose of the Overpass is fivefold. It is designed to: 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;

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			3. Provide access to new and proposed developments in the vicinity of the intersection of the Diego Martin Highway and the Western Main Road; 4. Improve road safety and network efficiency by eliminating unsafe turning movements and circuitous movements, like the bowtie on the Western Main Road; and 5. Provide a comprehensive upgrade of the drainage infrastructure of the lower Diego Martin River Valley.
Section 2 Definition of the Study Area			
1)	Section 2.1.1 at Page 3 states that the Municipality is divided along political (electoral) boundaries into eight (8) Electoral Districts. Please note that the list provided ten (10) Electoral Districts. Please indicate the correct number of Electoral Districts.	**Section 2.1.1 DESCRIPTION OF THE WIDER STUDY AREA, Pg. 3**	The Municipality is divided along political (electoral) boundaries into ten Electoral Districts, namely: 1. Chaguaramas/Pt. Cumana; 2. Morne Coco/Alyce Glen; 3. Belle Vue/Boissiere #1; 4. Petit Valley/Cocorite; 5. Moka/Boissierre #2; 6. St. Lucien/Cameron Hill; 7. Bagatelle/Blue Basin; 8. Diamond Vale; 9. Covigne/Richplain; and 10. Glencoe/Goodwood/La Puerta
2)	Section 2.1.2 and 2.1.2.1 at Page 5 states that the study area is delimited to roughly one kilometre from the site of the proposed Overpass and that the eastern limit is the Cocorite Section of the Western Main Road, outside Peake's Marine and the communities of Fort George. Please note that Peake's Marine and the communities of Fort	**Section 2.1.2 DESCRIPTION OF IMMEDIATE STUDY AREA, Pg. 5**	The immediate study area is defined as follows: • **Northern Limit:** Morne Coco Road at the Four Roads intersection; • **Southern Limit:** Coastline from Westmoorings to Cocorite;

<table>
<tr><th>No.</th><th>Question
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(Revised SIA Report)</th></tr>
<tr><td></td><td>George is not one kilometre from the proposed Overpass. Therefore, please provide the updated limits of the study area.</td><td></td><td>Eastern limit: Cocorite section of Western Main Road, outside West Shore Medical Private Hospital; and
Western limit: Western Main Road at Diego Martin River.</td></tr>
<tr><td>3)</td><td>Table 2.1 at Page 6, defined the surrounding receptors in the immediate study area. Please note that there are additional receptors such as but not limited to the preschool within Powder Magazine, gas stations and Stuart Brothers, were not identified. Please provide a revised listing of the receptors within the immediate study area.</td><td>Section 2.1.2.1 RATIONALE USED FOR THE DELINEATION OF THE STUDY AREA, Pg. 5</td><td>
<table>
<tr><td>Residential Developments</td><td>Powder Magazine Phase 2
Victoria Keyes
Four Roads Community
Victoria Gardens
Victoria Villas
Chaconia Crescent
Spanish Court
West Moorings</td></tr>
<tr><td>Businesses</td><td>West Mall
SuperPharm
KFC
Guardian Holdings Limited
Trinidad and Tobago Chamber of Industry and Commerce
Starlite Shopping Plaza
Massy Stores, Westmall
Life Fitness Club
Domino's
NP Quik Shoppe Plus Service Station
3x Petroserv Ltd
Stuart Brothers W.I. Ltd
King Signs
Sunnyview Vetcare Services
GAK Electrical and Plumbing</td></tr>
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<tr><td></td><td></td><td></td><td>
<table>
<tr><td>Educational Institutions</td><td>Four Roads Government Primary School
Busby's Preparatory School
The International School of Port of Spain</td></tr>
<tr><td>Sensitive Receptors</td><td>Westshore Medical Private Hospital
The Community Hospital of Seventh Day Adventists.</td></tr>
<tr><td>Sporting Facilities</td><td>Paragon Sport's Club</td></tr>
<tr><td>Religious Institutions</td><td>Kingdom Hall of Jehovah's Witnesses</td></tr>
<tr><td>Utilities</td><td>T&TEC Substation, Westmoorings</td></tr>
<tr><td>Emergency/Rescue Facilities</td><td>Four Roads Police Station
Four Roads Fire Station</td></tr>
<tr><td>Adjacent Developments</td><td>Diego Martin Regional Corporation Administrative Complex (construction in progress)
West Park Savannah</td></tr>
</table>
</td></tr>
<tr><td>4)</td><td>Section 2.2 at Page 9, states that there is approximately 1800 m of road construction for the four lane roadway proposed for Connector Road and the single lane connector loop road. In response to Question 3 of the RFI under section 3.2, the total length is 1.2 km. Please clarify the length of the proposed road.</td><td>Section 2.2 DESCRIPTION OF PROJECT | VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED WORKS, Pg. 8</td><td>Length of the proposed road, including the construction of new roads and improvements to existing roads, is 2.5 km.</td></tr>
<tr><td colspan="4">Section 3 Socio-Cultural and Economic Baseline Assessment</td></tr>
<tr><td>1)</td><td>Based on Table 3.3 at Page 33 entitled Population Projections for Communities in the Diego Martin</td><td>Table 3.3: Population Projections for</td><td>Table 3.3 Revised pgs 33 - 34</td></tr>
</table>

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	Region, it was stated that it communities that have been built out since the last census was not included. This suggests that Victoria Keyes and Chaconia Crescent were not included in this projection. As such, please provide a revised table based on current and projected communities for the Diego Martin Region, given the five-fold purpose of the Overpass and road infrastructure as stated in the Executive Summary of the Social Impact Assessment Report.	**Communities in the Diego Martin Region Pg 33**	
2)	Figures 3.5-3.7 at Pages 35-37 showed in decrease in population from 2021, 2031 and 2041. Please provide a justification for this decrease in population given that communities have been built out since the last census.	**Section 3.3.1.2.4 POPULATION PROJECTION RESULTS: FIVE-YEAR INTERVALS 2016-2041 pg 31**	Between 8th June 2000 and the 9th January 2011, the total population of all of the selected communities exhibited a decline which is projected to have continued into 2016. Interestingly, the overall population for the selected communities is projected to remain virtually unchanged between 2011 and 2041 except for marginal fluctuations. Across the sexes, more interesting trajectories emerge and are characterized by declining population sizes in the case of the male population and increasing population sizes. Within most of the communities, total population sizes have been projected to change marginally between 2011 and 2041. However, noteworthy population size increases are projected for north Diego Martin communities such as Blue Basin and Bagatelle. On the contrary, total population size declines are more likely to be evident in some of those communities characterized by greater levels of household affluence.

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			The communities with the greatest levels of affluence in Diego Martin are likely to have greater proportions of their respective populations in older age groups when compared to other communities. This means that there are likely to be smaller proportions of younger persons, in particular, women in peak childbearing age groups. This is further exacerbated by the fact that the relatively fewer younger women in such communities are more likely to have attained educational and labour force profiles that render them less likely to exhibit fertility levels that are above replacement level. This is inimical to a process that will contribute to noteworthy gains, if any, in population sizes in such communities. The historical affluence of these communities may also be associated with somewhat greater longevity of life of their residents. To this end, the higher concentration of older persons well beyond retirement age indicates that these populations are likely to experience further threats to population growth due to inherent higher risks of mortality. For these reasons, gains in population size in the most affluent communities seem much less likely to be realized during the 2020s and 2030s. Moreover, real estate market values in these communities also place limitations on the extent to which in-migration is likely attract population groups with high fertility attributes albeit in a global environment that is characterized by fertility levels that are below replacement level.

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3)	Figure 3.12 at Page 45, entitled Business Establishments in Diego Martin by Type of Ownership. Please note that the information submitted in not clear. Please resubmit.	**Section 3.3.3 LOCAL ECONOMY - MAJOR ECONOMIC ACTIVITY, Pg. 44**	Figure 3.12 illustrates businesses registered in the Diego Martin Region by Legal Status. Of the registered businesses which operate in Diego Martin, the vast majority (95%) are Private Limited Liability Companies, followed by Sole Proprietorship. The chart also shows that the private sector, which comprises of corporate enterprise and individual proprietorships, had the highest percentage. In comparison to other business establishments in the Diego Martin area, there are few government offices present in the study area.
4)	Section 3.4.6.3 makes reference to Figure 3.20 at Page 64. Please note that the description and the figure do not correspond. Please rectify.	**Section 3.4.6.3 COMMUNITY CENTRES AND RECREATIONAL FACILITIES, Pg. 59**	Description adjusted. Community Centres in the populated area of the municipality are limited (Figure 3.20). There also exists a wide cross section of Recreational Facilities exist in the municipality (Figure 3.21) for swimming, basketball, football and netball, but many residents do journey to neighbouring Port-of-Spain for outdoor sporting activity and recreation. However, in the Chaguaramas Peninsula, the natural environment offers possibilities for recreation for individuals and families – sea bathing, fishing, golf, hiking and riding.

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5)	Section 3.4.6.5 makes reference to Figure 3.21 at Page 65. Please note that the description and the figure do not correspond. Please rectify.	**Section 3.4.6.4 HUMAN RECEPTORS IN THE DIEGO MARTIN MUNICIPALITY, Pg. 59**	Section adjusted to reference the appropriate Figure. As part of its remit, the regional corporation is charged with the responsibility of the development of a disaster management system for the municipality guided by the National Disaster Management Policy and the Ministry of Local Government Disaster Management Policy. A number of emergency shelters are available for use in times of crisis (Figure 3.23).
6)	Section 3.4.6.7 at Page 6.11 makes reference to Figure 3.22. No description was provided. Please provide.	**N/A**	Section 3.4.6.7 removed.
7)	Section 3.5 at Page 70 makes reference to a Figure with no number. Please provide the Figure number.	**Section 3.5 VEHICULAR OWNERSHIP AND TRAFFIC, Pg. 69**	Since the decommissioning of the rail system in Trinidad during the mid-1960's, constant increasing demand for travel has been accommodated by the intensive development of a highway network linking east and west as well as north and south communities both in Trinidad and in Tobago (Ministry of Planning and Development of Trinidad and Tobago 2015). Even so, there is significant congestion due to high traffic volumes in relation to road capacity, poor secondary roads in need of repair, low connectivity and restricted egress. The situation in the municipality of Diego Martin is no different. **Figure 3.26** provides information on vehicle ownership in the Municipality.
8)	Section 3.7.1.2 at Page 78 makes reference to the Baseline Assessment of Air in Diego Martin. It states that an air quality exercise was conducted at four locations within the study area for the period February 11, 2015 to March 08, 2015 by	**Section 3.7.1.2 BASELINE AMBIENT AIR QUALITY MONITORING AND METEOROLOGICAL**	Based on issues raised by stakeholders at public consultations for the project held in July and September 2019, in November 2019, NIDCO engaged the services of Ecoengineering Consultants Limited to undertake new testing of air quality to update baseline measurements.

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	Ecoengineering (Figure 3.30). Please note that not all of the locations stated in the report fall within the study area and no rationale was provided to demonstrate how the data outside the study area was applied to be representative of the study area. Additionally, given the increase in road traffic within the study area as well as other ongoing and proposed construction activities, the data may not be representative of current air emissions. Please resubmit updated baseline data for air emissions within the study area or provide a discussion on how the historical data was used to accurately represent the present conditions within the study area. Additionally Figure 3.30 is not clear. Please resubmit a legible Figure for 3.30.	**DATA COLLECTION IN DIEGO MARTIN, Pg. 77**	Sampling for the wet season was done for the period November 14th to November 27th, 2019. Additionally, sampling was done during the dry season for the period January 13th to February 21st 2020. The subsections that follow document the monitoring locations, methodology and the ambient air quality monitoring results from both wet and dry seasons. The dry and wet season monitoring results can be found in Appendices F and G respectively. Figure 3.30 and Figure 3.31 depict the Air Quality Monitoring Locations November 2019 and January 2020.
9)	Section 3.7.2.2 at Page 104 makes reference to the Baseline Assessment of Noise in Diego Martin. It states that a noise quality exercise was conducted at four locations within the study area for the period February 11, 2015 to March 08, 2015 by Ecoengineering. Please note that not all of the locations stated in the report fall within the study area and no rationale was provided to demonstrate how the data outside the study area was applicable. Additionally, given the other ongoing and proposed construction activities, the data may not be representative of current noise levels. Please resubmit updated baseline data/assessment for noise levels within the study area.	**Section 3.7.2.2 BASELINE ASSESSMENT OF NOISE IN DIEGO MARTIN, Pg. 111**	Ecoengineering Consultants Limited (Ecoengineering) was also contracted by the National Infrastructure Development Company Limited (NIDCO) to conduct Baseline Noise Monitoring for the construction of a vehicular overpass in the vicinity of Powder Magazine. The Report was prepared in accordance with the Noise Pollution Control Rules (NPCR) reporting requirements. Noise monitoring was conducted by Ecoengineering Consultants Limited at the same five (5) locations as the air quality monitoring locations (Figure 3.52). The dates of the noise monitoring were as follows: • November 17, 2019 (weekend); and • November 21, 2019 (weekday). Noise monitoring was conducted by Ecoengineering Consultants Limited at the same five (5) locations as the

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			air quality monitoring locations (see Table 3.20 and Figure 3.53). Photographs 6 to 10 show noise monitoring at each of the five locations.
Section 4 Analysis of Potential Impacts			
1)	Section 4.5.3 at Page 120 states that of the five residential communities in the vicinity of the Overpass, two are at risk of long term impacts that can be irreversible. Powder Magazine Phase II and Victoria Keyes might experience a decline in air quality, and an increase noise pollution, from the Overpass and a change in land use in their immediate vicinity. It was further stated that the mitigation measures of planting of trees and shrubbery will assist with reduction of air pollutants and noise levels. However, given that the Overpass is significantly less than 300 m away (which was the suggested distance for safety from pollution associated with vehicular emissions stated at Page 143 of the Social Impact Assessment Report) from residential developments, approximately eight (8) metres in height and with the loop between the Victoria Keyes and Powder Magazine developments, the EMA is not satisfied that the basis for the mitigation measures are technically sound. As such, the Applicant is required to conduct air dispersion modelling using a refined model to predict the concentration levels and dispersion of temporal variability of traffic-related air pollutants and to ascertain the defined zone(s) of impact. The	**Section 5.1.3 AIR DISPERSION MODELLING, Pg 149**	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). Baseline conditions (Diego Martin Highway between Morne Coco and Western Main Road) indicated annual average NOx concentrations were over the annual NO2 limit of 40 µg/m3. 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

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	worst case concentration of air pollutants as well as the frequency of such air pollutants within the study area and zone(s) of impact must be provided. The predicted concentrations must be evaluated against the Air Pollution Rules 2014. The model must also consider peak traffic times and terrain. A full description of the modelling system used, model validation, justification on input parameters and limitations must be provided. Additionally, all input and output data files used in the model must be provided to the EMA as a soft copy. It is expected that the model will be used to evaluate any proposed mitigation measures, including any re-design of the road infrastructure, in reducing the near-road exposures and their associated adverse health effects on the surrounding receptors.		µg/m3. 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 NO2 limit. 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). 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 NO2 (EMA Air Pollution Rules 2014. A detailed discussion the potential health impacts and an analysis of the mitigation measures can be found in Appendix J Air Quality Dispersion Modelling for the

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			Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements.
Section 5 Social Management			
1)	Section 5.2.2 at Page 132 states that servicing of equipment on site should be done in a designated area and spill kits be available to contain any impact of spills. Spent lubricants are to be collected offsite for disposal. Contaminated soil to be removed from site for remediation elsewhere. Please confirm whether equipment will be serviced on site, if it will be, please illustrate on an appropriate map.	**Section 5.2.2 MANAGEMENT PLAN DURING CONSTRUCTION, Pg. 152**	Figure 2.10 depicts the proposed site layout for the project. Only minor servicing on vehicles and equipment is to be performed on site on the designated area. Major servicing is to be outsourced at specialized shops. Servicing of equipment on site will be done in a designated area and spill kits will be available to contain any impact of spills. Spent lubricants are to be collected for off-site disposal. Contaminated soil is to be removed from site for remediation elsewhere. No discharge from concrete washings is to be allowed into surface drains. Arrangements should be put in place to treat with disposal of materials not fit for use like:
Appendix A- Stakeholder Engagement Plan			
1)	Section 1.6, Matrix 1 at Pages 12-16, the following is stated repeatedly: 'SIA Report to be placed at strategic locations for a statutory period of 30 days to receive public comments (responsibility of the EMA).' Please state the basis for this statement and inclusion in the Stakeholder Engagement Plan. The onus is on the Applicant to ensure that the results of the Social Impact Assessment is communicated to the relevant stakeholders. The EMA's responsibility, outside of an Environmental Impact Assessment	**Appendix A, Matrix 1, Pg. 12**	**SIA Report** was available for viewing at the Diego Martin Regional Corporation (DMRC) located at 17-18 Diego Martin Main Road, 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 to receive comments.

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	(EIA) is to ensure that any reports submitted via the CEC Process is lodged at the National Register for access to any member of the public. The included statement gives a false impression to the stakeholders consulted during the SIA Process on the availability of the SIA Report and their ability to provide feedback. Alternatively, the Applicant can lodge the SIA Report at locations within the study area and inform the stakeholders where it can be accessed and timeframe for providing comments. Further, the chosen method for sharing the SIA Report must be communicated to the EMA, including any timeframe provided to the stakeholder to provide their comments. As such, please ensure that the stakeholders that were consulted are communicated as to the location of the submitted SIA Report (i.e. at the EMA's National Register located at #8 Elizabeth Street, St. Clair).		
Appendix B- Stakeholder Engagement Plan			
1)	Page 307, Step 1 of the Grievance Redress Plan states that one of the channels to receive complaints will be via the Community Relations Officer (CRO). While a telephone number was another of the channels identified, it was not clear as to whether this is the number through which the CRO can be contacted or whether another person will be taking those calls. With respect to the CRO, it must be clearly identified and communicated to the stakeholders whether this person will be	**Section 8: STEPS OF THE GRIEVANCE REDRESS MECHANISM, Section 2.1.1.1, Fig 2.2 pg 5. This information can be located in Appendix B of the document.**	**The third box in Figure 2.2 now reads:** The CRO will be located at National Infrastructure Development Company Limited (NIDCO), The Atrium, Don Miguel Road Extension, San Juan. Telephone contact for the CRO (Office hours between the hours of 8:00am and 4:00pm): 1 (868) 674-8042 & 638-8236

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	available onsite, where onsite and the hours the CRO will be available to meet with a complainant. Please clarify.		

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EXECUTIVE SUMMARY

This Report presents the Social Impact Assessment on the Construction of a Vehicular Overpass in the vicinity of Powder Magazine and Related Road Improvements along the Diego Martin Highway, Diego Martin (Application Reference: CEC5500/2018). The Overpass and Ancillary Works are sponsored by the Ministry of Works and Transport in its efforts to improve the infrastructure of the country in the keeping with Vision 2030.

The purpose of the Overpass is fivefold and as it is designed to:

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;
4. Improve road safety and network efficiency by eliminating unsafe turning movements and circuitous movements, like the bowtie on the Western Main Road; and
5. Provide a comprehensive upgrade of the drainage infrastructure of the lower Diego Martin River Valley.

The area of study consists of an alignment of several communities on the Diego Martin and Western Main Road in the immediate study area, and the wider Municipality of Diego Martin. The northern limit of the immediate study area is the Morne Coco Road and the Four Roads Intersection. The southern limit is the coastline from Westmoorings to Cocorite. The eastern limit is the Cocorite section of the Western Main Road, outside of West Shore Medical Private Hospital . The western limit is the Western Main Road at the Diego Martin River. It embraces an area where there tends to be major congestion as a huge flow of traffic funnels out of the Diego Martin Valley on a morning and squeezes back into its suburbs on an afternoon into a dormitory community.

Diego Martin has a population with high vehicle ownership. Notwithstanding the slight decline in population between the two last censuses, the number of households has grown, signalling the expansion of a middle- and upper-class residential community living in some of the higher end multiple residences constructed in the present decade. Much more than 50 percent of households have at least one vehicle for private use in the municipality.

Another important feature of the municipality is that while the public sector is very small as a source of employment in the municipality, much less than 10 percent, over 30 percent of employees worked in the public sector. This means that most have to leave the municipality on a daily basis to places of work. The community had a higher than average labour force participation rate and there is a much larger percentage than the national average in the higher educational brackets.

The relief of traffic congestion is part of the overall policy of the Government to improve the infrastructure and, in so doing, to raise productivity in the country. However, the construction of the Overpass in the location identified dictates that another major issue be confronted, namely heavy flooding which this area has experienced in recent years, in part because of the rapid expansion of built construction and a drainage infrastructure which is totally inadequate to present requirements.

The assessment of this infrastructure project required consultation with the primary stakeholders in the area where the overpass is to be constructed and the drainage works are to be undertaken. These consultations, focus group meetings and interviews were conducted to source their views.

Secondary data- demographic, socio-economic and technical - provided the base for analysis of the probable impact of the infrastructure project.

Discussions in the public consultations and other fora suggest that there is recognition of the need to undertake an important intervention like the overpass. However, the communities where it is proposed that it be built are concerned lest they succumb to the effects of air pollution, with the more vulnerable – babies, children and the elderly being particularly at risk. Although there have been no recent data collected at the site of these communities, the increase in traffic in recent years would have already contributed to a rise in air pollution.

Shairsingh, Jeong, and Evans (2019) point to high levels of black carbon in air in roadways in Trinidad, a feature characteristic of high usage of diesel. Data routinely collected by the EMA in Trinidad at sites on heavily congested Beetham Highway and in Chaguanas on the Mulchan Seuchan Road show that in the last two years, there were periods when the air quality index rose to danger zone, creating difficulty to people with respiratory complaints. However, the precipitating factors could be attributed to the presence of Sahara Dust, a factor also identified in the academic paper. The building of any facility where vehicles would travel will result in emissions given the use of internal combustion engines in the country.

The report examines the possibilities for controlling impacts especially of air and noise pollution during construction and post construction. A number of other impacts are noted and mitigating measures identified for:

- Perceived possibility of increase in crime;
- Closure of Bowtie on Western Main Road;
- Increased congestion in other areas – Columbus Boulevard Intersection;
- Air Pollution during construction;
- Noise pollution during construction;
- Increased run-off from Overpass and ancillary works; and
- Air and noise pollution post construction.

It is anticipated that the completion of the vehicular overpass will contribute to increased productivity as large numbers experienced reduced time allocated to travelling and more time available for productive work. There is also the additional employment in the short to medium term from two large projects in the area, namely:

- The Overpass Project and the implementation of the comprehensive drainage plan for the area; and
- The building of the Diego Martin Regional Corporation Complex;

The risks to health from pollution cannot be avoided. However, these can be mitigated with monitoring the levels in the vicinity of the Overpass at Powder Magazine Phase Two and by the instituting of regular checks on vehicles on the road for levels of emission and other measures that will be detailed herein. There is, of course, the matter of a major societal response in the quality of fuel, both diesel and gasoline, that are allowed to be used in vehicles on the roads in Trinidad and Tobago.

1 INTRODUCTION

This socio-cultural baseline report forms part of the Social Impact Assessment (SIA) for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements (Application Reference: CEC 5500/2018). The terms of reference for the Social Impact Assessment of the proposed project calls for a description of the baseline socio-cultural characteristics of the study area. The baseline should consist of information on the socio-demographic characteristics of the communities in the study area including:

- Present and projected population size and population growth rates;
- Socio-economic characteristics of the resident and business populations by age, sex, income, educational attainment, religion, etc.;
- Economic activity and employment patterns;
- Skills based of the population;
- Employment and labour market patterns;
- Capability of the population to participate in project employment opportunities;
- Publicly accessible emergency facilities located within or in proximity to the study area;
- Land use policy for the project area and future development plans;
- Identification of resource users;
- Identification of known archaeological and cultural resources within the study area;
- Identification of recreational areas and facilities; and
- Customs, aspiration and attitudes of the acceptability of the proposed project to residents, resource users and other stakeholders.

The report provides the results of the review of relevant secondary data and an analysis of current conditions in the affected communities as described by the potentially affected communities and other stakeholders. The Socio-cultural study also analyses the implications of the proposed vehicular overpass to living conditions within the immediate and wider community from the perspective of community stakeholders.

The purpose of the Overpass is fivefold: it is designed to:

6. Improve the transportation network in order to accommodate future growth and development in the Western Peninsula;
7. Improve the connectivity for the commuters from the Diego Martin Valley heading into the Western Peninsula;
8. Provide access to new and proposed developments in the vicinity of the intersection of the Diego Martin Highway and the Western Main Road;
9. Improve road safety and network efficiency by eliminating unsafe turning movements and circuitous movements, like the bowtie on the Western Main Road; and
10. Provide a comprehensive upgrade of the drainage infrastructure of the lower Diego Martin River Valley.

1.1 STRUCTURE OF THE REPORT

The report consists of eight sections. This, the first section, introduces the report focusing on the boundaries of the study area and the communities that are likely to be affected by the proposed project.

Section 1	Introduction
Section 2	Definition of the Study Area
Section 3	Socio-Cultural and Economic Baseline Assessment
Section 4	Analysis of Potential Impacts
Section 5	Mitigation Strategy and Management Plan
Section 6	Monitoring and Intervention Strategy
Section 7	Conclusion
Appendices	

2 DEFINITION OF THE STUDY AREA

2.1 BOUNDARIES OF THE STUDY AREA

2.1.1 DESCRIPTION OF THE WIDER STUDY AREA

The Diego Martin Regional Corporation is situated in the north west of the island of Trinidad and includes the Chaguaramas peninsula in the west and intensely urbanised valleys of the Northern Range leading into the Capital City of Port of Spain. The municipality is an administrative district that encompasses a land area of 125sq. km. The Diego Martin Regional Corporation shares its eastern boundary with the Port of Spain City Corporation and the San Juan-Laventille Regional Corporation. Diego Martin's settlement structure is characterised by a series of densely settled north-south valleys located north of the City of Port of Spain and west of the San Juan-Laventille Regional Corporation; hillside development on the western periphery of the City of Port of Spain; coastal settlements along its southern edge and low density rural settlement on the north coast.

The Chaguaramas Peninsula, known worldwide for its natural beauty, dominates the western portion of the Municipality. The Diego Martin Valley extends for approximately eight kilometres. It is comprised of a number of settlement areas and these include River Estate, Green Hill, Richplain, Diamond Vale, Blue Range, Sierra Leone, La Puerta and Four Roads. Petit Valley extends from the Four Roads area, northeast through the hills of the Northern Range. The Western Main Road provides access to the valley and further west to Carenage and the Morne Coco Road forms a link with Maraval to the east via Petit Valley and Saddle Road. The southern end of the Diego Martin Valley that opens to the coast includes the communities of Powder Magazine, Victoria Keyes, Victoria Gardens and Westmoorings. A series of settlements along the lower foothills of the Northern Range and along the narrow coastal plain to Chaguaramas include Goodwood Park/Newbury Hill, Shorelands, Bayshore, Glencoe, La Horquette Valley, Point Cumana, L'Anse Mitan, Sea View Gardens and Carenage.

The Municipality is divided along political (electoral) boundaries into ten Electoral Districts, namely:

1. Chaguaramas/Pt. Cumana;
2. Morne Coco/Alyce Glen;
3. Belle Vue/Boissiere #1;
4. Petit Valley/Cocorite;
5. Moka/Boissierre #2;
6. St. Lucien/Cameron Hill;
7. Bagatelle/Blue Basin;
8. Diamond Vale;
9. Covigne/Richplain; and
10. Glencoe/Goodwood/La Puerta.

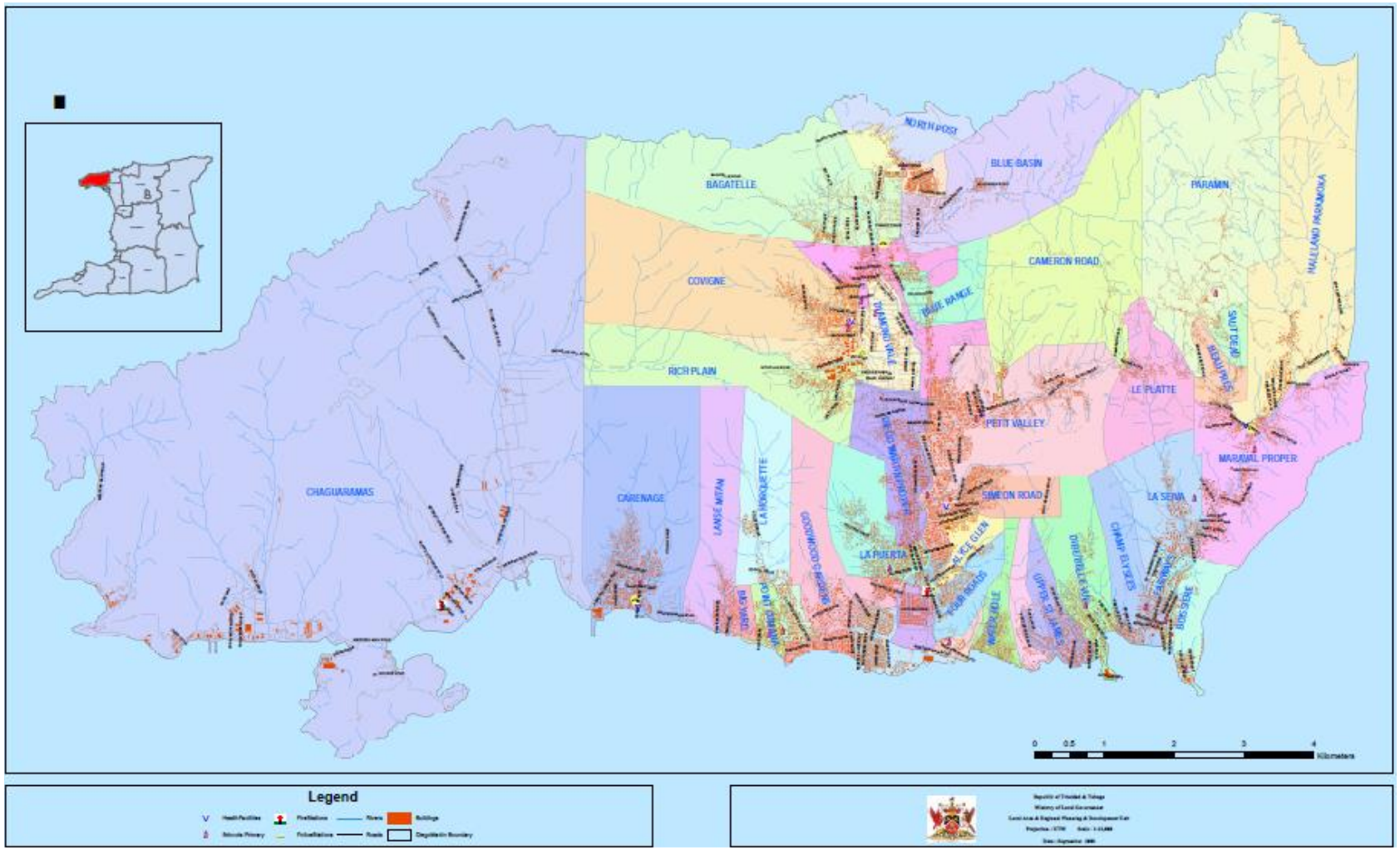


Figure 2.1: Map of the Communities of the Municipality of Diego Martin

2.1.2 DESCRIPTION OF IMMEDIATE STUDY AREA

The area under study consists of the immediate study area and wider Municipality of Diego Martin. The immediate study area includes the several communities along the existing alignment of the Diego Martin Highway (DMH) and Western Main Road (WMR) (Figure 2.3).

Figure 2.2: Location of the Proposed Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements

The immediate study area is defined as follows:

- **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 West Shore Medical Private Hospital; and
- **Western limit:** Western Main Road at Diego Martin River.

2.1.2.1 RATIONALE USED FOR THE DELINEATION OF THE STUDY AREA

The study area is delimited to roughly one kilometre from the site of the proposed Overpass. It embraces an area where there tends to be congestion as traffic funnels out of the Diego Martin Valley on a morning and returns into its suburbs on an afternoon, as burgesses return home. Figure 2.3 provides a frame of the location, with coordinates. Table 2.1 highlights the surrounding receptors that can be affected by noise and vibrations, air emissions, run-off from the site, including storm-water and sediment, spills, emergencies or other upset conditions, increased traffic.

Table 2.1: Surrounding Receptors in Immediate Study Area

Residential Developments	Powder Magazine Phase 2 Victoria Keyes Four Roads Community Victoria Gardens Victoria Villas Chaconia Crescent Spanish Court West Moorings
Businesses	West Mall SuperPharm KFC Guardian Holdings Limited Trinidad and Tobago Chamber of Industry and Commerce Starlite Shopping Plaza Massy Stores, Westmall Life Fitness Club Domino's NP Quik Shoppe Plus Service Station 3x Petroserv Ltd Stuart Brothers W.I. Ltd King Signs Sunnyview Vetcare Services GAK Electrical and Plumbing
Educational Institutions	Four Roads Government Primary School Busby's Preparatory School The International School of Port of Spain
Sensitive Receptors	Westshore Medical Private Hospital The Community Hospital of Seventh Day Adventists.
Sporting Facilities	Paragon Sport's Club
Religious Institutions	Kingdom Hall of Jehovah's Witnesses
Utilities	T&TEC Substation, Westmoorings
Emergency/Rescue Facilities	Four Roads Police Station Four Roads Fire Station
Adjacent Developments	Diego Martin Regional Corporation Administrative Complex (construction in progress) West Park Savannah

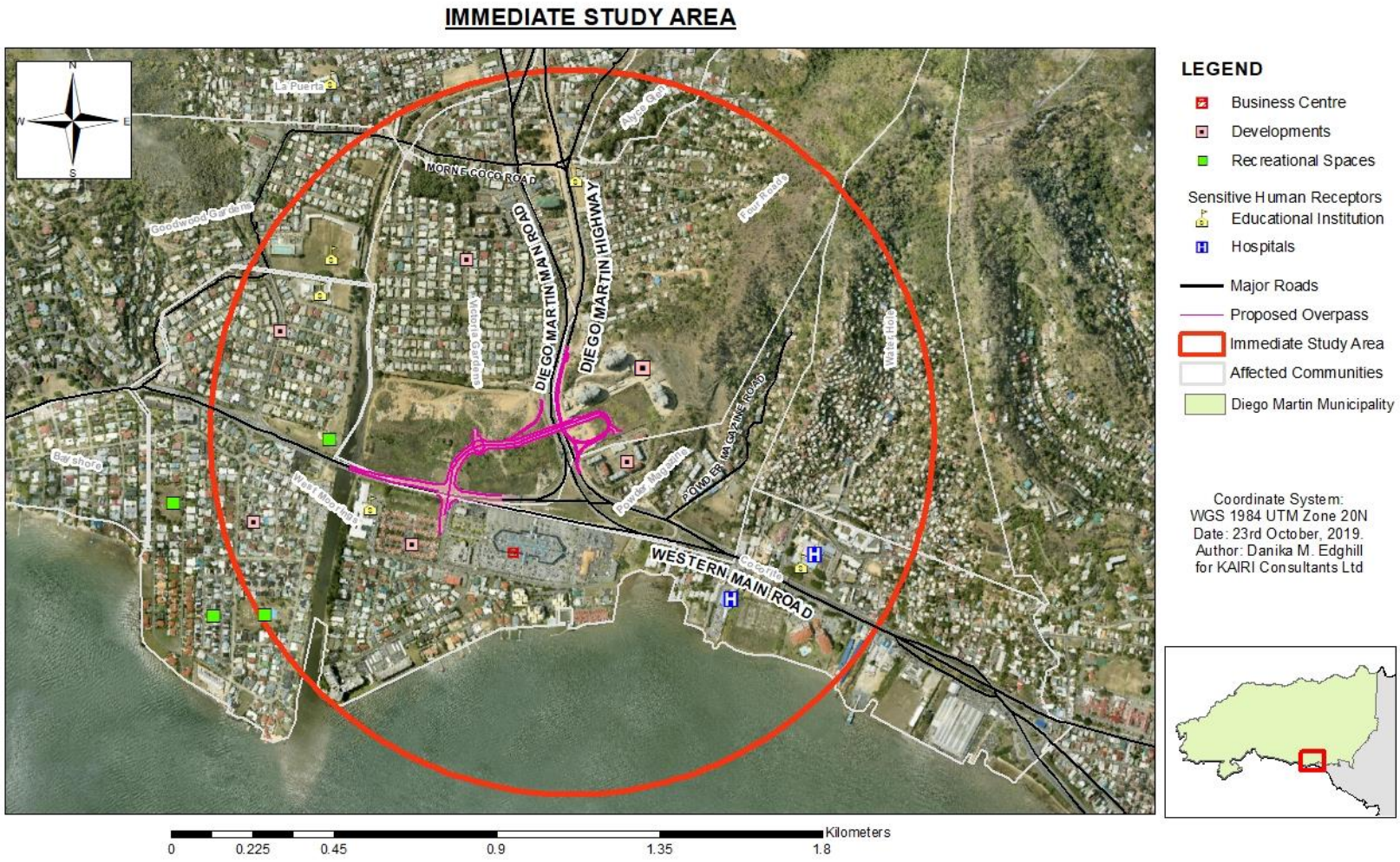


Figure 2.3: Study Limits for Social Impact Assessment (SIA) for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements

2.2 DESCRIPTION OF PROJECT | VEHICULAR OVERPASS IN THE VICINITY OF POWDER MAGAZINE AND RELATED WORKS

The original Diego Martin Highway was constructed in the 1960s when the population and vehicle ownership was significantly lower in Diego Martin. At the time of its construction, the intersection was well suited to accommodate the prevailing traffic. However, by the 1990s, it became apparent that the arrangements were untenable. 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 and Transport, through NIDCO engaged a consultant WSP Limited to undertake a feasibility study with the aim of eliminating conflicts and improving safety at the Diego Martin Highway, Western Main Road Intersection. During this study, public consultations were held with individual stakeholders and community groups to discuss concerns. These concerns were taken into consideration in coming up with alternatives for the conceptual designs. Conceptual designs were completed in 2018.

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 most recent design represents an iteration of earlier designs that have been more elaborate, and therefore more costly to achieve. The new option will also provide less disruption to the neighbouring residents in the operational phase. The purpose of the project is fourfold:

1. 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; and
4. To improve the road safety and the network efficiency by eliminating unsafe turning movements and circuitous movements.

The construction of a new vehicular overpass and other road works carded for this area are intended to improve the circulation and turning movements for traffic using the Diego Martin Highway (DMH) and Western Main Road (WMR) in the vicinity of Powder Magazine. It will also provide connectivity for other proposed developments in the area of Cocorite Farms (Trintoplan Consultants Limited 2019). The new four-lane overpass bridge will span the six-lane DMH along a new connector road (Connector Road) from the WMR and Columbus Boulevard Intersection to the DMH and Powder Magazine Access Road via the new Connector Loop Road. Related works comprise of drainage including a detention pond, and a retaining wall (Figure 2.8). There will also be road widening on the WMR and Columbus Boulevard where Connector Road starts at the intersection of WMR and Columbus Boulevard.

The principal features of the impending works are described below:

- **Earthworks** – The section of site carded for the proposed route of Connector Road and its roundabout would first have to be cleared of all existing vegetation, then graded to the desired level (Figure 2.7). Excavation to the required level is to be done in order for the pavement structure to be installed.
- **Drainage** – The drainage works would comprise of roadside drains, concrete culvert crossings, and detention ponds South of Victoria Gardens (5000 cubic metres) and South of Victoria Keyes (2400 cubic meters). The detention ponds will be used for retaining excess stormwater to control the discharge into the drainage system.

- **Vehicular Overpass Construction –** The foundation of the overpass would comprise of auger piles and pile-caps. The abutments will be of reinforced concrete. The superstructure would be supported on AASHTO IV Beams or equivalent with a reinforced concrete deck. The bridge would span the full width of the DMH. In addition to the construction of the new overpass, there will also be a new 75m long retaining wall at the eastern descent from the overpass and a roundabout along Connector Road.
- **Road Construction** – There is approximately 2.5 km of new road construction for the four-lane roadway proposed for Connector Road and the single lane connector Loop Road and for improvements to the existing road (Figure 2.4). Subsequent to the removal of existing material a new pavement structure is to be constructed. The pavement structure would consist of a capping layer, subbase, base course and standard asphalt. All road construction will be done to the levels and grades shown on the Contract Drawings. Road widening to facilitate additional lanes at the WMR-Columbus Boulevard Intersection would require new road pavement structure construction and lane markings.

The design by Trintoplan Consultants Limited is illustrated in Figure 2.5 below. Some elements of the WSP design have been utilised. However, the frontage road and retaining walls have been eliminated. The primary focus of the revised conceptual design was to make provisions for the missing turning movements and to provide access to other forthcoming developments, namely, the Diego Martin Regional Corporation Administrative complex and the proposed West Park Savannah.

The proposed overpass will enable five new vehicular movements (Figure 2.6) These include the following:

- **Eastbound to northbound** - Turn on connector road, through roundabout to ramp to north;
- **Eastbound to westbound** - on to connector road, around roundabout and back to traffic lights, and then back to the west on the WMR;
- **Westbound to East Bound** - Western Main Road to intersection with connector roads, right turn at the traffic light, around the roundabout and back on the Western Main Road;
- **Southbound to west bound** - exit the highway via the connector loop road, go over the bridge, around the roundabout to the traffic signalized intersection at the Western Main Road;
- **To Powder Magazine Phase 2 -** go over the bridge down the loop road to the new connector to the local road serving Powder Magazine Phase 2. A new vehicular access will be created on to the loop road for Powder Magazine to eliminate direct access on to Diego Martin Highway.

There are five key components to the revised design. The first component involves the construction of a fully signalized Intersection at Columbus Boulevard with the connector road (Figure 2.11). The Connector road will be a dual carriageway with 2 lanes in each direction, in addition to a left turning lane on the south bound at the intersection with Columbus Boulevard. On the Western Main Road, there is a dual carriageway (as exists now). In the east and west bound directions, there will be two right turn lanes at the intersection with the connector road. The Connector road will have a Roundabout to access the new developments - West Park Savannah and the Diego Martin Regional Corporation Admin Complex.

The second component involves the construction of a ramp off the Diego Martin Highway southbound which will connect to the Eastern connector loop road (Figure 2.12). This will join the connector road and cross the highway in an overpass structure. The loop road will have an entrance to Powder Magazine Phase 2 and an egress from Powder Magazine Phase 2 and Victoria Keyes. The third component will be the construction of a four lane Overpass Structure over the Diego Martin Highway and northbound ramp from the Western Connector Road (Figure 2.13). A cross section of the four-lane double span bridge over the Diego Martin Highway can be seen in Figure 2.14 below. One span is approximately 17.5m and the other is approximately 21.7m. The bridge will be supported on auger piles. As mentioned previously, the fifth major component of the proposed project is drainage (Figure 2.15 and Figure 2.16).

The drainage works will comprise of roadside drains, concrete culvert crossings, a 5000 cubic metres detention pond South of Victoria Gardens and a 2400 cubic meters detention pond South of Victoria Keyes.

The detention ponds will be used for retaining excess stormwater to control the discharge into the drainage system. During construction, silt traps would be placed where temporary drains outfall at the Diego Martin River. These traps would be cleaned regularly, and after every rainfall event. The temporary drainage plan for during construction is illustrated in Figure 2.9 below.

2.2.1 SITE LAYOUT

Figure 2.10 details the site layout for the prospective contractor. The layout makes provisions for the Contractor's office, the site office, parking for employees, parking for equipment and machinery, stockpiling, refuelling and a wash bay for equipment and machinery moving in and out the project site.

Figure 2.4: Roads to be Constructed/Improved for Proposed Vehicular Overpass and Drainage Works in the Vicinity of Powder Magazine

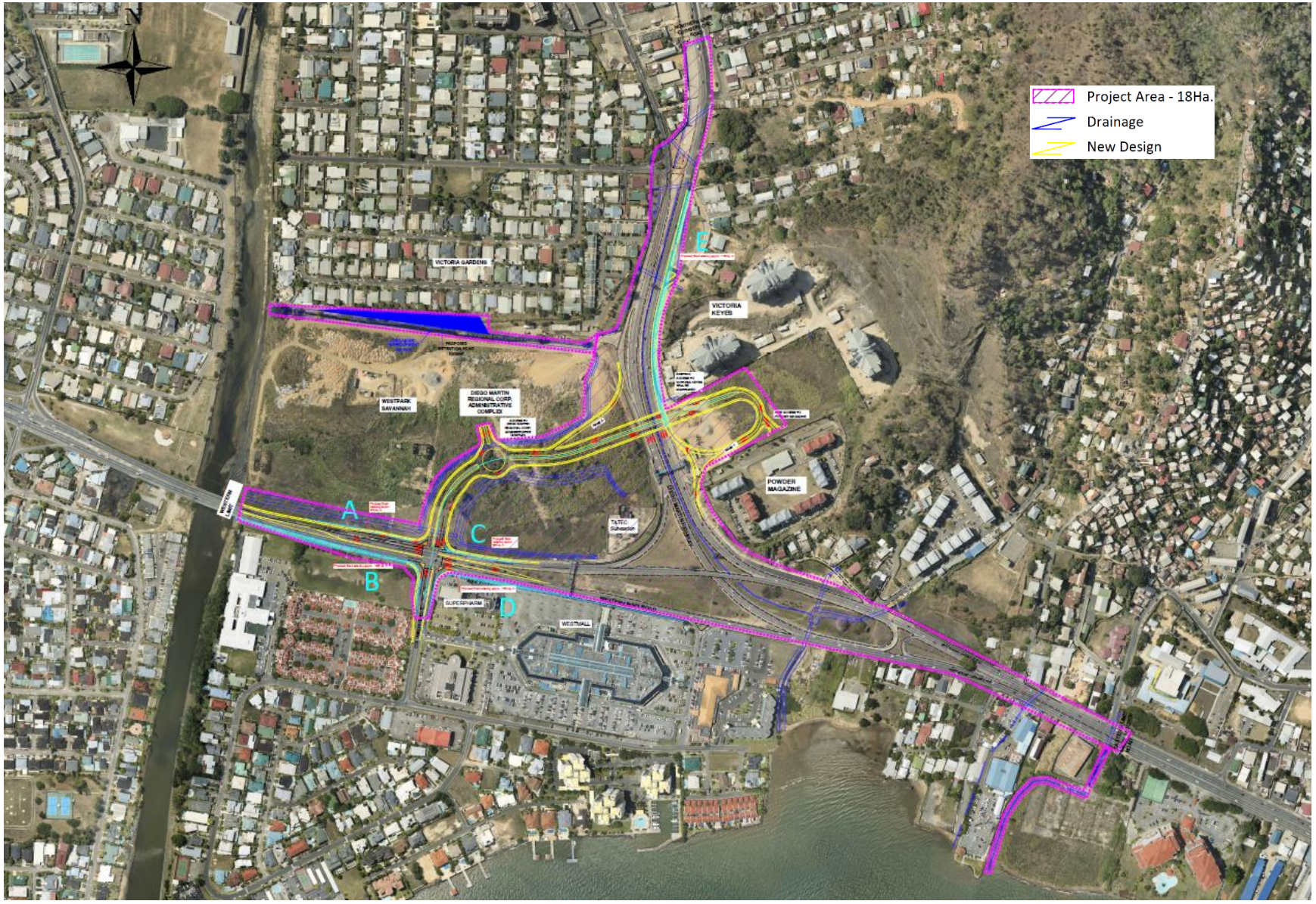


Figure 2.5: Project Area for Proposed Vehicular Overpass and Drainage Works in the Vicinity of Powder Magazine

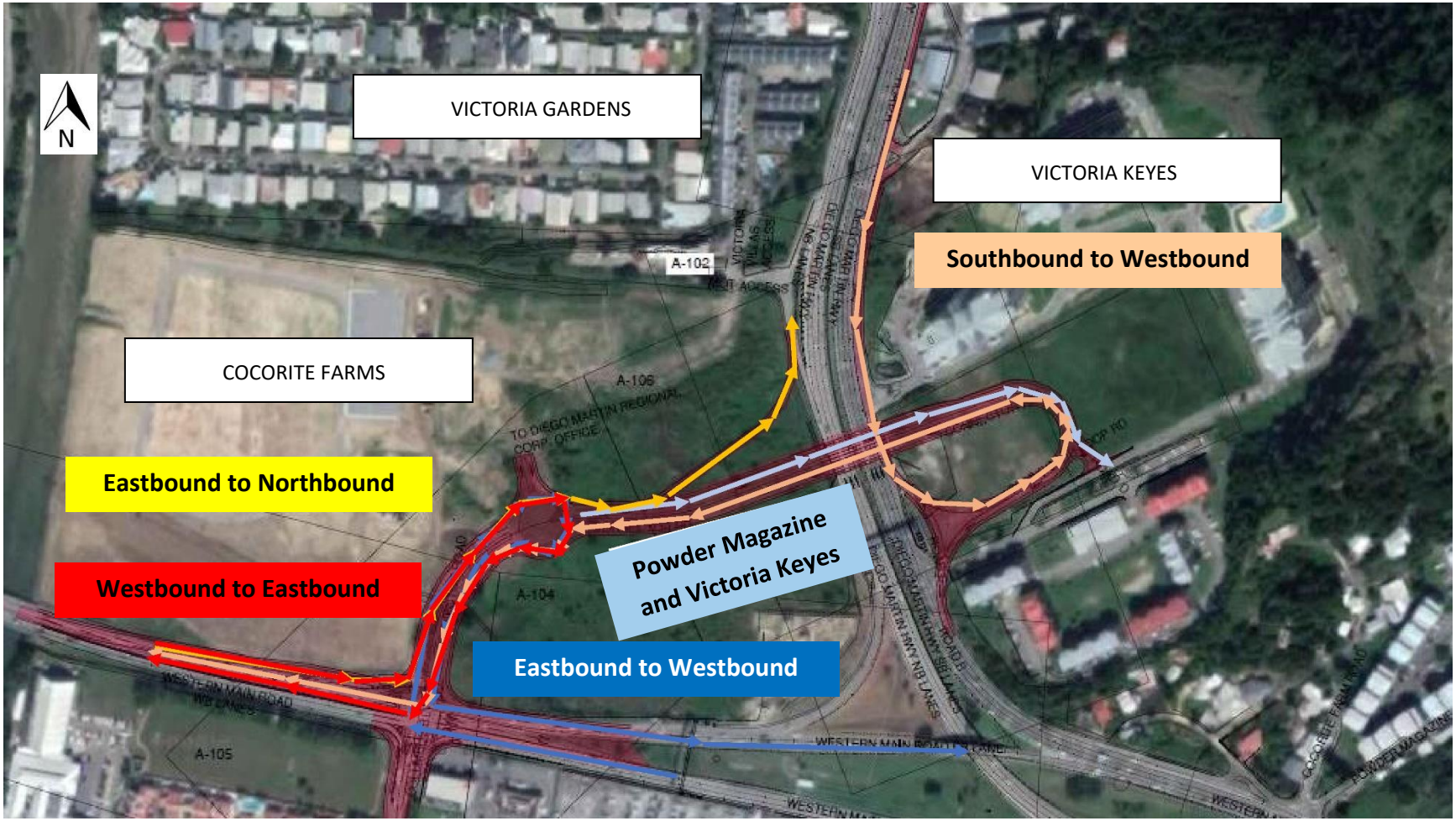


Figure 2.6: Vehicular Movements Allowed By Vehicular Overpass In The Vicinity Of Powder Magazine And Related Road Improvements

Figure 2.7: Vegetation to be Cleared as part of the Project | Vehicular Overpass in the Vicinity of Powder magazine and Related Road Improvements

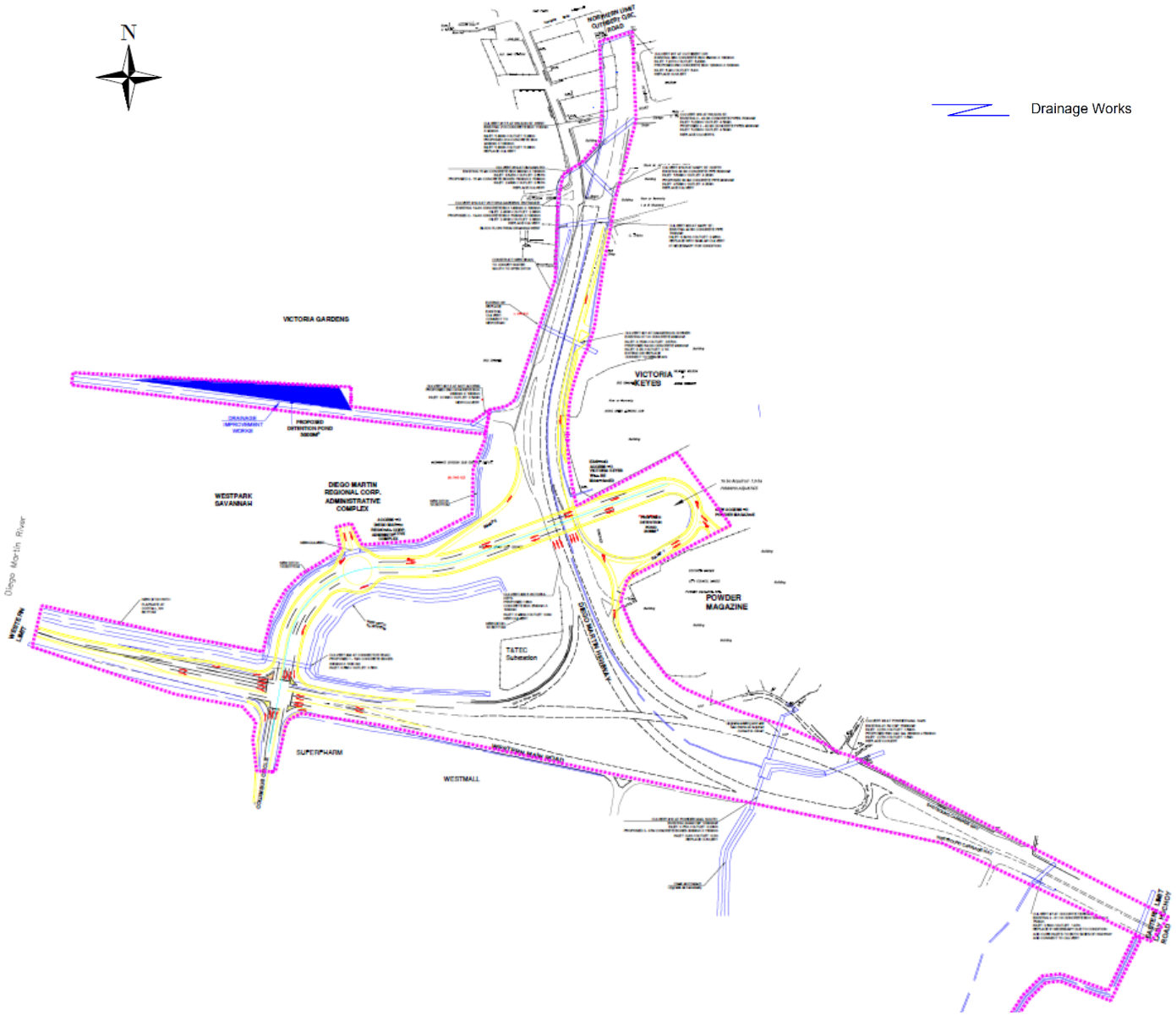


Figure 2.8: Drainage Plan | Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Improvements

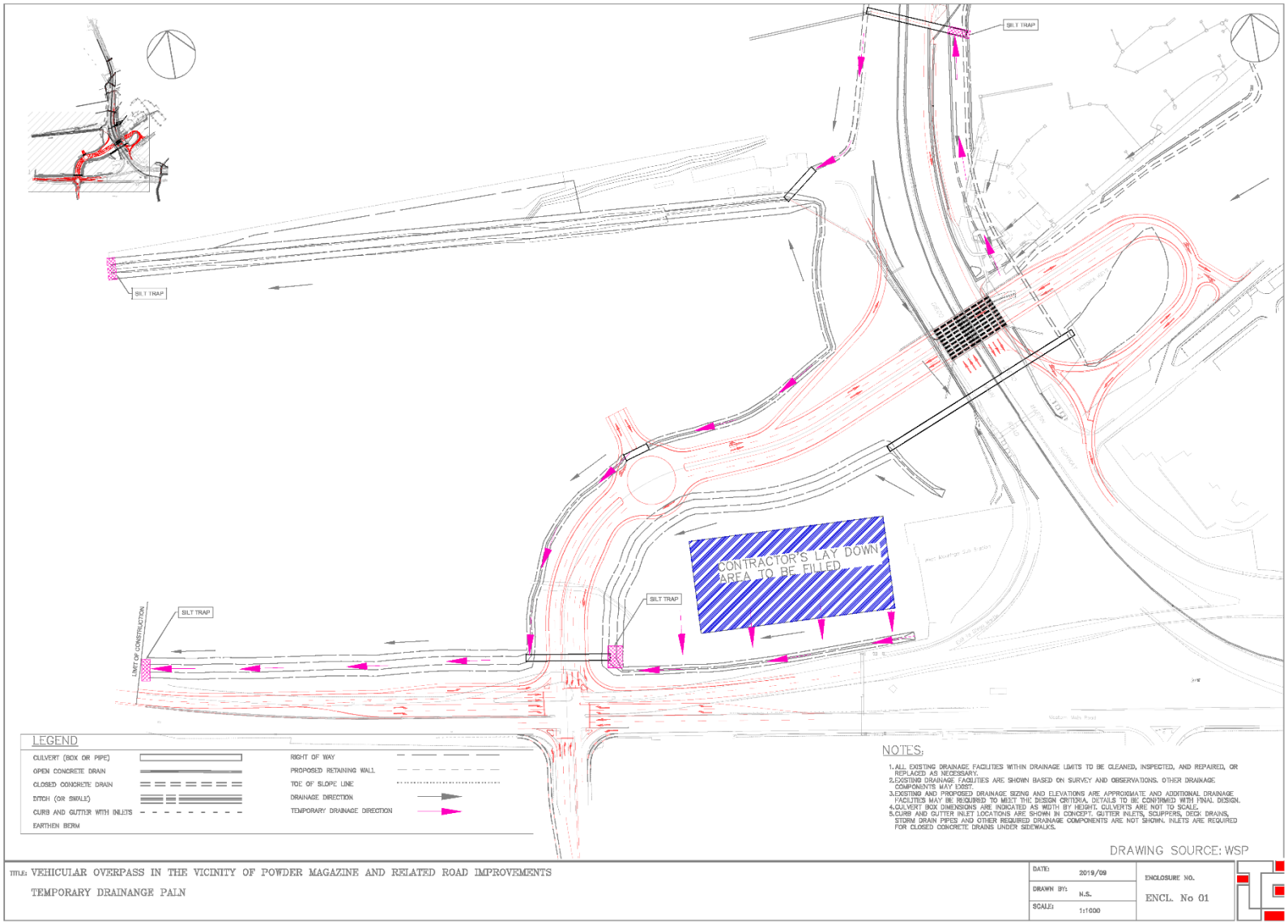


Figure 2.9: Temporary Drainage Plan | Vehicular Overpass in the Vicinity of Powder magazine and Related Road Improvements

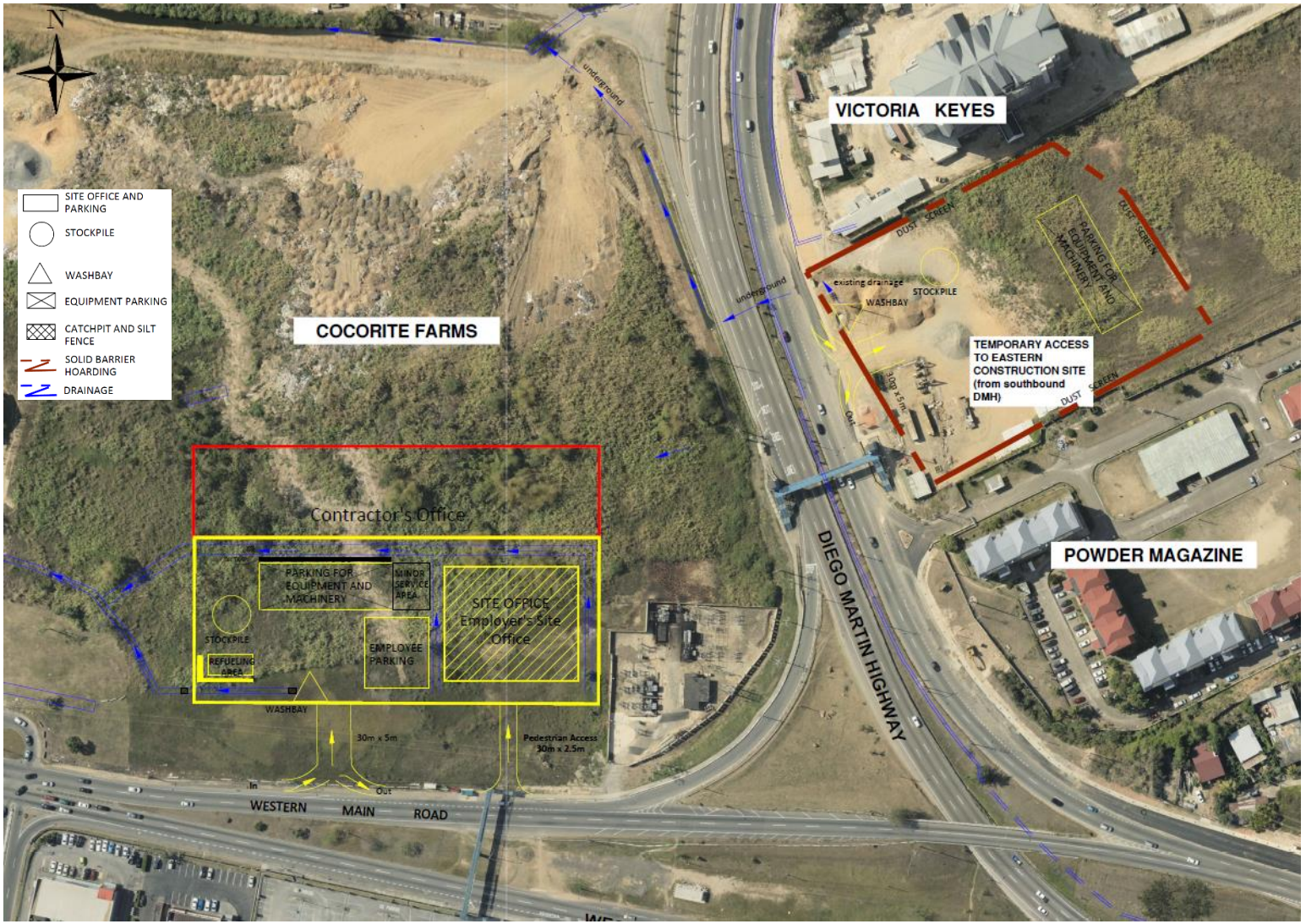


Figure 2.10: Site Layout During Construction of the Vehicular Overpass in the Vicinity of Powder magazine and Related Road Improvements[1] [2]

[1] Only minor servicing on vehicles and equipment is to be performed on site on the designated area. Major servicing is to be outsourced at specialized shops.
[2] Preliminary design drawings for tender only.

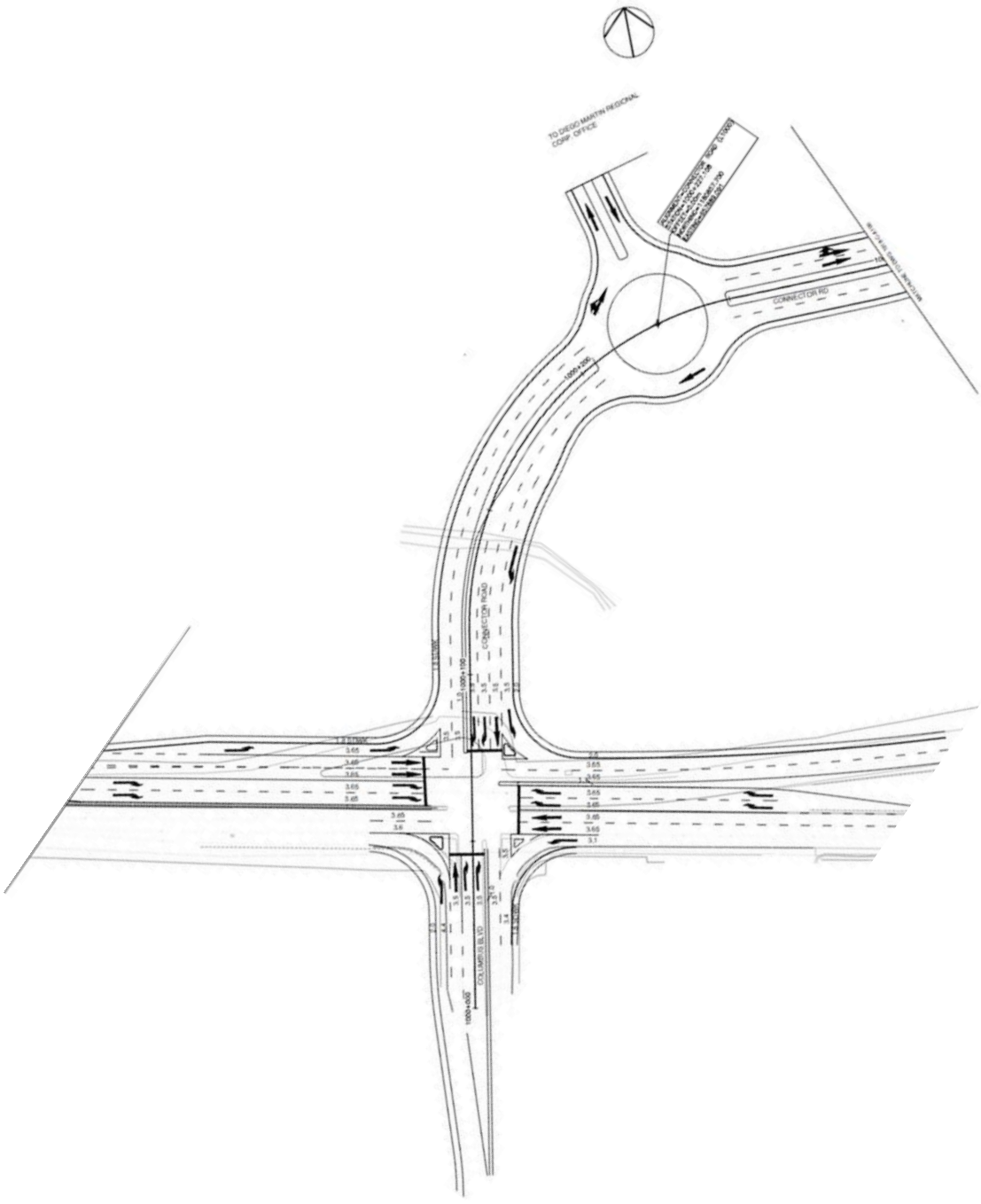


Figure 2.11: Key Components 1 - Fully signalized intersection and Western Connector road

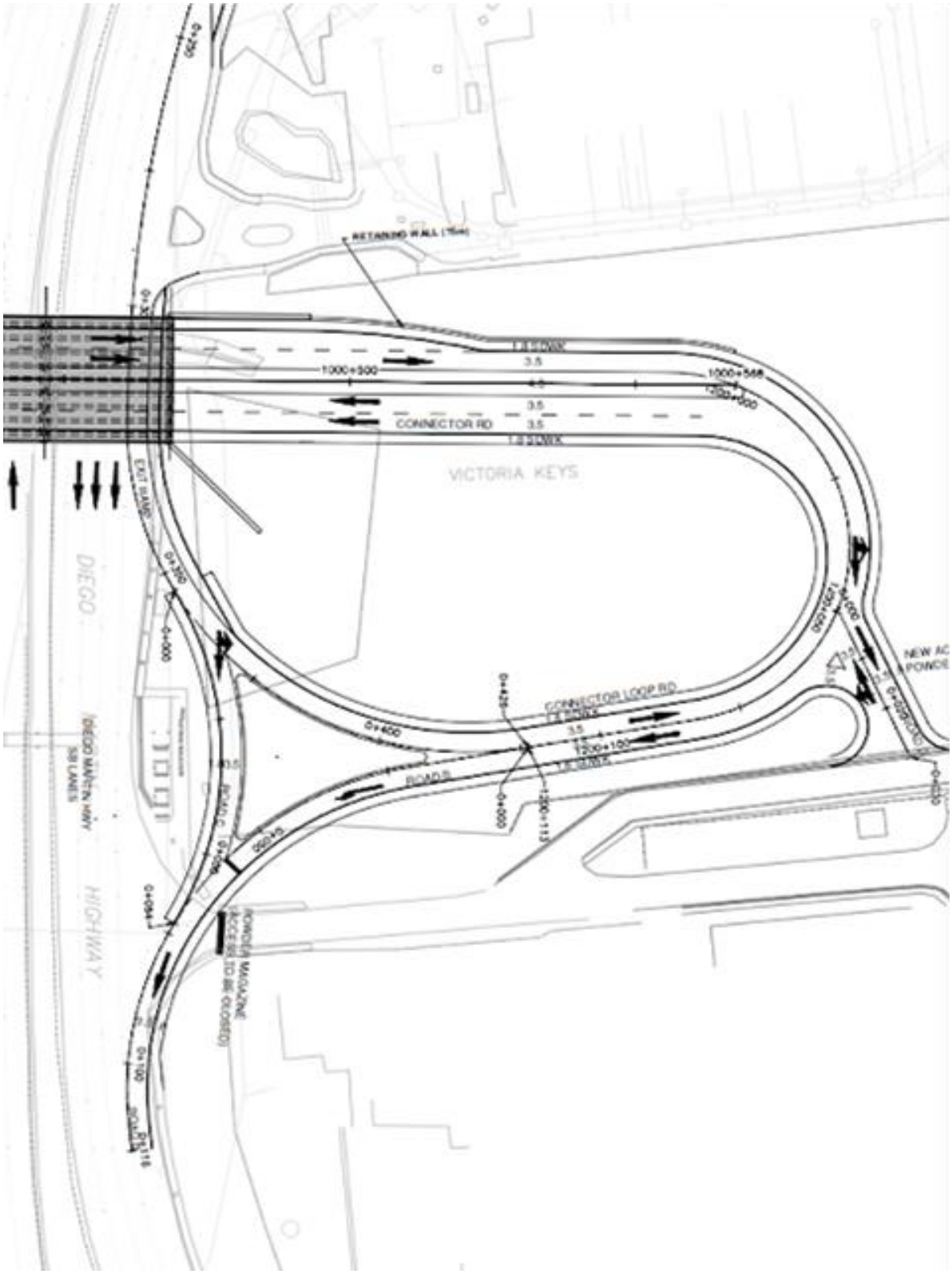


Figure 2.12 Key Components 2 Eastern Connector Road, new Powder Mag. 2 entrance & new exit for Powder Mag. 2 & Victoria Keyes.

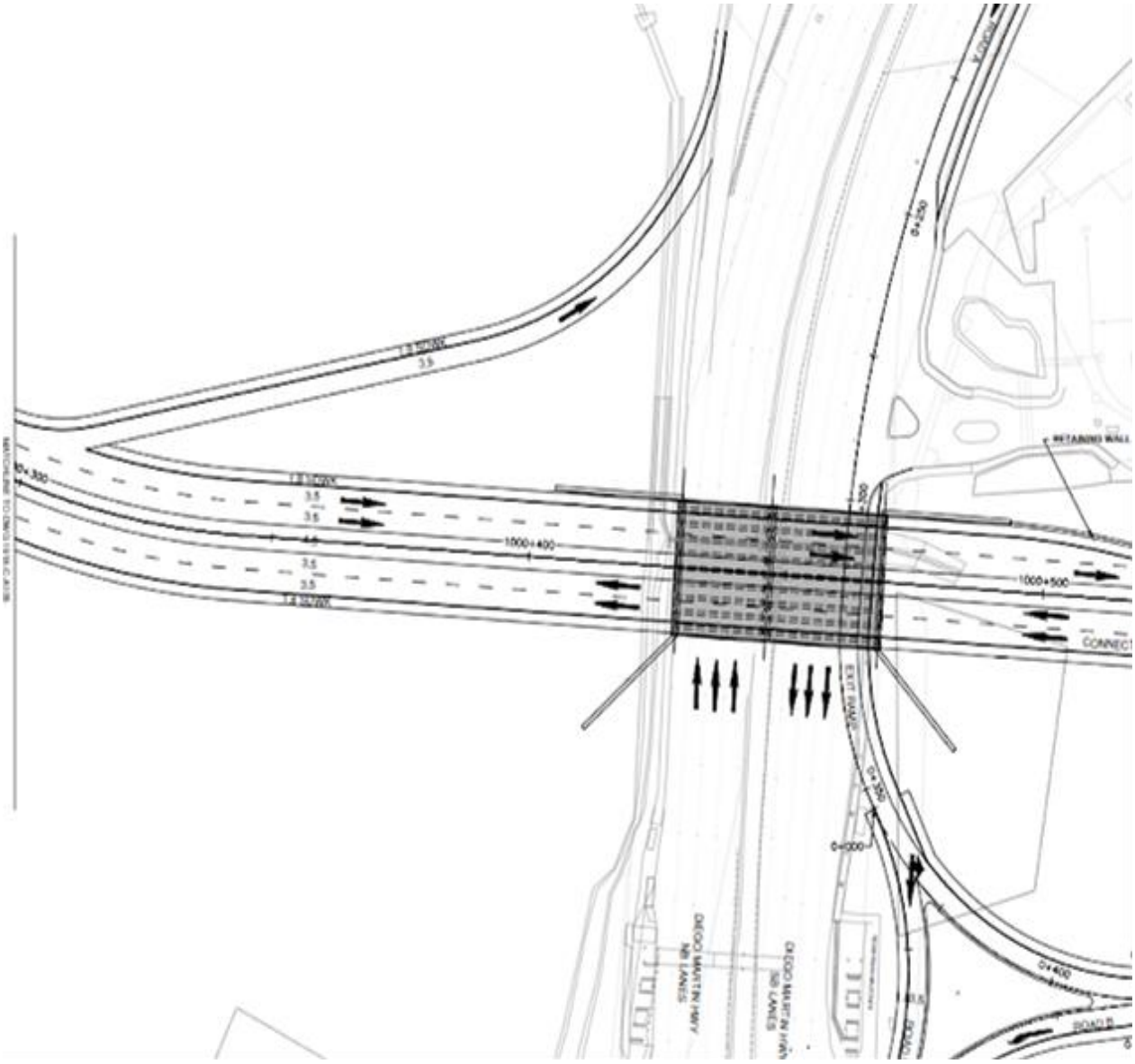


Figure 2.13 Key Components 3 OVERPASS AND NORTHBOUND RAMP

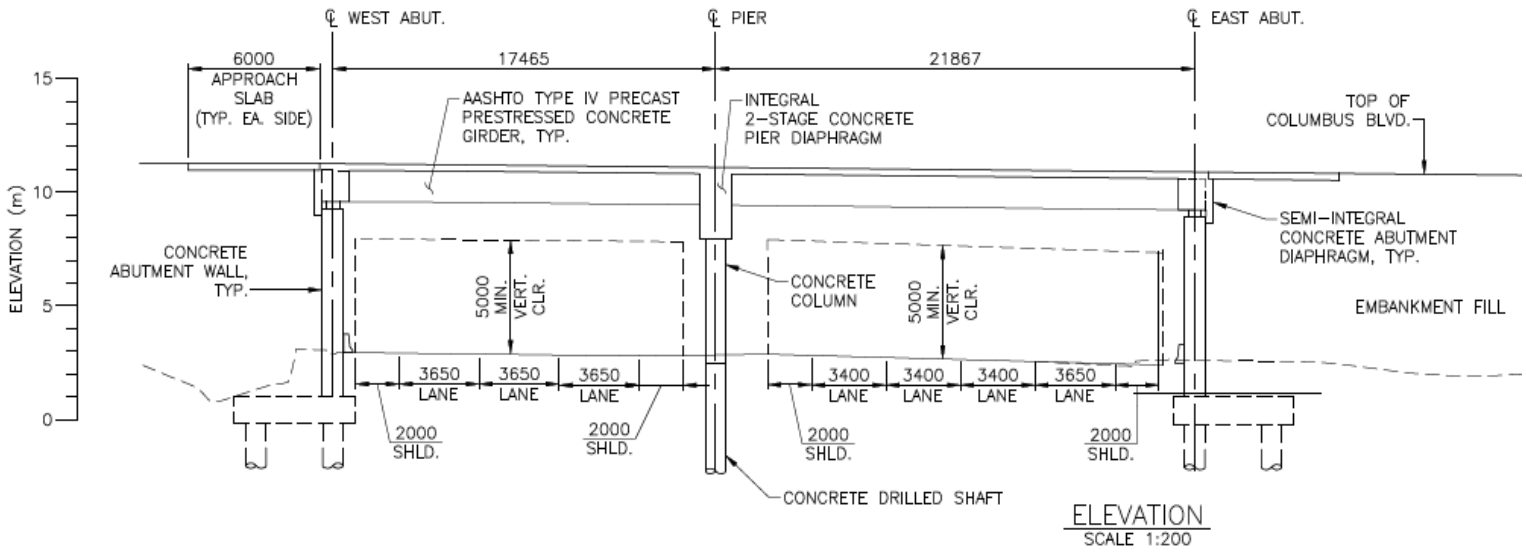


Figure 2.14: Key Component 4 Overpass Structure over the Diego Martin Highway

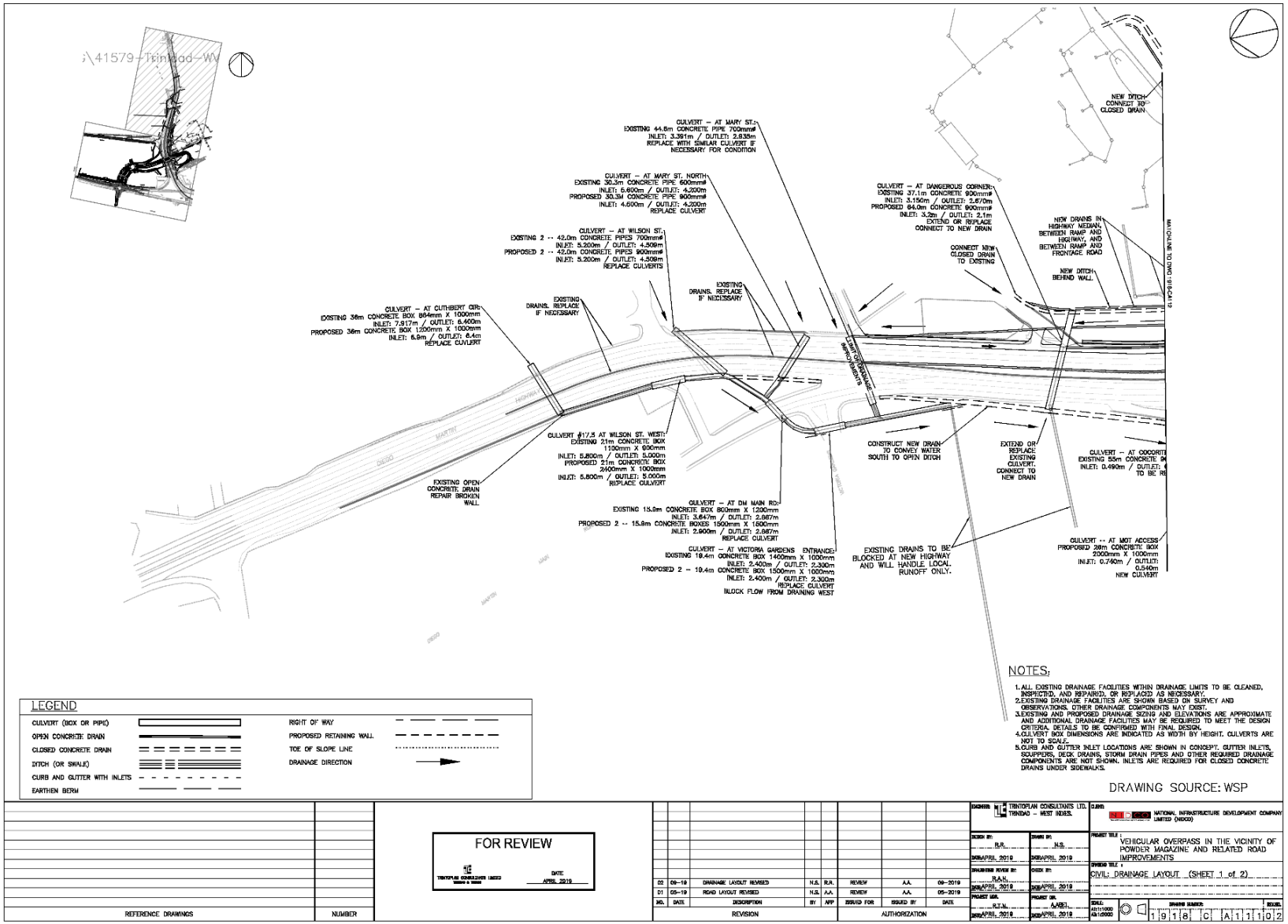


Figure 2.15: Key Component 5 Road and Drainage Layout Pt 1

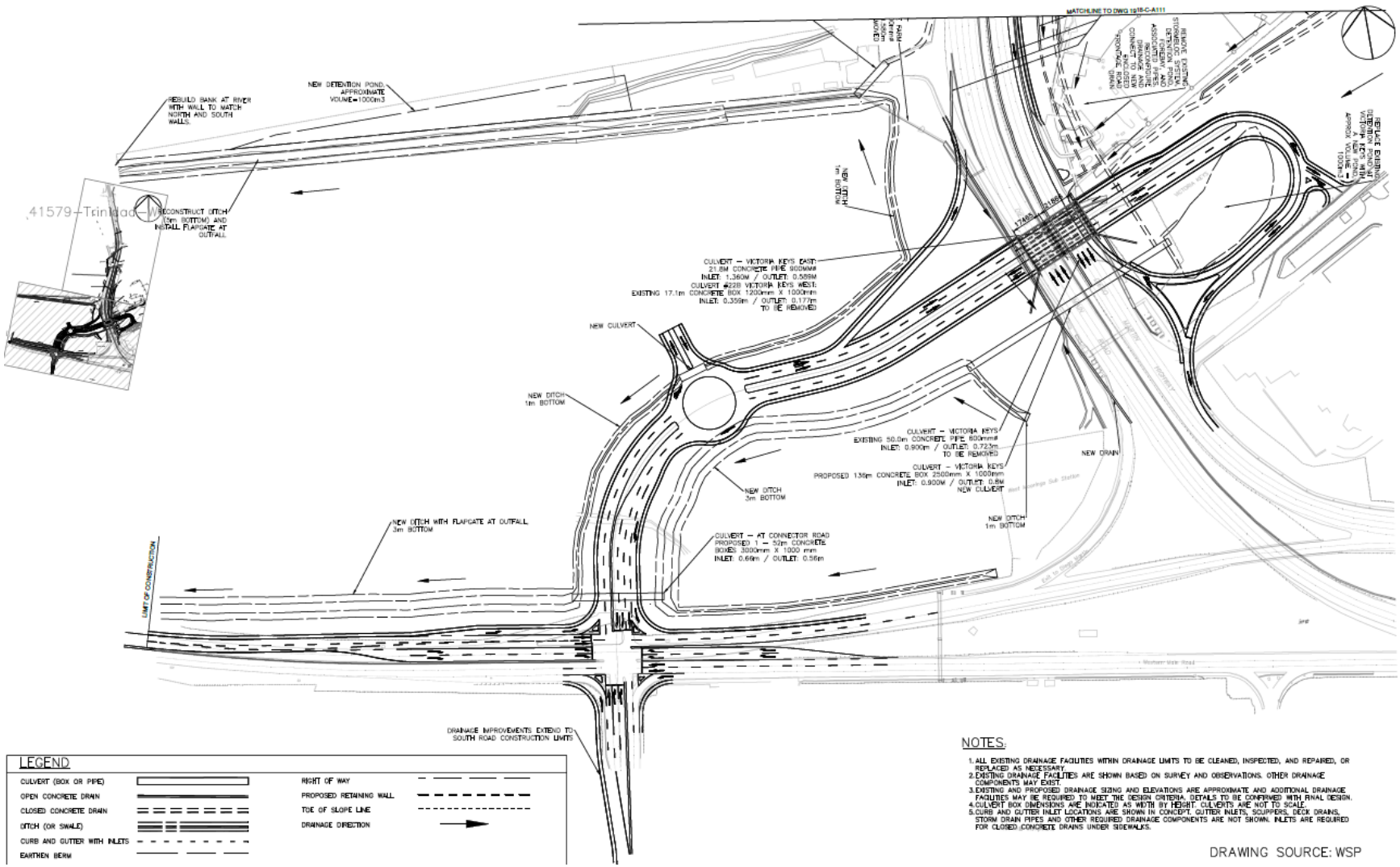


Figure 2.16: Key Component 5 Road and Drainage Layout Pt 2

3 SOCIO-CULTURAL AND ECONOMIC BASELINE ASSESSMENT

3.1 METHODOLOGICAL APPROACH

The objectives of the baseline socio-cultural study are the following:

- Provide social, environmental and economic baseline data on communities projected to be impacted, utilising extensive secondary information and primary data.
- Provide the following sectoral analyses: municipal administration and local governance, community consultation and participation, agriculture, education, health, human sensitive receptors, labour force, gender, human rights, cultural heritage, disaster and emergency, security and justice and ecosystem services.
- Utilise these sectoral profiles to constitute a knowledge base that can inform responsible project planning, management and monitoring, and evaluation.
- Identify the issues and concerns of the affected communities and the Municipalities that are key to sustainable development of the area and which could be influenced by the project.
- Provide and examine the perception and fears of the affected people and record how they believe the implementation of this project may influence their lives.
- Make recommendations on the types of socioeconomic and environmental impacts, risks and issues that should be the focus of the SIA.

The following research tools and methodologies were used for baseline research. The research effort was founded on:

1. Secondary data collection: the purpose was to -

- Review relevant legislation including the Environmental Management Act of 2000; the CEC Rules (2001).
- Review national plans and programmes that are relevant to the sustainable development of the affected areas including Vision 2030 National Strategic Plan; Diego Martin Municipal Development Plans (2011-2020); Local Area Economic Profiles for Diego Martin (2017); National Budget Statements 2015-2018.
- Review and collate secondary sectoral information including map data from agencies Ministries of Works and Transport, Agriculture, Land and Fisheries, Education, Health, Community Development, Rural Development and Local Government, National Security, Office of Disaster Preparedness and Management (ODPM).
- Review the 2011 population statistics for the affected communities, the sub-regions and municipalities within which the communities are located including statistics and projections on:
    - Total population by sex, age group, ethnic composition, religion and disability;
    - Household characteristics – number of households and sex of head of household;
    - Household characteristics – water sources, sanitation facilities, lightning assets, and environmental problems experienced; and
- Verify the information reviewed through field investigations:
    - Using the information collected (secondary and primary data), compile profiles of the affected communities – identify the socio-economic characteristics of the communities including transport and travel patterns.

- Hold interviews with government departments operating within the Municipality of Diego Martin to augment the information collected through secondary sources.

2. Field investigations: the purpose was to -

- Conduct exploratory (rapid appraisal) field surveys of affected communities to verify secondary information reviewed and to determine changes that have taken place in recent times, to understand the socioeconomic and cultural context of the different settlements, and to identify and describe their problems and opportunities through the active interaction with local communities. These surveys included windscreen surveys and discussions with random individuals.

- Conduct interviews and discussions with key local informants (semi-structured with individuals) to obtain information on living conditions within the communities, travel and transport patterns, to identify and prioritise socio-cultural conditions and issues of concern to the sustainable development of the settlements.

- Conduct focus group discussions with the community/village councils in respect of the local living conditions, prioritising development issues and concerns and to identify (from the perspective of community residents) the implications of proposed roadway for their living conditions.

3. Method of prediction: the purpose was to -

- Extrapolate changes in population of the study area for the intercensal period 2000-2011. The extrapolation model used was based upon exponential trending in accordance with the following model $P_t = P_0 * e^{rt}$ where t is the time that lapsed in years between the 2000 and 2011 census dates, P_t is the enumerated population for the 2011 census date, P_0 is the enumerated population for the 2000 census date and 100*r is the period annual growth rate (as a percentage) based on exponential trending.

3.2 MUNICIPAL CONTEXT

3.2.1 POLICY CONTEXT

3.2.1.1 VISION 2030 NATIONAL DEVELOPMENT STRATEGY

The Vision 2030 National Development Strategy provides a broad socio-economic development framework for Trinidad and Tobago to the year 2030. The Strategy recognises that transportation networks and the circulatory systems are the backbone of an economy, ensuring that people, goods and services reach where they need to go.[3] In this context, the policy places emphasis on the quality of the country's road infrastructure as well as on the improvement of road interconnectivity between and among rural and urban communities. Under the third development theme of the Strategy – *Improving Productivity through Quality Infrastructure and Transportation* – the goal is a Trinidad and Tobago with an inter-connected, well maintained transport infrastructure. The three strategic initiatives in support of this development theme involve:

- Improving and expanding the road infrastructure network;
- Adopting an integrated planning approach to flood mitigation; and
- Upgrading drainage systems.

For the first five years of the Strategy (from 2016 to 2020) focus has been placed on the expansion of the national road network to facilitate safe, efficient movement of people and goods. The construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements falls under this strategic initiative.

Vision 2030 advocates the development and implementation of an Integrated Flood Management Plan, strategies to maintain or augment the productivity of floodplains while providing protective measures against losses due to flooding. Additionally, Vision 2030 identifies a number of measures to be adopted to improve the drainage infrastructure and reduce the incidence of flooding in low lying areas, which includes improvement works to the Diego Martin River.

3.2.1.2 DIEGO MARTIN MUNICIPAL DEVELOPMENT PLAN

The Diego Martin Municipal Development Plan (MDP) provides a comprehensive prescription for sustainable development of the municipality from 2011 through to 2020. The goal of the plan is to ensure successful development of the municipality that will result in the creation of sustainable communities and a high quality of life for its burgesses. The vision for Diego Martin is one where a high quality of life will be created that is free of crime and supported by the provision of equitably distributed social and infrastructure services to all burgesses.

[3] *Government of the Republic of Trinidad and Tobago, 2016. Vision 2030 National Development Strategy, 2016-2030: Development Strategies to 2020. Available [Online], https://www.planning.gov.tt/sites/default/files/Vision%202030-%20The%20National%20Development%20Strategy%20of%20Trinidad%20and%20Tobago%202016-2030.pdf*

3.3 SOCIO-DEMOGRAPHIC CHARACTERISTICS

3.3.1 POPULATION CHARACTERISTICS

According to the 2011 Population and Housing Census, the population of the Municipality of Diego Martin stood at 102,957 persons, representing some 7.8 percent of the national population of 1,328,019 persons. Between 2000 and 2011, Diego Martin, similarly to the cities of San Fernando and Port of Spain, showed a population decrease of 2.6 percent (Figure 3.1). The population of Diego Martin is almost equally distributed in terms of gender, with a female population of 52,239 (50.7%) and a male population of 50,718 (49.3%).

The 2011 census revealed that an average of 3.2 persons lived in the 32,404 recorded private households in Diego Martin. This showed a decline in the size of the average household since the 2000 Census of 0.3 persons, down from 3.5 persons per household (Table 3.1). However, the number of households increased by 10.4 percent, which was less than the growth in the number of households observed in Trinidad (16.1%). The regional corporation of Diego Martin has accounted for a maximum of 8.2% and a minimum of 7.6% of the nation's total population. Significantly, the increase in the number of households notwithstanding stagnant or declining population can be associated with the growing popularity of the region as location for residential accommodation which has been reflected in a demand for housing in the area for middle- and high-income family units.

Table 3.1: Changes in Non-institutional Population and Household Characteristics in Trinidad and Tobago and Diego Martin, 2000-2011

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
	2011	2000	2011	2000	2011	2000	2000-2011	2000-2011
Trinidad and Tobago	1,322,546	1,250,652	401,382	343,180	3.3	3.6	0.5%	1.5%
Trinidad	1,261,812	1,197,426	381,257	328,000	3.3	3.7	0.5%	1.4%
Diego Martin	102,340	103,930	32,404	29,352	3.2	3.5	-0.1%	0.9%

Source: CSO 2011 Population and Housing Census

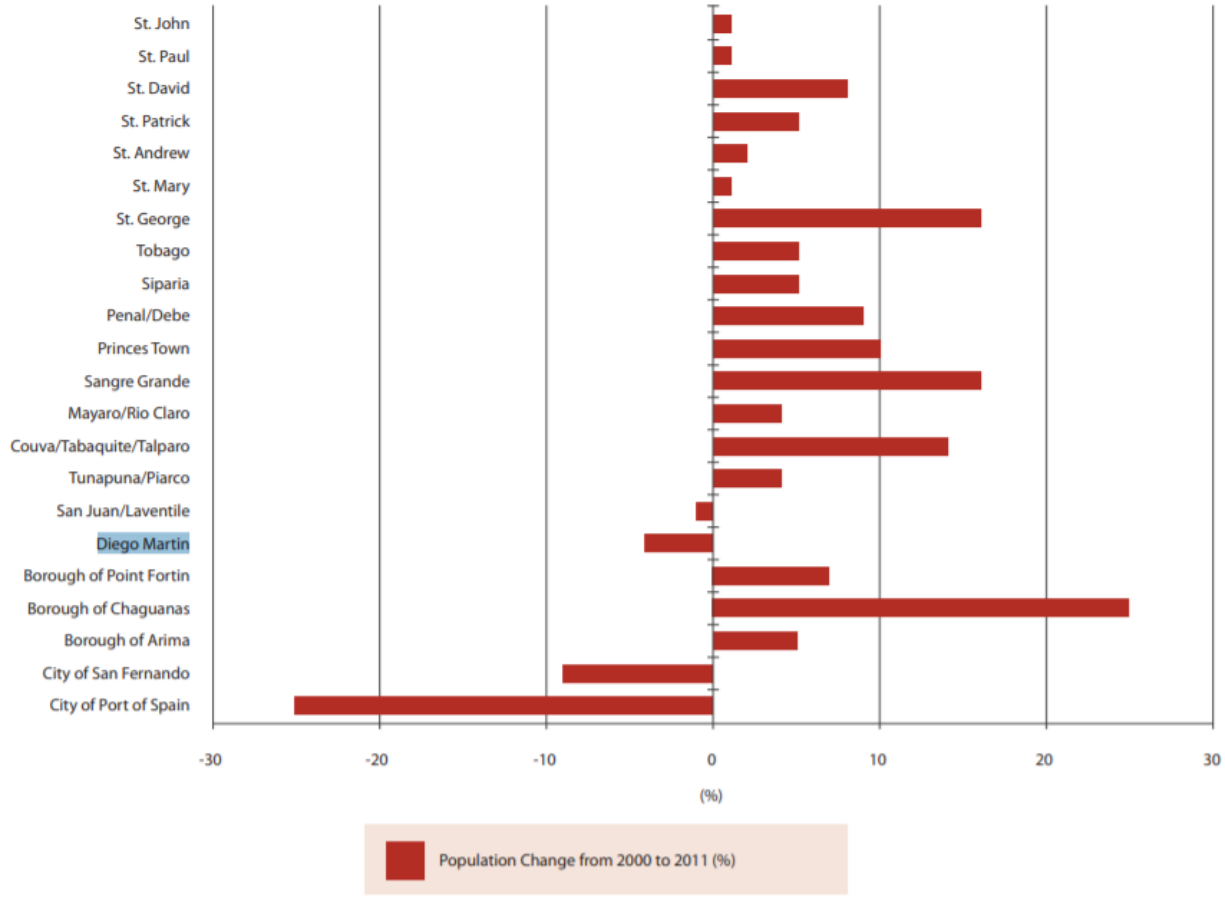


Figure 3.1: Population Change by Administrative Area
Source: CSO 2011 Population and Housing Census

3.3.1.1 POPULATION DENSITY

In 2011, the Municipality of Diego Martin was the fifth most densely populated area of Trinidad and Tobago with a density of 817 persons per square kilometre (Table 3.2 and Figure 3.2). The region's population density is higher than the national average of 259 person per square kilometre and is due to 7.8% of the national population existing in a land area that occupies 2.5% of the total land area of Trinidad and Tobago. As its population dipped slightly, the population density of the region decreased correspondingly from 839 persons per square kilometre in 2000. From 2000 to 2011, Diego Martin maintained its population density position relative to the other municipalities.

Table 3.2: Population Density of Diego Martin, 2000 and 2011

Year	Density (Per Sq. km)	Population
1990	728	91,778
2000	839	105,720
2011	817	102,957

Source: CSO 2011 Population and Housing Census

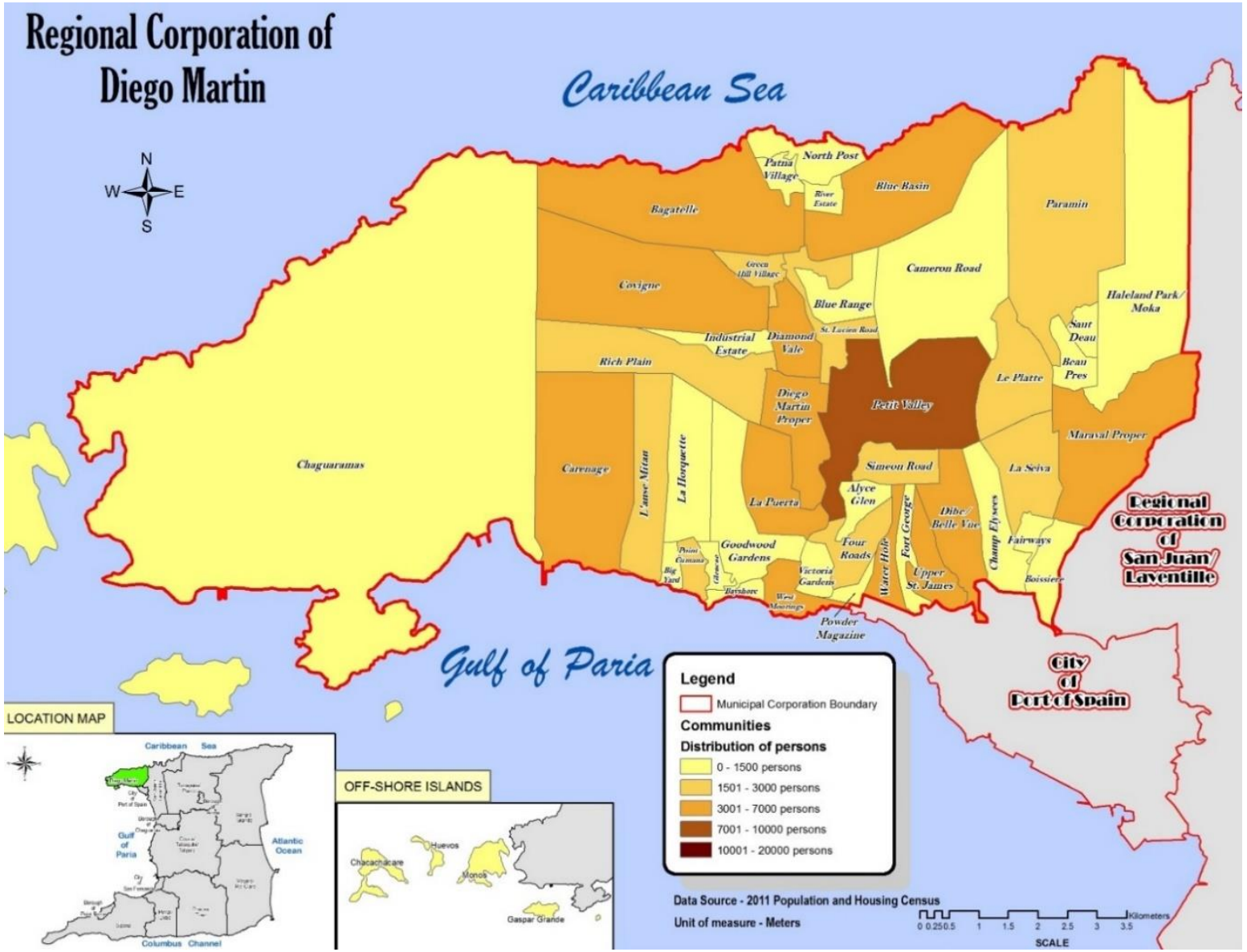


Figure 3.2: Population Density by Community in the Municipality of Diego Martin 2011

3.3.1.2 PROJECTED POPULATION SIZE

3.3.1.2.1 DATA SOURCE

The data sources for the population projections of the selected communities were the respective Community Registers for the Trinidad and Tobago Population and Housing Censuses that were conducted in 1990, 2000 and 2011. The observed census population sizes were obtained for each of the selected communities as enumerated on the respective census dates: 15th May 1990; 8th June 2000 and 9th January 2011. The respective population sizes were disaggregated by sex and all population projections were generated for the sex-disaggregated populations. The enumerated population sizes provide a basis for assessing the reliability of population counts and estimating annual rates of population growth within sex-disaggregated populations in each of the selected communities.

3.3.1.2.2 ESTIMATING ANNUAL GROWTH RATES

The base period used for the estimation of annual rates of population growth was the intercensal period 2000-2011. The extrapolation model was based upon exponential trending in accordance with the following model $P_t = P_0 * e^{rt}$ where t is the time that lapsed in years between the 2000 and 2011 census dates, P_t is the enumerated population for the 2011 census date, P_0 is the enumerated population for the 2000 census date and 100*r is the period annual growth rate (as a percentage) based on exponential trending. For each of the selected communities, r is estimated and used as a basis for making assumptions about the characteristics features of critical components of period population change and hence, further assumptions about period population growth rates that are likely to characterize annual rates of population growth in subsequent quinquennial periods between 2011 and 2041.

3.3.1.2.3 SOME UNDERLYING ASSUMPTIONS – BASE PERIOD GROWTH RATE

During the base period, a positive population growth is indicative of a greater preponderance of youthful populations. This could be due to sustained higher levels of fertility among women in childbearing ages or a greater likelihood of gains through migration especially where in-migrants are younger persons. In communities characterized by positive population growth during the base period, a plausible assumption is positive population growth during subsequent quinquennial periods during which growth rates are assumed to be retarding across every five-year period by a magnitude of 0.1 percentage points.

Communities that exhibit negative population growth rates during the base period are more likely to have been characterized by population ageing due to declining fertility, increasing numbers of annual deaths due to phenomenal population ageing, and greater likelihood of population leakage due to the outmigration of principally younger populations. In communities characterized by negative population growth during the base period, a plausible assumption is negative population growth during subsequent quinquennial periods during which the decline in rates are assumed to be retarding across every subsequent five-year period by a magnitude of 0.05 percentage points.

Despite having positive population growth during the base period, projected population sizes resulted in some communities experiencing negative population growth rates in subsequent five-year periods. In such cases, it is assumed that negative population growth would persist during subsequent quinquennial periods during which annual growth rates are assumed to decline by a magnitude of 0.05 percentage points across every subsequent five-year period.

The number of dwelling units in each of Chaconia Crescent and Victoria Keys is 120 and 264 respectively. It is assumed that there is one household per dwelling unit and that the average household size in both sets of units is equivalent to that of Victoria Gardens, a neighbouring community.

Based on the 2011 Population and Housing Census, the average household size of Victoria Gardens was estimated to be 2.9 and is assumed to decline by a magnitude of 0.1 every ten years until 2041. These average household sizes have been applied to the number of assumed households in the two sets of units with projections terminating in 2041.

These projections yield total population sizes for each of the target years 2021, 2026, 2031, 2036 and 2041. The total population sizes are disaggregated according to sex using the sex ratio that was observed for Victoria Gardens during the 2011 population housing census and assumed to prevail in the two sets of units indefinitely with a female majority. Specifically, it was assumed that there were 91.9 males per 100 females.

The assumed marginal decline in average household size is consistent with national trends especially in the case of populations that are classified as aging.

3.3.1.2.4 POPULATION PROJECTION RESULTS: FIVE-YEAR INTERVALS 2016-2041

Sex-disaggregated population sizes permitted the computation of total population sizes for the selected communities (Table 3.3). Accordingly, population sizes for populations categorized as male, female and both sexes are produced for the following census dates: 15th May 1990, 8th June 2000 and 9th January 2011 and projected at five-year intervals beginning from 9th January 2016 through to 9th January 2041 (See Figure 3.3 through Figure 3.7).

Between 8th June 2000 and the 9th January 2011, the total population of all of the selected communities exhibited a decline which is projected to have continued into 2016. Interestingly, the overall population for selected communities is projected to remain virtually unchanged between 2011 and 2041 except for marginal fluctuations.

Across the sexes, more interesting trajectories emerge and are characterized by declining population sizes in the case of the male population and increasing population sizes. Within most of the communities, total population sizes have been projected to change marginally between 2011 and 2041. However, noteworthy population size increases are projected for north Diego Martin communities such as Blue Basin and Bagatelle. On the contrary, total population size declines are more likely to be evident in some of those communities characterized by greater levels of household affluence.

The communities with the greatest levels of affluence in Diego Martin are likely to have greater proportions of their respective populations in older age groups when compared to other communities. This means that there are likely to be smaller proportions of younger persons, in particular, women in peak childbearing age groups. This is further exacerbated by the fact that the relatively fewer younger women in such communities are more likely to have attained educational and labour force profiles that render them less likely to exhibit fertility levels that are above replacement level. This is inimical to a process that will contribute to noteworthy gains, if any, in population sizes in such communities. The historical affluence of these communities may also be associated with somewhat greater longevity of life of their residents. To this end, the higher concentration of older persons well beyond retirement age indicates that these populations are likely to experience further threats to population growth due to inherent higher risks of mortality. For these reasons, gains in population size in the most affluent communities seem much less likely to be realized during the 2020's and 2030's. Moreover, real estate market values in these communities also place limitations on the extent to which in-migration is likely to attract population groups with high fertility attributes albeit in a global environment that is characterized by fertility levels that are below replacement level.

3.3.1.2.5 LIMITATIONS

Despite the availability of population size data for 2000 and 2011 from the respective Community Registers, corresponding data from the 1990 Register were not available for the following Diego Martin communities: Chaguaramas, Powder Magazine, Covigne, Glencoe, Victoria Gardens and Cameron Road. It is quite likely that the populations within these communities were enumerated and contained within the populations of contiguous communities. These omissions are reflected in the tabular representations of the population sizes of communities in Diego Martin based on the 1990 Population and Housing Census. However, it should be noted that such omissions would have no impact on the respective projected population sizes.

At the community level, period data reflecting births, deaths and migratory movements do not exist to permit valid accounts of their impact on population size. This placed limitations on the use of alternative approaches for projecting population sizes within the selected communities to the extent that trend extrapolation based on the assumption of exponential growth constituted the best option.

3.3.1.2.6 POPULATION OUTLOOK FOR THE REGION

It must be noted that the projections provided above are based on demographic modelling and are derived from census data, the last being 2011. A trend noted in the intercensal period 2000 – 2011 is likely to have become more pronounced since 2011, which has been referred earlier, namely, the increase in the number of households in spite of slow or declining rates of population growth. The attractiveness of the area for middle- and high-income households has been evident in the expansion in residential accommodation in single family residences and in elite flats. Some of the latter did not exist at the time of the last census: Powder Magazine, Victoria Keyes and Chaconia Crescent are major additions to the housing stock and are the communities located nearest to the planned overpass.

There are other comparable developments taking place in the area, both at the upper end of the income scale as well as in some communities with informal settlements. The net impact might well result in an increase in population, but surely an increase in the number of households. The projections generated for this exercise take no account of the recent influx of Venezuelan refugees/immigrants many of whom might have settled in the municipality of Diego Martin as a popular suburban district.

In respect of the overall impact on the transport sector, most importantly, there will be a likely increase in households that rely on individual transport vehicles for commuting in and out of the area into Port of Spain and beyond. The traffic counts of five years ago will need to be inflated by some factor to represent the current and prospective growth in the vehicular transportation with the expansion of commerce and residential accommodation over the next ten to twenty years.

Table 3.3: Population Projections for Communities in the Diego Martin Region[4]

DIEGO MARTIN COMMUNITIES	15th May 1990	8th June 2000	9th January 2011	9th January 2016	9th January 2021	9th January 2026	9th January 2031	9th January 2036	9th January 2041
BOTH SEXES POPULATION									
Carenage	4,995	5,671	5,624	5,603	5,584	5,567	5,550	5,536	5,522
Chaguaramas	…	903	261	155	94	57	35	22	14
L'Anse Mitan	1,690	1,824	1,813	1,807	1,800	1,789	1,775	1,757	1,736
Big Yard	910	1,118	929	851	781	716	657	603	553
La Horquette	1,133	787	725	698	673	650	628	607	588
Point Cumana	2,044	1,807	1,823	1,826	1,821	1,816	1,812	1,809	1,805
La Puerta	2,468	4,187	3,891	3,760	3,634	3,513	3,397	3,285	3,178
Westmoorings	2,473	3,951	3,519	3,333	3,157	2,991	2,835	2,688	2,549
Powder Magazine	…	1,191	1,423	1,540	1,655	1,762	1,854	1,926	1,973
Simeon Road	690	2,584	2,649	2,667	2,665	2,657	2,649	2,642	2,636
Diego Martin Proper	10,123	6,435	5,968	5,761	5,562	5,372	5,190	5,015	4,847
Rich Plain	2,606	2,756	2,874	2,917	2,938	2,931	2,916	2,902	2,889
Diego Martin Industrial Est	822	1,282	1,097	1,020	950	885	825	770	719
Diamond Vale	6,590	5,794	5,388	5,208	5,036	4,871	4,713	4,562	4,417
Covigne	…	4,181	3,996	3,913	3,833	3,755	3,681	3,608	3,539
Glencoe	…	807	718	680	644	609	577	547	519
Bayshore	590	678	508	444	388	339	296	259	227
Victoria Gardens	…	1,214	1,134	1,098	1,064	1,031	1,000	970	940
Alyce Glen	550	759	787	797	801	803	803	801	797
Four Roads Diego Martin	3,669	2,652	2,293	2,141	3,075	2,944	2,784	2,670	2,525
Chaconia Crescent	-	-	-	-	*336*	*336*	*324*	*324*	*312*

[4] Note that these projections do not include districts that have been built out since the last census.

DIEGO MARTIN COMMUNITIES	15th May 1990	8th June 2000	9th January 2011	9th January 2016	9th January 2021	9th January 2026	9th January 2031	9th January 2036	9th January 2041
BOTH SEXES POPULATION									
Victoria Keyes	-	-	-	-	*739*	*739*	*713*	*713*	*686*
Green Hill Village	809	1,939	1,759	1,681	1,607	1,537	1,470	1,407	1,348
Bagatelle (Diego Martin)	2,991	4,645	5,715	6,272	6,831	7,367	7,849	8,244	8,527
Patna Village	537	632	501	449	403	361	324	291	261
River Estate	1,590	1,659	1,393	1,283	1,182	1,089	1,004	926	854
Blue Basin	1,504	2,466	3,447	4,019	4,651	5,333	6,046	6,767	7,470
North Post	381	347	424	464	505	545	583	616	650
St. Lucien Road	1,411	1,990	2,303	2,455	2,598	2,722	2,816	2,873	2,925
Petit Valley	11,295	9,382	9,405	9,418	9,434	9,452	9,473	9,496	9,521
Le Platte	1,542	1,700	1,673	1,661	1,649	1,638	1,628	1,617	1,608
Cameron Road	…	829	1,028	1,132	1,238	1,340	1,432	1,509	1,566
Blue Range	1,187	1,072	922	859	800	746	695	648	605
Goodwood Gardens	1,159	1,350	1,238	1,191	1,147	1,106	1,068	1,033	1,001
ALL AREAS	65,759	78,592	77,228	77,104	77,124	77,220	77,329	77,371	77,311

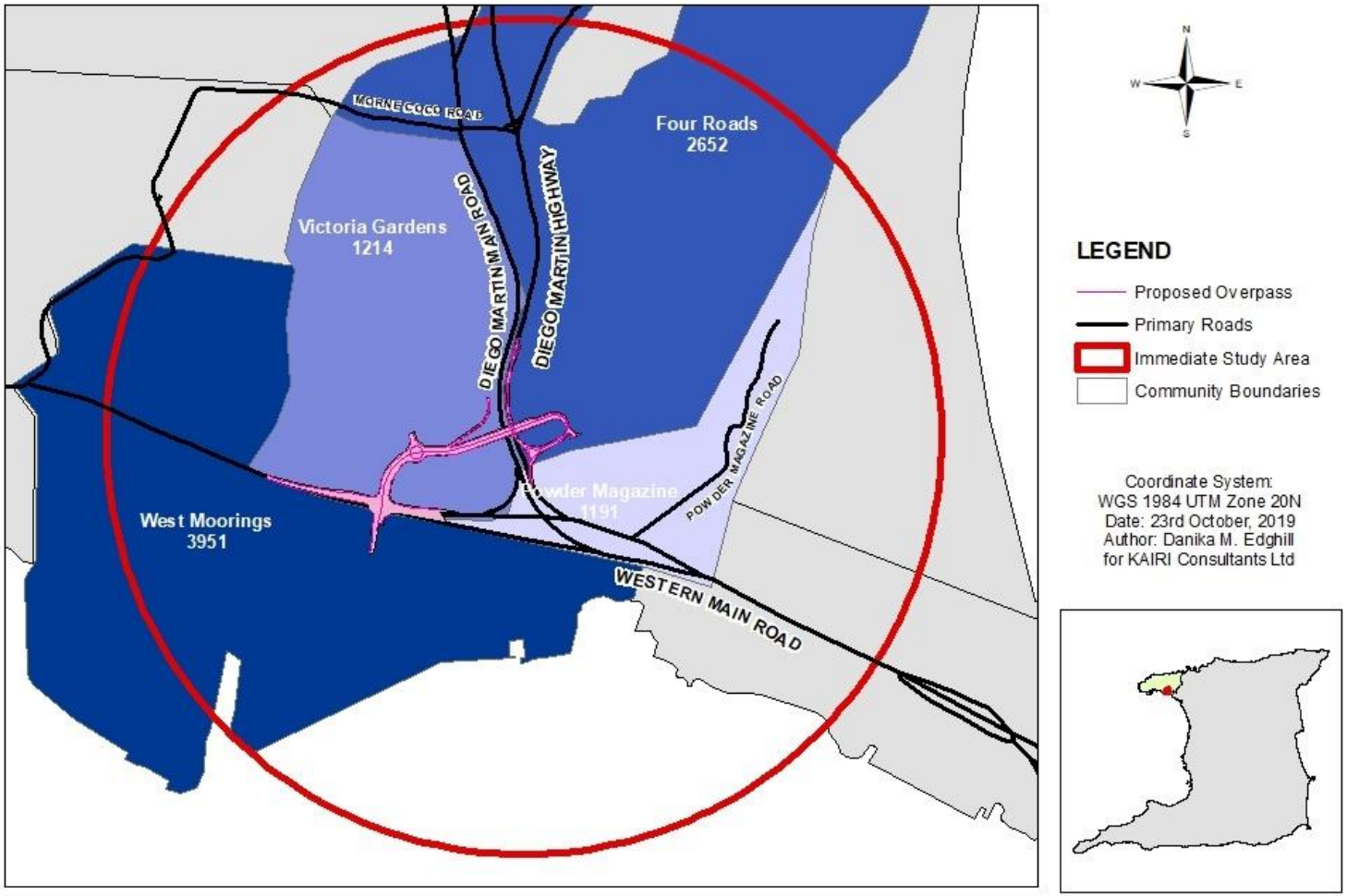


Figure 3.3: Total Population in the Immediate Study Area 2000

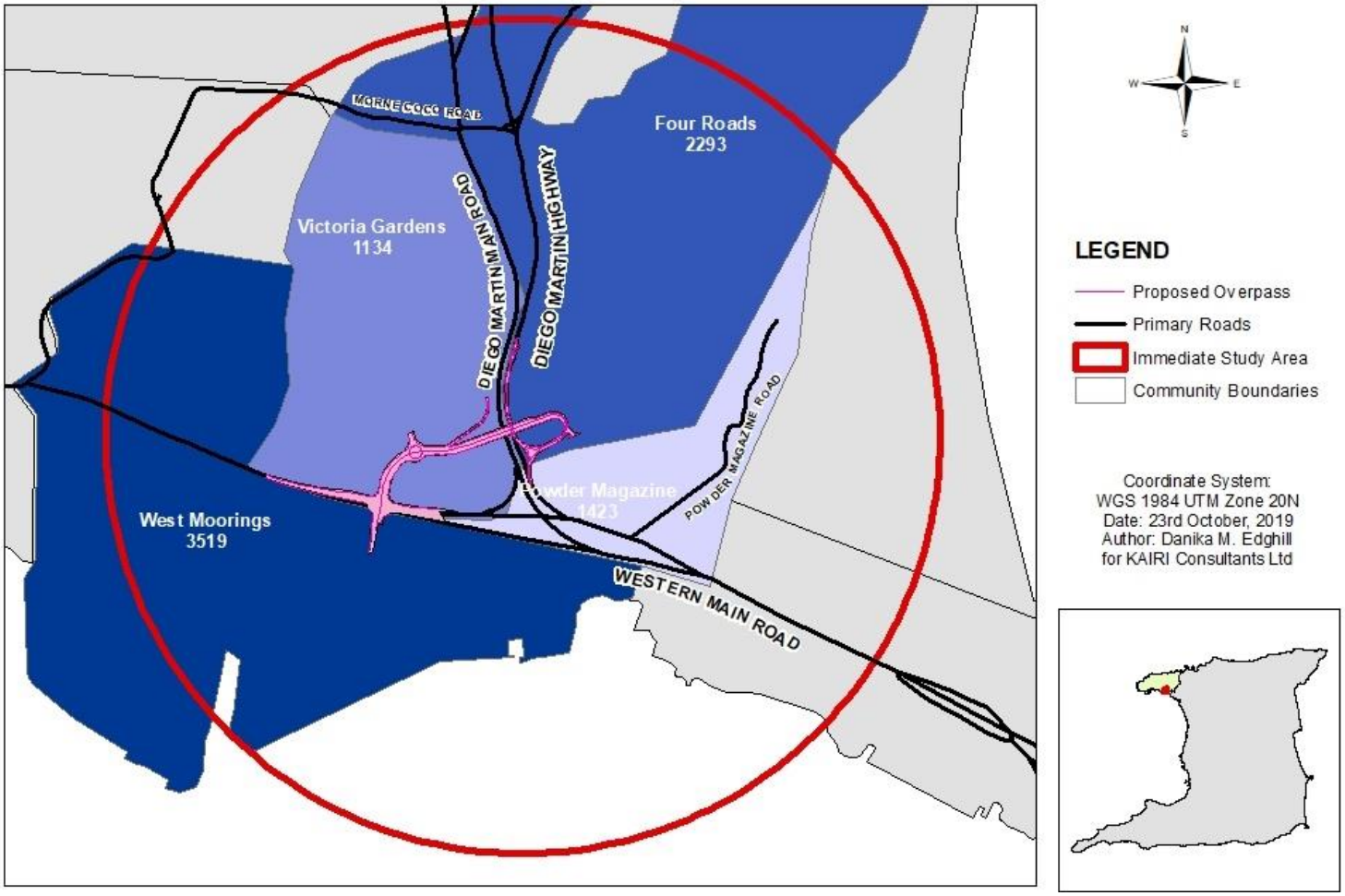


Figure 3.4: Total Population in the Immediate Study Area 2011

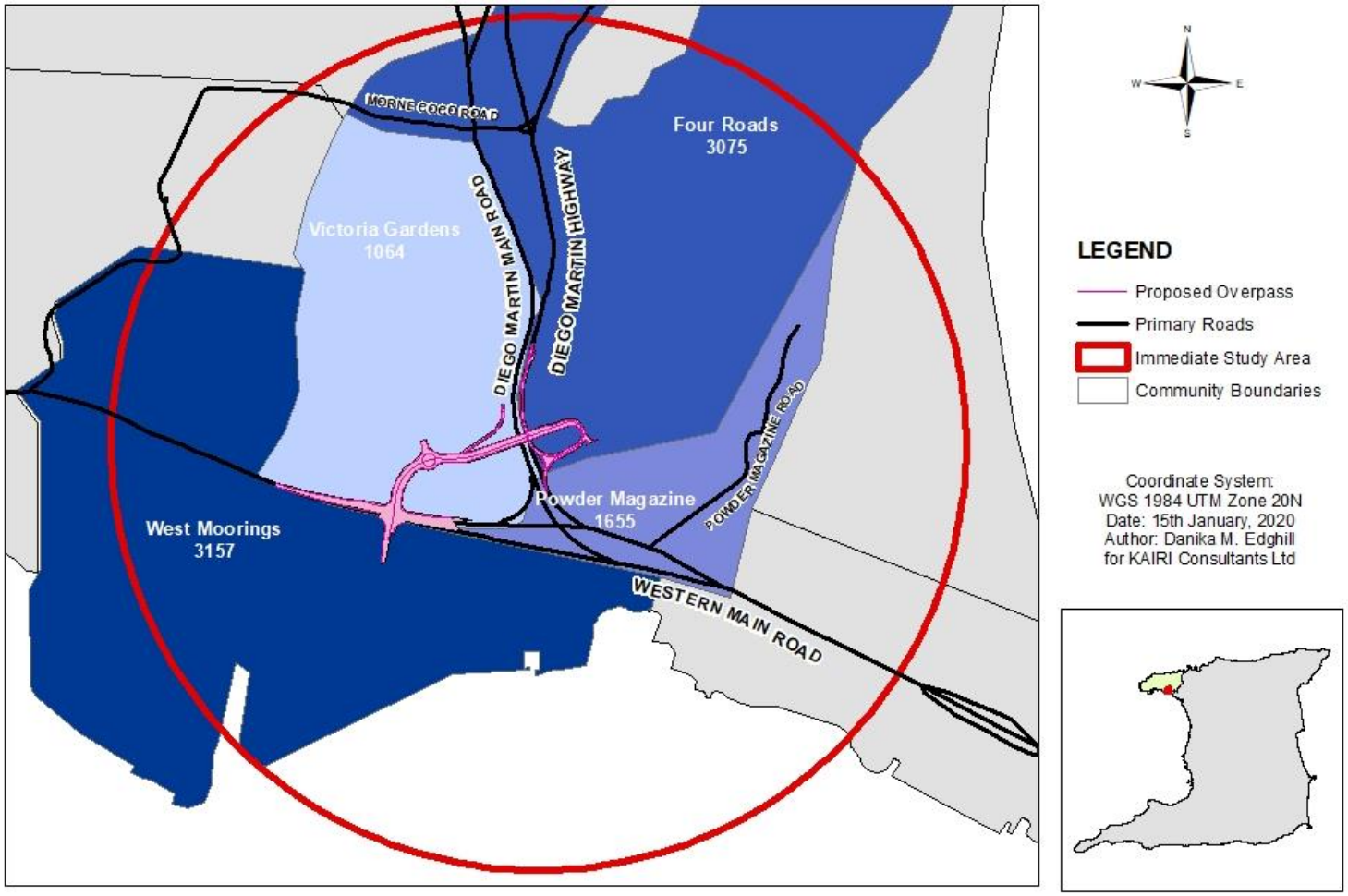


Figure 3.5: Total Population in the Immediate Study Area 2021

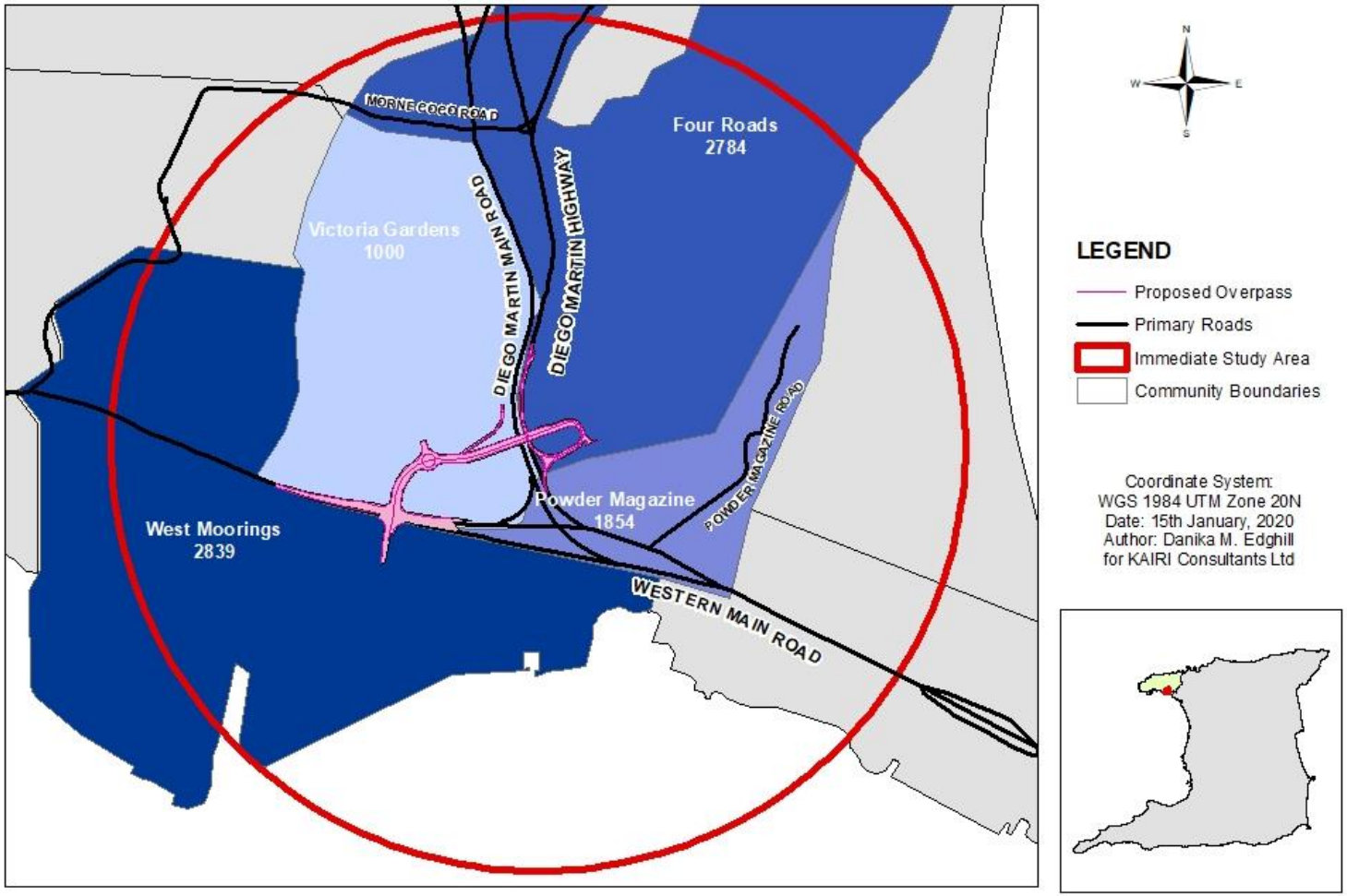


Figure 3.6: Total Population in the Immediate Study Area 2031

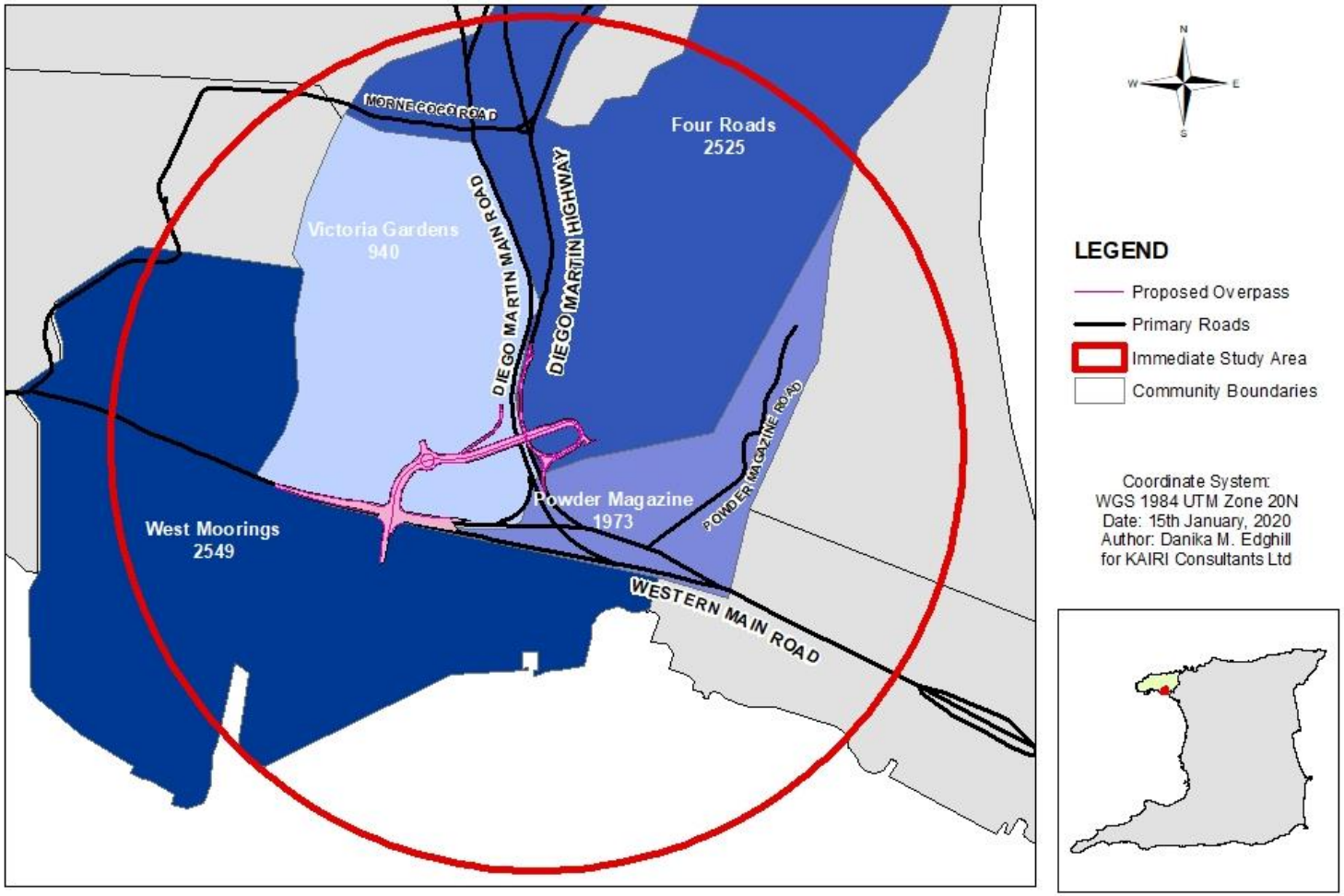


Figure 3.7: Total Population in the Immediate Study Area 2041

3.3.2 SOCIO-ECONOMIC CHARACTERISTICS OF THE RESIDENT POPULATION

3.3.2.1 AGE PROFILE AND DEPENDENCY

Figure 3.8 shows the municipality's age and sex pyramids for 2000 and 2011, reflecting the changing structure of the population over time. The 2011 pyramids for both the male and female population show growth in the youngest age group (0-4 years). A similar widening of the older age groups is also noted and reflects an aging population. The population of Diego Martin is relatively young, with roughly half of the population (50.7%) under 35 years of whom 21.3 percent is between 0 and 15 years. The age group between 10 and 19 years, the majority of whom make up the secondary school age population, accounts for 13.7 percent of the municipality's population. Persons, 65 years and older, made up 12.3 percent of the total population. The population of dependent groups (all persons aged 0-14 years and 65+ years) decreased from 33.6 percent of the total population in 2000 to 32.2 percent in 2011. Conversely, the working-age population (persons between 15 and 64 years) increased from 66.4 percent in 2000 to 67.7 percent in 2011.

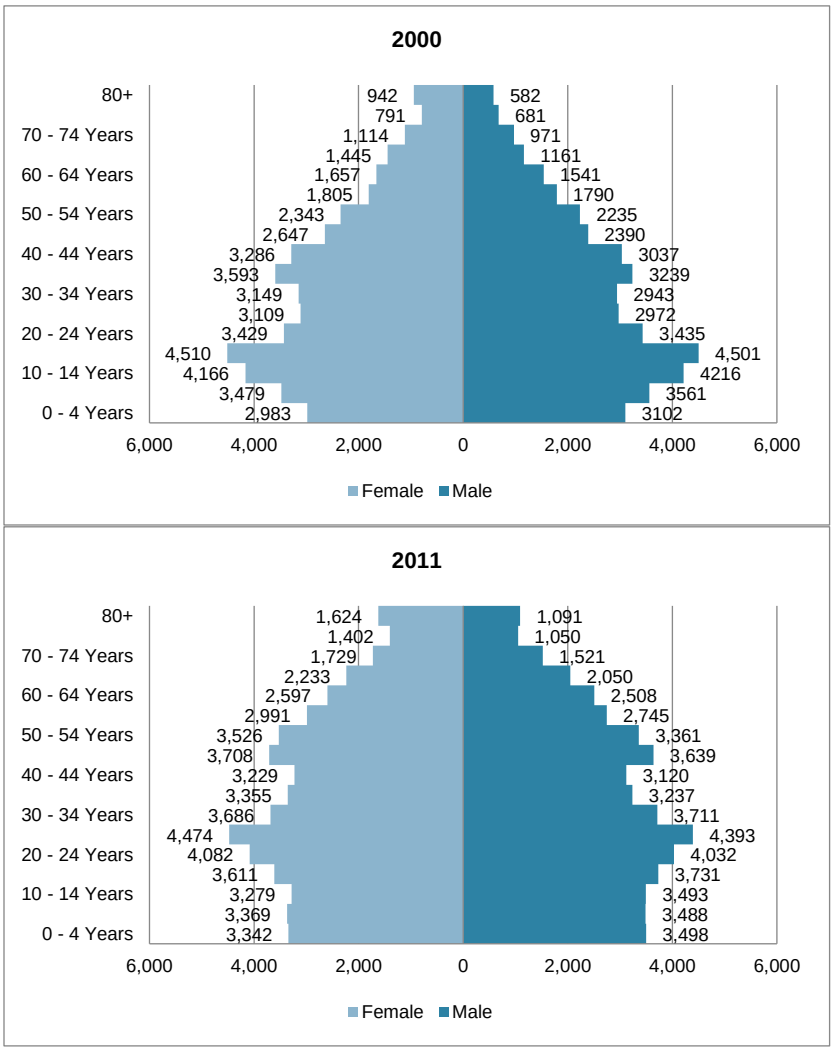


Figure 3.8: Age/Sex Composition of the Population of Diego Martin, 2000, 2011

The age dependency ratio (the ratio of the population between 0 and 14 years and 65+ years to the working- age population, between 15 and 65 years) for Diego Martin in 2011 stood at 47.6 percent; above the national ratio of 41.9 percent and this was due primarily to the increased aging population. This ratio for Diego Martin represents an improvement compared to the 2000 figure of 50.2 percent. The child dependency ratio in 2011 was estimated at 29.4 percent, and elderly dependency at 18.2 percent.

3.3.2.2 EDUCATIONAL ATTAINMENT

According to the 2011 Census, 24.1 percent of Diego Martin's population had attained primary-level education which is lower than the national figure of 29.8 percent (Figure 3.9). Forty five percent of population of Diego Martin had attained secondary and post-secondary, making it 1.4 percent higher than was observed with the national population. Tertiary non-university level educational attainment stood at 7.0 percent and 12.3 percent for those who attained tertiary university-level education. Females outnumbered males at every educational attainment level except the lowest level - primary school. Table 3.4 shows the educational attainment of the Diego Martin population by age group.

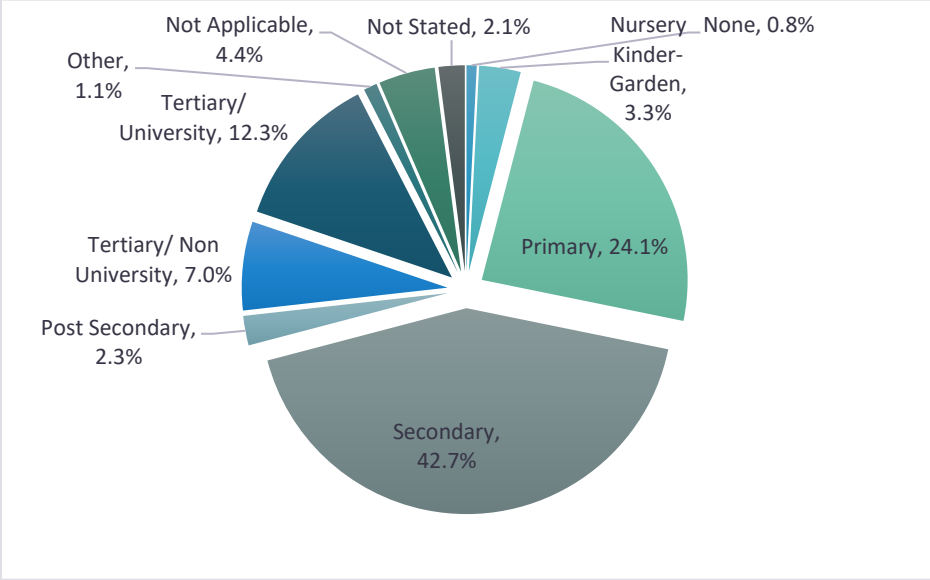


Figure 3.9: Non-Institutional Population of Diego Martin by Educational Attainment

Source: CSO Population and Housing Census, 2011

Table 3.4: Non-Institutional Population of Diego Martin by Age Group and Educational Attainment

Age	Total	None	Nursery/ Kindergarten	Primary	Secondary	Post-Secondary	Tertiary/ Non University	Tertiary/ University	Other	Not Applicable	Not Stated
Diego Martin	102,340	817	3,339	24,704	43,707	2,372	7,127	12,548	1,086	4,541	2,098
0 – 4	6,835	-	2,257	36	-	-	-	-	-	4,541	-
5 - 9	6,839	141	801	5,836	-	-	-	-	-	-	60
10 - 14	6,752	71	222	3,530	2,880	-	-	-	-	-	49

Age	Total	None	Nursery/ Kindergarten	Primary	Secondary	Post-Secondary	Tertiary/ Non University	Tertiary/ University	Other	Not Applicable	Not Stated
15 - 19	7,295	40	10	404	5,696	321	346	343	75	-	59
20 - 24	8,087	23	6	239	4,780	294	972	1,539	122	-	113
25 – 29	8,834	35	3	570	5,013	266	1,017	1,656	154	-	118
30 – 34	7,361	19	2	478	4,274	211	800	1,324	97	-	155
35 - 39	6,542	36	5	372	3,708	196	673	1,301	98	-	154
40 - 44	6,292	39	2	612	3,311	191	649	1,217	79	-	191
45 - 49	7,282	64	7	1,490	3,488	187	566	1,171	114	-	196
50 - 54	6,847	55	1	2,123	2,570	157	512	1,124	100	-	205
55 - 59	5,710	44	3	1,904	2,101	157	419	824	60	-	196
60 - 64	5,086	48	7	1,761	1,894	118	352	698	61	-	147
65 - 69	4,255	57	3	1,588	1,434	97	322	550	63	-	141
70 - 74	3,235	38	2	1,401	1,017	76	201	381	24	-	94
75 -79	2,430	41	2	1,073	776	39	149	240	23	-	87
80+	2,659	67	3	1,284	763	63	149	180	17	-	133

Source: CSO Population and Housing Census, 2011

A review of the highest qualification attained by Diego Martin's population showed that some 42.1 percent of those 15 years or older had no qualifications. This group would also include some persons who may not have written examinations to receive certification. Table 3.5 shows that 3.2 percent indicated that their highest qualification attained was school leaving certificate, with another 2.5 percent reporting that they attained CXC Basic as their highest qualification.

Almost one fifth of the population (19.7%) attained GCE 'O' level/CXC General or 'A' Levels as their highest educational qualification, while 7.6 percent were granted Diplomas, Associate Degrees or Equivalent Certification. Another 7.5 percent would have achieved either a Bachelor's degree, Post Graduate Diploma/ Professional Qualification or a Master's degree. Some 0.3 percent of the population 15 years and older earned doctorate degrees. More women attained Bachelors but more men attained Masters and professional certification than their female counterparts. This can be seen in Table 3.5.

Table 3.5: Non-Institutional Population of Diego Martin by Age Group and Highest Educational Attainment

	Diego Martin		Female Population		Male Population	
	No of Persons	Percentage of Population	No of Persons	Percentage of Population	No of Persons	Percentage of Population
Total	102,340	100	52,127	100	50,212	100
None	43,040	42.1%	20,514	39.4%	22,526	44.9%
School Leaving Certification	3,325	3.2%	1,776	3.4%	1,549	3.1%
CXC Basic	2,521	2.5%	1,235	2.4%	1,286	2.6%
GCE 'O'/CXC Gen/SC	17,951	17.5%	10,222	19.6%	7,728	15.4%
GCE "A"/ CAPE/ HSC	2,223	2.2%	1,318	2.5%	905	1.8%
Diploma or Equivalent Certificate of Achievement	5,592	5.5%	3142	6.0%	2,450	4.9%

	Diego Martin		Female Population		Male Population	
	No of Persons	Percentage of Population	No of Persons	Percentage of Population	No of Persons	Percentage of Population
Associate Degree Higher Diploma	2,147	2.1%	1,261	2.4%	886	1.8%
Bachelor's degree	4,811	4.7%	2,572	4.9%	2,239	4.5%
Master's degree	1,890	1.8%	941	1.8%	948	1.9%
Post Graduate Diploma/ Professional Qualification	1,020	1.0%	478	0.9%	542	1.1%
Doctorate	306	0.3%	120	0.2%	187	0.4%
Other	724	0.7%	357	0.7%	367	0.7%
Not Stated	16,791	16.4%	8,190	15.7%	8,600	17.1%

Source: CSO Population and Housing Census, 2011

About 55 percent of persons in the age groups 20-24 years to 40-44 years had qualifications of CXC/GCE 'O' levels and above. About 58 percent of the population in the 20-24 age grouping had obtained CXC/GCE "O" level passes, demonstrating higher levels of educational qualification compared to the older age groups. Further, as much as 30 percent of the population within the age group of 15-19 years to the 54-59 years reported that they did not have any certification, thereby placing them in a "low skill trap" where they are not likely to participate in certification programmes on their own unless motivated to do so.

On the other hand, with a population with generally higher levels of educational attainment than the national average, and more so among the female population, labour force participation is likely to be higher than the national average among the population of working age. With much of the employment being outside of the Diego Martin area, there would have been a substantial mobility of residents on trips and therefore of traffic to places outside of the study area. The existence of an industrial estate and the growth of business and commerce in the municipality would trigger also some inflows, on a daily basis, of workers employed in establishments in the municipality.

3.3.2.3 RELIGIOUS AFFILIATION

In 2011, Roman Catholic was the largest single religious grouping in Diego Martin (44.8% of the population), followed by Pentecostal/Evangelical/Full Gospel (9.7%), Anglican (8.5%) and Baptist-Spiritual Shouter (4.7%). Interestingly, the groupings 'Other' and 'Not Stated' constituted a significant proportion of the population. Figure 3.10 shows the distribution of the population for the religious groupings. Overall, Christianity dominated religious affiliation.

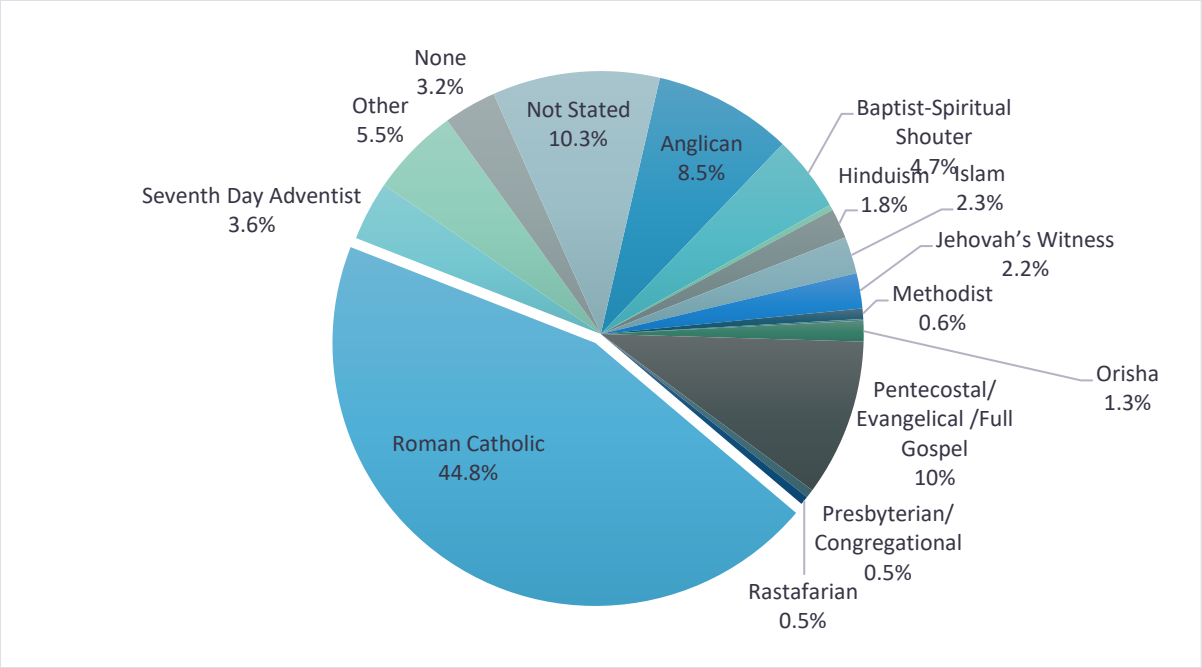


Figure 3.10: Religious Affiliations in Diego Martin, 2011
Source: CSO 2011 Population and Housing Census

3.3.3 LOCAL ECONOMY - MAJOR ECONOMIC ACTIVITY

Information on the share of output contributed by the various sectors is seen in Figure 3.11. The Wholesale and Retail Trade was the dominant sector in the municipality. Accommodation and food services activities followed more or less reflecting the national pattern. It is noteworthy that the information and Communication sector and professional and scientific activities as a share of output were much more significant in the Diego Martin municipality than in the nation as a whole. In Construction and, significantly, in Transport and Storage, Diego Martin was above the national average.

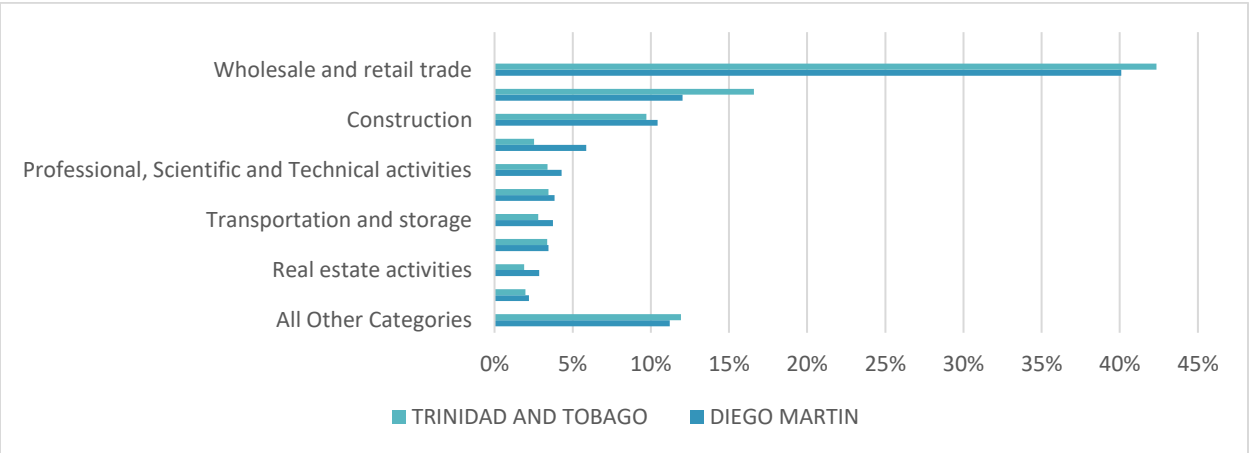


Figure 3.11: Number of Business Establishments in Diego Martin and Trinidad and Tobago as at 2018

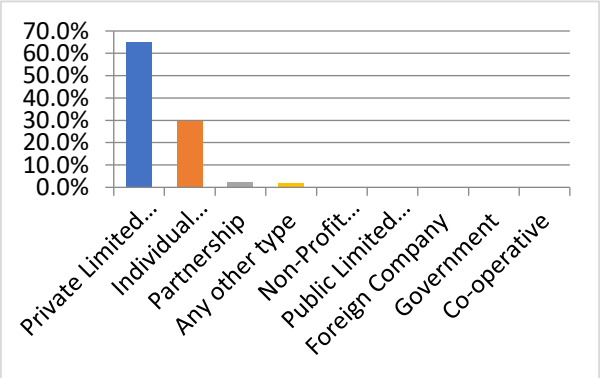


Figure 3.12 illustrates businesses registered in the Diego Martin Region by Legal Status. Of the registered businesses which operate in Diego Martin, the vast majority (95%) are Private Limited Liability Companies, followed by Sole Proprietorship. The chart also shows that the private sector, which comprises of corporate enterprise and individual proprietorships, had the highest percentage. In comparison to other business establishments in the Diego Martin area, there are few government offices present in the study area.

Figure 3.12: Business Establishments in Diego Martin by Type of Ownership
Source: Central Statistical Office - Business Surveys Establishments

3.3.4 EMPLOYMENT PATTERNS IN THE MUNICIPALITY OF DIEGO MARTIN

The majority of establishments hired less than ten workers. There were only a few establishments which had as many as 50 or more employees on their payroll. The third highest average and median incomes were recorded in Diego Martin, which, prima facie, suggests that it was one of the better-off municipalities in the country (Figure 3.13).

The municipality had a higher labour force participation rate and lower unemployment rate than the national average for all of the period 2012 to 2016 (Table 3.7, Table 3.8 and Figure 3.14). As expected, Diego Martin had a higher percentage of its labour force in the higher-level occupational categories – Managerial, Professional and Technical - and a lower percentage in semi-skilled and Elementary Occupations.

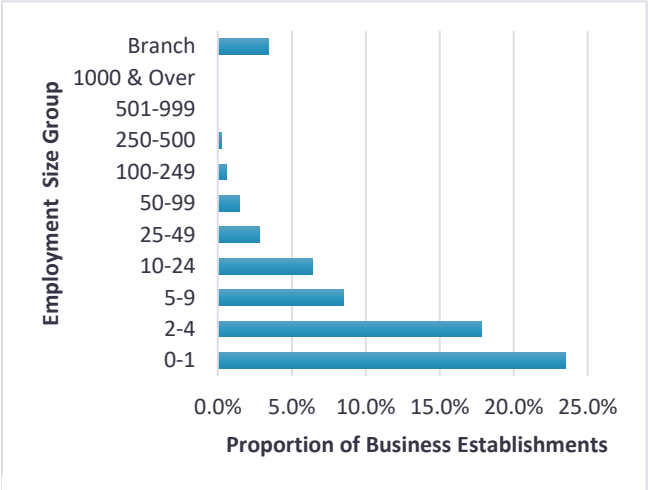


Figure 3.13: Business Establishments in Diego Martin by Employment Size Group

In effect then, residents in the municipality were some of the higher-level personnel in the economy, who, most likely, participated in the higher echelons of the labour market and earned their keep in employment outside of the area. This would have required substantial numbers needing to travel outside of the community to work, on a daily basis. The traffic that this generates is what is responsible for much of the congestion evident in the area during the workweek.

In decomposing the working age population into its various components, as much as 72 percent were employees. Significantly, although public sector establishments were only a very small percentage of the productive sector in the municipality, as much as 32 percent of employees in the municipality worked in the public sector. Clearly, most of them commuted outside of the municipality to workplaces elsewhere in the country. This points to the demand for transportation to destinations outside of the municipality. Given the high density of the population in the Diego Martin area, and the limited road access into and out of the area, the Diego Martin Highway and Main Road are likely to carry heavy traffic on a daily basis.

Table 3.6: Average and Median Monthly Income by Administrative Area 2012 - 2016

Income Category	Year	Trinidad and Tobago	Administrative area															
			Port of Spain	San Fer-nando	Arima Bor-ough	Point Fortin Bor-ough	Chagua-nas Bor-ough	St. George	*of which*			Rest of St. George	Ca-roni	Nariva/ Mayaro	St. Andrew/ St. David	Vic-toria	St. Pat-rick	To-bago
									Diego Martin	St. Anns	Taca-rigua							
		Trinidad and Tobago Dollars																
*Average Income	2012	4965	6033	5933	4947	5184	4726	5430	6366	4239	5686	4178	5340	3629	4569	5231	4102	4814
	2013	5211	6354	6890	4936	5795	4103	5448	7014	4128	5202	4449	5547	3952	4305	5161	4622	4845
	2014	5580	5627	7191	5452	6312	5181	5524	6302	4654	5615	5067	5700	4306	4746	5906	5118	5146
	2015	5737	6515	7267	6249	6635	6208	5993	6748	4899	6331	5400	5745	4545	5184	5730	5149	5305
	2016	6077	5829	7237	6566	6344	6487	6496	6876	5127	7486	5707	5750	6180	4579	5935	5916	5730
Median income	2012	4000	4500	5000	4000	4000	4000	4000	4000	3500	4500	3500	4100	3000	4000	4500	3800	4000
	2013	4000	5000	5000	4000	4900	3000	4167	5000	3500	4000	4000	4800	3500	3500	4000	4000	4200
	2014	4500	4500	5000	4000	5000	4000	4400	5000	4000	4200	4000	5000	3500	3500	4000	4000	4200
	2015	5000	5000	6000	5000	5000	5000	4667	5000	4000	5000	4600	5000	4000	4000	5000	4000	4500
	2016	5000	5000	6000	5000	5000	5000	5000	5000	4500	5500	4500	5000	4500	4000	5000	5000	5000

Source: Central Statistical Office, Continuous Sample Survey of the Population 2016

Table 3.7: Decomposition of the Working Age Population in Diego Martin by Labour Force Status 2012 - 2016

Administrative area	Year	Non-Institutional population 15 years old and over	Labour force					Percentage		Not in labour force
			Total labour force	Persons with jobs	Unemployed			Labour force as a percentage of population 15 years old and over	Unemployed as a percentage of labour force	
					Total unemployed	Persons without jobs and seeking work	Other unemployed			
			(3) + (4)		(5) + (6)			(2) ÷ (1)	(4) ÷ (2)	(1) - (2)
		Both sexes (Hundreds '00)								
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Trinidad and Tobago	2012	10 550	6 528	6 205	324	240	84	61.9	5.0	4 022
	2013	10 596	6 502	6 263	238	173	65	61.4	3.7	4 095
	2014	10 634	6 586	6 368	217	162	56	61.9	3.3	4 048
	2015	10 651	6 453	6 233	220	155	65	60.6	3.4	4 198
	2016	10 689	6 385	6 132	253	203	50	59.7	4.0	4 304
Diego Martin	2012	806	502	488	14	9	5	62	3	304
	2013	843	518	507	12	4	7	61	2	325
	2014	783	492	486	6	4	2	62.8	1.2	291
	2015	799	504	494	10	8	2	63.1	2.0	295
	2016	899	565	554	12	7	6	62.8	2.1	333

Source: Central Statistical Office, Continuous Sample Survey of the Population 2016

Table 3.8: Persons With Jobs By Occupational Group, Sex And Administrative Area

Administrative Area	Year	Total all occupation	Occupational group								
			Legislators, senior officials and managers	Professionals	Technicians and associate professionals	Clerks	Service workers (incl. defence force) and shop sales workers	Agricultural, forestry and fishery workers	Craft and related workers	Plant and machine operators and assemblers	Elementary occupations
		Both sexes (Hundreds '00) and (%)									
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Trinidad and Tobago	2012	6205	8%	5%	13%	11%	16%	2%	15%	9%	20%
	2013	6263	9%	5%	13%	11%	15%	2%	15%	9%	20%
	2014	6348	9%	5%	13%	11%	16%	2%	15%	9%	19%
	2015	6233	10%	6%	12%	11%	15%	2%	15%	9%	19%
	2016	6132	10%	6%	13%	10%	15%	2%	16%	9%	18%
Diego Martin	2012	488	11%	6%	16%	11%	16%	3%	11%	7%	17%
	2013	507	15%	8%	18%	9%	14%	4%	11%	6%	14%
	2014	486	13%	7%	14%	12%	15%	3%	12%	6%	18%
	2015	494	13%	8%	15%	11%	15%	2%	14%	7%	15%
	2016	554	13%	10%	15%	10%	14%	3%	13%	7%	15%

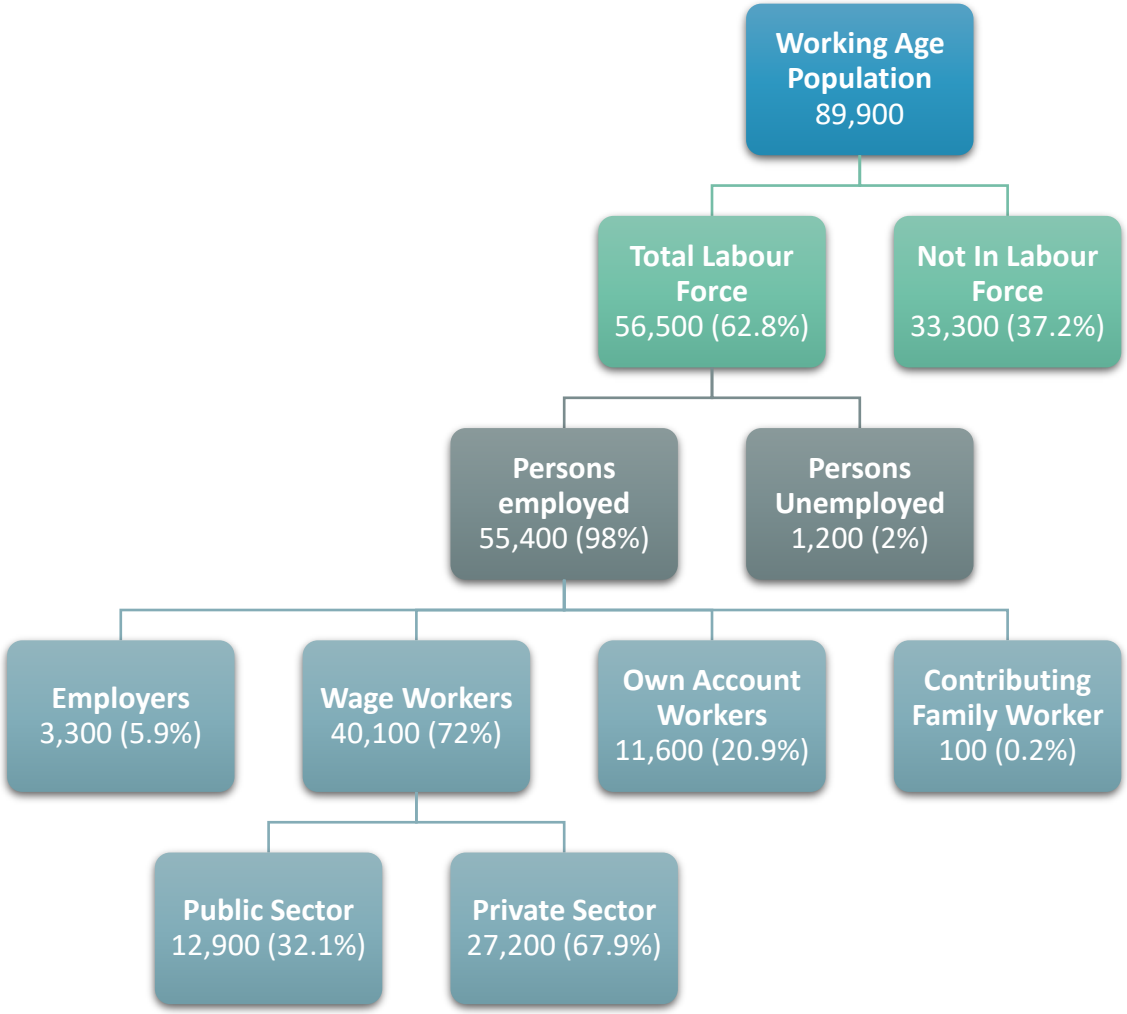


Figure 3.14: Decomposition of the Working Age Population in Diego Martin by Labour Force Participation and Labour Force Status
Source: Central Statistical Office, Continuous Sample Survey of the Population 2016

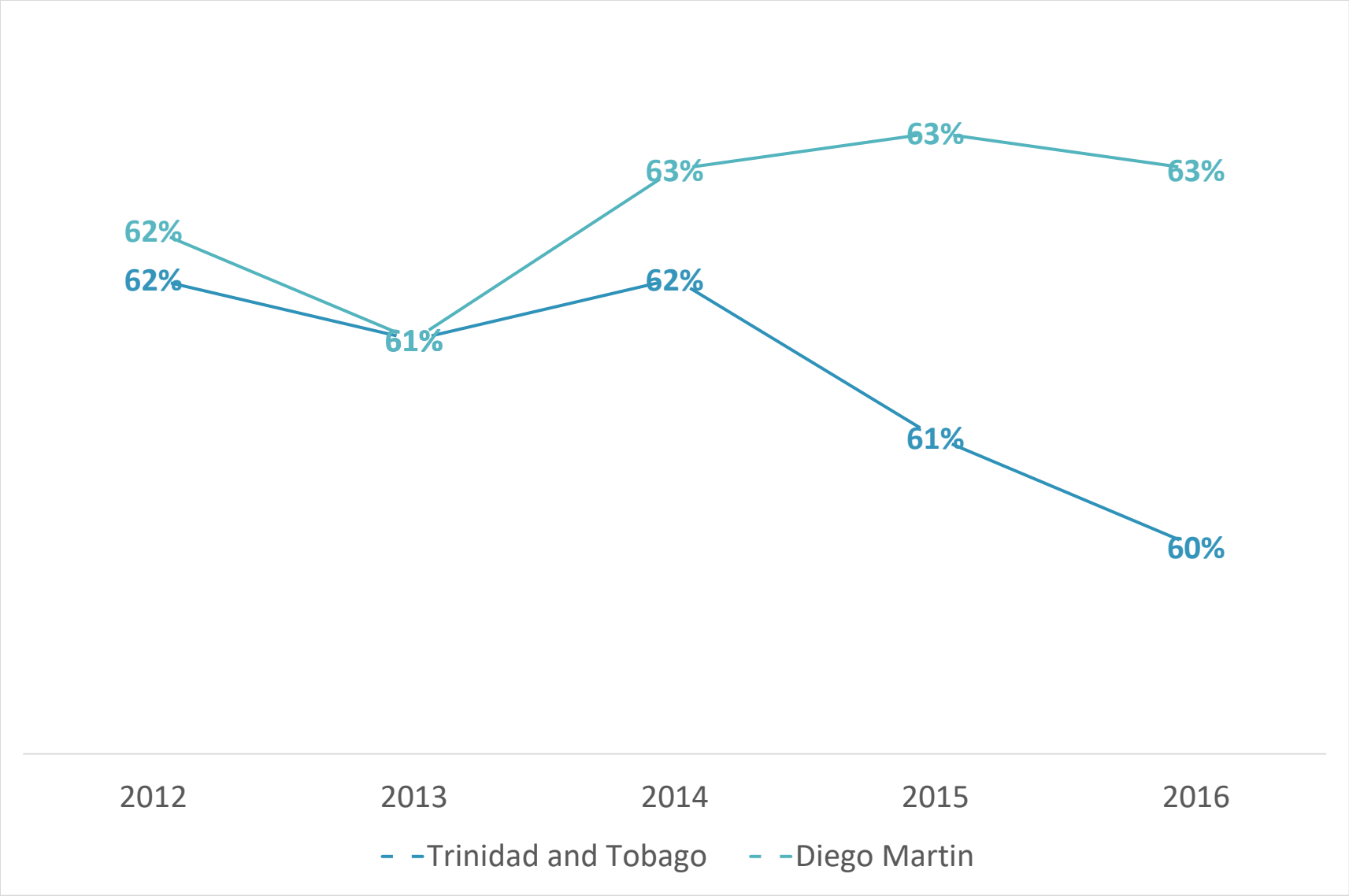


Figure 3.15: Labour Force Participation Rate 2012 - 2016 for Trinidad and Tobago and Diego Martin
Source: Central Statistical Office, Continuous Sample Survey of the Population 2016

3.4 RESOURCE USE

The Diego Martin region is a sizeable natural environment characterised by a series of densely settled north-south valleys located north of the City of Port of Spain and west of the San Juan/Laventille region; hillside development on the western periphery of the City of Port of Spain; coastal settlements along its southern edge and low density rural settlement on the north coast. The Chaguaramas Peninsula, known worldwide for its natural beauty, dominates the western portion of the region.[5]

3.4.1 LAND USE OF THE IMMEDIATE STUDY AREAS

Diego Martin is mostly forested hillsides and valleys with the only flat land on the south shore and on the floodplains of the Diego Martin, Maraval, and Cuesta Rivers (Figure 3.16)[6]. The inland landscape is dominated by the Northern Range slopes, valleys, and tropical mountain forest cover. Fertile agricultural lands lie along the Tucker Valley and popular beaches can be found on the northern and southern coasts of the region[7].

Informal settlements and illegal squatting have exacerbated the impact of hillside development within the region and resulted in marked increases in flooding events and land slippage, more so in the recent past. The area provides a vibrant environment for a wide range of business and industrial activities, from dockyard services and other maritime-related industries to small high-tech enterprises. With several education campuses (UTT; Trinidad & Tobago Hospitality & Tourism Institute; Caribbean Fisheries Training and Development Institute) located here, there are opportunities to develop the synergies between entrepreneurial businesses, eco-business and research/training providers of potentially international significance in an attractive environment close to Port of Spain.

The immediate study area is comprised of low and high-rise middle and upper middle-income residential units – Victoria Keyes, Victoria Villas, Chaconia Crescent, and Powder Magazine No. 2, and single-family residences in the gated community of Victoria Gardens. There is also the long established lower middle-income community of Four Roads, also with mainly single-family residences. In this high-density suburban district, there is also a bustling shopping mall - the Starlite Shopping Plaza. There are two petrol filling stations, and a Police Station and a Fire Station, all within a one-kilometre radius area.

[5] *Diego Martin Municipal Investment Plan, MLG 2012.*
[6] *Diego Martin Regional Development Plan, MLG 2010.*
[7] *National Spatial Development Strategy, MPSD 2013.*

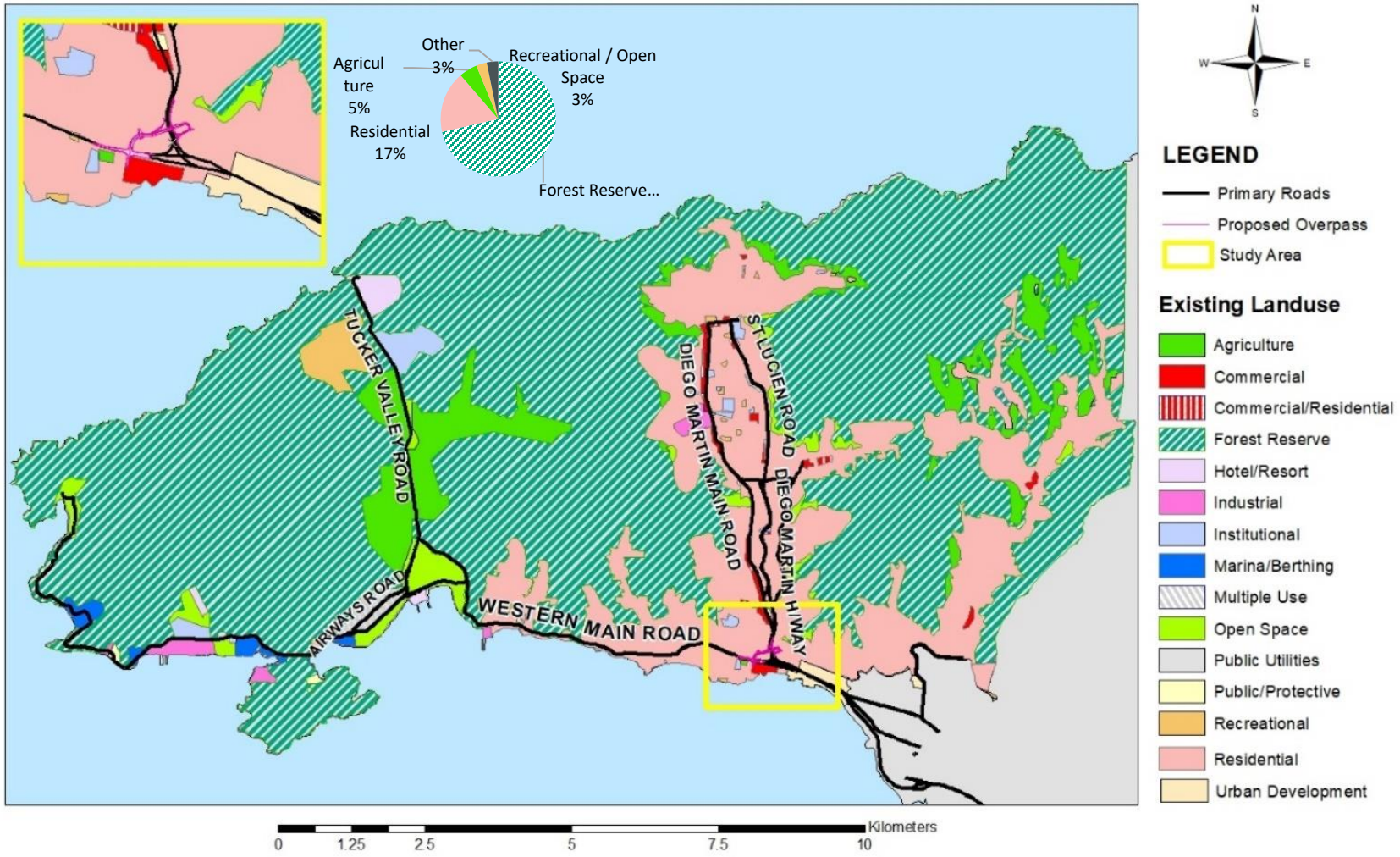


Figure 3.16: Land Use in the Municipality of Diego Martin
Source: Town and Country Planning Division, Ministry of Planning & Development 2009

3.4.1.1 COASTAL AND MARINE RESOURCES

The Diego Martin/Carenage hills are predominantly limestone with the floor of the Diego Martin valley composed largely of North West Peninsula gravels. These important water-bearing aquifers are the main source of potable water in the region. However, poor waste management, unauthorised development, and run-off from inland degrade the region's water quality[8].

The pattern of currents in the Gulf of Paria also results in sewage, solid waste and chemical pollutants collecting from sources along other parts of the west coast. Despite water quality issues, the sheltered nature of the waters along the southern coast makes these areas popular recreation destinations. Local marinas are well utilised, accommodating both domestic and internationally owned yachts. Given its location outside of the main hurricane belt, Trinidad's west coast is an attractive location to harbour vessels and Chaguaramas has the potential to develop this opportunity further[9].

According to the NSDS's Core Strategy and Regional Guidance document, what is called for in the region is "...making prudent use of natural resources to deliver economic diversification... In this context, the [region] has a wealth of largely untapped natural resource-based development opportunities, particularly in the tourism and eco-tourism, agriculture, maritime and eco-business-related sectors." Expansion of residential accommodation along the Western Main Road to the Carenage area and of marine related businesses has generated economic activity and attracted workers from elsewhere in the municipality and from further afield.

3.4.2 GEOLOGY/SOILS OF THE STUDY AREA

The main types of soil in the study include the following (MMM Group Limited, Trintoplan Consultants Ltd, and Ecoengineering Consultants Ltd 2015):

- **River Estate loams –** these are deep alluvial soils with free internal drainage. Moderate in potassium and phosphates with adequate calcium and magnesium. These soils have unsatisfactory water relations on slopes between 2° and 5°
- **St. Augustine clay –** these are terrace soils with free internal drainage. They are acid soils which are low in phosphates and potassium but moderate in nitrogen. These soils have unsatisfactory water relations on slopes 0-10° and have a risk of soil erosion on slopes between 10° and 20°.
- **Caroni Peaty Clay** – these are clays with a high percentage of humus, sub-soil of clay and peat. They are strongly acidic and well supplied with major nutrients. They also tend to have a high salt content. These soils have unsatisfactory water relations on slopes between 0° and 2°.
- **Maracas and Matelot sandy loams –** these are soils of the high uplands with free internal drainage. They are acid soils and are low in all the major nutrients. They have a risk of soil erosion on slopes 10° or more.

The major geological formations at the project site include the Maracas Formation, alluvium, Chancellor Formation and Morvant Beds. Detailed descriptions are as follows (MMM Group Limited, Trintoplan Consultants Ltd, and Ecoengineering Consultants Ltd 2015):

1. **The Maracas Formation of the Cretaceous Age**, which is found throughout the western part of the Northern Range. These rocks lie apparently conformably above the Maraval Fm. A considerable part of the Maracas Fm consists of interbedded quartzites and phyllites, however, there seems to be a tendency for the lowest

[8] Diego Martin Regional Development Plan, MLG 2010.
[9] National Spatial Development Strategy, MPSD 2013.

part of the formation to contain more slates and sericitic phyllites than average, with some thin interbedded sericitic quartzites.

2. **Alluvium of Geologically Recent Origin.** Throughout the Northern Range there is alluvium at surface in the main valleys and south of the range itself. The valleys are wider and deeper in the west.
3. **Chancellor Formation (Fm).** Most of the Chancellor Formation is confined to the western end of the Northern Range, extending 36 km eastwards. There are four members in the Chancellor Fm: a lower limestone member lying apparently conformably on the Maracas Fm, succeeded by a phyllite member which is followed in turn by an upper limestone sequence; then finally by upper phyllitic beds.
4. **Morvant Beds** occur in the area between Laventille and San Juan. However there are outcrops of possible Morvant Beds which occur further west at the southern tip of the Lady Chancellor and on the shore of Cocorite Bay. The Morvant beds consist of coarse yellow to buff quartzitic sandstones, often in thick massive beds, and slates and shales.

3.4.3 TOPOGRAPHY AND DRAINAGE

The proposed alignment of the Diego Martin Highway and Western Main Road lies on flat land (<50 feet contour). However, to the east of the Diego Martin Highway, the land slopes upwards steadily to about 600 feet. The study area lies in the Lower Diego Martin River Catchment and is drained by the Diego Martin River, which discharges directly into the Gulf of Paria. The majority of the Diego Martin River is paved, except at the mouth of the River. The area is also drained by several municipal drains throughout the urban areas of Cocorite, Four Roads and Bayshore. The majority of these channels are paved and contain culverts which facilitate runoff from urban areas directly into the Gulf of Paria. However, within the recent past, the area has been subjected to devastating floods. These floods may have been attributed to a combination of very intense rainfall and an inadequate drainage infrastructure caused by rapid land cover changes (MMM Group Limited, Trintoplan Consultants Ltd, and Ecoengineering Consultants Ltd 2015).

3.4.4 WATER RESOURCES

Exploitable groundwater in Trinidad occurs in aquifers which consist mainly of unconsolidated sediments. The type of aquifer found within the study area is Alluvial and Piedmont Gravel-Fan Aquifers. The following information on this aquifer was obtained from MMM Group Limited, Trintoplan Consultants Ltd, and Ecoengineering Consultants Ltd (2015):

"Alluvial and Piedmont Gravel-Fan Aquifers are generally located within and to the south of the Northern Range, from Chaguaramas in the west to Valencia in the east. These aquifers are mainly water-table aquifers. The major aquifer within this geological type that falls within the study area is the North-West Peninsula Gravels. The North West Peninsula Gravels comprise the alluvial deposits that occur in the north-south trending valleys of the Northern Range extending from Chaguaramas in the west to Port of Spain in the east. The river valleys here include Chaguaramas, Cuesa, Diego Martin, St. Ann's, Cascade and Maraval Rivers. Of relevance to this project is the Diego Martin River.

The well fields which comprise the North-West Peninsula Gravels are Tucker Valley, Diego Martin, River Estate and Port of Spain/Maraval. The deposits in these aquifers are composed mainly of gravel with boulders interbedded with thin layers of sand and subordinate clay, derived from erosion of the Northern Range phyllites, limestone and quartzose rocks".

The aquifer systems within the Northern Range are supplied mainly from rainfall entering the soil and reaching the water table via normal infiltration. Stream flow and subsurface flow are also significant contributors in the continual

process by which these aquifers are recharged. Stream bed infiltration is a secondary source of recharge and occurs as rivers run through the gravel fans especially in undeveloped areas.

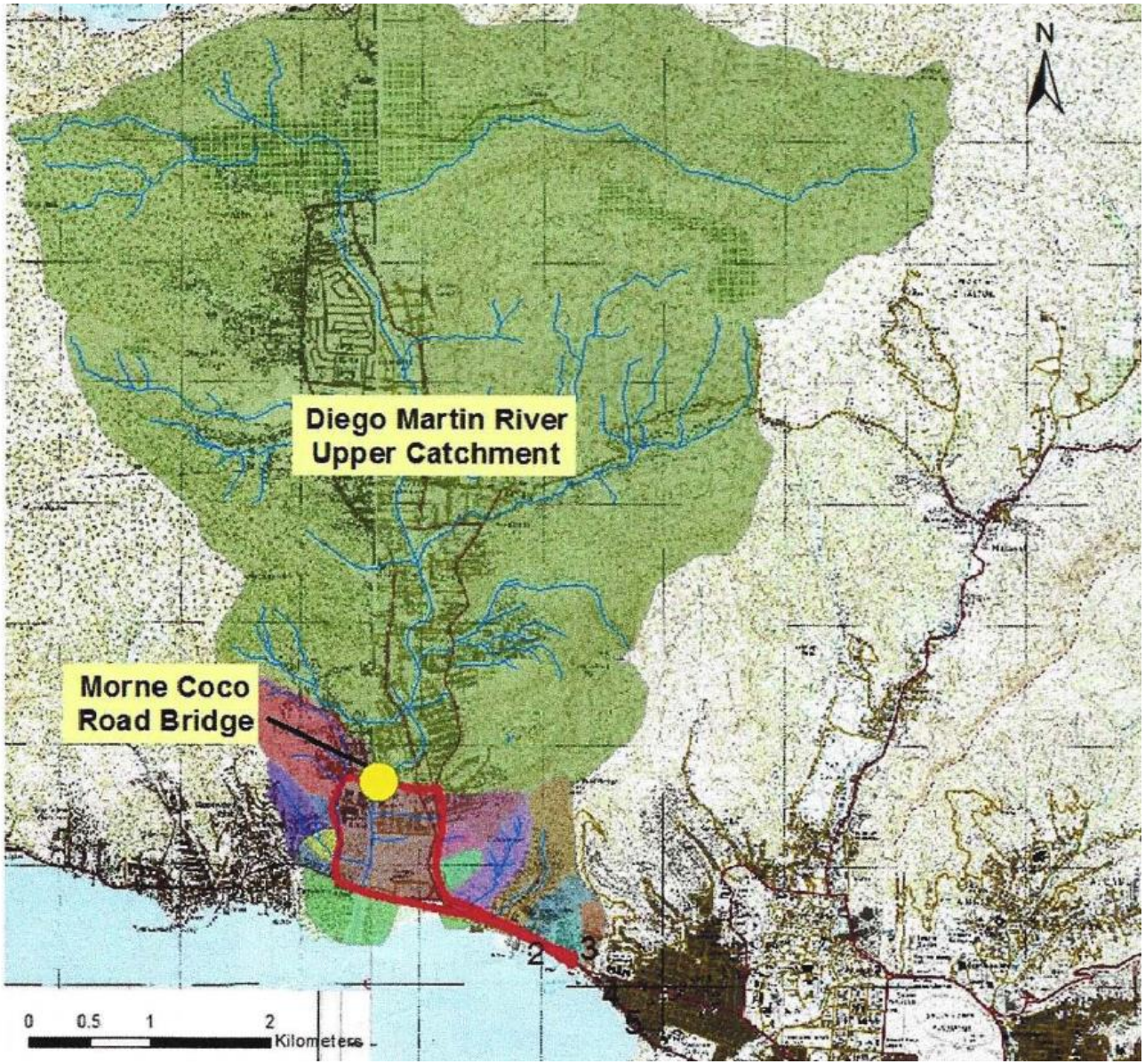


Figure 3.17: Diego Martin River Catchment

3.4.5 UTILISATION OF PHYSICAL AND SOCIAL INFRASTRUCTURE

3.4.5.1 COMMERCIAL DISTRICTS

There are five major commercial nodes in the municipality. The West Mall is the largest and attracts clientele from much of the North West of Trinidad, in addition to residents from the municipality. There are also the Glencoe, the Starlite, Alyce Glen, and the Diego Martin Consumers Cooperative Society shopping areas in the western area of the municipality, along with a number of business places strung out along the Diego Martin Main Road, the Morne Coco Road and in Carenage. In the eastern section of the municipality, there are the Ellerslie Plaza in Boissiere and the Shoppes of Maraval on the Saddle Road. There are much smaller business areas in Maraval, and in the various communities catering to local clients. There are also areas of informal vending activity especially of produce along some of the main thoroughfare.

3.4.5.2 INDUSTRIAL ESTATE

The Diamond Vale Industrial Park is the only major industrial site in the municipality. It is comprised of 21 hectares, and there are 26 factory buildings. Activities include fabrication of hazardous, toxic and flammable materials, manufacture of cotton products, ceramic, sanitary ware, crockery, pharmaceutical items, electric filaments, garments, food products, polyethylene, wood and paper products.

3.4.5.3 DOCKYARD/MARINA

A deep-water and sheltered harbour at Chaguaramas has long been established as a ship-repair yard. The anchorage depth is 15.2m and cargo pier depth 7.6m. Because Trinidad has been just outside the path of hurricanes, at the end of the island chain in the Eastern Caribbean, Chaguaramas is a favourite location for the dry-docking and storage of yachts in the Caribbean. There is also a marina which hosts a large number of yachting enthusiasts on the final port of call to the south-eastern Caribbean on voyages from the USA, and the North Atlantic.

3.4.5.4 TRANSPORTATION (LAND)

The municipality is serviced by a number of arterial roads that link it to the two neighbouring municipalities of the City of Port-of-Spain and the San Juan Laventille Municipality to the east. The Diego Martin Highway and the Diego Martin Main Road traverse much of the Diego Martin Valley, with connections to the various communities in the centre and the north of the Municipality – St. Lucien Road, Petit Valley Main Road, Majuba Cross Road, Ravine Road, and Ravine Road. The Western Main Road extends from Tragarete Road and merges with Audrey Jeffers Highway before creating an exit to the Diego Martin Highway as it extends through Carenage and eventually to Chaguaramas, which is beyond the municipality of Diego Martin and is under the authority of the Highways Division of the Ministry of Works and Transport.

The Morne Coco Road links the north of the Municipality to the Saddle Road which skirts the east of the municipality having provided an exit out of Port-of-Spain into the communities of the east of the Municipality of Fairways, La Seiva, and Maraval proper. High density of living accommodation, with the majority of residents employed outside of the municipality, has contributed to traffic congestion in most of the municipality.

3.4.5.5 WATER SUPPLY DISTRIBUTION

Water supply in Diego Martin is good, except in some of the housing areas on hill slopes. Water extraction is based on ground water sources from wells in the area.

3.4.5.6 WASTEWATER AND SOLID WASTE MANAGEMENT

While large sections of the municipality are sewered, there are squatter settlements and informal housing which lack water closets linked to sewer lines. Untreated sewage is discharged into the Diego Martin River and thence to the Gulf of Paria. There is also illegal dumping of waste, and indifferent servicing of skips which creates unhealthy conditions in some areas of the municipality.

3.4.5.7 DRAINAGE

There are areas of the municipality that are prone to flooding and development practices have contributed to large flood flows that challenge the existing discharge capacity. Residents in Victoria Gardens have experienced severe flooding in recent years. The proposed alignment of the Diego Martin Highway and Western Main Road lies on flat land (<50 feet contour). However, to the east of the Diego Martin Highway, the land slopes upwards steadily to about 600 feet. Along Morne Coco Road, the topography is undulating, rising westwards steadily to approximately 500 feet. The portion of the study area along the Western Main Road occurs on flat land.

The study area lies in the Lower Diego Martin River Catchment and is drained by the Diego Martin River, which discharges directly into the Gulf of Paria. The majority of the Diego Martin River is paved, except at the mouth of the River. The area is also drained by several municipal drains throughout the urban areas of Cocorite, Four Roads and Bayshore. The majority of these channels are paved and contain culverts which facilitate runoff from urban areas directly into the Gulf of Paria. However, within the recent past, the area has been ever increasingly subjected to devastating floods. These floods may be attributed to a combination of very intense rainfall and an inadequate drainage infrastructure caused by rapid land cover changes.

3.4.5.8 ELECTRICITY AND COMMUNICATIONS TECHNOLOGY

The population of the municipality enjoys universal access to electricity. The area is relatively well supplied with telecommunications services. The wide adoption of cell phones has democratised telecommunications services and rendered landlines marginal in the provision of access. Underground cabling exists but the bulk of the infrastructure is based on above ground wires and poles along streets. Internet penetration continues expanding and is not yet universal.

3.4.5.8.1 DWELLING/BUILDING STOCK

There have been a number of housing programmes over the years. While there has been a substantial amount of low-cost single-family units that have been built over the years, the municipality has attracted a large number of middle and high-end developments in recent years and is the location of some of the most elite districts in the country, including the town house and high-rise apartment sites. Because of this, the municipality has become an area of high density, in terms of housing accommodation.

3.4.6 LOCATIONS OF KEY FACILITIES

3.4.6.1 HEALTH

A wide range of health facilities caters to the needs of the burgesses of the Diego Martin region. Table 3.9lists available facilities. (Figure 3.18). The North West Regional Health Authority provides primary and secondary health care for the municipality. Within the municipality are located four health centres, providing primary health care and secondary services are available at the Port-of-Spain General, and St. Ann's Hospital. The residents of the municipality would rely on the public and private secondary care facilities that exist in Port-of-Spain which are within

easy reach of most areas of the municipality. Two private hospitals operate in the immediate study area, namely Westshore Medical Hospital and the Community Hospital of Seventh Day Adventists.

Table 3.9: Health Facilities in the Diego Martin Regional Corporation

Facility	Address	Type	Affiliation
Carenage Health Centre	Constabulary Street, Carenage	Health Centre	NWRHA
Diego Martin Health Centre	Church Street, Diego Martin	Health Centre	NWRHA
Petit Valley Health Centre	Simeon Road, Petit Valley	Health Centre	NWRHA
Maraval Health Centre	Saddle Road, Maraval	Health Centre	NWRHA
Westshore Medical Hospital	Western Main Road, Cocorite	Hospital	Private
Community Hospital of Seventh Day Adventists	Western Main Road; Cocorite	Hospital	SDA Church

3.4.6.2 EDUCATION

Public facilities for the provision of Primary and Secondary Education are available in the municipality (Figure 3.19): however, many residents send their children to schools outside of the municipality, especially at the secondary level.

3.4.6.3 COMMUNITY CENTRES AND RECREATIONAL FACILITIES

Community Centres in the populated area of the municipality are limited (Figure 3.20). There also exists a wide cross section of Recreational Facilities exist in the municipality (Figure 3.21) for swimming, basketball, football and netball, but many residents do journey to neighbouring Port-of-Spain for outdoor sporting activity and recreation. However, in the Chaguaramas Peninsula, the natural environment offers possibilities for recreation for individuals and families – sea bathing, fishing, golf, hiking and riding.

3.4.6.4 HUMAN RECEPTORS IN THE DIEGO MARTIN MUNICIPALITY

Figure 3.22 illustrates the human receptors located within the immediate study area and the wider Diego Martin Region. The key sensitive receptors in the immediate study area include a pre-school in the vicinity of Powder Magazine, the International School of Port of Spain, playgrounds west of Diego Martin river and north of Powder Magazine, and Dunross Preparatory School. 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.

3.4.6.5 DISASTER MANAGEMENT

As part of its remit, the regional corporation is charged with the responsibility of the development of a disaster management system for the municipality guided by the National Disaster Management Policy and the Ministry of Local Government Disaster Management Policy. A number of emergency shelters are available for use in times of crisis (Figure 3.23).

3.4.6.6 SAFETY AND SECURITY

The Emergency Services available in the municipality are comprised of the four health centres, primary and secondary schools that can be used as shelters, two Police Stations in Diego Martin and one each in Maraval and in

Chaguaramas, and one Fire Station in Diego Martin and another in Chaguaramas (Figure 3.24). There are two private hospitals just outside of the municipality – the Community Hospital and Westshore Medical Private Hospital. The public hospitals in St. James and in Port of Spain are at some greater distance away but readily accessible by ambulance.

Figure 3.18: Health Facilities in the Diego Martin Municipality

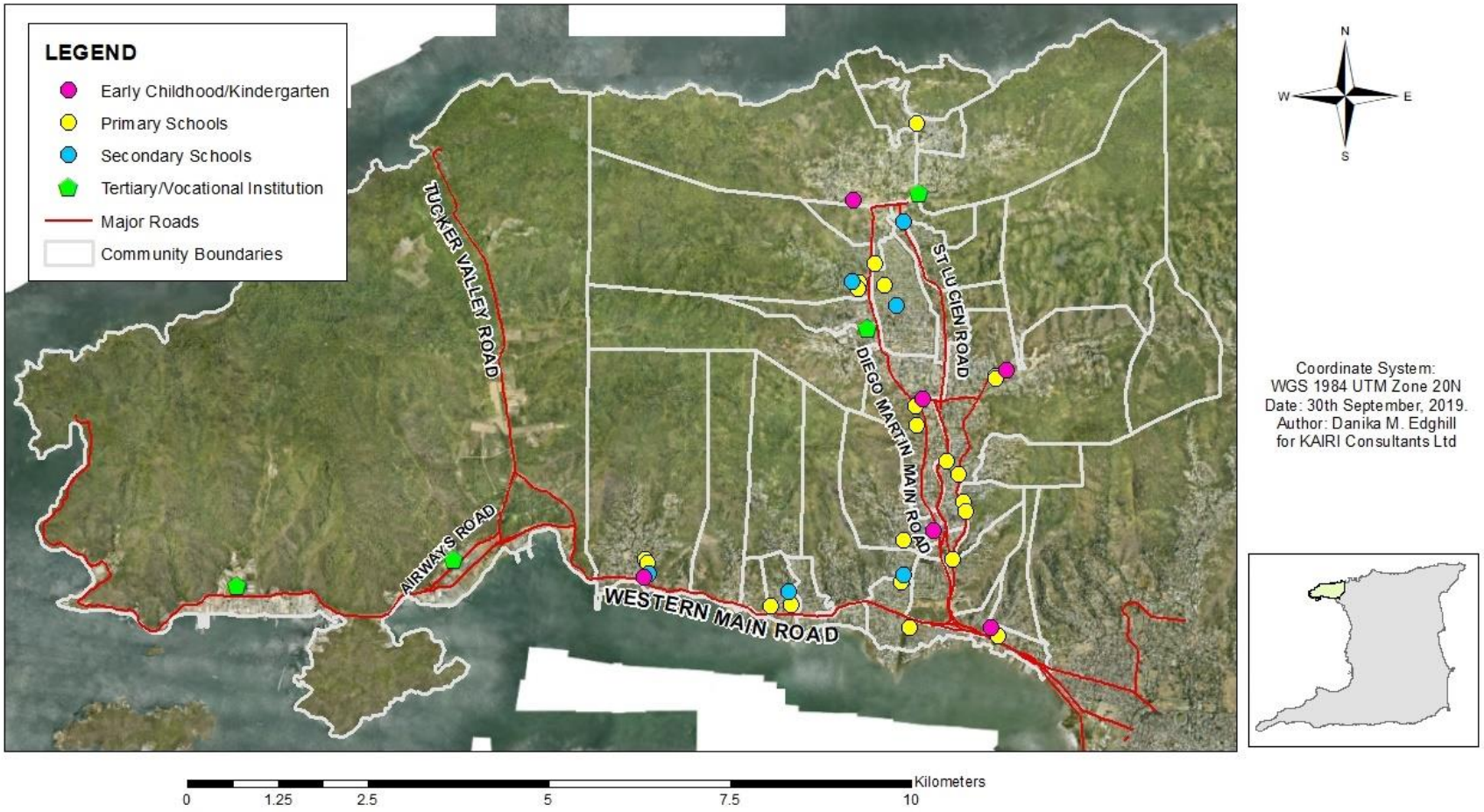


Figure 3.19: Educational Facilities in the Diego Martin Municipality

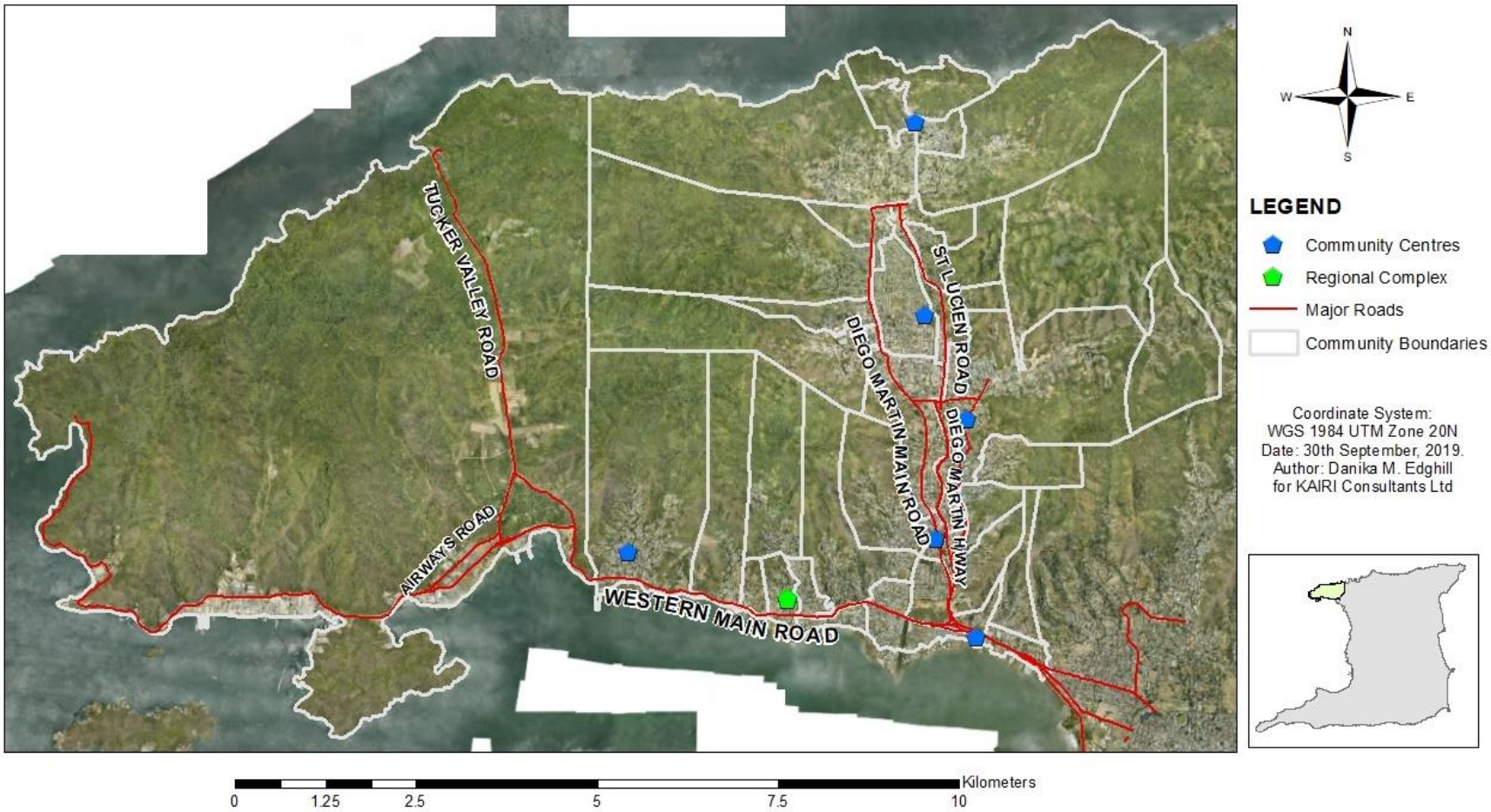


Figure 3.20: Community Facilities in the Diego Martin Municipality

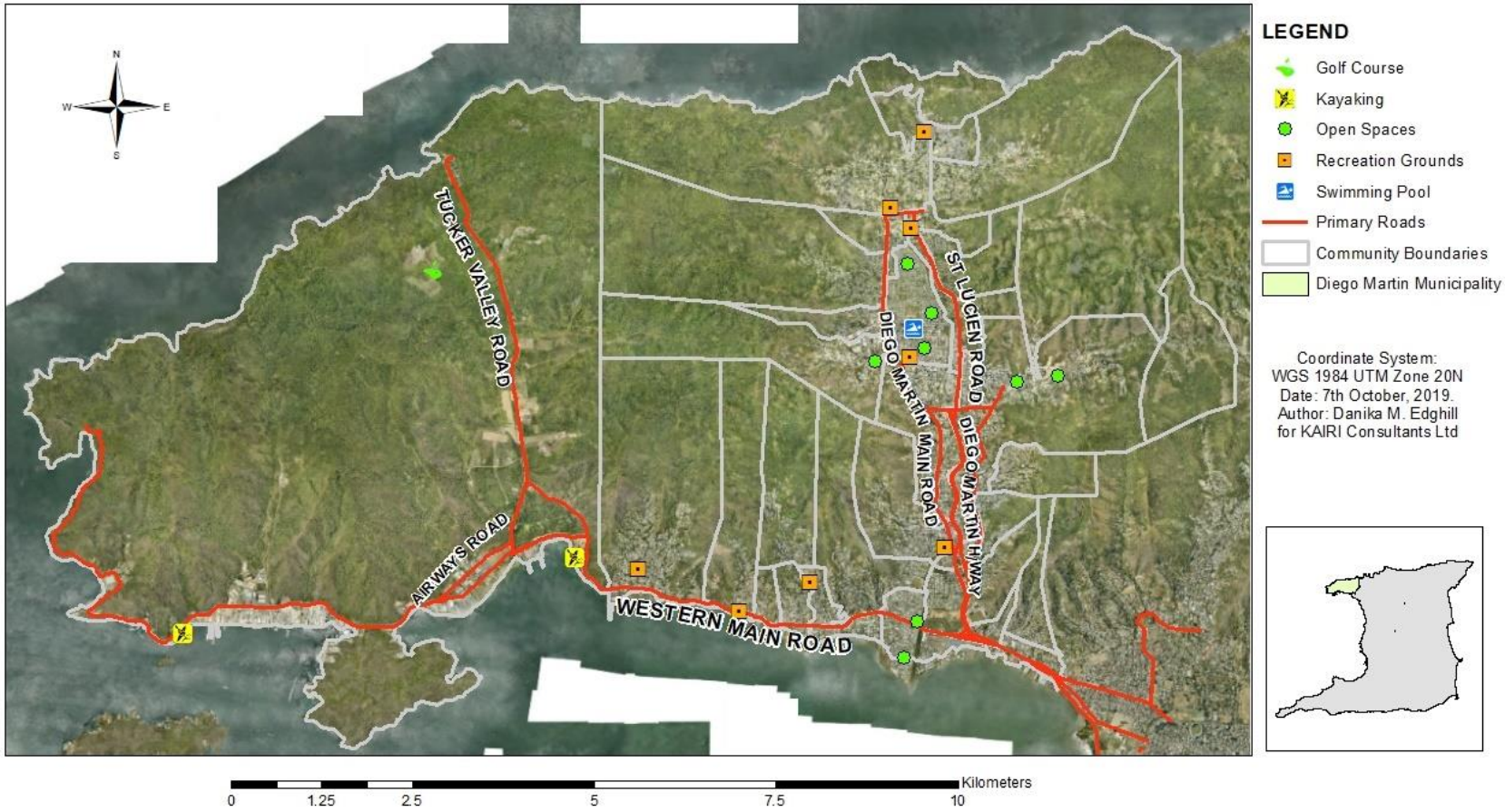


Figure 3.21: Sporting and Recreational Facilities in the Diego Martin Municipality

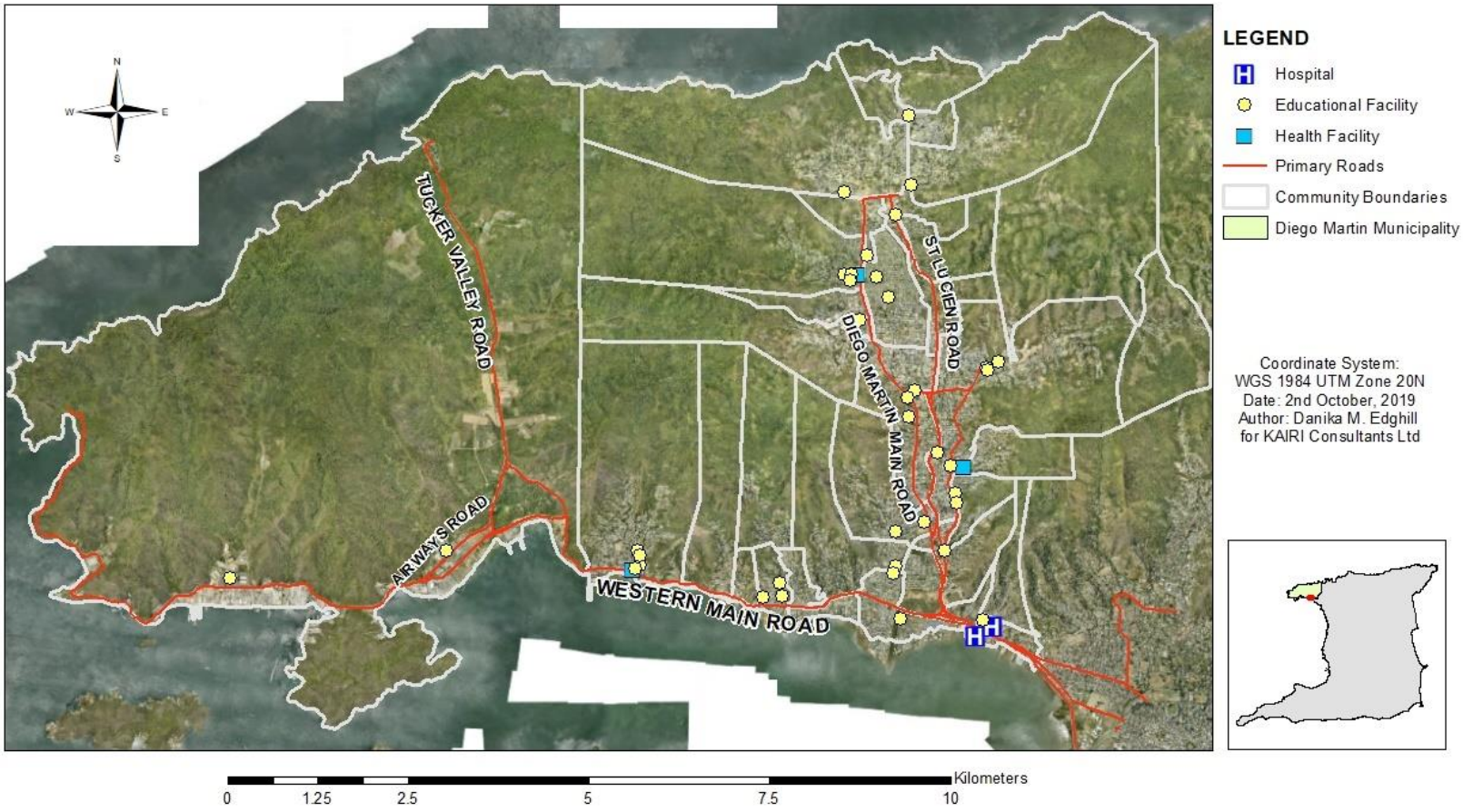


Figure 3.22: Human Receptors in the Diego Martin Municipality

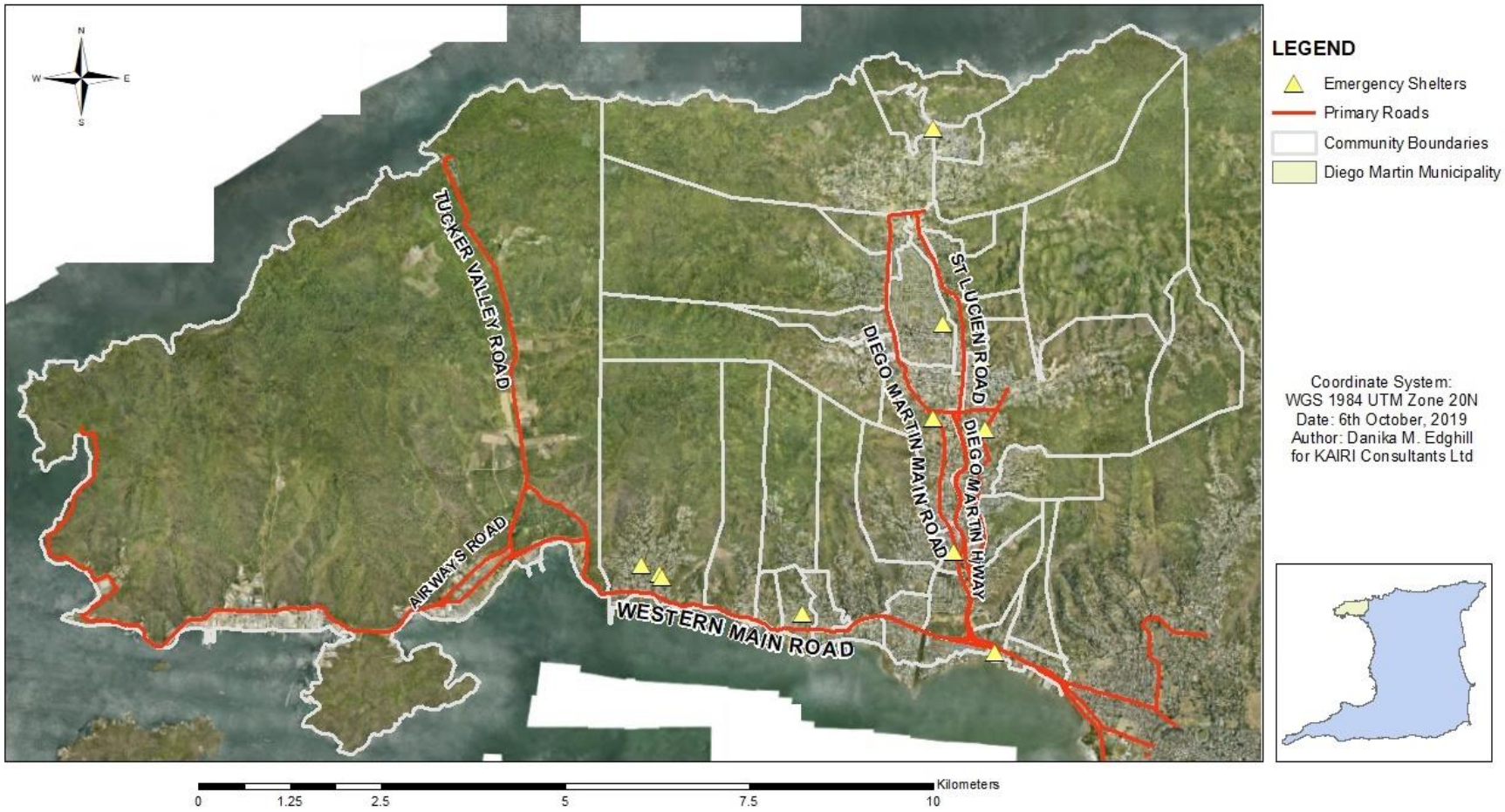


Figure 3.23: Emergency Shelters in the Diego Martin Municipality

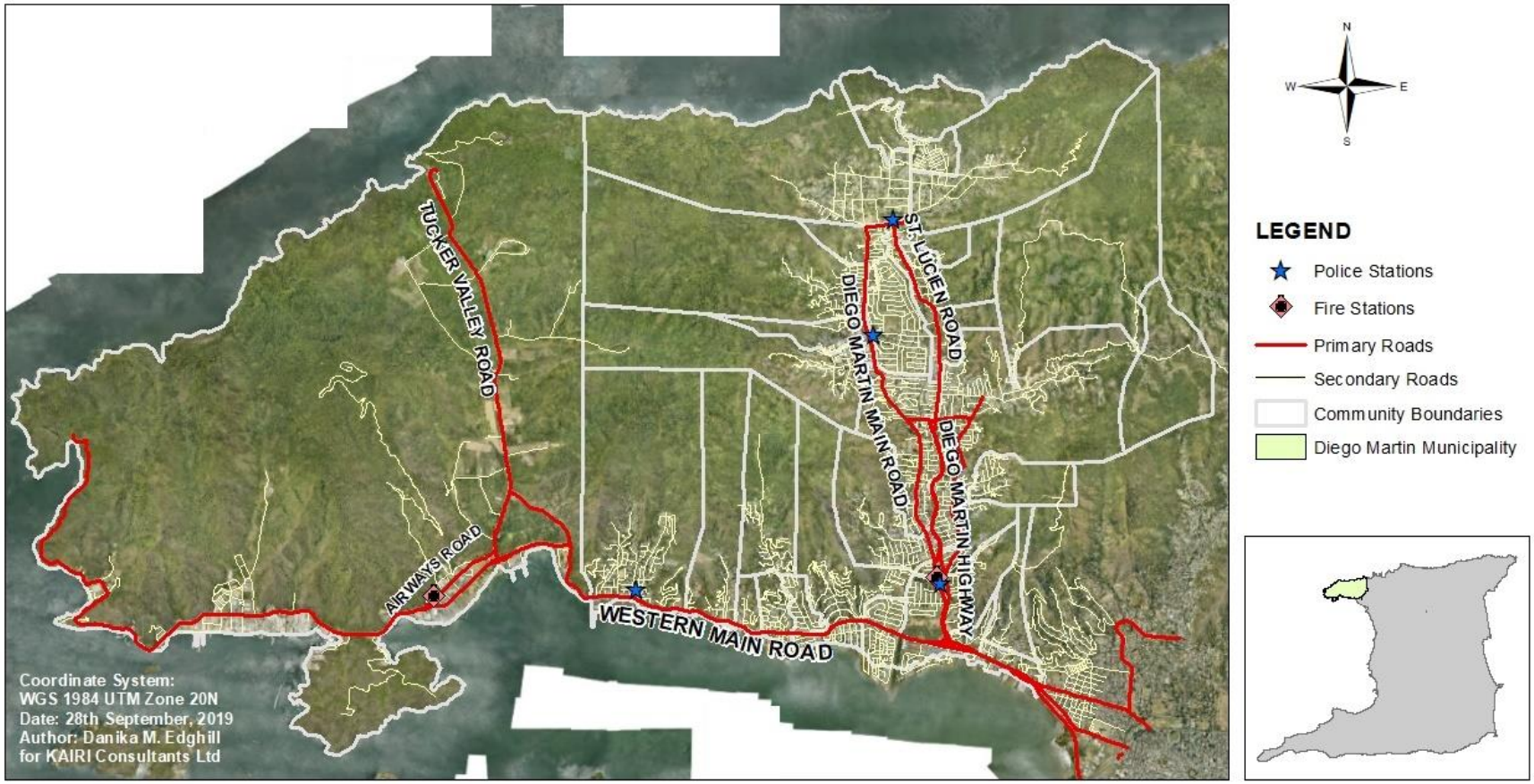


Figure 3.24: Safety and Security Facilities in the Diego Martin Municipality

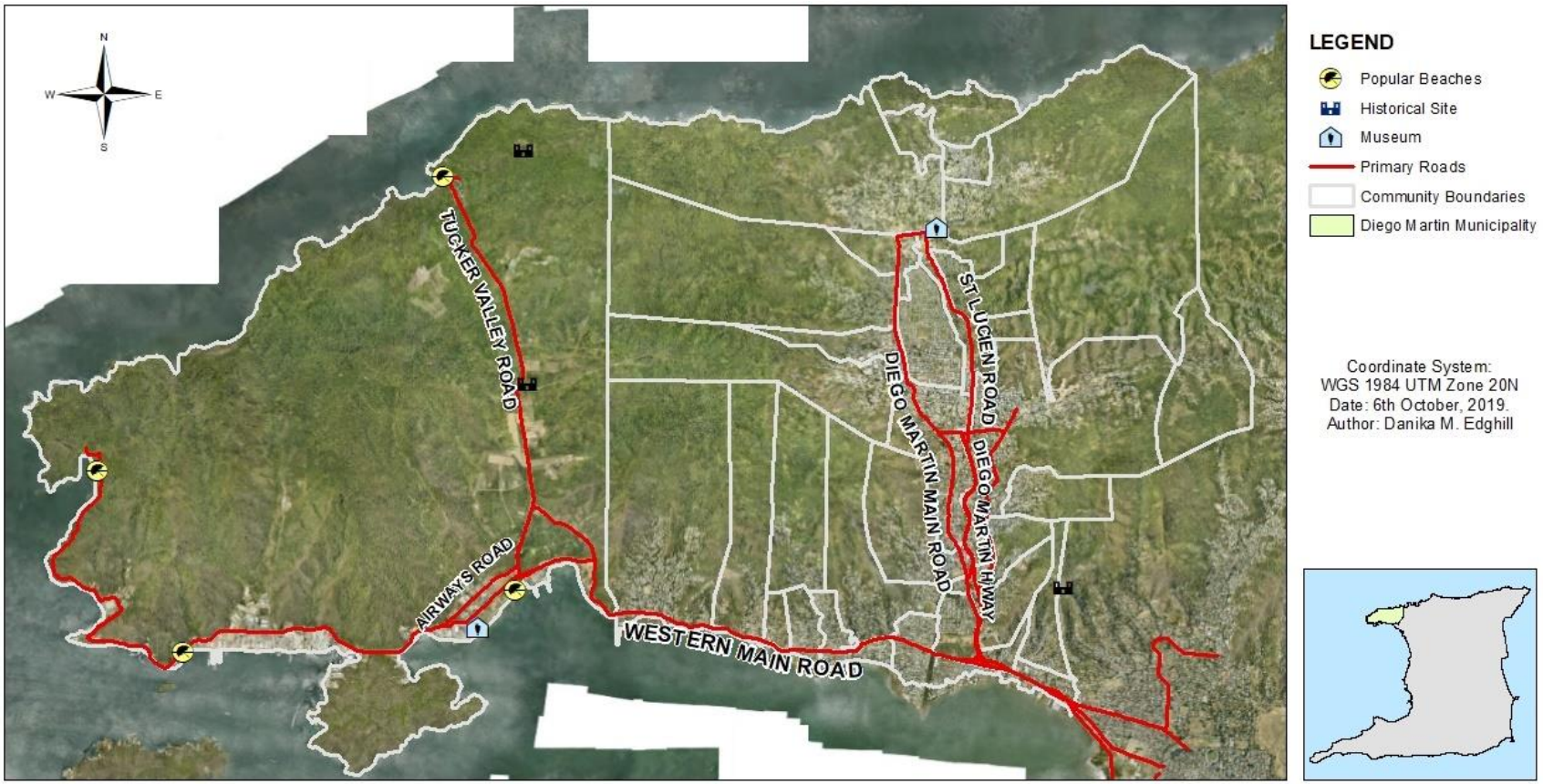


Figure 3.25: Cultural and Historical Resources in the Diego Martin Municipality

3.5 VEHICULAR OWNERSHIP AND TRAFFIC

Since the decommissioning of the rail system in Trinidad during the mid-1960's, constant increasing demand for travel has been accommodated by the intensive development of a highway network linking east and west as well as north and south communities both in Trinidad and in Tobago (Ministry of Planning and Development of Trinidad and Tobago 2015). Even so, there is significant congestion due to high traffic volumes in relation to road capacity, poor secondary roads in need of repair, low connectivity and restricted egress. The situation in the municipality of Diego Martin is no different. Figure 3.26 provides information on vehicle ownership in the Municipality. Except for Chaguaramas and the Off-shore Islands, there was no community with less than one quarter of households not owning a vehicle for private use. There were fourteen of the thirty-two communities where more than 75 percent of households had a vehicle for private use. The area had a very high density of vehicle ownership, therefore. Given high population density in the areas fit for residential accommodation, a high density of vehicle ownership implies high road usage and substantial traffic on workdays. With the increase in the number of new registrations since the Census of 2011, with the relative ease of availability of foreign used vehicles, the traffic situation would have been exacerbated in this municipality.

Since then, the level of vehicular ownership in Trinidad has exploded. Vehicle sales nationally continue to charge along. With average new vehicle registrations monthly in excess of 2,000 vehicles and annually in excess of 25,000 vehicles, current estimates put the national stock of vehicles in the vicinity of one million (Trinidad and Tobago Newsday 2019, Trinidad and Tobago Guardian 2019), potentially exceeding previous projections (Table 3.11) (MMM Group Limited, Trintoplan Consultants Ltd, and Ecoengineering Consultants Ltd 2015). 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, is just not considered to be advisable.

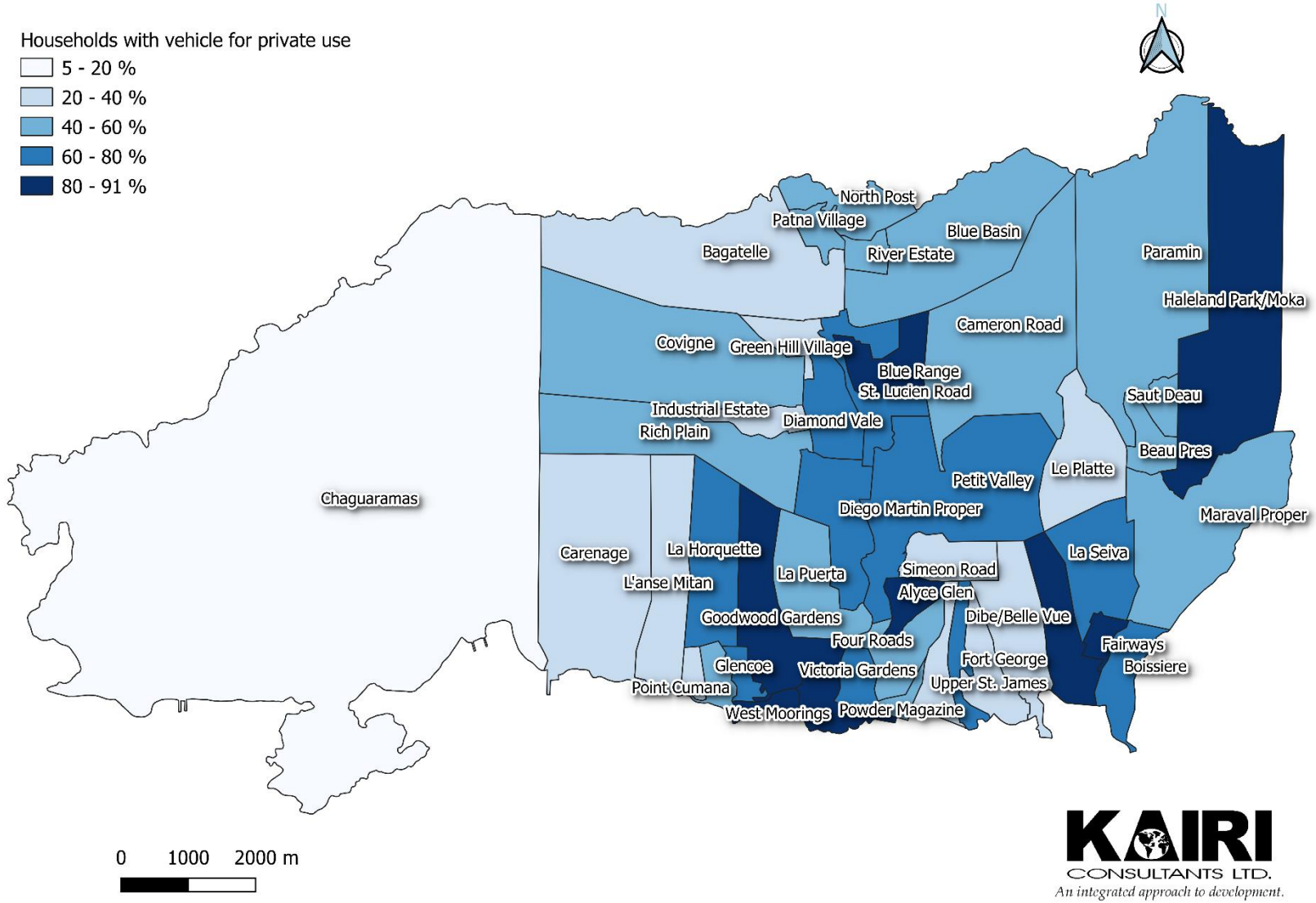


Figure 3.26: Proportion of Households with a Vehicle for Private Use by Community 2011
Source: CSO 2011 Population and Housing Census

Table 3.10: Registered Vehicles - Trinidad and Tobago 1995 - 2013

Year	up to 1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Private (Cars)		2208	7681	10820	18904	14641	12215	13956	17488	16634	17283	14914	24512	21150	15884	17781	12861	14368	21865	23626
Hired(Cars, Maxi Taxis)		56	138	250	1190	1675	1077	1043	896	792	806	622	768	575	402	379	362	153	378	141
Motorcycle		81	168	132	214	162	150	214	265	277	187	174	293	430	448	513	523	192	187	83
Rented		442	719	465	543	441	455	366	525	292	416	218	434	133	138	54	50	31	62	24
Goods		774	1551	2601	3311	2777	2607	2830	3184	3736	4019	3408	6954	7212	6632	3395	6266	3759	4782	1985
Omnibus		0	1	0	3	45	28	5	2	1	2	40	10	96	29	36	89	2	2	1
Tractor		74	50	146	129	199	241	161	121	169	145	121	299	189	119	109	150	104	88	65
Trailer		100	253	313	427	644	600	520	475	353	369	217	325	419	231	221	243	209	98	99
Other		8	24	22	27	56	71	31	44	34	32	60	74	82	138	12	317	19	26	42
TOTAL		3743	10585	14749	24748	20640	17444	19126	23000	22288	23259	19774	33669	30286	24021	22500	20861	18837	27488	26066
off road		-580	-1989	-2830	-5321	-4498	-3592	-4011	-4820	-4555	-4724	-4040	-6512	-5575	-4172	-4635	-3396	-3669	-5655	-5977
Net total		3163	8596	11919	19427	16142	13852	15116	18180	17734	18535	15735	27157	24711	19849	17865	17465	15169	21833	20089
Cumulative	**349530**	353,273	363,858	378,607	403,355	423,995	441,439	460,565	483,565	505,853	529,112	548,886	582,555	612,841	636,862	659,362	680,223	699,060	726,548	752,614
Net Cum total		348,950	351,284	361,028	373,286	398,857	420,403	437,429	455,745	479,011	501,129	525,073	542,374	576,980	608,669	632,227	655,966	676,555	693,405	720,571

Source: MMM Group Limited, Trintoplan Consultants Ltd, and Ecoengineering Consultants Ltd. 2015. Environmental Evaluation. In Feasibility Study for Improvements to Diego Martin Highway/ Western Main Road Intersection.

Notes

- No figures are available for the number of vehicles taken off the road in each year. It is reasonable to assume that the stock of vehicles (cumulative total) is reduced in each year by the number of vehicles taken off the road
- The assumption for this number is: it is equivalent to 25% of private vehicles & 50% of taxis registered in each year, which effectively gives a net addition to the number of vehicles registered per year and a new cumulative total.

Table 3.11: Projection of Registered Vehicles – Trinidad and Tobago 2020-2040

	2020	2030	2040
Annual Total	35800	42400	46500
Net annual total	28100	34000	37500
Cumulative Total	860000	1120000	1355000
Net cumulative total	845000	1080000	1285000

Source: MMM Group Limited, Trintoplan Consultants Ltd, and Ecoengineering Consultants Ltd. 2015. Environmental Evaluation. In Feasibility Study for Improvements To Diego Martin Highway/ Western Main Road Intersection.

3.6 DRAINAGE

Drainage has been well established as a perennial challenge for the immediate study area throughout the Social Impact Assessment Process. Drainage works are a major component of the entire project (Trintoplan Consultants Limited 2019) See Description of Project | Vehicular Overpass in the Vicinity of Powder magazine and Related Works above for details on the comprehensive drainage infrastructure which forms part of the related works for this project. Figure 3.27 shows the flood prone areas and catchments respectively from earlier studies. There is an existing network of roadside drains, culvert crossings, and a small detention pond adjacent to the entrance of the Victoria Keyes development. This detention pond will be decommissioned and a larger capacity detention pond (2,4000 cubic metres) will be constructed to accommodate the additional surface runoff expected from the proposed additional road network. The flood prone areas highlighted throughout stakeholder engagement are indeed consistent with those highlighted in the Feasibility Study of 2015 (MMM Group Limited, Trintoplan Consultants Ltd, and Ecoengineering Consultants Ltd 2015). The main drainage features within the area are the Diego Martin River on the west, a very large earthen drain running from east to west in Cocorite Farms, and a series of culverts which take drainage across the Diego Martin highway and Diego Martin Main Road which flow towards a concrete box drain running east west in Victoria Gardens .

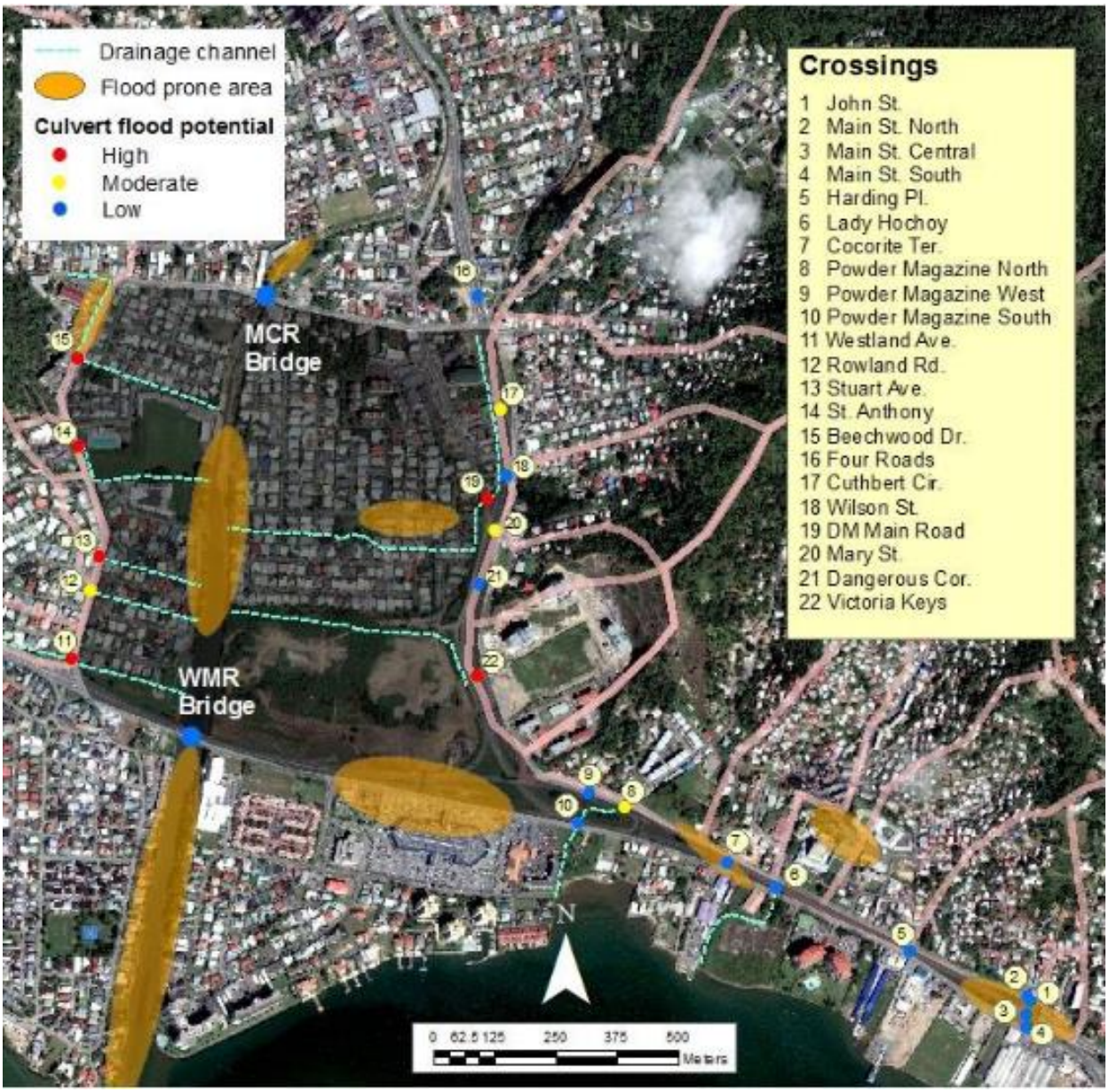


Figure 3.27: Flooding potential at the crossings and other locations 2015
Source: Trintoplan Consultants Limited. 2019. Stormwater Management Plan: Construction of A Vehicular Overpass in The Vicinity Of Powder Magazine And Related Road Improvements Project.

To better understand the drainage challenges affecting the local project area, one must consider wider drainage in the area (Figure 3.28). The water which affects the locality comes from areas which are somewhat removed from the site and from the hills on the eastern side of the Diego Martin Valley. The figure below shows the locations of five catchments which all flow towards the project area. These all come into the area via culverts which cross the Diego Martin Highway or the Diego Martin Main Road.

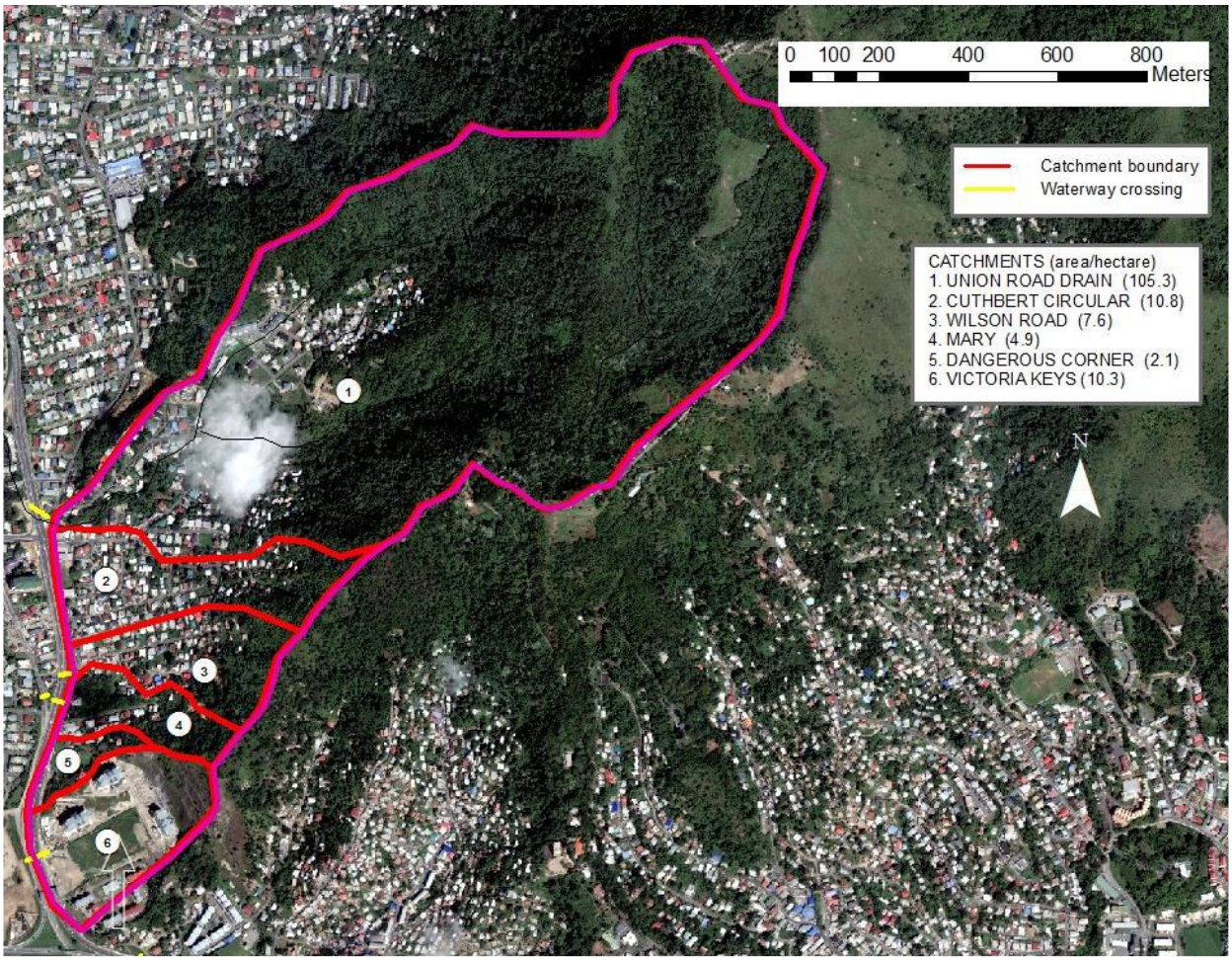


Figure 3.28: Location of Catchments
Source: Trintoplan Consultants Limited. 2019. Stormwater Management Plan: Construction of A Vehicular Overpass in The Vicinity Of Powder Magazine And Related Road Improvements Project.

The water from the catchments previously identified flows through a number of culverts which cross the Diego Martin Highway and the Diego Martin Main Road (Figure 3.29). The first four culverts (those in the vicinity of Cuthbert Circular, Wilson Road, Mary Street and Dangerous corner) all eventually get into a box drain that runs from east to west through Victoria Gardens. The one in the vicinity of Victoria Keyes flows into the large earthen drain in Cocorite Farms. Unfortunately, the capacity of that drain is too small to accommodate these peak flows Cooper (2015). Figure 3.29 summarizes the assessment results of the capability of each crossing to convey the design flows.

Flooding along Western Main Road was not attributed to the inadequate waterway openings of the crossings but rather due to blockages by debris and silt. It shows that for all the design conditions, flooding occurs at Powder Magazine North and that is for the most severe design conditions. Along Diego Martin Highway, all but two culverts can convey the flows from current design conditions. The exceptions are the crossings at Diego Martin Main Road and at Victoria Keyes. Work is needed in the short term to reduce the risk of flooding at these crossings. The crossing at Cuthbert Circular is unable to convey flows under future conditions and some consideration needs to be given to reduce this risk of flooding (Trintoplan Consultants Limited 2019).

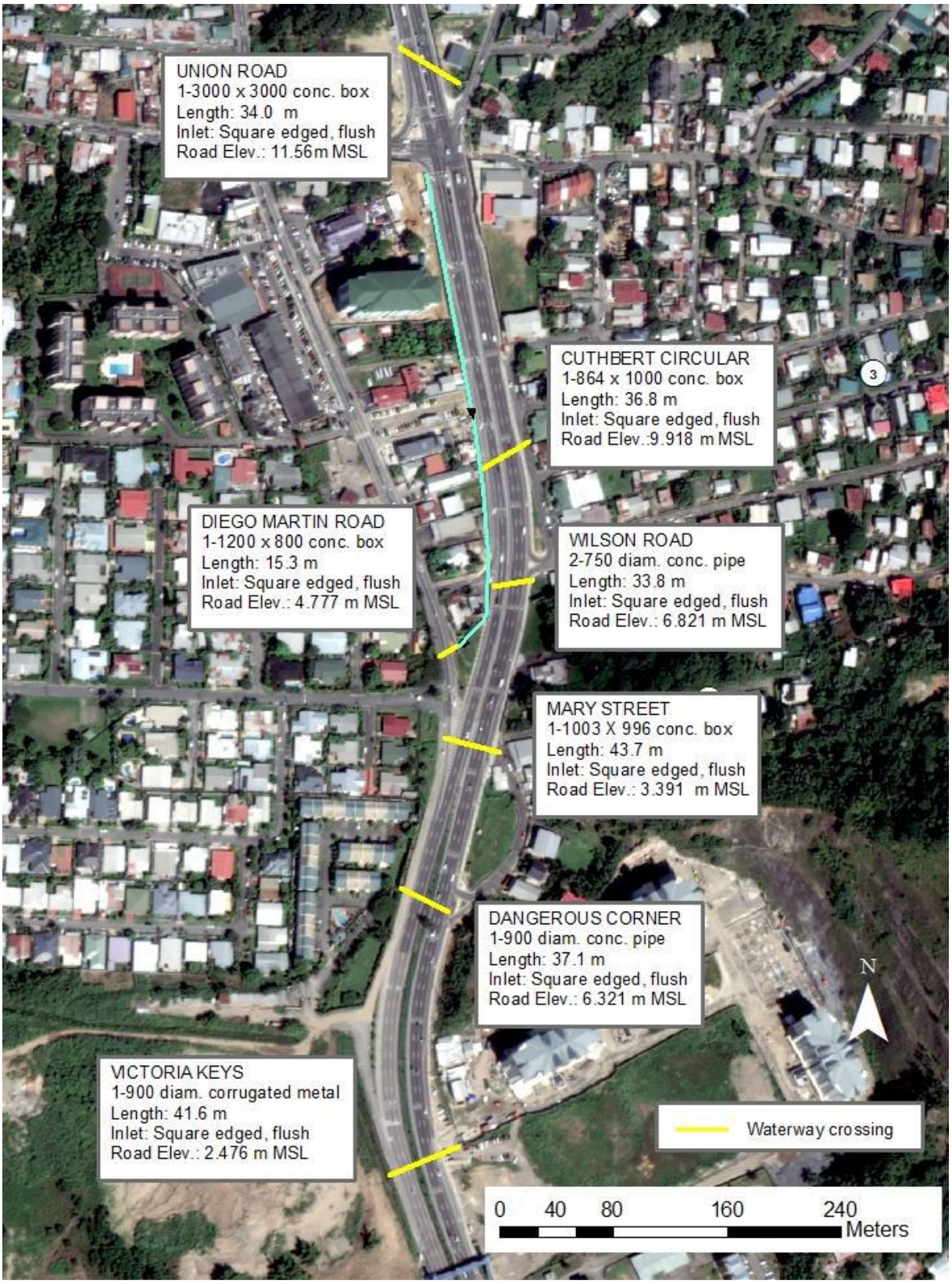


Figure 3.29: Culverts Out falling from Catchments

Source: Trintoplan Consultants Limited. 2019. Stormwater Management Plan: Construction of A Vehicular Overpass in The Vicinity Of Powder Magazine And Related Road Improvements Project.

3.7 AIR AND NOISE POLLUTION

Among the potential impacts to be discussed, Kairi Consultants Limited was required to evaluate the following:

- **Air** - The potential for the impact of increased volumes of dust/particulate matter during the construction phase and changes to air quality during the operation of the overpass, that might increase human exposure to pollutants including the potential health impacts associated with exposure to these contaminants/pollutants. Assess the impacts to ambient air quality that may be affected by project activities – parameters to be considered include, but are not limited to, Particulate matter (PM), including (Total Suspended Particulates [TSP], PM_{10} and $PM_{2.5}$), carbon monoxide (CO), and Ozone (0_3).
- **Noise** – estimate the potential for increased noise from construction activities during the site preparation and construction phase, as well as during the operational phase, to negatively impact nearby residents and other stakeholders.

The following sections discuss the impacts of air and noise in respect of the potential health issues that can arise from exposure of proximate communities to above permissible parameter levels.

3.7.1 AIR

Airborne particulate matter (PM) is one of the main atmospheric pollutants which has been historically associated with adverse effects on human health. As a consequence, the last decade has witnessed its inclusion in monitoring systems and networks for the safeguard of the population and of the environment (Tositti 2018). At present, in all the most developed countries as well as in rapidly developing ones, research and regulations concerning PM are implemented, enforced and continuously updated with the aim of both protecting the population and the environment based on the expanding understanding of this topic . Without policy intervention the situation will continue to grow worse with transport being a major contributor to greenhouse gas emissions since the growth rate of vehicles is will continue to outstrip the declining population growth rates projected by the 2010 census (Ministry of Planning and Development of Trinidad and Tobago 2015).

The traffic congestion problems are reinforced by the availability of subsidised gasoline and diesel, that most housing and business activities being concentrated along the main highway corridors, availability of cheap foreign used vehicles, the lack of confidence in public transport timetabled services to connect with working hours, no alternatives to car transport in rural areas, the fear of crime discouraging people from walking, cycling or waiting for public transport, the fear of rainfall and flooding combined with poor waiting facilities combine to discourage patronising public transport.

3.7.1.1 AIR POLLUTION CONTROL RULES

The legal framework for this investigation is the Air Pollution Rules (APR), 2014 (Table 3.12). These rules were laid before Parliament in January 27, 2015 and published in the Trinidad and Tobago Gazette on February 23, 2015 (Republic Of Trinidad And Tobago 2015). The APR is legislation developed under the Environmental Management Act Chapter 35:05. Through the APR, the EMA seeks to monitor the levels of specific air pollutants known to cause harm to human health and the environment, thereby improving overall air quality. To this end, prescribed standards for air pollutants in Ambient Air (Schedule 1) and for the release of air pollutants at distinct points (Schedule 2) have been established.

Table 3.12: First Schedule of Air Quality Guidelines

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

3.7.1.2 BASELINE AMBIENT AIR QUALITY MONITORING AND METEOROLOGICAL DATA COLLECTION IN DIEGO MARTIN

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 connector 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, in November 2019, NIDCO engaged the services of Ecoengineering Consultants Limited to undertake new testing of air quality to update baseline measurements. Sampling for the wet season was done for the period November 14th to November 27th, 2019. Additionally, sampling was done during the dry season for the period January 13th to February 21st 2020.

The following subsections document the monitoring locations, methodology and the ambient air quality monitoring results from both wet and dry seasons. The dry and wet season monitoring results can be found in Appendices F and G respectively.

3.7.1.2.1 MONITORING LOCATIONS

Figure 3.30 and Figure 3.31 depict the Air Quality Monitoring Locations November 2019 and January 2020.

Figure 3.30: Air Quality Monitoring Locations November 2019 and January 2020

Source: Ecoengineering Consultants Limited. 2019. "Construction of A Vehicular Overpass In The Vicinity Of Powder Magazine And Related Road Improvements - Ambient Air And Noise Monitoring And Discussion Of Impacts."

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

Figure 3.31: Photographs of Monitoring Locations

At each location, air quality parameters were monitored over a 24-hour period (Table 3.13). A GARMIN GPS hand-held Unit was used to acquire the exact coordinate of the sampling locations and recorded and documented (see Table 3.13) below.

Table 3.13: 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

The method and instrumentation used by KESTL during the monitoring exercise for each parameter is shown in Table 3.14 below.

Table 3.14: 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 $\mu gSO_2/m^3$
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.

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.

3.7.1.2.2 WET SEASON MEASUREMENT

Ecoengineering Consultants Limited (Ecoengineering) was contracted by the National Infrastructure Development Company Limited (NIDCO) to conduct Baseline Air Quality for the construction of a vehicular overpass in the vicinity of Powder Magazine. The Report was prepared in accordance with the Air Pollution Rules (APR) reporting requirements. Air quality monitoring was conducted for three (3) events over a two (2) week period (see Table 3.15: Air Quality Monitoring Schedule) at five (5) locations (see Figure 3.15) by Kaizen Environmental Services Limited (KESTL).

Table 3.15: 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

Ambient air quality monitoring was conducted for three (3) events over a two (2) week period at five (5) locations (see Figure 3.31 and Photographs 1 to 5) by Kaizen Environmental Services Limited (KESTL). The parameters monitored were:

- Total Particulate Matter (TSP),
- Particulate Matter (PM10),
- Particulate Matter (PM2.5),
- Volatile Organic Compounds (VOCs),
- Sulphur Dioxide (SO2),
- Nitrogen Dioxide (NO2),
- Carbon Monoxide (CO), and
- Ozone (O3).

3.7.1.2.2.1 $PM_{2.5}$, 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/m3 (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/m^3 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.

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, O3 with a limit of 120 µg/m^3. There are no guidelines for VOCs in ambient air.

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.

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. exposure of material to the wind.
- This prevents
- 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.

3.7.1.2.3 DRY SEASON MEASUREMENT

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. Their report documents the results of ambient air quality monitoring conducted in the dry season of 2020. This follows wet season monitoring conducted in 2019.

Monitoring was conducted as follows:

- January 13th – 15th, 2020
- January 20th – 22nd, 2020

- January 23rd – 25th, 2020

Figure 3.30 and Table 3.16 show 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.

Table 3.16: Dry Season Monitoring Locations and Co-ordinates

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	

3.7.1.2.3.1 PM2.5, PM10, AND TOTAL SUSPENDED PARTICULATES (TSP)

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.

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:

- 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 PM10 ranged between 3 µg/m3 and 29 µg/m3. 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

- PM2.5 = 65 µg/m^3
- PM10 = 75 µg/m^3 respectively.

- Thus, there were no exceedances of those limits during the three monitoring events in either season.
- These values may be used as the baseline for comparison with air quality monitoring conducted during construction of the vehicular overpass.

3.7.1.2.3.2 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/m3 and 1042 µg/m3 while O_3 concentrations ranged between 9 µg/m^3 and 80 µg/m^3. VOC concentrations ranged between 0.8 µg/m3 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/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.

3.7.1.3 AIR QUALITY INDEX FOR TRINIDAD

Kairi Consultants Limited sought to utilise pollutant data collected by the Environmental Management Authority through its National Air Quality Index as a proxy. The air quality index is a composite indicator used by government agencies to communicate to the public how polluted the air currently is or how polluted it is forecast to become. As the AQI increases, a larger percentage of the population is likely to experience increasingly severe adverse health effects. The generation of an AQI value involves a conversion of measured pollutant concentrations to a number on a scale of 0 to 500. (

Table 3.17). The AQI values are categorised by the Level of Health Concern, with each category assigned a colour (Figure 3.32). The higher the AQI value, the greater the level of air pollution and the greater the health concern. For example, the colour orange means that sensitive groups (elderly persons, infants or persons with respiratory ailments or heart disease) may experience health effects, while red means that everyone may begin to experience health effects with sensitive groups experiencing more serious health effects.

Table 3.17: Air Quality Index Scale

AIR QUALITY INDEX LEVELS OF HEALTH CONCERN	NUMERICAL VALUE	MEANING
Good	0 to 50	Air quality is considered satisfactory and air pollution poses little or no risk.
Moderate	51 to 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very unhealthy	201 to 300	Health alert: everyone may experience more serious health effects.
Hazardous	301 to 500	Health warnings of emergency conditions. The entire population is more likely to be affected.

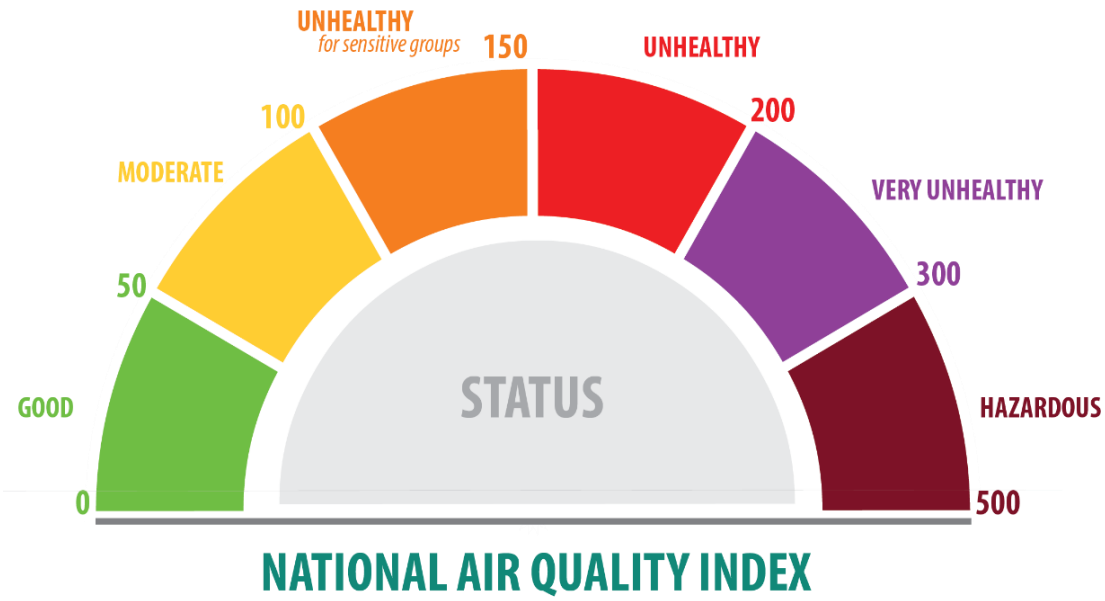


Figure 3.32: National Air Quality Index for Trinidad and Tobago

In order to measure these pollutants, an Ambient Air Quality Monitoring Station (AAQMS) is employed. An AAQMS contains equipment which measures pollution concentrations in ambient air (outdoor breathable air). The pollutants measured are particulate matter of diameter 1 micrometres and micrometres (PM10 and PM2.5), sulphur, dioxide,

carbon monoxide, nitrogen dioxide and ozone. As the AQI increases, the level of health concern will change, e.g. an AQI increase of 100 to 120 or higher will result in a change of moderate to unhealthy for sensitive groups. The EMA currently has two Monitoring Stations in Trinidad and Tobago. The first one is located roughly 200 metres South of the West Bound Lane of the Beetham Highway in Port of Spain (TRI5432015-TRI5452015) (Figure 3.33), while the second monitoring station is located roughly 15 metres west of Mulchan Seuchan Road and 100 metres west of the north bound lane of the Uriah Butler Highway in Chaguanas (TRI5422015-TRI5442015) (Figure 3.42). 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

Figure 3.34 , Figure 3.35, Figure 3.43 and Figure 3.44 depict the daily air quality indices for five pollutants in 2018 and 2019 from both AAQMSs. With a view to visualise data captured on these pollutants, pollution roses are utilised. The pollution rose is a means of illustrating the frequency distribution of wind direction temporally correlated with a chosen pollutant.(Duboue 1978). The Air Quality Dashboard provides year to date pollution rose plots for all five air pollutants measured in both Chaguanas and Port-of-Spain, and these can be found for each of the five measured pollutants for the period 2018 and 2019. The above average values of pollutants observed in 2019 might be attributed to the fact that the pollution flowers account for values observed for January to October, and not for the full year. The daily data shows that pollutants fall largely within the Good and Moderate Levels, occasionally falling into unhealthy and hazardous levels at different times of the year. Some degree of cyclicality has been witnessed in observed data for PM2.5 at both monitoring stations, which may be partly explained by the occurrence of Sahara Dust (Akpinar-Elci and Olayinka 2018, Rajkumar and Siung Chang 2000, Ivey, Simeon, and Monteil 2003, Monteil 2008). Notable differences in levels of pollutants can be observed between the monitoring stations in Port of Spain and Chaguanas. It is likely that the compounded effect of heavy traffic along Mulchan Seuchan Road and the Uriah Butler Highway have caused the comparatively elevated levels of PM10 and PM2.5 for that monitoring location.

3.7.1.3.1 PORT OF SPAIN

Figure 3.33: Monitor Station: Port of Spain TRI5432015-TRI5452015

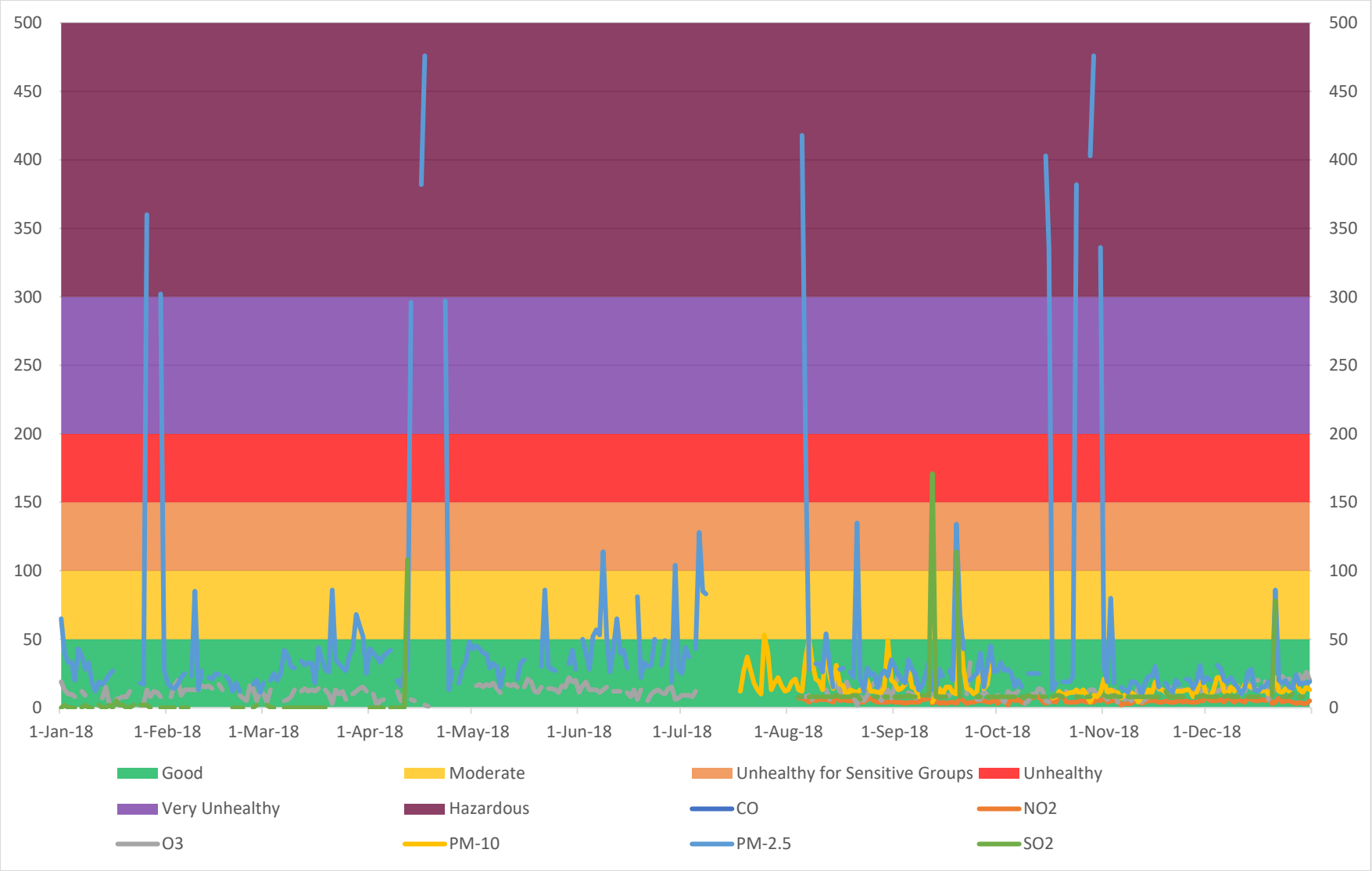


Figure 3.34: Air Quality Indices for Selected Pollutants at Port of Spain Monitor Station (TRI5432015-TRI5452015) 2018

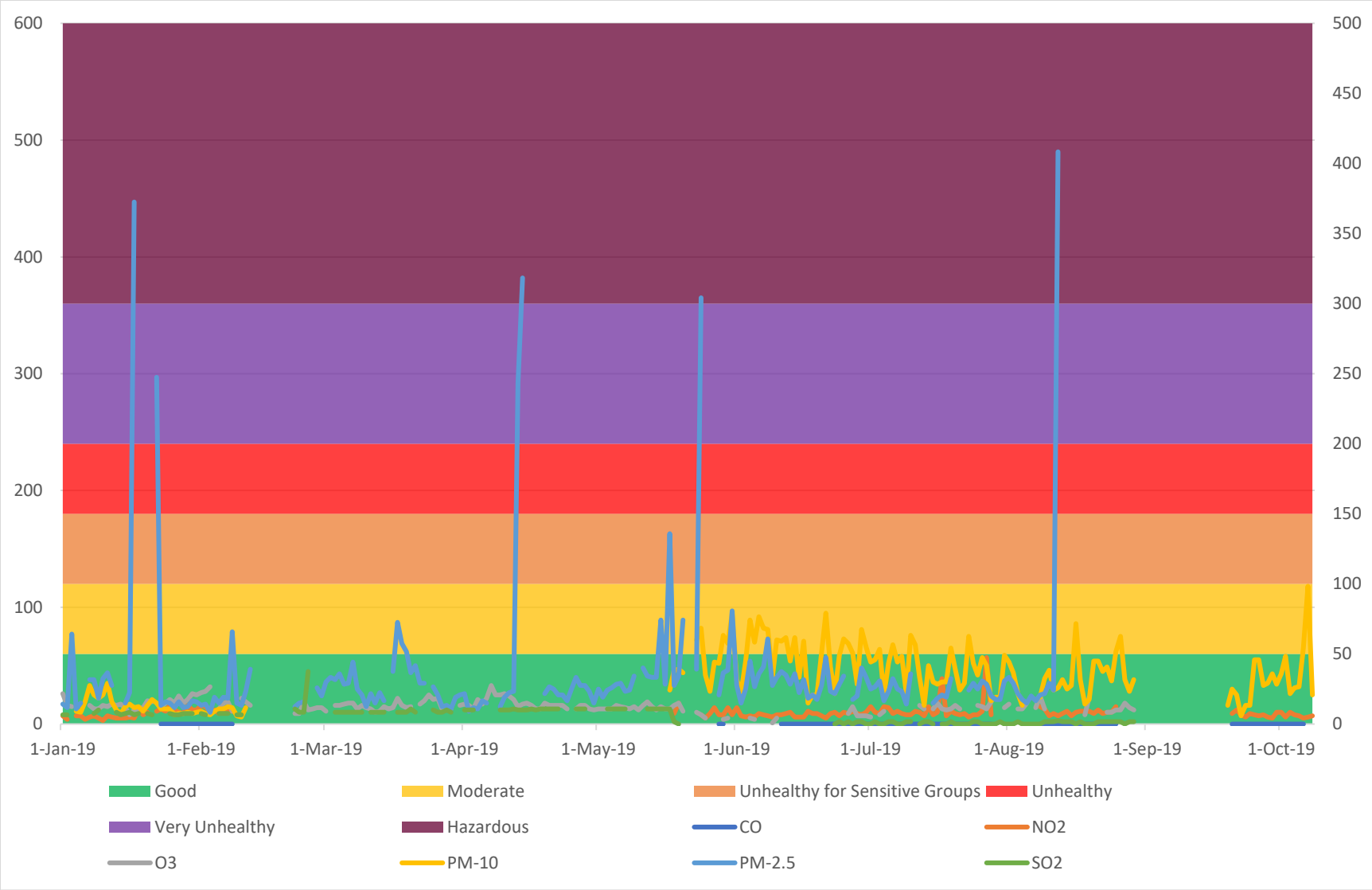


Figure 3.35: Air Quality Indices for Selected Pollutants at Port of Spain Monitor Station (TRI5432015-TRI5452015) 2019

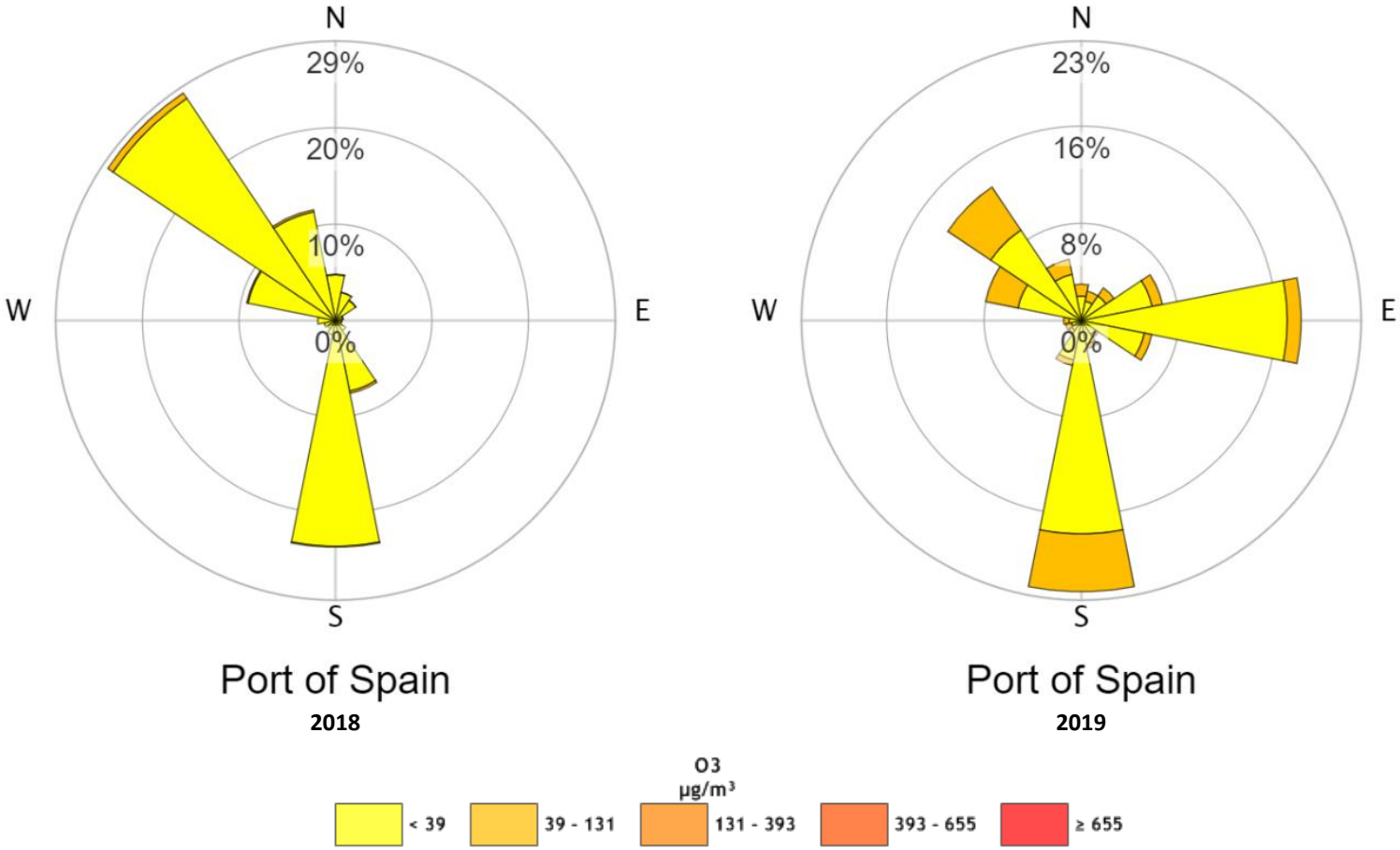


Figure 3.36: O3 Pollution Roses at Port of Spain Monitor Station (blowing from) (Jan 01, 2018 - Dec 31, 2018 and Jan 01,2019 - Oct 15, 2019

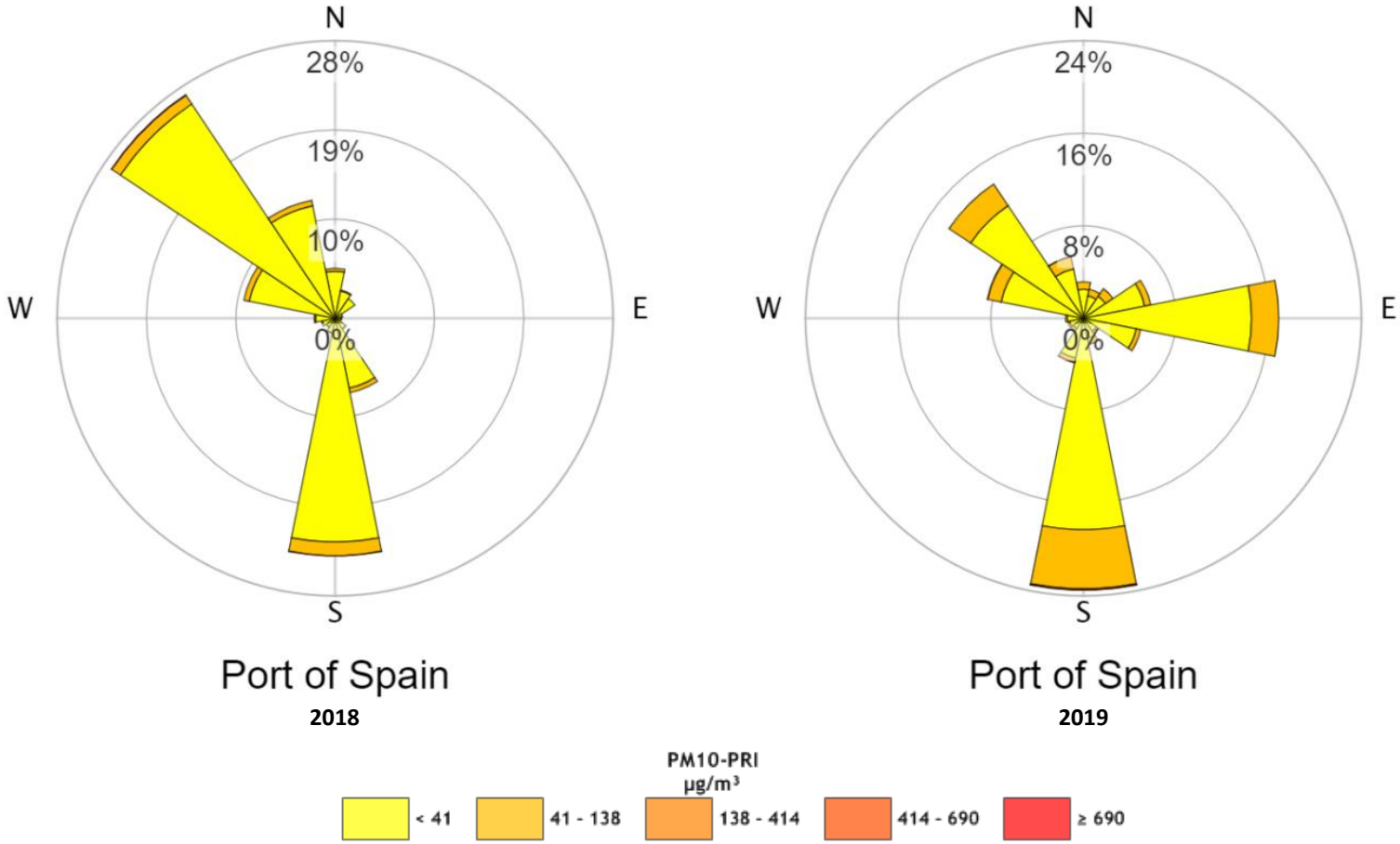


Figure 3.37: PM10 Pollution Roses at Port of Spain Monitor Station (blowing from) (Jan 01, 2018 - Dec 31, 2018 and Jan 01,2019 - Oct 15, 2019

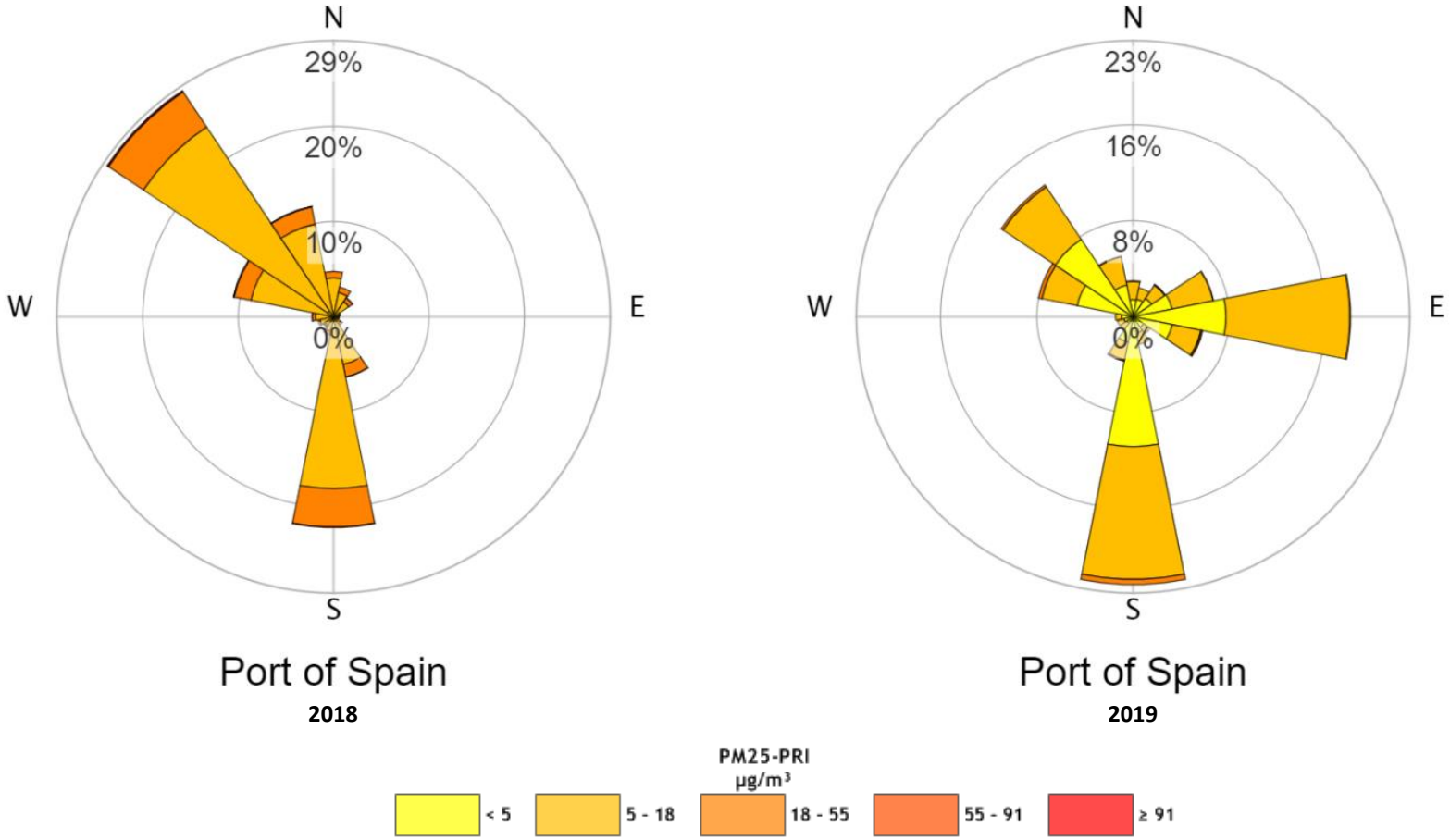


Figure 3.38: PM 2.5 Pollution Roses at Port of Spain Monitor Station (blowing from) (Jan 01, 2018 - Dec 31, 2018 and Jan 01,2019 - Oct 15, 2019

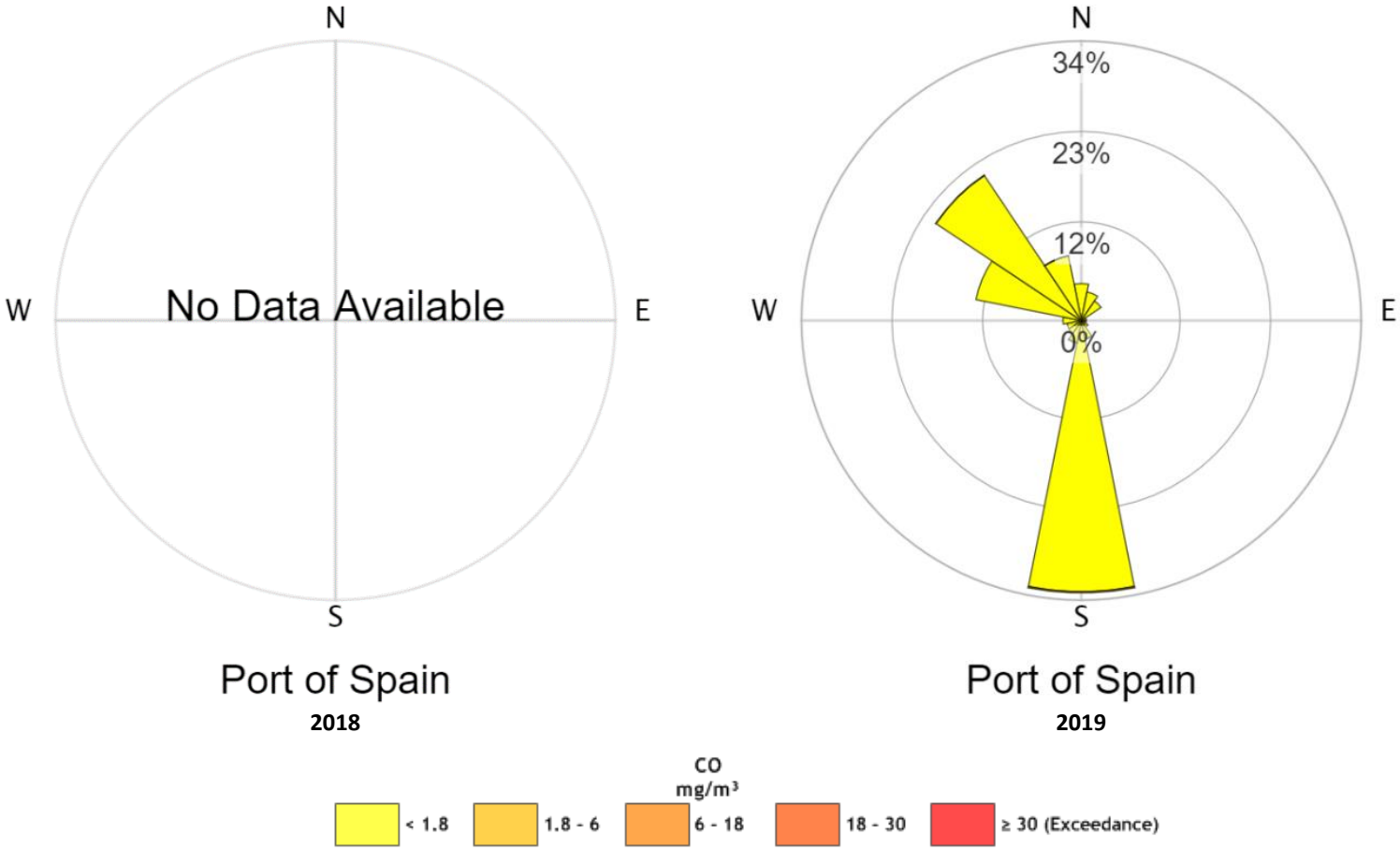


Figure 3.39: CO Pollution Roses at Port of Spain Monitor Station (blowing from) (Jan 01, 2018 - Dec 31, 2018 and Jan 01,2019 - Oct 15, 2019

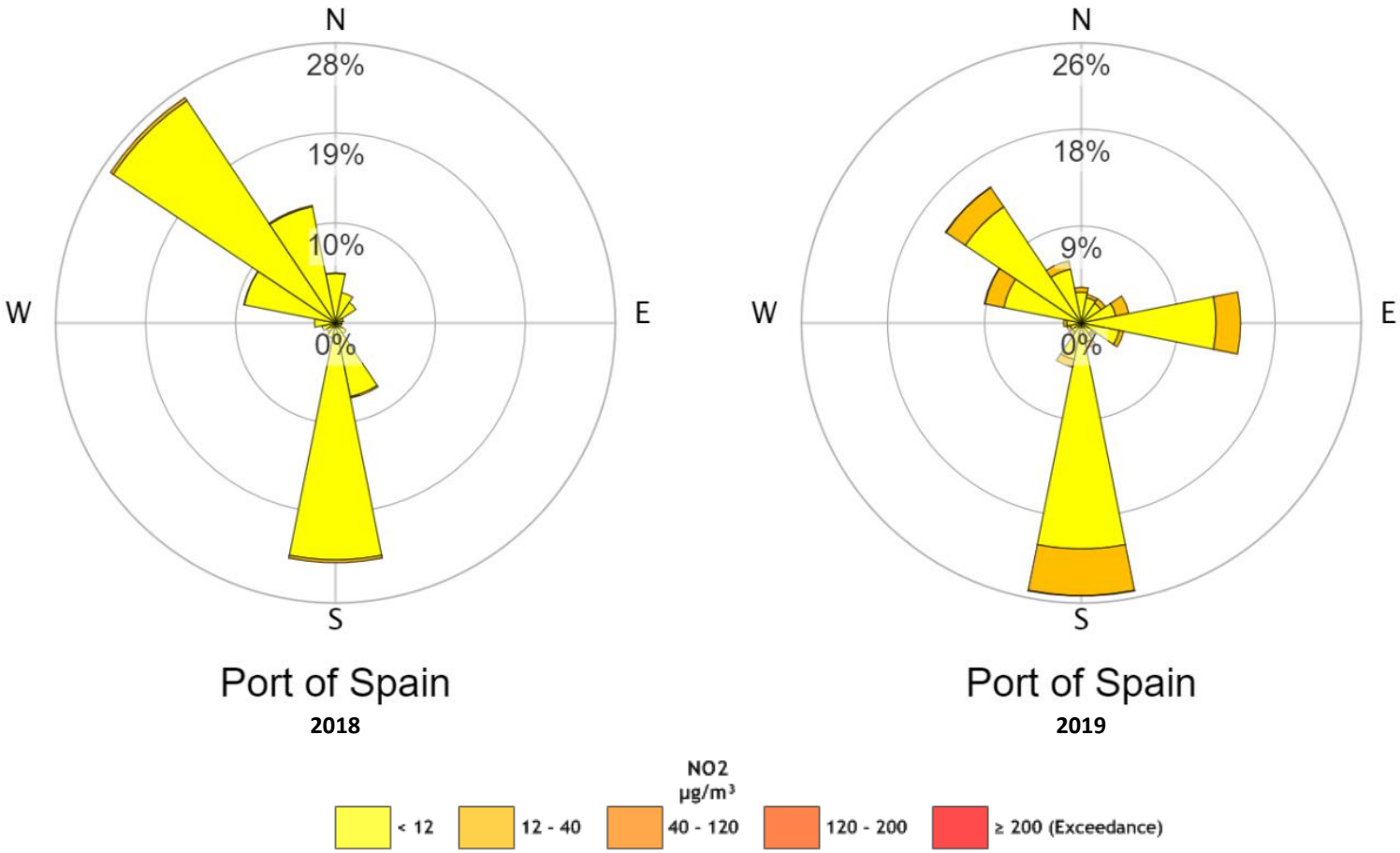


Figure 3.40: NO2 Pollution Roses at Port of Spain Monitor Station (blowing from) (Jan 01, 2018 - Dec 31, 2018 and Jan 01,2019 - Oct 15, 2019

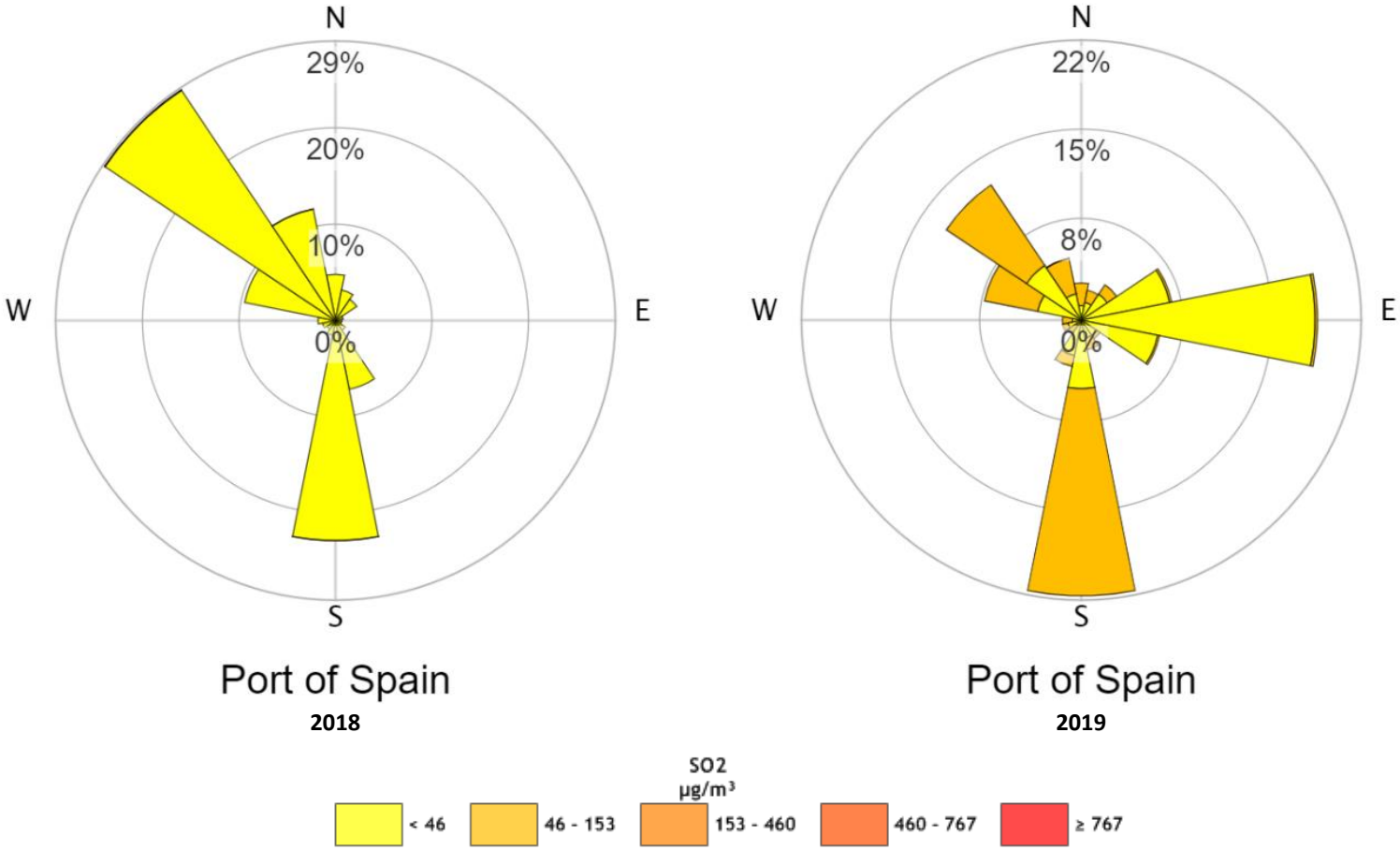


Figure 3.41: SO2 Pollution Roses at Port of Spain Monitor Station (blowing from) (Jan 01, 2018 - Dec 31, 2018 and Jan 01,2019 - Oct 15, 2019

3.7.1.3.2 CHAGUANAS

Figure 3.42: Location of Monitor Station: Chaguanas TRI5422015-TRI5442015

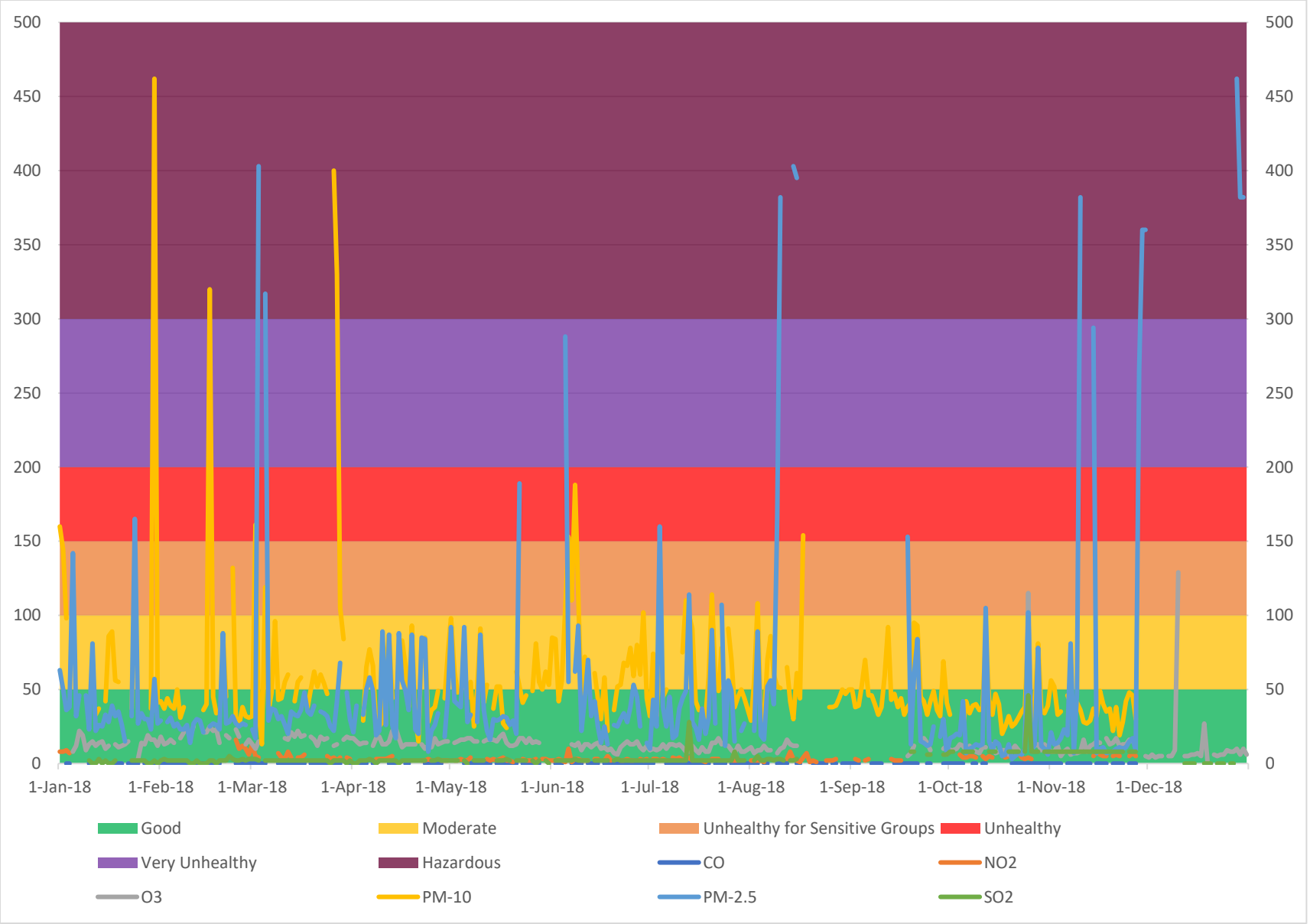


Figure 3.43: Air Quality Indices for Pollutants at Monitor Station: Chaguanas TRI5422015-TRI5442015 2018

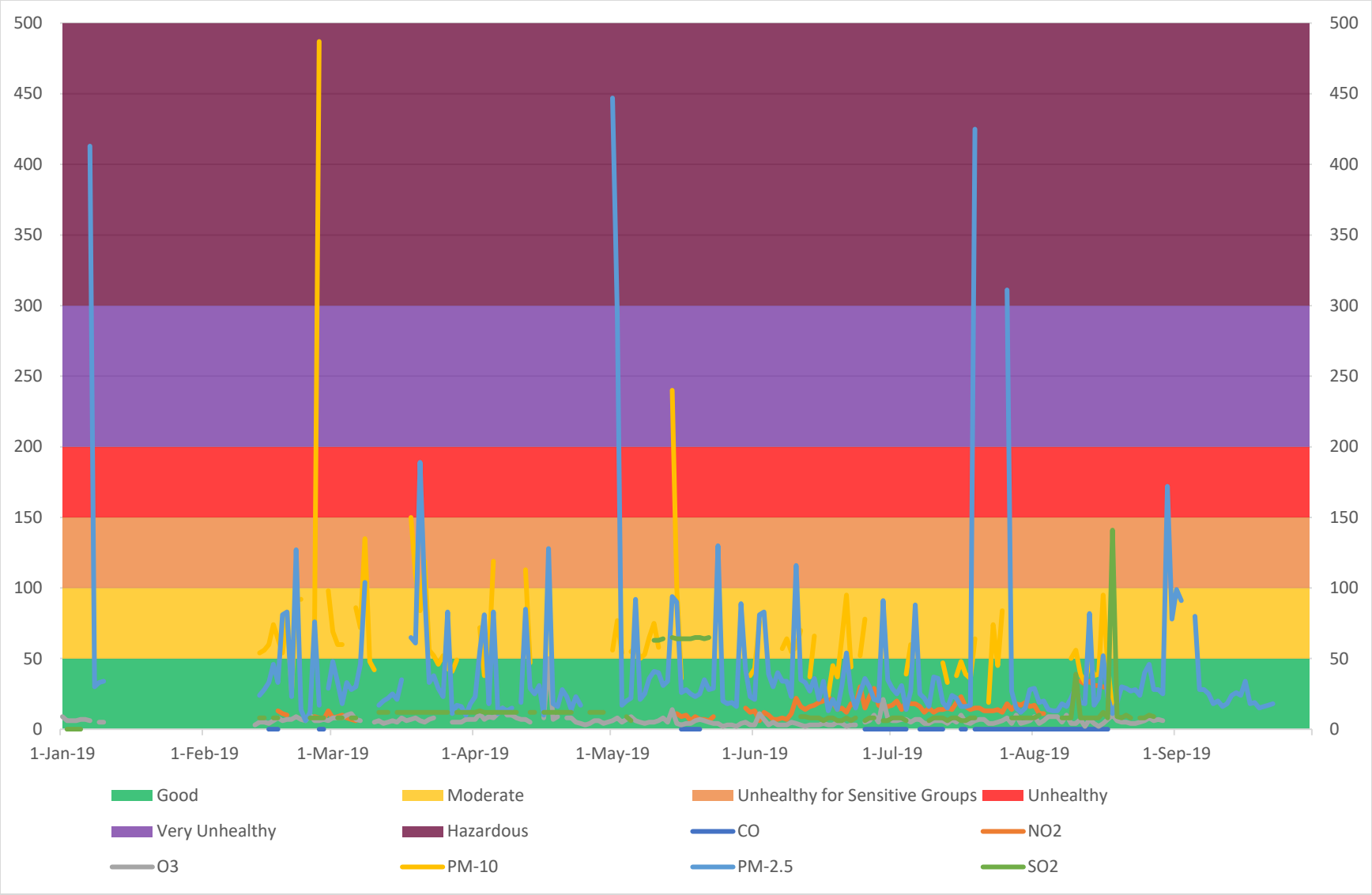


Figure 3.44: Air Quality Indices for Pollutants at Monitor Station: Chaguanas TRI5422015-TRI5442015 2019

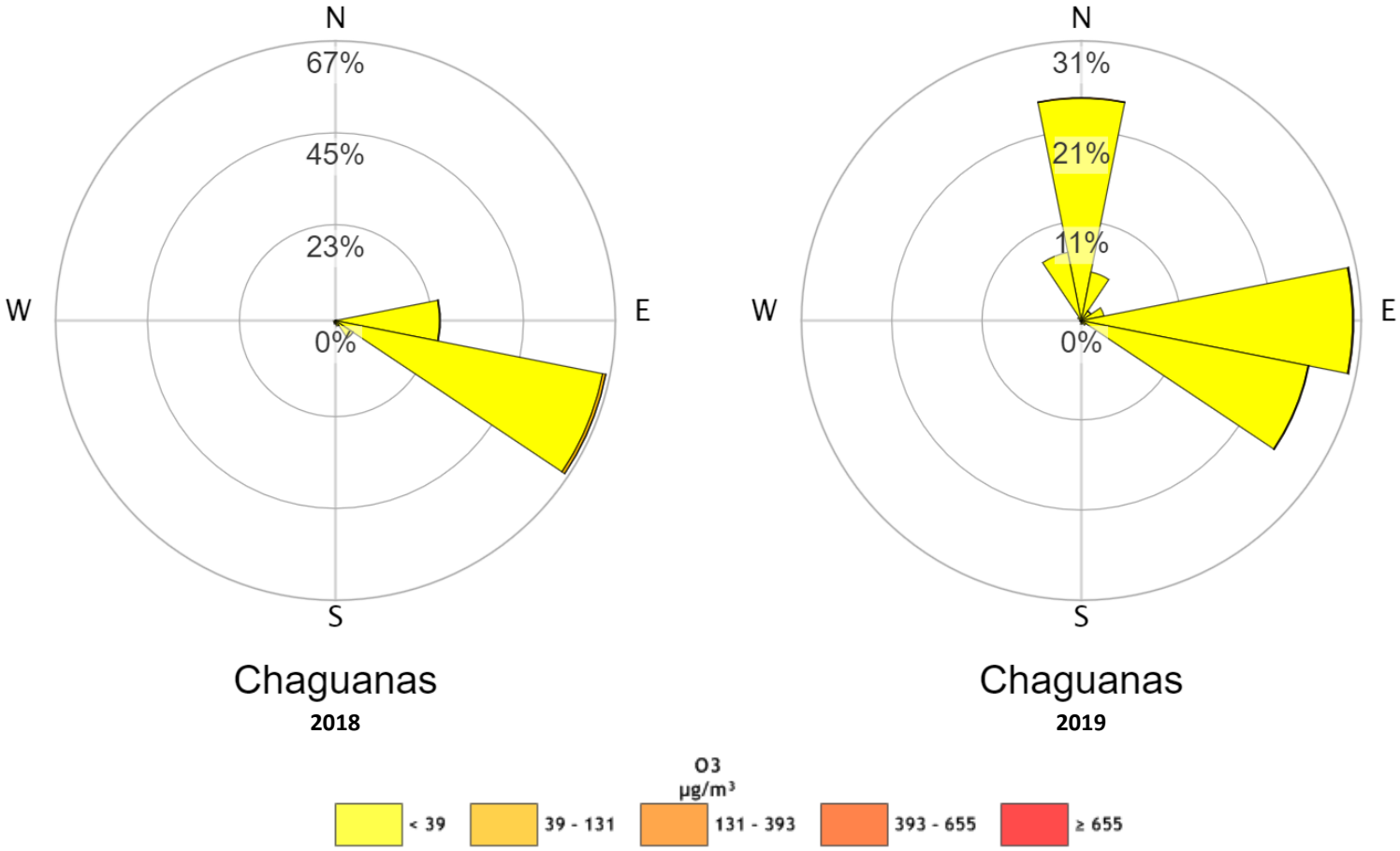


Figure 3.45: O3 Pollution Roses at Chaguanas Monitor Station (blowing from) (Jan 01, 2018 - Dec 31, 2018 and Jan 01,2019 - Oct 15, 2019

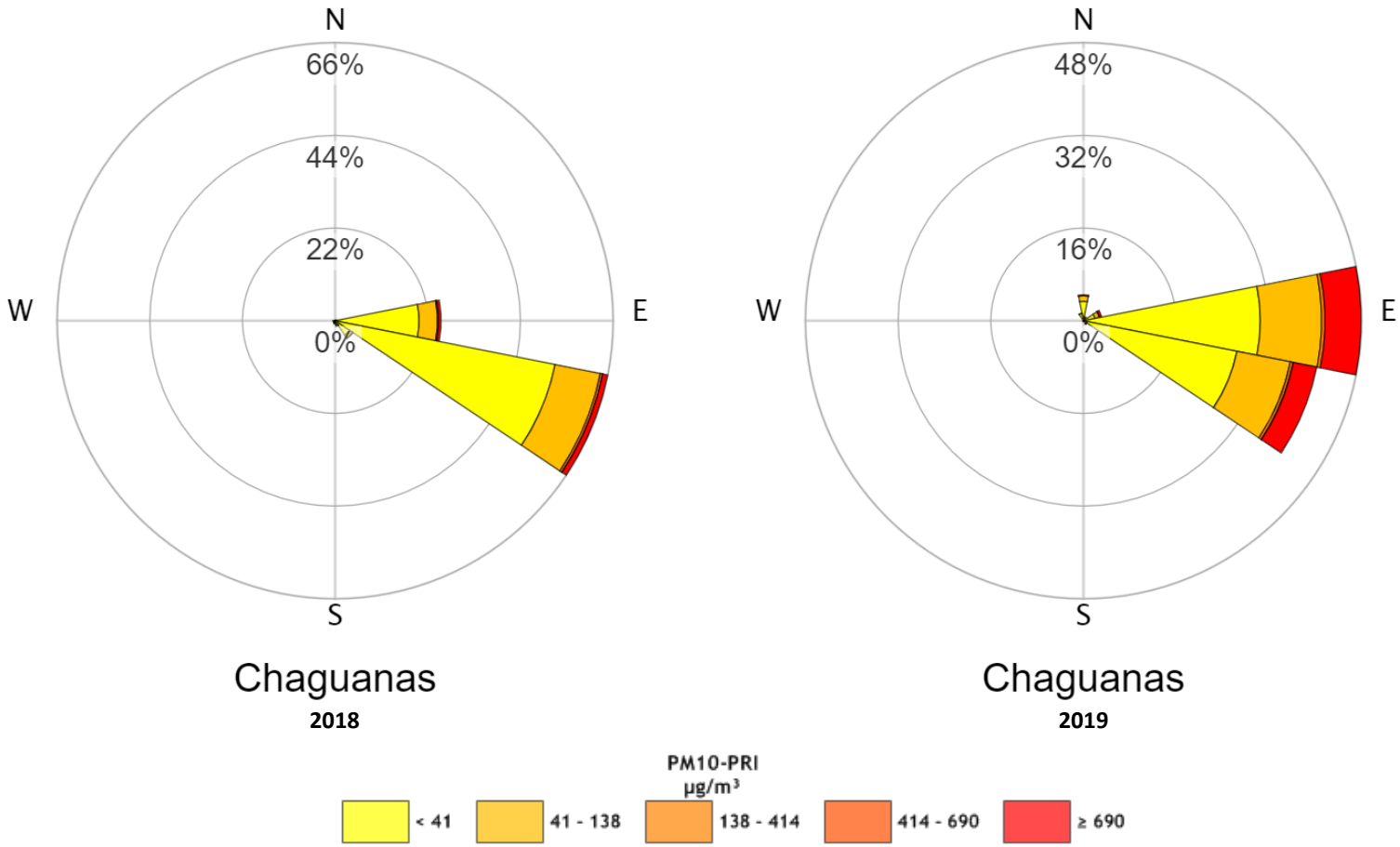


Figure 3.46: PM10 Pollution Roses at Chaguanas Monitor Station (blowing from) (Jan 01, 2018 - Dec 31, 2018 and Jan 01,2019 - Oct 15, 2019

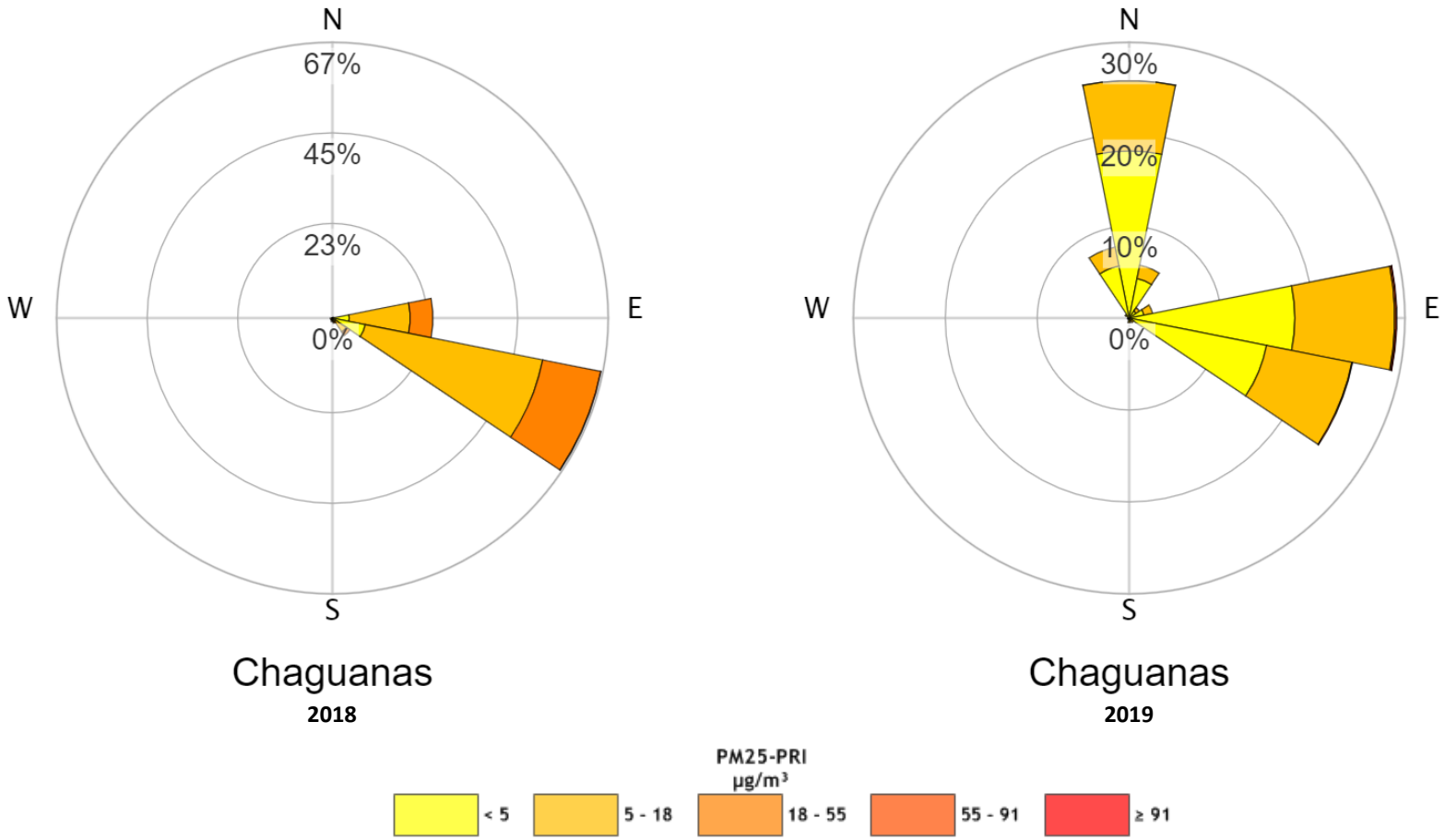


Figure 3.47: PM 2.5 Pollution Roses at Chaguanas Monitor Station (blowing from) (Jan 01, 2018 - Dec 31, 2018 and Jan 01,2019 - Oct 15, 2019

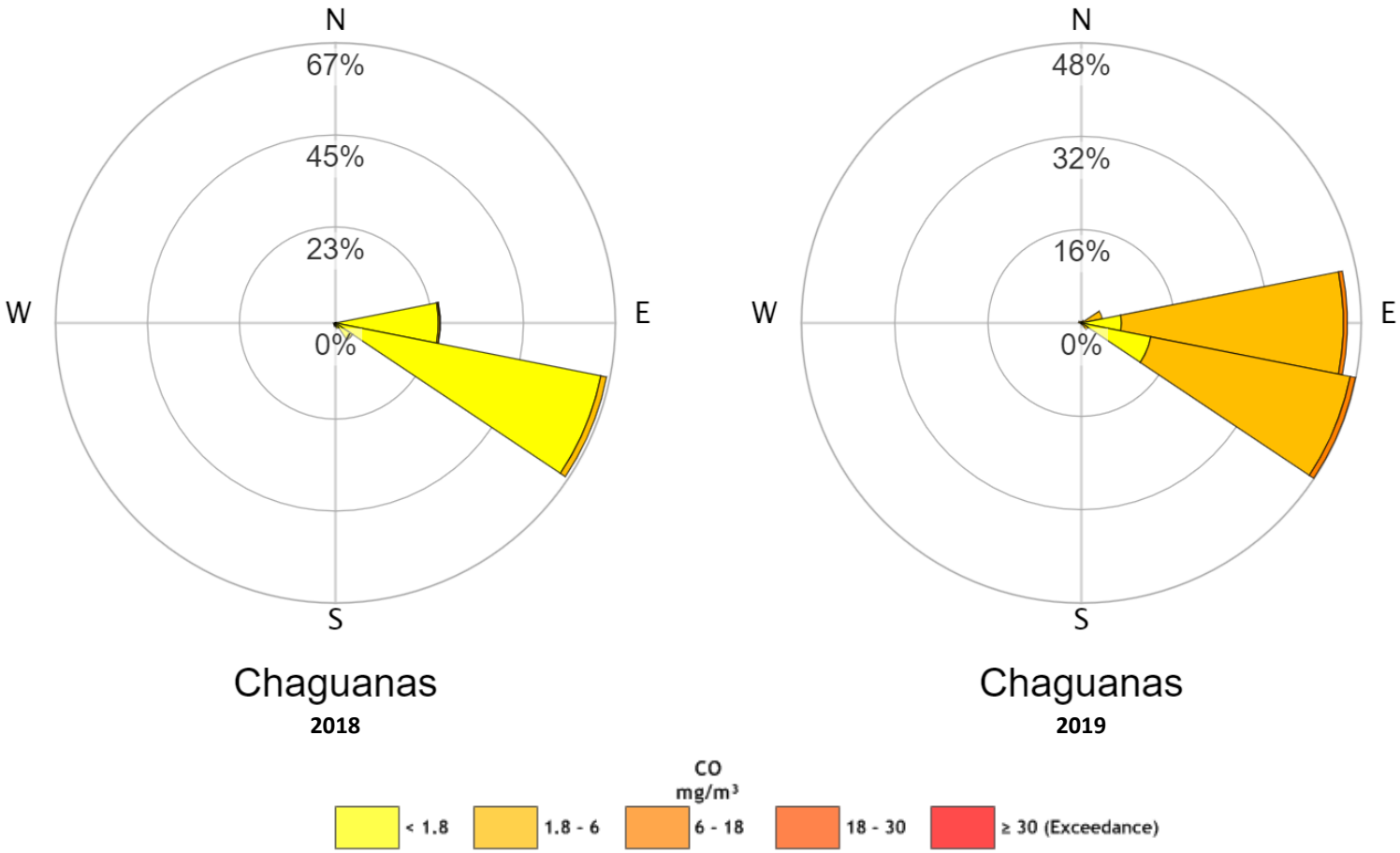


Figure 3.48: CO Pollution Roses at Chaguanas Monitor Station (blowing from) (Jan 01, 2018 - Dec 31, 2018 and Jan 01,2019 - Oct 15, 2019

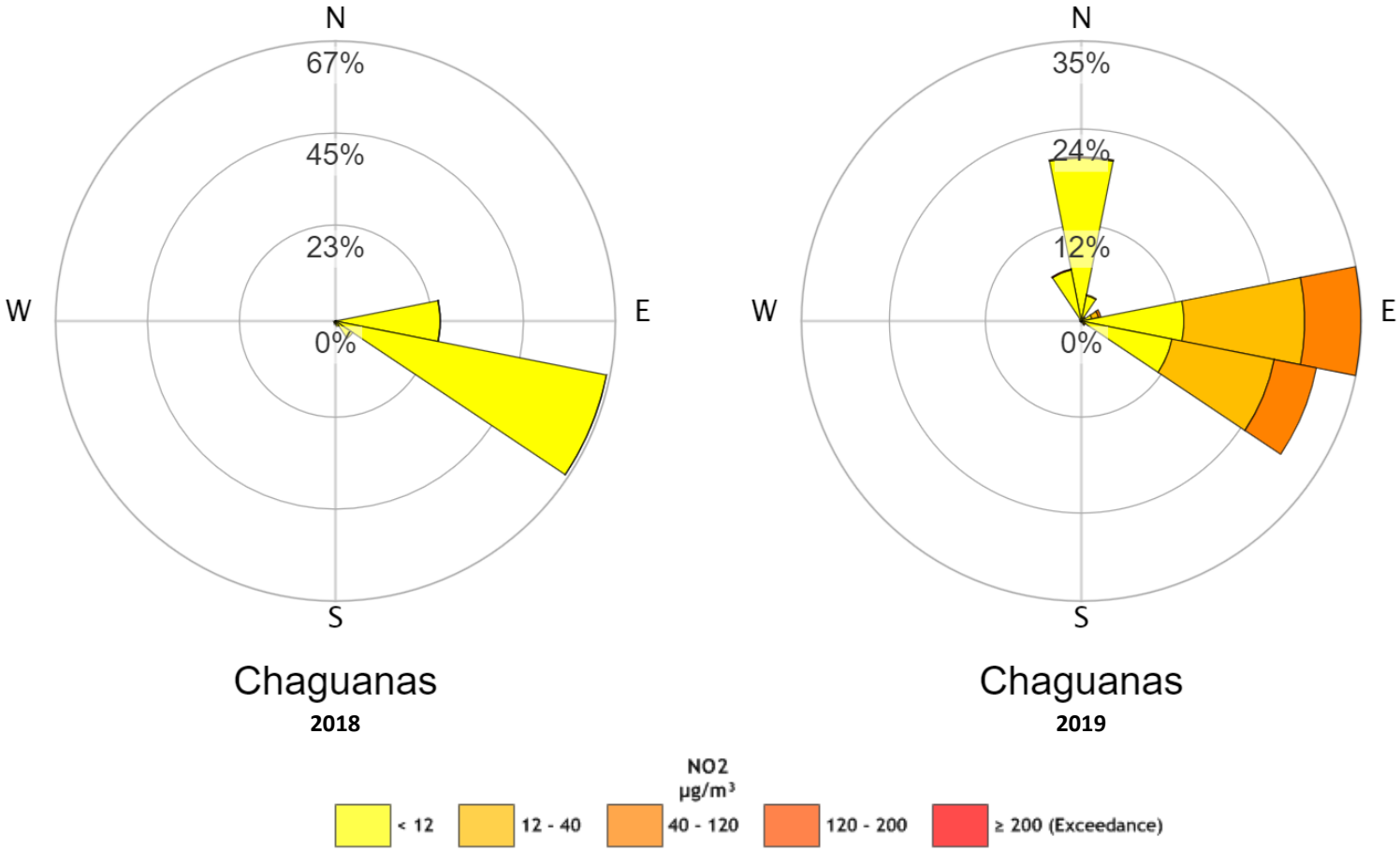


Figure 3.49: NO2 Pollution Roses at Chaguanas Monitor Station (blowing from) (Jan 01, 2018 - Dec 31, 2018 and Jan 01,2019 - Oct 15, 2019

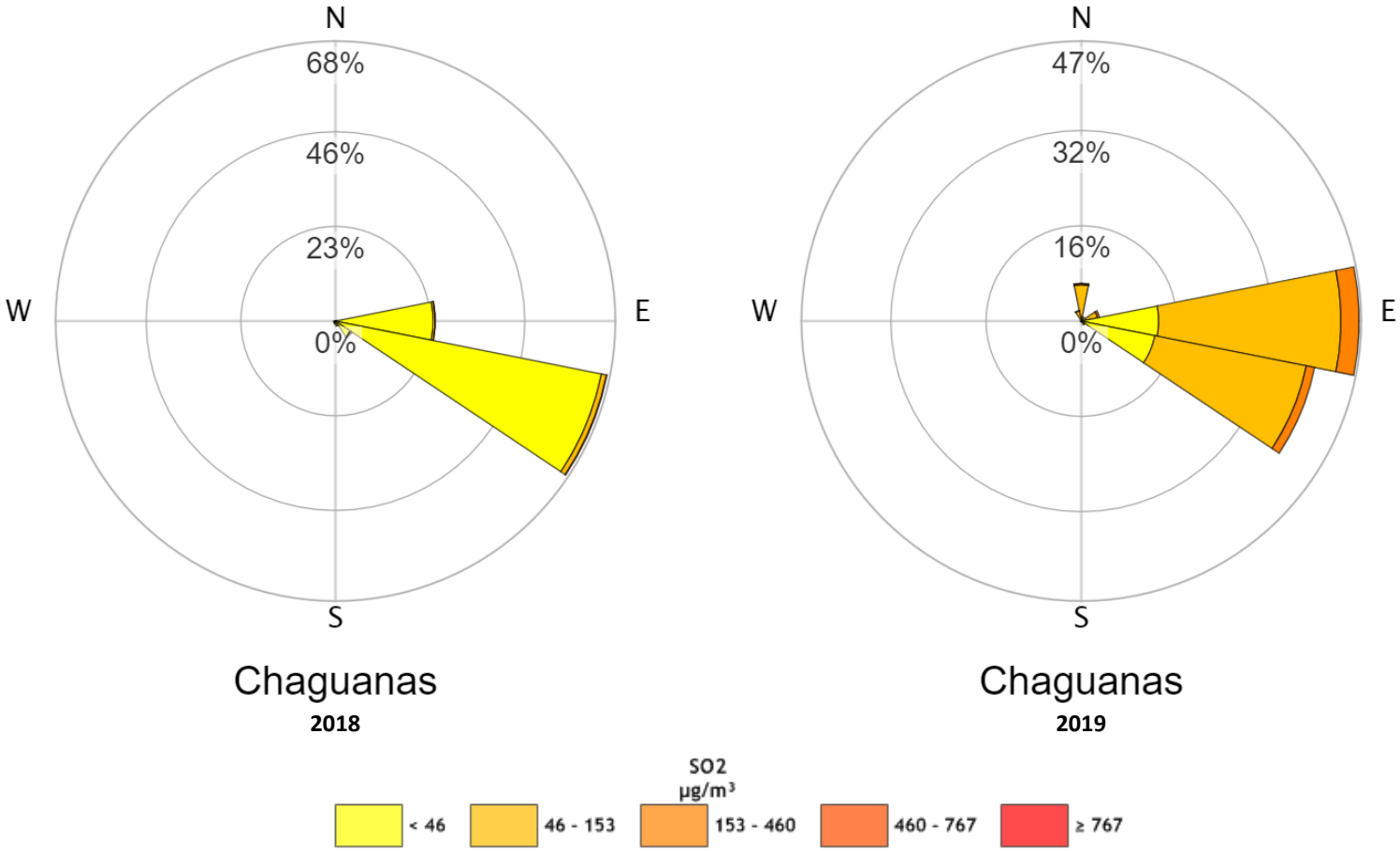


Figure 3.50: SO2 Pollution Roses at Chaguanas Monitor Station (blowing from) (Jan 01, 2018 - Dec 31, 2018 and Jan 01,2019 - Oct 15, 2019

3.7.1.4 PROJECTED INCREASE

The passage of traffic within the project area will emit air contaminants in the form of dust and exhaust emissions (oxides of carbon, sulphur and nitrogen and volatile organic compounds). This is an unavoidable consequence along any roadway. The road improvements are expected to contribute to improved traffic flow, but not significantly increase traffic along the road.

3.7.1.5 POTENTIAL HEALTH ISSUES ARISING FROM EXPOSURE POLLUTANTS IN EXCESS OF MAXIMUM PERMISSIBLE LEVELS

Air pollution is composed of a variety of gaseous pollutants and particulate matter. These pollutants arise from a variety of sources such as road vehicles, industrial emissions and wood-burning (Capello and Gaddi 2018a). Many cities worldwide are facing levels of air pollutants over the regulatory limits (Kumar et al. 2015). Air pollutants can be classified into primary and secondary. Primary pollutants are those directly emitted into the atmosphere by human activities (vehicle engines, industrial production, etc.) and by natural processes (windblown dust, volcanic activity, etc.). Secondary pollutants are formed within the atmosphere when primary pollutants react with sunlight, oxygen, water and other chemical compounds present in the air.

As for public health, major pollutants are particulate matter (PM), tropospheric ozone (O3), nitrogen dioxide (NO2) and sulphur dioxide (SO2). NO2 and SO2 are produced by the combustion of fossil fuels and contribute to photochemical smog, as well as to acid rain. O3 is a major component of photochemical smog, an air pollution phenomenon that forms when primary pollutants like NO2 and carbon monoxide (CO) react with sunlight to form a variety of secondary pollutants. PM is mainly attributed to the combustion of fossil fuels, especially coal and diesel fuel. In general, the smaller the size of the particles, the larger their effects are on human health (Heal, Kumar, and Harrison 2012).

Together with conventional air pollutants, which are currently under regulation, there is an increase in interest towards unregulated pollutants, such as airborne ultrafine particles (UFPs; diameter less than 100 nm). UFPs are considered to show even higher health impacts compared with fine particles (Health Effects Institute 2013). These particles are so small in size that they contribute almost a negligible mass, unlike fine or coarse particles, but contain significant numbers and therefore are represented by particle number concentrations (PNC). In typical urban environments, ultrafine particles contribute up to 80% of the total PNCs (Kumar et al. 2010). The dominant source of ultrafine particles in the urban environment is road vehicles.

A study by Kumar et al. (2014) reviewed the concentrations of particles in various cities worldwide. They reported that average PNCs in the European cities are much lower compared with those in Asian cities. This is expected due to a much lower sulphur content in the fuel. Recent Euro 5 and 6 emission standards included, for the first time, the limits of particle number emissions for the heavy-duty vehicles. However, there are yet no standards to control their ambient concentrations in urban areas. The European Committee for Standardisation (CEN) at the European level is currently taking an initiative to standardise the measurement methods for ultrafine particles, which is likely to result in regulatory guidelines in the near future in Europe.

A more recent review (Kumar et al. 2016) reported on average PNCs in different places of urban areas. The place with higher concentrations, usually referred to as pollution hotspots, of ultrafine particles is found close to the intense sources (industrial plants, motorways, harbours) or in microenvironments with low air exchange rates such as street canyons. The other most prominent pollution hotspots of ultrafine particles, which are important from an exposure perspective, are traffic intersections. At the traffic intersections, the vehicles go under variable driving

conditions such as acceleration, deceleration and stop and go, resulting in much higher emissions compared with traffic under free-flow traffic conditions (Kumar and Goel 2016).

A contemporary study completed by Shairsingh, Jeong, and Evans (2019) evaluated transborder and traffic influences of on air pollution in two Caribbean states. The authors underscored that exposure to ambient air pollution has been linked to adverse health outcomes ranging from asthma to premature mortality. However, little to no information exists on the exposure of residents and visitors in the Caribbean islands. While a few previous studies have quantified levels of PM10 from Sahara dust in Trinidad, Shairsingh, Jeong, and Evans (2019) focussed on a local source of air pollution, traffic emissions. Mass concentrations of black carbon (BC) and PM2.5 were measured at ten locations across the islands of Trinidad and Tobago over a three-week period. PM2.5 concentrations were observed to be heavily influenced by air masses showing origins from the Sahara Desert (31%), North America (26%) and Atlantic Ocean (42%), which resulted in similar average concentrations between the two islands. Average concentrations of BC were five times higher in Trinidad than Tobago (2.0 vs 0.43 µg/m3). In addition, BC in Trinidad was three times higher near than away from major roads (2.21 vs. 0.72 µg/m3), with concentrations reaching levels comparable to those near highways in large metropolitan cities ()Table 3.18. The elevated BC concentrations observed in this study suggests that significant exposure to diesel exhaust is occurring in Trinidad, with significant contributions from traffic.

Table 3.18: Average BC and PM2.5 mass concentrations that was observed in this study and selected comparator cities.

City	Trinidad		Tobago	Toronto	Detroit	New Delhi	Hong Kong	Mexico	Mexico	Italy
	NR	UB	UB	NR	NR	NR	NR	NR	UB	UB
BC (µg/m³)	2.2	0.7	0.4	1.7	1.5	11	3.8	1.6	0.9	0.8
PM2.5 (µg/m³)	14.1	15.8	24.8	10	9.2	133	47.1	19.2	17	18.7
Source	Shairsingh, Jeong, and Evans (2019)			Vette et al. (2013)	Saraswat et al. (2013)	Saraswat et al. (2013)	Zhang et al. (2017)	Lopez-Reyes et al. (2015)	Minguillón et al. (2014)	Cesari et al. (2018)

Source: Shairsingh, Kerolyn K, Cheol-Heon Jeong, and Greg J Evans. 2019. "Transboundary and traffic influences on air pollution across two Caribbean islands." Science of the Total Environment 653:1105-1110. doi: 10.1016/j.scitotenv.2018.11.034.

Approximately 20 million tons of Sahara dust can be transported to the Caribbean islands every year as a result of the North Atlantic Trade winds (Prospero et al. 2008, Garrison et al. 2014). This phenomenon has led to Caribbean islands focussing on associations between exposure to Saharan dust and adverse health outcomes, specifically asthma admissions. In 1997, researchers from the Environmental Management Authority and Pan American Health Organization conducted a study in Trinidad to quantify PM10 levels(Rajkumar and Siung Chang 2000). In that study, 24-h PM10 concentrations were observed to be N150 µg/m3 when air masses originated from the Sahara Desert, while concentrations dropped to 70 µg/m3 when the air mass did not originate from the Sahara Desert. Concurrent to that study, researchers in Barbados also investigated associations between Sahara dust and paediatric asthma in 1997 (Prospero et al. 2008). Similar PM10 mass concentrations from their continuous regulatory monitors were observed when air masses originated from the Sahara Desert (140 µg/m3) however lower levels were observed when the air masses did not originate from the Sahara Desert (3 µg/m3).

The effects of air pollution on human health have been studied for decades, but only a partial and limited picture exists of the true extent of the problem (Capello and Gaddi 2018b). Although inhalation is the main form of assimilation, toxins can enter the human body through other ways such as ingestion or skin absorption. Different components can have direct or indirect effects, alone or in combination with other toxins or microorganisms, interacting with human cells, tissues, organs, and systems (Capello and Gaddi 2018a). Different sources, concentrations, times, and modes of exposure are linked to different effects; people subject to air pollution have

unique susceptibility and vulnerability. The effects can show themselves immediately with a clear cause-and-effect relationship or after days, weeks, months, or years, so that a clear causal connection cannot be established.

Particulate matter (PM), ozone (O3), carbon monoxide (CO), sulphur dioxide (SO2), nitrogen oxides (NOx) and lead [3–5] have been identified as a major cause of health problems in children (See Table 3.19). Carbon monoxide, PM2.5, nitrogen oxides, hydrocarbons, other hazardous air pollutants (HAPs) and ozone are related to traffic pollution. In rural areas, fumes from combustion can be a major cause of indoor and outdoor air pollution.

Table 3.19: Effects of air pollution on the respiratory system in children

Respiratory conditions or symptoms	Alleged responsible pollutants	Alleged type of exposure
Asthma onset	NO_2	Early life
	SO_2	
	$PM_{2.5–10}$	
	O_3	
	Traffic-related air pollution	Continuous
	$PM_{2.5–10}$	Short exposure
	O_3	
Wheeze and exacerbation of asthma[a]	NO_2	Higher peak in previous hours/day/week
	NO_x	
	SO_2	
	$PM_{2.5}$	
	O_3	
	CO	
	NO_2	Facilitate viral infections to trigger exacerbation after 1 week from exposure
Nonallergic asthma	Traffic-related air pollution	Early exposure
Airway inflammation	$PM_{2.5}$	
Progression to adult COPD	$PM_{2.5}$	Chronic
	O_3	
Decrease in lung function	SO_2, NO_2, NO_x, $PM_{2.5–10}$, $PM_{2.5}$ absorbance, O_3	Current and long-term exposure
	$PM_{2.5}$	Subchronic exposure
	O_3	
	Black smoke, PM_{10}, NO, CO	Acute exposure, affecting baseline function
	O_3	Acute exposure
Respiratory tract infection	NO_2	Short-term exposure
	$PM_{2.5}$	
	O_3	
	Solid and biomass fuel	Indoor, continuous/recurrent
	NO_2	Long-term exposure, annual average
	$PM_{2.5}$	
	$PM_{2.1}$	
Otitis media	Tobacco smoke	Passive environmental smoke; continuous (recurrent episode of otitis and earache)
Pharyngitis	Fungi	Indoor, short term
	Tobacco smoke	Passive and active smoking
Rhinitis and olfactory function	NO_2	Early life
	SO_2	
	PM_{10}	

Source: Capello 2018. Clinical handbook of air pollution-related diseases.

Epidemiological studies on the adverse effects of air pollution on senior citizens (Figure 3.51) focus on the more commonly monitored air pollutants (primarily SO2, CO, NO2, O3 and PM as a primary and secondary particulate), but they often estimate, based on the individual case, different levels of intensity in outcome (Simoni et al. 2015, Brook et al. 2010).

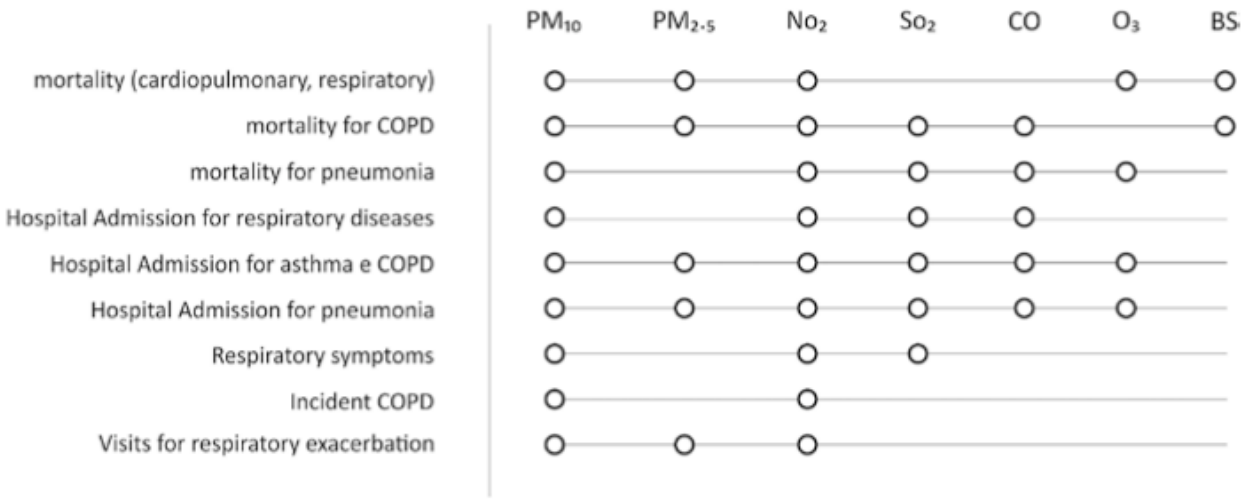


Figure 3.51 : Main Respiratory Health Effects Due to Outdoor Pollution Exposure in the Elderly CO (carbon monoxide), NO2 (nitrogen dioxide), PM (particulate matter), SO2 (sulphur dioxide), O3 (ozone), BS (black smoke) and COPD (chronic obstructive pulmonary disease). Source: Capello 2018. Clinical handbook of air pollution-related diseases.

Pollution is often an invisible enemy, which creates concern only when its presence is unequivocally evident or when it exhibits immediate consequences for human health. The critical point is that people may be constantly exposed to air pollution even when they think they are safe; that can happen at home and in residential areas, while traveling or commuting, at school or in the workplace, or in all the other locations where people go for leisure or for any other reason. The burden for individuals and societies is becoming too heavy to bear, and immediate actions are needed to reduce the amount of pollutants emitted into the atmosphere locally and globally, to protect the environment—and, ultimately, people—from their effects.

3.7.2 NOISE

Noise is pervasive in everyday life and can cause both auditory and non-auditory health effects. Evidence of the non-auditory effects of environmental noise exposure on public health is growing (Basner et al. 2014). Observational and experimental studies have shown that noise exposure disturbs sleep and causes daytime sleepiness, increases the occurrence of hypertension and cardiovascular disease, and impairs cognitive performance in schoolchildren (Murphy and King 2014, Slabbekoorn 2019, Stansfeld and Matheson 2003). The importance of adequate noise prevention and mitigation strategies for community health is crucial. For the proposed project, noise is expected to be generated from the engines, exhaust, horns, alarms, and operation of construction vehicles and equipment. With the implementation of appropriate mitigation measures, potential impacts of noise levels are not expected to increase by more than 5 dBA above ambient noise levels, so this impact is not considered to be of significant concern.

3.7.2.1 NOISE POLLUTION CONTROL RULES, 2001;

Zone III - General Area. Under Section 2 of the Noise Pollution Rules, 2001, Zone I (Industrial Areas) is defined as areas 'expressly approved for industry by a competent governmental entity'. Zone II, Environmentally Sensitive Areas means a portion of the environment so designated under Section 41 of the Act, and Zone III (General Area) refers to

all of Trinidad and Tobago except Environmentally Sensitive Areas and Industrial Areas. The proposed project area falls within Zone III - General Area. 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 (Leq) and maximum instantaneous unweighted peak sound pressure level (Lpeak).

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:

a) a) 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
b) b) 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:

1. □□ 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
2. □□ 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 considered in this study. In fact, the noise levels measured during this study would constitute background noise levels which can be used for comparison during future studies.

Section 7 of the Noise Rules lists a number of activities which are exempt from the prescribed standards. One of these activities is:

“(k) Construction activity when conducted on a construction site between the hours of 7:00 a.m. and 7:00 p.m. of the same day.”

The proposed project will require a variation if work is to proceed at night, and that work is expected to exceed the specified limits.

3.7.2.2 BASELINE ASSESSMENT OF NOISE IN DIEGO MARTIN

Ecoengineering Consultants Limited (Ecoengineering) was also contracted by the National Infrastructure Development Company Limited (NIDCO) to conduct Baseline Noise Monitoring for the construction of a vehicular overpass in the vicinity of Powder Magazine. The Report was prepared in accordance with the Noise Pollution Control Rules (NPCR) reporting requirements. Noise monitoring was conducted by Ecoengineering Consultants Limited at the same five (5) locations as the air quality monitoring locations (Figure 3.52). The dates of the noise monitoring were as follows:

- November 17, 2019 (weekend); and
- November 21, 2019 (weekday).

Noise monitoring was conducted by Ecoengineering Consultants Limited at the same five (5) locations as the air quality monitoring locations (see Table 3.20 and Figure 3.53). Photographs 6 to 10 show noise monitoring at each of the five locations.

Equivalent continuous sound pressure levels (Leq) and Instantaneous unweighted peak sound pressure levels (Lpeak) 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.

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 3.20) below.

Table 3.20: 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

Figure 3.52: Noise Monitoring Locations 2019

Source: Ecoengineering Consultants Limited. 2019. "Construction Of A Vehicular Overpass In The Vicinity Of Powder Magazine And Related Road Improvements - Ambient Air And Noise Monitoring And Discussion Of Impacts."

PHOTOGRAPH 6: LOCATION 1

PHOTOGRAPH 7: LOCATION 2

PHOTOGRAPH 8: LOCATION3

PHOTOGRAPH 9: LOCATION 4

PHOTOGRAPH 10: LOCATION 5

Figure 3.53: Photographs of Noise Monitoring Locations

3.7.2.2.1 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). While Locations 2, 3 and 4 are surrounded by houses Photograph 11). At Locations 1 and 5, the dispersion characteristics are excellent since these sites are surrounded by wide open spaces and buildings so the dispersion characteristics are not as good.

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.

3.7.2.2.2 NOISE RESULTS

This section summarizes the readings for the noise monitoring exercise undertaken on November 17 and 21, 2019. Table 3.21 lists the Leq values for morning and afternoon monitoring on a weekday and weekend. Copies of the instrument log sheets are included in Appendix F[10].

Table 3.21: 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**

[10] Appendix F - 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

During the monitoring period, none of the Leq or Lpeak values were over the limits specified in the Noise Pollution Control Rules, 2001, except for one Lpeak measurement at Location 1. The Leq 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.

Locations 1 (located west of SuperPharm) and 5 (located along the Diego Martin Highway in the vicinity of Victoria Keys) had similar Leq 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 Leq values ranging between 48.1 dBA and 62.2 dBA were recorded (see Figure 3.54 and Figure 3.55). The highest Lpeak of 115 dB was recorded at Location 1. The highest Lpeak at the other four locations was 103.5 dB (see Figure 3.56 and Figure 3.57). 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 Leq levels exceeded the applicable noise limits stipulated in the NPCR when compared with the absolute limits. However, the morning Lpeak was slightly exceeded at Location 1 on the weekend.

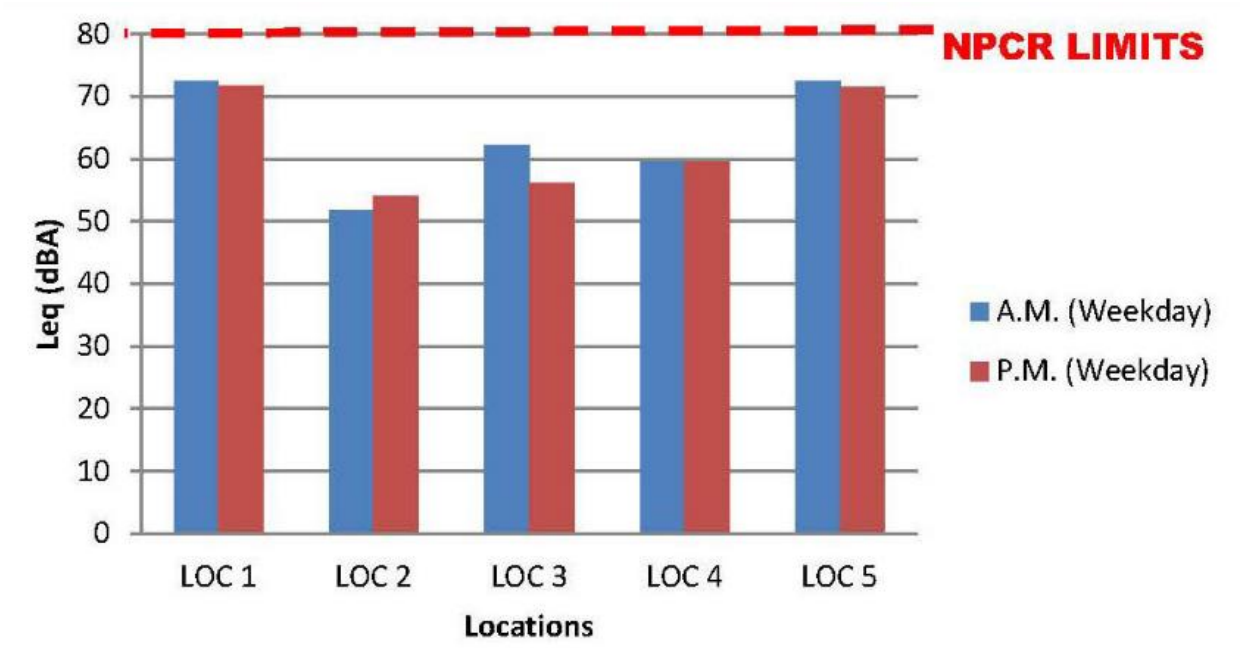


Figure 3.54 : L_{EQ} RESULTS (WEEKDAY)

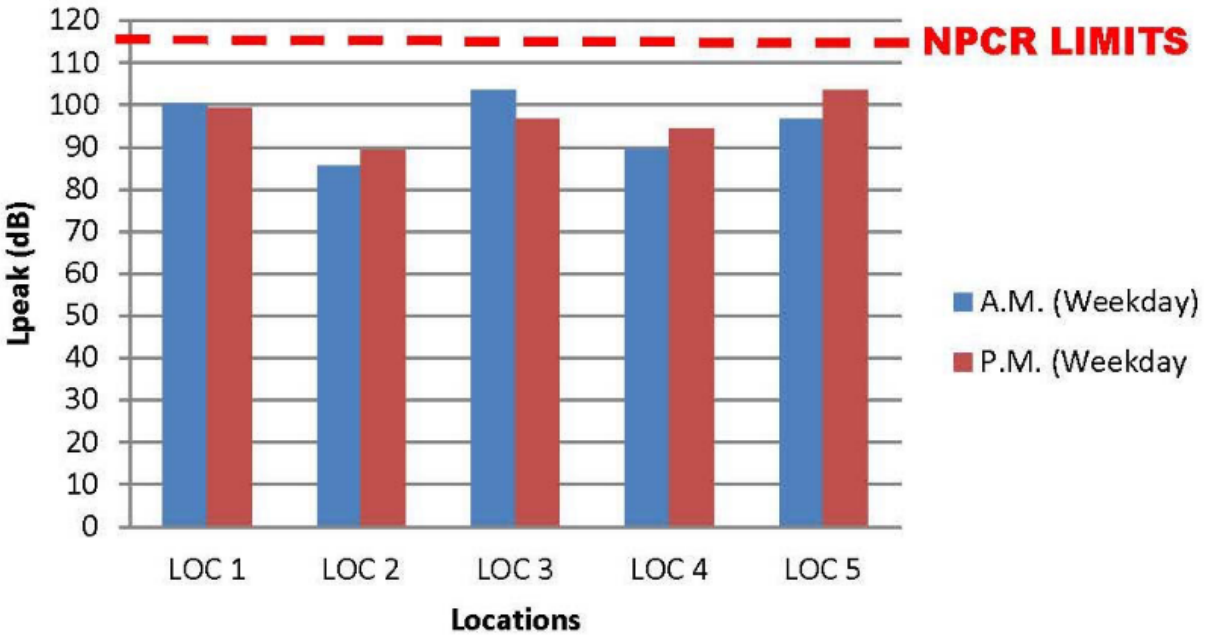


Figure 3.55: L_{PEAK} RESULTS (WEEKDAY)

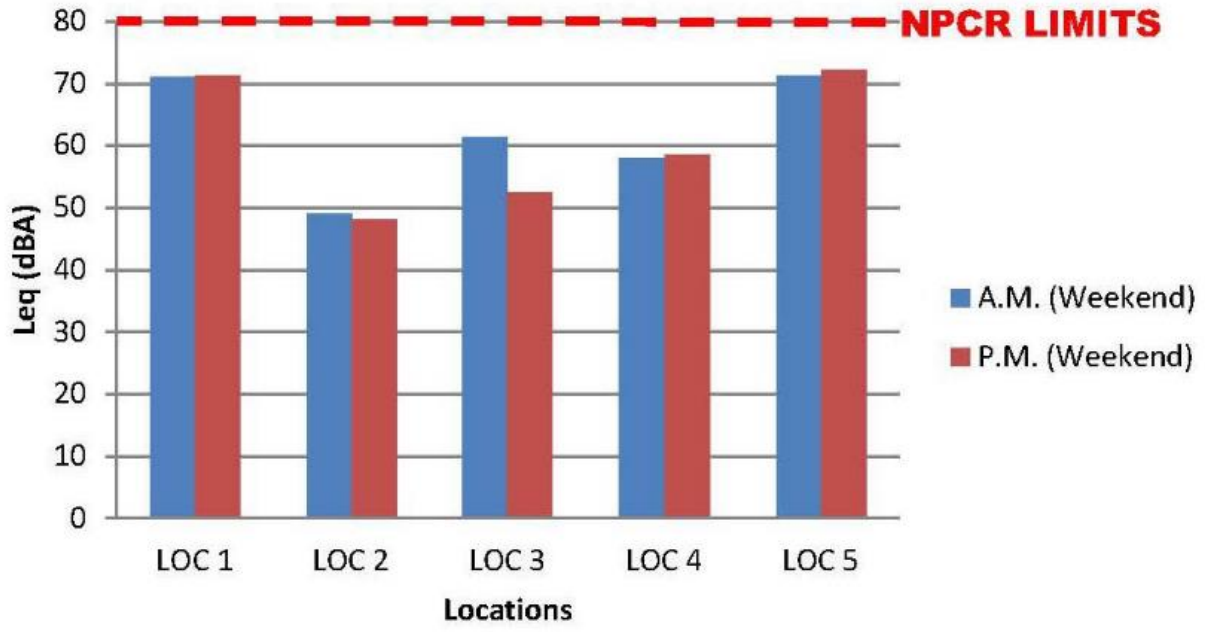


Figure 3.56 : L_{EQ} RESULTS (WEEKEND)

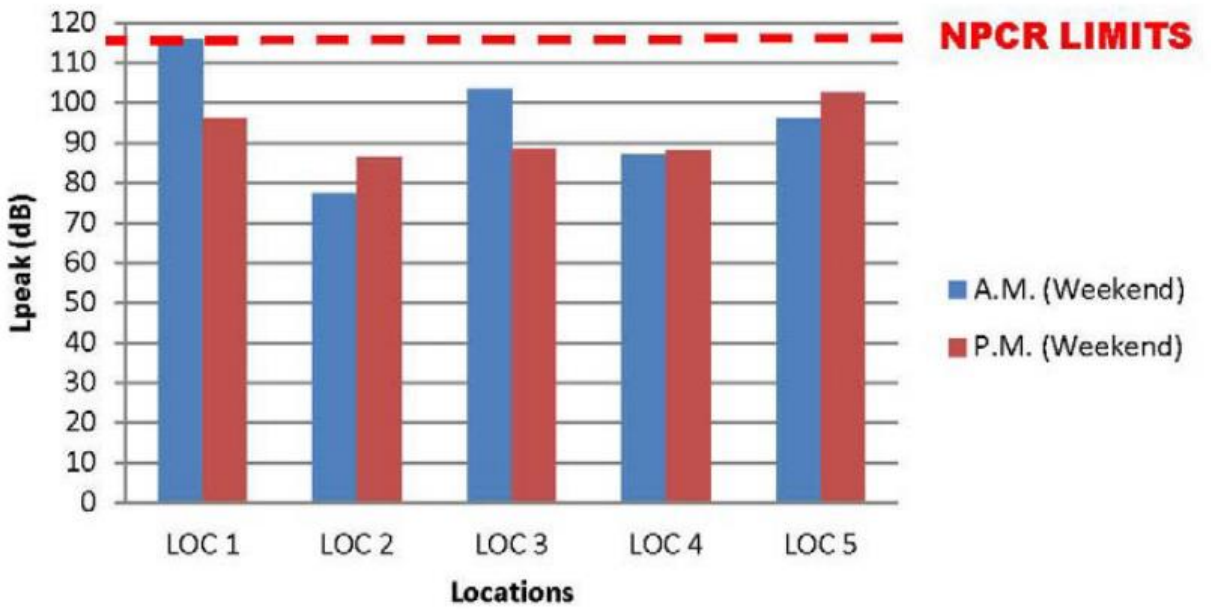


Figure 3.57$_{LPEAK}$ RESULTS (WEEKEND)

Table 3.22 summarizes the sound pressure level for morning and afternoon during the weekend and weekday monitoring.

Table 3.22: 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 Leq sound pressure levels fluctuated during the monitoring periods for both the weekday and weekend. Morning Leq values ranged from 51.8 dBA to 79.1 dBA and were higher than values recorded for the afternoon period with Leq values of 48.1 dBA to 72.1 dBA being recorded (see Figure 3.58 and Figure 3.59).Similarly, morning Lpeak values (ranging between 85.7 dB to 115.9 dB) were higher than afternoon values (88.4 dB to 103.5 dB) (see Figure 3.60 and Figure 3.61).). The highest morning Leq was recorded at Location 2 on the weekend while the lowest was also at Location 2 but on the weekday.

The highest morning Lpeak was measured at Location 1 on the weekend and this value exceeded the NPCR limit of 115 dB. The highest afternoon Lpeak 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. vehicle noises and natural sounds from animals (birds, dogs, etc.).

This can be attributed to Lpeak 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 (. 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.).

Weekday Leq 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 Leq 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 Lpeak reading (115.9 dB) was recorded on the weekend at Location 1 during the morning period.

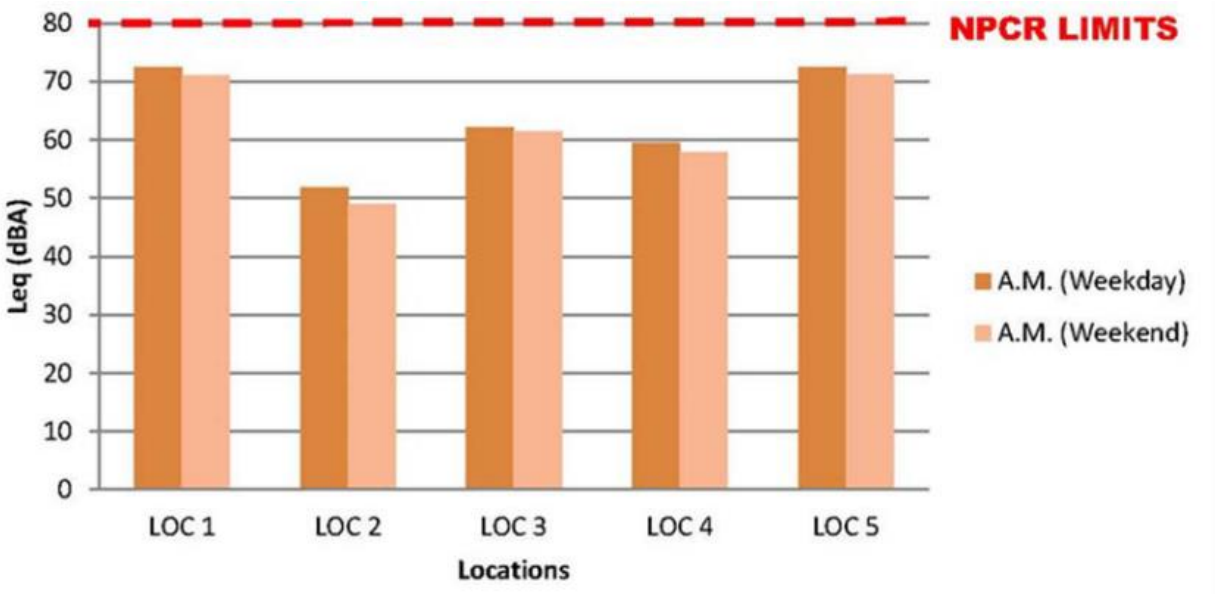


Figure 3.58: COMPARISON OF L_{EQ} RESULTS (WEEKDAY AND WEEKEND) MORNING PERIOD

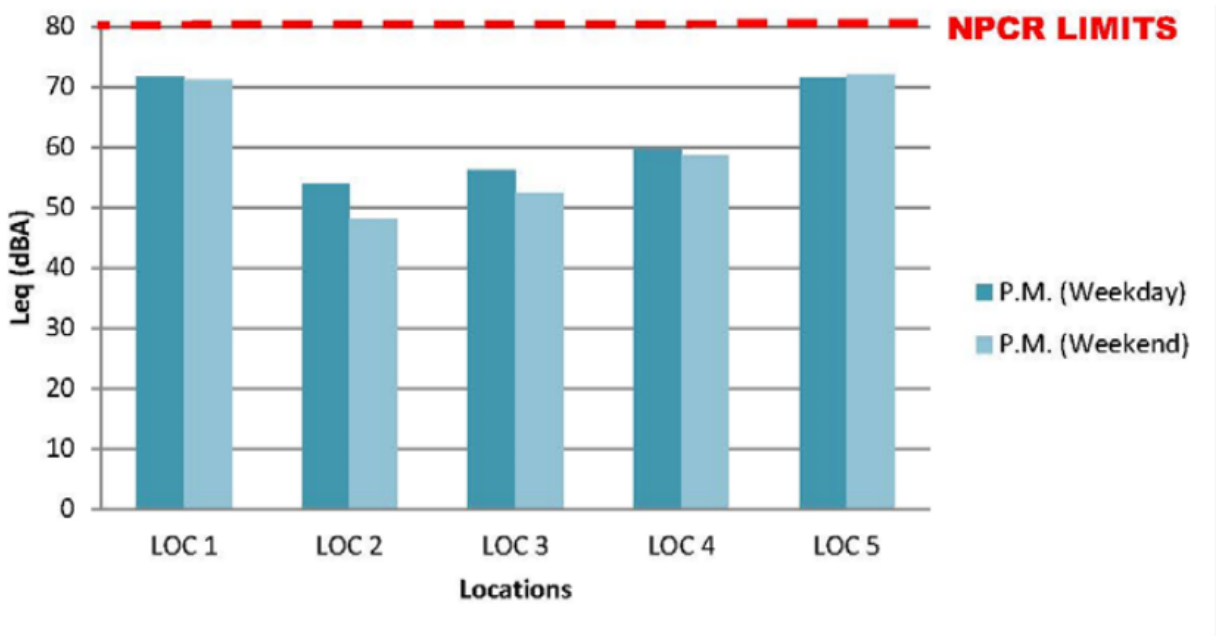


Figure 3.59: COMPARISON OF L_{EQ} RESULTS (WEEKDAY AND WEEKEND) AFTERNOON PERIOD

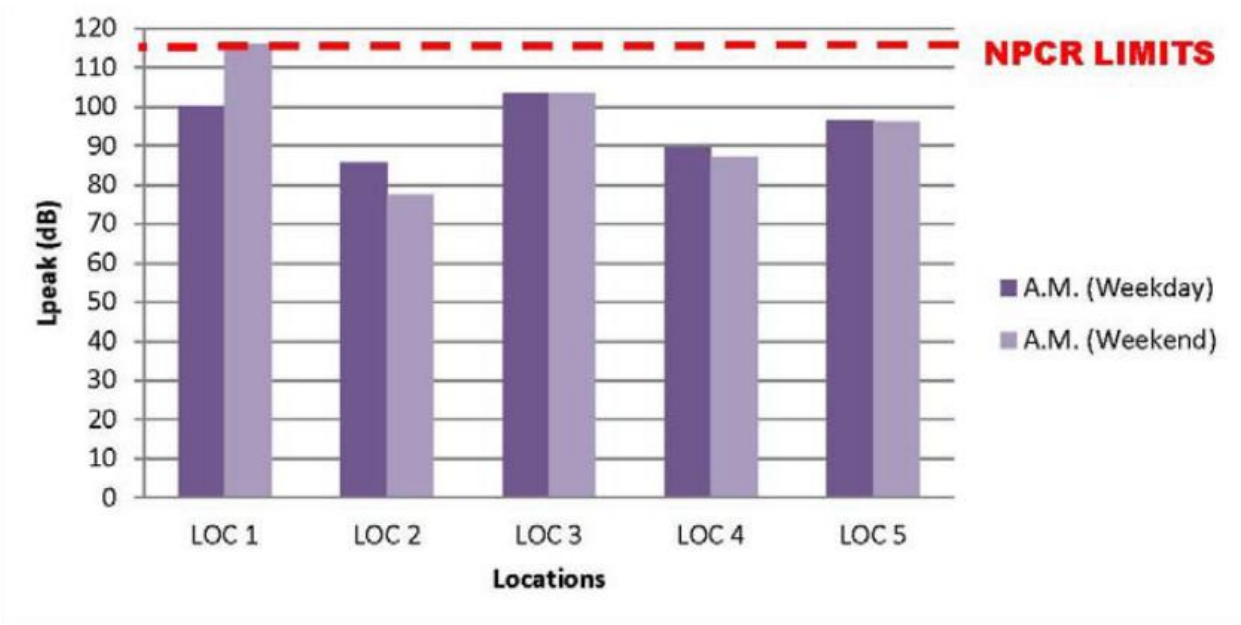


Figure 3.60: COMPARISON OF L_{PEAK} RESULTS (WEEKDAY AND WEEKEND) MORNING PERIOD

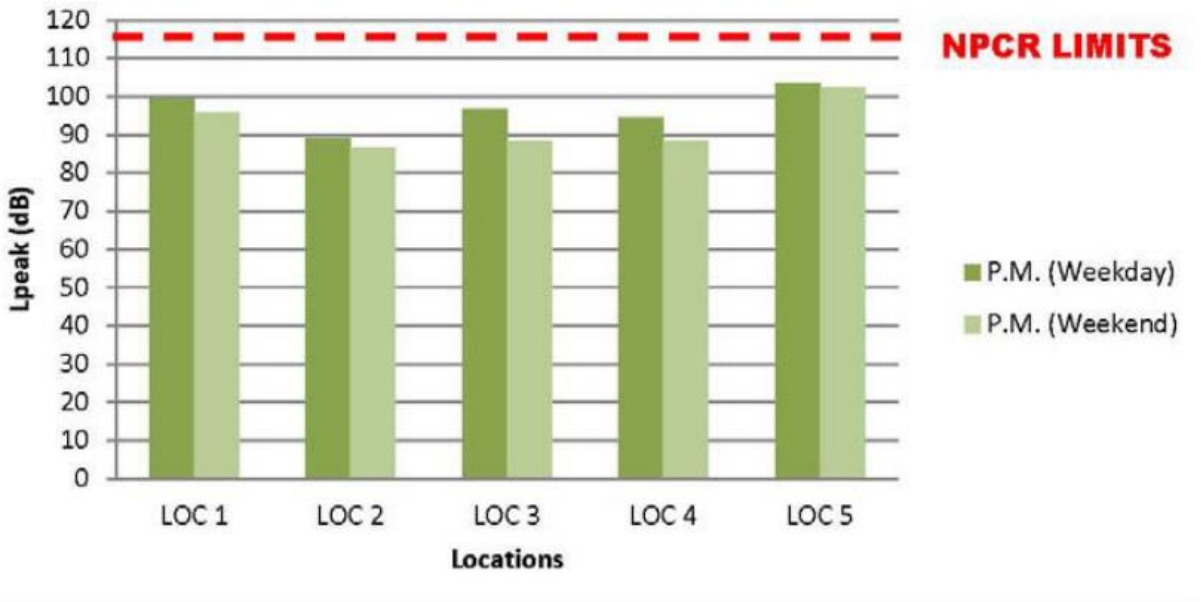


Figure 3.61: COMPARISON OF L_{PEAK} RESULTS (WEEKDAY AND WEEKEND) AFTERNOON PERIOD

3.7.2.3 PROJECTED INCREASE

During the operation phase, traffic noise will be an unavoidable consequence of the improvement works. Noise will be generated from the engines, exhaust, horns, alarms, and operation of construction vehicles and equipment. With the implementation of appropriate mitigation measures potential impacts are classified as LOW. The main sources of noise were identified to be from vehicular traffic. The proposed improvement works are expected to improve traffic flow in the area and necessarily increase its flow significantly. Therefore, noise levels are not expected to increase by more than 5 dBA above ambient noise levels. As such, noise during operation is not expected to be of significant concern.

3.7.2.4 POTENTIAL HEALTH ISSUES ARISING FROM EXPOSURE TO NOISE LEVELS ABOVE PERMISSIBLE

Baseline noise data gathered show that noise in the project area is compliant with the absolute limit for Leq in the NPCR. Additionally, all Lpeak 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 motorcycles, 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 (Leq) 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).

Construction noise can affect persons residing at the adjacent communities (such as Powder Magazine Phase 1 & 2, Victoria Gardens and Westmoorings) and can be a nuisance to neighbouring institutions (schools and hospitals) and commercial businesses. Loud noise can cause persons to become stressed and suffer sleep disturbance – all of which may lead to increased blood pressure and anxiety. Increased noise levels can also affect wildlife on surrounding lands. Terrestrial fauna at and around the site that may be impacted by noise include birds. If night time works are scheduled, regardless of the noise level generated, it will become a particular nuisance to the residents of the area.

Some level of noise is expected to impact the project site, including noise during transport of material and machinery to and from the sites. However, noise relating to demolition is expected to be higher, where the removal of asphalt, removal of houses and other infrastructure will require the use jackhammers and other noise intense equipment. This higher intensity noise can impact neighbouring residences, institutions and commercial businesses.

Should noise pollution be unmitigated for extended periods during construction, the literature has identified the following potential health effects (Hammer, Swinburn, and Neitzel 2013, Stansfeld and Matheson 2003, Basner et al. 2014)

- Difficulty in sleeping
- Reduced cognitive functioning
- Cardiovascular problems (high blood pressure)
- Emotion and behavioral change
- Reproduction problems
- Reduced Motivation

Figure 3.62 provides a depiction of the acute and chronic effects and resultant long-term risks stemming from primary exposure. Given the proximity of Victoria Keyes and Powder Magazine 2 to the construction site, mitigation measures for noise pollution during the construction phase of the project would be paramount. It is expected that the use of auger piling will reduce the possibility of intense noise that would have been occasioned by pile driving.

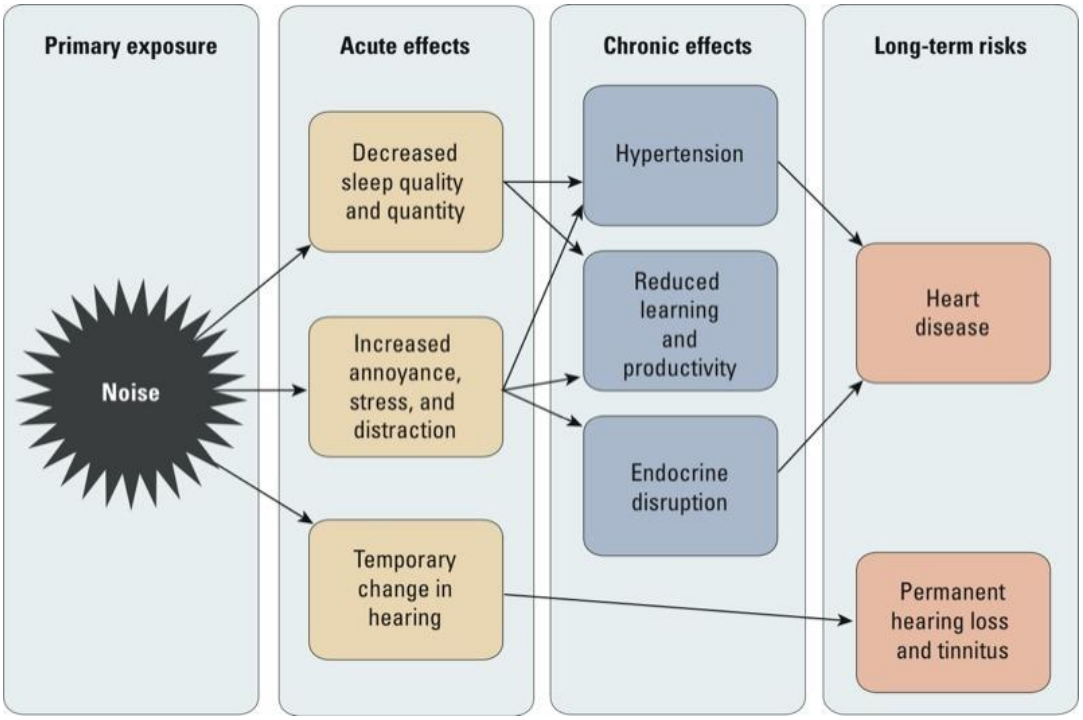


Figure 3.62: Selected Effects of Noise
Source: Hammer, Monica S, Tracy K Swinburn, and Richard L Neitzel. 2013. "Environmental noise pollution in the United States: developing an effective public health response." Environmental health perspectives 122 (2):115-119.

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.

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 and 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, agencies, religious leaders and school principals) of construction activities advance.

3.8 DEVELOPMENTS AT COCORITE FARMS

The Government of the Republic of Trinidad and Tobago, through the Ministry of Rural Development and Local Government (MORDLG) is desirous of constructing a building for use as the Administration Complex for the Diego Martin Regional Corporation (DMRC) to meet the current and projected responsibilities of the Corporation; and a

Branch of the First Citizens Bank Limited (FC) (Figure 3.63). The building site is located at Cocorite Farm at the corner of Western Main Road and Diego Martin Highway. It is on an open parcel of land, south of the residential area of Victoria Gardens. The site area is ~2.0236Ha.

The building has been designed to accommodate two (2) floors totalling approximately 30,000ft^2 with DMRC and FC allotted roughly 15,000ft^2 each. Based on the space constraints of the site, the Design Consultant, GSAL Designs Ltd, in agreement with the MORDLG, FC and NIDCO, submitted a design for a single structure facility with considerations for the operations and parking areas for each organization.

Ancillary requirements such as guard booths, an electrical kiosk, and Mechanical, Electrical and Plumbing (MEP) Services, parking spaces and site development were also included in the design. In addition, the facility has been designed to cater for future expansion. Construction is proposed to commence on 11th November 2019 for a duration of ten (10) months. Expected date of completion is 11th September 2020

On the West is the West Park Savannah which is under construction, The West Park Savannah is immediately adjacent to the Diego Martin River West and as at the finalisation of this assessment, is nearing completion (Figure 3.64)..

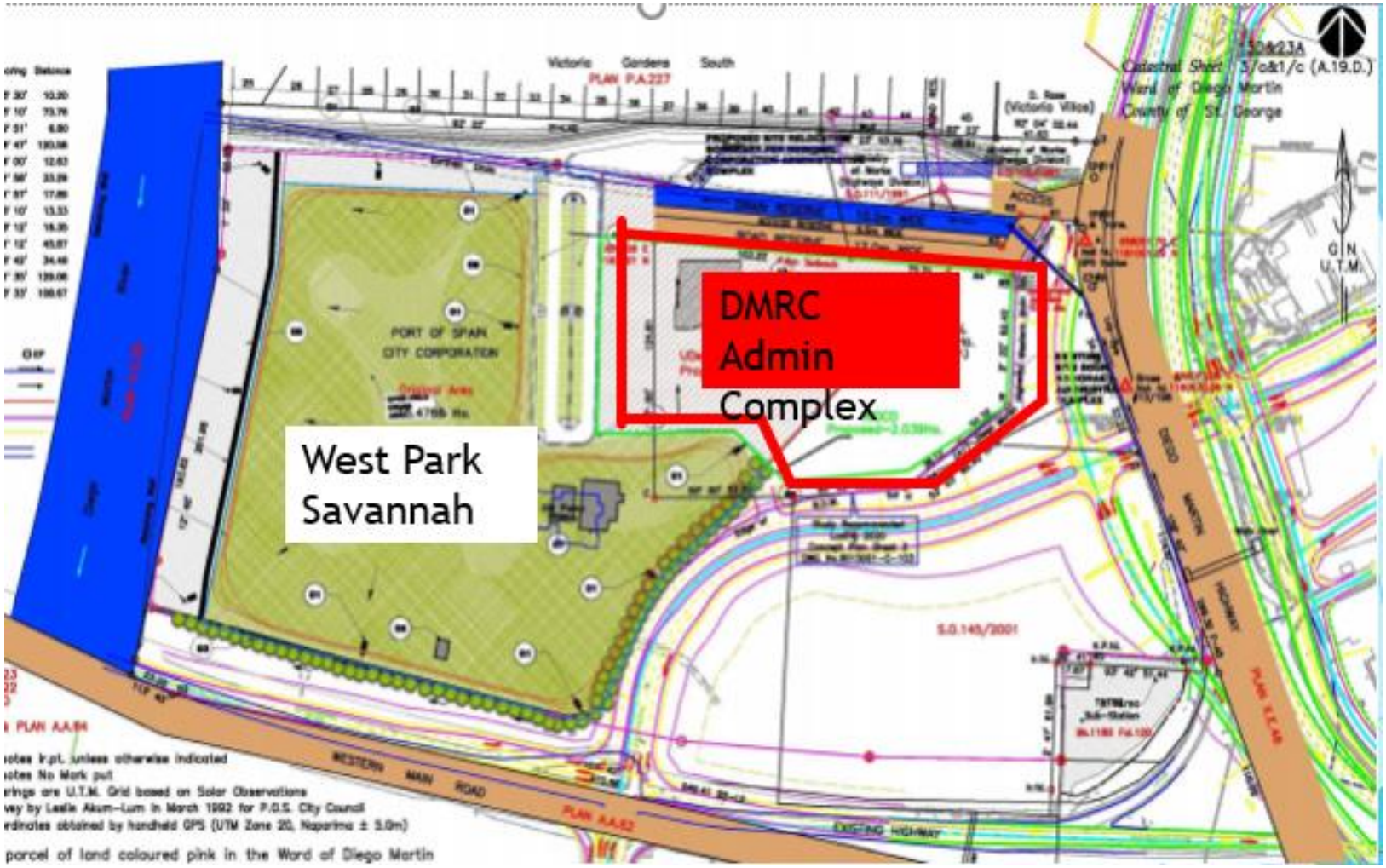


Figure 3.63: West Park Savannah and the Diego Martin Regional Corporation Administrative Complex

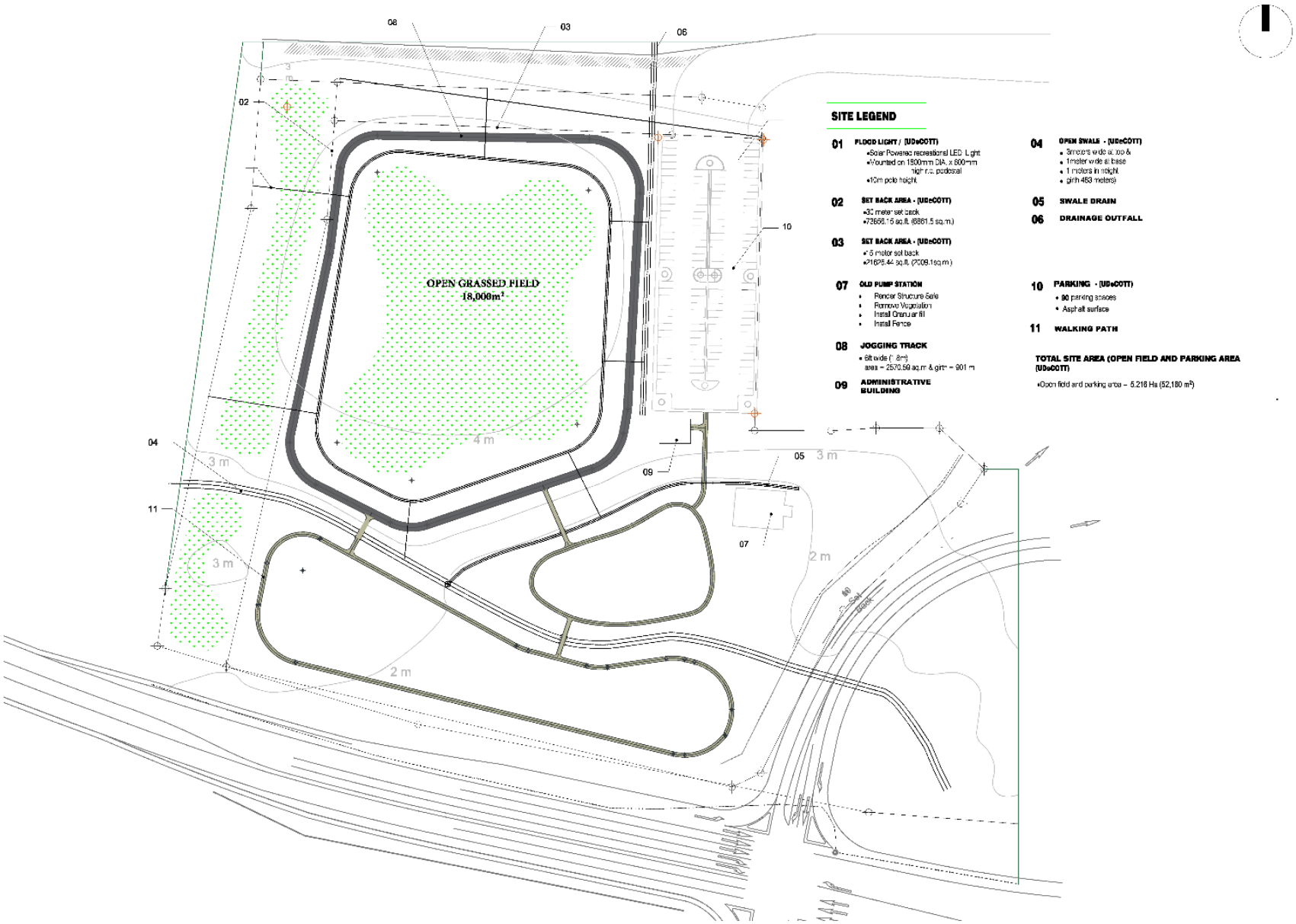


Figure 3.64: West Park Recreational Savannah

4 ANALYSIS OF POTENTIAL IMPACTS

As noted earlier, any physical investment in the infrastructure in a community involves a reconfiguration of space and is likely to have some impact on the utilisation of the space by individuals and communities who live, work or operate in any way in that space. In effect, then, just as human activity impacts on physical space in what they build or how they utilise or transform it, the transformed space impacts on individuals and communities, once constructed or built.

A vehicular overpass can affect a local population in a number of significant ways including their way of life; the cohesion, stability, character, services and facilities in local and neighbouring communities; the use of resources; their health and wellbeing; quality of their biophysical environment and resources; quality of the living environment and amenity; family, community, and social networks; material wellbeing, personal and property rights; concerns, fears and aspirations; culture and identity; and political system. In this particular case, the overpass can be seen as additive to major road development that has been undertaken in recent years in support of the expansion of housing and living accommodation and of the growth of business and commerce in the municipality of Diego Martin in recent years.

4.1 PURPOSE AND OBJECTIVES

The purpose of the Social Impact Assessment (SIA) is to identify and assess (qualitatively and quantitatively) the type and extent of impacts to the human environment arising from the proposed vehicular overpass.

The objectives of the Social Impact Assessment Process are:

- To identify all impacts that could arise during each phase of the project and distinguish, where applicable, between negative and positive impacts, direct and indirect impacts, immediate, short-term and long-term impacts. and cumulative impacts;
- To illustrate significance with direct comparisons made between estimates of the potential impacts and the baseline conditions for given indicators:
- To assess the cumulative impacts that are likely to result from the proposed activities in combination with other existing, approved and proposed projects in the area;
- Where possible, to describe impacts quantitatively and to consider those that can occur in unforeseen circumstances.

4.2 Methodological Approach

The underlying assumption in social impacts assessments is that projects financed by government bodies should create no harm and, preferably benefits for project affected people (Kvam 2018). As the red downward arrow in the Figure 4.1indicates adverse impacts such as pollution may take place, but they should be minimized, and affected people should be appropriately compensated and supported. Mitigation of adverse impacts is considered a requirement, while net positive impact should also be sought, including for those who are initially affected negatively (indicated by the light green arrows in Figure 4.1). The timeline for mitigation of adverse impacts will depend on types of impact: Some impacts need to be mitigated immediately, such as risks to health and safety. Others may be done more gradually over time, such as livelihood restoration in cases of displacement, which may require a longer-term effort. Net positive impact is desired but is not generally considered a requirement to comply with environmental and social standards.

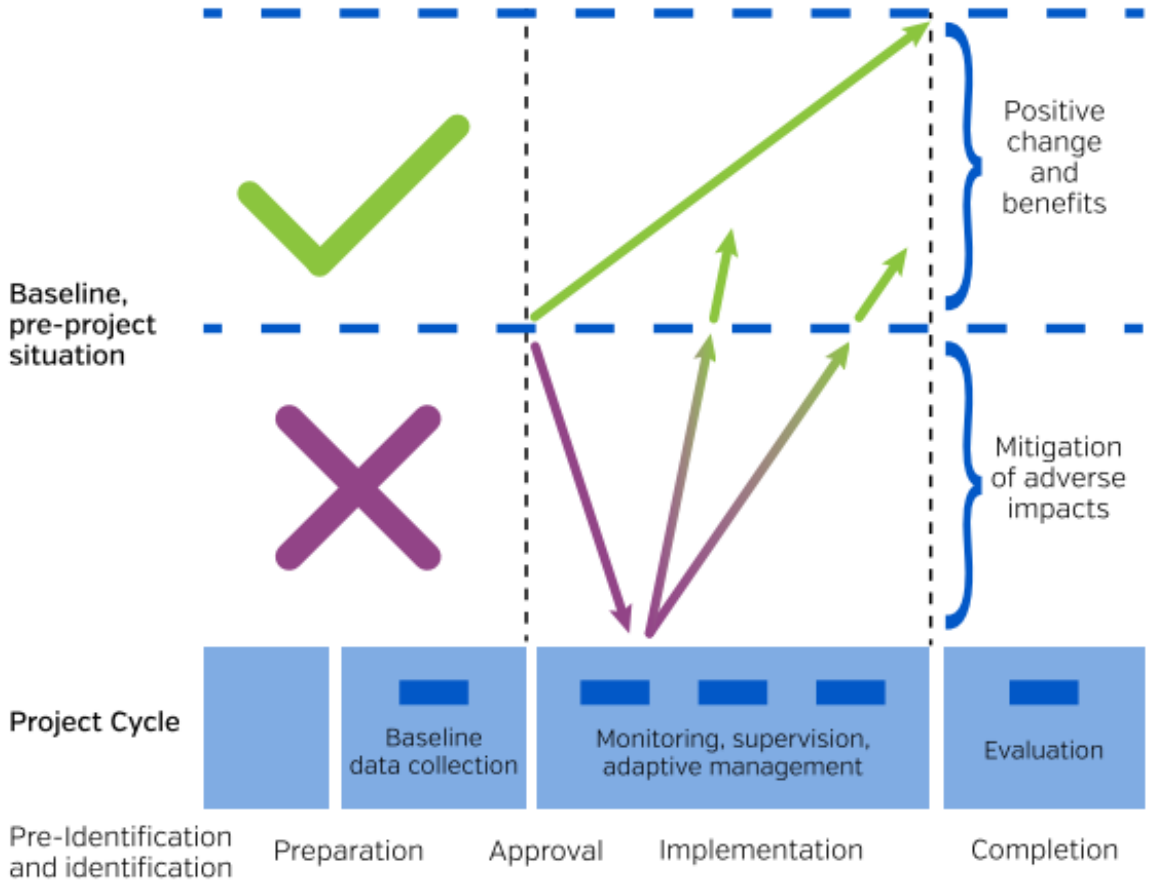


Figure 4.1: Measuring Project Impact[11]

4.2.1 DEFINITION OF A SOCIAL IMPACT

The environmental and social standards and safeguards policies focus both on promoting sustainable and positive development, and on managing risks of adverse impacts from the project. The assessment is concerned with both positive and negative aspects of the project, and both actual, already existing issues, and potential, future issues.

A social impact is any social change which takes place a result of an implementation of project, including the effect on specific communities, individuals or groups. The possible mitigation measures can be identified, and to the extent that negative impacts cannot be avoided totally, the residual impacts can be identified. There is need to evaluate the significance of the impacts through:

a. Determination of impact characteristics
b. Determination of the impact extent (scale)
c. Determination of social receptor sensitivity (vulnerability)
d. Assignment of impact significance based on impact scale and social receptor sensitivity.

4.2.2 IMPACT CHARACTERISTICS

[11] Kvam, Reidar. 2018. *Social Impact Assessment: Integrating Social Issues in Development Projects:* Inter-American Development Bank.

Impact characteristics can be disaggregated as to whether they are positive (beneficial) or negative (adverse), and indirect, direct and/or cumulative. Kairi Consultants Ltd adapted an assessment matrix from Omondi and Gandhi (2013) for evaluating social impacts. The matrix provides potentially significant impact assessment with regard to:

a) The intensity of the impact;
b) The duration of the impact;
c) The extent of the impact; and
d) The probability of the impact occurring

These are described in detail in subsections 4.2.2.1 to 4.2.2.4.

4.2.2.1 IMPACT INTENSITY

The impact intensity characterises the extent of change which happens as a consequence of an identified impact.

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.	0
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.	3
Medium	Significant effects on the functioning or sustainability of social groups, specific ecosystems, services, or resources.	6
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.	12

4.2.2.2 IMPACT DURATION

The impact duration describes how long an anticipated impact is expected to affect the population

Duration	Definition	
Short-Term	Limited to the site preparation/ construction phase of the proposed works, or	1
	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	2
	Occurring intermittently during the maintenance of the proposed works 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	3
	Occurring continually during the maintenance of the works	
Permanent	Irreversible	4

4.2.2.3 IMPACT EXTENT

The Impact Extent considers the geographical extent of the potential impact.

Extent	Definition	
Onsite	Within the immediate vicinity of the proposed works	1

Localised	Within 1km of the proposed works which are expected to affect the terrestrial, riverine and the nearshore environments.	2
Regional	Within the municipality of Diego Martin	3
National	Outside the defined regional area.	4

4.2.2.4 IMPACT PROBABILITY

Probability	**Definition**	
Highly Improbable	<20% chance of occurring	1
Improbable	20 to 40 % chance of occurring	2
Probable	40 to 70 % chance of occurring	3
Highly probable	over 70 % chance of occurring but less than 90 %	4
Definite	over 90 % chance of occurring	5

4.2.3 RISK MATRIX AND SIGNIFICANCE RATINGS

Impacts were assessed using the above parameters and then the significance criteria were used based on the formula below (Table 4.1):

$$Risk = Consequence \times Probability = (Extent + Duration + Magnitude) \times Probability$$

Table 4.1: Risk Matrix

		Consequence (Extent + Duration + Intensity)																		
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Probability	**1**	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	2	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
	3	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
	4	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80
	5	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100

Table 4.2: Impact Significance Rating

Significance	**Range**	**Description**
Low	< 30	Where this impact would not have a direct influence on the decision to develop in the area
Medium	30 – 60	Where the impact could influence the decision to develop in the area unless it is effectively mitigated
High	> 60	Where the impact must have an influence on the decision process to develop in the area

4.2.4 OVERVIEW OF STAKEHOLDER ENGAGEMENT PROCESS

Stakeholder engagement is an essential part of the SIA process, and is a cornerstone of informed decision-making and good governance. It is good practice to use the stakeholder engagement process not only as a means of consultations and dialogue, but also as a means of obtaining and verifying data and information that may be used in

the design and implementation of the project. This may include joint assessments where local communities are involved in determining risks and opportunities, and in establishing indicators and mechanisms for participatory monitoring (Kvam 2017).

In the conduct of the present SIA, the terms of reference required two public consultations to be held with affected stakeholders throughout the process. The public consultations held in July and in September 2019 provided insights to the perception of a range of stakeholders on the impact of the Overpass and related works. Most crucially, Kairi conducted focus group discussions to secure more in-depth information from stakeholders based on their very specific circumstances. These meetings were held over the period July to September 2019 with the following stakeholders.

1. Trinidad and Tobago Chamber of Industry and Commerce
2. Four Roads Government Primary School
3. WestShore Medical
4. Guardian Group Limited
5. Diego Martin Regional Corporation
6. Ministry of Rural Development and Local Government
7. Victoria Gardens Residents' Association
8. Victoria Keyes Residents' Association
9. Powder Magazine Residents Phase II
10. Chaconia Crescent Residents' Association
11. Four Roads Association
12. SuperPharm Ltd
13. Route 1 Maxi Taxi Association
14. Community Hospital of Seventh Day Adventists.

Five of these focus groups are residents in the immediate vicinity of the proposed Overpass. A summary of the discussions and a listing of the participants of these focus group discussions can be found in Appendix C - Stakeholders Engaged. The focus group discussions sought to elicit responses on the following questions, posed to stakeholders:

1. What immediate, short-term, long-term impacts and cumulative impacts do you anticipate for the proposed vehicular overpass?
2. What positive and negative impacts do you anticipate during and post-construction of the project?
3. What impacts, if any, do you foresee for vulnerable groups (youth, the elderly and differently abled)?
4. Do you have any questions regarding the proposed design of the Diego Martin Vehicular Overpass?

The issues raised in the focus group discussions were triangulated with those emerging from the first public consultation on July 4th, 2019 at the Four Roads Government Primary School and the results of the socio-cultural and economic baseline assessment.

4.3 NO ACTION ALTERNATIVE

The original Diego Martin highway was constructed in the 1960s when the population of the valley was significantly lower than it is now. Additionally, 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 current level of traffic. However, by the 1990s it became apparent that the arrangements were inadequate. The construction of an overpass at this location was first approved via Cabinet Minute No. 2320 of September 11, 2003 and Cabinet Minute No. 1949 of July 19, 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. 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. The study in 2015 showed that with the existing the traffic volumes, the road was operating over capacity (MMM Group Limited, Trintoplan Consultants Ltd, and Ecoengineering Consultants Ltd 2015). The study found the following:

- The forecast 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 were 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 were 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. It means also that there will be a drag on the productivity of the work-force resident in the Diego Martin Valley specifically, as many spend hours in congested traffic on their way to and from work.

4.4 POSITIVE SOCIAL IMPACTS – BENEFITS AND OPPORTUNITIES OF THE PROPOSED OVERPASS AND DRAINAGE WORKS

The proposed overpass and drainage works have the potential to generate significant local benefits and opportunities in many ways.

The overpass and drainage works will:

- Improve accessibility and connectivity in the municipality
- Contribute to the reduction of congestion regionally
- Provide access to new developments,
- Reduce travel time from the Valley to the Western peninsular
- Provide conditions propitious to increased population growth due to enhanced access to the municipality
- Contribute to local business development
- Promote greater regional economic activity
- Temporarily create jobs for locals during construction
- Create opportunities for the provision of goods and services to the project
- Contribute to the alleviation of prevailing drainage and flooding challenges in the immediate study area.

On completion of the overpass and related works, businesses at West Mall will be more readily accessible to the buying public in the Diego Martin Valley. Travel time to the west will be reduced for those travelling from the Valley to Carenage, and taxi-drivers can experience an increase in productivity from the reduced travel time into and out

of the area. Cargo to and from the industrial estate can be more expeditiously delivered. There will be a positive cumulative impact for the residents and commuters in the Diego Martin area as congestion is eased.

While trips from Westshore Hospital to the east will involve a longer route by way of the overpass, there will be a lower risk of accidents which has been a problem with the 'bow-tie'. Its closure will reduce accidents between vehicles seeking to negotiate from the bowtie across the east-bound lanes on the left of the Western Main Road. Access to the Community Hospital will be rendered safer to visitors/clients coming from the east, requiring them to approach the Hospital from the west. The construction of the DRMC Complex will coincide with that of the Overpass and will lead to ready access for the public to the Corporation.

The construction activity is likely to last eighteen months and there is an opportunity for the hiring of local labour, even though the Contractor is likely to bring workforce already in the employ of the firm. There will be indirect employment in the medium term as businesses at West Mall benefit from greater accessibility of the location by an expanded clientele. The reduced congestion will also improve access of would-be shoppers at the StarLite Shopping Plaza, with a comparable positive employment effect.

The overpass will contribute to the economic infrastructure of the area, in so far as it reduces travel time thereby improving social productivity overall: workers can get to their places of work and return to their homes in less time than currently, and likewise can their children and students in the daily commute to school and educational establishments outside of the municipality. Businesses in the region will become more readily accessible to the buying public. The contribution to the reduction in congestion on the roads and the improved circulation among the road networks in Diego Martin will impact human health, by curtailing the concentration of emissions of carbon monoxide and other pollutants that elevate the PM2.5 and other markers of air quality.

4.5 ADVERSE SOCIAL IMPACTS BY PHASE OF PROJECT

4.5.1 THE PRE-CONSTRUCTION PHASE

In the pre-construction phase, community engagement was initiated and represents a positive feature of the project in so far as the key stakeholders were consulted directly for their views. The project has honoured the requirement that there be the fullest involvement of stakeholders from the very beginning: there is an inherent obligation that people who are to be impacted by major decisions about their space have the right to be consulted – a Human Right.

On the issue of perception in the pre-construction phase, the focus groups registered their thoughts on the project overall. Some see it as a very positive development while others see it in a very negative light.

While all groups recognise that there is a serious problem of traffic congestion in the area, some feel that the required intervention does not merit an overpass, which is seen as an expensive solution. None feel that the status quo should be maintained i.e. things should remain as they are. Of the five residents' associations, that responded to the invitation to focus group discussions, the Chaconia Crescent Residents alone have been enthusiastic about the Overpass for its potential to relieve congestion in the area.

The other stakeholders generally see the Overpass in positive terms. These include the representatives of the business community and the Municipal Corporation who expect that the relocation of its offices to the soon to be constructed Regional Complex will improve their service to their publics. On the other hand, there is a concern lest the building of the Overpass merely shifts the problem of congestion to the intersection of Columbus Boulevard and the Western Main Road.

4.5.2 CONSTRUCTION PHASE

In respect of the construction phase, there is one immediate positive impact identified in the form of the demand for labour from the surrounding community. While the overpass component of the projects is not labour intensive, the ancillary works are, and include the drainage works, electrical works, utility relocation, signal works, road marking, reinstatement works and other structural works that will require skilled and semi-skilled workers.

There are a number of negative impacts to be noted and to be addressed. Some are short term and relate to the very nature of construction which disrupts other activities that might have been ongoing. Businesses in the area might lose clients in the short term since negotiating vehicular access to particular establishments might pose a challenge to some clients. Economic activity might be affected by even more traffic congestion since the increase in the number of heavy vehicles going to or leaving the construction site slow traffic down even further.

Some of the impacts will last only for the period of construction and there can be a return to a normal state when construction is complete. Thus, air pollution and noise specifically from construction activity might be totally eliminated at the end. However, during construction, the health status of vulnerable groups – the elderly and children and babies – might be impacted negatively, notwithstanding the controls that the contractors might introduce to mitigate risks from emissions from equipment and from dust.

Planned technical measures can control for some of the negative impacts. Auger piling in lieu of pile driving is a requirement on the contractor and protects residents and other stakeholders from noise that might occur in the establishment of the foundations for the structure.

Air pollution from the use of equipment on site can be controlled by ensuring that all heavy equipment is in good working order, and exhaust fumes are within allowable limits. Tyres of trucks leaving the site will be required to pass through a wash-bay to prevent tyres depositing mud or clumps of earth on the roadway as trucks leave the site. There is a requirement for piles of aggregate and accumulated mounds to be sprinkled to prevent dust and particulate dispersal from the site.

There are challenges that need to be anticipated in the site preparation by the contractor. The area is prone to flooding and there is a risk that during construction of the Overpass run-off from rain may not be easily contained and the flood problem can be exacerbated. Public health and safety can be threatened with the accumulation of stagnant puddles of water on the site creating an environment propitious for the breeding of mosquitoes. Contractors are expected to observe the requirements of the Occupational Health and Safety Act, which enjoins them to provide protective gear for workers on site and for visitors to the project during construction. There is now a protocol in all such matters that contractors are expected to abide by during construction.

What is significant for present purposes is the differentiation among the negative impacts between those that are reversible and those that are not. A major objective is to reduce negative impacts to a minimum and to mitigate them by applying measures that treat with those that are irreversible such that the negatives can be managed at the lowest possible costs or using Best Available Technologies Not Entailing Excessive Cost (BATNEEC) and Best Practicable Environmental Options (BPEO).

4.5.2.1 IMPACTS ON THE SOCIO-ECONOMIC ENVIRONMENT

The preparation of the site for the construction of the overpass and ancillary works will be attended with substantial disruption to the daily lives of residents in the immediate vicinity, at Victoria Keyes and Powder Magazine Phase 2. Air and noise pollution are likely impacts. The removal of soil and the movement of construction vehicles and equipment on the site are going to occasion the spread of dust particles in the air and, depending on the air currents, can impact areas well beyond these communities, including Victoria Villas, Victoria Gardens and Chaconia Crescent, West Mall and Westmoorings.

Table 4.3: Socioeconomic Impacts During Construction

Detail	Extent	Duration	Intensity	Probability	Rating
Employment of labour from the municipality	Localised	Medium-Term	Minor	Definite	35
Reduction in Local Business Activity	Localised	Short-Term	Minor	Highly Probable	24
Concurrent Construction of the DMRC Complex	Localised	Short-Term	Minor	Highly Probable	24
Traffic Disruption	Localised	Short-Term	Medium	Highly Probable	36

4.5.2.2 IMPACTS TO COMMUNITY HEALTH

There are implications for the health of residents: there are impacts during the construction and operational phases of the project. Dust from cleared areas in site preparation and construction, exhaust fumes from vehicles and equipment operating on site will reduce air quality in the area.

Table 4.4: Impacts to Community Health During Construction

Detail	Extent	Duration	Intensity	Probability	Rating
Air Pollution	Localised	Short-Term	Medium	Highly Probable	36
Noise Pollution	Localised	Medium-Term	Medium	Highly Probable	40
Change in land use (Clearing of Vegetation)	Localised	Medium-Term	Medium	Definite	50

4.5.3 POST CONSTRUCTION PHASE

As expected, the post construction phase is characterised by all the long-term impacts. There are three positive impacts identified in Table 5.1- Business Activity, Economic Activity and Traffic Congestion. With some relief of congestion, business and economic activity generally will receive a boost, and productivity should increase on a number of fronts. Significantly, they extend across the region of the municipality and thus have relevance for the majority of the population of the area. The social benefits are extensive, as burgesses in several capacities derive benefits, which are real notwithstanding their being diffuse.

The baseline air and noise assessments provide a useful snapshot of the current prevalence of polluants in the immediate study area. A detailed discussion the potential health impacts and an analysis of the mitigation measures can be found in Appendix J Air Quality Dispersion Modelling for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements

4.5.3.1 IMPACTS ON THE SOCIO-ECONOMIC ENVIRONMENT

Post-construction, motorists are likely to become quickly adapted to the new route of accessing the west of the municipality from the north of Diego Martin. Residents in the affected communities will have a much longer period of adjustment. The speed with which the municipal authorities and the MOWT move to take responsibility in their respective roles will be an important factor, in the adjustment process. The operational phase includes the maintenance of trees and the provision of foliage to provide to reduce noise and absorb some of the pollutants from

the emission of vehicular traffic along the overpass. The identification and rating of the Socio-economic impacts are summarised in Table 5.4.

Table 4.5: Socioeconomic Impacts Post-Construction

Detail	Extent	Duration	Intensity	Probability	Rating
Closure of bowtie on Western Main Road (Disruption to Commute of Residents and Taxi Services from POS - Cocorite)	Regional	Long-Term	Major	Definite	90
Possible Increase in Crime to areas with enhanced access	Localised	Long-Term	Minor	Probable	24

4.5.3.2 IMPACTS TO COMMUNITY HEALTH

There are residents who are likely to experience continuing health problems from the higher level of atmospheric pollution to which they shall be constantly exposed when the overpass would have been constructed. Given the high rates of vehicle ownership in the area and the increase in the number of middle- and higher-income households in the municipality, the findings on PM 10 and related markers in 2015 are likely to have been exceeded. In effect, whether the Overpass is built or not, air quality in the area is likely to have depreciated by the surge in the use of private vehicles with risks to the vulnerable.

The trend established in the census of 2011, in which over fifty percent of households had a vehicle for private use, would have continued throughout the present decade. All residents of Diego Martin are likely to be exposed to high levels of emissions from vehicle use. Moreover, with the pervasive risk of Sahara Dust, only constant recording at the local level on a daily basis and at very least, during the dry season and the wet season, might allow for disaggregation of the impact of vehicular traffic on air quality.

There are possibly countervailing factors at work at the site where the Overpass is to be constructed. Congestion in the area might have already contributed to elevated readings on the PM2.5 benchmark. Ecoengineering found that the TSP and PM 10 values were well within the respective limits in 2015, when a base line study was conducted. The reduction of congestion with the Overpass will lead actually to dispersal of emissions and reduced concentrations that would otherwise have built up from the existing tendency for congestion. Only a study that extends over a reasonable time period might establish the net effect.

Table 4.6: Impacts to Community Health Post-Construction

Detail	Extent	Duration	Intensity	Probability	Rating
Air Pollution (post construction)	Localised	Long-Term	Minor	Highly Probable	32
Noise Pollution (post construction)	Localised	Long-Term	Minor	Highly Probable	32
Change in land use (Change in Vegetation)	Localised	Long-Term	Minor	Definite	40

4.6 CUMULATIVE IMPACTS

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity (collectively referred to in this document as “developments”) when added to other existing,

planned, and/or reasonably anticipated future ones. For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognized as important on the basis of scientific concerns and/or concerns of affected communities International Finance Corporation (2013)[12].9

The cumulative impacts are potentially positive in respect of the employment and business activity that derive from the Overpass and ancillary works as well as the DMRC Administrative Complex having an overlap in terms of timing. The concentrated increase in employment deriving from the two projects in the period of overlap, will in itself trigger further rounds of business and employment expansion as workers seek goods and services, some of which will be supplied by businesses in the area, including from the informal sector and itinerant suppliers of food, snacks etc on job sites. The net employment extends beyond the workers engaged in the overpass and related works and includes those who find short term employment in the businesses in the area.

Cumulative impacts result when the effects of an action are added to or interact with other effects in a particular place and within a particular time. It is the combination of these effects, and any resulting environmental degradation, that should be the focus of cumulative impact analysis. Activities that can affect the impacts discussed above are limited to the construction phase of the project. Within the Cocorite Farms area construction activities related to this project as well as that of two additional projects will be taking place. The following gives a brief description of the projects.

4.6.1 DIEGO MARTIN REGIONAL CORPORATION ADMINISTRATIVE COMPLEX (DMAC)

The proposed start date is November 11th 2019 and end date is September 11th 2020. The project involves constructing a building for use as:

1. **The Administration Complex for the Diego Martin Regional Corporation (DMRC)** to meet the current and projected responsibilities of the Corporation, and
2. **A Branch of the First Citizens Bank Limited (FC).**

The building site is located at Cocorite Farms at the corner of Western Main Road and Diego Martin Highway (Figure 3.63**).** It is an open parcel of land, south of the residential area of Victoria Gardens. The site area to date is approximately 2 hectares. The DMAC site would be accessed from the new access road to be built as part of the DMHI project (located through Cocorite Farms, south of the site). During construction, the site may be accessed from an existing entrance on the north-eastern corner of the site.

4.6.1.1 CUMULATIVE IMPACTS OF THE DMAC

The areas of concern with regards to potential cumulative impacts are:

- Traffic Disruptions
- Erosion and Sedimentation

The DMAC site preparation and substructure works are proposed to be completed by March 2020; therefore, the cumulative impact regarding noise and dust should be minimal. Earthworks, excavation and embankment works are

[12] International Finance Corporation. 2019. "Cumulative Impact Assessment Resource Page." https://www.ifc.org/wps/wcm/connect/Industry_EXT_Content/IFC_External_Corporate_Site/Hydro+Advisory/Resources/Cumulative+Impact+Assessment+Resource+Page

proposed to begin in March 2020 for the overpass. This project will not affect the Eastern activities associated with the Diego Martin Overpass as they are separated by the Diego Martin Highway.

4.6.2 DEVELOPMENT OF WEST PARK SAVANNAH AT WEST MOORINGS

The Development of West Park Savannah at West Moorings is a recreational space with basic drainage infrastructure that will benefit the communities of Diego Martin and its environs. UDeCott is responsible for project management. The development is anticipated to include the following:

- Temporary drainage
- Site office/washrooms
- 114 car park spaces to be constructed as grass pavers
- Open field and
- LED lighting

4.6.2.1 CUMULATIVE IMPACTS OF WEST PARK SAVANNAH

It is not envisaged that this project will contribute significantly to the environmental impacts associated with the construction of the Diego Martin Highway as it is involves the establishment of a green space. As such there will be limited earth disturbance. In light of this the cumulative impacts of this project will be beneficial for the development of Cocorite Farms. (Figure 3.64).

We also take into consideration that each project will have its own environmental management plan for their works. At this time there are no proposed activities taking place on the Eastern side of the project that would lend to having cumulative impacts; as such the cumulative impacts are focused on the western side of the proposed project.

5 MITIGATION STRATEGIES AND MANAGEMENT PLAN

5.1 IMPACT MITIGATION STRATEGY

The mitigating measures can be differentiated into immediate/short-term and medium/long term measures. A key feature in the implementation of measures in the medium to long term is that there will be need for the institutionalization of the response. For example, the dredging of the river by Diego Martin by MOWT can no longer be in response only to a flood episode.

A Grievance Redress Plan has been developed for approval by the EMA. Stakeholders will have an opportunity to submit their concerns or complaints on the project through a formalized system to be implemented by the executing agency, NIDCO. As part of the process, opportunities are given for recourse, both internal and external., in the treatment of grievances. The table below lists some of the mitigating measures to be implemented for adverse impacts, and the agencies likely to be responsible. There are also measures that might improve or complement benefits.

The expectation in projects of this nature is that the projects should ensure that any potential or actual adverse impacts are identified. Once identified, adverse impacts should be avoided or reduced, and mitigated in different ways when they are unavoidable. In standard practice, following the application of mitigation and compensation measures, affected individuals and groups should not be worse off than before. Once significant risks have been identified, they must be managed. This is done through applying a logical sequence of steps, referred to as a mitigation hierarchy. It involves the following:

1. Identify and anticipate risks of potential adverse impacts, through analysis and consultation (discussed in previous sections)
2. Avoid potential adverse impacts, applying an alternatives analysis including a no-project scenario.
3. Minimize or reduce the impacts, for example by reducing the physical footprint of a project through changes in design of civil works.
4. Restore or rehabilitate where possible, for example by providing alternative access to water sources that have been cut off by a project.
5. Compensate or offset residual impacts as warranted.

5.1.1 MITIGATION DURING CONSTRUCTION PHASE

Air and noise pollution are the major negatives to be addressed in the period of construction. There is also a potential problem of traffic congestion as the entry and exit of heavy vehicles may at times lead to further slowing of traffic in the area.

5.1.1.1 CONTROLLING AIR POLLUTION DURING CONSTRUCTION

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, to reduce exposure of material to the wind.
- Trucks tires should be washed in exiting the construction site to eliminate chance of trapped earth being deposited on the roadway. The contractor must implement dust control measures and maintain wet surfaces. All transport vehicles are to be supplied with tarpaulins to avoid material falling or flying off the tray of trucks in motion on highway.
- During earthworks (including excavation) implement dust control measures at source, including frequently wetting bare surfaces and access way.
- Vehicles on the site and equipment powered by fuel – gas or diesel will be the source of emissions. Regular checks will be necessary to ensure that these are well within the limits of standards set by manufacturers.

5.1.1.2 NOISE POLLUTION DURING CONSTRUCTION

The following mitigation measures can be employed for the control of noise and vibrations:

- Augured piles are to be used rather than pile driving equipment.
- All vehicles are to be inspected for their mufflers to ensure noise emission control systems are fully functional.
- 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, agencies, religious leaders and school principals) of construction activities advance.
- Use of a noise barrier fence along the outer Victoria Keyes perimeter fence (southside). Specifications of the fence are provided Appendix J[13] -Specifications for the Highway Noise Barrier System

5.1.1.3 EMPLOYMENT OF LABOUR

The employment of labour has potentially positive impact. The goal here is not to mitigate but rather to enhance possibilities. Although the project is not labour intensive, there are likely to be opportunity for some amount of local labour to be drafted into the project, especially among the semi-skilled and unskilled. The contractor should be encouraged to put measures in place to leave openings for some amount of local labour: the DMRC can play a positive role here in promoting employment of locals in need of work on both projects – the Overpass and Drainage Project, and the building of the Administrative Complex of the Regional Corporation.

[13] 9 Appendix J – Specifications for Highway Noise Barrier System

Table 5.1: Mitigation Measures During Construction Phase

Impact	Rating (Pre-Mitigation)	Proposed Mitigation Measures	Rating (Post-Mitigation)
Employment of labour from the municipality	**Medium**	• Construction contracts to stipulate priority in recruitment of local unskilled labour	**Low**
Air Pollution	**Medium**	• 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. • To the extent that is practical, clear and cut slopes on a phased basis to limit the area exposed. • 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. • Installation of wash bays at the exit points of the project site (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. • Hoarding of project site • Installation of dust screens • 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. • Monitoring to be undertaken at established monitoring sites in accordance with APR 2014 guidelines • 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.	**Low**

Impact	Rating (Pre-Mitigation)	Proposed Mitigation Measures	Rating (Post-Mitigation)
		• Keep stockpiles to a minimum and use as soon as practical, thereby reducing a source of dust. • Trucks tires should be washed in exiting the construction site to eliminate chance of trapped earth being deposited on the roadway. The contractor must implement dust control measures and maintain wet surfaces. All transport vehicles are to be supplied with tarpaulins to avoid material falling or flying off the tray of trucks in motion on highway.	

Impact	Rating (Pre-Mitigation)	Proposed Mitigation Measures	Rating (Post-Mitigation)
Noise Pollution	**Medium**	• 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. Where practical, conduct noise intense works outside of school hours. • 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. • conduct periodic monitoring of vehicles for noise levels, and for other infractions of standards set for vehicles on the road and on building sites • All vehicles are to be inspected for their mufflers to ensure noise emission control systems are fully functional. • 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, agencies, religious leaders and school principals) of construction activities advance.	**Low**

Impact	Rating (Pre-Mitigation)	Proposed Mitigation Measures	Rating (Post-Mitigation)
Traffic Disruption	**Medium**	• Construct additional lanes to either side of the existing road before excavating and reconstructing existing road surfaces • Appropriately plan movement of construction vehicles • Where required, allocate persons to direct traffic in areas where construction is taking place • Place the appropriate warning and directional signs at areas where construction is taking place • Limit the movement of heavy vehicles on roads / lanes used by the public during peak hour traffic • Identification and enforcement of haul routes (including avoiding dangerous routes during specific times); • Provision of appropriate barriers and signage to demarcate areas in which construction traffic is active and prevent access to the general public;	**Low**

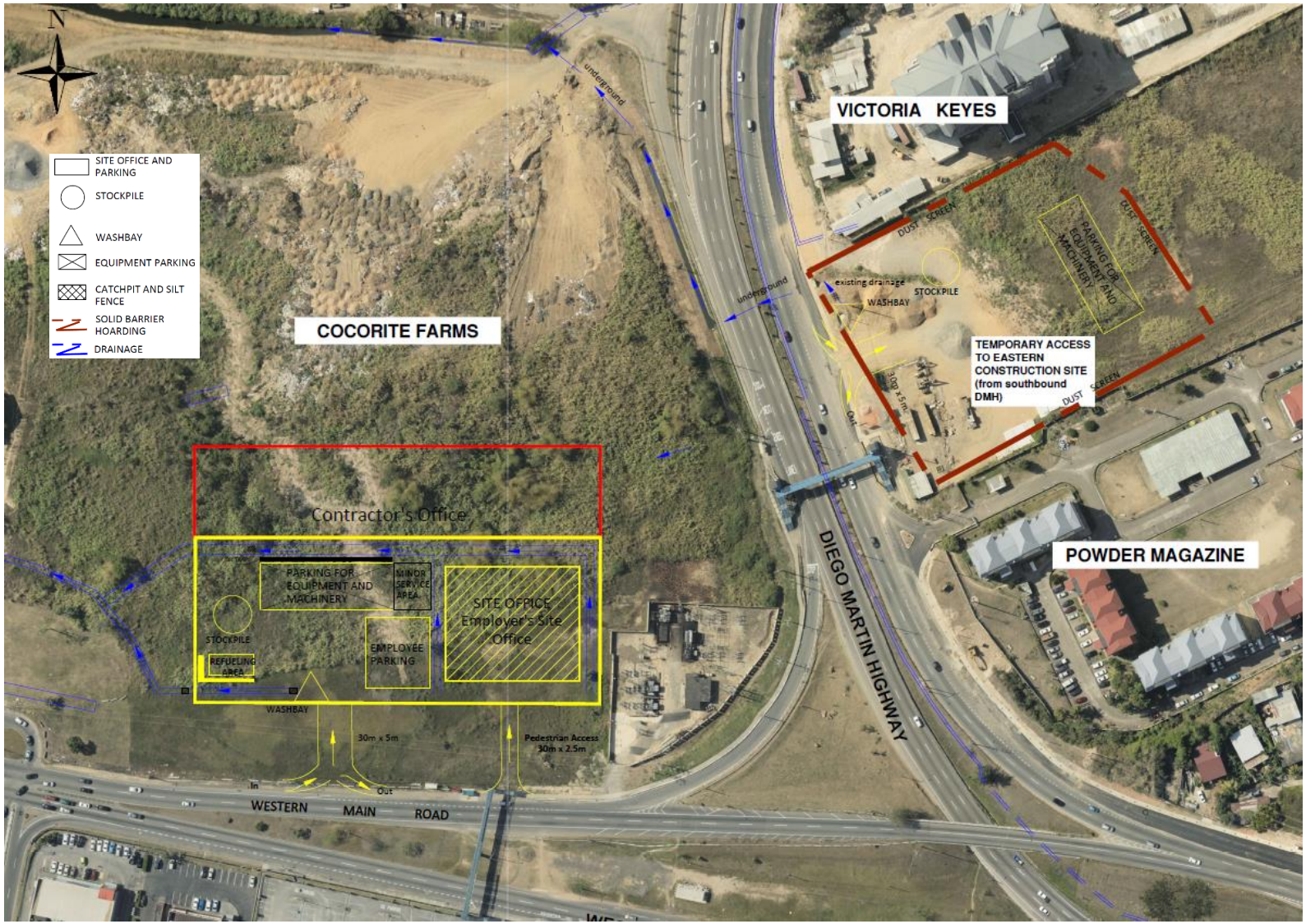


Figure 5.1: Proposed Mitigation Measures During Construction

5.1.2 MITIGATION DURING OPERATIONAL PHASE

It is recognised that increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. To avoid or minimize adverse impacts on human health and the environment, the following mitigation strategies are aimed at avoiding or minimizing pollution and promoting more sustainable use of resources.

5.1.2.1 AIR POLLUTION IN COMMUNITIES

The design of the Overpass locates it on a sliver of land that separates the two communities of Victoria Keyes and Powder Magazine II. The emissions from automobiles are likely to be a constant in the air breathed by residents in these two communities. While the only available study done specifically on the area by Ecoengineering in 2015 found that the indicators on air quality were well within the safe limit, traffic congestion in the area of Victoria Keyes and Powder Magazine would have led to an increase on the level found in 2015 in at least two communities – Victoria Gardens and Victoria Villas. As noted earlier, with over 50 percent of households having at least one vehicle for private use, the vehicle ownership in the Diego Martin Valley is one of the highest in the country.

The MOWT as the sponsor of the Overpass Project will have the responsibility for:

- Regular monitoring of air quality in the area and making such information available to residents in these communities and to the wider public.
- Regular allocation of transport officers to assess vehicles for contravention of emission standards.
- Promotion of the use of equipment and devices among residents that assist in the purification of air within homes.
- Regular maintenance of the Overpass to keep it as pleasing to the eye as possible.

As part of its wider remit to the country, the Ministry should institutionalise:

- Monitoring of and reporting on air quality on highways and major intersections across the country.
- Random inspection of vehicles on the road to establish emission levels and other requisites for road safety are being observed.

Research shows that roadside vegetation affects nearby air quality (Fuller et al. 2017, Deshmukh et al. 2019, Baldauf 2016). If properly designed, vegetation barriers can be used to reduce near-road air pollution, either alone or in combination with solid noise barriers.

5.1.2.2 FLOODING OF WATER AND SEWAGE IN VICTORIA GARDENS AND IN POWDER MAGAZINE

The flooding in the lower reaches of the Diego Martin has become a perennial problem, with huge losses to residents in at least two communities – Victoria Gardens and Victoria Villas. The existing drainage system for the area has been incapable of managing regular run-off, let alone episodes of heavy rainfall. With torrential rain episodes, the deficiency in the drainage infrastructure impacts the sewerage systems with raw sewage escaping from manholes into roadways and communities.

The Comprehensive Drainage Plan for the lower Diego Martin Valley being implemented as part of this project has been designed to solve the drainage problem. The implementation complements the building of the overpass in which itself will contribute to additional run-off of water from rain. The drainage plan extends over a much wider area than the Overpass. Other measures needed in mitigating the risk of flooding will involve commitment of resources for the following:

- Designing and implementing the Drainage System in collaboration with WASA in respect of the sewerage system.
- Quarterly clearing of the course of the Diego Martin River.
- Quarterly dredging of the mouth of the Diego Martin River.
- Collaboration with DMRC in the clearing of water courses that lead to the streams and the Diego Martin River.
- Mounting of public campaign on disposal of discarded items and waste.

5.1.2.3 CLOSURE OF THE BOWTIE

Notwithstanding the unpopularity of this measure accidents, including fatalities in the area dictate that the remaining Bowtie be closed and motorists access Powder Magazine No.1 and Cocorite by using the Overpass in travelling from Port of Spain.

There will be need for public education in the introduction of this measure, and this will need to be supported with appropriate signage warning motorists. Traffic Management will need to be anchored on the regular monitoring of population on trends and traffic growth.

Table 5.2: Mitigation Measures During Operational Phase

Impact	Rating (Pre-Mitigation)	Proposed Mitigation Measures	Rating (Post-Mitigation)
Closure of bowtie on Western Main Road (Disruption to Commute of Residents and Taxi Services from POS - Cocorite)	**High**	• 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 • Incorporation of appropriate signage and safety measures (barriers, formalised crossing points) to reduce the risk of accidents. • Media Notification (Newspaper, Ministry Website, Facebook – 1 week before the implementation of the closure of the bowtie)	**Medium**
Air Pollution (post construction)	**Medium**	• Barriers should extend beyond the area to be protected or can wrap around and extend away from the roadway.	**Low**
Noise Pollution (post construction)	**Medium**	• Construction of a highway sound barrier system	**Low**

5.1.3 AIR DISPERSION MODELLING

Coastal Dynamics Limited (CDL) was engaged by NIDCO to conduct the air dispersion modelling for the Vehicular Overpass. The full air dispersion modelling report can be found in Appendix J Air Quality Dispersion Modelling for the Construction of a Vehicular Overpass in the Vicinity of Powder Magazine and Related Road Improvements. 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 required 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. The modelling methodology utilized was the U.S Environmental Protection Agency (US EPA) AERMOD dispersion modelling system. The model considered 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 (PM2.5, PM10), total hydrocarbons (HC) and sulphur dioxide (SO2).

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 NO2 limit of 40 µg/m3. 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 µg/m3. 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 NO2 limit.

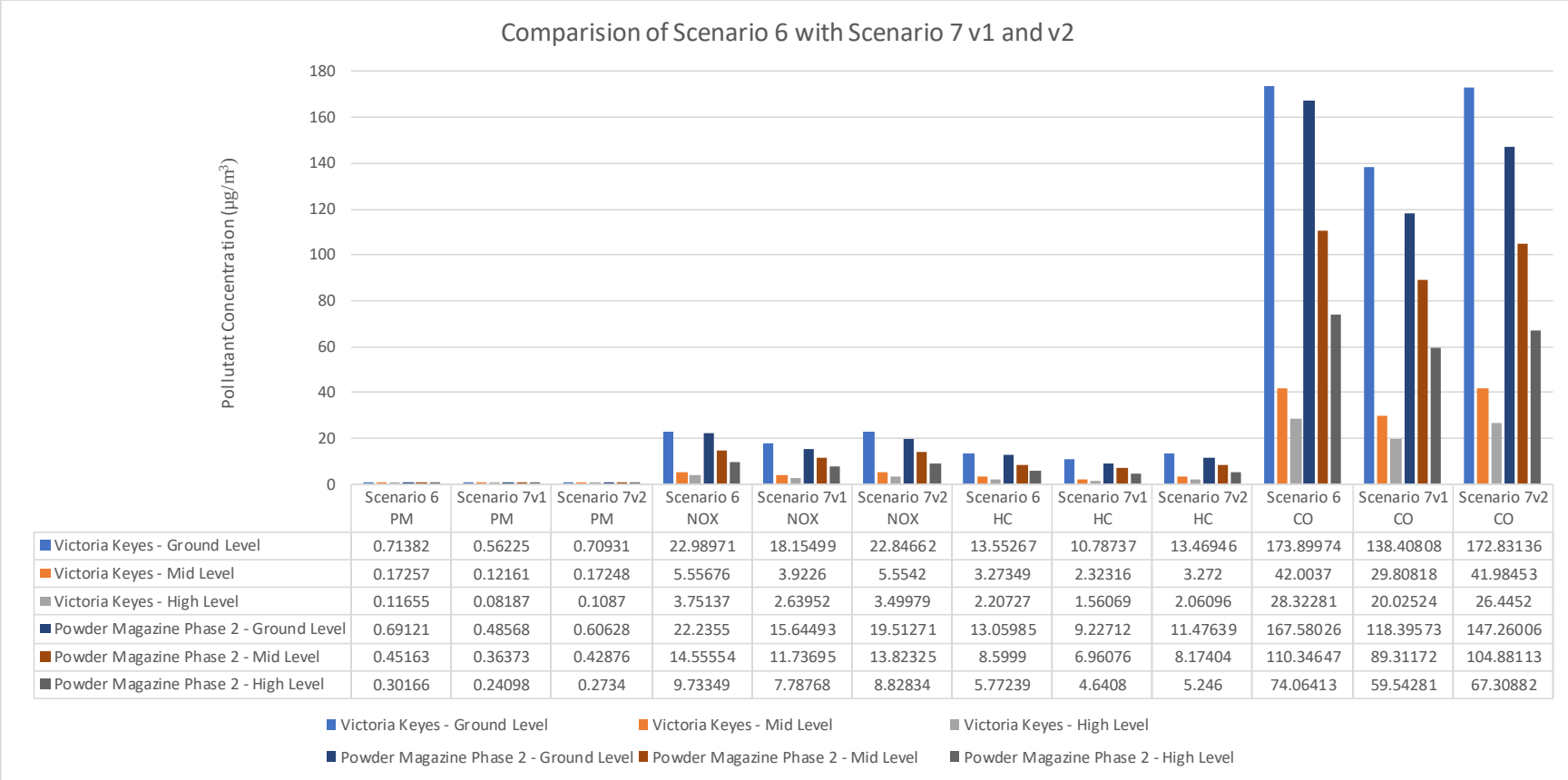
Construction emissions modelled in Scenarios 2 and 3 also resulted in exceedances in NOx values with the NO2 Ambient Air Limits in the EMA Air Pollution Rules (2014). Due to the large construction area of 188 881 m2 selected for the occurrence of construction works, this accounted for worst case conditions. 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 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 5.2 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 NO2 (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 5.2: A comparison of the sensitive receptor concentrations at Victoria Keyes and Powder Magazine for versions 1 and 2

5.2 SOCIAL MANAGEMENT PLAN

5.2.1 OBJECTIVES OF THE PLAN

The objectives of the social management plan are as follows:

- Address mitigation measures raised;
- Include the responsibilities of the various agencies, a schedule, a list of all the measures;
- 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.
- Provide a list of all Applicant commitments for mitigation, monitoring and follow-up measures

5.2.2 MANAGEMENT PLAN DURING CONSTRUCTION

The contractor will be responsible for all mitigation measures during the construction phase. It is his duty to develop the following plans:

- HSE Management Plan (includes an Emergency Response Plan), in compliance with the Occupational Safety and Health Act (2004)
- Traffic Management Plan,
- Environmental Management Plan (this will include measures for dust, air, noise, waste, water quality etc),
- Stormwater Management Plan (which will include temporary measures during construction and final drainage design measures for the operational phase).

All the Plans are reviewed by the Supervising Consultant and the Employer (and possibly MOWT) before it can be approved. These are supposed to be approved before the start of any works and is a requirement of the Contractor's contract. Follow up measure will be executed by the Supervising Consultant who is appointed to oversee the works of the Contractor. This is an independent agency that monitors and approves all the works of the Contractor. NIDCO and MOWT will also conduct routine site inspections of the Contractor's works. This will be done with a view to ensure that mitigation measures are being implemented.

Figure 2.10 depicts the proposed site layout for the project. Only minor servicing on vehicles and equipment is to be performed on site on the designated area. Major servicing is to be outsourced at specialized shops. Servicing of equipment on site will be done in a designated area and spill kits will be available to contain any impact of spills. Spent lubricants are to be collected for off-site disposal. Contaminated soil is to be removed from site for remediation elsewhere. No discharge from concrete washings is to be allowed into surface drains. Arrangements should be put in place to treat with disposal of materials not fit for use like:

- Expired concrete or rubble
- Asphalt rubble
- Vegetation trimmings
- Steel remnants
- Regular removal of waste be done from the construction site to an approved landfill.
- Vehicles not to exceed thirty kilometres per hour while on the site, and all trucks to be covered with tarpaulin to reduce dispersal of dust in the air.
- Periodic safety drills be conducted on site with entire work force.
- Air and noise monitoring to be conducted on site and reading reported to EMA at quarterly intervals

5.2.2.1 SITE HAND-OVER

The site for the Overpass, having been duly surveyed and demarcated, is to be formally handed over to the selected Contractor at a mutually agreed to date. By that time, the Contractor would have prepared a Management Plan, with time schedules, outlining all the steps that are to be followed from the first day of work to the hand-over of the Overpass, when it would have been completed 17 to 18 months later.

5.2.2.2 STAFFING

The Contractor would normally have appointed the Supervising Engineer and other Engineers and technical staff dedicated to the project. Among the complement of staff appointed will be the Health and Safety Officer, who may also have to operate as a Labour Relations and Recruiting Officer, and a Secretary/Administrative Assistant to the Engineer. The site office(s) will need to have access to the regular services of the utilities – Telephone, Electricity, and water.

5.2.2.3 SITE PREPARATION

The project will involve the mobilization of a workforce and of equipment/machinery over the period of 17 to 18 months. Following the hand-over of the site, the Contractor has to move quickly to establish the site boundaries with appropriate perimeter fencing, and the establishment of the site office. The site has to be secured appropriately and there should be personnel hired either in the employ of the Company or contracted to the Company to supply security services.

This should be followed by equipping the site with facilities to receive the first set of workers. These include toilet facilities, change rooms, for both men and women, and small tool supply and storeroom. Access to potable water has to be provided. Some of these facilities are usually secured from firms that equip building sites with all the appurtenances required to maintain a functioning workforce.

Larger contractors would usually have all of these paraphernalia at their main construction compound, and the issue then is when and what is to be delivered and installed at the site office and building works compound.

On the wall of the site office, the Contractor is required to have statutory information displayed: Name of Company and Registered Address, NIS, Health and Safety rules. The location of Muster Point must be prominently displayed.

Given the nature of the construction, it is expected that there will be a fair amount of heavy equipment to be located on site and arrangements have to be put place for their onsite servicing, and or for the vehicles that will service them to have an area demarcated on the site for such services to be rendered.

Given that there will be substantial movement of trucks in and out of site, and there is need for tyres to be washed to avoid earth from the site being strewn along the existing road-way, there is need for a substantial area to be paved to receive and dispatch heavy trucks as they make their way off-site having had their tyres washed. Given the need to contain the quantum of dust and other particles getting into the air from these vehicles, care will need to be exercised in the design of the compound such that the neighbouring communities suffer the least disturbance to their ambient surroundings.

One of the critical requirements in this project is that no more vegetation is to be removed except what is absolutely necessary. Moreover, the restoration of vegetation is also a requirement along with the planting of shrubbery and appropriate foliage when the project would have been completed. The Contractor will need to organize for the husbandry of what can be saved in the removal of vegetation cover, during the period of construction.

The organizing of such has to be defined on the site plan of the contractor just as his plans for drainage of the site, with due regard for such matters as the constructing of drains to accommodate run-off and to reduce the risk of flooding. Drains must be free of debris and other obstructions.

5.2.2.4 COMMUNITY RELATIONS OFFICER

There is need for the Contractor to have such an officer on site to discuss with members of the community any problems that may arise.

5.2.3 MANAGEMENT PLAN POST-CONSTRUCTION

Subsequent to the completion of the project, the overpass will be handed over to the MOWT, Highways Division. The Highways Division will be the agency responsible for maintaining the road pavement structure, median and verges. The Drainage Division will be charged with the responsibility of the maintenance of the new culverts and drains. All proposed monitoring activities for air and noise will be the responsibility of the MOWT.

There will be a team within the Ministry of Works assigned to routine maintenance work along the DMH, DMMR and St Lucien Rd. Works are done on a three-week cycle, one cycle would include:

- Vegetation control
- Clearing curbs and slippers
- Opening of roadside inlets

On another cycle, the same team would clear open main drains along the reserve. On a fortnightly basis, the Road Overseer and the Works Supervisor are also expected to jointly inspect the roadway and off carriageway and schedule repairs accordingly.

Table 5.3: Social Management Plan and Schedule of Implementation

Impact	Agents Responsible	Schedule of Implementation	Measures
Employment of local labour	Contractor	Procurement and Construction Phase	• Construction contracts to stipulate priority in recruitment of local unskilled labour • Contractor must demonstrate the overall local content to be 40% of Total Contract Value excluding Contingencies, Provisional Sums, and VAT to which it proposes to execute the Works utilizing local content, in connection with both the design and construction phases of the Contract. The local content less than 20% will be declared as non-compliant
Air Pollution During Construction	Contractor	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. • To the extent that is practical, clear and cut slopes on a phased basis to limit the area exposed. • 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. • Installation of wash bays at the exit points of the project site (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. • Hoarding of project site • Installation of dust screens • 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. Monitoring to be undertaken at established monitoring sites in accordance with APR 2014 guidelines
Noise Pollution	Contractor; MOWT	During Construction	• 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

Impact	Agents Responsible	Schedule of Implementation	Measures
			and hospitals, notify Principals and Managers/CEOs of these works. Where practical, conduct noise intense works outside of school hours • 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. • conduct periodic monitoring of vehicles for noise levels, and for other infractions of standards set for vehicles on the road and on building sites
Traffic Disruption	Contractor;	Construction Phase	• Construct additional lanes to either side of the existing road before excavating and reconstructing existing road surfaces • Appropriately plan movement of construction vehicles • Where required, allocate persons to direct traffic in areas where construction is taking place • Place the appropriate warning and directional signs at areas where construction is taking place • Limit the movement of heavy vehicles on roads / lanes used by the public during peak hour traffic • Identification and enforcement of haul routes (including avoiding dangerous routes during specific times); • Provision of appropriate barriers and signage to demarcate areas in which construction traffic is active and prevent access to the general public;
Air Pollution (post construction)	MOWT; EMA;	Operational Phase	• Barriers should extend beyond the area to be protected or can wrap around and extend away from the roadway.
Noise Pollution (post construction)	MOWT	Operational Phase	• Construction of a highway sound barrier system
Closure of bowtie on Western Main Road (Disruption to Commute of Residents and Taxi	MOWT, Highways Division MRDLG;	Operational Phase	• 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 • Incorporation of appropriate signage and safety measures (barriers, formalised crossing points) to reduce the risk of accidents.

Impact	Agents Responsible	Schedule of Implementation	Measures
Services from POS - Cocorite)			• Media Notification (Newspaper, Ministry Website, Facebook – 1 week before the implementation of the closure of the bowtie)

Routine Maintenance work along Proposed Overpass	MOWT	Operational Phase	• Maintenance work to be done on three-week cycle, one cycle would include:
			  ○ Vegetation control
			  ○ Clearing curbs and slippers
			  ○ Opening of roadside inlets
			• The same team would clear open main drains along the reserve.
			• On a fortnightly basis, the Road Overseer and the Works Supervisor are also expected to jointly inspect the roadway and off carriageway and schedule repairs accordingly.

6 MONITORING AND INTERVENTION

The problem of congestion in the Diego Martin municipality dates back more than a decade. The municipality has had substantial expansion of its road network over the last two decades. However, there remain areas of considerable congestion, including at the location identified for the overpass, which, along with the drainage infrastructure, is the subject of the present project.

The overpass is expected to provide partial relief to congestion in the area, by easing traffic flows and separating the traffic connecting between the Valley and the west of the peninsula. In so doing, it would allow the substantial dormitory community of the Valley to commute to work, school or other daily activity with a lower commitment of time on the road. The Overpass along with other infrastructure to come will improve circulation in the area.

In the previous section a number of negative impacts were identified, and measures have been outlined to mitigate these impacts. This section seeks to establish monitoring arrangements to reduce or mitigate the negative impacts, during the period of construction and in the operational phase of the project.. It is assumed that where the impacts are positive, these can be maximised, for the benefit of the local community, the region and even the nation as a whole. As a working principle of stakeholder participation, the agencies identified with responsibilities for monitoring and mitigating impacts, should seek to engage the residents' associations in the area proximate to the planned overpass as well as the Route 1 Taxi Drivers' Association, all of whom participated keenly in the discussions of the building of the overpass.

Construction of the DMRC Administrative Complex is due to start in November 2019. The Overpass and Drainage Works are due to start in the first quarter of 2020. These are two large projects being undertaken within less than two Kilometres from one another. Their cumulative impact will register in some respects negatively on the traffic on the Western Main Road. While the trucks servicing the two projects have different points for axis and exit of their respective sites, they would all use the Western Main Road if they are coming from the east of Diego Martin. NIDCO is the project manager for both projects and should be able within its internal operations, to coordinate and ensure any negatives in the form of congestion of heavy trucks on the road to Diego Martin can be minimised. Collaboration between the two project groups in NIDCO can eliminate or reduce any such cumulative negative impact.

MOWT, DMRC and NIDCO should cooperate to ensure that the respective contractors commit to the employment of local labour. The complex is likely to provide more opportunities for employment of local labour, but the Overpass is not to be absolved of such a responsibility. In maximising employment from both projects, there is a multiplier factor that can work at least in the short term to stimulate business activity and other employment in the area

Table 6.1: Impact Areas During Construction and Monitoring Strategies

Impact Areas/ Measures/Action	Monitoring (key indicators)	Responsible Agency
Air and Noise Pollution before Construction	• Placement of monitors at Powder Magazine and collection of base data on air pollution (P2.5, P10 and TSP) noise pollution (decibels) at site for future reference	• MOWT before start of construction
Handover of site to Contractor	• Dated Acceptance of site by Contractor	• MOWT at start up
Contractor's Management Team appointed	• Key staff in place: Construction Manager/Supervising Engineer with other key staff including Health and Safety Officer	• Contractor
Perimeter fencing and Site Office establishment with appropriate facilities for undertaking civil works	• Site Office established and other facilities installed in keeping with regulations of OSHA, EMA, Fire Department and Public Health: toilets, change rooms, supply stores, heavy equipment on site storage, statutory requirements displayed – NIS, Business Registration • Muster Point delineated • Security Services in place	• Contractor at start up,
Recruitment of Workers	• Contractor must demonstrate the overall local content to be 40% of Total Contract Value excluding Contingencies, Provisional Sums, and VAT to which it proposes to execute the Works utilizing local content, in connection with both the design and construction phases of the Contract. The local content less than 20% will be declared as non-compliant	• Contractor
Health and Safety	• HSE Management Plan in place and training of workers undertaken	• Contractor at start to supply to NIDCO/MOWT
Clearing of land consistently with area earmarked for overpass	• Area of vegetative cover removed, relative to the area of the overpass in the existing green space not to exceed a percentage formally agreed between MOWT and Contractor	• Contractor to supply to NIDCO/MOWT

Impact Areas/ Measures/Action	Monitoring (key indicators)	Responsible Agency
Traffic Disruption	• Traffic Management Plan detailing entry and exit of vehicles on to site and around site, with siting of vehicles organised to create minimum of impact on surrounding communities.	• Contractor to supply to NIDCO/MOWT
Drainage/Site Management/ Storm water control on site	• Drainage/Environmental Management and Storm Water Management: log of episodes of storm water from site overflowing onto public road	• Contractor to supply to NIDCO/MOWT
Air Pollution (During Construction)	• PM10 &PM2.5, TSP, NO2, SO2, CO & Ozone according to the EMA Air Pollution Rules 2014. Meteorological data can also be measured (wind speed, direction, temp, rainfall, humidity, and barometric pressure). • Facilities to test diesel powered and other gas-powered on-site equipment for emissions and weekly record kept and available for viewing • Wash-bay facilities in place to wash tires of trucks exiting the site • Stockpiles of sand and aggregate kept to a minimum, and covered to prevent particle dispersal in the air • Transport vehicles supplied with tarpaulin and trays of trucks always covered	• Contractor/MOWT to supply EMA with monthly data on air quality • Contractor to keep log of vehicle and equipment maintenance
Noise Pollution (During Construction)	• Regular checks of onsite diesel- and gas-powered vehicles and equipment for readings of noise levels and log of weekly tests of onsite vehicles and equipment • Log kept of days and hours over which noise intense work performed	• Contractor

Table 6.2: Impact Areas During Operational Phase and Monitoring Strategies

Impact Areas/ Measures/Action	Monitoring (key indicators)	Responsible Agency
Air Pollution Post Construction	• Regular monitoring of air quality at and information made available to residents in these communities • Transport Officers of MOWT to conduct periodic vehicles assessments in the area for contravention of emission standards set out in regulations • Promotion of foliage and shrubbery in the general area of the Overpass to absorb particulates and other noxious material • Institutionalize monitoring of and reporting on air quality on highways and major intersections across the country.	MOWT to implement and report to EMA
Noise Pollution Post Construction	• Officers of the Transport Division of the MOWT to conduct random checks on vehicles for noise levels in excess of the allowable limits.	MOWT
Management and Maintenance of Overpass	• Highways Division maintaining the road pavement structure, median and verges etc.	MOWT
Closure of Bowtie	• Need to be supported with appropriate signage warning motorists and indicating access to these communities. • Record of accidents post closure to be monitored	MOWT

7 CONCLUSION

The vehicular overpass in the vicinity of Powder Magazine No.2, related road improvements and drainage plan are part of the upgrade of the infrastructure in this area of the municipality of Diego Martin. The overpass will straddle the approach to the valley or the exit from the valley depending on the direction of travel. It will assist in containing the congestion that exists at this point in the road systems of the Diego Martin Main Road and the Diego Martin Highway.

The municipality is home to a large suburban population which is really a dormitory community, with many of the residents earning their incomes outside of the municipality. Labour force participation is higher than the national average and the stock of skills and education in the workforce is also above the national average. The vehicle population is high with more than 50 percent of households owning a vehicle for private use.

This highly educated workforce is often caught in traffic snarls with much otherwise productive time being frittered away as they sit immobile for long spells in traffic. This is an acute example of waste of productive time which might have redounded to increased GDP and economic growth of the country. The building of the overpass is not without negative impact; however, it may put at risk of air pollution the more vulnerable in the communities in the immediate vicinity of the overpass. Indeed, given the high density of the population in the existing settlement areas, there are very few locations in the Diego Martin Valley where a major road might be built without putting at risk of air pollution the more vulnerable members of the community.

The overpass is complemented by a major drainage project for the lower Diego Martin Valley where there has been major flooding of homes in recent years, with the consequential losses to residents in the affected communities. The drainage plan is comprehensive and embraces an area spanning most of the communities in the Lower Diego Martin Valley. The design includes the creation of detention ponds. With the inclusion of regular servicing of the river course of the Diego Martin River, and with the dredging of the mouth of the river, the area is likely to be at very low risk of flooding. The slowing of congestion and the reduced risk of flooding are the immediate benefits of this project.

In this project, an attempt was made to identify the more serious impacts and to develop measures and initiatives that mainly through state actors and in particular, the MOWT, the sponsor of the Overpass, the negatives can be mitigated. An important rider in all of this is that the MOWT has to step on its mandate and its remit which includes not only the building of roads but also on the monitoring of road users and steering them in the direction of adopting best practice in the maintenance and use of their vehicles, evident in the control of emissions, reduction in noise of vehicles as a courtesy to fellow users of the road and to residents on streets and highways where they travel.

One of the negative impacts that persists in the operational phase of the project is the fact of air pollution from vehicular traffic which, with the overpass, will be brought into the direct ambience of the residents of Victoria Keyes and Powder Magazine No.2. A wall barrier was proposed by the design-build contractor to mitigate against dust and can serve as a noise barrier. A high density of vehicle ownership among residents of Diego Martin guarantees substantial traffic in all the communities of the municipality. Indeed, only a minority of residents of the Diego Martin Valley are likely to living at least 300 metres from a major roadway: this is the suggested distance for safety from air pollution from vehicular traffic. The residents of these communities may well experience an improvement in air quality since currently heavy congestion of traffic in their area with vehicles in a stop-go mode over an extended period guarantees high levels of atmospheric pollution. Traffic flowing through the overpass may well deliver less pollutants in this neighbourhood.

The Ministry of Works will need to maintain constant monitoring of air quality in the area with monitors being set at Powder Magazine No.2. Ensuring that motorists observe the speed limit, by the application of camera monitoring will assist in containing emissions.

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