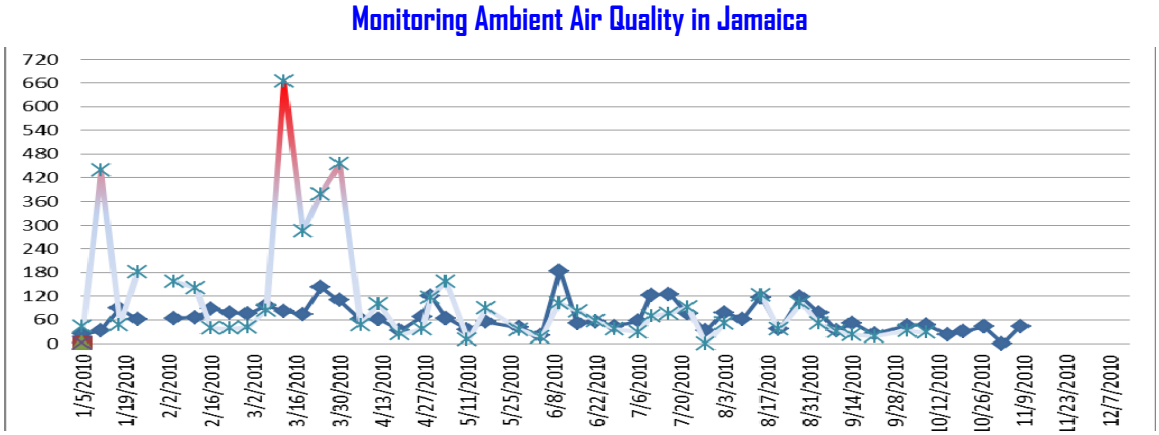
2010
Ambient Air Quality Report



Prepared by
National Environment and Planning Agency
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Ambient Air Quality Report

Prepared by

National Environment and Planning Agency

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Jamaica

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TABLE OF CONTENTS

CONTENT **PAGE**

List of Figures

Figures

List of Tables

List of Abbreviations

Alpart	Aluminium Partners of Jamaica
APDL	Air Pollutant Discharge Licence
AQMP	Air Quality Management Programme
CAMS	Cross Roads Ambient Monitoring Station
CAPs	Criteria Air Pollutants
CCCL	Caribbean Cement Company Limited
CO	Carbon Monoxide
JAM	Jamalco
JAAQS	Jamaica Ambient Air Quality Standards
JAQMP	Jamaica Air Quality Management Programme
JBGL	Jamaica Broilers Group Limited
JEP	Jamaica Energy Partners
JPSCo	Jamaica Public Service Company Limited
KSA	Kingston and St. Andrew
LNG	Liquid Natural Gas
NEPA	National Environment and Planning Agency
NO_2	Nitrogen Dioxide
NOR	Noranda Jamaica Bauxite Partners
NRCA	Natural Resources Conservation Authority
MLW	Mud Lake West
PAPs	Priority Air Pollutants
Pet	Petrojam
PM_{10}	Particulate Matter less than 10 microns
RAMS	Rockfort Ambient Monitoring Station
SO_2	Sulphur Dioxide
TSP	Total Suspended Particulates
ULDF	Ultra Low Diesel Fuel
WIN	Windalco

Appendices

Appendix A

Executive Summary

The first report provides quantitative and qualitative analysis of the ambient concentrations of:

- Total Suspended Particulate (TSP)
- Particulate Matter Less than 10 Microns (PM_{10})
- Sulphur Dioxide (SO_2)
- Nitrogen Dioxide (NO_2)
- Carbon Monoxide (CO)

The report outlines the amount of stations now in operation across the island. The locations of these stations, parameters monitored, operator(s) and commission date of each station are given. The report also brakes down the monitoring responsibility shared across the island by sectors.

In the first section of the report a statistical analysis is done for the fifty seven (57) monitoring locations across the country. The status of the ambient air is given for each site monitored during 2010 along with an analysis of the causes and trends. The status of the hourly ambient levels, twenty four (24) hour average ambient levels and average annual levels are quantitatively analyzed. These are compared with the National Standards set by the Natural Resources Conservation Authority and the communities that are impacted are identified in some cases.

The report goes on to statistically compare the annual average ambient air quality between 2010 and previous years for all the sites that have historical data available and outlines the trends. It also seeks to identify the results of the trends and explains why ambient levels have increased or decreased.

The report concludes by giving a qualitative analysis of the ambient air in the island specific to each type of pollutant and mentions strategies the Agency will undertake to maintain and improve the country's air quality

1.0 Background

The National Environment and Planning Agency (NEPA) launched its Air Quality Management Programme (AQMP) in March 2010. The programme focuses on specific goals, one of which is the continuous assessment and improvement of the country's ambient air quality.

NEPA has been monitoring and assessing the ambient air quality chiefly in the parishes of Kingston and St. Andrew since 2006. The Agency conducts monitoring for Total Suspended Particulates (TSP), Particulate Matter less than 10 Microns (PM_{10}), Sulphur Dioxide (SO_2) and Nitrogen Dioxide (NO_2). Since 2007, however the Agency has ceased its monitoring of both SO_2 and NO_2 because of equipment failure.

In December 2009 NEPA issued Natural Resources Conservation Authority (NRCA), Air Pollutant Discharge Licence (APDL) to thirty (30) facilities across the country. The Licenses included specific conditions which required facilities to conduct ambient air monitoring in areas designated by the Agency. Many of these ambient air monitoring stations have been in place for the entire year of 2010 and some have been recently installed in the 4th quarter of 2010. Data from these stations are collected based on the frequency standards set by the Agency and reported monthly. This data along with the data from the stations operated by the Agency is used to analyze ambient air across the country. The data is verified and appropriate quality assurance checks are carried out on each data set reported to the Agency. These procedures ensure the highest quality of data analysis to provide the public with factual information.

The larger industries across the island such as Bauxite, Cement and Power Production installed ambient air monitoring stations, in some cases, as far back as 2003. They did this to comply with the requirements of their funders, local environmental permits and international environmental obligations. Most of this data however could not be used by the Agency because of the poor reporting, poor quality and no verification. All trends and comparisons made in this report are from data gathered during 2009 and in rare cases 2008. Since the first quarter of 2010 the Agency has put in place a number of strategies to ensure consistent and quality data from the network operated by licensed industries. The Agency is now capable of making a more thorough assessment of the data to provide the public with information.

2.0 Current Ambient Monitoring Network Status

Table 1 below shows:

- The stations across the island
- Their status
- Their operator(s)
- The parameters monitored
- Parish location
- Approximate year of commission

Table1: Jamaica's Ambient Monitoring Network

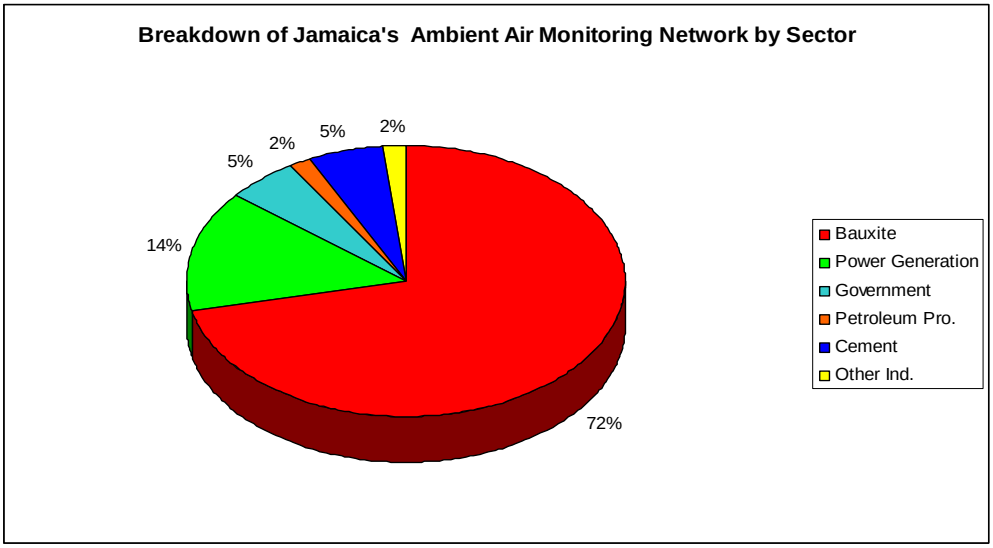
STATION	PARISH,LOCATION	PARAMETERS	OPERATOR	STATUS	Commission
1	KIN, Crossroads	TSP, PM10	NEPA	ON	2006
2	KIN, Harbour View	TSP,	NEPA	ON	2006
3	KIN, Hope Road	TSP, PM10	NEPA	ON	2006
4	KIN, Collage Commons	PM10	CCCL	ON	2008
5	KIN, Rock Fort	PM10	CCCL	ON	2008
6	KIN, Maritime Institute	PM10	CCCL	ON	2008
7	KIN, Marcus Garvey Dr	SO2, NO2	JEP	ON	2009
8	KIN, Garmex	SO2, NO2	JEP	ON	2009
9	KIN, Garmex	SO2, NO2, PM10	JPSCO	ON	2009
10	KIN, Petrojam	SO2, NO2, PM10	Pet	ON	2009
11	KIN, Bournemount Dr.	SO2, NO2, PM10	JPPC	ON	2010
12	St. CAT, Terminal	SO2, NO2, PM10	JPSCO	OFF	2011
13	*St. CAT, Port Esquivel	TSP	WIN	ON	post 2007
14	*St. CAT, Port Esquivel	TSP	WIN	ON	post 2007
15	St. CAT, Bounting Prop.	PM10	WIN	OFF	post 2007
16	St. CAT, Free Town	PM10	JBGL	ON	2011
17	St. CAT, Longville Park	SO2, NO2, PM10	JEP	ON	2009
18	St. CAT, Lauder wood	SO2, NO2, , O3	JPSCO	ON	2008
19	St. CAT, Orangefield	SO2,NO2,TSP	WIN	ON	post 2007
20	*St. CAT, Mud stacking	TSP	WIN	ON	post 2007
21	St. CAT, Hayfield Close	SO2,NO2,TSP	WIN	ON	post 2007
22	St. CAT. Amity Hall	TSP	WIN	ON	post 2007
23	St. CAT, Brighton St.	TSP	WIN	ON	post 2007
24	St. CAT, Clapham	TSP	WIN	ON	post 2007
25	St. CAT, Faithspen	PM10	WIN	ON	post 2007
26	St. CAT, Hayfield Club	PM10	WIN	ON	post 2007
27	CLA, New Bowens	SO2, NO2, CO, PM10	JAM	ON	post 2007
28	CLA, haise Corn piece	SO2, NO2 CO, PM10	JAM	ON	post 2007
29	CLA, Kemps Hill	SO2, NO2	JAM	ON	post 2007
30	*CLA, Rocky Point	TSP	JAM	ON	post 2007
31	MAN, Ballynure	PM10	JAM	ON	post 2007
32	MAN, Broadleaf	PM10	JAM	ON	post 2007
33	MAN, Windsor	PM10	JAM	ON	post 2007

34	MAN, Asia	PM10	JAM	ON	post 2007
35	MAN, Mile Gully	PM10	JAM	ON	post 2007
36	MAN, Kendal	TSP SO2, NO2, CO	WIN	ON	post 2007
37	MAN, Kendal 2	TSP	WIN	ON	post 2007
38	MAN, Mud lake South	TSP	WIN	ON	post 2007
39	MAN, Mud lake East	TSP	WIN	ON	post 2007
40	*MAN, Mud lake West	TSP	WIN	ON	post 2007
41	ST. Elz, Lower Warminster	TSP	Alpart	ON	2010
42	ST. Elz, Brinkley	TSP	Alpart	ON	post 2007
43	ST. Elz, Steven Run	TSP	Alpart	ON	2010
44	ST. Elz, Myersville	TSP	Alpart	ON	post 2007
45	ST. Elz, Gazeland	TSP	Alpart	ON	2010
46	ST. Elz,Sports club	TSP	Alpart	ON	post 2007
47	ST. Jam, Bogue	SO2, NO2	JPSCO	ON	2009
48	ST. ANN, Farm Town	TSP	NOR	ON	post 2007
49	ST. ANN, Old Folly	TSP	NOR	ON	post 2007
50	ST. ANN, Bengal	TSP	NOR	ON	post 2007
51	ST. ANN, Queens Road	PM10	NOR	ON	post 2007
52	ST. ANN, Clinic	TSP	NOR	ON	post 2007
53	ST. ANN, Rousseau	TSP	NOR	ON	post 2007
54	ST. ANN, Farm Town	TSP	NOR	ON	post 2007
55	ST. ANN, Calderwood	TSP	NOR	ON	post 2007
56	ST. ANN, Clydesdale	TSP	NOR	ON	post 2007
57	ST. ANN, Greens Hill	TSP	NOR	ON	post 2007

*** Represent stations that are located within a facility's boundary of operation and are not technically defined as Ambient Monitoring Stations. Some of these stations are still reported on to the Agency because they provide useful information. These stations are included in this report only for information and analysis and are not to be considered by the reader as ambient stations**

Jamaica currently has 57 operating stations spread across the island. Forty-six (46) of these stations are located outside of the Kingston and St. Andrew region. The Bauxite companies own and operate 41 of these stations which represent 90% of the ambient monitoring done in the parishes outside of the country's capital Kingston. Figure 1 shows the breakdown of the ambient monitoring network by sectors in the country.

Figure1: Chart Showing Breakdown of Jamaica's Ambient Monitoring Network by Sectors



Pollutants Monitored

Jamaica focuses directly on the ambient concentrations of Criteria Air Pollutants (CAPs)[1]. These pollutants all have ambient air quality standards. Standards are reflected by time base averaging periods. Table 2 below is the current Jamaica Ambient Air Quality Standards (JAAQS).

Table2: Jamaica Ambient Air Quality Standards

Pollutant	Averaging Time	Standard (maximum concentration in ug/m^3)
TSP	Annual 24h	60 150
PM_{10}	Annual 24h	50 150
Lead	Calendar Quarter	2
Sulphur Dioxide	Annual 24h 1h	80 primary, 60 secondary 365 primary, 280 secondary 700
Photochemical Oxidants (Ozone)	1h	235
Carbon Monoxide	8h 1h	10,000 40,000
Nitrogen Dioxide	Annual 1h	100 400

Standards also have been set for a wide range of Priority Air Pollutants (PAPs). A list of these PAPs can be obtained from the "Natural Resources Conservation Authority (Air

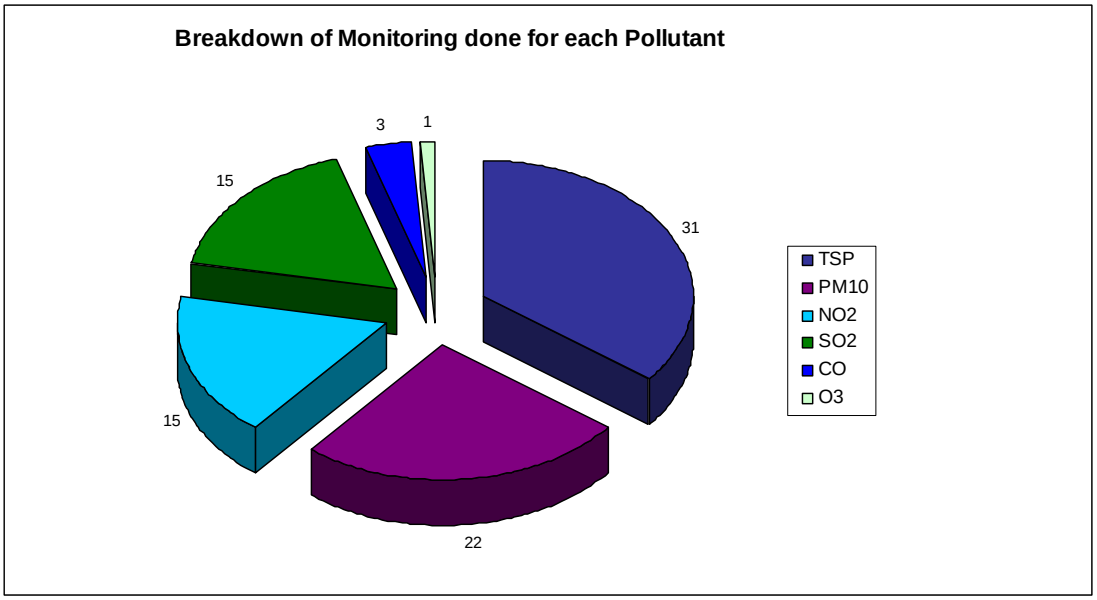
[1] Criteria Air Pollutants are listed as Sulphur Dioxide (SO2), Nitrogen Dioxides (NO2), lead (Pb), Carbon Monoxide, Ozone, Total Suspended Particulate (TSP) and Particulate Matter less than 10 microns (PM10)

Quality) Regulations 2006" or from the National Environment and Planning Agency's website www.nepa.gov.jm. Although standards have been in place for these pollutants since 2006, the levels of most of these pollutants are yet to be quantified in the countries ambient air. Currently monitoring is only being undertaken for the CAPs with the exception of Lead. The CAPs being measured currently have been the main focus of monitoring because:

- These pollutants are the main emissions produced from the air pollution discharge sources existing on the island
- The country's main energy source is Oil which produces significant quantities of these pollutants
- Equipment and technology is more affordable and available to monitor these types of pollutants
- Air Dispersion models done for all the major industries in the country show these pollutants as creating a significant impact on the environment and the public.

Figure 2 shows the percentage of monitors currently equipped to monitor each type of pollutant. Appendices A, Figures 41-46 show the location of these sites by parish

Figure 2: Breakdown of Stations Equipped to Monitor Air Pollutants



It is important to note that although there are 57 stations in the country 16 of these stations are multi-use stations that monitor more than one pollutant. Hence figure 2 indicates a sum of 87 monitors divided among 57 stations.

3.0 Ambient Air Quality tracking and Analysis for 2010

Total Suspended Particulates (TSP)

Figure 3: Graph showing trend in ambient air quality for TSP at the six stations in the Kingston and St. Andrew area from January to December 2010

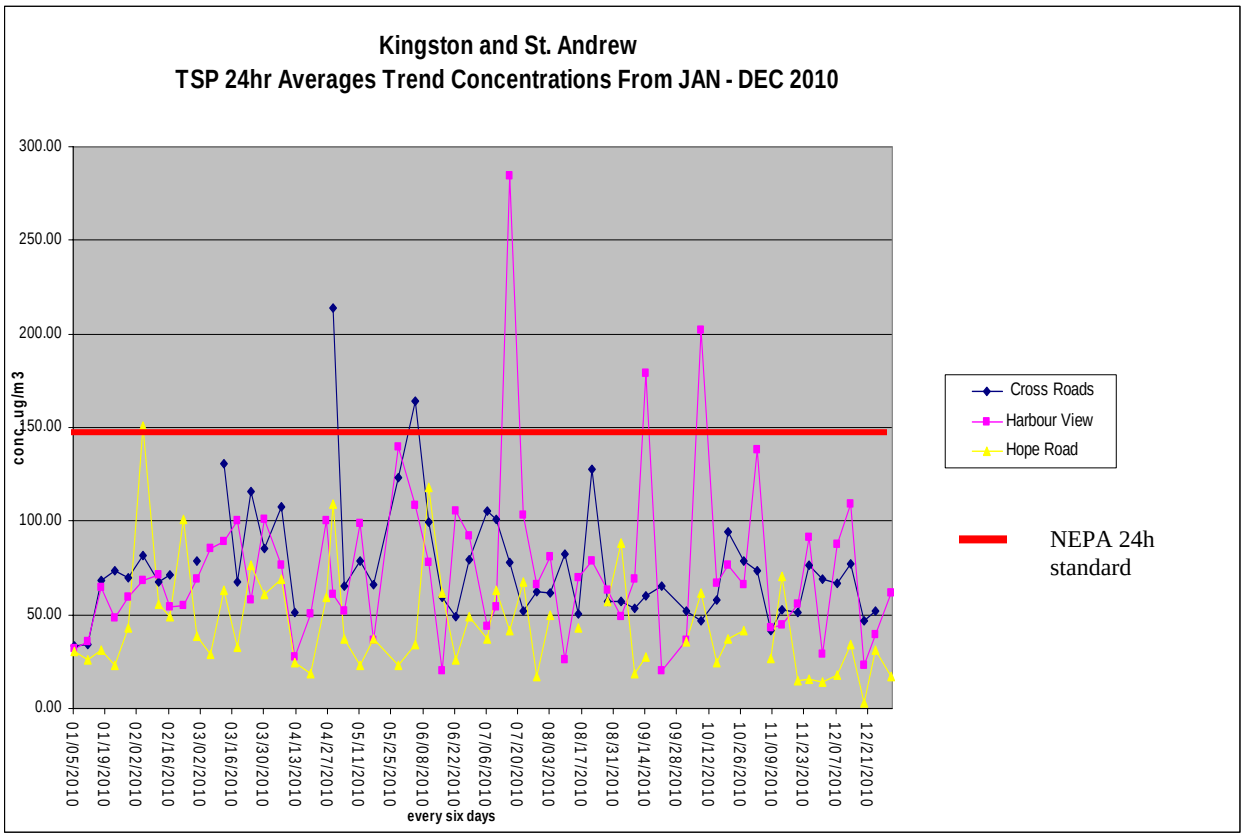
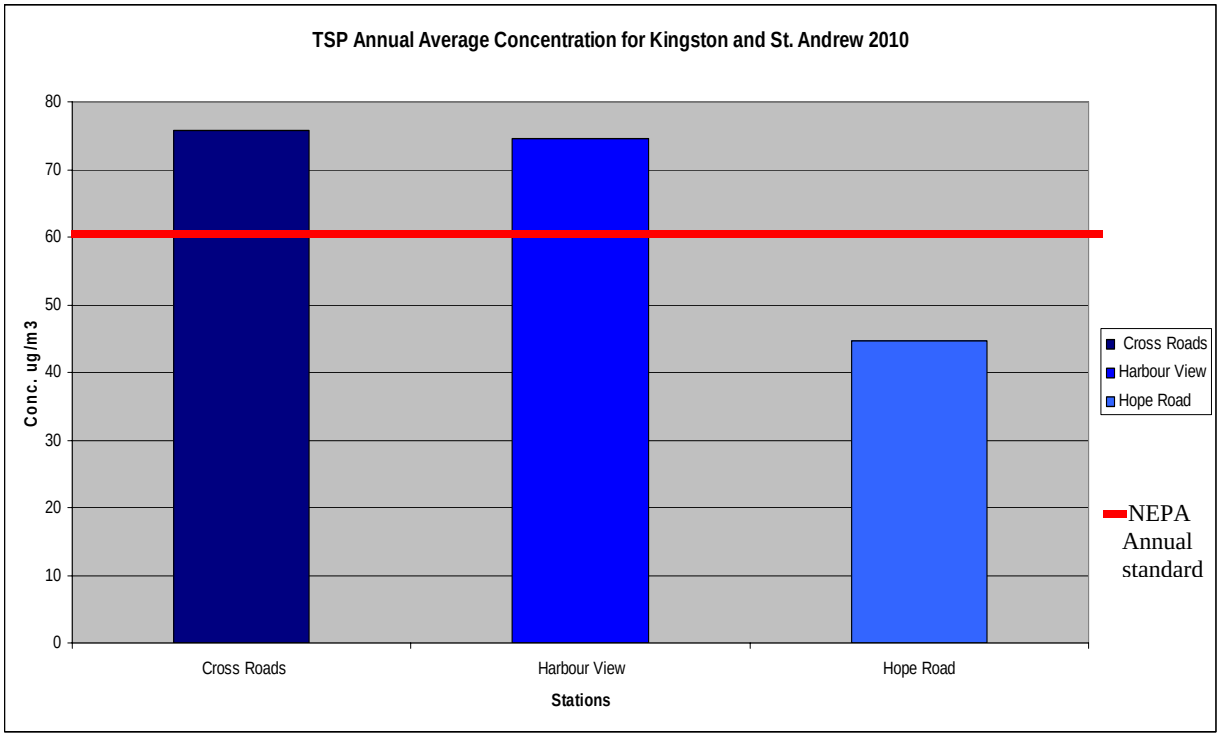


Figure 4: Graph showing Annual TSP average concentrations at all monitoring stations in the Kingston and St. Andrew area for 2010



Figures 3 show at least 5 excedancees for the year of the country's 24 hour averaging ambient standard concentration of TSP. The stations most affected were Cross Rroads and Harbor View. During the months of July to September the graph also shows that concentrations at the Cross Roads and Harbour View stations exceeded the standards more frequently. Three of the five exceedances occurred during this period. During this period as well concentrations seem to be at their highest.

Figure 4 shows clearly that the annual average ambient air concentration standard for TSP, 60ug/m^3, has been exceeded at the Crossroads and Harbour View stations. Averages were as high as 16 ug/m^3 above the annual standard.

These two stations have one common denominator they all are affected by the major cement production facility in the area. Each site however, has its own unique major contributor which may also be a source of the consistently high concentrations of TSP. Harbour View is affected by an abundance of mining in the area and the use of trucks to haul quarried material along haul and main roads. Mining and the fugitive dusting from the cement production plant will contribute to high concentrations of TSP.

The station located at Crossroads is down wind of the cement plant and is located beside a major intersection that carries high traffic levels each day. Fugitive dusting from the road ways, vehicular emissions and dusting from an open lot adjacent to the stations property is the major source of high levels of TSP in this area. The station is also exposed to emissions

from an incinerator at a supermarket close to the stations property. The effects of this source though cannot be quantified as information on its operation is limited.

Strategies to combat these high concentration levels will be discussed further in this report.

Figure 5: Graph showing trend in ambient air quality for TSP at the six stations in the South St. Elizabeth area from Jan-Dec 2010

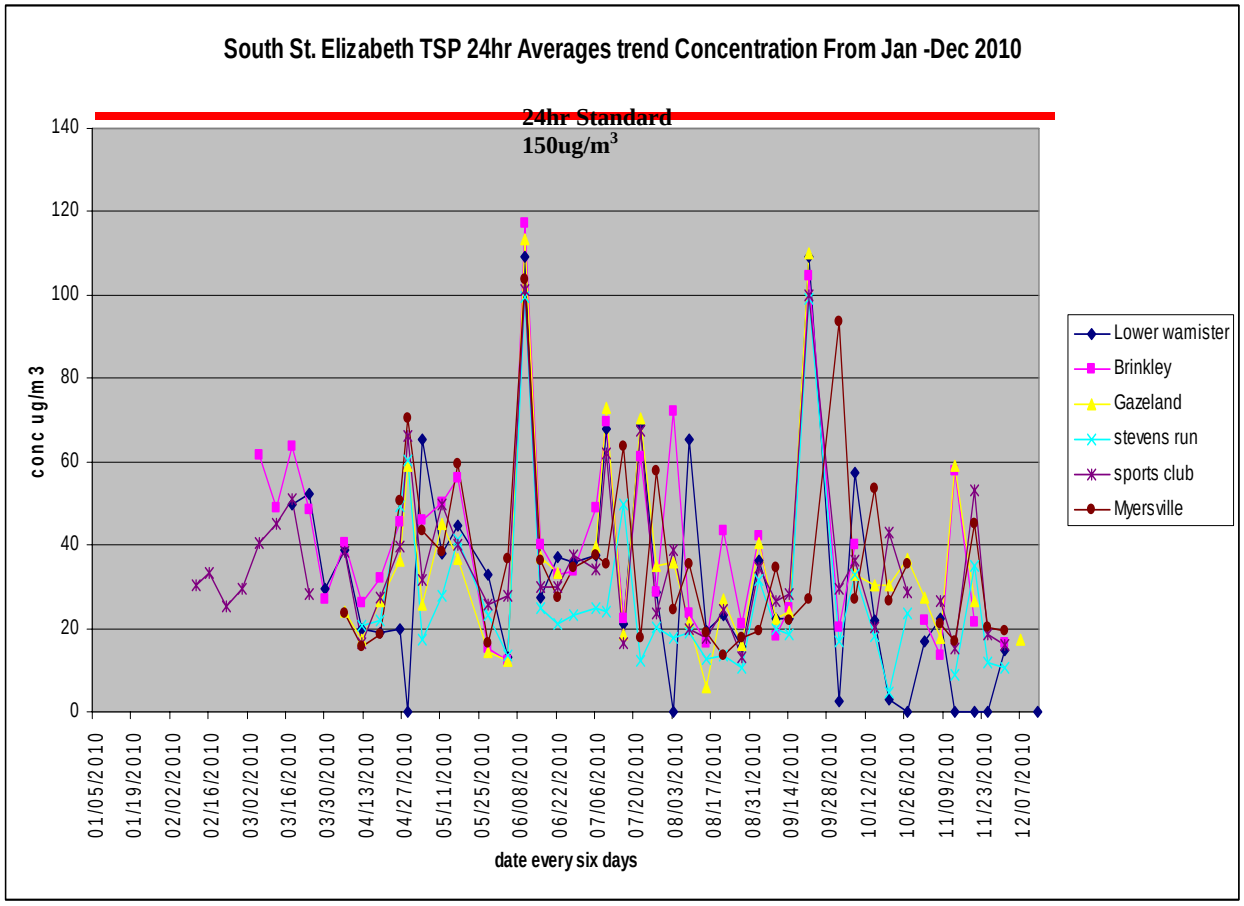
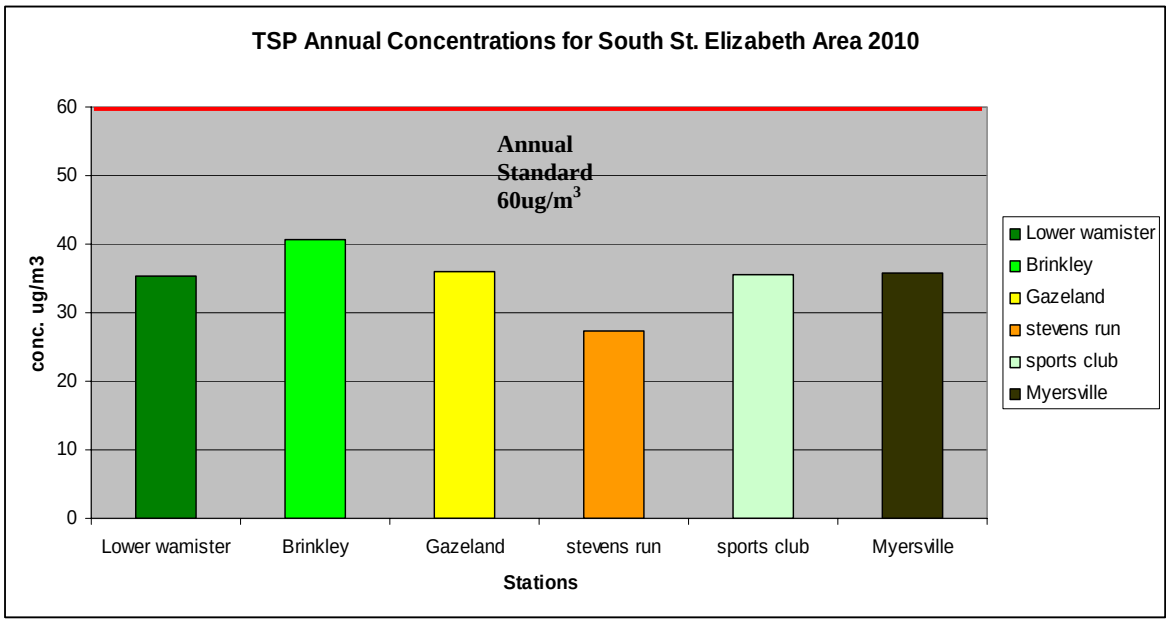


Figure 6: Graph showing Annual TSP average concentrations at all monitoring stations in the South St. Elizabeth for 2010



Figures 5 and 6 indicate that both 24 hour average concentrations and annual average concentrations are within the national standards. The stations located in this area of the country are in the communities surrounding the major alumina plant in the area. During 2010 there was no production at this plant. TSP levels were mainly as result of fugitive dusting from the 700 hectare red mud storage area which experienced dry spells especially during the first quarter of the year. Dusting which contributes to TSP concentrations could also have resulted from the disturbance of road ways from farming equipment, trucks and light motor vehicles. Two peaks on the graph in figure 5 are evident in June and again in September. However these did not breach the 24 hour standard and was associated with the Red Mud Storage Area surface being dry, and thus releasing TSP to the surroundings.

Figure 7: Graph showing trend in ambient air quality for TSP at the five stations in the Kirkvine and Battersea Manchester area from Jan-Dec 2010

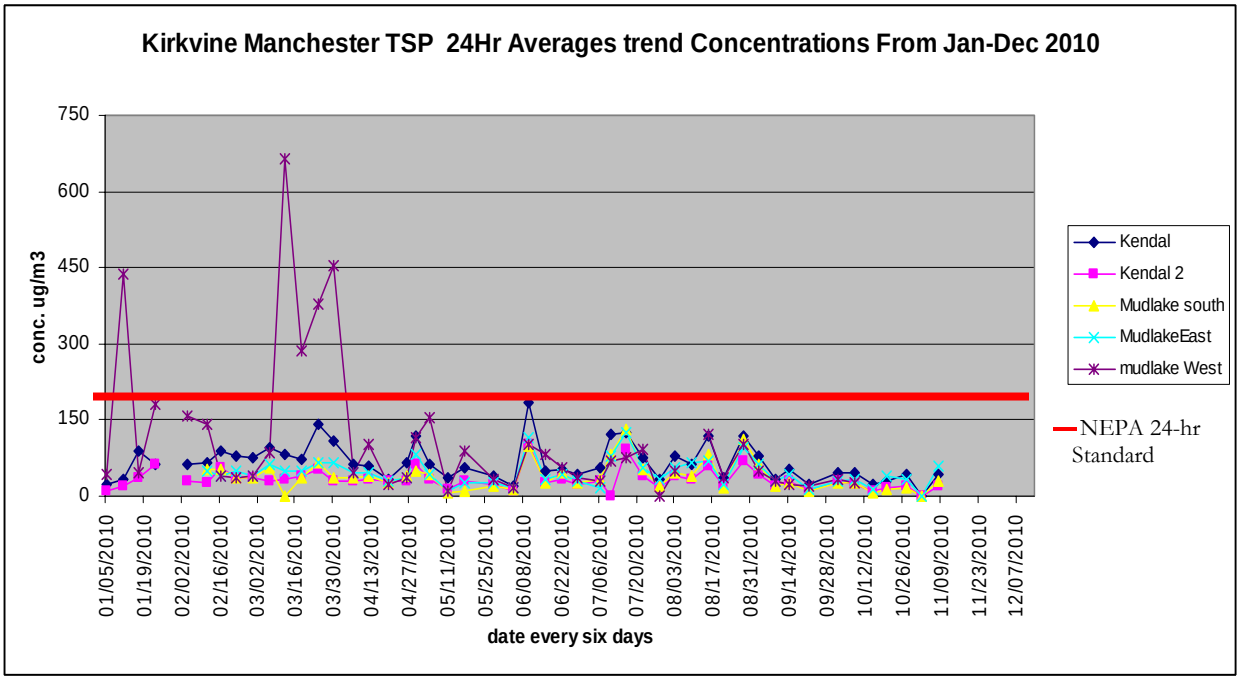


Figure 8: Graph showing Annual TSP average concentrations at all monitoring stations in Kirkvine and Battersea Manchester for 2010

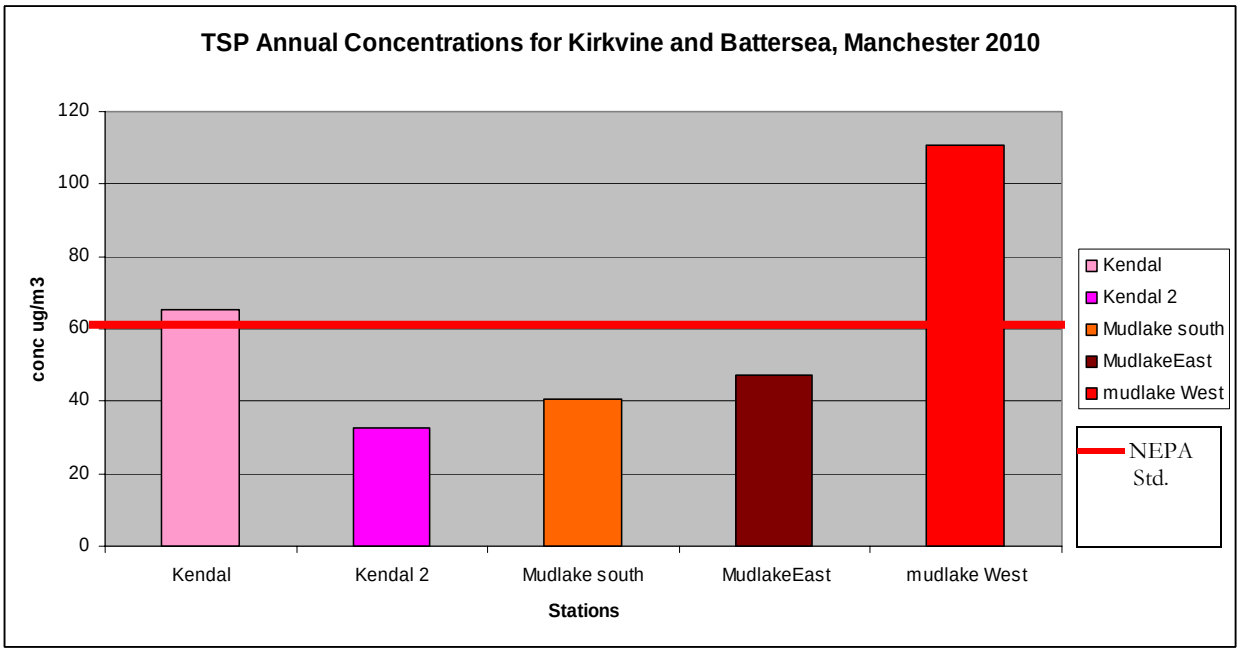


Figure 7 indicates that during 2010 the station located West of the Mud-lake exceeded the 24 Hour average ambient standard on approximately eight occasions. The two major peaks in January and March were synonymous with the two major dusting events that took place because of the drying of the surface of the Mud-lake. During both these events the company reported the incident to NEPA. The incident was investigated by the relevant government Agencies and the appropriate enforcement and remediation actions taken. It is important to note however that this station is located on the edge of the mud-lake within the refinery's boundaries. Technically this station would not be considered as an ambient station because of its location. However it is an excellent indicator of what levels of TSP are released from the lake. This is why it has been included in this report.

The graph shows that as of September ambient levels have been trending down. The stations in this area are affected by both the major alumina refinery and the Mud-lake. During 2010 the refinery did not operate and hence all TSP levels were due to the Mud-lake, general fugitive emissions from road ways and agricultural production.

Figure 8 indicates that the annual standard at the ambient station at Kendal exceeds the annual averages. The source for this exceedance is not clearly identified as it is not directly downwind of any major sources apart from the refinery stacks, which were not in operation. On closer analysis of the Kendal station TSP concentration trends in Figure 9, it was observed that the Mud-Lake West (MLW) Station 24 hour trends were similar to the Kendal trends. The only deviation occurred during the heavy dusting events from the Mud-lake in January and March. The MLW Station is approximately 251° downwind of the Kendal Station. The Kendal Station is located 250m North West of the industrial dumpsite operated by the refinery. The surface of this site is largely exposed and void of vegetation with stockpiles of hydrate and bauxite along with other debris. The MLW station is downwind of the dumpsite in the same general direction of 251 °. This area may be the cause of the continued high background levels at the Kendal TSP station.

Figure 9: Comparison of TSP trends in 2010 for Mud-lake West Station and Kendal Station

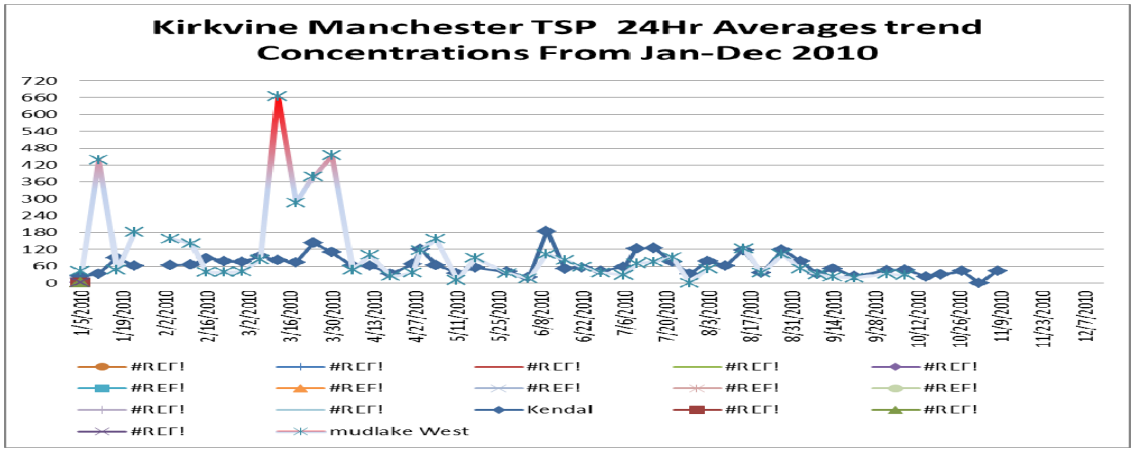


Figure 10: Graph showing trend in ambient air quality for TSP at the seven stations in the Ewarton and Port Esquivel area of St. Catherine from Jan-Dec 2010

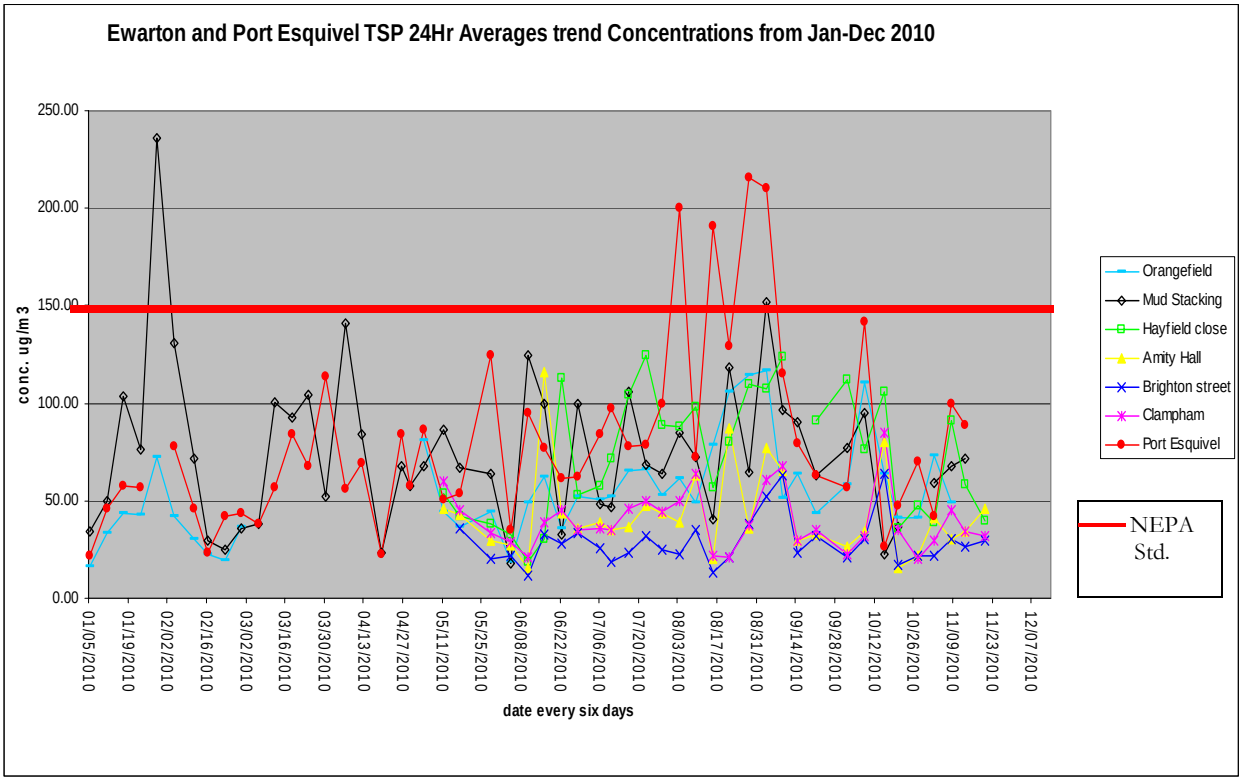
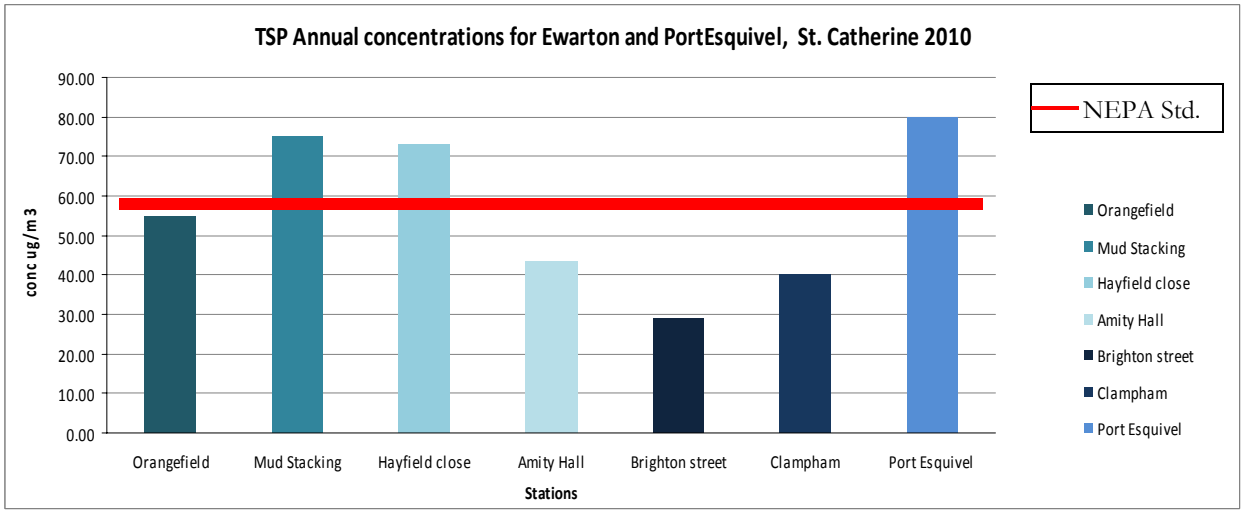


Figure 11: Graph showing Annual TSP average concentrations at all monitoring stations in Ewarton and Port Esquivel, St. Catherine for 2010



In figure 10 at least five (5) exceedances of the 24 hour standard occurred during 2010. At the two sites were this occurred both stations were located just on the peripheral of the facilities. As discussed before technically these stations cannot be classified as Ambient

Monitoring Stations. However they provided indications as to the quantity of TSP leaving the facility. The stations in the Ewarton area are:

- Orangefield
- Mud Stacking
- Hayfield
- Amity Hall
- Brighton Street
- Clampham

These are all affected by the Alumina Refinery and the Bauxite Mining Haul roads and other mining activities. TSP levels at Orangefield and Hayfield are close to and above the annual standard respectively. Figure 11 shows the results of TSP annual averages. TSP for all the stations at Ewarton are impacted significantly by the Refinery and the Haul roads mining. The impact from the construct of the third leg of highway 2000 in the area shows little impact on the stations at Clampham and Amity Hall, which are closest to it. Annual averages are below the standard and 24 hour trends have remained below the standard as well.

The major source of TSP at the Port Esquivel region is the Port during offloading of material from trains and loading to ships or vice versa. Alumina, hydrate and grains are some of the sources of TSP in this area. The Port has put in place strategies to reduce the effects of TSP which will be assessed during 2011.

Figure 12: Graph showing trend in ambient air quality for TSP at the eight stations in the Discovery bay area of St. Ann from Jan-Dec 2010

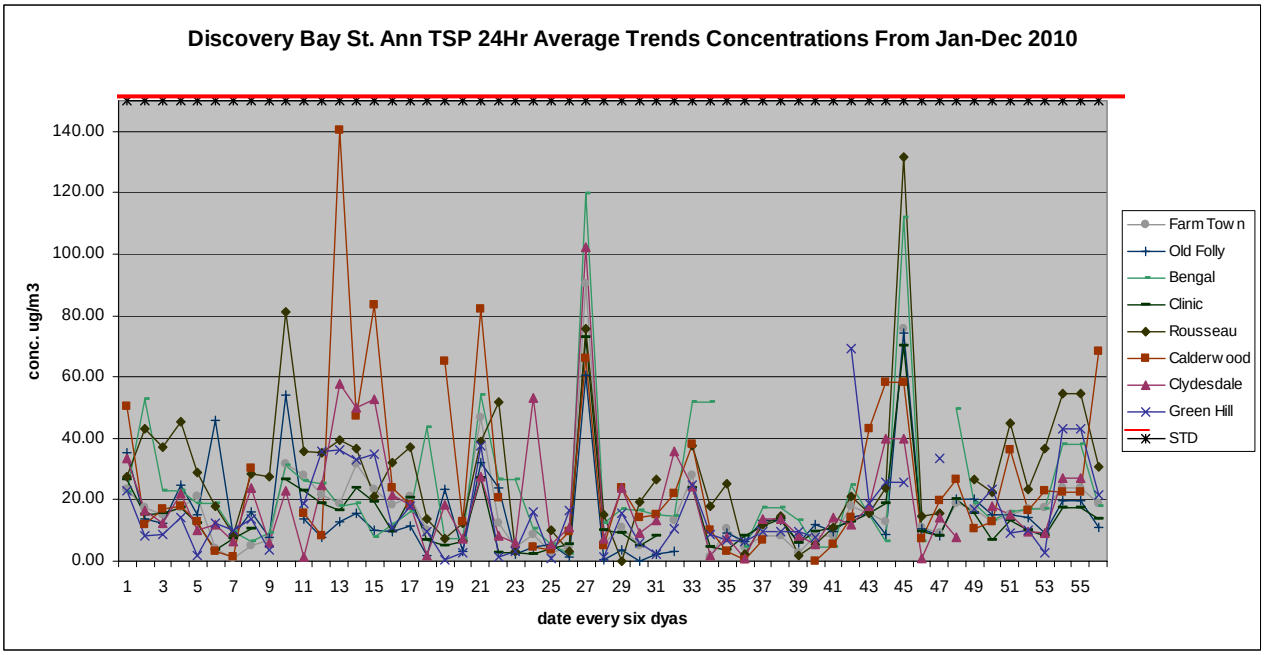
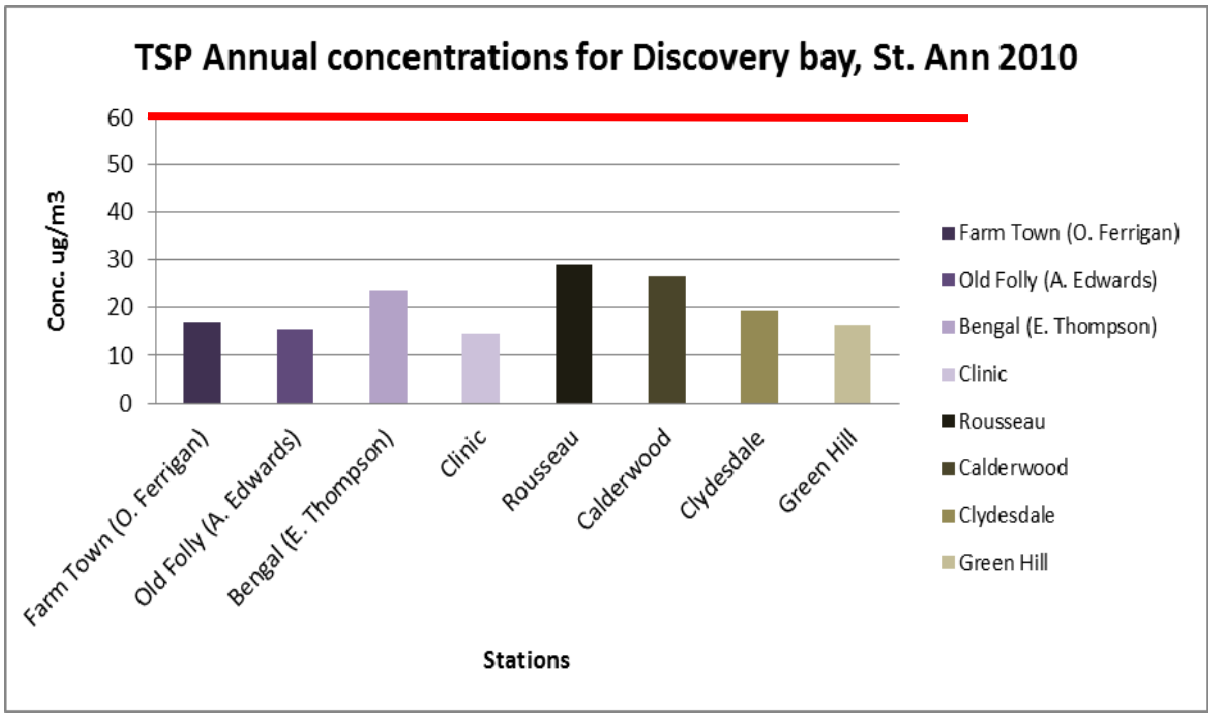


Figure 13: Graph showing Annual TSP average concentrations at all monitoring stations in Discovery Bay, St. Ann for 2010



The Discovery Bay area is affected by one major source, the bauxite facility in that area. Drying of Bauxite, transfer, ship loading and mining are the major sources of TSP. Figures 12 and 13 indicate that the network set up in communities across the area did not record an exceedance in either the 24 hour ambient standard or the annual standard. Data trend in figure 12 also indicate that all the stations are affected by the same source judging from the peaks on the graph. The stations affected by the plant and port operations are:

- Farm Town
- Old folly
- Bengal
- Clinic
- Rousseau

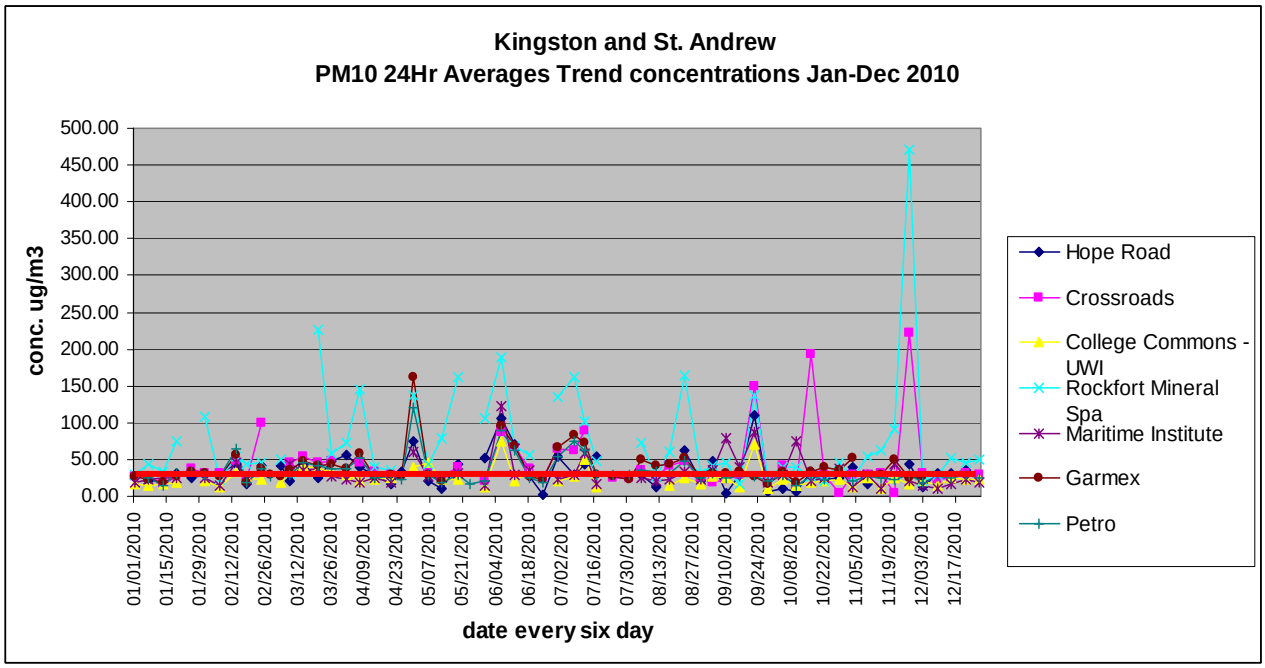
These stations all pack with different maximums during the same time period on the graph showing clearly that these peaks are from a specific source. The same goes for the mining region but with much less clarity because of the effects from trucks on the haul roads creating dusting. The stations directly impacted by mining are:

- Calderwood
- Clydesdale
- Green Hill

The Bauxite Company has also put in place more strategies to reduce the emissions which will be assessed in 2011.

Particulate Matter Less than 10 Microns (PM_{10})

Figure 14 Graph showing trend in ambient air quality for PM_{10} at the seven stations in the Kingston and St. Andrew region from Jan-Dec 2010



The Rockfort station (RAMS) is directly affected by the fugitive dusting and production activities of the cement plant. The station is also beside the road which is a receiving body for the fallout from the plant. Vehicles travelling on the road will also disturb the surface and create further release of PM_{10}. Figure 14 suggest that the stations located at Crossroads, College Commons and Maritime Institute are all affected by the cement plant located at Rockfort. Peaks on the graph of the RAMS in Figure 14 correlate with peaks at these stations. During 2010 the 24 hour average standard was breached a total of eleven occasions at the stations monitored. The Rockfort and Cross roads stations showed the most exceedances with 10 of the 11 occurring at these two stations.

The Cross Roads station (CAMS) shows one exceedance that did not correspond to the RAMS and this may be due to the sources of PM_{10}, similar to those explained in the TSP analysis section of this report. Figure 15 shows more clearly that sources affecting the RAMS seem to be also affecting the CAMS. It is also important to note that the CAMS is down wind of the RAMS (see appendix A) therefore spikes at the CAMS which are not as a result of sources affecting the RAMS would not affect this station.

The only station that breached the annual standard was the RAMS and this was as a result of consistently high readings from fugitive cement dust (see figure 16)

Figure 15: Comparison of trends between Crossroads and Rockfort from January to December 2010

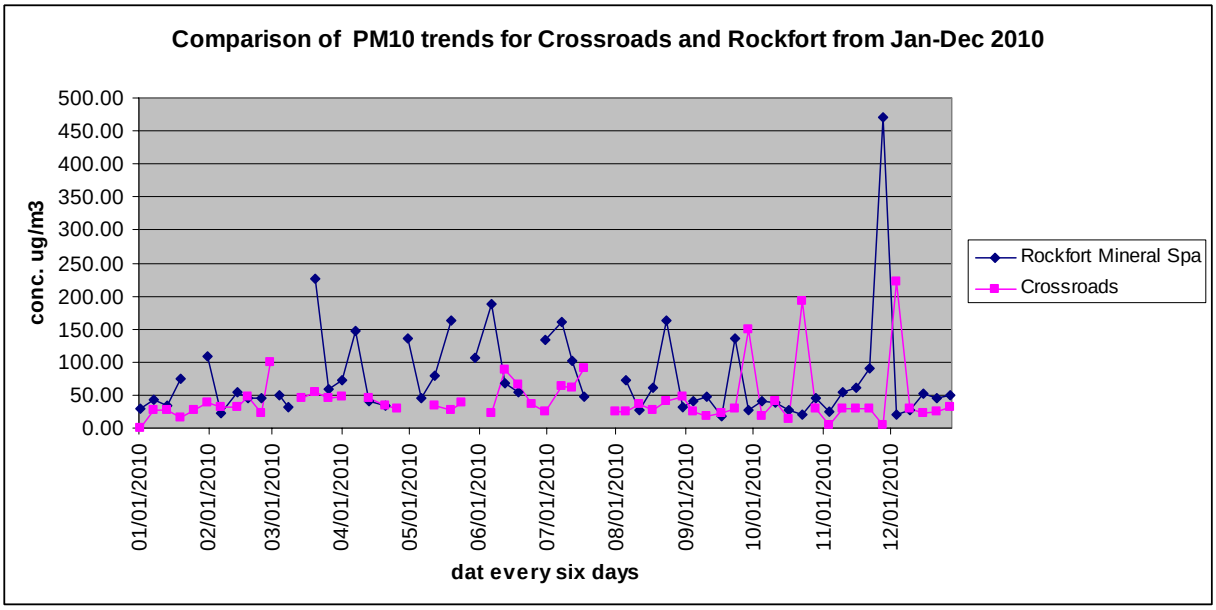


Figure 16: Graph showing Annual PM10 average concentrations at all monitoring stations in Kingston and St. Andrew for 2010

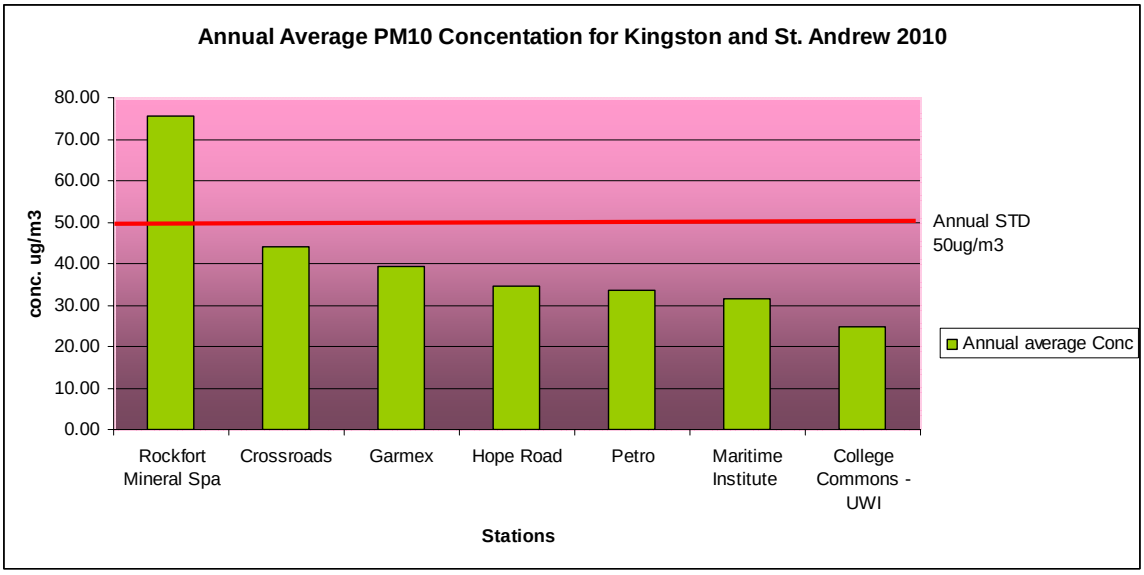
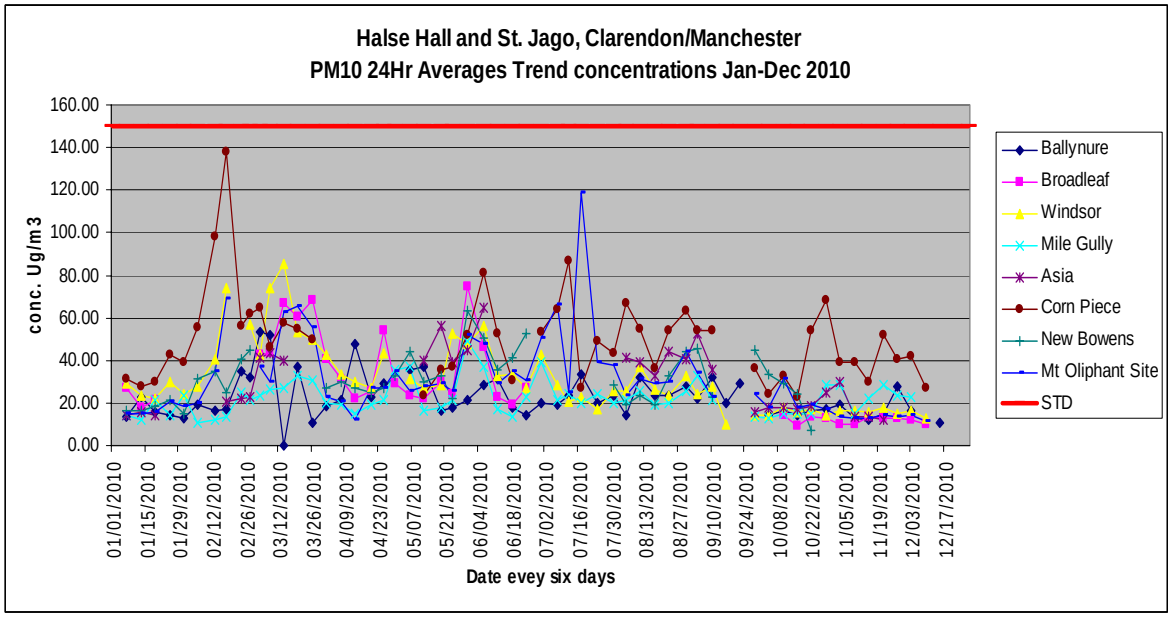


Figure 17: Graph showing trend in ambient air quality for PM10 at the eight stations in the Halse Hall, Clarendon and St. Jago, Manchester Bauxite mining areas from Jan-Dec 2010



The Hayes Corn Piece Station and the New Bowens Station are directly impacted by the major Alumina Refinery in Clarendon. These stations are located in the communities surrounding this facility. Fugitive dusts as well as stack emissions affect the PM_{10} concentrations in these communities reflected by the stations readings. In 2010 data gathered indicates that the 24 Hour averaging concentration standard was not exceeded on any occasion. Figure 17 however shows consistent spikes in the readings of PM_{10} at the Hayes Corn Piece Station. The consistently high readings have lead to the station breaching the annual averaging standard of 50ug/m^3 (see figure 18). Strategies to reduce the PM_{10} release to this community will be closely monitored during 2011.

All other stations presented on the graph in figure 17 monitor areas within the mining lease lands of the same bauxite company. The only significant spikes can be seen at the stations located at Ballymure, Windsor and Broadleaf. These stations are directly affected not only from open mining pits but from loaded trucks transporting bauxite along the haul roads. The bauxite company has put in place strategies to mitigate the effects of dusting in these areas. Control is however extremely difficult as some residential homes are as close as 50m to nearest pit and even closer to the haul roads.

Figure 18: Graph showing Annual PM10 average concentrations at all monitoring stations in Halse Hall, Clarendon and Mining areas in St. Jago, Mt. Oliphant and Mile Gully Manchester for 2010

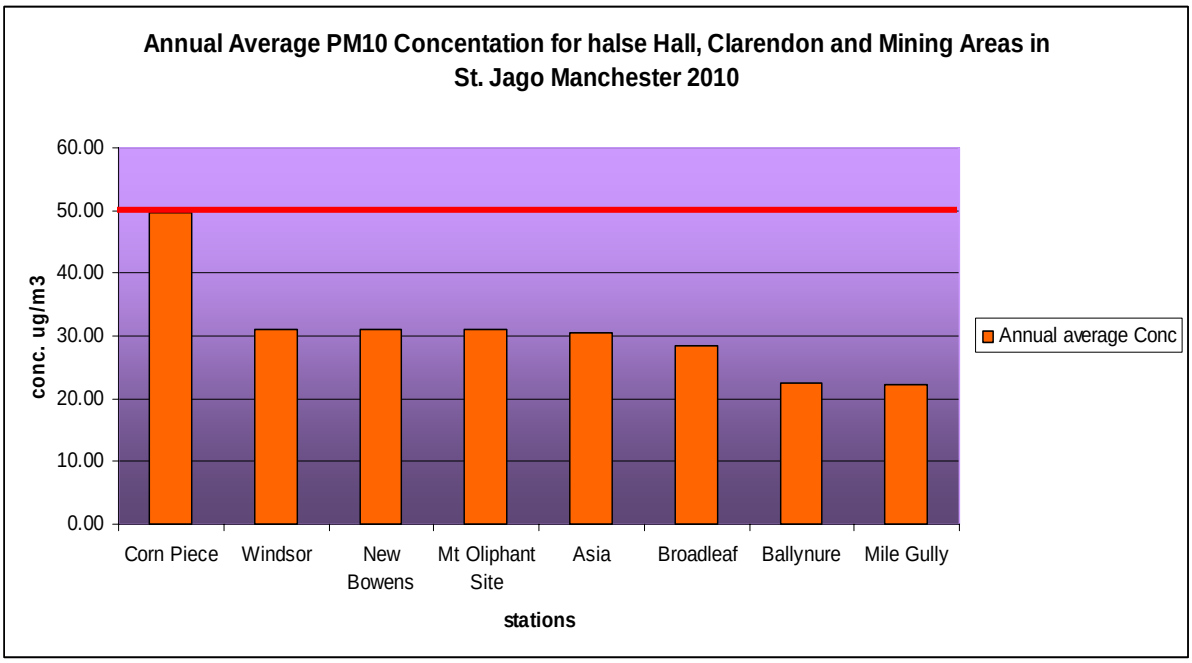
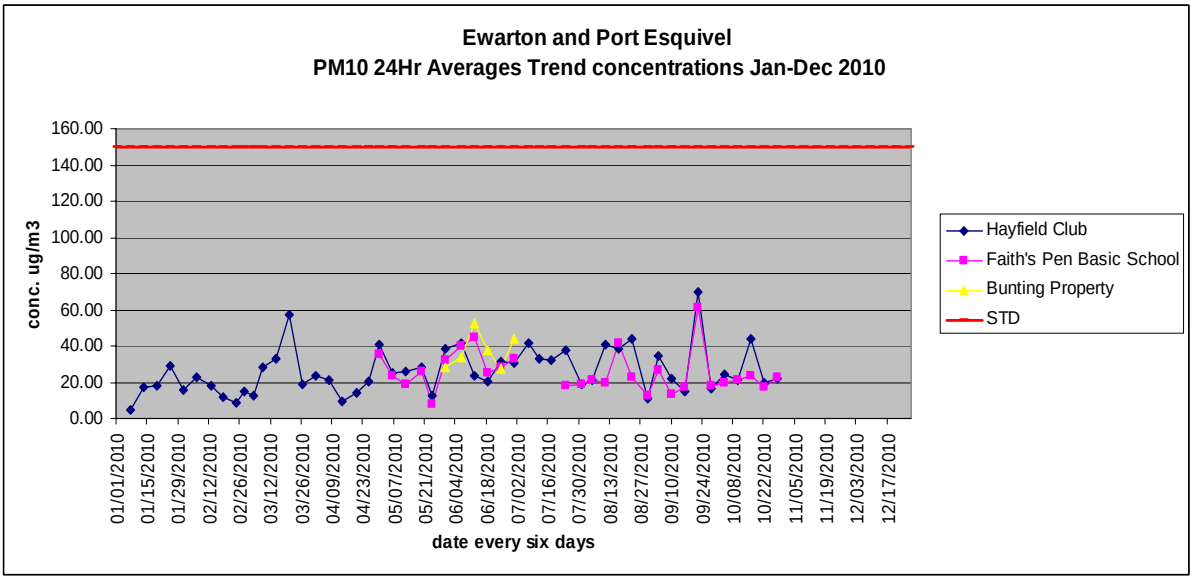


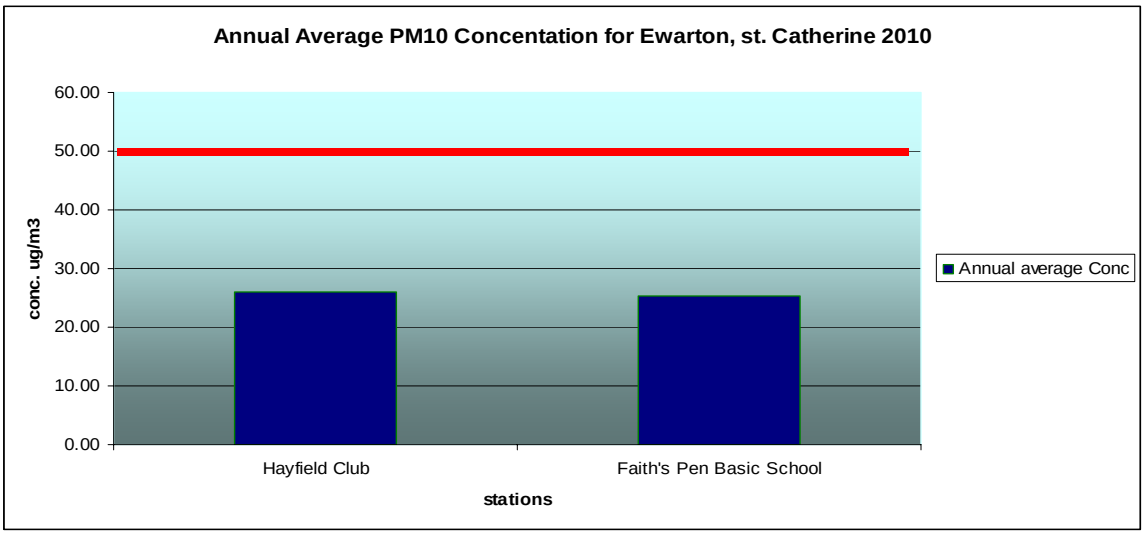
Figure 19: Graph showing trend in ambient air quality for PM10 at the two stations in Ewarton, St. Catherine and the station located at Port Esquivel from Jan-Dec 2010



All stations operated in the two areas did not exceed the 24 hour averaging ambient standard in 2010. The two stations located at Hayfield and Faiths' Pen were impacted by the major activities of the Alumina refinery and Bauxite mining. The station located at Bunting property could not be effectively assessed because only 5 readings were available from the

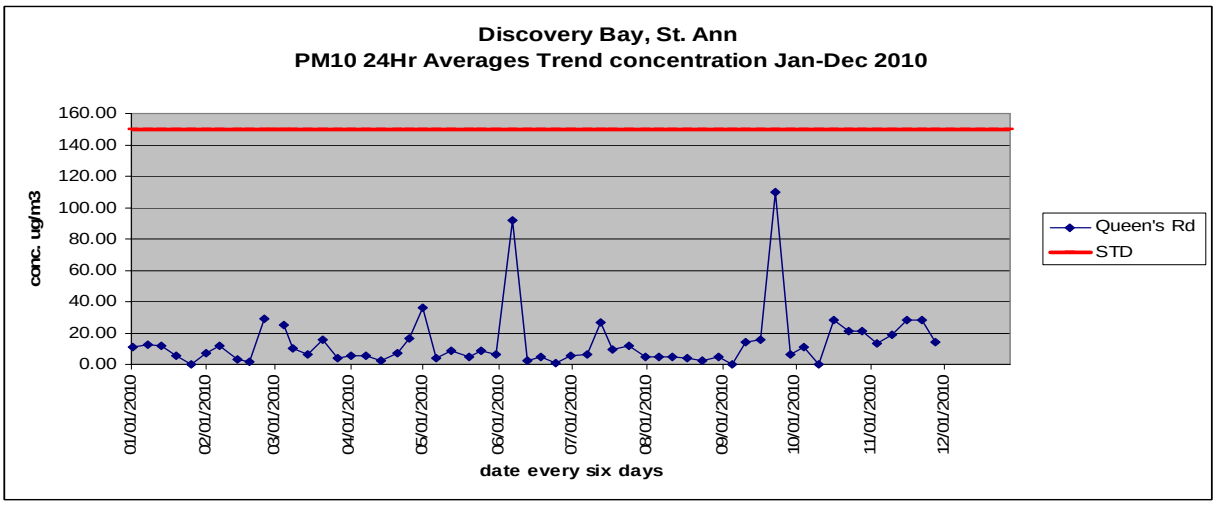
station during 2010 because of logistical problems. The Bunting property station however is set up to assess impacts from the activities at the port in St. Catherine, Port Esquivel.

Figure 20: Graph showing Annual PM10 average concentrations at all monitoring stations in Ewarton, St. Catherine for 2010



No assessment of annual averages at the Bunting property was done because of the limited data set. Annual averages for all the stations in Ewarton were well within the annual standard for 2010.

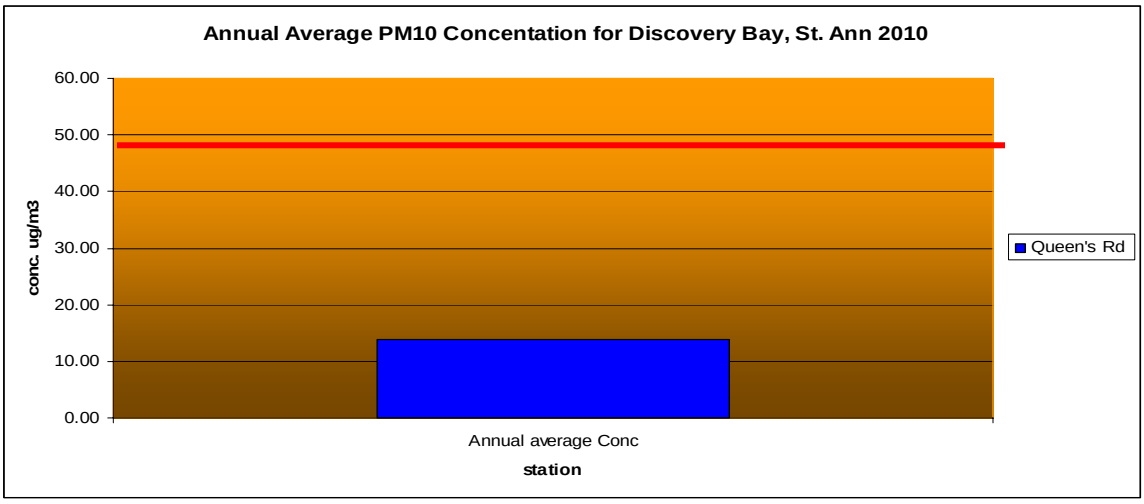
Figure 21: Graph showing trend in ambient air quality for PM10 at the station in Ewarton Discovery Bay St. Ann from Jan-Dec 2010



The station located at Queens Road is impacted by the major bauxite refinery in the area. It is also located close to the North Coast Highway and could also be affected by the release of particulates from the road surface. The old road which has lost most of its surface is also beside the station. Residents who access their homes from this road could also create an

impact on the station by driving on this roadway. The station recorded no breaches of the 24 hour standard during 2010. The two peaks on the graph did not correspond exactly with the peaks on the TSP graph for that area. They occurred in the same week however and may be as result of the plant activities.

Figure 22: Graph showing Annual PM10 average concentrations at all monitoring stations in Discovery bay, St. Ann for 2010



Sulphur Dioxide

Hourly trends for daily concentration of Sulphur Dioxide (SO_2) across the country from all ten monitoring stations operated during 2010 did not record an exceedance of the 700ug/m3 national standard.

Figure 23: Graph showing trend in ambient air quality for Sulphur Dioxide at the stations in Kingston and Montego Bay from Jan-Dec 2010

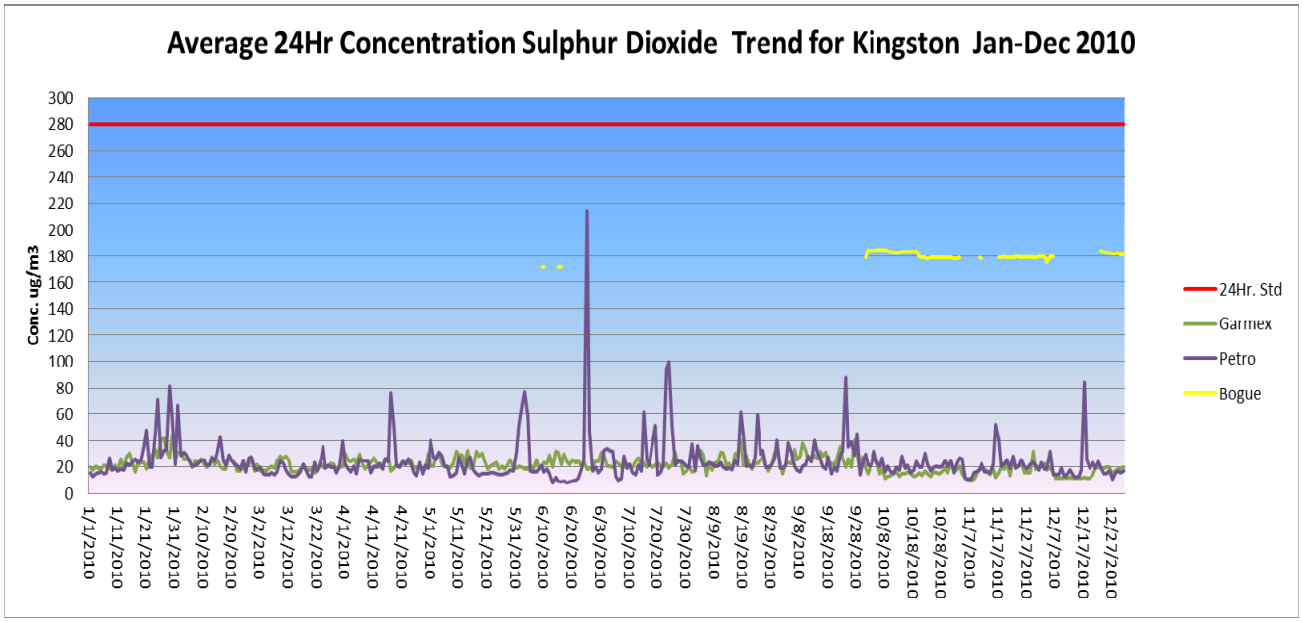
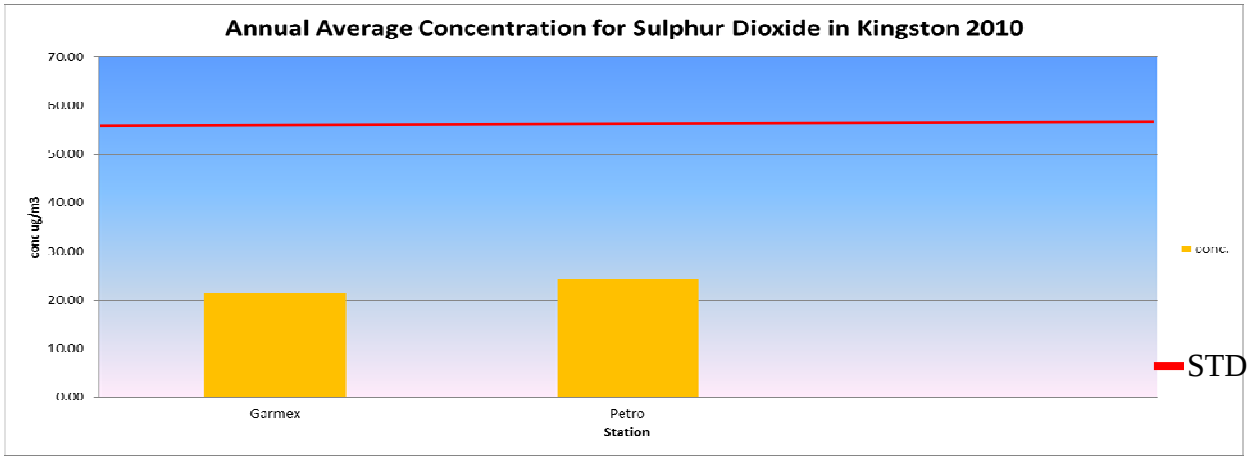


Figure 24: Graph showing Annual Sulphur Dioxide average concentrations at all monitoring stations in Kingston for 2010



During 2010 there were only two stations that operated in the Kingston. Both stations are impacted by the industrial activities along the Marcus Garvey Drive area. There is minimal impact from traffic because of the siting of the monitors. No breach in the average 24 hour concentration was recorded in 2010 at the two stations. The annual average was well below the standard of 60 ug/m^3.

Analysis for the station located at Bogue, St. James was not possible during 2010 because of logistic difficulties at the station. This station is impacted mainly by the Power Station located in the area.

Although SO_2 levels monitored during 2010 were below the standards set by the NRCA, the Agency will aim to reduce Sulphur emissions from industry and fuel use. The limit placed on industry of 2.2% Sulphur in Heavy Fuel Oil for new facilities and 3% Sulphur in Heavy Fuel Oil for existing facilities is one of the reasons for this low level. The NRCA has also limited the Sulphur content in diesel oil to 0.5%. The eminent upgrade in the country's oil refinery which should result in the production of Ultra Low Diesel Fuel (ULDF) will further reduce the levels of Sulphur in the ambient environment. A shift in the main energy source to Liquid Natural Gas (LNG) is now in the early stages and if fully implemented will continue to reduce the levels of Sulphur emissions released by industry.

Figure 25: Graph showing trend in ambient air quality for Sulphur Dioxide at the stations in Ewarton, St. Catherine from Jan-Dec 2010

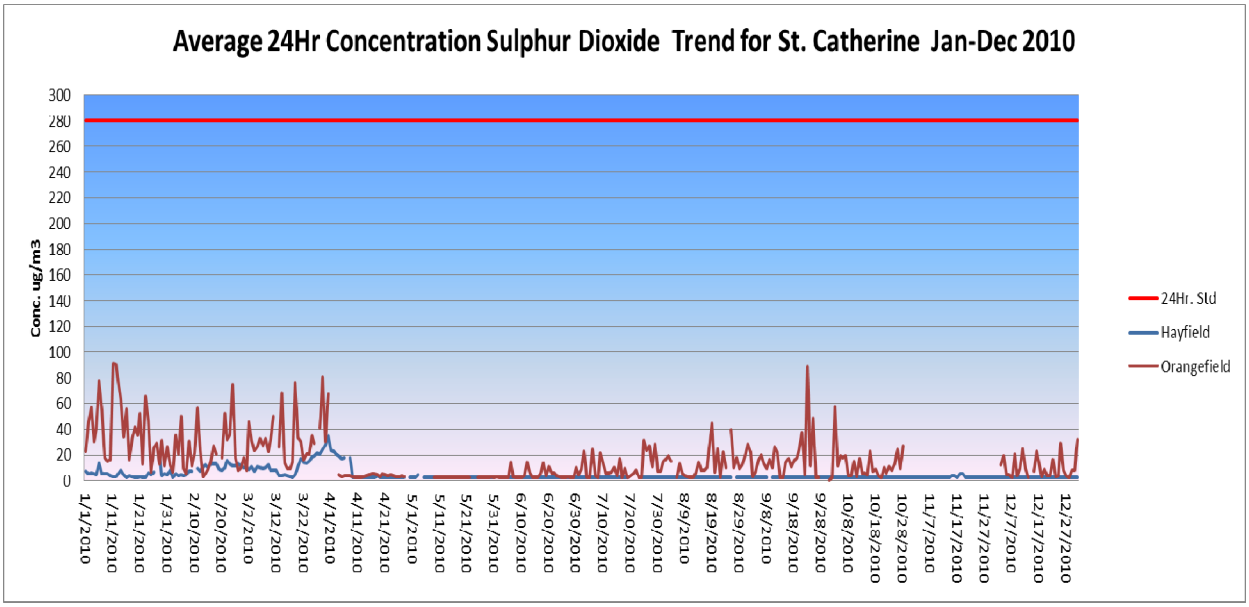
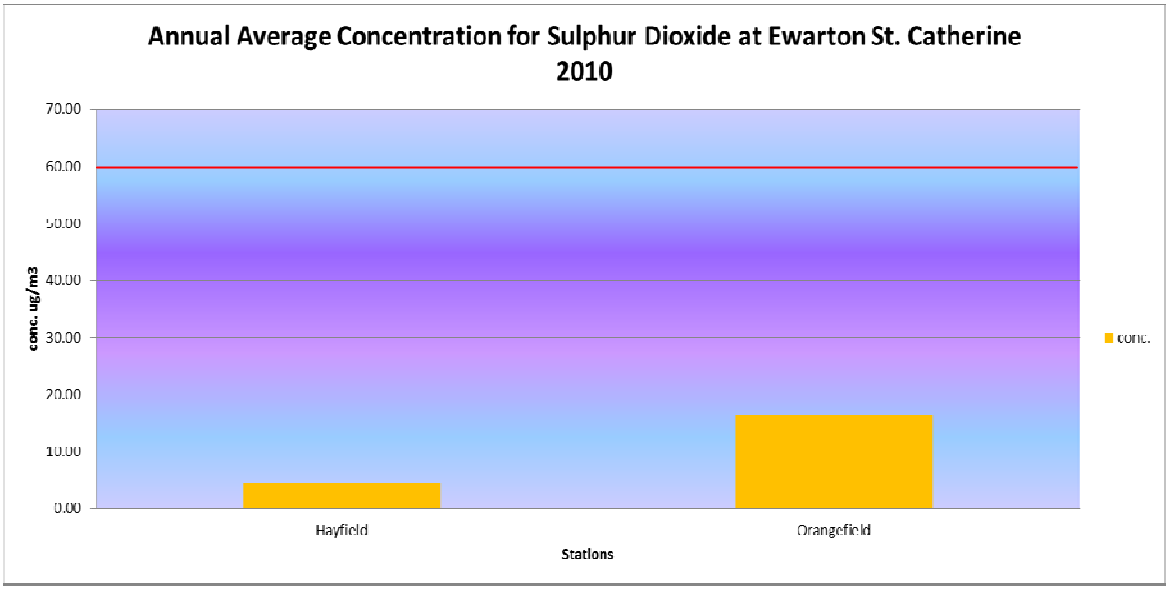


Figure 26: Graph showing Annual Sulphur Dioxide average concentrations at all monitoring stations in St. Catherine for 2010



The stations located in St. Catherine are impacted by the major bauxite industry in Ewarton. Levels recorded in 2010 show that there was no breach of the hourly, 24 hour and annual standards. The major polluter in this area was not in operation for the first six months of the year and could be reason for the low levels of sulphur dioxide during 2010. Monitoring will continue during 2011 to make an analysis in the area. The NRCA has also imposed the 3% sulphur content limit in the fuel used at the facility to further ensure that levels remain low.

Figure 27: Graph showing trend in ambient air quality for Sulphur Dioxide at the stations in Clarendon and Kirkvine Manchester from Jan-Dec 2010

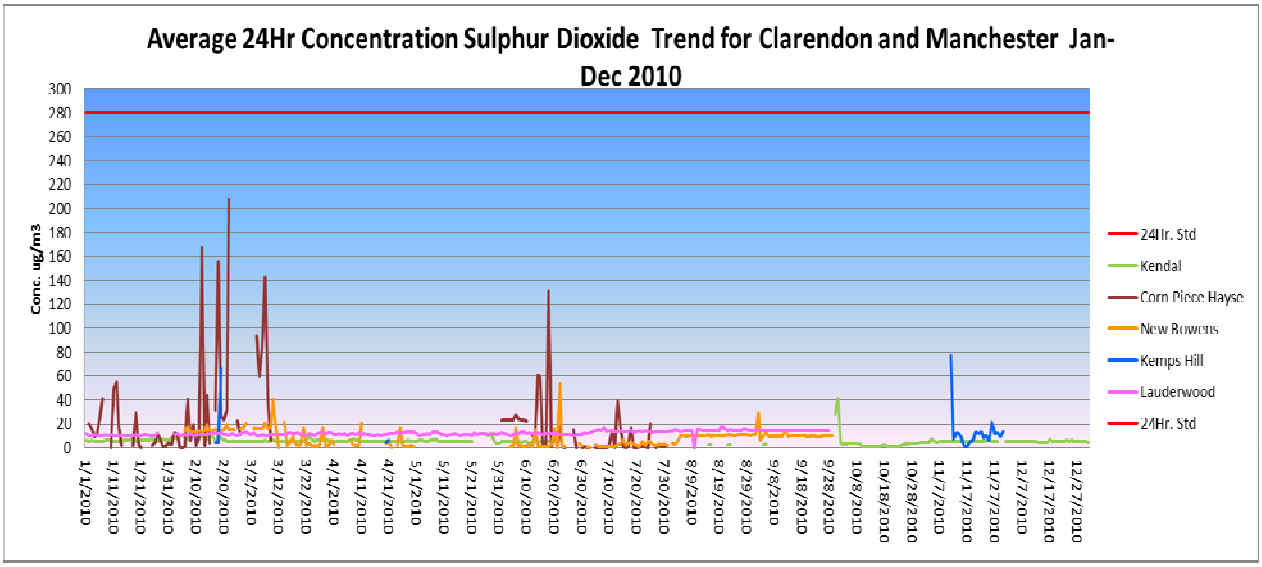
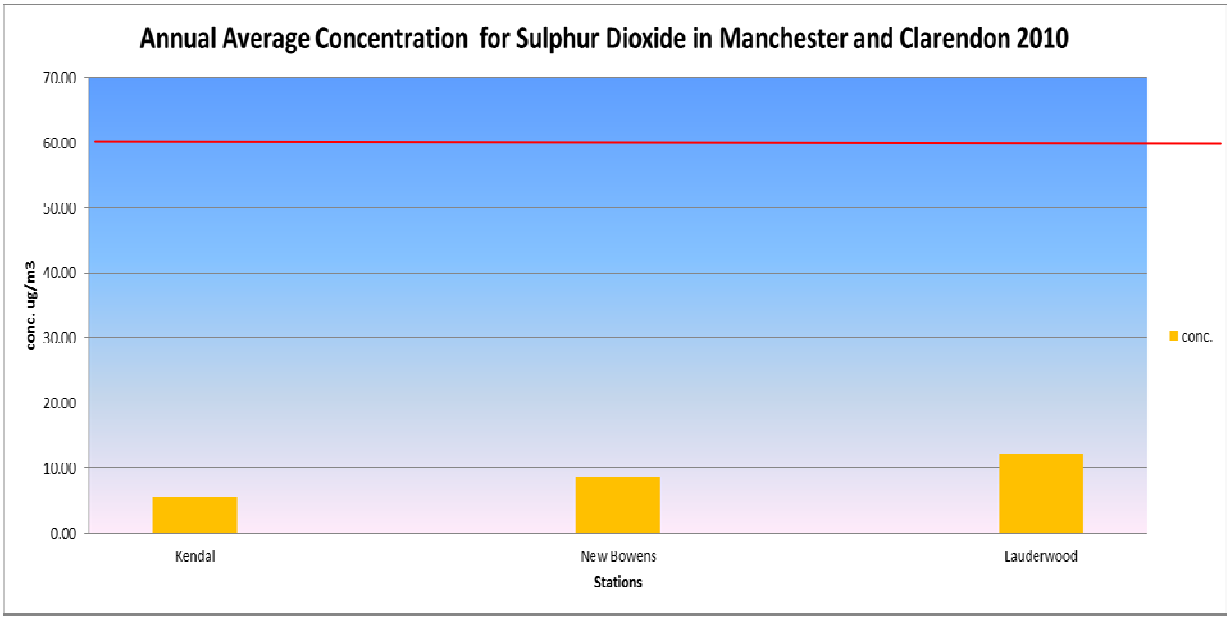


Figure 28: Graph showing Annual Sulphur Dioxide average concentrations at all monitoring stations in Clarendon and Manchester for 2010



Stations located in Clarendon are impacted by the Alumina Refinery, the Sugar estates and the power producing plants in the Old Harbour Bay. The station located in Manchester is only impacted by the alumina refinery in the area. However the refinery was not in operation during 2010 so all measurements recorded were due to other sources such as vehicular traffic.

The stations located in Clarendon recorded no breaches during 2010 for all averaging periods. All the major facilities impacting these stations have been limited to the sulphur content of their fuel used to carry out production. Figure 29 only shows annual averages for three of the five stations. Two of the stations had operating difficulties during 2010 and did not achieve the 75% threshold of data recovery to make an annual analysis. Improvement in data recovery for these stations will provide a more detailed analysis in 2011.

Nitrogen Dioxide

Figure 29: Graph showing trend in ambient air quality for Nitrogen Dioxide at the stations in Kingston and Montego Bay from Jan-Dec 2010

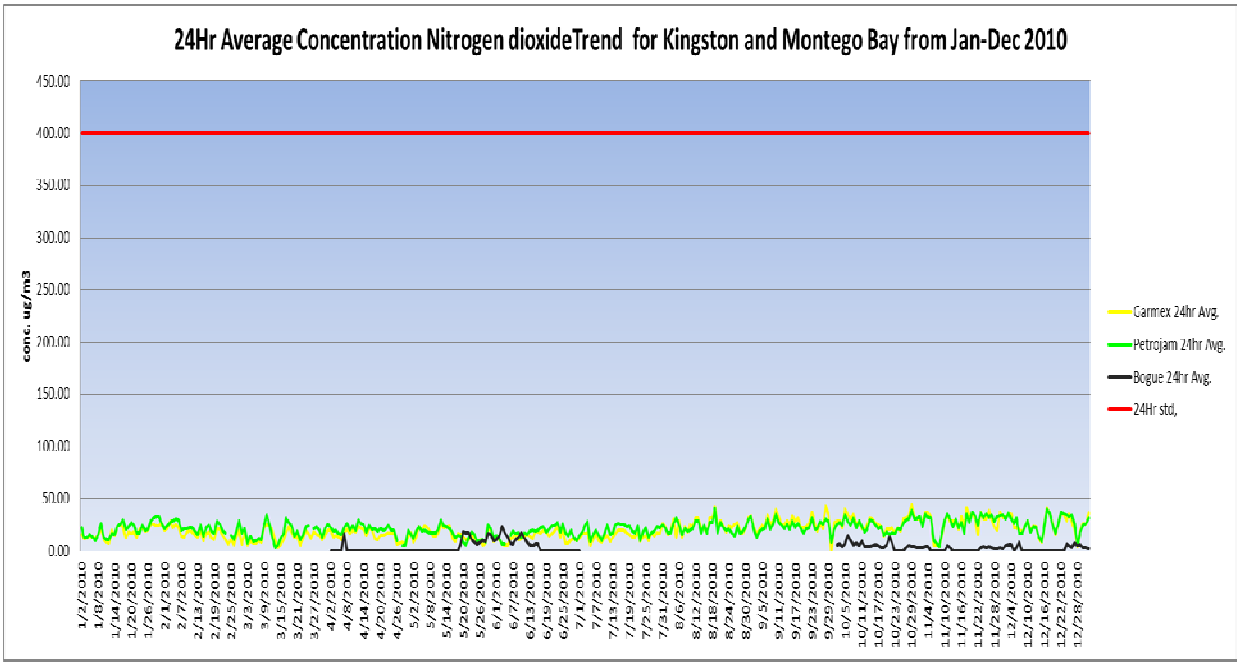
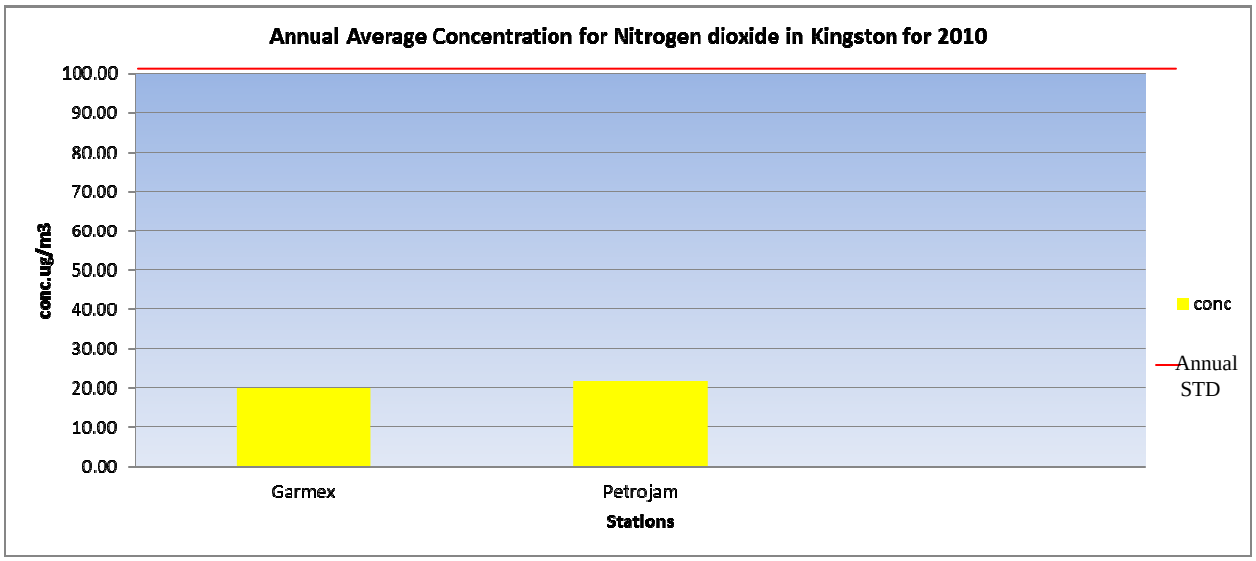
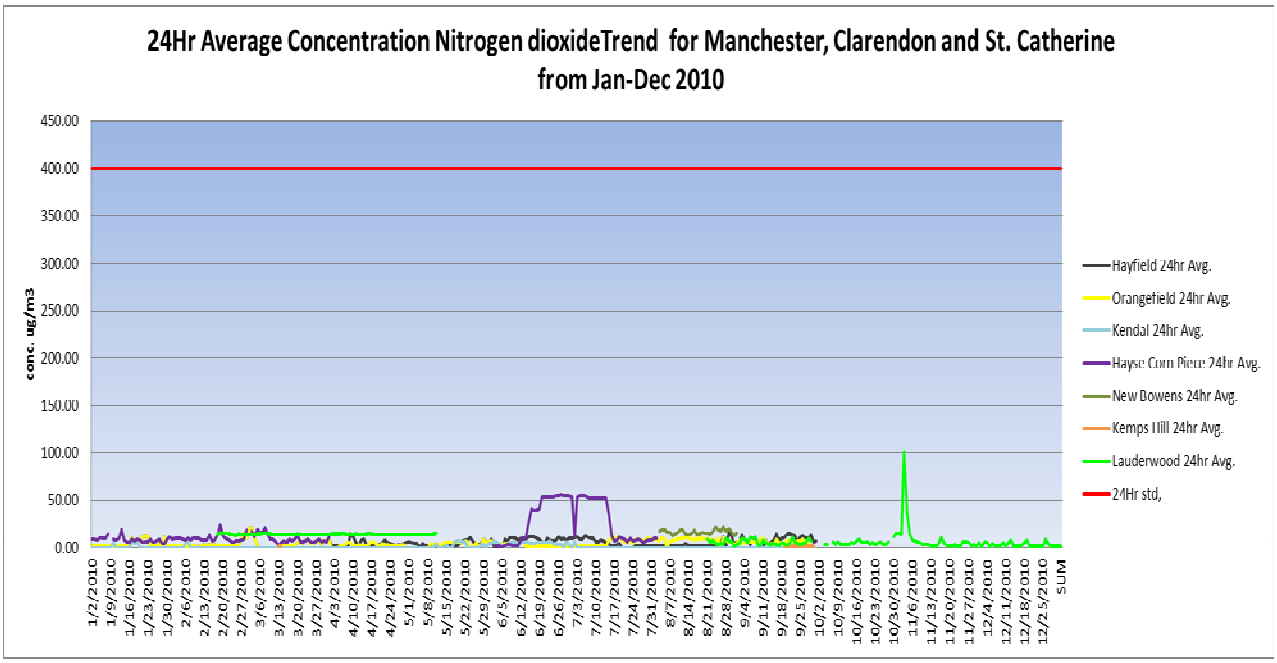


Figure 30: Graph showing Annual Nitrogen Dioxide average concentrations at all monitoring stations in Kingston for 2010



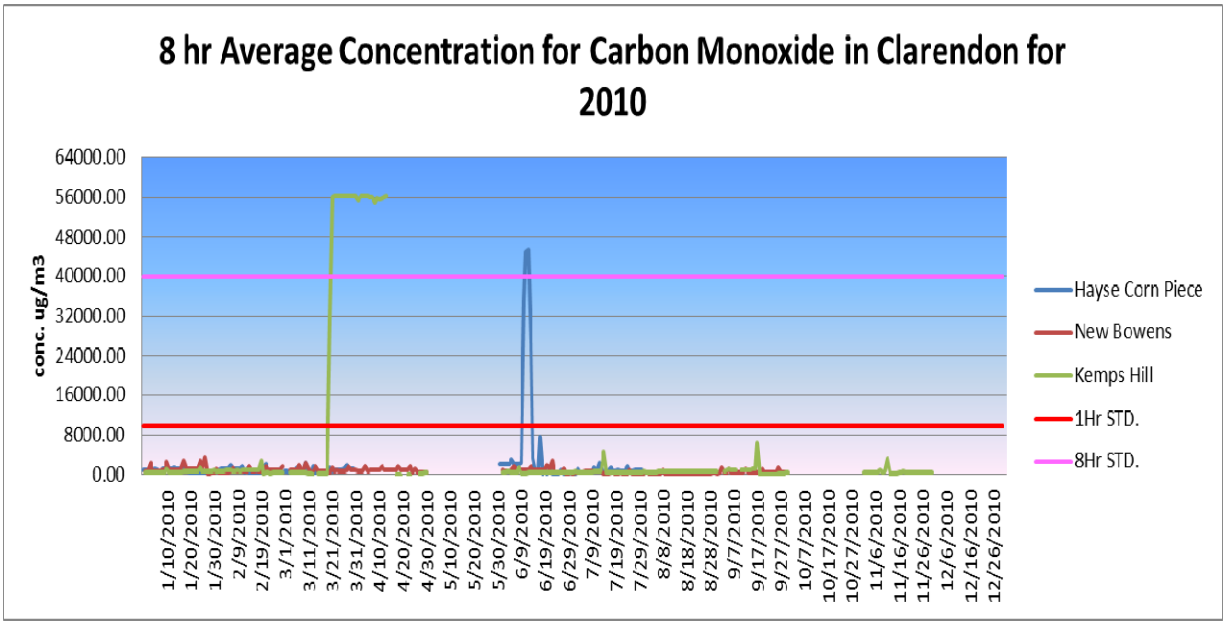
Ambient average 24 hour concentration for Nitrogen Dioxide did not exceed the standard at the stations monitored in Kingston and Montego Bay. The stations in Kingston are impacted significantly by the industries along Marcus Garvey Drive. Nitrogen Dioxide is produced from the combustion of fuel. Traffic is a significant contributor of Nitrogen Dioxide. The stations that monitored NO_2 in 2010 were not directly impacted by traffic however hourly trends in data could identify some relation with traffic peak hours and spikes in the readings. The data as well as Nitrogen Dioxide emissions from vehicular traffic will be investigated further in 2011. Figure 31 only shows annual concentrations for the stations in Kingston. The Bogue station in Montego Bay could not be analyzed because of the less than 75% data recovery from that station. The station faced equipment failure in 2010 which was corrected towards the end of the year.

Figure 31: Graph showing trend in ambient air quality for Nitrogen Dioxide at the stations in Manchester, Clarendon and St. Catherine from Jan-Dec 2010



All the stations in this section and shown in Figure 32 are impacted by the same sources mentioned in previous sections of this report. None of the stations recorded any exceedances in the ambient standard for 24 hour averages in 2010. None of the stations achieved the 75% threshold to make an analysis of the annual average concentration impacting the areas. The stations faced both logistics and electrical difficulties during 2010 and have been repaired.

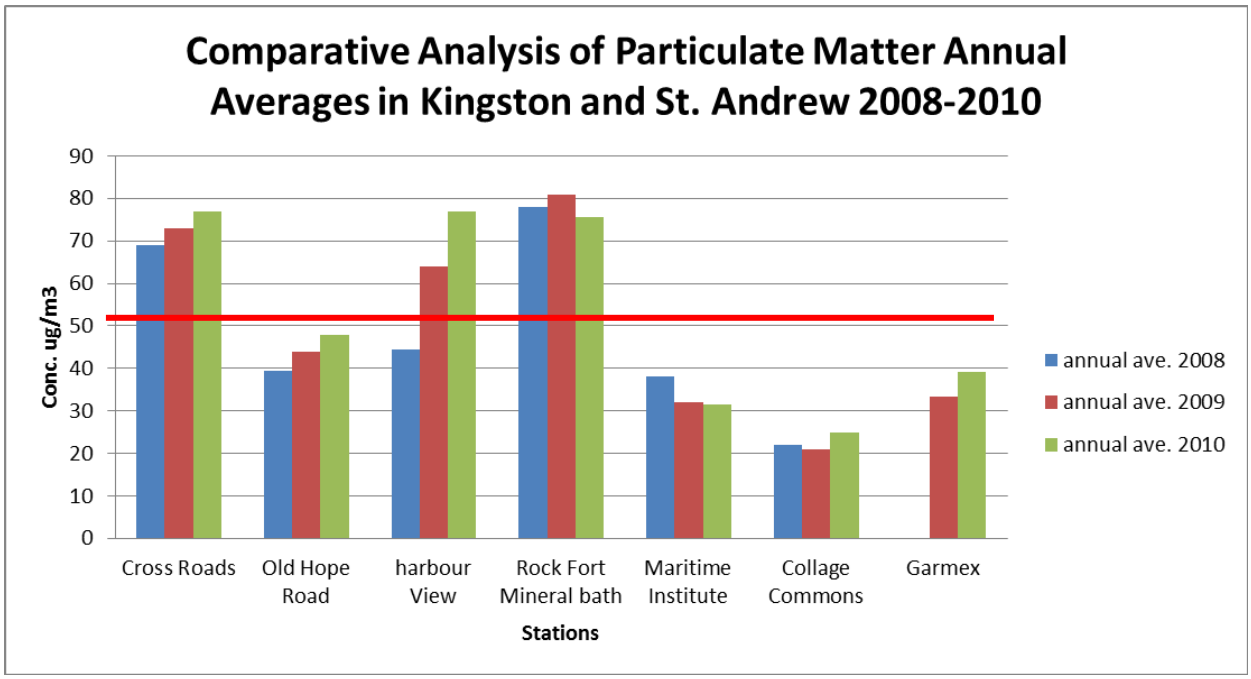
Figure 32: 8 Hour Average concentrations for Carbon Dioxide in Clarendon for 2010



The stations located in Clarendon are all impacted by the sources mentioned previously in this document. The Kemps Hill and Hayes Corn Piece station showed exceedances in the 8 and 1 hour average concentrations in 2010. Data from these stations still did not make the 75% recovery threshold. Apart from the bauxite industry in the region the station located at Kemps Hill may also be impacted by the burning of cane fields which could be responsible for the continued exceedance in March of 2010. An analysis and more consistent data gathering needs to be undertaken in 2011 to determine what strategy needs to be put in place in this area.

4.0 Analytical Trends in Concentrations

Figure 33: Shows concentrations for PM10/TSP at stations across Kingston and St. Andrew from 2008-2010



The analysis shows a continued rise in Particulate matter at seven of the eight locations monitored in the Kingston and St. Andrew area. The major polluters represented by the seven major and significant air emission discharges in the corporate area have not increased their production rate during this period. Some of the facilities have actually reduced their activities because of the global economic recession.

Three of the eight stations have breached the annual average for the last two to three years and is of great concern to the Agency. Exposure limits for annual levels at these sites have exceeded the 50ug/m^3 limit for PM_{10} and the 60 ug/m^3 limit for TSP. In 2011 the Agency will be looking at the various sources that impact these sites to put in place effective measures to reduce the ambient levels

The amount of traffic, construction and mining which create fugitive particulate emissions have increased over the past three years based on data from the Ministry of Transport and Works and Ministry of Energy and Mining.

The increase in these fugitive sources may be the cause of these increases. The Agency has developed a Strategy to target these fugitive sources and is incorporated in the Jamaica Air Quality Management Programme (JAQMP) launched in 2009. This strategy along with many others aimed at the seven facilities in Kingston and St. Andrew and across the island should reduce the ambient levels in 2011.

Figure 34: Shows concentrations for Sulphur Dioxide at stations across Kingston and St. Andrew from 2009-2010

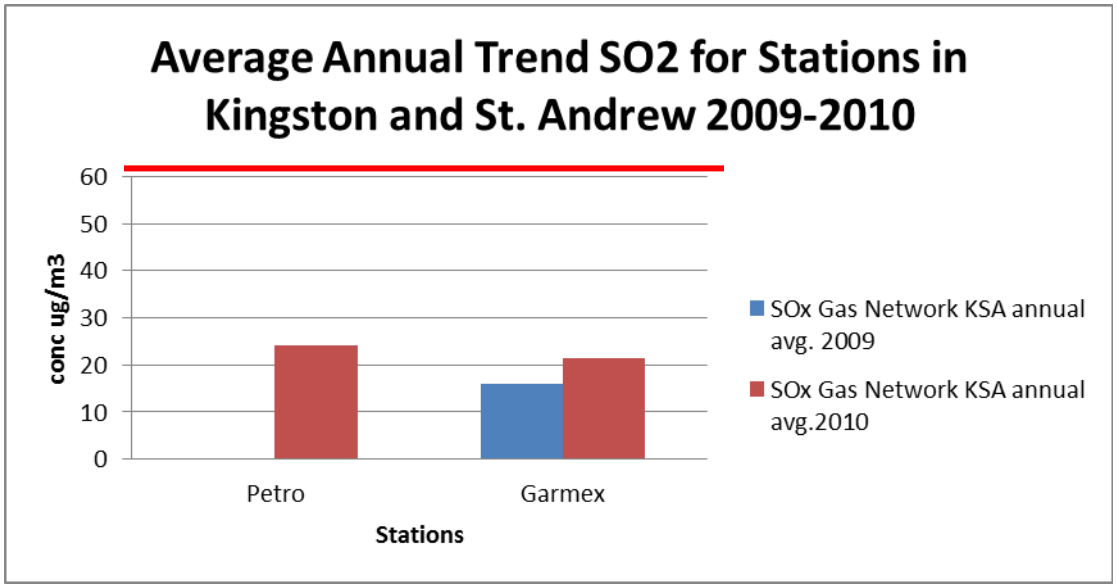
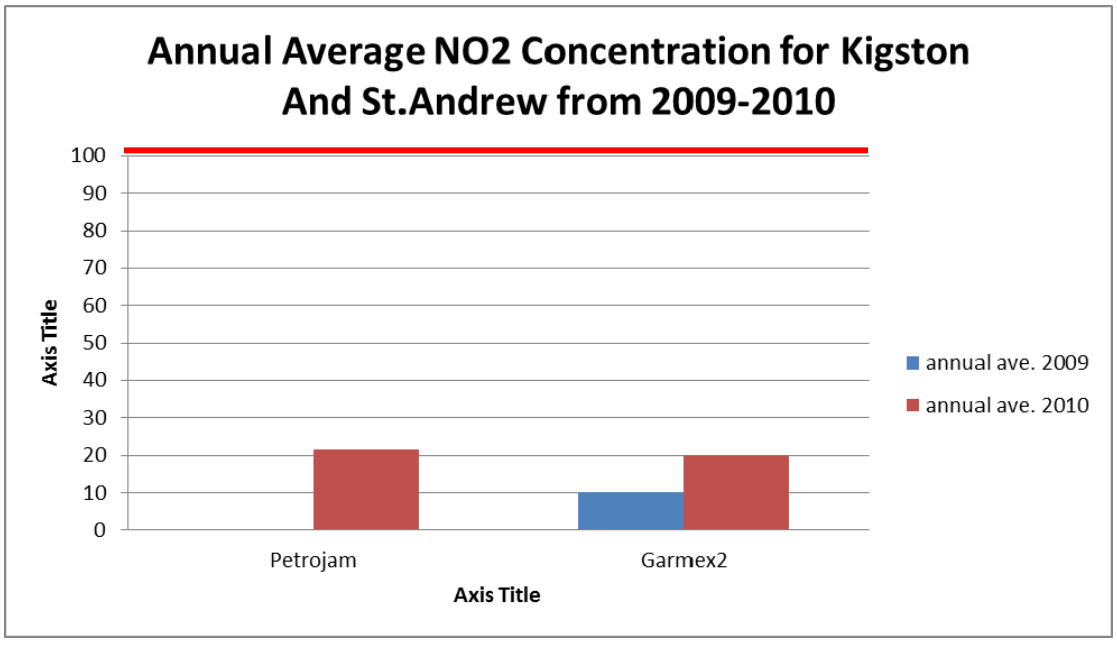


Figure 35: Shows concentrations for Nitrogen Dioxide at stations across Kingston and St. Andrew from 2009-2010



No data for Gases was available in 2008 and only one station had quality data in 2009 to make an analysis. The early trend in Figures 35 and 36 shows an increase of almost 5 ug/m^3 for Sulphur Dioxide and 10 ug/m^3 for Nitrogen. Further analysis is needed before the trend can be accepted, however all measures will be put in place to keep the levels well below the annual standard of 100ug/m^3 in 2011 and record a decrease in levels.

Figure 36: Shows concentrations for PM10 at stations outside of Kingston and St. Andrew from 2009-2010

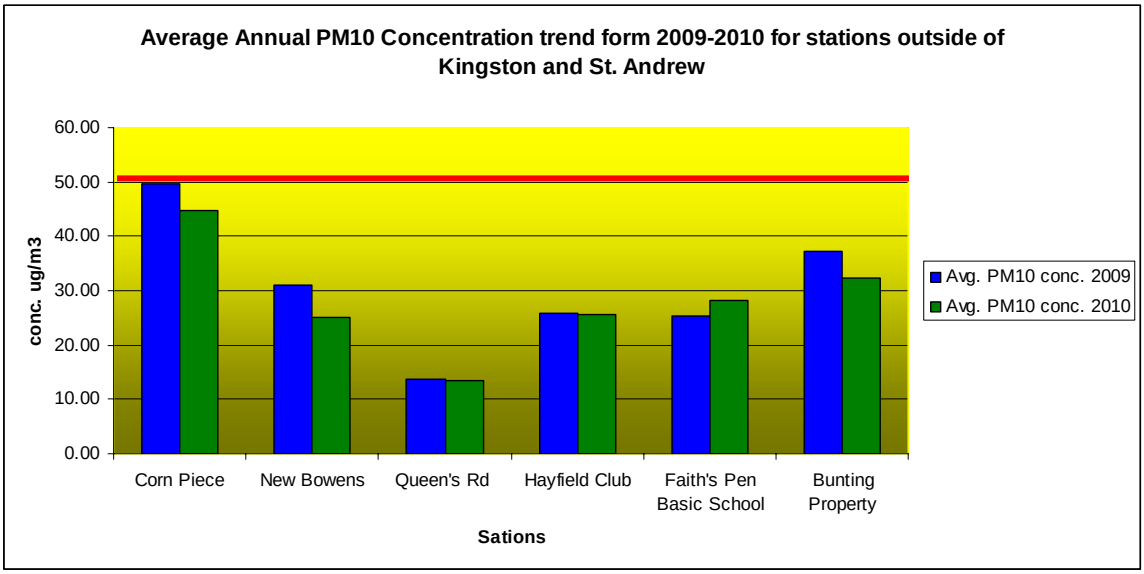
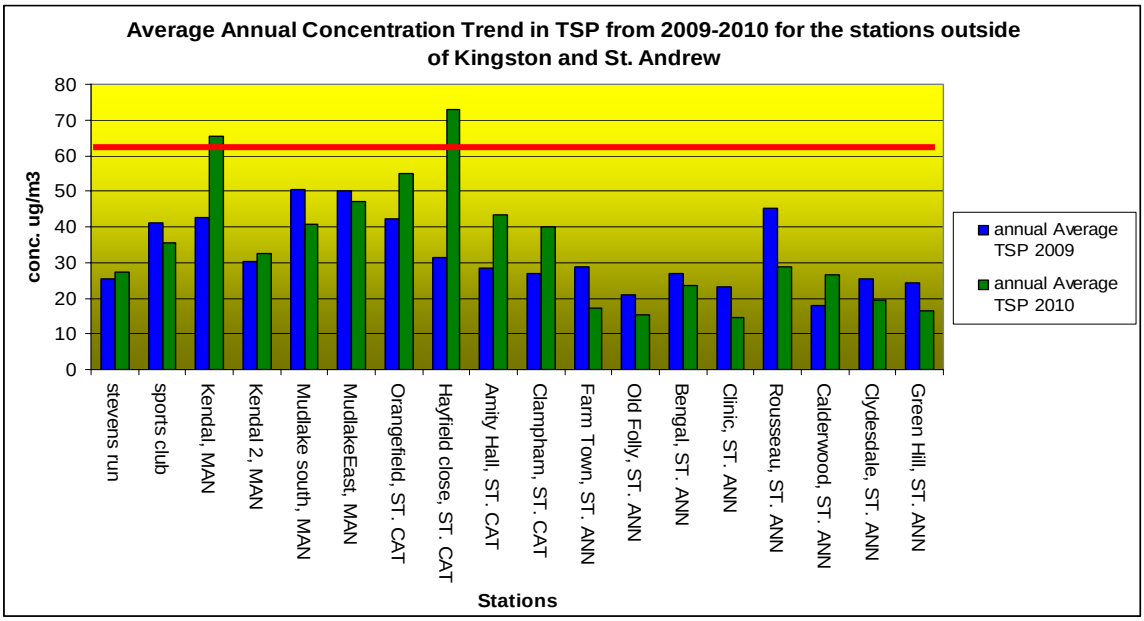


Figure 37: Shows concentrations for TSP at stations outside of Kingston and St. Andrew from 2009-2010



Ambient TSP and PM10 concentrations outside of Kingston and St. Andrew are mainly impacted by the major Alumina industries across the island. It can be seen that in St. Ann the major bauxite plant has actually shown improvement in its ambient levels for all its sites except one. All the other sites affected by residue disposal areas (mud lakes) fugitive dusting, continue to show increases in the ambient levels. Stations located in St. Catherine have also been impacted by the restart of the large Alumina refinery and its mining activities in 2010. The refinery was out of operation for the larger portion of 2009. Marked increase at the

Hayfield Close station is because of bauxite mining activities in that area. The situation at Kendal is explained in previous sections before in this report and will be further investigated to find the cause of this increase and average above the standards.

Figure 38: Shows concentrations for Sulphur Dioxide at stations outside of Kingston and St. Andrew from 2009-2010

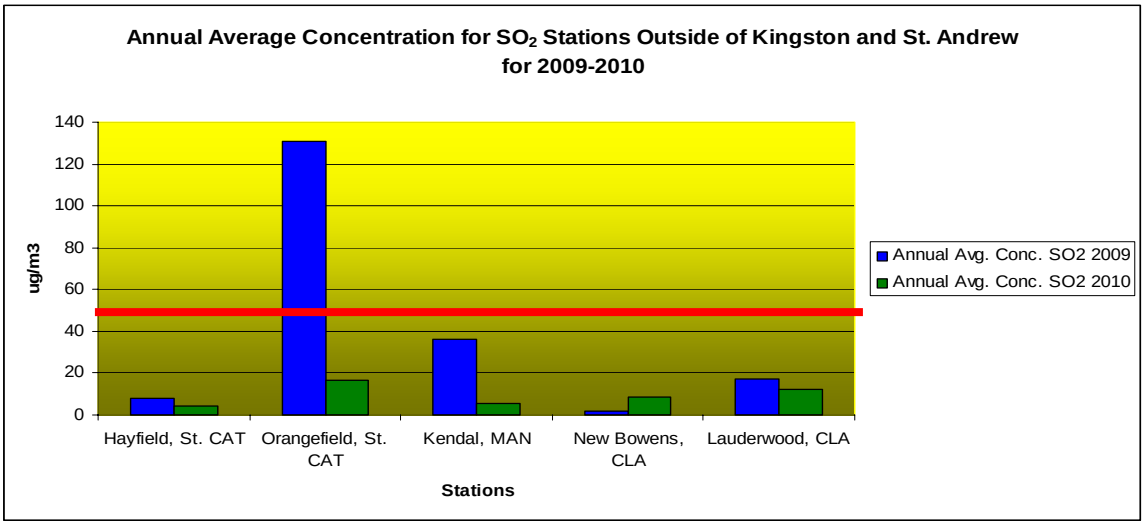
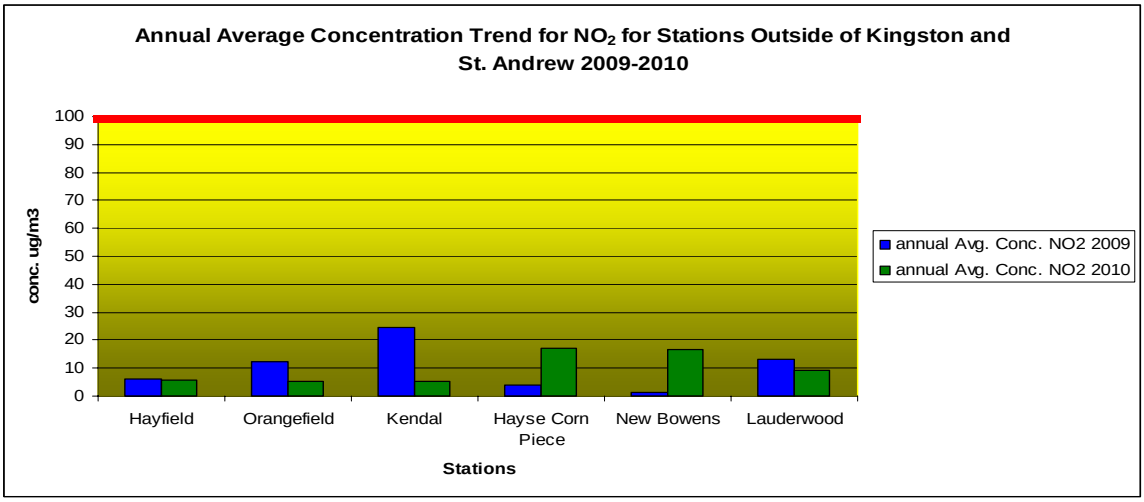


Figure 39: Shows concentrations for Nitrogen Dioxide at stations outside of Kingston and St. Andrew from 2009-2010



Concentration trends in Sulphur Dioxide across the country have shown decreases from 2009 to 2010 mainly because of the shut down of the bauxite industry that affects the areas that the stations are located. The only station that recorded an increase was the one located near the facility that was still in operation in 2010.

Nitrogen Dioxide levels also trend downwards for the stations that have historical data. The two stations that trended upwards are located beside the only Alumina refinery that was in full operation during 2010.

Conclusion

Ambient concentration levels of particulate matter in the Kingston and St. Andrew area are trending upwards and at some of the sites they are well above the ambient limit for human exposure. This is of major concern to the Agency and strategies to reduce levels and reduce impact are being undertaken. The source of the impact seems to have shifted from the major industries in the Kingston and St. Andrew (KSA) region and this needs further investigation in order to find the root cause of this increasing trend.

Particulate matter levels outside of the KSA region are driven by the bauxite sector and the down turn has impacted the levels both negatively and positively. Positively in that fugitive dust from mining, stack emissions and refinery operations have reduced leading to a reduction in ambient levels. However the vast open red mud disposal (mud lakes) areas have dried up and become in most cases dust-bowls. These areas become increasingly difficult to manage leading to the high levels reported during 2010. These areas can only be managed by continued wetting during the dry season. The restart of the sector in 2011 along with more stringent management practices by these facilities should result in improved ambient levels in these areas.

In general the ambient air in the KSA region with respect to particulate matter is fair to poor. The ambient air improves however the further inland from the Harbour, where most of the industries are located. There are also impacts from the major traffic roadways and this impact compromises the ambient air for some of the areas further inland.

The other parishes in the island have relatively good ambient air quality with respect to particulate matter. The conditions improve as the radius around the bauxite refinery and mining areas increases. However, the network in the rest of the country needs to be improved to incorporate impacts from sugar cane harvesting and refining, other industrial activities and traffic.

The entire island has recorded on average good ambient air quality for Sulphur Dioxide and Nitrogen Dioxide. Carbon Monoxide levels must be further investigated to make a conclusion. The increasing trend for both Nitrogen Dioxide and Sulphur Dioxide in the Kingston and St. Andrew region especially must be addressed before it reaches any further. The strategies and limits set for fuel and the industry should aid in this effort.

Detailed modeling of the KSA area is to be undertaken in 2011 and the results will provide guidelines to inform policy and improve the ambient air of the area. This model will be transferred to the rest of the island to aid in the effort to improve and maintain the country's ambient air quality in 2011 and beyond.

Appendix A

Location of Ambient Monitors in Monitoring Networks Across the Country

Figure 40: Map of monitoring Network in Kingston and St. Andrew

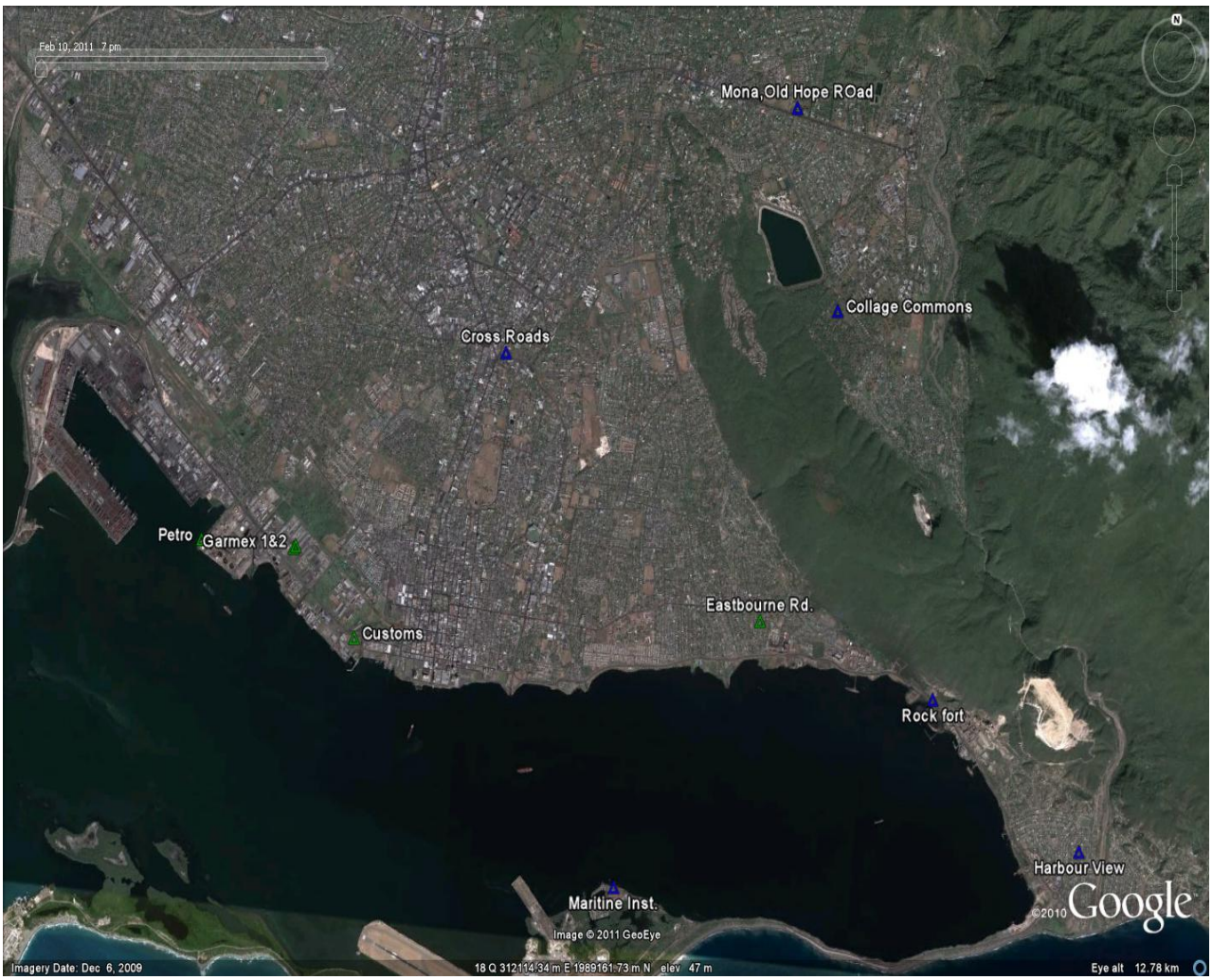


Figure 41: Map of monitoring Network in Ewarton, St. Catherine

Figure 42: Map of monitoring Network in Kirkvine, Manchester

Figure 43: Map of monitoring Network in South , St. Elizabeth

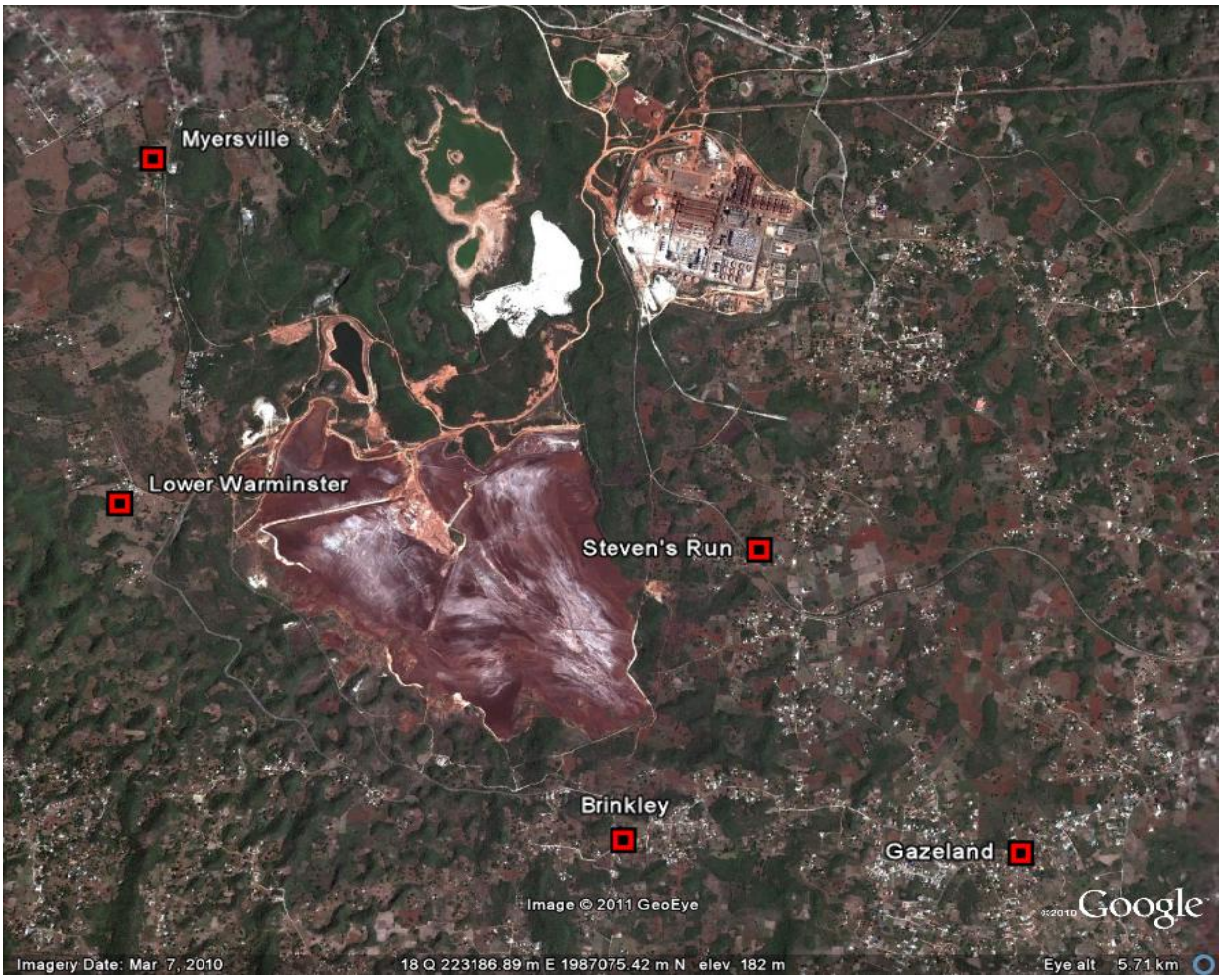


Figure 44: Map of monitoring Network in Discovery Bay, St. Ann

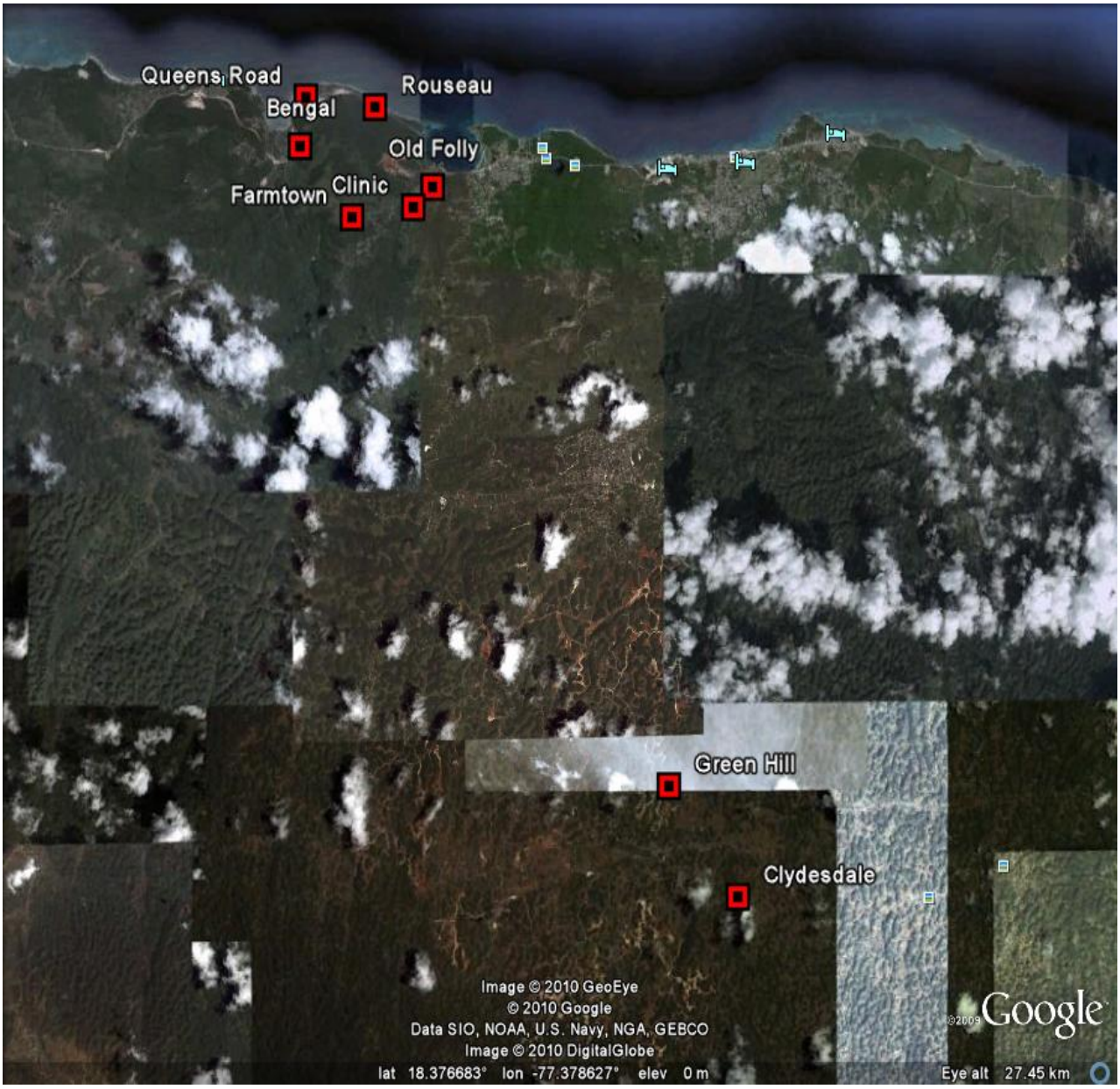


Figure 45: Map of monitoring Network in, South St. Catherine and Clarendon

Figure 46: Map of monitoring Network in Bogue, St. James