Contractor

Forth Crossing Bridge Constructors

HOCHTIEF Solutions
American Bridge International
DRAGADOS
Morrison Construction

Project

FORTH REPLACEMENT CROSSING

Document title

AIR QUALITY MONITORING REPORT

JULY 2013

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Contents

1. INTRODUCTION

1.1. Air quality monitoring is being undertaken by FCBC during the construction of the Forth Replacement Crossing and the associated road network. This report details the air quality monitoring that is currently being undertaken across the site and presents the monitoring results for July 2013.

1.2. Air quality monitoring during this period has been undertaken in accordance with the Code of Construction Practice (CoCP) and the Dust and Air Pollution Management Plan (DAPMP) contained within the Environmental Management Plan (EMP).

2. MONITORING EQUIPMENT AND LOCATIONS

2.1. Air quality is being monitored on site using both automatic light scatter dust meters and Frisbee gauge dust deposition monitoring. Thirteen Frisbee gauges are set up at sensitive locations across the site to measure dust deposition rates (Figure 1). Seven automatic light scatter meters have also been installed at various sensitive locations to measure real time particulate matter (PM_{10}) concentrations and the Total Suspended Particle (TSP) concentrations (Figure 2). Table 1 lists the air quality monitoring equipment present at each monitoring location. The installation of the air quality monitoring equipment was not simultaneous across the site, thus installation dates are also given in Table 1.

2.2. Light scatter type monitoring equipment have been selected as a site monitoring tool to create a live network which assesses the levels of fugitive particulate matter, principally airborne dust. These monitors require less space, maintenance and power than other real time monitors such as a Tapered Element Oscillating Microbalance (TEOM) which is used and designed to measure particulate levels to exceedingly high standards, including measuring long-term compliance to statutory limits. Light scatter meters are more practicable to deploy. However, the meters do generally record levels higher than those measured by the TEOM. The meters can also be affected by atmospheric moisture content which further increases reported levels. Accordingly, any elevations of statutory limits should be treated as precautionary exceedances. The monitors are reliable for on-site monitoring and the establishment of action thresholds to ensure unforeseen activities generating significant dust are identified and suitably controlled. Light scatter meters are becoming the construction and waste industries norm for particulate dust monitoring.

2.3. In association with air quality monitoring across the site, weather conditions (temperature and relative humidity) are also continually measured by the light scatter meters at Inchgarvie Lodge and Clufflat Brae. Weather stations, located at the sound level meters at Echline and Linn Mill which are adjacent

to the light scatter meters at these monitoring locations, also continually record weather data, including temperature, relative humidity, wind speed and wind direction.

2.4. In addition to the fixed monitoring equipment used at sensitive locations across the site, a daily dust log for both the North and South sites has been kept by the FCBC Environmental Department. This daily dust inspection is used to identify any dust occurring as a result of construction works and any actions required. This log also records the weather conditions at the time of the inspection.

2.5. Frequent environmental site inspections are also undertaken by members of the FCBC Environmental Department. These inspections include a dust check to assess the following:

- dust levels on site;
- suppression/dampening down; and
- transportation of materials.

In relation to these inspections, the FCBC Environmental Department hold an environmental actions register where any environmental issues, including those relating to air quality, can be noted and closed out appropriately.

Figure 1: Example of an Installed Frisbee Gauge Meter

Figure 2: Example of an installed Automatic Light Scatter Dust Meter

Table 1: Air Quality Monitoring Locations

Ref:	Monitoring Location	Monitoring Equipment	Installation Date	Construction Activities in July
M1	Whinny Hill	Frisbee	21/03/12	Band drains at King Malcolm Drive Breaking rock at Castlandhill Road and haulage to Ferrytoll
		Automatic light scatter meter	16/02/12	
M7	Butlaw Fisheries	Frisbee	05/10/11	Pier S6 –backfilling Marine works Society Road embankment works
M8	Barracks West	Frisbee	31/08/11	Pier S6 –backfilling Marine works Society Road embankment works S7/S8 area – scaffolding for pier rebar prefabrication Marine works Utility works at Pier S5 causeway
M9	Barracks East	Frisbee	31/08/11	Pier S6 –backfilling Marine works Society Road embankment works S7/S8 area – scaffolding for pier rebar prefabrication Marine works Utility works at Pier S5 causeway
M10	Inchgarvie Lodge	Frisbee	22/08/11	Launch – backfilling, blinding concrete for lay down area Abutment – curing of main crossing bearing plinths Scaffolding erection for piers Society road embankment works
		Automatic light scatter meter	17/10/11	

M11	Linn Mill	Frisbee	22/08/11	Launch – backfilling, blinding concrete for lay down area Abutment – curing of main crossing bearing plinths Scaffolding erection for piers Pier trials Society road embankment works
		Automatic light scatter meter	06/12/11	
M12	Clufflat	Frisbee	29/08/11	Launch – backfilling, blinding concrete for lay down area Abutment – curing of main crossing bearing plinths Pier trials
M13	Clufflat Brae	Frisbee	21/09/11	
		Automatic light scatter meter	24/10/11	
M14	Springfield	Frisbee	15/08/11	Launch – backfilling, blinding concrete for lay down area Abutment – curing of main crossing bearing plinths Pier trials Gyratory – structures
M15	Echline	Frisbee	16/08/11	Launch – backfilling, blinding concrete for lay down area Bulk excavation for mainline
		Automatic light scatter meter	10/11/11	
M16	Scotstoun	Frisbee	07/09/11	Bus link embankment works including import of fill
		Automatic light scatter meter	14/02/12	
M17	Dundas Home Farm	Frisbee	29/08/11	Utilities works Embankment works for mainline
		Automatic light scatter meter	23/02/12	
M18	Newton	Frisbee	22/08/11	None
		TEOM	23/05/12	

3. AIR QUALITY MONITORING RESULTS

3.1. Automatic Light Scatter Dust Meter Monitoring Results

3.1.1. Light scatter results for July 2013 have been presented in a monthly chart; this can be found in Appendix A. Results show that the PM_{10} levels were largely below threshold levels and generally followed the same pattern across the site. During July there were 15 days on which exceedances of the threshold occurred. These exceedances occurred at Scotstoun, Dundas and Clufflat. However, only those exceedances occurring at Scotstoun are thought to be related to construction works. Table 2 lists the locations at which the exceedances occurred on these dates. The dust log (section 3.4 and Appendix D) provides further details with regard to the conditions and the actions taken as a result of each exceedance.

Table 2: Exceedances of the PM10 threshold

Date	Monitoring Location	Notable conditions
01/07/13	Scotstoun	Vehicle movements on-going at this location. Windy conditions
03/07/13		Vehicle movements on-going at this location. Very windy. Rain showers throughout day.
05/07/13		Vehicle movements on-going at this location.
08/07/13	Dundas	Foggy conditions
09/07/13	Scotstoun	Vehicle movements on-going at this location. Dry conditions.
11/07/13	Dundas	Error with meter.
13/07/13	Dundas and Clufflat	Saturday - no works at these locations. Foggy conditions (am).
17/07/13	Scotstoun	Vehicle movements on-going at this location. Windy conditions.
18/07/13		Vehicle movements on-going at this location.
19/07/13	Dundas	Foggy conditions
20/07/13		
21/07/13		
22/07/13		
23/07/13		
25/07/13		

3.1.2. The results at Dundas are not considered to be related to construction. The meter at Dundas is particularly sensitive to foggy, misty and hazy conditions (see 2.2). Foggy conditions were observed and recorded on 8, 13, 19 to 23 and 25 July, with high humidity levels recorded at the light scatter meters located at Clufflat and Inchgarvie on these dates, in addition to nearby weather stations noting foggy conditions on these dates. With regard to the exceedance on 11 July, there was an error with the device at 3:55 pm and the results were unrealistically high (5 minute average greater than 15,000µg/m3). However, as the cause is uncertain, the data has not been excluded, though it is not considered to be related to construction works.

3.1.3. The exceedance at Clufflat on 13 July was caused by a period of high particulate levels in the late afternoon and early evening. No works were being undertaken on this day (Saturday) and winds were not such that wind-blown dust could have affected this location (as recorded at weather stations across the site). It is, therefore, thought that the exceedance was caused by local, non-construction related factors.

3.1.4. The exceedances at Scotstoun on 1, 3, 5, 9, 17 and 18 July appear to be localised events. It is likely that the results for this monitor were affected by dust associated with vehicle movements at the site entrances close to this monitoring location and also further affected by dust associated with the adjacent road. A road sweeper is in operation at this location which reduces the dust levels associated with the road, whilst a bowser works full time on dust suppression in the south network areas to dampen down all areas of site, including the site entrances. Where required, an additional bowser was deployed in the south network areas. On several of the dates on which exceedances occurred, strong winds were also noted. Windy conditions were found to influence the recorded PM_{10} results; in such instances, mitigation measures were deployed as far as reasonably practicable.

3.1.5. During periods of high dust levels, the environmental department were notified by trigger alerts and there was close liaison with the works manager and section head of the south networks area to ensure that mitigation was in place.

3.1.6. The PM_{10} results have also been compared to the daily mean results obtained from the TEOM air quality monitoring stations located in Newton, Rosyth, Broxburn, Queensferry Road, Edinburgh and St Leonards, Edinburgh (an urban background site). The TEOM at Newton was installed by West Lothian Council, facilitated by FCBC, during May 2012. The comparison between the light scatter and TEOM results demonstrates that both sets of results generally follow the same pattern at similar levels, indicating that the pattern observed throughout July was largely due to regional changes in air quality, with the exceptions as discussed above.

3.2. Total Suspended Particles

3.2.1. The TSP results for July 2013 have been presented in a monthly chart; this can be found in Appendix B. The TSP levels at monitoring locations during July were generally low and all within the threshold level, with the exception of 11 and 19 July at Dundas and 13 July at Clufflat. These exceedances were related to device error and foggy conditions at Dundas and a localised event that is not considered to be related to construction works at Clufflat (Table 3), as discussed in relation to the high PM_{10} levels noted above (see 3.1). All locations were mostly found to follow a similar pattern across the site, demonstrating that in general the levels were influenced by regional changes in TSP levels, rather than construction works, with some exceptions relating to the PM_{10} levels discussed in section 3.1.

Table 3: Exceedances of the TSP threshold

Date	Monitoring Location	Notable conditions
11/07/13	Dundas	Device error
13/07/13	Clufflat	Saturday – no works at this location. Foggy conditions (am).
19/07/13	Dundas	Foggy conditions.

3.3. Frisbee Dust Deposition Results

3.3.1. The Frisbee dust deposition results for July 2013 have been presented in charts and can be found in Appendix C. To present results, all the monitoring locations have been grouped, based on locality, into the following:

- ***Group 1:*** M7 Butlaw Fisheries, M8 Barracks West, M9 Barracks East, M10 Inchgarvie Lodge and M11 Linn Mill;
- ***Group 2:*** M12 Clufflat, M13 Clufflat Brae, M14 Springfield and M15 Echline;
- ***Group 3:*** M16 Scotstoun Park and M17 Dundas Home Farm;
- ***Group 4:*** M18 Newton; and
- ***Group 5:*** M1 Whinny Hill.

3.3.2. Frisbee dust data deposition results were collected fortnightly, and the results averaged over this fortnight period to give a daily dust deposition rate. Two collections were made in July; 10 and 24 July.

3.3.3. The site action level for the dust deposition rate has been set at 250 mg/m^2/day. Exceedances of this level are treated as a potential incident and a formal review of the works in the vicinity of the site is instigated. A lower, site review level has been set at 140 mg/m^2/day. Where concentrations exceed the lower action threshold the site works are reviewed to ensure good practice is implemented; it is essentially a warning that additional controls may be required.

3.3.4. During July there were exceedances of the site review level at three locations and exceedances of the action level at two locations (see Table 4). With the exception of the locations where exceedances occurred, Frisbee results from monitoring locations across site were generally found to be low.

Table 4: Exceedances of the dust deposition thresholds

Fortnight ending	Threshold Exceeded	Monitoring Location	Notable conditions at time of collection
10/07/13	Review	Barracks East	Located close to embankment works at Society Road. Also at turning point for vehicles.
		Scotstoun	Some vegetation/animal particles noted in sample.
24/07/13	Review	Newton	Frisbee located immediately adjacent to on-going building works at property.
	Action	Barracks East	Located close to embankment works at Society Road. Also at turning point for vehicles.
		Scotstoun	Some vegetation/animal particles noted in sample.

3.3.5. With regard to the exceedances at Scotstoun, appropriate reviews of the works in the area, the potential of works to have affected dust levels and any mitigation measures in place were undertaken. It is possible that these were caused by construction works due to the dust observed during some inspections and the particulate matter levels recorded by the light scatter meter at Scotstoun. Additional mitigation measures were therefore put in place (refer to 3.1.4).

3.3.6. However, it should be noted that the samples collected were found to be contaminated with vegetation from mature trees above the gauge and animal particles. Therefore, the exceedances are not considered to be entirely related construction works. The laboratory responsible for testing the dust samples have confirmed that, during summer months, there is likely to be an increase in the amount of vegetation and animal

particles collected in the samples. As the Frisbee gauge does not discriminate on particle type, this can lead to 'false' increased results.

3.3.7. The exceedance of the review level at Newton is not considered to be related to construction works. On-going building works at the property are immediately adjacent to the Frisbee gauge and, therefore, are thought to have contributed to the levels recorded at this location.

3.3.8. The exceedance of the review threshold for the period ending 10 July, and the exceedance of the action threshold for the period ending 24 July at Barracks East are thought to have been caused by vehicles turning immediately adjacent to the Frisbee gauge and the deposition of material close by for the Society Road embankment works. However, this appears to be a localised exceedance as the results at Barracks West (located within 100 meters of Barrack East) show no high results. It should also be noted that there are no sensitive receptors in the immediate vicinity of the Barracks East gauge.

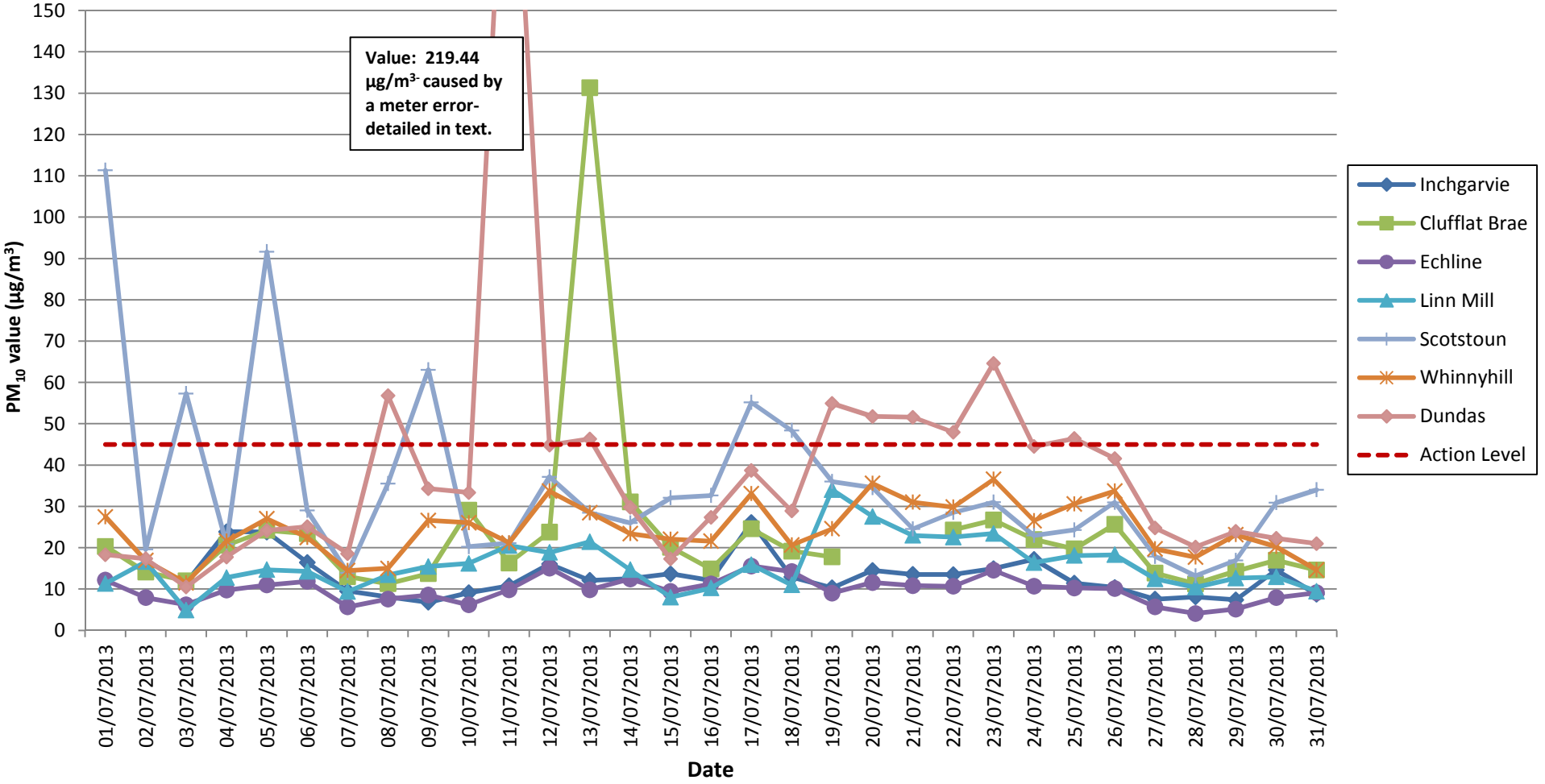
3.4. Daily Dust Log and Environmental Inspections

3.4.1. A summary of the daily dust log for July can be found in Appendix D. Dust was noted in the southern areas of site on six occasions. Vehicle movements were largely noted to be the cause of dust on site, with strong winds also found to be blowing dust on site. On one occasion, excavation works associated with the south network mainline were found to be causing dust. However, this was very localised and the dust was not leaving the site boundary. In each instance, measures to dampen down the works areas as far as reasonably practicable were employed, notably the use of the bowser to dampen down the tracks and excavation areas. Furthermore, the road sweeper was also in operation as required.

3.4.2. During this period full environmental inspections were also undertaken weekly across the site and covered areas where works were being undertaken. In July there were no instances of dust noted during these inspections. During inspections, dampening down was observed which was adequately controlling dust on site.

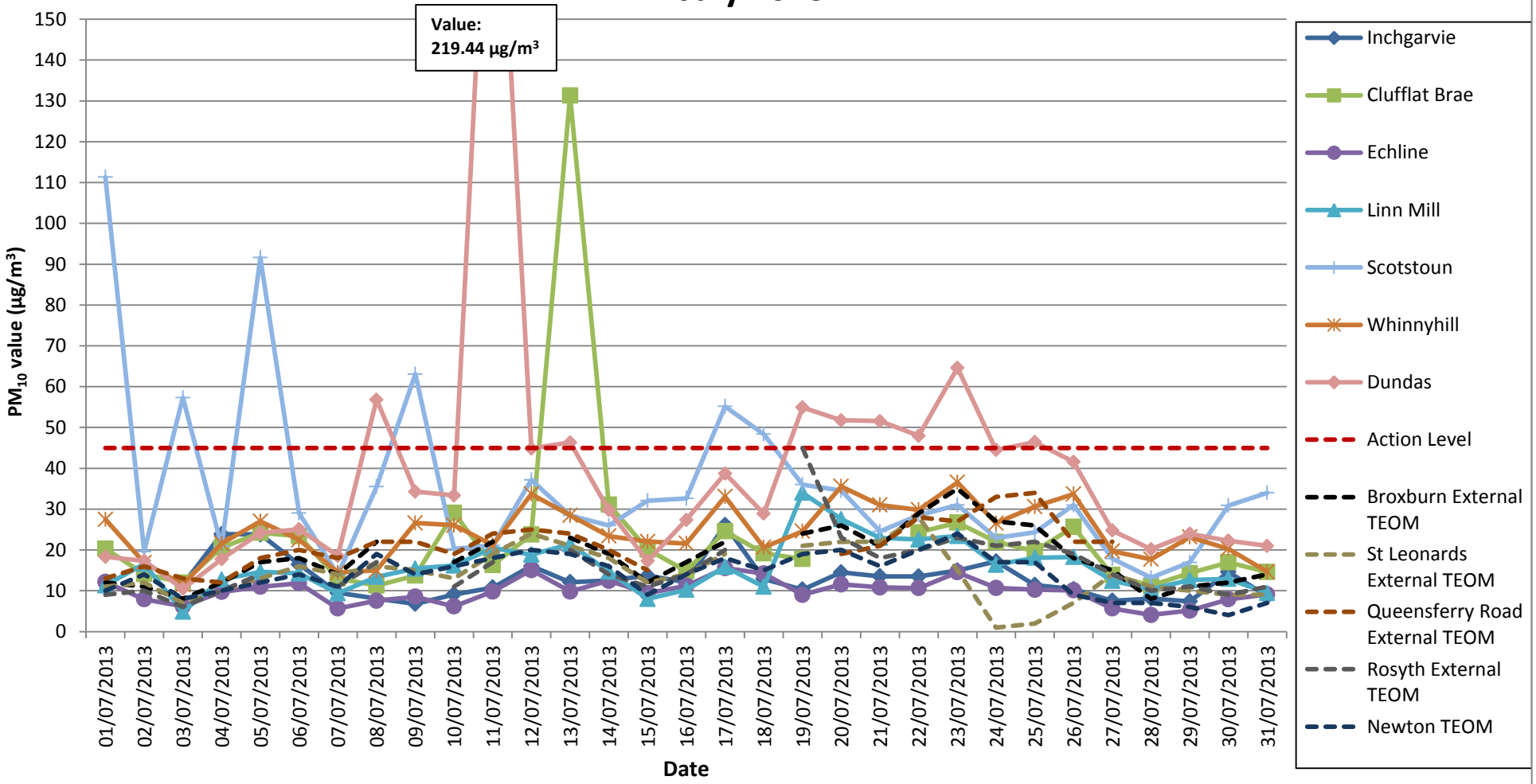
APPENDIX A: LIGHT SCATTER METER RESULTS

Air Quality Monitoring
Particulate Matter (PM10) Results for all Monitoring Locations
July 2013



Note: Please refer to section 3 of the Air Quality Monitoring Report: July 2013.

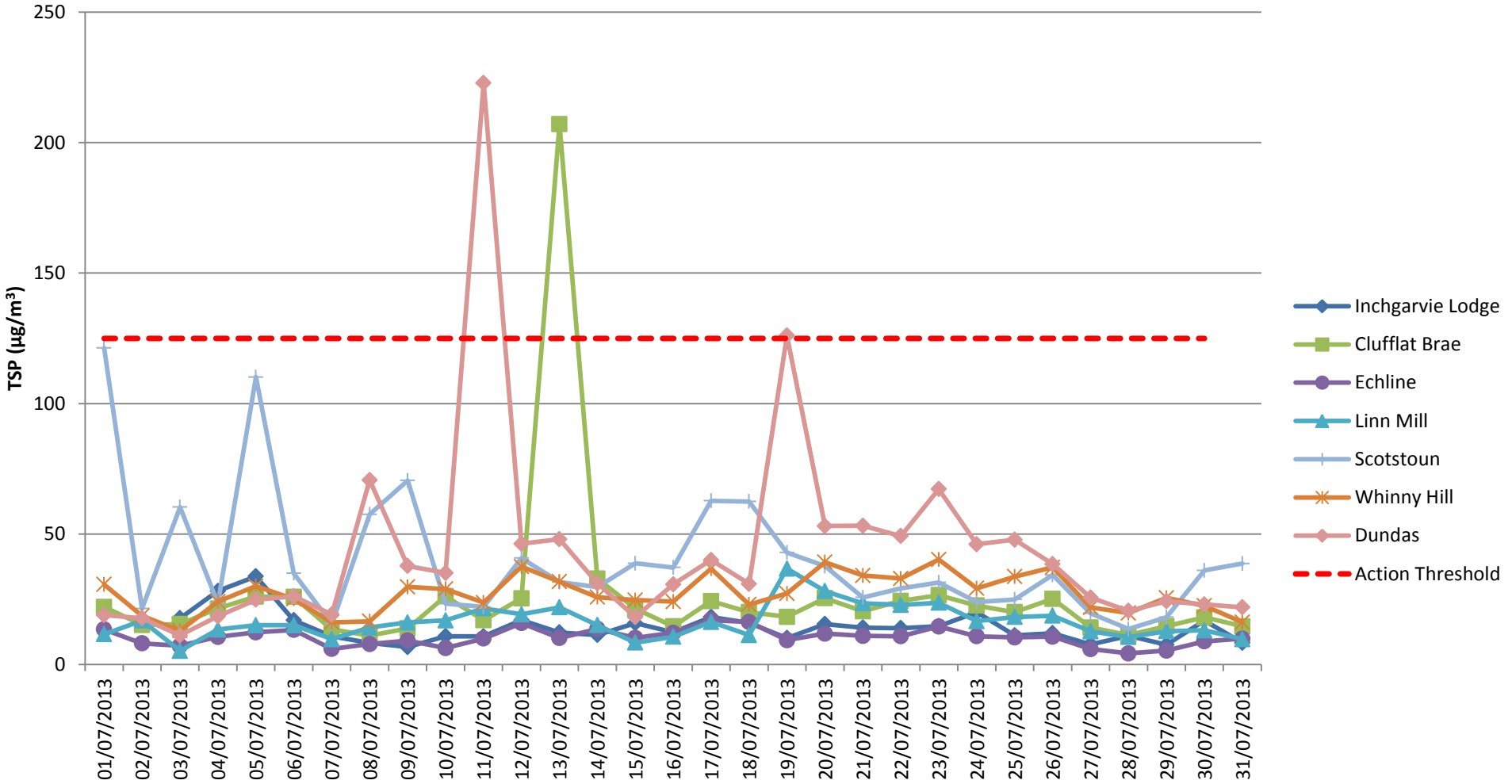
Air Quality Monitoring
Particulate Matter (PM10) Results for all Monitoring Locations with TEOM
July 2013



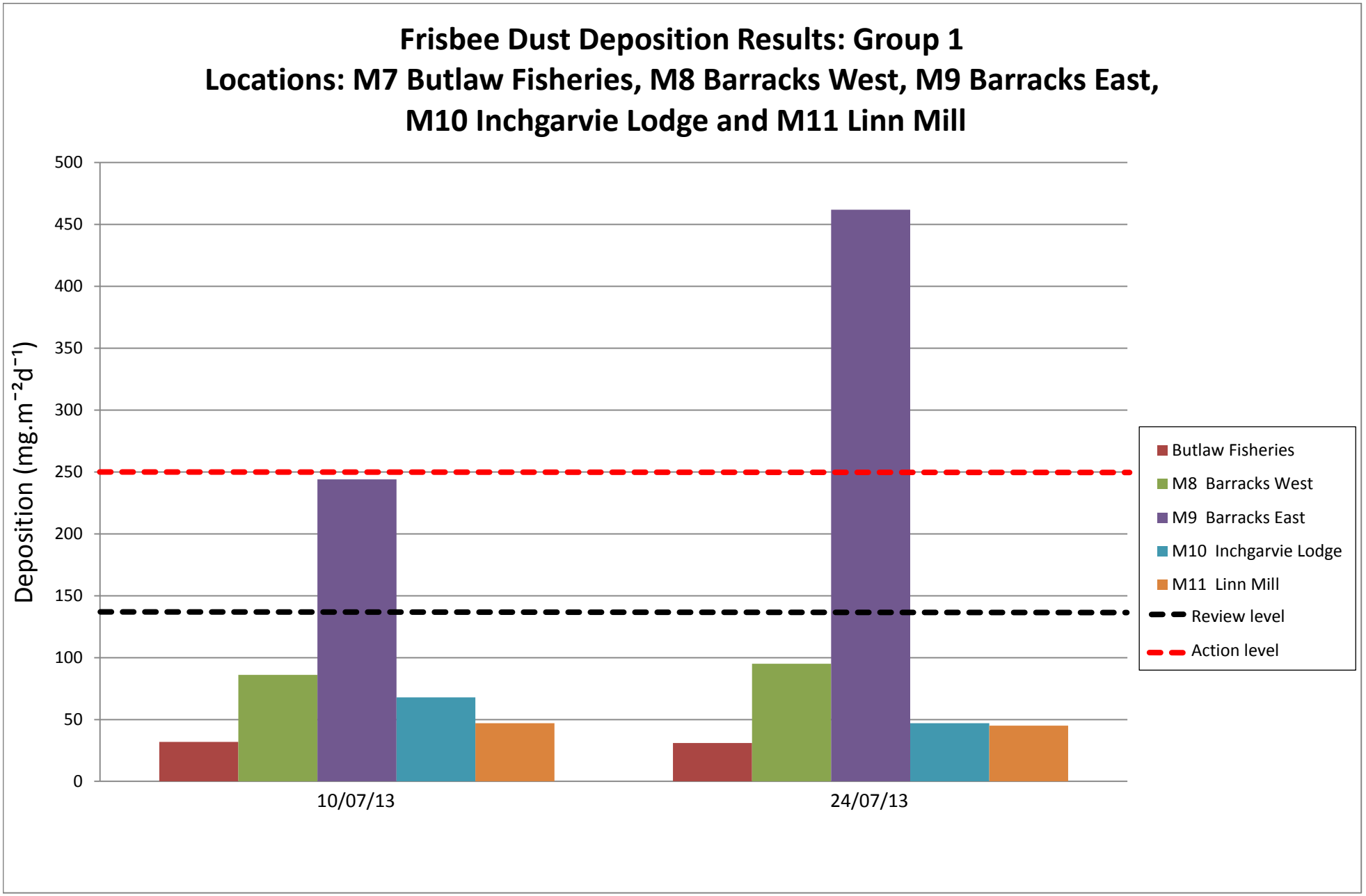
Note: Please refer to section 3 of the Air Quality Monitoring Report: July 2013.

APPENDIX B: TOTAL SUSPENDED PARTICLES

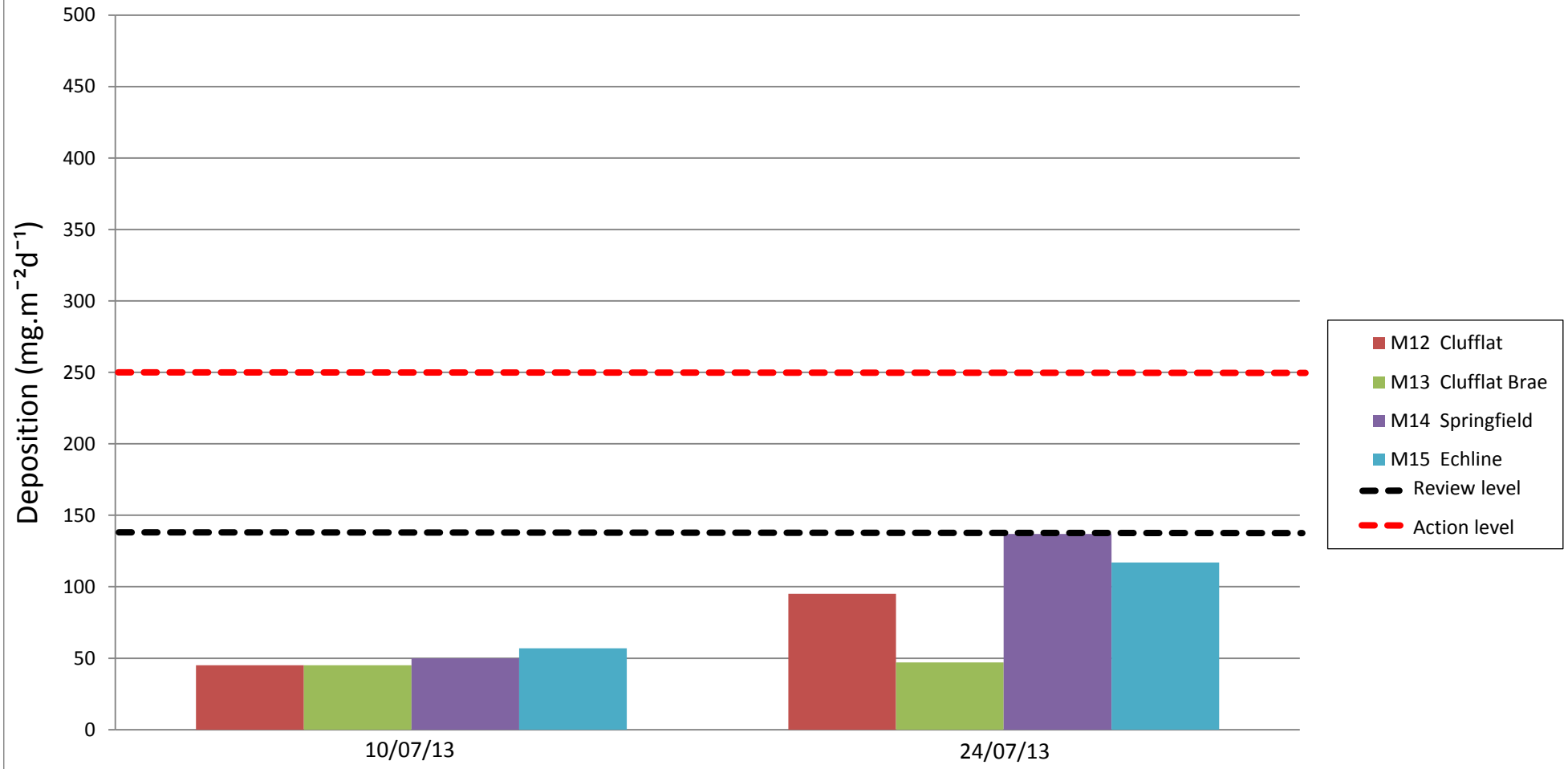
Total Suspended Particles (TSP) Results
July 2013



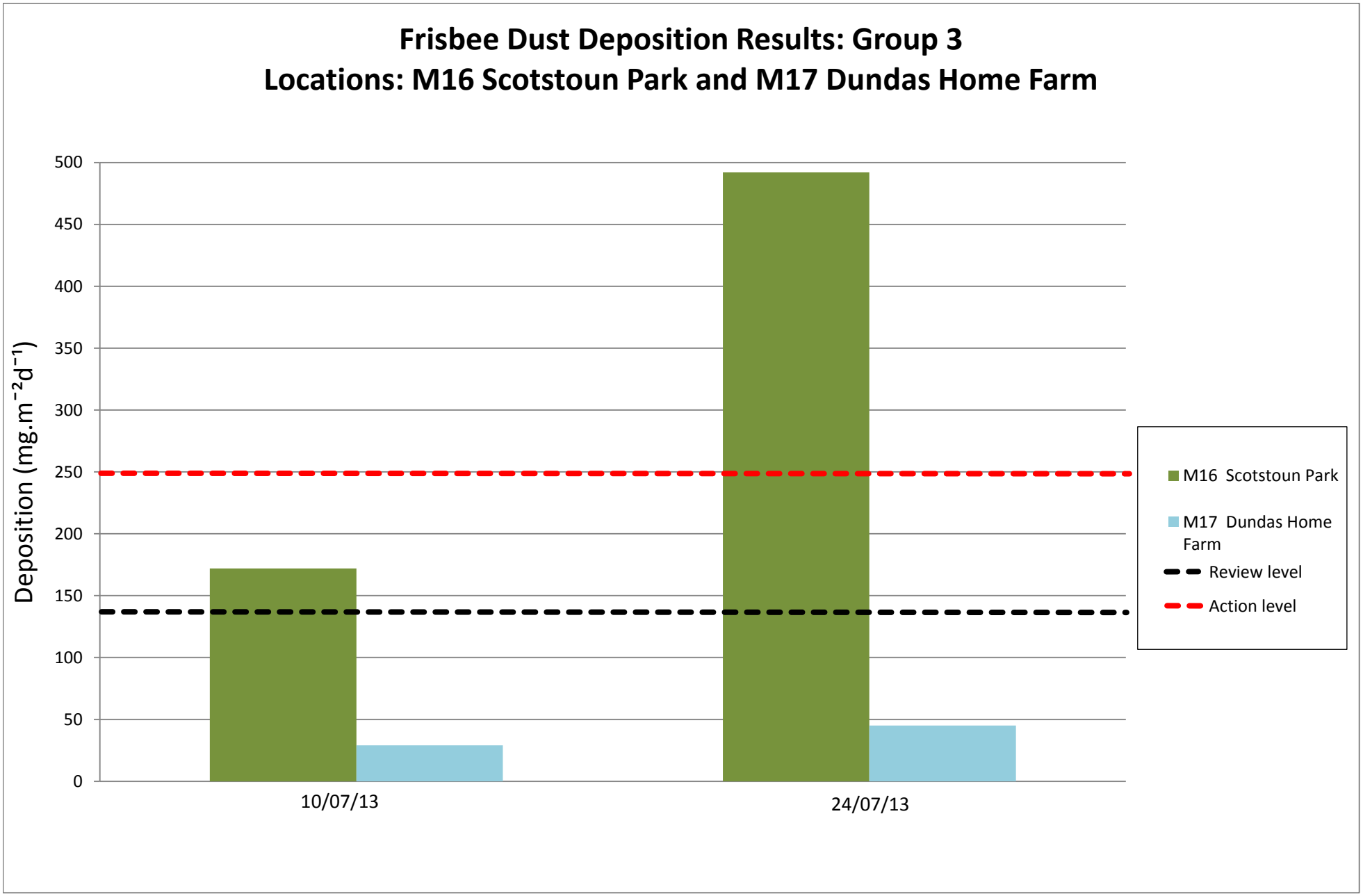
APPENDIX C: FRISBEE GAUGE RESULTS


Frisbee Dust Deposition Results: Group 1
Locations: M7 Butlaw Fisheries, M8 Barracks West, M9 Barracks East,
M10 Inchgarvie Lodge and M11 Linn Mill
Deposition (mg.m⁻²d⁻¹)
500
450
400
350
300
250
200
150
100
50
0
10/07/13
24/07/13
Butlaw Fisheries
M8 Barracks West
M9 Barracks East
M10 Inchgarvie Lodge
M11 Linn Mill
Review level
Action level

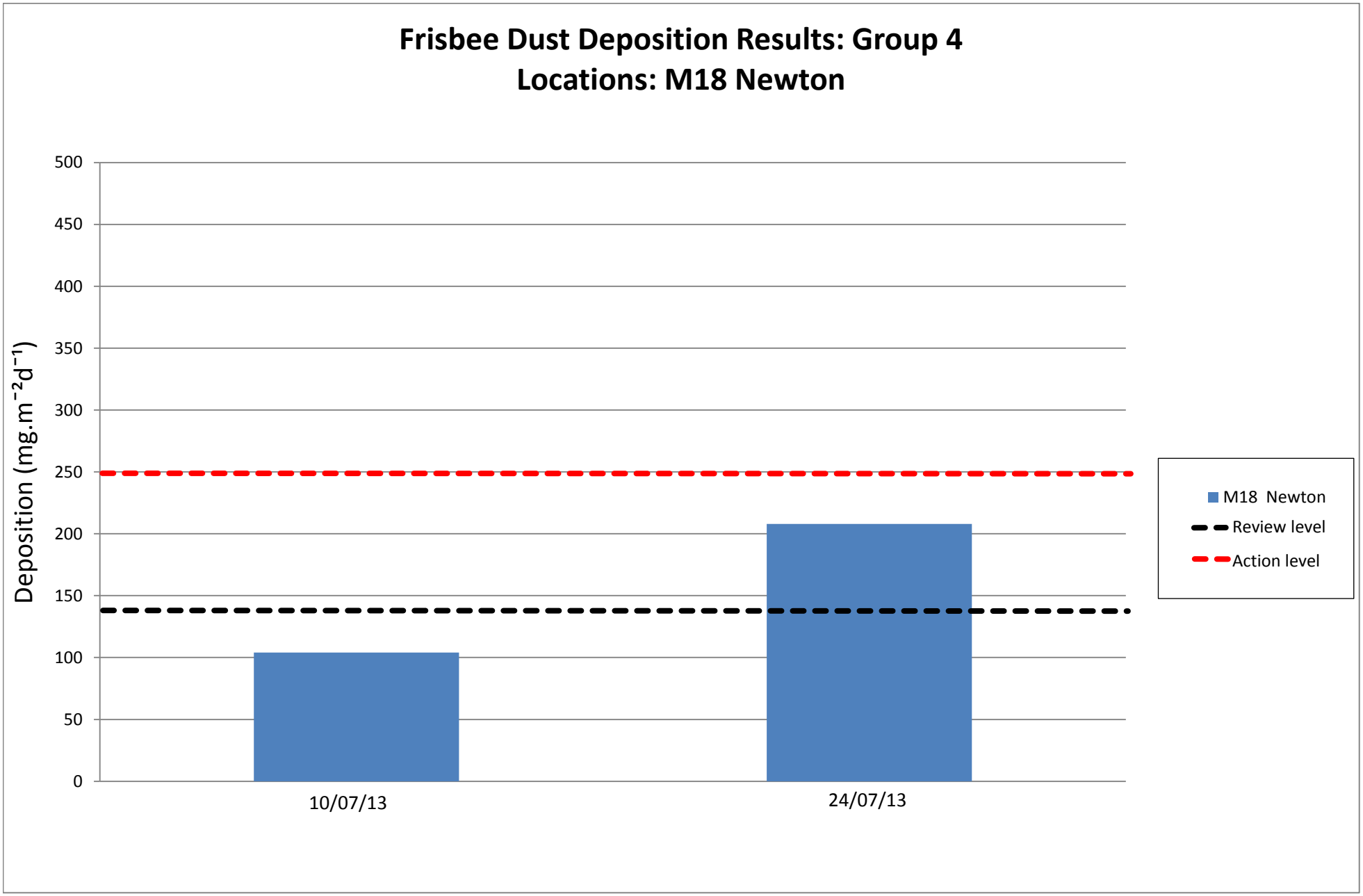
Frisbee Dust Deposition Results: Group 2
Locations: M12 Clufflat, M13 Clufflat Brae, M14 Springfield and M15 Echline

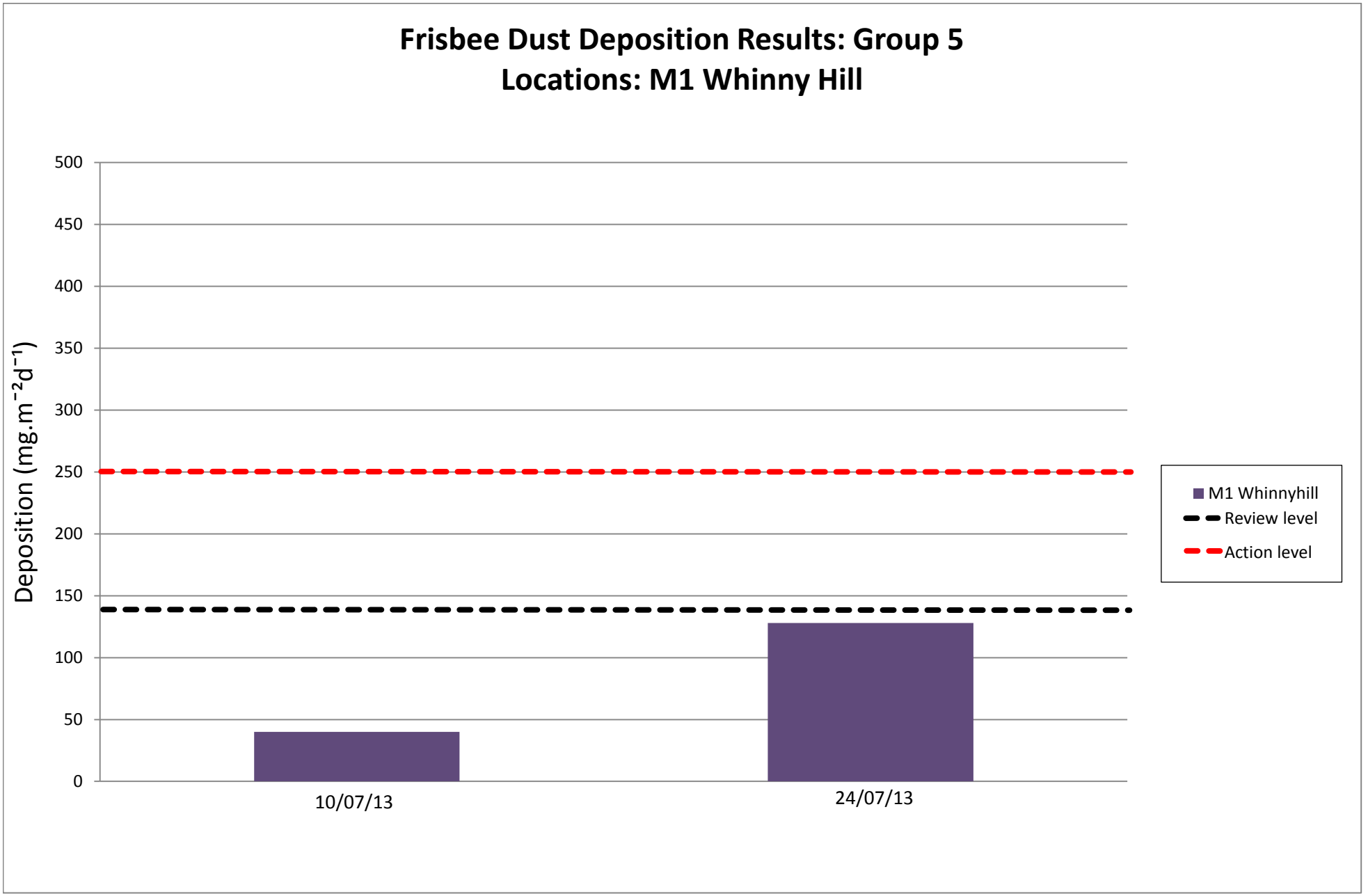


Frisbee Dust Deposition Results: Group 3
Locations: M16 Scotstoun Park and M17 Dundas Home Farm



Frisbee Dust Deposition Results: Group 4
Locations: M18 Newton




Frisbee Dust Deposition Results: Group 5
Locations: M1 Whinny Hill
Deposition (mg.m⁻²d⁻¹)
500
450
400
350
300
250
200
150
100
50
0
10/07/13
24/07/13
M1 Whinnyhill
Review level
Action level

APPENDIX D: DAILY DUST LOG

Daily Dust Log - North - July 2013

DATE	LOCATION	WIND	WIND DIRECTION	GROUND SURFACE	VISIBLE DUST	DUST DUE TO WORKS (if applicable)	CAUSES OF DUST (if applicable)	COMMENTS AND ACTIONS
01/07/2013	N	STRONG	SW	DRY	N			Windy conditions
02/07/2013	N	STRONG	SE	DAMP	N			Raining
03/07/2013	N	STRONG	SW	DAMP	N			Very windy with rain showers
04/07/2013	N	STRONG	SW	DAMP/WET	N			Rain showers - wet ground conditions
05/07/2013	N	MEDIUM	SW	DRY	N			Dry conditions
06/07/2013	N							
07/07/2013	N							
08/07/2013	N	MEDIUM	ENE	DRY	N			Foggy conditions (Haar) (am). Dry and warm confitions (pm)
09/07/2013	N	MEDIUM	NE	DRY	N			Dry conditions.
10/07/2013	N	MEDIUM	ENE	DRY	N			Dry conditions.
11/07/2013	N	LIGHT	ENE	DRY	N			Dry conditions - hazy.
12/07/2013	N	LIGHT	WSW	DRY	N			Dry, hot conditions. Hazy.
13/07/2013	N							
14/07/2013	N							
15/07/2013	N	MEDIUM	SW	DRY	N			Dry, hot conditions
16/07/2013	N	MEDIUM	SW	DRY	N			Dry, hot conditions
17/07/2013	N	MEDIUM	WSW	DRY	N			Dry, hot conditions
18/07/2013	N	LIGHT	WSW	DRY	N			Dry, hot conditions
19/07/2013	N	LIGHT	ENE	DRY	N			Dry, hot conditions
20/07/2013	N							
21/07/2013	N							
22/07/2013	N	LIGHT	NE	DAMP	N			Foggy/misty
23/07/2013	N	MEDIUM	NNE	DAMP/WET	N			Misty/foggy - some heavy downpours
24/07/2013	N	LIGHT	ENE	DAMP	N			Misty/foggy (am).
25/07/2013	N	LIGHT	ENE	DAMP/WET	N			Foggy conditions. Raining.
26/07/2013	N	MEDIUM	NE	WET	N			Thundery showers (pm)
27/07/2013	N							
28/07/2013	N							
29/07/2013	N	LIGHT	SSW	DRY	N			Damp conditions (am), turning dry (pm)
30/07/2013	N	MEDIUM	SW	DRY	N			
31/07/2013	N	LIGHT	SW	DRY	N			

Daily Dust Log - South - July 2013

DATE	LOCATION	WIND	WIND DIRECTION	GROUND SURFACE	VISIBLE DUST	DUST DUE TO WORKS (if applicable)	CAUSES OF DUST (if applicable)	COMMENTS AND ACTIONS
01/07/2013	S	STRONG	SW	DRY	Y	Y	wind blown dust	Windy conditions causing dust to blow on (and off) site, noted at launch area. Dust alerts for Scotstoun - members of team on site at time of some alerts and no visual dust observed.
02/07/2013	S	STRONG	SE	DAMP	N			Raining
03/07/2013	S	STRONG	SW	DAMP	N			Very windy with rain showers
04/07/2013	S	STRONG	SW	DAMP/WET	N			Rain showers - wet ground conditions
05/07/2013	S	MEDIUM	SW	DRY	Y	Y	vehicle movements	Alerts receieved at Scotstoun. Dust due to vehicle movements. Contact with works manager - additional bowser brought in to assist.
06/07/2013	S							
07/07/2013	S							
08/07/2013	S	MEDIUM	ENE	DRY	N			Foggy conditions (Haar) (am). Dry and warm confitions (pm). Evidence of dampening observed at sites by B800
09/07/2013	S	MEDIUM	NE	DRY	N			Dry conditions. No dust visually observed at time of inspection.
10/07/2013	S	MEDIUM	ENE	DRY	N			Dry conditions. No dust visually observed at time of inspection.
11/07/2013	S	LIGHT	ENE	DRY	N			Hazy conditions - hazy. Error with Dundas light scatter monitor noted at 4pm.
12/07/2013	S	LIGHT	WSW	DRY	N			Dry, hot conditions. Hazy.
13/07/2013	S							
14/07/2013	S							
15/07/2013	S	MEDIUM	SW	DRY	N			Dry, hot conditions
16/07/2013	S	MEDIUM	SW	DRY	Y	Y	Material and vehicle movements	Slight dust noted at Dundas - bowser with rain gun sent to area. Slight dust due to vehicle moevements at Scotstoun - bowser returning to area with additional water.
17/07/2013	S	MEDIUM	WSW	DRY	Y	Y	Vehicle movements	Alerts at Scotstoun. Slight dust due to vehicle movements - contact with works manager - bowser with rain gun sent to area.
18/07/2013	S	LIGHT	WSW	DRY	Y	Y	Excavation	Very slight dust observed due to excavation. Dust not spreading off site. Bowser movements observed across site at time of inspection
19/07/2013	S	LIGHT	ENE	DRY				Foggy (haar) (am). Dry, hot conditions
20/07/2013	S							
21/07/2013	S							
22/07/2013	S	LIGHT	NE	DAMP	N			Foggy/misty
23/07/2013	S	MEDIUM	NNE	DAMP/WET	N			Misty/foggy - some heavy downpours
24/07/2013	S	LIGHT	ENE	DAMP	N			Misty/foggy (am). Bowser observed on site.
25/07/2013	S	LIGHT	ENE	DAMP/WET	N			Foggy conditions. Raining.
26/07/2013	S	MEDIUM	NE	WET	N			Thundery showers (pm)
27/07/2013	S							
28/07/2013	S							
29/07/2013	S	LIGHT	SSW	DRY	N			Damp conditions (am), turning dry (pm)

30/07/2013	S	MEDIUM	SW	DRY	Y	Y	Vehicle movements	Slight dust observed due to vehicle movements at site access. Contact with works manager. Bowser on site. Minimal vehicle movements.
31/07/2013	S	LIGHT	SW	DRY	N			