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Project **FORTH REPLACEMENT CROSSING**

Document title

**DUST AND AIR QUALITY MONITORING REPORT**

**NOVEMBER 2011 TO JANUARY 2012**

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## **1. INTRODUCTION**

**1.1.** This report details the results of the air quality monitoring that has been undertaken during the construction works for the main crossing and associated network. The periods covered in this report are as follows:

- November 2011
- December 2011
- January 2012

**1.2.** Air quality monitoring has been undertaken in accordance with the Code of Construction Practice (CoCP) and the Dust and Air Quality Management Plan contained within the Environmental Management Plan.

## 2. MONITORING EQUIPMENT AND LOCATIONS

**2.1.** Air quality has been monitored on site using both automatic light scatter dust meters and Frisbee gauge dust deposition monitoring. Twelve Frisbee gauges have been set up at sensitive locations across the site to measure dust deposition rates (Figure 1). Six automatic light scatter meters have also been installed at various sensitive locations to measure real time particulate matter (PM<sub>10</sub>) concentrations (Figure 2). Table 1 lists the air quality monitoring equipment at each monitoring location.

**2.2.** The installation of the air quality monitoring equipment has not been simultaneous across the site. The installation dates have been given in Table 1. The main construction activities undertaken at each location have also been listed in Table 1.

**2.3.** In addition to monitoring equipment, daily and weekly dust inspections have been undertaken across the site by the FCBC Environmental Department.



**Figure 1: Example of an Installed Frisbee Gauge Meter**



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

**Table 1: Air Quality Monitoring Locations**

<b>Ref:</b>	<b>Monitoring Location</b>	<b>Monitoring Equipment</b>	<b>Installation Date</b>	<b>Construction Activities</b>
M1	Whinny Hill	Automatic light scatter meter	16/02/12	Site Clearance
M7	Butlaw Fisheries	Frisbee	05/10/11	Marine works only
M8	Barracks West	Frisbee	31/08/11	Marine works only
M9	Barracks East	Frisbee	31/08/11	Marine works only
M10	Inchgarvie Lodge	Frisbee	22/08/11	Trial Grouting Haul road LMA Fencing
		Automatic light scatter meter	17/10/11	
M11	Linn Mill	Frisbee	22/08/11	Trial Grouting Haul road LMA Fencing
		Automatic light scatter meter	06/12/11	
M12	Clufflat	Frisbee	29/08/11	Trial Grouting Haul road LMA Fencing
M13	Clufflat Brae	Frisbee	21/09/11	
		Automatic light scatter meter	24/10/11	
M14	Springfield	Frisbee	15/08/11	Trial Grouting Haul road
M15	Echline	Frisbee	16/08/11	Site Clearance Access points
		Automatic light scatter meter	10/11/11	
M16	Scotstoun	Frisbee	07/09/11	Site Clearance Access points Haul route & crossing points at underground utility
		Automatic light scatter meter	14/02/12	
M17	Dundas Home Farm	Frisbee	29/08/11	Site Clearance Access points Haul route & crossing points at underground utility
		Automatic light scatter meter	Not yet installed	
M18	Newton	Frisbee	22/08/11	None

### **3. AIR QUALITY MONITORING RESULTS**

#### **3.1. Automatic Light Scatter Dust Meter Monitoring Results**

- 3.1.1.** Light scatter results for the period November 2011 to January 2012 have been presented in monthly charts. These can be found in the Appendix A. Results show that there were exceedances of the trigger thresholds at most locations. The trigger level for PM<sub>10</sub> concentration is set at 50 µg/m<sup>3</sup>.
- 3.1.2.** Readings at Echline appeared to be low in comparison to the other meters on site. As meters across the site would be expected to read similarly, with the exception of during an air pollution incident, these low readings were investigated in consultation with the supplier. The supplier confirmed that the meter was reading low by a factor of approximately 10, thus the results have been updated to reflect this.
- 3.1.3.** Exceedances of the daily PM<sub>10</sub> threshold that occurred within the period are shown in Table 2. These exceedances generally occurred as single daily peaks or short periods of two days rather than continued periods of exceedances. Real time triggers were received to inform of exceedances, initiating investigations into the cause (see appendices of this report). No exceedances during the period were found to be attributable to construction, and investigative reports/daily inspections showed that there were no instances where mitigating measures were necessary.
- 3.1.4.** The weather conditions encountered during the period are covered in Appendix C. Weather conditions (temperature and relative humidity) are continually measured by the light scatter meters at Inchgarvie Lodge and Clufflat Brae. A weather station, located at the noise meter at Echline which is adjacent to the light scatter at this monitoring location, also continually records weather data. Weather conditions

were noted during site checks. Frozen and wet ground surfaces were frequently noted during the winter periods covered in this report (Appendix C). Such weather conditions limit the amount of airborne dust as particulates largely remain in situ during these conditions. Alternative explanations for the high PM<sub>10</sub> values obtained have thus been sought.

- 3.1.5.** An important consideration is that light scattering is often very high at relative humidities exceeding 80%; small particles grow to sizes that scatter light more efficiently as they acquire liquid water. As a result, ambient temperature nephelometers (light scatter meter) overestimate mass concentrations at high humidities when particles have a large soluble component. During winter the humidity is generally over 80%; humidity of over 90% has also been recorded in the area during this period. An indication of humidity levels is given in Appendix C.

**Table 2: PM<sub>10</sub> Exceedances**

Month	Location	Dates of Exceedances
November 2011	Inchgarvie Lodge	12/11/11 28/11/11
	Clufflat Brae	12/11/11 to 18/11/11 20/11/11 to 24/11/11 26/11/11 to 29/11/11
	Echline	12/11/11 15/11/11 to 17/11/11 21/11/11
December 2011	Inchgarvie Lodge	04/12/11 10/12/11 to 11/12/11 22/12/11 24/12/11 29/12/11
	Clufflat Brae	01/12/11 04/12/11 08/12/11 to 12/12/11 14/12/11 to 22/12/11
	Echline	17/12/11 to 18/12/11
	Linn Mill	10/12/11
January 2012	Inchgarvie Lodge	02/01/12 07/01/12 to 08/01/12 11/01/12 16/01/12 to 17/01/12
	Clufflat Brae	17/01/12 to 18/01/12
	Echline	17/01/12 to 18/01/12
	Linn Mill	17/01/12

**3.1.6.** Several days during the periods covered in this report have been affected by stormy conditions, in particular strong winds. It is possible, therefore, that some of the results have been adversely affected by such conditions. For instance, particularly strong winds were witnessed on 8 December 2012, which coincides with an exceedance at Clufflat Brae. Further weather conditions that may have given rise to the high PM<sub>10</sub> concentrations experienced during this period are foggy or hazy conditions. Foggy conditions in the Forth Estuary are common, with fog often thicker closer to the estuary.

**3.1.7.** Exceedances during the first two weeks of January at Inchgarvie, for instance, can be attributed to damage caused by adverse weather conditions. PM<sub>10</sub> values at Inchgarvie Lodge during these weeks were higher than those recorded at both Clufflat Brae and Linn Mill. PM<sub>10</sub> concentrations at Inchgarvie Lodge exceeded the 50 µg/m<sup>3</sup> threshold on four occasions, whilst there were no exceedances at either Clufflat Brae or Linn Mill. These monitoring locations are all within 400 meters of each other, Clufflat Brae and Inchgarvie Lodge are both located to the North-East of the construction works, and there were limited works in the vicinity at this time, thus similar results would be expected at all monitoring locations. The differences found are thought to be the result of strong winds having blown over the boundary fence on which the meter was mounted at Inchgarvie Lodge, causing the meter to rest in an incorrect position which exacerbated the results.

**3.1.8.** Some results show periods when the PM<sub>10</sub> concentration was high at all monitoring locations, for instance on 12 November 2012 and 17 January 2012. Dust checks on these dates show that there were no construction works on-going that would give rise to high particulate matter concentrations. Rather, these results are caused by a regional event that is not related to construction on site.

## **3.2. Frisbee Dust Deposition Results**

**3.2.1.** The Frisbee dust deposition results for November 2011 through to January 2012 have been presented in charts and can be found in Appendix B. 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

**3.2.2.** Frisbee dust data deposition results have been collected fortnightly, and the results averaged over this period to give a daily dust deposition rate. The only exception to this has been the 28/12/11 result; no Frisbee results were collected on this date as it was during the Christmas break (24/12/11 to 09/01/12). As a result, the Frisbee results collected on 11/01/12 were averaged over a four week period. However, it should be noted that for two weeks during this period (24/12/11 to 09/01/12) no construction works were conducted. The action level for the dust deposition rate has been set at 250 mg/m<sup>2</sup>/day.

**3.2.3.** Results for Group 3 and Group 4 show that the action level was not exceeded. During November, December and January dust deposition results at Newton were below 50 mg/m<sup>2</sup>/day while results at Dundas Home Farm show that dust deposition rates were consistently below 100 mg/m<sup>2</sup>/day. Additionally, dust deposition results at Scotstoun were also found to be largely below 100 mg/m<sup>2</sup>/day.

**3.2.4.** Results for Group 2 monitoring locations show that all monitoring locations other than Clufflat Brae were found to be within the threshold for the period covered in this report. Results obtained for Clufflat Brae for the fortnightly period ending on 30/11/11 show an exceedance of the dust deposition action level; results show a peak of 451 mg/m<sup>2</sup>/day for this period. However, it should be noted that this result was affected by adverse weather conditions causing the gauge to blow over and, as a result, was not attributable to construction works.

**3.2.5.** Two monitoring locations in Group 1 were also adversely affected by weather conditions. Results obtained for M9 Barracks East and M11 Linn Mill show abnormally high dust deposition rates for the period

ending 11/01/11, with rates of 831 mg/m<sup>2</sup>/day and 605 mg/m<sup>2</sup>/day recorded respectively. These results have been attributed to high winds during the period causing the monitoring equipment to blow over and, as a result, the Frisbee gauge contained high quantities of soil and dirt. The low dust deposition rates found for the other monitoring locations within this locality demonstrate that the results obtained were anomalies and thus not attributable to construction works in the area. With the exception of these anomalous results, all other results for the period show dust deposition rates of lower than 75 mg/m<sup>2</sup>/day for the monitoring locations in Group 1.

- 3.2.6.** Frisbee dust deposition results for all monitoring locations indicate that the levels of dust attributable to construction activities are low.

### **3.3. Site Inspections**

- 3.3.1.** Daily and weekly inspections of the site were also undertaken during the monitoring period. A summary of the daily dust log can be found in Appendix C of this report.

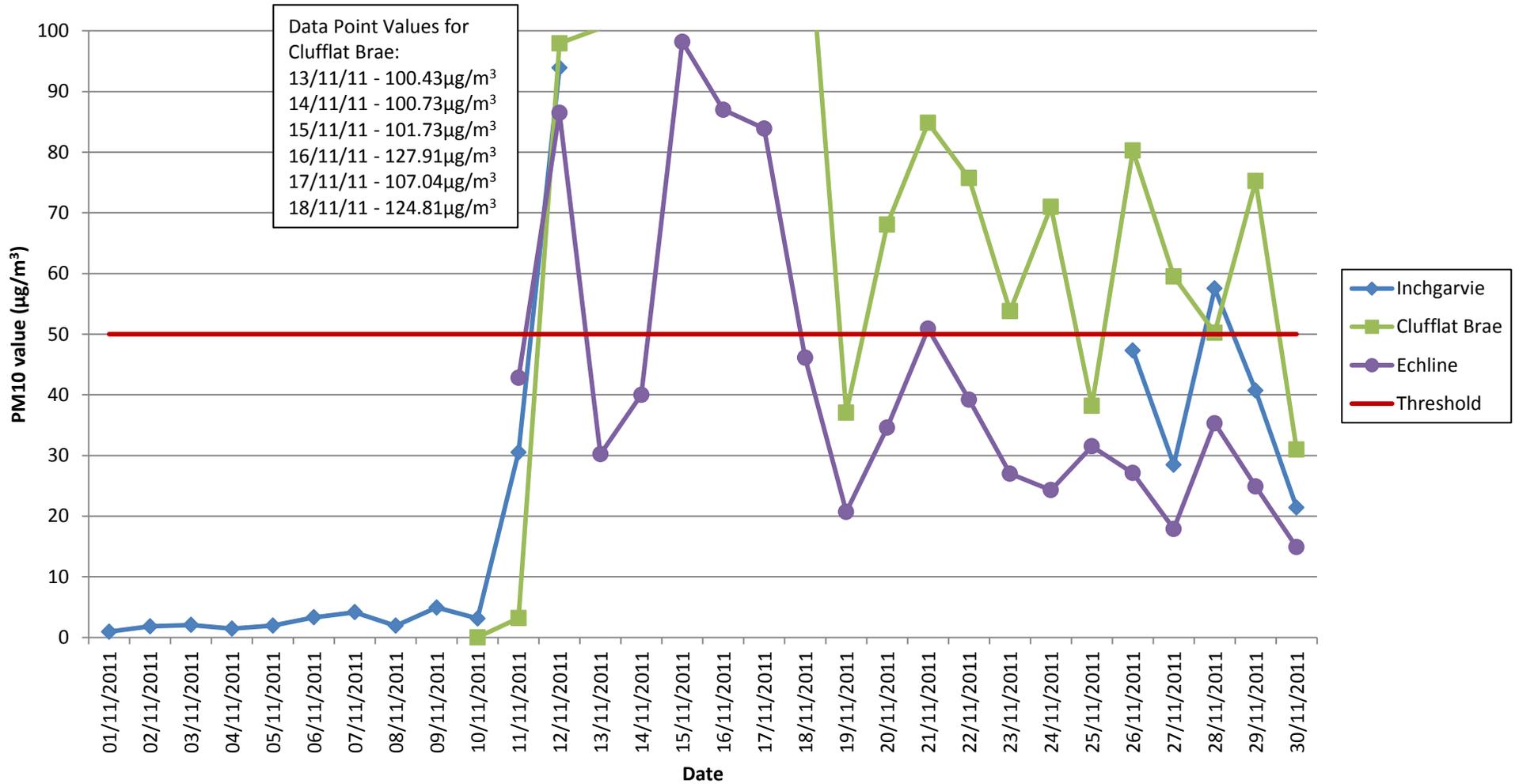


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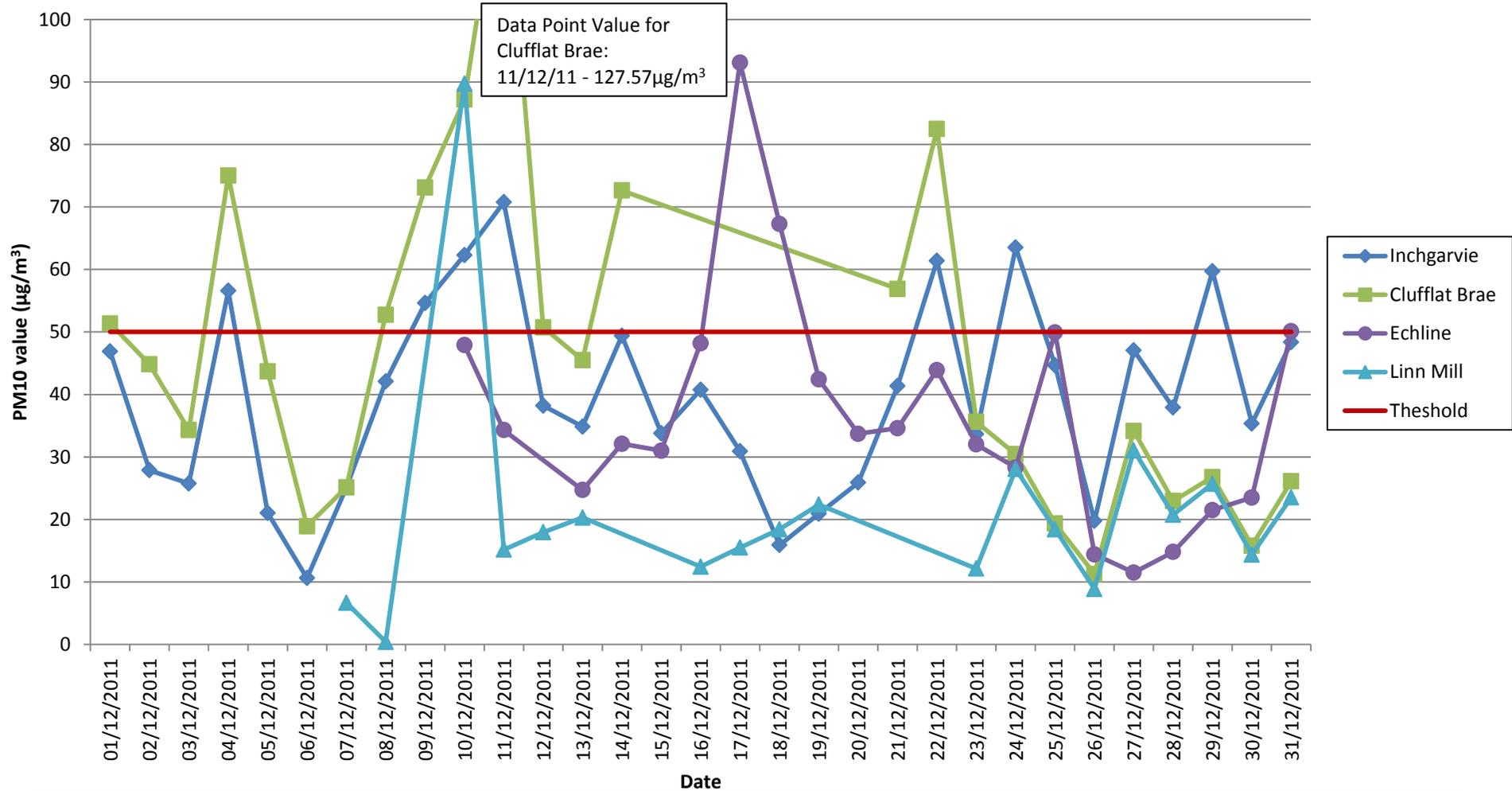
## **APPENDIX A – PARTICULATE MATTER RESULTS**

## PM10 Results November 2011: All Locations



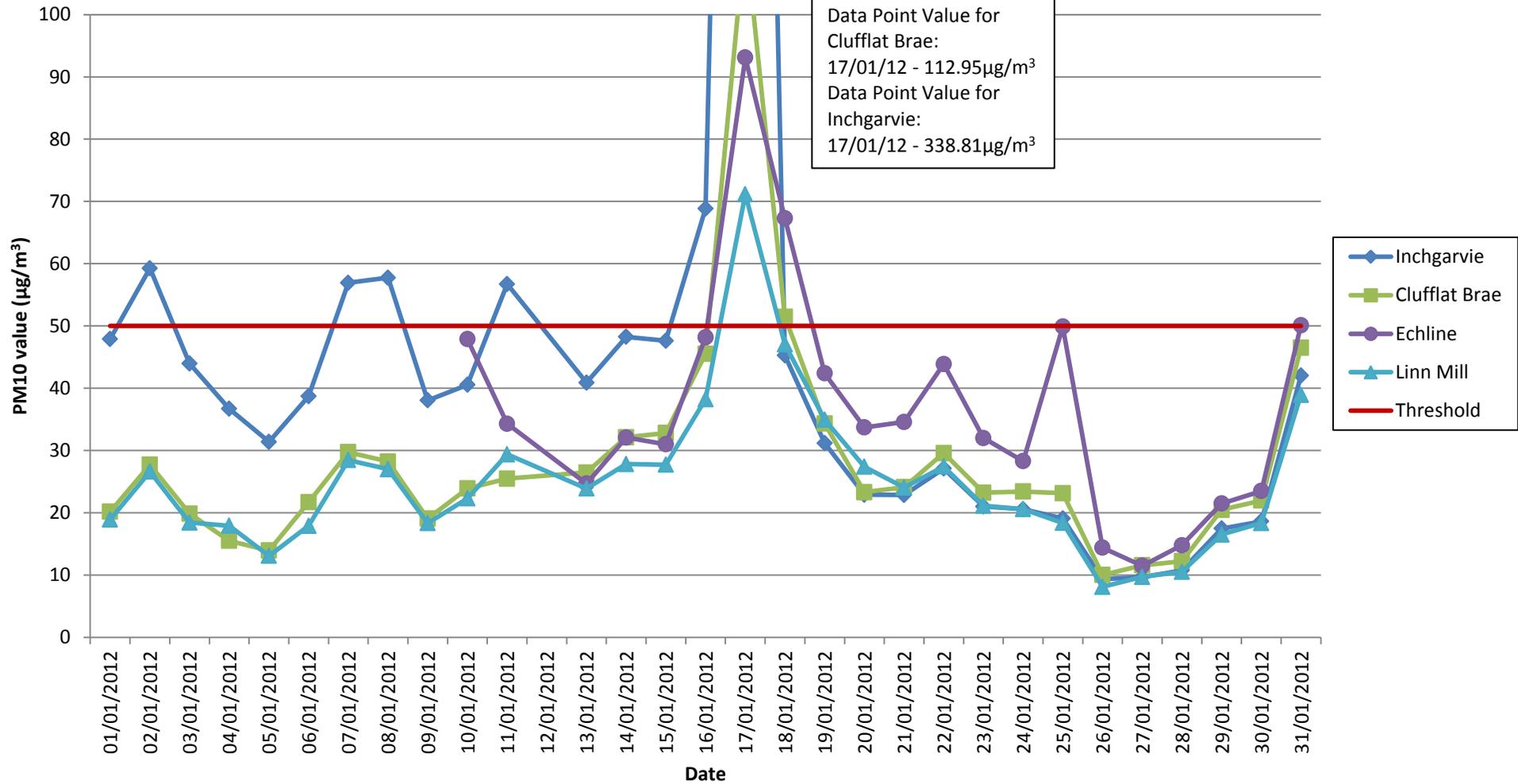
Note: Monitoring began at Clufflat Brae on 09/11/11 and at Echline on 10/11/11. Data is missing for Inchgarvie for the period 12/11/11 to 25/11/11 due to device error. The presented data for Echline has been multiplied by 10.

## PM10 Results December 2011: All Locations



Note: Monitoring began at Linn Mill on 06/12/11. Due to device error, data is missing for the following: Clufflat Brae - the period 15/12/11 to 20/12/11; Echline - the period 25/12/11; and Linn Mill - 09/12/11, 14/12/11, 15/12/11 and the period 20/12/11 to 22/12/11. No construction works were conducted over the Christmas period (24/12/11 to 09/01/12). The presented data for Echline has been multiplied by 10.

## PM10 Results January 2012: All Locations



Data Point Value for  
Clufflat Brae:  
17/01/12 - 112.95µg/m<sup>3</sup>  
Data Point Value for  
Inchgarvie:  
17/01/12 - 338.81µg/m<sup>3</sup>

- ◆ Inchgarvie
- Clufflat Brae
- Echline
- ▲ Linn Mill
- Threshold

**Note:** Data is missing for the period 01/01/12 to 09/01/12 for Echline and for all locations on 12/01/12 due to device error. No construction works were conducted over the Christmas period (25/12/11 to 09/01/12). The presented data for Echline has been multiplied by 10.



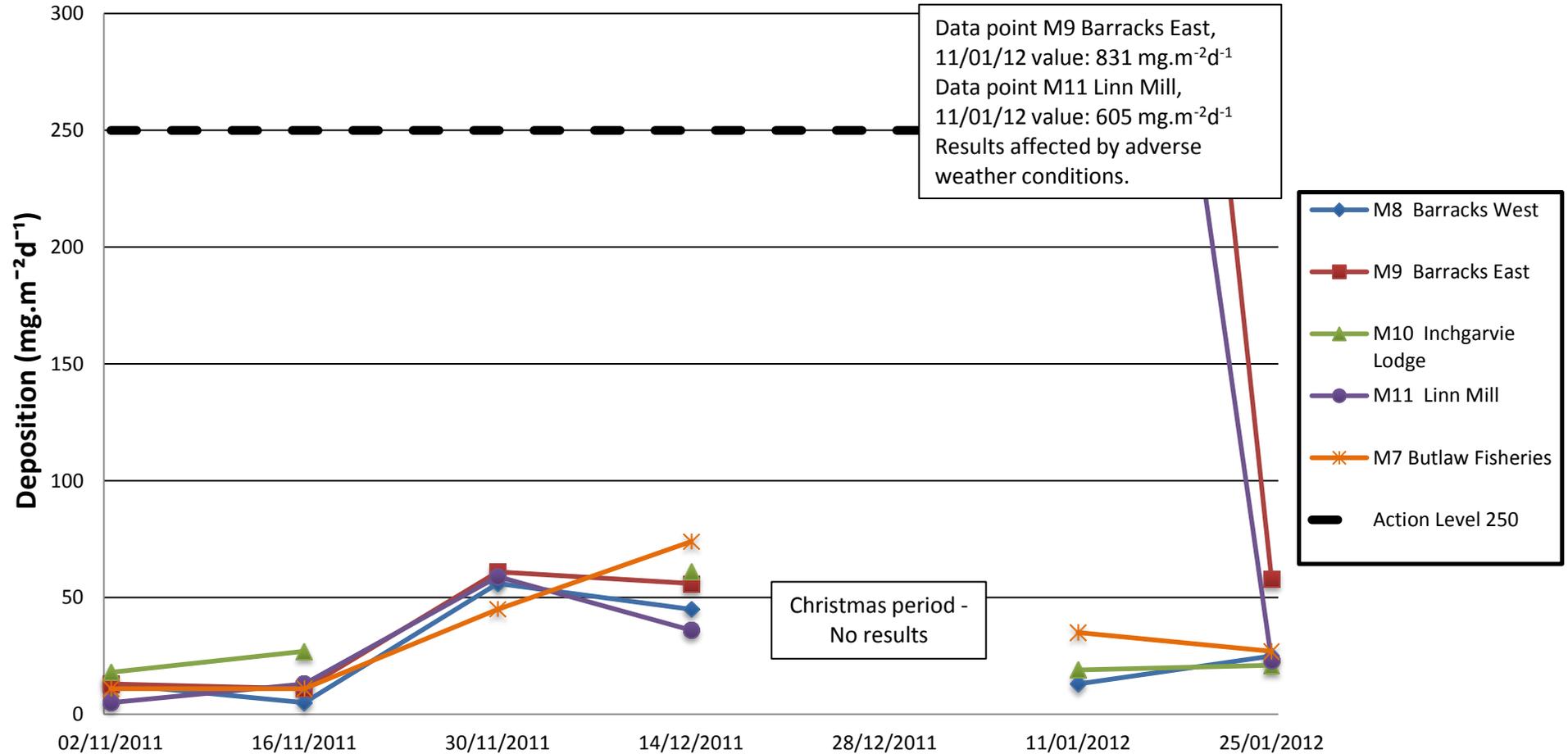
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## **APPENDIX B – FRISBEE DUST DEPOSITION RESULTS**

## Frisbee Dust Deposition Results: November 2011 to January 2012

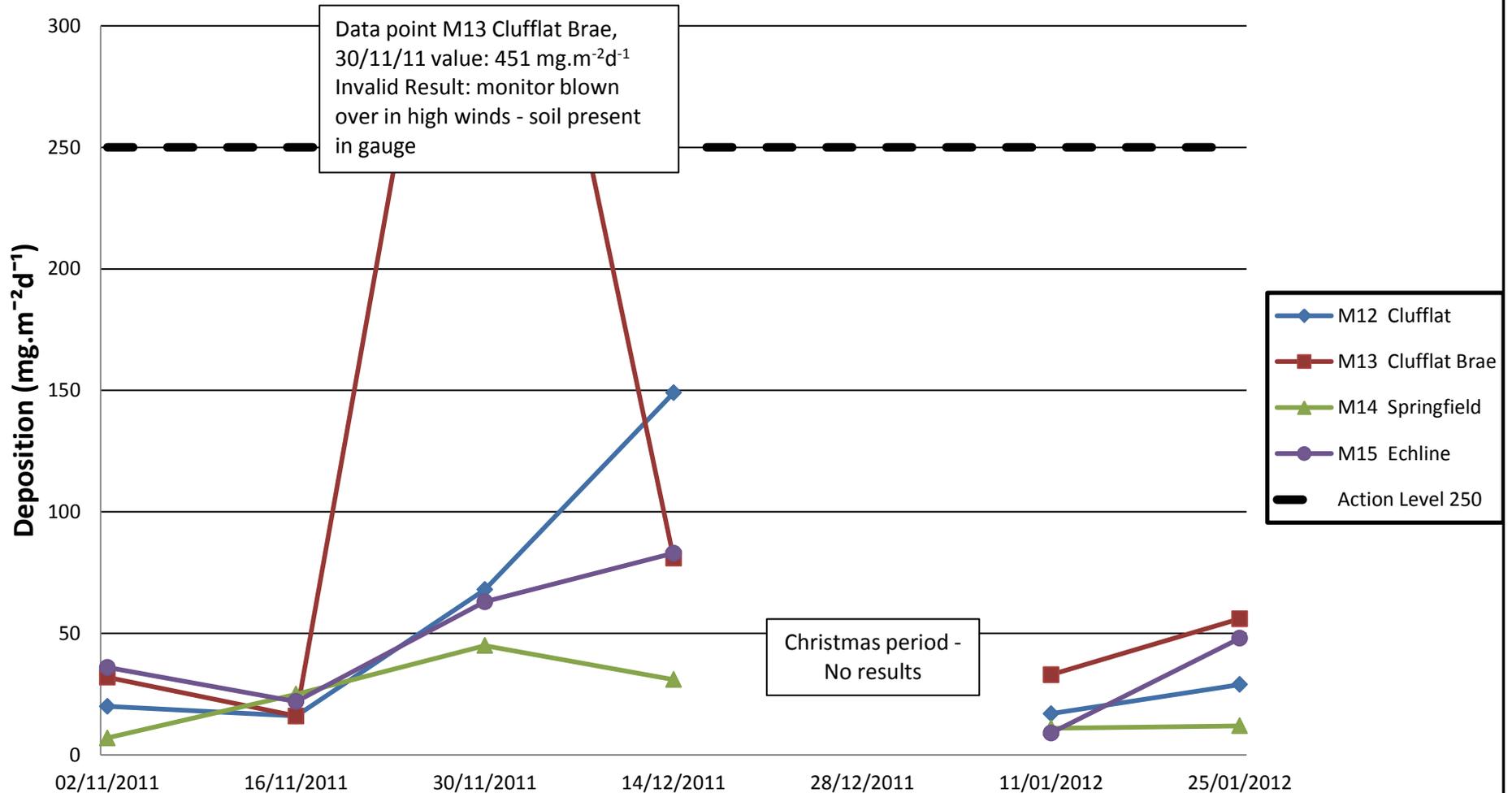
Locations: M7 Butlaw Fisheries, M8 Barracks West, M9 Barracks East, M10 Inchgarvie Lodge and M11 Linn Mill



**Note:** Frisbee dust data results are missing for Inchgarvie for 30/11/11 as the bottle was broken in transit. No Frisbee dust data results were collected on 28/12/11 as this was during the Christmas period, during which no construction works were conducted.

## Frisbee Dust Deposition Results: November 2011 to January 2012

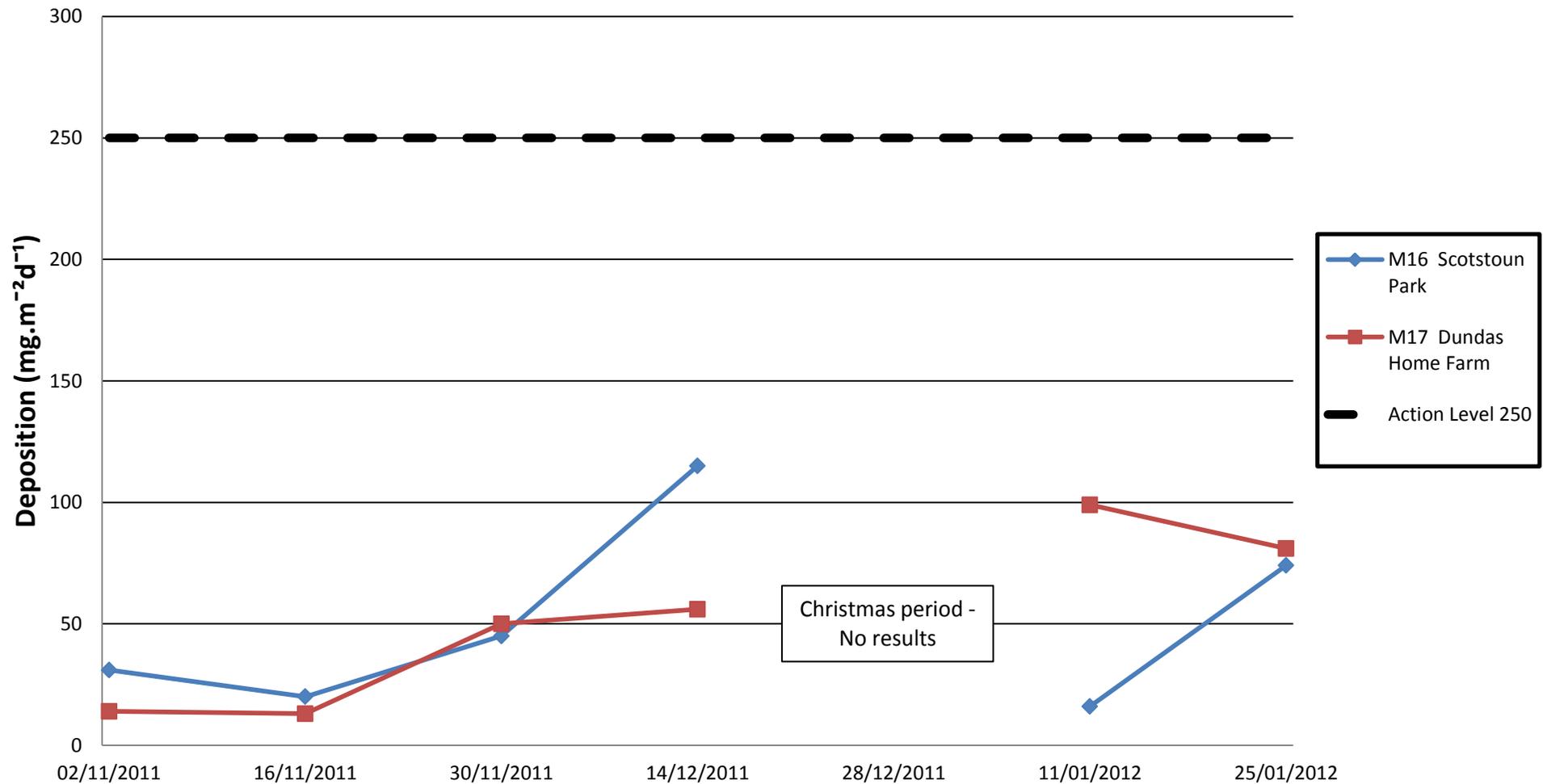
### Locations: M12 Clufflat, M13 Clufflat Brae, M14 Springfield and M15 Echline



**Note:** No Frisbee dust data results were collected on 28/12/11 as this was during the Christmas period, during which no construction works were conducted.

## Frisbee Dust Deposition Results: November 2011 to January 2012

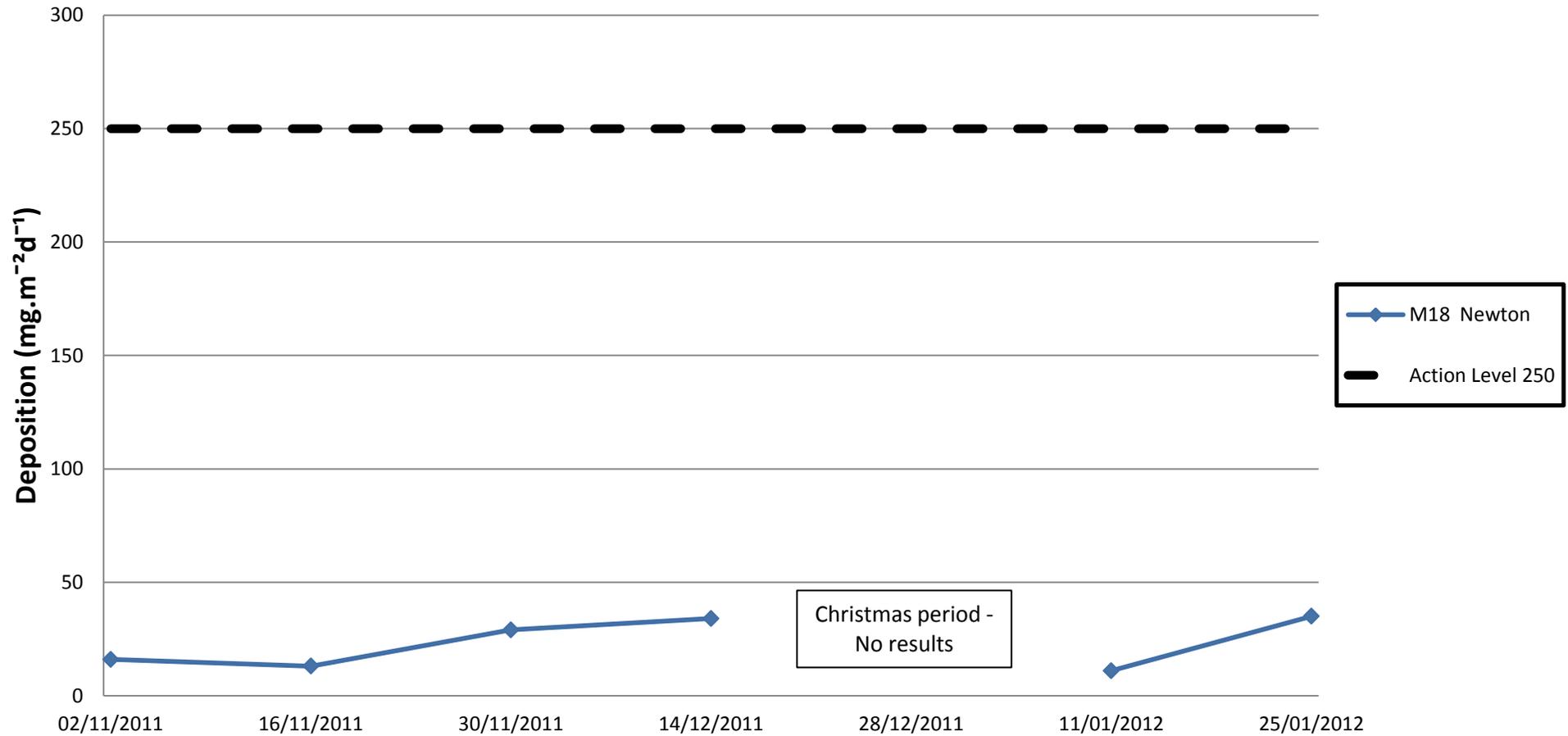
### Locations: M16 Scotstoun Park and M17 Dundas Home Farm



**Note:** No Frisbee dust data results were collected on 28/12/11 as this was during the Christmas period, during which no construction works were conducted.

# Frisbee Dust Deposition Results: November 2011 to January 2012

## Location: M18 Newton



**Note:** No Frisbee dust data results were collected on 28/12/11 as this was during the Christmas period, during which no construction works were conducted.



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## **APPENDIX C – DAILY DUST LOG SUMMARY**

### Daily Dust Log - North - November 2011 to January 2012

Date	Check By	Exceedance?	Dust from Construction (Y/N)	Additional Measures required (Y/N)	Comments	Action (where applicable)
01/11/2011	NAM		N	N	high humidity	
02/11/2011	NAM		N	N	wet ground	
03/11/2011	NAM		N	N	high humidity	
04/11/2011	NAM		N	N	high humidity	
07/11/2011	NAM		N	N	high humidity (fog)	
08/11/2011	LSN		N	N	high humidity (fog)	
09/11/2011	NAM		N	N	high humidity	
10/11/2011	NAM		N	N	high humidity	
11/11/2011	LSN		N	N	high humidity	
14/11/2011	LSN		N	N		
15/11/2011	NAM		N	N	wet ground	
16/11/2011	NAM		N	N	wet ground	
17/11/2011	LSN		N	N		
18/11/2011	NAM		N	N	wet ground	
21/11/2011	LSN		N	N	wet ground	
22/11/2011	LSN		N	N	wet ground	
23/11/2011	NAM		N	N	wet ground	
24/11/2011	NAM		N	N		
25/11/2011	NAM		N	N	high humidity (fog)	
28/11/2011	NAM		N	N	high humidity	
29/11/2011	LSN		N	N	high humidity (fog)	
30/11/2011	NAM		N	N	high humidity	
01/12/2011	LSN		N	N	high humidity	
02/12/2011	NAM		N	N	high humidity (fog)	
05/12/2011	LSN		N	N	high humidity & low temperatures (frozen ground)	
06/12/2011	LSN		N	N	high humidity (fog) & low temperatures (frozen ground)	
07/12/2011	NAM		N	N	high humidity & low temperatures (frozen ground)	
08/12/2011	NAM		N	N	high winds & high humidity	
09/12/2011	LSN		N	N	high humidity & low temperatures	
12/12/2011	NAM		N	N	high humidity & low temperatures	
13/12/2011	ESE		N	N	high humidity & low temperatures	
14/12/2011	ESE		N	N	high humidity & low temperatures	
15/12/2011	LSN		N	N	high humidity & low temperatures	
16/12/2011	ESE		N	N	high humidity & low temperatures	
19/12/2011	LSN		N	N	high humidity & low temperatures	
20/12/2011	ESE		N	N	high humidity	

21/12/2011	ESE		N	N	high humidity	
22/12/2011	KGN		N	N	high humidity	
23/12/2011	LSN		N	N	high humidity	
09/01/2012	ESE		N	N	high humidity	
10/01/2012	NAM		N	N	high humidity (fog)	
11/01/2012	LSN		N	N	high humidity	
12/01/2012	ESE		N	N	wet ground	
13/01/2012	NAM		N	N	high humidity & low temperatures (frozen ground)	
16/01/2012	ESE		N	N	high humidity & low temperatures (frozen ground)	
17/01/2012	KGN		N	N	high humidity (fog)	
18/01/2012	LSN		N	N	high humidity (fog)	
19/01/2012	NAM		N	N	high humidity & low temperatures (frozen ground)	
20/01/2012	ESE		N	N	high humidity	
23/01/2012	ESE		N	N	wet ground	
24/01/2012	KGN		N	N	high humidity & low temperatures	
25/01/2012	KGN		N	N	high humidity	
26/01/2012	ESE		N	N	high humidity (fog) & low temperatures (frozen ground)	
27/01/2012	LSN		N	N	high humidity (fog) & low temperatures (frozen ground)	
30/01/2012	ESE		N	N	low temperatures (frozen ground)	
31/01/2012	ESE		N	N	low temperatures (frozen ground)	

**Daily Dust Log - South - November 2011 to January 2012**

Date	Check By	Exceedence?	Dust from Construction (Y/N)	Additional Measures required (Y/N)	Comments	Action (where applicable)
01/11/2011	NAM		N	N	high humidity	
02/11/2011	NAM		N	N	wet ground	
03/11/2011	NAM		N	N	high humidity	
04/11/2011	NAM		N	N	high humidity	
07/11/2011	NAM		N	N	high humidity (fog)	
08/11/2011	LSN		N	N	high humidity (fog)	
09/11/2011	NAM		N	N	high humidity	
10/11/2011	NAM		N	N	high humidity	
11/11/2011	LSN		N	N	high humidity	
14/11/2011	LSN	Clufflat	N	N		
15/11/2011	NAM	Multiple	N	N	wet ground	
16/11/2011	NAM	Multiple	N	N	wet ground	
17/11/2011	LSN	Multiple	N	N		
18/11/2011	NAM	Clufflat	N	N	wet ground	
21/11/2011	LSN	Multiple	N	N	wet ground	
22/11/2011	LSN	Clufflat	N	N	wet ground	
23/11/2011	NAM	Clufflat	N	N	wet ground	
24/11/2011	NAM	Clufflat	N	N		
25/11/2011	NAM		N	N	high humidity (fog)	
28/11/2011	NAM	Multiple	N	N	high humidity	
29/11/2011	LSN	Clufflat	N	N	high humidity (fog)	
30/11/2011	NAM		N	N	high humidity	
01/12/2011	LSN	Clufflat	N	N	high humidity	
02/12/2011	NAM		N	N	high humidity (fog)	
05/12/2011	LSN		N	N	high humidity & low temperatures (frozen ground)	
06/12/2011	LSN		N	N	high humidity (fog) & low temperatures (frozen ground)	
07/12/2011	NAM		N	N	high humidity & low temperatures (frozen ground)	
08/12/2011	NAM	Clufflat	N	N	high winds & high humidity	
09/12/2011	LSN	Clufflat	N	N	high humidity & low temperatures	
12/12/2011	NAM	Clufflat	N	N	high humidity & low temperatures	
13/12/2011	ESE		N	N	high humidity & low temperatures	
14/12/2011	ESE	Clufflat	N	N	high humidity & low temperatures	
15/12/2011	LSN	Clufflat	N	N	high humidity & low temperatures	
16/12/2011	ESE	Clufflat	N	N	high humidity & low temperatures	
19/12/2011	LSN	Clufflat	N	N	high humidity & low temperatures	
20/12/2011	ESE	Clufflat	N	N	high humidity	

21/12/2011	ESE	Clufflat	N	N	high humidity	
22/12/2011	KGN	Multiple	N	N	high humidity	
23/12/2011	LSN		N	N	high humidity	
09/01/2012	ESE		N	N	high humidity	
10/01/2012	LSN		N	N	high humidity (fog)	
11/01/2012	LSN	Inchgarvie	N	N	high humidity	
12/01/2012	KGN		N	N	wet ground	
13/01/2012	ESE		N	N	high humidity & low temperatures (frozen ground)	
16/01/2012	ESE	Inchgarvie	N	N	high humidity & low temperatures (frozen ground)	
17/01/2012	KGN	Multiple	N	N	high humidity (fog)	
18/01/2012	LSN	Multiple	N	N	high humidity (fog)	
19/01/2012	LSN		N	N	high humidity & low temperatures (frozen ground)	
20/01/2012	ESE		N	N	high humidity	
23/01/2012	ESE		N	N	wet ground	
24/01/2012	KGN		N	N	high humidity & low temperatures	
25/01/2012	KGN		N	N	high humidity	
26/01/2012	ESE		N	N	high humidity (fog) & low temperatures (frozen ground)	
27/01/2012	LSN		N	N	high humidity (fog) & low temperatures (frozen ground)	
30/01/2012	ESE		N	N	low temperatures (frozen ground)	
31/01/2012	ESE		N	N	low temperatures (frozen ground)	