Brooklyn Industrial Precinct

Road Dust Abatement Options Assessment

EPA Victoria

July 2012

Report

Report Preparation

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EPA Victoria

Brooklyn Industrial Estate

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Executive Summary

Net Balance Management Group Pty Ltd (Net Balance) was commissioned by EPA Victoria (EPAV) to prepare an assessment of potential road dust mitigation strategies for identified roads and road verges within the Brooklyn Industrial Precinct, Victoria. The objectives of the assessment were to undertake a literature review of dust mitigation options and to utilise dispersion modelling to compare the current unmitigated dust impacts with the proposed mitigation options with a view to identifying an optimal mitigation strategy.

The roads and verges at the centre of this assessment service a large number of commercial and operational vehicles from the Brooklyn Industrial Precinct. The present condition of the roads and verges varies, with areas of degraded bitumen, significant pot holes and poor drainage. Roads within the precinct are typically covered with a layer of dust/mud deposited by vehicles leaving the unsealed industries that use the roads. The proposed dust mitigation strategies under review included the following treatment methods:

- Establishment of vegetation on the road verges.
- Sealing of roads and road verges.
- Wetting of unsealed road verges.
- Suitable repairs to degraded areas of roads.
- Cleaning (sweeping) of roads.
- Washing of roads.
- Combination of road cleaning (sweeping)/washing and verge treatment.

Based on the assessment detailed in this report, Net Balance makes the following recommendations:

- **Seal Bunting Road**

  Bunting Road is the single largest source of road dust within the precinct. Sealing the road surface has the potential to result in a 47% reduction in PM_{10} emissions from Bunting Road (roughly 10% of total precinct road dust emissions), and will also help reduce emissions from McDonald Road due to track-out.
- **Minimise dust track-on via wheel washes at problematic facility exits**

  Installation of wheel-washes at facility exits has the greatest potential to reduce road dust emissions from the precinct (up to 40% of total precinct road dust emissions). However, due to cost and logistics issues, it is unlikely that this technology can be applied across the entire precinct. As such, it is recommended that the installation of wheel washes target specific facilities (with known track-out issues) along the most problematic roads. Priority roads include Bunting (once sealed), Somerville, Jones, McDonald and Old Geelong Roads.
- **Periodically wash roads and clear build-up from gutters targeting areas of track-out**

  Periodic washing of roads has the potential to provide an overall reduction of 23% of total precinct road dust emissions. It is recommended that road washing targets Somerville and McDonald Roads, as well as Bunting Road (once sealed) and Old Geelong Road (once verges are sealed).

- **Targeted sealing of road verges**
  Sealing of road verges along the western end of Old Geelong Road, as well as at a number of facility exits along Somerville and McDonald Roads is recommended in order to minimise dust track-out. It was noted that vegetation on such road verges cannot presently be sustained due to frequent vehicle movements.

1 Introduction

1.1 Overview

Net Balance Management Group Pty Ltd (Net Balance) were commissioned by EPA Victoria (EPA) to undertake an assessment of road dust (PM_{10})[1] mitigation strategies for potential application in the Brooklyn Industrial Precinct, Victoria.

This project builds upon, and was prepared in parallel to, the road dust assessment presented in the Net Balance's *Brooklyn Industrial Precinct Road Dust Assessment 2012*.

Both projects focus on a number of high dust risk roads, each of which services a large number of commercial and private vehicles from the Brooklyn industrial precinct. The scope of this assessment is confined to the vehicle movements within the identified risk areas at the following locations:

1. Somerville Road (between Paramount Road and Koroit Creek).
2. Paramount Road (between Somerville Road and Indwe Street).
3. McDonald Road.
4. Francis Street (between Cemetery Road and Geelong Road).
5. Cemetery Road.
6. Market Road (between William St and Somerville Road).
7. Old Geelong Road.
8. Jones Road.
9. Bunting Road.

Dust mitigation strategies investigated in this assessment include:

- Minimisation of dust track-out from unsealed sites.
- Establishment of vegetation on the road verges.
- Sealing of roads and road verges.
- Wetting of unsealed road verges.
- Suitable repairs to degraded areas of roads.
- Cleaning (sweeping) of roads.
- Washing of roads.
- Combination of road cleaning (sweeping)/washing and verge treatment.

An aerial photo showing locations of relevance to this study is presented in Figure 1-1.

Particulate emissions in the PM_{10} size fraction were selected as the focus of this study because:

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[1] PM_{10} refers to particulates within an equivalent aerodynamic diameter of 10 microns or less.

- Dust in this size fraction is established as an environmental indicator in the State Environment Protection Policy (Ambient Air Quality) by virtue of its toxicity.
- Long term monitoring of ambient PM_{10} concentrations has been undertaken at a number of locations nearby the Brooklyn Industrial Precinct.
- PM_{10} was agreed with EPA Victoria as the key indicator for assessment.

The present condition of the roads and verges vary, with areas of degraded bitumen, significant pot holes and poor drainage. Roads within the precinct are typically covered with a layer of dust/mud deposited by vehicles leaving the unsealed industries that use the roads. EPAV is currently working with the community and industry to reduce the overall dust burden from the area.

1.2 Objectives

The objectives of this risk assessment are:

1. Undertake a review of literature review focussed on the identified dust mitigation options with a view to providing a quantitative estimate of the potential for abatement.
2. To utilise dispersion modelling to compare the current unmitigated dust (PM_{10}) impacts with the proposed mitigation strategies under PM_{10} emission scenarios based on location-specific traffic data.

1.3 Assessment Methodology

The methodology adopted for the purposes of this assessment can be summarised as follows:

1. Establish a 'base-case' dispersion model configuration for road dust emissions from the Brooklyn industrial precinct under normal operating conditions. Refer to the Net Balance's *Brooklyn Industrial Precinct Road Dust Assessment 2012* for full detail on this methodology item.
2. Undertake a review of literature review focussed on the identified dust mitigation options with a view to:
    a. Provide a quantitative estimate of the potential for abatement.
    b. Identify the most suitable mitigation strategy options with consideration to site constraints.
3. On the basis of observations made by Net Balance during a site visit on 17 April 2012, determine which roads to which each mitigation option:
    a. May be practically applied.
    b. Has the potential to result in the desired dust abatement.
4. Compare the base-case inventory of PM_{10} emissions from the identified high risk areas to

inventories compiled for each mitigation option reviewed.

5. Drawing on steps 1 – 4, undertake dispersion modelling of roadway PM_{10} emissions on the basis of the adopted mitigation strategies utilising the AUSROADS dispersion model.
6. Preparation of contour plots showing predicted ground level PM_{10} concentrations (excluding background levels) for the base case and each mitigation option comparison against the National Environment Protection Measure (Air) and State Environment Protection Policy (Air Quality Management) PM_{10} intervention levels.

FIGURE 1-1

Site Location

0 0.5 1
km

Traffic Monitoring Locations

1	Market St
2	Somerville Rd (west)
3	Somerville Rd (east)
4	Paramount Rd
5	McDonald Rd (north)
6	McDonald Rd (south)
7	Bunting Rd
8	Old Geelong Rd (west)
9	Old Geelong Rd (east)
10	Francis St
11	Cemetery Rd

Brooklyn Industrial Precinct

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2 Literature Review

Each identified mitigation option is discussed below with reference to:

1. Potential effectiveness for generic road applications.
2. Potential effectiveness in application to the Brooklyn Industrial Precinct.

2.1 Minimisation of dust track-out from unsealed sites

2.1.1 Potential mitigation

Wet dust suppression is one of the most common methods used to control open dust sources at construction sites because a source of water tends to be readily available on a construction site[2]. There are a number of products available to enable efficient wheel wash performance, wide enough to accommodate most articulated dump trucks up to 30 tonnes. Additional suppression methods include sealing pavements and limiting vehicle speeds, providing a potential range of 40-80% reduction in PM_{10} emissions caused by dust track-out. 50% reduction was utilised for modelling purposes to determine the effective potential mitigation.

2.1.2 Applicability

Net Balance's site visit found dust track-out to be a key cause of road dust emissions in the Brooklyn Industrial Precinct. It is considered that application of measures to reduce dust track-out are a key strategy for reducing overall emissions. Example measures include:

- Wheel washes at the exits to unsealed sites.
- Sealing site driveways.
- Sealing road verges near site exits.

Examples of dust track-out in the Brooklyn industrial precinct are provided below.

[2] Countess Environmental. (2006) *WRAP Fugitive Dust Handbook.* Western Governors' Association, Colorado.

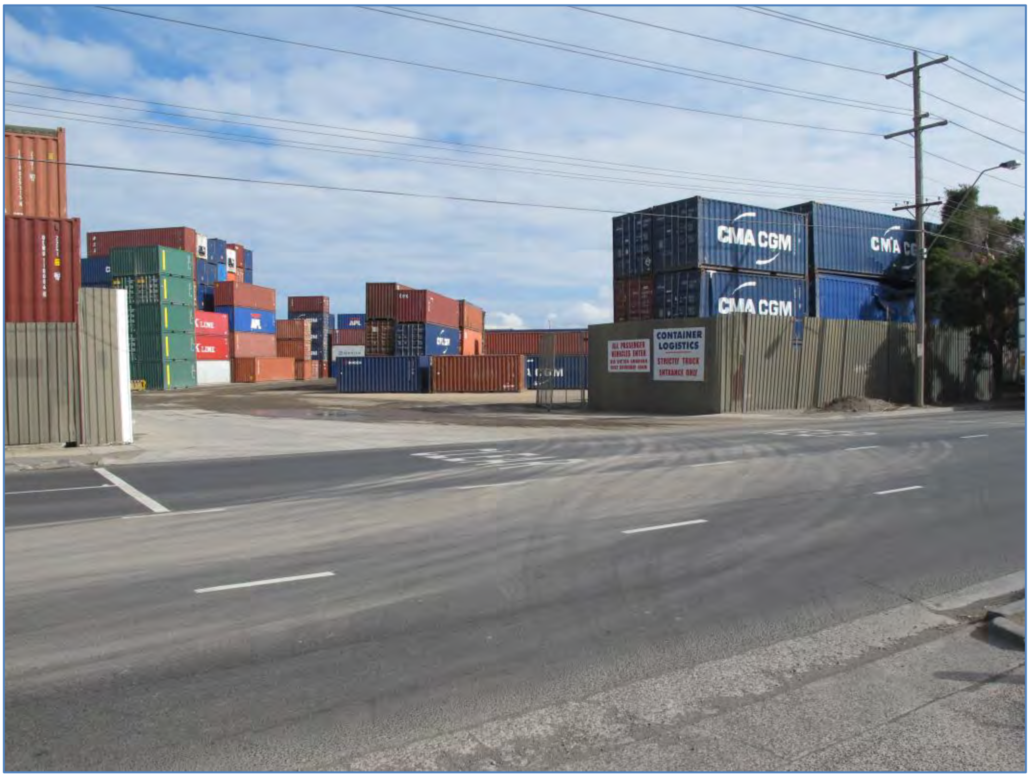

Figure 2-1 Somerville Rd site exit – Example 1

Figure 2-2 Somerville Rd – Example 2

Figure 2-3 McDonald Rd site exit – Example 3

Figure 2-4 Jones Rd – Example 4

2.2 Establishment of vegetation on the road verges

2.2.1 Potential mitigation

Unpaved roads and verges generally consist of a graded and compacted road bed. The forces created by the rolling wheels of vehicles remove fine particles from the road bed and also pulverise aggregates lying on the surface[3], commonly creating a source of dust nuisance.

Vehicle movements along paved roads with unpaved shoulders (verges) have the potential to contribute to fugitive PM_{10} emissions. In addition to this, a portion of paved road dust emissions are suspected to be from dust carried out of unpaved roads or verges which are subsequently deposited on paved road surfaces.

No-till and minimum-till vegetation planting procedures minimise topsoil erosion, conserve water and reduce dust emissions[4]. This mitigation strategy can reduce wind-generated fugitive emissions because vegetative cover is left on the soil surface. The fraction of vegetative cover along with its shape and density of coverage determines the effectiveness of dust control[5].

The potential challenges of establishing vegetation in the road verges as a dust mitigation strategy include ensuring the vegetation can grow in trafficable areas, and complying with applicable road and safety standards.

2.2.2 Applicability

Net Balance's site visit found that verges on the majority of roads investigated are sealed or vegetated. Exceptions to this include:

- Old Geelong Road, with wide unsealed verges west of the Jones Road intersection and obvious dust track-on issues (refer Figure 2-5).
- Exits from sites, particularly along Somerville and McDonald Roads, where vegetation cannot be sustained on road verges due to frequent vehicle movements (refer Figure 2-6).

On the basis of these observations, it is considered that the establishment of vegetation on road verges is only applicable to the west end of Old Geelong Road and may not be sufficiently resilient to vehicle movements for application in this instance.

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[3] Watson, Dr J. G. (1996) *Effectiveness Demonstration of Fugitive Dust Control Methods for Public Unpaved Roads and Unpaved Shoulders on Paved Roads* (DRI Document No. 685-5200). Fresno: Desert Research Institute.

[4] Rice, R. W., (1983) *Fundamentals of no-till farming*. Athens: American Association for Vocational Instructional Materials.

[5] Leys, J. F., (1991) *Towards a better model of the effect of prostate vegetation cover on wind erosion.* Vegetatio.

Figure 2-5 Old Geelong Road verge, west of Jones Road

Figure 2-6 Road verge vegetation, Somerville Road

2.3 Sealing of roads and road verges

2.3.1 Potential mitigation

Unpaved roads and other unpaved areas with vehicular activity are unlimited sources of dust when vehicles are moving. The grinding of particles by tires against the road surface shifts the size distribution toward smaller particles, especially those in the PM_{10} fraction[4].

Because fine particles easily become airborne along unpaved areas, an effective mitigation strategy is to seal these areas, thus reducing the amount of fugitive dust as the road surface is not easily pulverised by vehicle tires.

Where unsealed road and road verges are subject to frequent vehicle movement, is considered that emissions may be reduced significantly by sealing such areas. On the basis of emission factors established for paved and unpaved roads in Net Balance's *Brooklyn Industrial Precinct Road Dust Assessment 2012*, it is considered that sealing highly trafficked roads and road verges has the potential to reduce emissions by 53% from those roads/verges.

2.3.2 Applicability

The majority of roads and road verges in the Brooklyn industrial precinct are sealed, with the exception of:

- Bunting Road, a known major dust source in the area (refer Figure 2-7).
- Old Geelong Road, with wide unsealed verges west of the Jones Road intersection and obvious dust track-on issues (Figure 2-1).
- Exits from sites, particularly along Somerville and McDonald Roads, where vegetation cannot be sustained on road verges due to frequent vehicle movements (refer back to above figure) (refer Figure 2-6).

It is considered that sealing of these roads and verges offers a practical dust mitigation option for the Brooklyn industrial precinct.

Figure 2-7 Bunting Road

2.4 Wetting of unsealed road verges

2.4.1 Potential mitigation

Water adhering to soil particles increases mass and surface tension forces, thereby decreasing suspension and fugitive dust transport[6]. Furthermore, cohesion of wetted particles often persists after the water has evaporated due to the formation of aggregates and surface crusts, providing additional dust mitigation. Rosbury and Zimmer[7] concluded that the addition of water to create surface moisture content exceeding 2%, resulted in more than 80% reductions for PM_{10} emissions when compared to an unmitigated surface. A more recent study by Flocchini[8] affirmed that

[6] Watson J. G., Chow, J. C., Thomson, G, P. (2000) *Air Pollution Engineering Manual – Chapter 4 – Fugitive Dust Emissions.* Air & Waste Management Association.

[7] Rosbury, K. D., Zimmer, R. A., (1983) *Cost-effectiveness of dust controls used on unpaved haul roads, Volume I – Results, analysis, and conclusions.* PEDCo Environmental Inc.

[8] Flocchini, R. G., Cahill, T. A., Matsumaura, R. T., Carvacho, O., Lu, Z., (1994) *Study of fugitive PM_{10} emissions from selected agricultural practices on selected agricultural soils.*

increasing the surface moisture content from 0.56% to 2% can achieve greater than 86% reduction in PM_{10} emissions.

It is important to note, however, that excessive moisture causes dust to adhere to vehicles surfaces, where it can be carried out of unpaved roads, and deposited on paved (or unpaved) surfaces. This situation may create a worsening effect on existing dust conditions due to the increased volume of soil and dust in disturbance areas. This problem is reported to exist within Brooklyn Industrial Precinct where trucks leave heavily watered sites. As such, any application of this measure should be undertaken judiciously so as not to cancel-out any potential benefits.

While it is evident that wetting of unsealed road verges can provide an effective mitigation strategy, it should be noted that the same amount of moisture affects different dust surfaces in different ways[4], and a soil survey may be required in order to determine the soil's relative ability to absorb moisture prior to adhering to wheels and vehicle surfaces.

2.4.2 Applicability

The only road within the survey area with unsealed road verges suitable for the application of this measure is the western end of Old Geelong Road. However, it is considered that dust emissions from this verge are associated more with vehicle track-on of material only the sealed road surface, rather than direct dust emissions from vehicles driving on the verge. As such, it is considered that the application of watering to unsealed road verges has limited applicability in the Brooklyn industrial precinct (Figure 2-5).

2.5 Suitable repairs to degraded areas of roads

2.5.1 Potential mitigation

Areas of degraded bitumen, significant pot holes and poor drainage can result in the pulverisation of exposed road base material by frequent traffic, which in turn acts as localised unpaved road surfaces. By repairing the affected areas, the road will be reinstated to former condition and the effect of fugitive dust sources will be reduced to paved road levels.

2.5.2 Applicability

With the exception of Bunting Road, which is effectively unpaved (and is therefore best managed as per Section 2.3), Jones Road was found to be the most degraded of the roads surveyed. Other road surfaces were generally found to be in good condition. As demonstrated in Figure 2-4, dust emissions from Jones Road are primarily associated with dust track-on from unsealed sites. As such, it is considered that this mitigation option has limited applicability in the Brooklyn industrial precinct.

2.6 Cleaning (sweeping) of roads

2.6.1 Potential mitigation

Mechanical broom sweepers use large rotating brooms to lift the material from the street onto a conveyor belt. In the context of dust mitigation, many studies have concluded that the method is ineffective.

Chow *et al*. (1990)[9] conducted a street sweeping study specifically addressing the potential reduction of PM_{10} emissions from paved roads. The authors concluded that daily street sweeping with a regenerative air vacuum sweeper resulted in no detectable reductions in geological contributions to PM_{10} in the sweeping area[1]. The street sweeper used in the study proved to be ineffective for reducing the PM_{10} emissions from the road surface.

A study conducted by the Australian Cooperative Research Centre for Catchment Hydrology also observed the effectiveness of Australian street sweeping and concluded that no effective removal (greater than 50% removal efficiency) was evident for particle sizes smaller than 125 microns[10].

2.6.2 Applicability

On the basis of the above-discussed studies, it is considered that mechanical street sweeping is not likely to provide significant reductions in PM_{10} emissions from roads in the Brooklyn industrial precinct. However, on the basis of Sections 2.7 and 2.8, which address road washing and a combination of road washing/sweeping, it is considered that sweeping alone has the potential to result in a 17% reduction in emission from subject road surfaces.). Such sweeping should be conducted periodically and target areas where dust track-out from unsealed sites is evident (refer Figure 2-1).

2.7 Washing of roads

2.7.1 Potential mitigation

The washing of roads can be compared to water flushing, which is a method of using pressurised sprays from a water truck to dislodge road dust and transport it to the kerb (where a kerb exists).

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[9] Chow, J.C., J.G. Watson, R.T. Egami, C.A. Frazier, Z. Lu, A. Goodrich and A. Bird (1990). *Evaluation of regenerative-air vacuum street sweeping on geological contributions to PM_{10}*. J. Air Waste Manage. Assoc. 40, 1134-1 142.

[10] Walker, T. A., Wong, T. H. F., (1999) *Effectiveness of street sweeping for stormwater pollution control.* Cooperative Research Centre for Catchment Hydrology (CRC-CH).

Water flushing generally results in more consistent and higher efficiencies than sweeping, with 30-80% effectiveness[11].

Water flushing can be expected to reduce particle re-suspension while the road surface is still wet[4], but attention should be drawn to state planning policies and guidelines regarding the deposition of sediment into stormwater systems. It may be necessary to implement an erosion and sedimentation control plan in order to prevent excessive sediments entering stormwater drainage structures and outlets.

2.7.2 Applicability

It is considered that road washing alone offers the potential to reduce dust emissions by 30% from roads subject to such treatment (the lower end of the potential range). Such washing should be conducted periodically and target areas where dust track-out from unsealed sites is evident (refer Figure 2-1).

2.8 Combination of road cleaning (sweeping)/washing

2.8.1 Potential mitigation

The combinations of water flushing and sweeping has been recorded to be effective, removing 47-90% of particulates[4]. It is important to highlight the potential constraints associated with complying with guidelines regarding the deposition of sediment into stormwater systems.

2.8.2 Applicability

It was noted during the site visit that material washed from the wood surface during rain events collects in gutters where it can be re-entrained. This observation indicates that any road washing should be accompanied by efforts to remove built-up material from gutters and locations where it may be tracked back out onto roads and re-entrained. Such washing should be conducted periodically and target areas where dust track-out from unsealed sites is evident. An example of such a location is provided in Figure 2-8.

[11] U.S. EPA (1982) *Control techniques for particulate emissions from stationary sources* (Report No. PB83-127480). NC: Research Triangle Park.

Figure 2-8 Paramount Road: material build-up in kerb

3 Potential Emissions Reductions

Table 3-1 lists each of the modelling scenarios that were used to determine the most desirable dust abatement options for each road. The modelling scenarios that were included were:

- Wheel washes at facility exits;
- Sealing of the roads and road verges;
- Periodic cleaning (sweeping) of roads;
- Periodic washing of roads; and
- A combination of road cleaning sweeping/washing and various verge treatments.

There were several modelling scenarios which were considered to be impractical or ineffective dust abatement options for the Brooklyn Industrial Precinct, as revealed in the Literature Review (Section 2 of this report):

- Establishment of vegetation on the road verges;
- Wetting of road verges on predicted poor air quality days; and
- Repairs conducted to roads.

The above scenarios were considered to have no likely benefit on reducing PM_{10} emissions and were hence excluded from the modelling exercise.

Table 3-2 shows the expected results of PM_{10} emissions for each abatement option that was modelled. PM_{10} emissions were modelled and estimated based on techniques previously outlined in air quality dispersion modelling prepared for EPA Victoria by Net Balance, and includes the following:

- Emissions Estimation Techniques detailed in USEPA AP 42 Compilation of Air Pollutant Emission Factors – 13.2.1 Paved Roads.
- Emissions Estimation Techniques detailed in the National Pollutant Inventory Emissions Estimation Technique Manual for Mining V2.3.
- Traffic data for each location recorded for Net Balance by Counters Plus Pty Ltd between 17 April and 16 May 2012.

A site inspection was undertaken by Net Balance on the 17th of April 2012, the findings from which facilitated the characterisation of the surface of each road and informed the adoption of appropriate emission rates.

Table 3-1 Investigated dust abatement options and potential effectiveness (% reduction) for each road

Road	Identified dust sources	Verge condition	Road condition	Wheel washes at facility exits	Sealing of the roads and road verges.	Periodic cleaning (sweeping) of roads.	Periodic washing of roads.	A combination of road cleaning sweeping/washing and various verge treatments.
Market Rd	Dust is tracked in from other locations - no unsealed entrances.	Grass - good condition. Minimal exposed earth. Concrete drains.	Good	0%	0%	17%	30%	47%
Somerville Rd (east)	Several unsealed entrances causing dust track-on.	Some un-vegetated verges at entrances, but track-on is minor.	Good	50%	0%	17%	30%	47%
Somerville Rd (west)	Several unsealed entrances causing dust track-on.	Some un-vegetated verges at entrances, but track-on is minor.	Good	50%	0%	17%	30%	47%
Paramount Rd	Several unsealed entrances causing dust track-on.	Some un-vegetated verges, but track-on is minor.	Good	50%	0%	17%	30%	47%
McDonald Rd (north)	Several unsealed entrances causing dust track-on.	Some un-vegetated verges, but track-on is minor.	Good	50%	0%	17%	30%	47%
McDonald Rd (south)	Dust is tracked in from other locations - no unsealed entrances.	Grass - good condition. Minimal exposed earth. Concrete drains.	Good	50%	0%	17%	30%	47%
Bunting Rd	Unsealed road and entrances.	Unsealed verges with no drainage	Poor	50%	47%	0%	0%	0%
Old Geelong Rd (east)	Track-on from unsealed site and road verges.	Unsealed road verges with no drainage.	Moderate	50%	24%	17%	30%	47%

Road	Identified dust sources	Verge condition	Road condition	Wheel washes at facility exits	Sealing of the roads and road verges.	Periodic cleaning (sweeping) of roads.	Periodic washing of roads.	A combination of road cleaning sweeping/washing and various verge treatments.
Old Geelong Rd (west)	Dust is tracked in from other locations - no unsealed entrances.	Grass - good condition. Minimal exposed earth. Concrete drains.	Good	50%	0%	17%	30%	47%
Francis St	Dust is tracked in from other locations - no unsealed entrances.	Grass - good condition. Minimal exposed earth. Concrete drains.	Good	0%	0%	17%	30%	47%
Cemetery Rd	Dust is tracked in from other locations - no unsealed entrances.	Grass - good condition. Minimal exposed earth. Concrete drains.	Good	0%	0%	17%	30%	47%
Jones Rd	Track-on from unsealed site and road verges.	Unsealed road verges with no drainage.	Moderate to poor	50%	24%	17%	30%	47%

Table 3-2 Predicted annual PM_{10} emissions following application of each proposed dust abatement option

Road	t PM_{10}/year					
	No Mitigation	Wheel washes at facility exits	Sealing of the roads and road verges.	Periodic cleaning (sweeping) of roads.	Periodic washing of roads.	A combination of road cleaning sweeping/washing and various verge treatments.
Market Rd	18	18	18	15	12	9
Somerville Rd (West of McDonald)	41	21	41	34	29	22
Somerville Rd (East of McDonald)	34	17	34	28	24	18
Paramount Rd	11	6	11	10	8	6
McDonald Rd (North of Bunting)	11	5	11	9	8	6
McDonald Rd (South of Bunting)	19	10	19	16	13	10
Bunting Rd	60	30	32	60	60	60
Old Geelong Rd (West of Jones)	7	3	5	6	5	4
Old Geelong Rd (East of Jones)	9	5	9	8	7	5
Francis St	23	23	23	19	16	12
Cemetery Rd	2	2	2	2	1	1
Jones Rd	21	10	16	17	15	11
Precinct total	**257**	**150**	**222**	**224**	**198**	**164**

4 Potential Impact Reductions

The 5 proposed mitigation options where compared against the base-case scenarios from the air quality dispersion modelling previously prepared for EPA Victoria by Net Balance.

4.1 Atmospheric dispersion modelling

Dispersion Modelling was undertaken using the EPA Victoria model – AUSROADS. Default model settings have were adopted except in cases where adjustments have been made to configure the model to reflect specific site and anemometer location characteristics. Table 4-1 summarises the AUSROADS model Configuration and

Table 4-2 the geometry of modelled roadways. Further setting details can be found in the attached AUSROADS text output file (see Appendix B:).

This study utilised multiple receptors and the emission rates detailed in Section 3 to predict ground level PM_{10} concentrations over a broad spatial domain in order to gauge the impact of vehicle-generates PM_{10} emissions from the precinct relative to the NEPM air quality standard and SEPP(AQM) intervention level.

The 2002 EPA regulatory dispersion modelling datasets contain a set of background PM_{10} concentration data for use in regulatory assessments. This dataset demonstrates frequent elevated PM_{10} levels (although no exceedances of either the NEPM air quality standard or SEPP(AQM) intervention level). As the direct inclusion of such data in the dispersion model configurations would obscure the detail of impacts from individual sources (i.e. the subjects of this study), it was instead included indirectly, via the use of the third model configuration, described above.

Table 4-1 AUSROADS model configuration

Parameter	Setting
Meteorological Dataset	2002 Footscray EPA Regulatory dataset.
Link Types	At Grade
Lanes	2
Lane Width (metres)	4
Background Concentration	0
Anemometer Height	12m
Sigma Theta Averaging Period	60 mins
Met. Site Roughness Height	0.5m
Horizontal Dispersion	Sigma Theta
Wind Profile Exponents	Irwin Urban
Averaging Times	24 hour
Terrain Effects	Ignored (due to relatively flat regional terrain).
Surface Roughness	Residential (0.4m)

Table 4-2 Roadway geometry

Road	X1	Y1	X2	Y2	Length
Market Rd	309,666	5,813,314	309,769	5,814,037	730
Somerville Rd (West of McDonald)	309,302	5,813,362	310,583	5,813,184	1,293
Somerville Rd (East of McDonald)	310,583	5,813,184	311,691	5,813,035	1,118
Paramount Rd	311,691	5,813,035	311,785	5,813,786	757
McDonald Rd (North of Bunting)	310,536	5,812,853	310,583	5,813,184	334
McDonald Rd (South of Bunting)	310,448	5,812,264	310,536	5,812,853	596
Bunting Rd	309,589	5,812,992	310,536	5,812,853	957
Old Geelong Rd (West of Jones)	308,881	5,811,993	309,165	5,811,957	286
Old Geelong Rd (East of Jones)	309,165	5,811,957	309,434	5,811,921	271
Francis St	310,764	5,812,323	311,546	5,812,215	789
Cemetery Rd	311,546	5,812,215	311,597	5,812,576	365
Jones Rd	309,165	5,811,957	309,314	5,813,017	1,070

4.2 Potential impacts and improvements

Without abatement, PM_{10} emissions are predicted to result in peak PM_{10} concentrations at the nearest residential area that exceed the NEPM air quality standard and SEPP(AQM) intervention levels to the south of the industrial precinct (south of Geelong Road and McDonald Road intersection.

Each abatement option has the potential to yield the following potential improvements:

- **Wheel washes at facility exits**

  The results are shown in Figure A-2. The number of properties with NEPM and SEPP exceedances to south of the precinct are expected to be reduced by approximately 70-80% based on area. Total PM_{10} emissions from the precinct are expected to be reduced by 107 Tonnes per year.
- **Sealing of the roads and road verges**

  The results are shown in Figure A-3. The number of properties with NEPM and SEPP exceedances to south of the precinct are expected to be reduced by approximately 10-20% based on area. Total PM_{10} emissions from the precinct are expected to be reduced by 34 Tonnes per year.

- **Periodic cleaning (sweeping) of roads**

  The results are shown in Figure A-4. The number of properties with NEPM and SEPP exceedances to south of the precinct are expected to be reduced by approximately 15-25% based on area. Total PM_{10} emissions from the precinct are expected to be reduced by 33 Tonnes per year.

- **Periodic washing of roads**

  The results are shown in Figure A-5. The number of properties with NEPM and SEPP exceedances to south of the precinct are expected to be reduced by approximately 30-40% based on area. Total PM_{10} emissions from the precinct are expected to be reduced by 59 Tonnes per year.

- **A combination of road cleaning sweeping/washing and various verge treatments**

  The results are shown in Figure A-6. The number of properties with NEPM and SEPP exceedances to south of the precinct are expected to reduce by approximately 60-70% based on area. Total PM_{10} emissions from the precinct are expected to be reduced by 92 Tonnes per year.

5 Conclusions and Recommendations

Based on the assessed abatement options and the results summarised in Table 3-2 and Section 4.2, a combination of abatement options is considered to provide the optimum solution. Net Balance therefore makes the following recommendations:

- **Seal Bunting Road**
  Bunting Road is the single largest source of road dust within the precinct. Sealing the road surface has the potential to result in a 47% reduction in PM_{10} emissions from Bunting Road (roughly 10% of total precinct road dust emissions), and will also help reduce emissions from McDonald Road due to track-out.
- **Minimise dust track-on via wheel washes at problematic facility exits**
  Installation of wheel-washes at facility exits has the greatest potential to reduce road dust emissions from the precinct (up to 40% of total precinct road dust emissions). However, due to cost and logistics issues, it is unlikely that this technology can be applied across the entire precinct. As such, it is recommended that the installation of wheel washes target specific facilities (with known track-out issues) along the most problematic roads. Priority roads include Bunting (once sealed), Somerville, Jones, McDonald and Old Geelong Roads.
- **Periodically wash roads and clear build-up from gutters targeting areas of track-out**
  Periodic washing of roads has the potential to provide an overall reduction of 23% of total precinct road dust emissions. It is recommended that road washing targets Somerville and McDonald Roads, as well as Bunting Road (once sealed) and Old Geelong Road (once verges are sealed).
- **Targeted sealing of road verges**
  Sealing of road verges along the western end of Old Geelong Road, as well as at a number of facility exits along Somerville and McDonald Roads is recommended in order to minimise dust track-out. It was noted that vegetation on such road verges cannot presently be sustained due to frequent vehicle movements.

6 Limitations

Net Balance Management Group Pty Ltd (Net Balance) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for use by EPA Victoria and only those third parties who have been authorised in writing by Net Balance. The report is based on Net Balance's interpretation of the State Environment Protection Policies and generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the project brief.

The methodology adopted and sources of information used by Net Balance are outlined in this report. All data used in the assessment was supplied through verified means, and Net Balance has assumed that all data supplied is accurate and complete unless otherwise indicated. Net Balance has made no independent verification of this information beyond the agreed scope of works and Net Balance assumes no responsibility for any inaccuracies or omissions.

This report was prepared through May to June 2012 and is based on the conditions encountered and information reviewed at the time of preparation. Net Balance disclaims responsibility for any changes that may have occurred after this time.

The outputs of dispersion modelling are highly dependent on the quality of input data. Therefore, Net Balance and EPA Victoria are of the opinion that the results of modelling can only be used for broad guidance as to potential environmental impacts.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Appendix A: **Contour Plots**

FIGURE A-1

PM10 Emissions from Roads
No abatement

0 0.5 1
km

Contours:
PM10 Concentration (ug/m3)
Predicted Peak
24-hour Average
No Background

SEPP(AQM) Intervention Level

60 ug/m3
24- hour average

NEPM Air Quality Standard

50 ug/m3
24- hour average
Goal: Less than 5 exceedances per year

Brooklyn Industrial Precinct

MMPJ12EPA037 Brooklyn Dust 12

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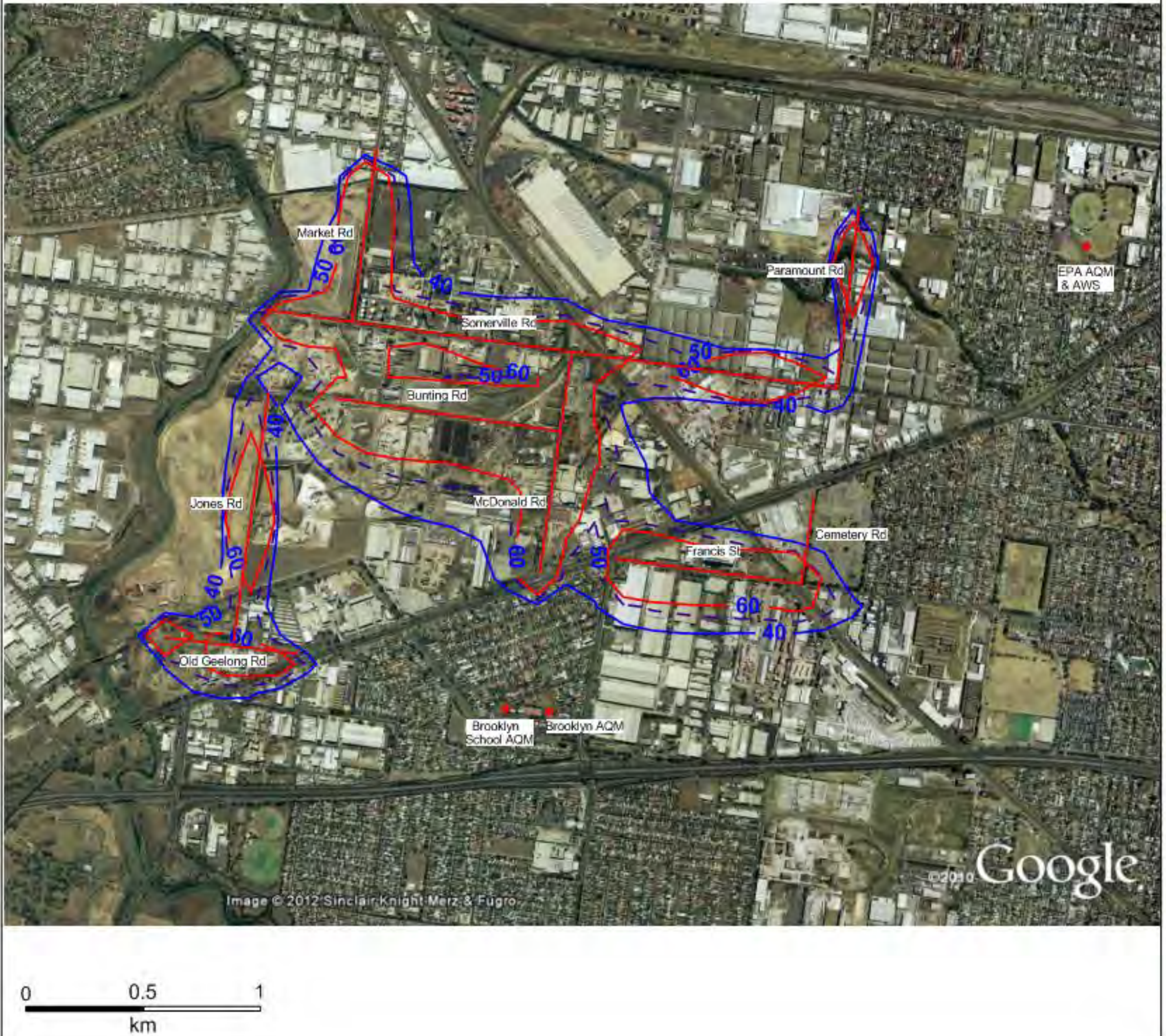

FIGURE A-2

PM10 Emissions from Roads
Reduced track-on

Contours:
PM10 Concentration (ug/m3)
Predicted Peak
24-hour Average
No Background

SEPP(AQM) Intervention Level

60 ug/m3
24- hour average

NEPM Air Quality Standard

50 ug/m3
24- hour average
Goal: Less than 5 exceedances per year

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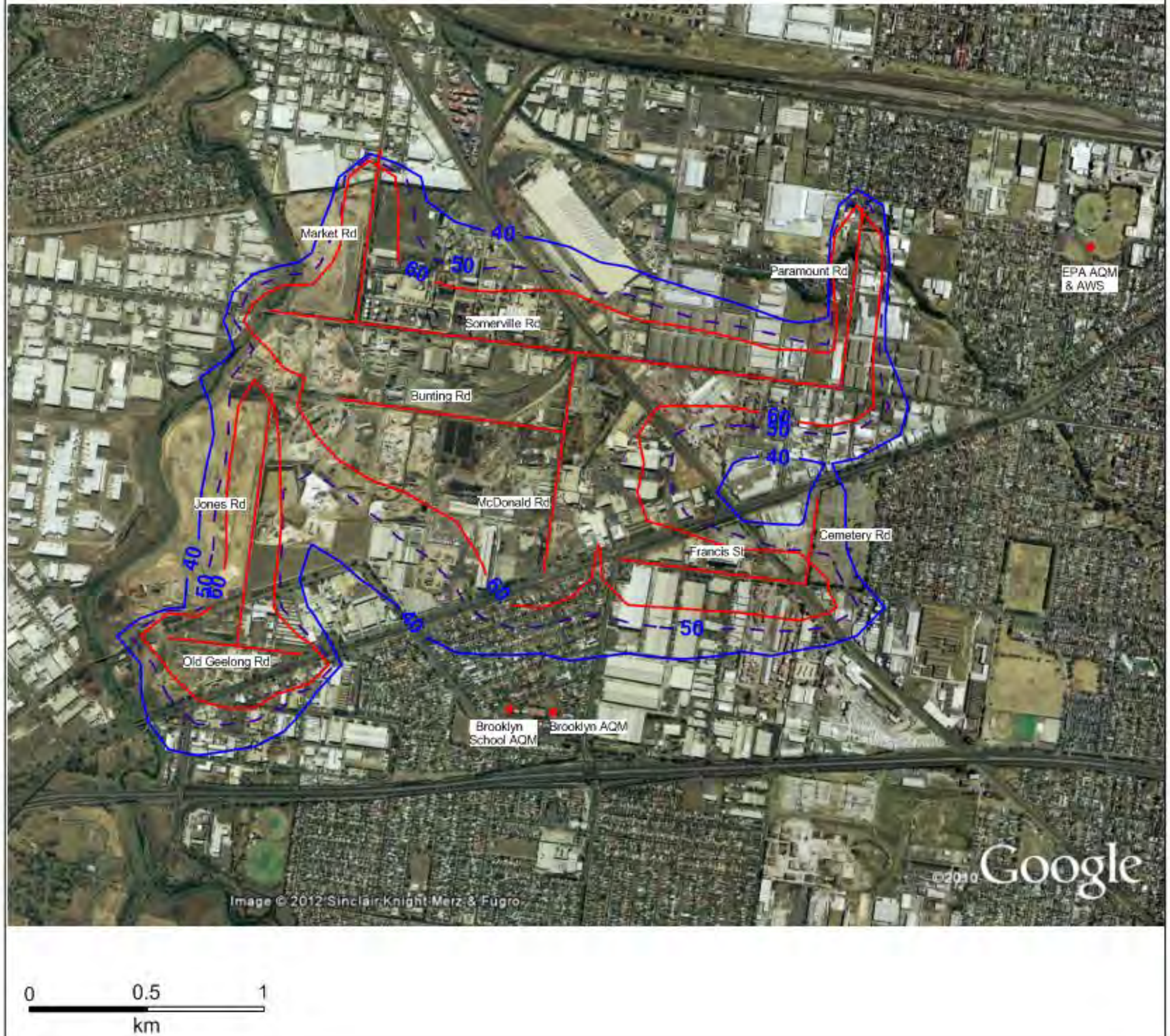

FIGURE A-3

PM10 Emissions from Roads
Sealing of the roads and road verges

Contours:
PM10 Concentration (ug/m3)
Predicted Peak
24-hour Average
No Background

SEPP(AQM) Intervention Level

60 ug/m3
24- hour average

NEPM Air Quality Standard

50 ug/m3
24- hour average
Goal: Less than 5 exceedances per year

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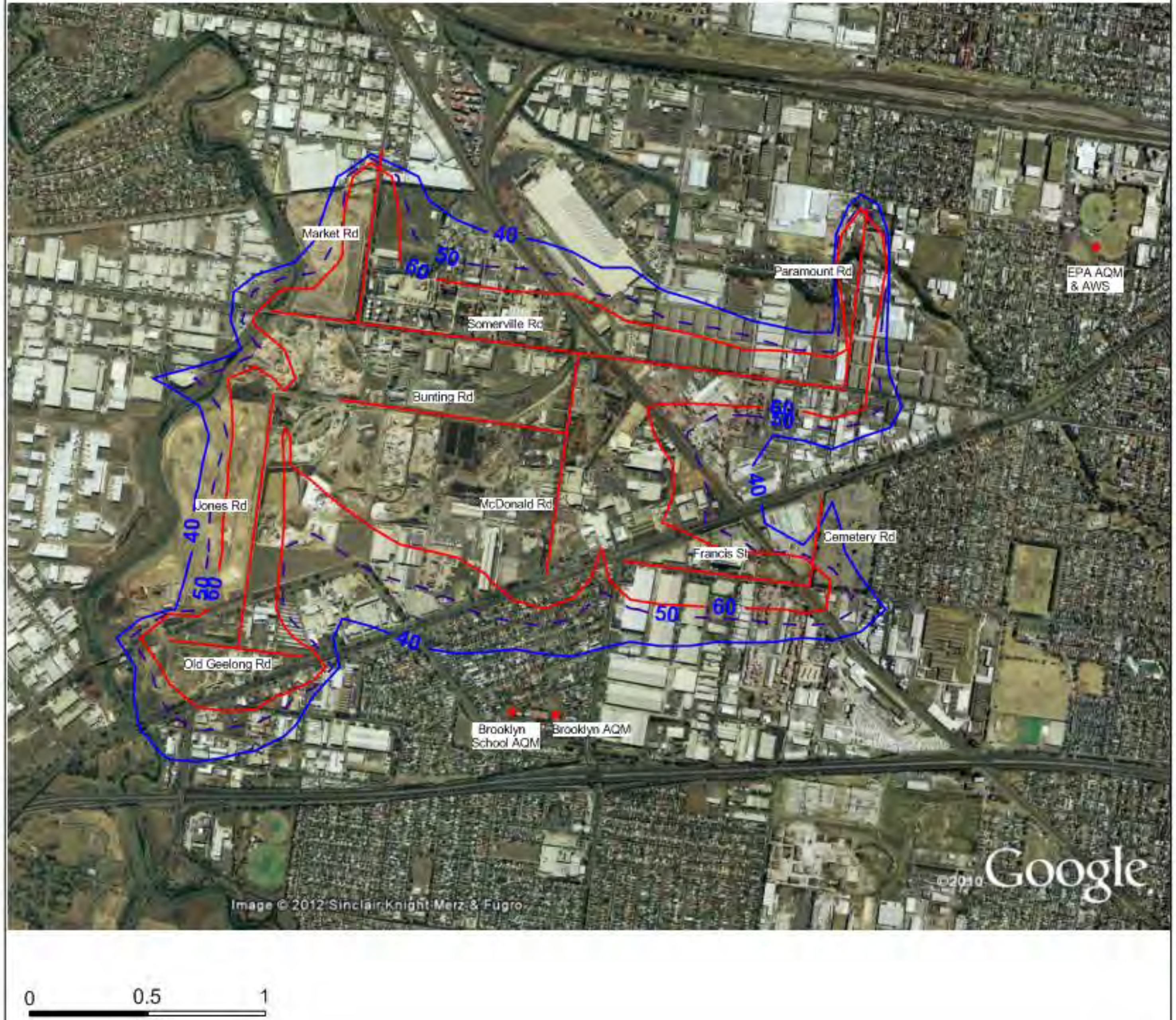

FIGURE A-4

PM10 Emissions from Roads
Periodic cleaning (sweeping) of roads

Contours:
PM10 Concentration (ug/m3)
Predicted Peak
24-hour Average
No Background

SEPP(AQM) Intervention Level

60 ug/m3
24- hour average

NEPM Air Quality Standard

50 ug/m3
24- hour average
Goal: Less than 5 exceedances per year

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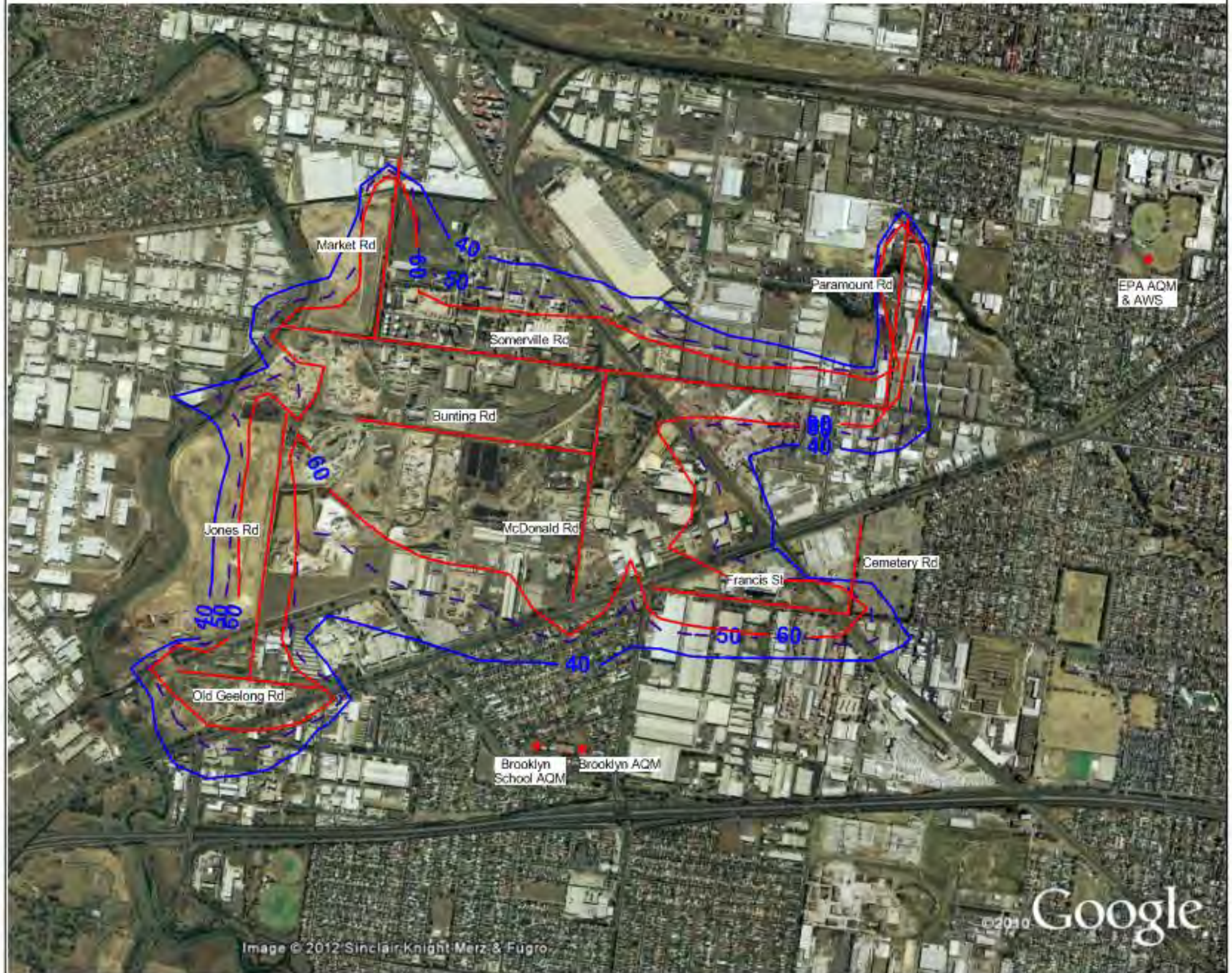

0 0.5 1
km

FIGURE A-5

PM10 Emissions from Roads
Periodic washing of roads

Contours:
PM10 Concentration (ug/m3)
Predicted Peak
24-hour Average
No Background

SEPP(AQM) Intervention Level

60 ug/m3
24- hour average

NEPM Air Quality Standard

50 ug/m3
24- hour average
Goal: Less than 5 exceedances per year

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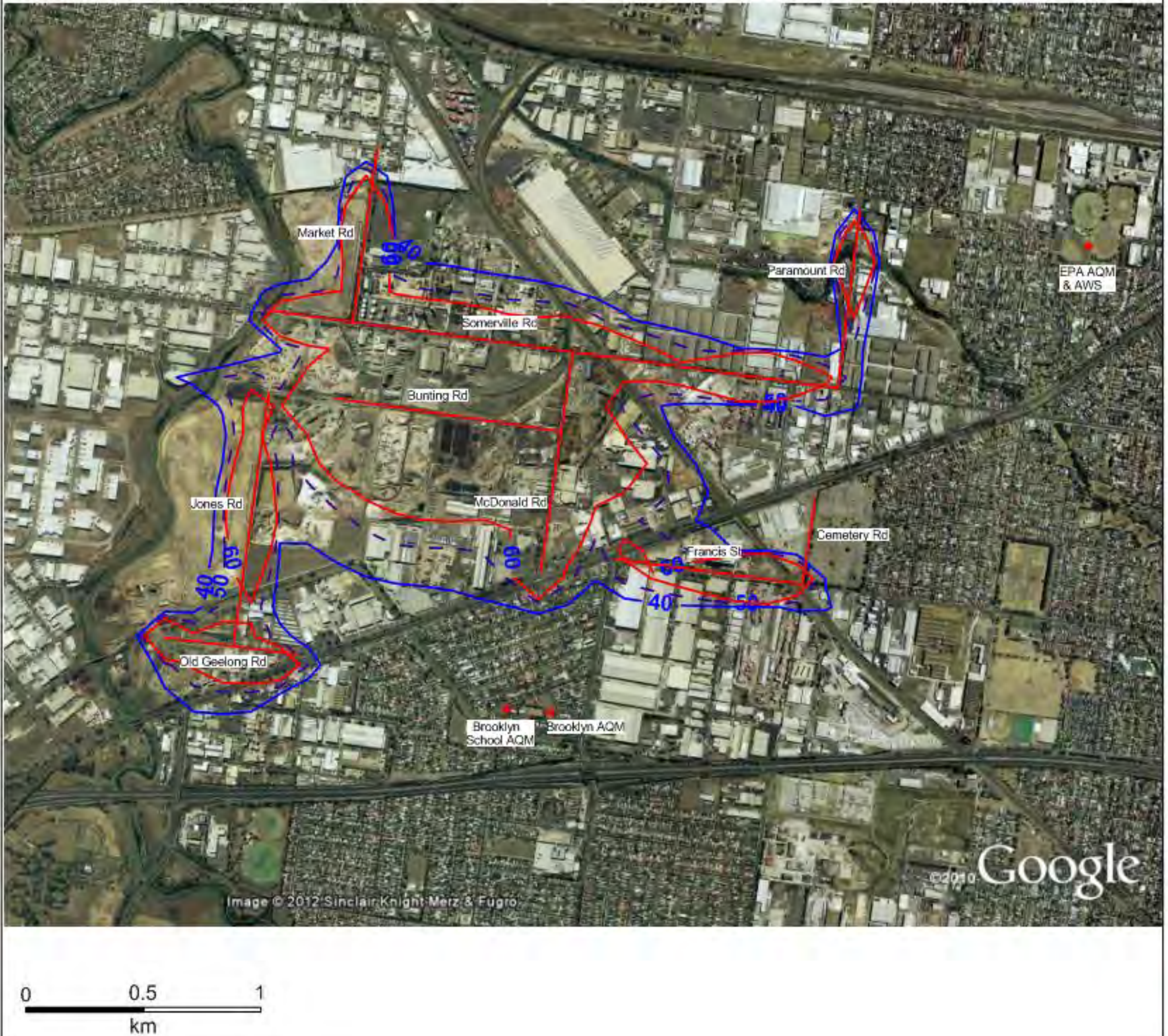

FIGURE A-6

PM10 Emissions from Roads
Periodic washing and sweeeping of roads

Contours:
PM10 Concentration (ug/m3)
Predicted Peak
24-hour Average
No Background

SEPP(AQM) Intervention Level

60 ug/m3
24- hour average

NEPM Air Quality Standard

50 ug/m3
24- hour average
Goal: Less than 5 exceedances per year

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