Appendix L

Preliminary Hazard Analysis

Sustainable Resource Centre, Terlba

CiviLake

17 June 2010

Preliminary Hazard Analysis

Sustainable Resource Centre, Teralba

Preliminary Hazard Analysis

Sustainable Resource Centre, Teralba

Prepared for

CiviLake

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Introduction

Lake Macquarie City Council (LMCC) proposes to construct a waste recycling facility (the Facility) at Teralba, NSW. The Facility will be primarily for crushing, grinding and separating hard waste/ construction and demolition materials. The Facility has a number of potentially hazardous operations including fuelling of plant and equipment, potentially contaminated run-off and equipment fires. These may impact offsite and could cause bushfire at the adjacent properties. Hence, LMCC has engaged AECOM to conduct a preliminary hazard analysis (PHA) of the proposed Facility, the aim of which is to identify whether the proposed site operations have the potential to result in adverse offsite impacts.

Methodology

The methodology selected for the study was that prescribed in Hazardous Industry Planning Advisory Paper No.6, Hazard Analysis Guidelines.

Brief Description of the Proposed Facility

The proposed recycling facility (the Facility) would be located about 2kms north of Teralba on the floodplain to the south and west of Cockle Creek in the local council area of Lake Macquarie City Council (the Council). The land is surrounded by bushland, with a workfarm located about 300m to the east of the site. The closest residential area is located about 500m to the north.

The facility will be constructed on with a 1.5 m high bund wall surrounding the whole site. Stormwater retention ponds will be constructed to store all rainwater that a falls on the site for the operational use of dust suppression. A 1m depression covering about 1.5 hectares (ha) at the northern end of the site will be form part of the site contour and will be used for storage of concrete feedstock and stormwater following major rain events. No surface water will leave the site, ensuring maximum retention of water for dust suppression and eliminating surface water run-off risks.

A Double storey gatehouse will be constructed to allow visual screening of incoming loads. The incoming and outgoing weighbridge, located about 70 metres from the road verge, will be installed to allow for truck queuing. Site offices and plant storage structures will be fitted with rain water tanks and plumbed into toilets, showers and truck washbay. The entry to the site will be directly off Racecourse Road.

The operational plant will consist of the following equipment:

- 2 screening plants (processing capacity up to 300 tonne/hr);
- 3 large loaders, moving up to 400 tonne/hr depending on length of travel);
- 1ML of on site water storage;
- 60 tonne weighbridge; and
- Pug mill (ARAN Modumix 11, with full capacity of 400 tonne/hr, but operated at about half this capacity)

The proposed facility would operate Monday to Friday during daytime hours between 7:00am and 6:00pm. On Saturdays the facility would operate between 7:00am and 1:00pm. In addition the facility will cater for after hours deliveries only of materials resulting from site works undertaken to minimise community impact in areas such as schools, commercial areas and main roads (where construction and maintenance work times is defined by the RTA) and as a result it is necessary to carry out this work out of normal hours. Sundays and public holidays for receipt of materials only between 8:00 and 5:00pm Nights up to 50 nights per annum for limited deliveries No processing of incoming material would be conducted at night, Sundays or public holidays.

Identified Hazards & Assessed Risks

A detailed hazard identification was conducted and a hazard identification table prepared (see Appendix A). As a result of this analysis, a number of hazards were identified that could have the potential to impact offsite. Each hazard is listed and assessed below.

- Minor Storage of Dangerous Goods (DGs) – the storage of DGs at the site occurs in minor quantities only. The potential for impact offsite is negligible, as the quantity of materials stored would not result in an incident with sufficient consequence to reach the site boundary. Notwithstanding this care and spill response to DG spills requires address. A recommendation is made in relation to DG storage (see below)

- Contaminated Run Off – in the event of rainwater impacting the materials storages on site, there is a potential that the rainwater could become contaminated. However, the site is fully bunded and there will be no release of rainwater offsite. Hence, the risk of environmental impact from rain water run off is negligible. No recommendation is made with respect to this hazard.
- Refuelling of Plant & Mobile Equipment on Site – vehicles and plant will be refuelled using a tanker truck (4,000 L) that will visit site and fuel the vehicles/plant using a bowser type hose. Refuelling incidents could involve leaks from hoses or tanker truck and overfill of fuel tanks. The potential for impact to the environment is negligible as the site is fully bunded, however, ignition of spills could lead to fire and heat radiation impact to local bushland starting bushfires. A recommendations was made regarding this incident (see below).
- Contaminated Materials Delivered to the Site – the materials delivered to site will come mainly from construction wastes, hence, contamination would be minimal. However, collection of wastes from construction sites could contain some contamination in the form of liquids (in containers) and gases in cylinders. The processing of wastes with liquid contamination would result in negligible impact as spills would be contained on site (within the site bund). However, spills of flammable materials and gases could result in fire/explosion. The analysis identified that an explosion of a gas cylinder would be the worse case incident, impacting up to a distance of 25m from the explosion location. A recommendation was made with respect to this inciddnt (see below).

Conclusions

The analysis conducted in this study indicates that the site does not exceed the risk criteria published in HIPAP No.4 (Ref.5), hence, it is concluded that the Civilake Recycling Facility may be classified only as a potentially hazardous facility and therefore is permissible in the proposed location providing the re-zoning of the land is granted and the recommendations made in the following section are adopted.

Recommendations

Based in the analysis conducted in this study a number of recommendations are made to ensure the proposed facility meets the requirements of SEPP33 (Ref.3) and HIPAP No.4 (Ref.5). The following recommendations are made:

1) It was identified that minor spills of flammable liquids in the laboratory and shed could result in potential fire, hence it is recommended that spill kits be installed in the lab area and shed and that personnel at the site be trained in spill clean up and use of the spill kits at the site.
2) In the event of a flammable liquids spill, ignition and fire in the laboratory or shed, the spill would be limited in area and hence fire magnitude would be relatively small. To ensure fire growth potential is minimised, first attack fire fighting would be applied using fire extinguishers. It is therefore recommended that a dry powder fire extinguisher be installed in the shed and in the laboratory (two extinguishers, one in each area). It is also recommended that personnel at the site be trained in the use of first attack fire fighting.
3) In the event of a fuel spill during refuelling of vehicles and mobile plant at the site there is a potential for ignition and fire. Heat radiation from such fires could impact adjacent bushland resulting in bushfire. The analysis in this study identified that a fire during refuelling could result in initiation of a fire in adjacent bushland if the refuelling fire occurred within 12 m of the site boundary. It is therefore recommended that a dedicated refuelling point be established for mobile plant (e.g. front end loaders) within the site and that when such plant is refuelled, it be performed at the same location each time. It is also recommended that internal combustion engine powered equipment (i.e. screens, crushers, etc.) be re-fuelled in the centre of the site and at least 12m from the boundary.
4) It was identified that there is a potential for a gas cylinder to enter the site within waste materials. This cylinder could be crushed in the plant and equipment resulting in gas release and explosion. The adverse impact from such an explosion could reach distances up to 25 m from the explosion location. It is therefore recommended that the operational plant (e.g. crushers, shredders, etc. be located no closer than 25 m to the site boundary.

1.0 Introduction

1.1 Background

Lake Macquarie City Council (LMCC) proposes to construct a waste recycling facility (the Facility) at Teralba, NSW. The Facility will be primarily for crushing, grinding and separating hard waste/ construction and demolition materials. These will include concrete, bricks, gravel and crushed rock, road base, asphalt, soils, green waste and tiles. The operation will process up to 100,000 tonnes of material per annum.

The Facility has a number of potentially hazardous operations including fuelling of plant and equipment, potentially contaminated run-off and equipment fires. These may impact offsite and could cause bushfire at the adjacent properties. Hence, LMCC has engaged AECOM to conduct a preliminary hazard analysis (PHA) of the proposed Facility.

This document reports on the results of the PHA study of the Civilake Recycling Facility as Teralba, NSW.

1.2 Objectives

The objectives of the study are to:

- Conduct a PHA study of the Civilake Recycling Facility as Teralba, NSW, in accordance with the requirements of Hazardous Industry Planning Advisory Paper (HIPAP) No.6, Hazard Analysis Guidelines (Ref.1). and
- Report on the findings of the study in support of the development application for the Facility.

1.3 Scope of Work

The scope of work for the study is for a Preliminary Hazard Analysis of the proposed Civilake Recycling Facility at Teralba, NSW using HIPAP No.6 (Ref.1). The PHA study is for hazards associated with the operations at the site but does not include the assessment of bushfire hazards, these will be assessed by others.

2.0 Methodology

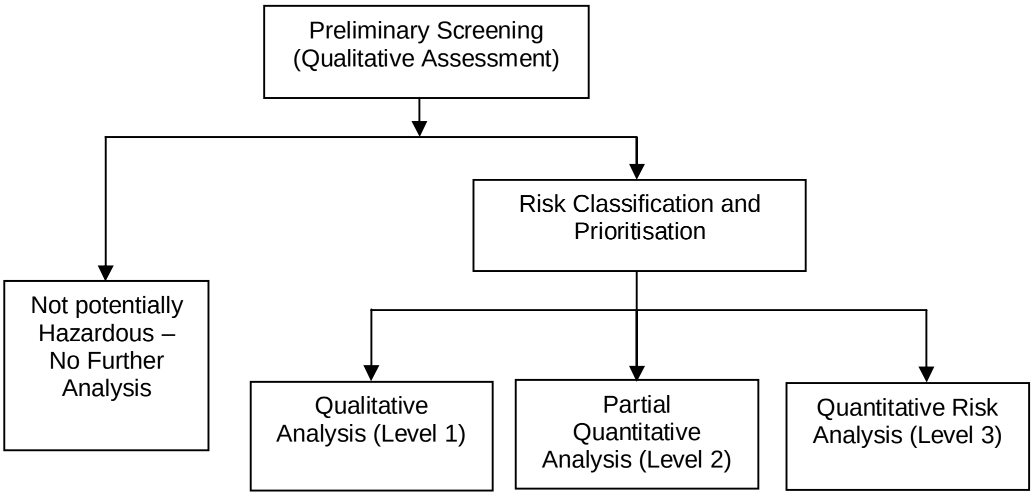
2.1 Multi Level Risk Assessment

The Multi Level Risk Assessment (Ref.2) approach was used to assist in setting the level of study required for the Civilake Recycling Facility (the Facility). The approach considered the development in context of its location, the quantity and type (i.e. hazardous nature) of dangerous goods likely to be stored and used, and its technical and safety management control. The Multi Level Risk Assessment Guidelines are intended to assist industry, consultants and the consent authorities to carry out and evaluate risk assessments at an appropriate level for the facility being studied.

The Multi Level Risk Assessment approach is summarised in **Figure 1.**There are three levels of assessment, depending on the outcome of preliminary screening. These are:

- **Level 1** – **Qualitative Analysis**, primarily based on the hazard identification techniques and qualitative risk assessment of consequences, frequency and risk
- **Level 2** – **Partially Quantitative Analysis**, using hazard identification and the focused quantification of key potential offsite risks
- **Level 3** – **Quantitative Risk Analysis (QRA),** based on the full detailed quantification of risks, consistent with Hazardous Industry Planning Advisory Paper No.6 – Guidelines for Hazard Analysis.

Figure 1 The Multi Level Risk Assessment Approach



The “Applying SEPP 33” (Ref.3) guideline may also be used to assist in the selection of the appropriate level of assessment. This guideline states the following:

“It is considered that a qualitative PHA may be sufficient in the following circumstances:

- *Where materials are relatively non-hazardous (for example corrosive substances and some classes of flammables)*
- *Where the quantity of materials used are relatively small*
- *Where the technical and management safeguards are self-evident and readily implemented*
- *Where the surrounding land uses are relatively non-sensitive.*

In these cases, it may be appropriate for a PHA to be relatively simple. Such a PHA should:

- *Identify the types and quantities of all dangerous goods to be stored and used*
- *Describe the storage/processing activities that will involve these materials*
- *Identify accident scenarios and hazardous incidents that could occur (in some cases, it would also be appropriate to include consequence distances for hazardous events)*
- *Consider surrounding land uses (identify any nearby uses of particular sensitivity)*
- *Identify safeguards that can be adopted (including technical, operational and organisational), and assess their adequacy (having regards to the above matters).*

A sound qualitative PHA which addresses the above matters could, for some proposals, provide the consent authority with sufficient information to form a judgement about the level of risk involved in a particular proposal.

A review of the potential hazards at the proposed recycling facility indicates that the hazardous materials proposed for storage at the site are minimal and that the majority of hazards would arise from potential rainwater run-off that could impact the environment. Hence, the majority of issues listed above apply to the proposed recycling facility and therefore a qualitative PHA has been performed, supplemented by quantitative analysis where required.

3.0 Brief Description of the Proposed Facility

3.1 Recycling Facility Location and Surrounding Land Use

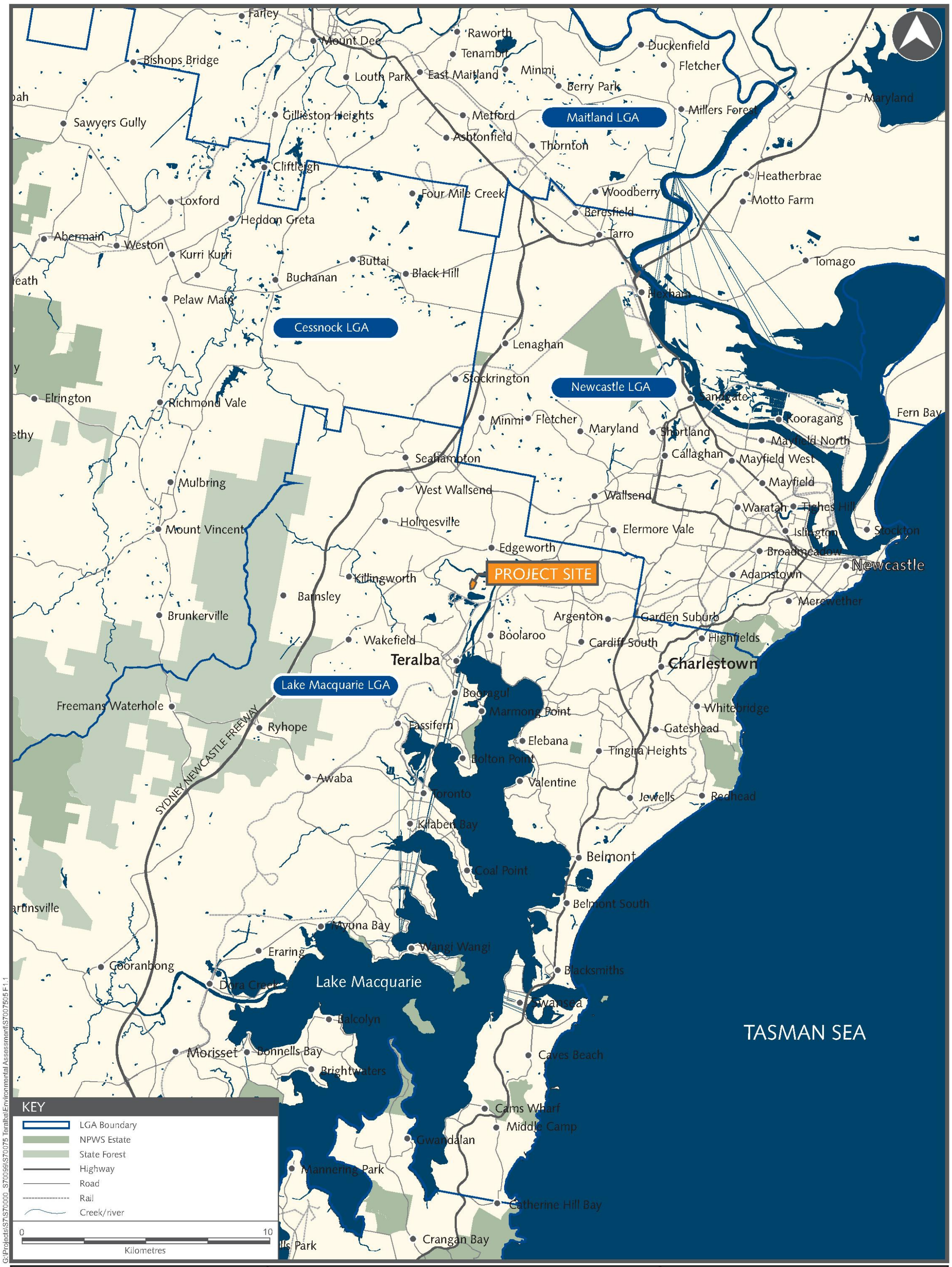
The proposed recycling facility (the Facility) would be located about 2kms north of Teralba on the floodplain to the south and west of Cockle Creek in the local council area of Lake Macquarie City Council (the Council). The land on which the proposed Facility will be located is currently zoned 7(2) Conservation (Secondary), with a small portion in the southeast corner zoned 7(1) Conservation (Primary). The proposed Facility is not permitted in land zoned 7(1) and 7(2), however, a land re-zoning application has been submitted by the Council to have the land zoned 4(1) Industrial (Core) or 9 Natural Resources. The proposed Facility would be permitted in these land zonings as long as the operations at the Facility are not hazardous under the provisions of SEPP33.

Figure 2 shows the regional location of the proposed recycling facility and **Figure 3** shows the local location of the Facility. The existing surrounding land uses are as follows:

- North & East – Swamp Oakland Bush Forrest, Riparian Melaluca Swamp Wetland and Swamp Mahogany paper Bark Forrest, Council operated wormfarm (about 300m from the Facility).
- South – Racecourse Road, undeveloped bushland across Racecourse Road, Cockle Creek Smelter 500m to the south.
- West – undeveloped bushland, closest occupied land is 1.5kms to the west.

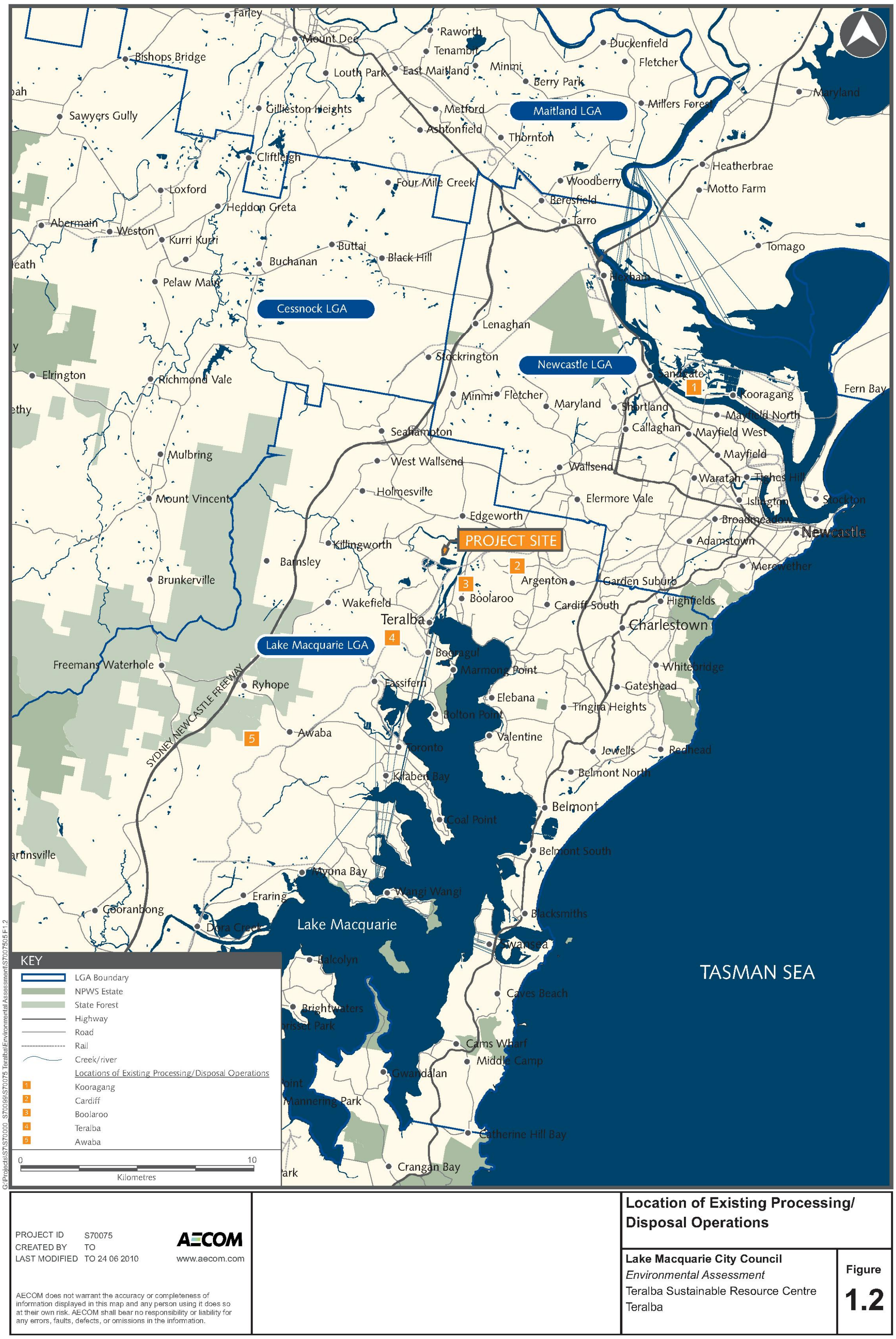
The closest residential area is located about 500m to the north.

Figure 2 Regional Location of the Proposed Facility



PROJECT ID S70075 CREATED BY TO LAST MODIFIED TO 24 06 2010 AECOM www.aecom.com AECOM does not warrant the accuracy or completeness of information displayed in this map and any person using it does so at their own risk. AECOM shall bear no responsibility or liability for any errors, faults, defects, or omissions in the information.		**Regional Context** **Lake Macquarie City Council** *Environmental Assessment* Teralba Sustainable Resource Centre Teralba	**Figure** **1.1**

Figure 3 Location of the Proposed Facility



3.2 Brief Description of Proposed Facility Operations

Figure 4 shows the proposed recycling facility site layout. The site will be accessed from Racecourse Road and entry will be via a security controlled gate with two way weighbridge. Vehicles will access the site via the entry road and travel in one direction around the internal "circular" road network. Deliveries to the site will generally be via tip truck. Trucks will travel to the required tip location (directed by the site security gate staff) and unload onto the designated area as directed. Trucks will then leave site via the main exit gate.

The site will reprocess up to 100,000 tonnes/ annum of hard waste material for resale. Materials including, but not limited to, concrete, asphalt, recycled asphalt pavement (RAP), road base, green waste, bricks, tiles and soil (from internal sources only) will be received via the weigh bridge (at the main entry gate) and charged as per a differential pricing schedule. Differential pricing will encourage source separation.

Once materials are deposited into respective stockpiles they will be reprocessed as required. Processing will vary for different feedstock, outputs and market availability. **Table 1** shows the potential processing pathways.

Table 1 Processing Pathways at the Recycling Facility

Feedstock	Processing	Product
Concrete, Bricks & Tiles	Crushing & Screening	Various Aggregates
		Crusher Dust
	Blending	Road Base N.G.B. 20 & N.G.S. 20
Asphalt/Road Base	Crushing/Screening	Recycled Roadbase
		Gravel Products
	Asphalt Recycler	Asphalt
Green Waste	Shredding, Mulching	Woodchip
	Composting	Compost
	Blending	Soil Blends
Soil	Screening/Blending	Soil Blends

External (non-CiviLake) product sales will be pick up or delivery. Internal product sales will largely be hauled via truck and dog combination.

Residual waste generated at the site will go to the Awaba Waste Management Facility. Products generated from the facility will be sold internally for Council operations and externally to suitable markets in the building and civil engineering industries in the Lower Hunter.

Figure 4 shows the proposed site layout. Design features of the site include:

- The proposed 1.5 m high bund wall surrounding the site which would be planted with native vegetation (grasses in power easement). The bund wall will prevent water flows from entering or leaving the site, and the vegetation will assist in minimising airborne dust leaving the site
- Stormwater retention ponds to store all rainwater that a falls on the site for the operational use of dust suppression.
- 1m depression covering about 1.5 hectares (ha) at the northern end of the site used for storage of concrete feedstock and stormwater following major rain events. No surface water will leave the ensuring maximum retention of water for dust suppression and eliminating surface water run-off risks.
- Double storey gatehouse to allow visual screening of incoming loads.
- Incoming and outgoing weighbridge located about 70 metres from the road verge to allow for truck queuing.
- Site offices and plant storage facilities with rain water tanks plumbed into toilets, showers and truck washbay,
- Entry off Racecourse Road accessing the weighbridge;
- Product storage bays away from processing areas to ovoid operational risk.

A stormwater management plan for the site will detail topography to ensure surface water from the entire site flows into on-site retention areas. CiviLake will conduct geotechnical and hydrological surveys of the site prior to determining a final layout, including a remediation action plan (RAP) as per the recommendation of the Draft LES (2007) and the Remediation Report (2002).

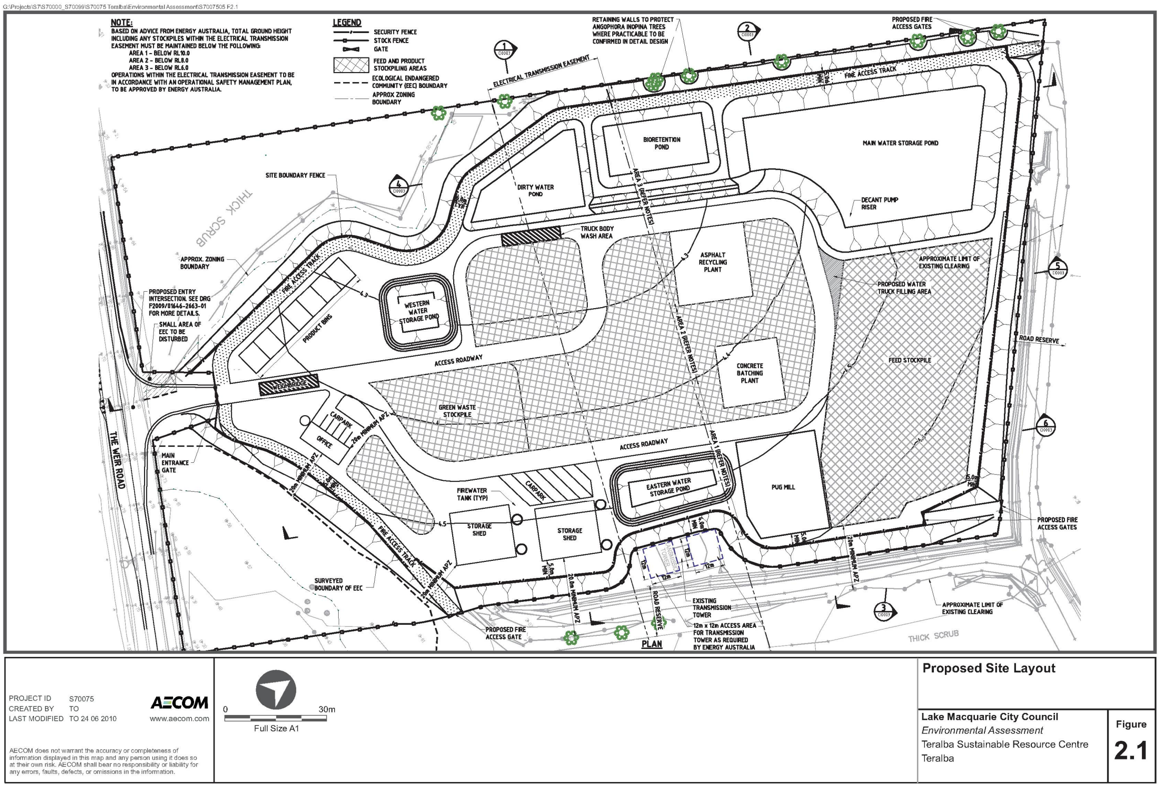
CiviLake have investigated a similar recycling facility operated by Fairfield Council at Hassel St Fairfield in determining the plant and resource requirements for the proposed recycling facility. Estimated resources would include:

- 2 screening plants (processing capacity up to 300 tonne/hr);
- 3 large loaders, moving up to 400 tonne/hr depending on length of travel);
- 1ML of on site water storage;
- 60 tonne weighbridge; and
- Pug mill (ARAN Modumix 11, with full capacity of 400 tonne/hr, but operated at about half this capacity).

The proposed facility would operate Monday to Friday during daytime hours between 7:00am and 6:00pm. On Saturdays the facility would operate between 7:00am and 1:00pm. In addition the facility will cater for after hours deliveries only of materials resulting from site works undertaken to minimise community impact in areas such as schools, commercial areas and main roads (where construction and maintenance work times is defined by the RTA) and as a result it is necessary to carry out this work out of normal hours.

Sundays and public holidays for receipt of materials only between 8:00 and 5:00pm Nights up to 50 nights per annum for limited deliveries No processing of incoming material would be conducted at night, Sundays or public holidays.

Figure 4 CiviLake Recycling Facility Site Layout



4.0 Hazard Analysis

4.1 General Hazard Identification

A hazard identification table has been developed and is presented at **Appendix A**. The methodology selected for the Civilake Recycling Centre is mainly qualitative, due to the nature of the hazardous materials stored and handled at the site and the relatively low hazard processes. This is supplemented by some quantitative assessment where incidents are identified to have a potential offsite impact.

4.2 Dangerous Goods Stored and Handled at the Facility

A review of the inventory of materials stored and handled at the facility indicates that there are not many Dangerous Goods held at the site. The following goods are stored and handled:

- **Laboratory & Storage Shed** - a minor Dangerous Goods store would be located in the storage shed & lab building. The chemicals stored in this area would be mainly paints, aerosols and laboratory chemicals (corrosives, etc.). These would be held in a Dangerous Goods cabinet and at quantities below minor storage levels listed in the Occupational Health and Safety (Dangerous Goods Amendment) Regulation - 2005.
- **Combustible Liquids –**mobile plant is used at the Facility including front end loaders and diesel powered shredders, screens and mills. Diesel fuel will not be stored at the site, however, a small diesel tanker will attend the site to fuel the mobile equipment as required.

There are no other Dangerous Goods stored at the site. However, the site processes waste materials that could contain contaminants. Rainwater impacting the site could become contaminated by the materials stored in the open areas of the site. Rainwater run-off could, therefore, cause damage to the biophysical environment adjacent to the Facility. It is noted that a number of sensitive areas are located close to the site including a SEPP14 wetlands located about 200m to the north of the Facility. Release of potentially contaminated water could result in impact to these sensitive areas.

In addition, larger contaminants (e.g. bottles, cans, drums, cylinders) of dangerous goods could enter the site in the waste. These materials could be released during processing (i.e. crushing and screening), resulting in contaminated materials release, flammable liquid ignition and fire and flammable gas ignition and explosion.

Each hazard is assessed in detail below.

4.3 Laboratory and Shed – Minor Storage

Minor storage quantities are nominally below 250 L of Dangerous Goods. The Dangerous Goods stored in the Laboratory and Shed will be located in a Dangerous Goods cabinet that will comply with the requirements of the relevant Australian Standard (nominally AS1940, Ref.4). In the event of a chemical leak in the cabinet, the liquid would fall to the base of the cabinet and be contained within the bund of the cabinet. The cabinet bund would contain any spills and prevent any release offsite, hence, there would be no impact offsite from this incident.

In the event of a release of flammable liquid in the cabinet, there is a potential for the liquid to ignite, resulting in a fire. The cabinet will be fire rated to contain any fire incidents, preventing heat radiation impact beyond the confines of the cabinet. Hence, there will be on impact offsite or potential for fire growth as the fire would be contained within the cabinet itself.

In summary there would be no impact offsite from incidents associated with the cabinet storage.

In addition to the storage incident potential, laboratory operators and maintenance personnel will use flammable liquids and chemicals in the storage shed and laboratory area. The quantity of chemicals and flammable liquids used at the site would all be relatively small (<100L for each chemical), hence, spills would be readily cleaned up using local spill kits. It is therefore recommended that a spill kit be installed in the lab area and shed and that personnel at the site be trained in spill cleanup and use of the spill kits at the site.

In the event of a flammable liquids spill, ignition and fire, the spill would be limited in area and hence fire magnitude would be relatively small. To ensure fire growth potential is minimised, first attack fire fighting would be applied using fire extinguishers. It is therefore recommended that a dry powder fire extinguisher be installed in the shed and in the laboratory (two extinguishers, one in each area). It is also recommended that personnel at the site be trained in the use of first attack fire fighting.

4.4 Contaminated Run-Off

During the processing of waste (i.e. concrete) there is a potential for dust and grit to be released from crushing equipment, reaching the ground and forming layers on processing equipment. Dust (e.g. concrete) is lime based and has he potential to have a high pH value (i.e. highly alkaline). Hence, when rainwater impacts the dust there is a potential for the water to become contaminated resulting in a highly alkaline liquid escaping offsite.

To eliminate the potential for contaminated water to be released offsite, the Facility will be constructed with a number of stormwater retention ponds that will collect any rainwater on site and prevent discharge to the environment. These ponds are shown in **Figure 3.3**. In addition, the site will be surrounded by a 1.5m high bund that will be planted with native vegetation. This bund will prevent any release of rainwater off the site without first being collected in an onsite pond.

A 1m depression will also be constructed at the site, covering an area of 1.5 hectares, on the northern end of the site. This area will be used for the storage of concrete feedstock and stormwater following major rain events.

The objective of containment of rainwater is not just for the protection of the environment, but to maintain a site based water supply for dust suppression. Whilst the proposed site water retention system is primarily for Facility water supply, it does minimise the surface water run off risks associated with the potential for impact to the environment.

Based on the above analysis, potentially contaminated stormwater release is considered to be a low risk and therefore would not constitute a significant hazard to the environment.

4.5 Refuelling of Vehicles and Plant

The site will operate with a number of internal combustion engine powered components (e.g. front end loaders, shredders, etc.). This equipment will require periodical refuelling using a small 4,500 L tanker that will visit site and refuel the equipment directly to the fuel tanks using a tanker mounted pump and fuel bowser type nozzle.

During the refuelling operation there is a potential for fuel leaks and spills to occur from split or failed hoses, overfill of the truck/equipment or tanker/vehicle tank failure. Whilst the likelihood of these incidents would be low, heat radiation impact offsite could occur if the incident eventuated.

A detailed fire impact analysis has been conducted in **Appendix B** to determine whether fire incidents could impact offsite, resulting in ignition of bushland adjacent to the site causing a bushfire in the adjacent forested areas. **Table 2** lists a summary of the results of the heat radiation impact analysis conducted in **Appendix B**.

Table 2 Impact Distance from Selected Heat Radiation Levels

Heat Flux (kW/m^2)	Distance to Heat Flux (m)
35	7.2
23	8.7
15	10.6
12.6	11.5
10	12.9
8	14.4
4.7	18.5
2*	28

* Heat of the sun at mid-day in summer

A review of the potential impacts of heat radiation (Ref.5) indicates that wood may be ignited from a naked flame where impacted by heat radiation in excess of $12.6kW/m^2$ for extended periods. Hence, if this level of heat radiation is conservatively used as the criteria for this incident, then from Table 3.2 the distance to this level of heat radiation impact is 11.6 m.

In the event a release incident and fire occurs, during refuelling within 11.6 m of the boundary, then there is a potential for the adjacent bushland to be ignited resulting in a bushfire. It is therefore recommended that a dedicated refuelling point be established for mobile plant (e.g. front end loaders) within the site and that when such plant is refuelled, it be performed at the same location each time. It is also recommended that internal combustion engine powered equipment (i.e. screens, crushers, etc.) be re-fuelled in the centre of the site and at least 12m from the boundary.

4.6 Contaminated Material Deliveries

Material deliveries to site may be contaminated with a number of Dangerous Goods, with the most likely Goods being:

- corrosives (e.g. pool chemicals) in bottles or small containers (<5 L);
- small cylinders of LPG (<9 kg);
- fuel/oil containers (<20 L); and
- toxic products (e.g. herbicides/pesticides) in small containers (<5 L)

All loads entering the site will be inspected for contaminants. The site entry gate will be constructed with two levels, the upper level containing a platform where gate operators can inspect the loads entering the site in high sided trucks. Hence, the potential for large containers entering the site is low. However, smaller containers of the sizes listed above could enter the site concealed in the load itself.

The potential for impacts offsite from corrosives of toxics is negligible, as once the materials are processed, the breaching of a container, within the crusher or shredder, would release the contents of the container to the ground around the equipment. As the site is fully bunded there would be no potential for release offsite.

The release of flammable/combustible liquids from 20 L containers could result in minor fires in the immediate vicinity of the equipment in which the containers was breached. This would result in a smaller fire that that assessed in **Section 4.5**. Hence, there would be no impact offsite as long as the recommendations made in **Section 4.5** are adopted.

In the event of an LPG cylinder (9kg) being passed through a shredder/crusher, there is a potential for the cylinder to be damaged, releasing the gas into the machine. Ignition of the gas within the confines of the machine would result in an explosion. An analysis of a 9 kg gas explosion has been conducted in **Appendix B**. The analysis identified that an explosion of 9 kg of gas would result in an overpressure at selected distances as shown in **Table 2**.

The maximum permissible explosion overpressure at the site boundary, before addition assessment is required, is 7 kPa. It can be seen from **Table 2** that the distance to 7 kPa is 24.5 m. The site boundary is located about 70 m from the crushing equipment, hence, there is no explosion overpressure impact exceeding the permissible criteria.

Based on this analysis, it is recommended that the operational plant is located no closer than 25 m to the site boundary.

5.0 Conclusions and Recommendations

5.1 Conclusions

The analysis conducted in **Section 4** of this study indicates that the site does not exceed the risk criteria published in HIPAP No.4 (Ref.5), hence, it is concluded that the Civilake Recycling Facility may be classified only as a potentially hazardous facility and therefore is permissible in the proposed location providing the re-zoning of the land is granted and the recommendations made in the following sub-section are adopted.

5.2 Recommendations

Based in the analysis conducted in this study a number of recommendations are made to ensure the proposed facility meets the requirements of SEPP33 (Ref.3) and HIPAP No.4 (Ref.5). The following recommendations are made:

1) It was identified that minor spills of flammable liquids in the laboratory and shed could result in potential fire, hence it is recommended that spill kits be installed in the lab area and shed and that personnel at the site be trained in spill clean up and use of the spill kits at the site.
2) In the event of a flammable liquids spill, ignition and fire in the laboratory or shed, the spill would be limited in area and hence fire magnitude would be relatively small. To ensure fire growth potential is minimised, first attack fire fighting would be applied using fire extinguishers. It is therefore recommended that a dry powder fire extinguisher be installed in the shed and in the laboratory (two extinguishers, one in each area). It is also recommended that personnel at the site be trained in the use of first attack fire fighting.
3) In the event of a fuel spill during refuelling of vehicles and mobile plant at the site there is a potential for ignition and fire. Heat radiation from such fires could impact adjacent bushland resulting in bushfire. The analysis in this study identified that a fire during refuelling could result in initiation of a fire in adjacent bushland if the refuelling fire occurred within 12 m of the site boundary. It is therefore recommended that a dedicated refuelling point be established for mobile plant (e.g. front end loaders) within the site and that when such plant is refuelled, it be performed at the same location each time. It is also recommended that internal combustion engine powered equipment (i.e. screens, crushers, etc.) be re-fuelled in the centre of the site and at least 12m from the boundary.
4) It was identified that there is a potential for a gas cylinder to enter the site within waste materials. This cylinder could be crushed in the plant and equipment resulting in gas release and explosion. The adverse impact from such an explosion could reach distances up to 25 m from the explosion location. It is therefore recommended that the operational plant (e.g. crushers, shredders, etc. be located no closer than 25 m to the site boundary.

6.0 References

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Appendix A

Hazard Identification Table

Appendix A Hazard Identification Table

Table 3 Hazard Identification Table

Hazard Identification Table			
Area/Operation	**Hazard Cause**	**Hazard Consequence**	**Safeguard**
Laboratory/Shed	Storage and handling of dangerous goods (flammable liquids)	Spill of Dangerous Goods (corrosives/toxics) and impact to people Spill of flammable liquids, ignition and fire	• Quantity of Dangerous Goods stored is classified as minor under the provisions of the various Australian Standards • Dangerous Goods will be stored in dedicated Dangerous Goods cabinets • PPE will be used for handling Dangerous Goods • Personnel will be trained in the storage and handling of Dangerous Goods • Materials Safety Data Sheets will be available at all Dangerous Goods locations
Site operational areas	Contaminated materials processed on site (i.e. concrete)	Alkaline water run off and potential impact to environments adjacent to the site.	• The site will be fully bunded with a 5m high berm around the whole site • Site stormwater collection ponds will be installed to contain any potentially contaminated stormwater run-off • A 1m deep x 1.5 hectare depression will be installed for the stockpiling of concrete at the site. This will retain and potentially contaminated (alkaline) run off from the raw materials are of the site
Re-fuelling of vehicles and plant at the site	Potential fuel spill during refuelling, ignition and fire	Heat radiation impact to adjacent bushland offsite, ignition of bush and bushfire	• Tanker driver and operator present during all transfer operations • Transfer conducted using bowser type nozzle with automatic shut off • Diesel fuel only transferred at site (low ignition potential as diesel will be transferred at temperatures below flash point) • Fire extinguishers available on the diesel delivery truck • Tanker drivers trained in emergency response, including EIPS information in the tanker cabin • Transfers conducted IAW the ADG (Ref.10) • Operation can be conducted well clear of site boundaries
Contaminated	LPG cylinder enters site in materials	LPG cylinder is crushed and releases gas	• All load inspected on arrival

Hazard Identification Table			
Area/Operation	**Hazard Cause**	**Hazard Consequence**	**Safeguard**
materials delivery	delivery	resulting in ignition and explosion	• Elevated inspection platform provided for inspection of loads in high sided trucks • Inspection of loads limits the size of containers that can enter the site (minimising hazard impact) • Operators trained to review loads when transferring from stockpiles to processing plant • Screens/"grizzly" installed on processing plant to prevent larger objects entering the crushing areas

Appendix B

Consequence Analysis

Appendix B Consequence Analysis

Fire Analysis

Fuelling of vehicles and plant at the recycling facility could lead to a leak of fuel, ignition and fire. The vehicles and plant will be fuelled using a small taker truck (<8,000 L) with tanker mounted pump, flexible hose and bowser type filling nozzle. The refuelling operation will be attended by the plant operator and tanker driver. In the event of a release from a failed hose, overfill, pump leak, tank or pipework leak, the fuel would spill to the ground under the full point and I ignited result in a pool fire.

In the event of a release, the tanker driver or plant operator would be able to initiate transfer shut down by depressing the emergency shut down button on the truck. This button is connected to the transfer pump and immediately stops the pump and fuel transfer. The tanker driver and/or plant operator could also shut down the transfer line isolation valves preventing fuel delivery to the hose and nozzle.

In both cases, fuel would be shut down and there would be no further spill to the ground. Assuming, conservatively that the fuel is transferred at a rate of 300 L/minute, and that it takes an operator 30 seconds to respond, shut down the pump and isolate the valves, the total spill volume would be 0.5 x 300 = 150 L.

In the worst case, the spill would occur on firm ground (i.e. compressed/compacted and there would be little soaking of the fuel into the ground. The pool depth would be 5mm (Ref.8) and therefore the pool diameter would be:

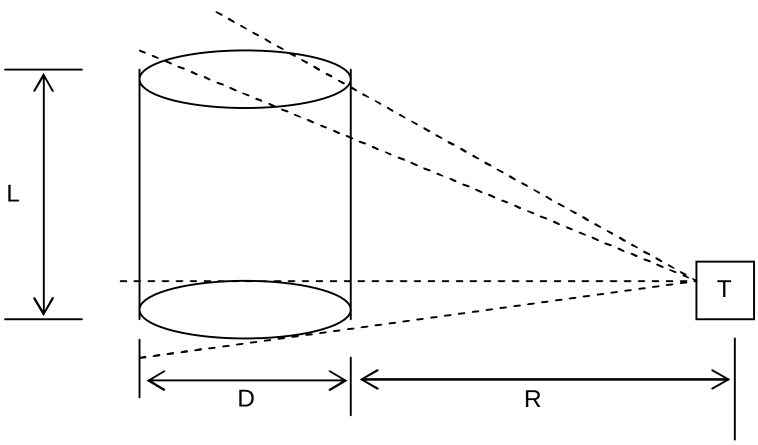
$\text{Vol} = \pi/4\ (D^2) \times t$

$0.15\text{m}^3 = \pi/4\ (D^2) \times 0.005$

$D = ((0.15/0.005) \times 4/\pi\ )^{0.5} = 6.2\text{m}$

The flame burns in the shape of a cylinder tilted in the direction of the wind. **Figure 5** shows a diagram of a pool fire impacting a target as a distance from the flame.

Figure 5 View Factor Method for Heat Radiation Calculations



Where: L = Flame length
D = pool diameter
R = distance to target
T = Target

Flame Height (L)

The flame height of a pool fire is given by the following correlation of Thomas (Ref.6):

$$L = 42D\left(\frac{m}{\rho_o\sqrt{gD}}\right)^{0.61}$$

where: L= mean flame height (m)
D= pool diameter (m)
ρ_o=ambient air density (typically 1.2 kg/m^3)
m= mass burning rate (kg/m^{2}s) = 0.0667, based on 5mm/min burn down rate (Ref.9)
g= acceleration due to gravity (9.81 m/s^2)

Hence, flame height for the CFPS transformer bund fire is:

L = 42 x 6.2 (0.0667/(1.2(9.81x 6.2)$^{0.5}$))$^{0.61}$ = 12.8 m

Heat Radiation Impact - To estimate the heat radiation impact at specific distances, the view factor method has been applied, which uses the heat radiation from the surfaces of the flame and applies a correction factor for flame shape and target distance/location.

The heat radiation at a specific distance from the flame can be estimated from the formula:

Ir = Ie x F x τ -------(**B1.2**)

Where: I_r = Target Heat (kW/m^2).
I_e= Flame Heat (kW/m^2) or surface emissive power (SEP).
τ = Transmissivity.
F = View Factor

View Factor - The calculation of the view factor (F) in **Formula B1.2** depends upon the shape of the flame and the location of the flame to the receiver. F is calculated using an integral over the surface of the flame, S. The formula can be shown as:

$$F = \iint_S \frac{\cos\beta_1 \cos\beta_2}{\pi d^2} \qquad \text{---------- (\textbf{B1.3})}$$

The above formula (B1.3) may be solved using the double integral or using a numerical integration method in spread sheet form. This is explained below.

A spreadsheet calculator (SSC)[1] has been developed to determine the radiation flux experienced at a “target” originating from a pool fire in a tank, bund or flammable liquid storage depot with fire walls. It is intended typically for fires of petroleum liquids though it can be used with any material so long as the “emissivity” of the flame is known. This is the heat flux at the surface of the flame and is given in kiloWatts per square metre (kW/m^2). The other parameters needed are: diameter of tank/bund, height of the tank/walls (if any), distance to target, height of flame, tilt of flame caused by wind. It is assumed that the tank/walls have some height although there is no reason not to use the calculator for pool fires at ground level by entering a zero height.

The SSC is designed on the basis of finite elements. The fire is assumed to be in the shape of a cylinder of the same diameter as the tank at its roof. The height of the fire can be calculated using **Formula B1.1**. Once the flame height is known, the surface of the cylinder can be divided into many separate plane surfaces. To do this, a plan view of the tank/bund was drawn and the relevant distances and angles allocated. The plan view is for the target and the tank in the same horizontal plane.

[1] The Spread Sheet Calculator was developed by Dr Wayne Davies of the Chemical Engineering Faculty, Sydney University and Mr. Steve Sylvester of AECOM.

The angle “theta” is varied from zero to 90 degrees in intervals of 2.5 degrees. Zero deg. represents the straight line joining the centre of the tank/bund to the target (x0, x1,x2) while 90 deg. is the point at the extreme left hand side of the tank/bund. In this way the fire surface is divided up into elements of the same angular displacement. Note the tangent to the circle in plan. This tangent lies at an angle, gamma, with the line joining the target to where the tangent touches the circle (x4). This angle varies from 90 deg at the closest distance between the tank /bund and the target (x0) and gets progressively smaller as theta increases. As theta increases, the line x4 subtends an angle phi with x0. By similar triangles we see that the angle gamma is equal to 90-theta-phi. This angle is important because the sine of the angle give us the proportion of the projected area of the plane. When gamma is 90 deg, sin(gamma) is 1.0, meaning that the projected area is 100% of the actual area.

Before the value of theta reaches 90 degrees the line x4 becomes tangential to the circle. The fire cannot be seen from the rear and negative values appear in the view factors to reflect this. The SSC filters out all negative contributions.

For the simple case, where the fire is of unit height, the view factor of an element is simply given by the expression:

$VF = \Delta A.\ \sin(gamma)/(\pi.\ x4.\ x4)$ .... Eq 1

where ΔA is the area of an individual element at ground level.

Note the denominator (π. x4. x4) is a term that describes the inverse square law for radiation assumed to be distributed evenly over the surface of a sphere.

As we see the value of x4 increases as theta increase and the value of sin(gamma) decreases as theta increase. This means that the contribution of the radiation from the edge of the circular fire drops off quite suddenly compared to a view normal to the fire. Note that the SSC adds up the separate contributions of Eq 1 for values of theta between zero until x4 makes a tangent to the circle.

It is now necessary to do two things: (i) to regard the actual fire as occurring on top of a tank/bund and (ii) to calculate and sum all of the view factors over the surface of the fire from its base to its top. The overall height of the flame is divided into 10 equal segments. The same geometric technique is used. The value of x4 is used as the base of the triangle and the height of the flame plus the tank, as the height. The hypotenuse is the distance from target to the face of the flame (called X4’). The angle of elevation to the element of the fire (alpha) is the arctangent of the height over the ground distance. From the cos(alpha) we get the projected area for radiation. Thus there is a new combined distance and an overall equation becomes:

$VF = \Delta A.\ \sin(gamma).\cos(alpha)/(\pi.\ x4'.\ x4')$ .... Eq 2

The SSC now turns three dimensional. The vertical axis represents the variation in theta from 0 to 90 deg representing half a projected circle. The horizontal axis represents increasing values of flame height in increments of 10%. The average of the extremes is used. e.g. if the fire were 10 m high then the first point would be the average of 0 and 1 i.e. 0.5 m. The next point would be 1.5 m and so on.

Thus, the surface of the flame is divided into 360 equal area increments per half cylinder making 720 increments for the whole cylinder. Some of these go negative as described above and are not counted because they are not visible. Negative values are removed automatically.

The sum is taken of the View Factors in Eq.2. Actually the sum is taken without the ΔA term. This sum is then multiplied by ΔA which is constant. The value is then multiplied by 2 to give both sides of the cylinder. This is now the integral of the incremental view factors. It is dimensionless so when we multiply by the emissivity at the “face” of the flame, which occurs at the same diameter as the tank/bund, we get the radiation flux at the target.

Transmissivity – is the reduction in heat radiation due to the presence of water vapour and carbon dioxide in the atmosphere between the radiation source and the target. This can be calculated using the following formula (Ref.9):

$$\text{Transmissivity} = 1.006 - 0.01171(\log10X(H_2O) - 0.02368(\log_{10}X(H_2O)))^2 - 0.03188(\log_{10}X(CO_2) + 0.001164(\log_{10}X(CO_2)))^2$$

Where: $X(H_2O)$ = (RH x L x Smm x 2.88651 x 102)/T
$X(CO_2)$ = L x 273/T
RH = relative humidity
L = path length in metres
Smm = saturated water vapour pressure in mm mercury (= 17.535 @ 293K)
T = temperature in degrees Kelvin (293K)

The distance from the fire to the boundary of the proposed CFPS (L) is 620m, relative humidity is selected as 70% (0.7). Using these values and the values listed above, the transmissivity parameter is calculated to be 0.54.

The following data was input to the spread sheet calculator:

- Pool diameter – 6.2m
- Flame height – 12.8m
- Transmissivity – 0.83 (for dstance to 4.7kW/m^2)
- SEP – 77 kW/m^2 (Ref.6)
- Angle of flame tilt – 15^o

The results of the analysis, using the SSC, indicated that the distance to a heat radiation of 4.7kW/m^2 was 18.5 m from the fire. A summary of the heat radiation impact analysis at selected distances from the fire is shown in **Table 5**.

Table 4 Heat Radiation Impact – Refuelling Fire

Heat Flux (kW/m^2)	Distance to Heat Flux (m)
35	7.2
23	8.7
15	10.6
12.6	11.5
10	12.9
8	14.4
4.7	18.5
2*	28

* Heat of the sun at mid-day in summer

Explosion Analysis

The hazard analysis identified that there is a potential for a gas cylinder (9kg LPG) o enter the site in waste materials. In the event this cylinder is crushed within the plant and equipment, there is a potential for explosion. To analyse the impacts from explosion, the TNT equivalence method is used, whereby the mass of gas is converted to and equivalent mass of TNT and the explosion overpressure impact is assessed based on empirical techniques.

The equivalent mass of TNT is calculated by:

$$W_{TNT} = \alpha \left(\frac{W.H_c}{H_{TNT}} \right)$$

Where: W = mass of fuel involved in the explosion (9 kg in the cylinder)
H_c = heat of combustion of the fuel (45,000 kJ/kg for propane or LPG)
H_{TNT} = TNT blast energy (5420 kJ/kg)
α = explosion efficiency (0.04 for LPG, Ref.9)

Hence,

W_{TNT} = 0.04 (9x45000/5420) = 3 kg TNT

Overpressure is now calculated using a scaled distance curve, based on actual distance from the blast and the TNT equivalent, this is given by:

$$z = \frac{R}{(W_{TNT})^{1/3}}$$

Where: R = distance from the blast (m)
W_{TNT} = kg equivalent of TNT

The crushing equipment operates close to the centre of the site, which is about 70m from the site boundary, using this value to estimate the overpressure impact at the site boundary from a cylinder explosion on the crusher:

Z = $70/(3)^{0.333}$ = 46/12.3 = 48.5

Z is now used to estimate the peak overpressure which can be read from a curve for scaled overpressure plots (see **Figure 6**). From **Figure 6** for a value of z = 48.5, the peak overpressure is read as $2x10^{-2}$ bar or 2kPa.

By the same analysis, the scaled distance to 7kPa is 17 m/kg$^{0.333}$). Hence, the actual distance is:

R = 17 x $(3)^{0.333}$ = 24.5m

Figure 6 **Scaled Parameter Plots for TNT Explosions**