

SHIRE OF COLLIE

GIBBS ROAD WASTE MANAGEMENT FACILITY

WASTE MANAGEMENT REVIEW



Gibbs Road Site Entrance

Prepared for
SHIRE OF COLLIE

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Executive Summary

The Shire of Collie (Shire) commissioned **IW Project** to undertake a waste management review of a range of current and potential future activities at its Gibbs Road Waste Management Facility. These activities related to improvements to current on-site activities as well as investigations into potential improved operational practices and some additional site activities. The scope of work included a determination of the estimated lifespan of the current landfill site, and possible options to extend the landfill lifespan, a review of current waste disposal practices, identification of opportunities for increased recycling, an assessment of the alternative option(s) of transporting waste to an alternative disposal location and an investigation into the development of a reuse shop.

The landfill airspace investigation determined that the current landfill available airspace is 550,000 m³, which equates to approximately 35 to 40 years of landfill lifespan. With good operational control, this could be extended out to approximately 45 years to 50 years. Optimising the landfill available airspace by increasing the landfill footprint and waste height has increased the available landfill airspace to 726,000 m³, which equates to approximately 45 to 50 years of landfill lifespan, with good operational control, this could be extended out to approximately 60 years to 70 years. Consequently, for both the current and optimum final waste profiles, there is ample available landfill airspace to cater for the Shire's long-term waste disposal needs.

In order to ensure the efficient operation of the landfill and to minimise landfill airspace consumption, a number of landfill planning, operational and closure improvements were identified, these range from minor changes in current operations through to a different approach to some landfill activities.

In striving to further divert waste from landfill, there is a range of improved recycling activities that the Shire should consider implementing. Some are simple improvements of existing recycling systems, while others relate to the implementation of new or substantially improved recycling systems.

Due to the extensive landfill airspace available on site, there is no immediate need for the Shire to transport waste to an alternative disposal location; however, should this be considered, the cost would be a function of the cost of operating the transfer station, the transport cost and the disposal cost at the alternative disposal location. Based on the modelling scenarios and assumptions, typically it will cost in the order of \$50/t to \$90/t to use a single trailer vehicle to transport waste 50 km to 150 km and \$40/t to \$65/t using a double road train, in addition, there would be the anticipated \$50/t to \$100/t for the disposal cost at a lined landfill site depending on the size of the alternative disposal location, the larger site being the cheaper disposal location (economy of scale). There would however be the saving in current landfill operating costs, which have been estimated at \$60/t.

In the event that the landfill is closed, the landfill operating costs will cease; however, the Shire will continue to incur the transfer station costs as well future transport and disposal costs. Effectively, this will save approximately \$60/t landfill costs, but incur approximately \$50/t transport costs and a minimum of \$50/t landfill disposal fee (Cleanaway Dardanup). That is a net cost increase in the order of \$50/t.

The development of a reuse shop will have minimal impact on reducing the quantity of waste going to landfill and subsequently result in an insignificant reduction in landfill operating costs. These cost savings are insufficient to justify the development of a reuse shop; however, the Shire should also consider the community and environmental benefit of a reuse shop. Ultimately a reuse shop will cost the Shire money to develop and operate. It is for the Shire to determine whether these costs are justifiable or whether, for a similar financial outlay, there could be a better recycling, environmental and social outcome.

Based on the waste management review the Shire should:

- Optimise the landfill footprint and height to increase the available landfill airspace and consequently the landfill lifespan;
- Improve the following landfill operations:
 - Develop an overall landfill management plan for the site;
 - Set out the agreed waste profile for site operators to use as a guide for future waste placement;
 - Operate the landfill with a single tipping area, the exception being asbestos and clinical waste;
 - Dispose of the dedicated waste compactor and old tracked loader and purchasing a good second-hand tracked loader for landfill waste placement and compaction;
 - Optimise the use of cover material;
 - Improve litter control;
 - Increase the depth of waste placement;
 - Provide guidance for site staff on the short to medium term landfill filling plan;
 - Monitor the consumption of landfill airspace by regular topographic survey;
 - Maintain the existing staffing levels and maximise staff efficiency to divert waste from landfill;
- Improve the following recycling activities:
 - Maximise involvement and participation in existing recycling activities;
 - Expand the current cardboard collection at the transfer station to include all recyclable packaging materials;
 - Consider implementing a yellow bin swap arrangement at the transfer station;
 - Implement a hazardous household waste collection system;
 - Use the Shire Planning and Building Licence process to manage large demolition projects that generate a significant quantity of waste material;

- The Shire is to monitor the potential development of energy from waste projects in the region and assess the opportunities for participation in these projects;
- Not consider transporting waste to an alternative waste disposal facility as there is extensive available landfill airspace on site and the cost of waste transport and disposal is significantly more than the cost of on-site landfilling; and,
- Consider the development of a small community operated reuse shop at the entrance to the landfill, ideally with the initial infrastructure being funded by the Waste Authority or other community grant sources.

1. Introduction

The Shire of Collie (Shire) commissioned **IW Project** to undertake a waste management review of a range of current and potential future activities at its Gibbs Road Waste Management Facility. These activities related to improvements to current on-site activities as well as investigations into potential improved operational practices and some additional site activities.

The scope of work included the following items:

- Determination of the estimated lifespan of the current landfill site, and possible options to extend the landfill lifespan;
- Review of current waste disposal practices, including labour and resources and suggest improvements based on industry best practice;
- Identification of opportunities for increased recycling;
- Assessment of the alternative option(s) of transporting waste to a regional waste facility, or other sites, whilst still maintaining a transfer station at the Gibbs Road site; and,
- Investigation and development of a business case for a reuse shop incorporating best practice from other similar sized sites.

2. Background

The waste management facility is located on Reserve 36457, Gibbs Road, Collie, Western Australia, approximately 2 km east of the central business district of Collie. Historically the site has been an unmanned landfill; however, in 1997 the Shire manned the site and developed a waste transfer station at the front entrance to keep all small customers away from the active landfill area. Since then, a weighbridge has been installed and a range of recycling activities progressively implemented.

The site is licensed by the Department of Environment Regulation as a Category 62 Solid Waste Depot and a Category 64 Class II Putrescible Landfill Site with design capacity of 10,000 tonnes per annum and 50,000 tonnes per annum respectively. The site is the primary waste management facility for the Shire.

Currently the site has the following range of waste management activities:

- Waste transfer station;
- Minor recycling activities;
- Scrap metal recycling;
- Greenwaste separation and mulching; and,
- Landfill.

3. Landfill Airspace and Lifespan

3.1. Waste Quantity

Based on data provided by the on-site weighbridge (past three year average), there is approximately 8,200 tonnes of waste sent to landfill each year. The population is forecast to be stable for the foreseeable future (*Western Australia Tomorrow Population Report No. 7, 6006-2026. Forecast Profile Collie(s) – average annual growth rate for median scenario modelling (Band C) = 0.1%/yr; lowest = -0.8%/yr; highest = 1.0%/yr*); hence, landfill tonnes are anticipated to be stable and remain stable at current levels.

3.2. Waste Density

Although the Shire has a dedicated waste compactor, this machine has not been operational for some time and a D9 dozer or 950H front-end loader are currently being used to spread and lightly compact the incoming waste material. Industry best practice achieves a typical waste density of approximately 0.85 t/m³ to 0.90 t/m³ using a large (50 t) dedicated waste compactor. This drops off to 0.80 t/m³ to 0.85 t/m³ if a smaller (40 t) compactor is used. Tracked machines can achieve a waste compaction of 0.50 t/m³ to 0.70 t/m³, while wheeled machines generally only achieve waste compaction rates of 0.40 t/m³ to 0.60 t/m³ (tyre punctures result in less willingness to compact the waste effectively). The above theoretical compaction rates are highly dependent on the waste type and operational methodology such as the thickness of the layer of waste being compacted, the number of passes of the machine and the amount of cover material used. The depths of waste in the landfill also influences the ultimate density of the waste mass, as the upper layers of the waste surcharge the lower layers, increasing settlement in the waste mass and allowing for additional waste to be placed on top of the landfill to fill the airspace that has been achieved via waste settlement. This is however only possible while the landfill area is active. Once the area has been capped, any subsequent settlement cannot be refilled.

The most significant impacts on the actual waste density achieved on site will be the type of machine used to compact the waste and the way that the landfill is operated. Ultimately the landfill waste density could fluctuate between a minimum of 0.40 t/m³ through to a maximum of approximately 0.90 t/m³. Even with the optimum type of machine, there is still a heavy reliance on landfill operations to maximise the landfill waste density.

The above refers to “waste density”, which is the quantity of waste that can be placed in one cubic metre of landfill airspace, not the density of all of the material within one cubic metre of landfill airspace. That is the above values exclude landfill cover material.

3.3. Current Landfill Airspace

In 2008, the Shire of Collie commissioned Cardno BSD (Cardno) to determine the available landfill airspace on site. As part of this project Cardno developed a final pre-settlement waste profile which achieved a maximum waste height of RL 203 m and a top of capping height of RL 204 m. The profile incorporated variable waste slopes ranging from the steepest of approximately 1 vertical in 4 horizontal, down to 1 in 15.

The current available landfill airspace was calculated using the most recent site topographic survey (*SkiViz, 11 March 2017*) as the base formation and the Cardno pre-settlement waste profile as the upper waste surface. Although the Cardno waste profile design included a 1 m thick cap on top of the waste mass, the “top of cap” surface was not reworked to lower the surface down to the “top of waste” level. As there is no regulatory maximum waste height, the position was adopted whereby the 1 m cap would be placed on top of the “top of cap” surface and hence providing the Shire with an additional 1 m of landfill airspace across the full site.

Based on the above, as of 11 March 2017 (date of the base survey) there was 550,000 m³ of available landfill airspace on site.

3.4. Current Landfill Lifespan

The lifespan of the landfill is a function of the available remaining airspace and the annual quantity of waste that can be placed into the available airspace.

Table 3.4.1 – Current Landfill Lifespan provides the current landfill lifespan based on 8,200 t/yr and a range of waste densities.

Table 3.4.1 – Current Landfill Lifespan

Available Airspace	Waste Density			
	0.40 t/m ³	0.50 t/m ³	0.70 t/m ³	0.90 t/m ³
550,000 m ³	27 yrs	34 yrs	47 yrs	60 yrs

As can be seen, the greater the waste density, the longer the landfill lifespan. Based on reasonable waste operation practises, there should be at least 35 years to 40 years of available landfill on site. With good operational control, this could be extended out to approximately 45 years to 50 years.

3.5. Optimal Landfill Airspace

IW Projects considered the option of maximising the available landfill airspace on site. This was a function of optimising the landfill footprint and determining a reasonable slope for the final waste profile.

3.5.1. Landfill Footprint

The preferred landfill footprint would be to maximise the use of the cleared area on site and not require the clearing of any additional native vegetation, while still retaining all other non-landfill operational areas. Based on these considerations, it is proposed to expand the landfill footprint to the east, over an existing excavation. This expansion provides a wider and more uniform landfill footprint, which facilitates an increase in the landfill airspace and a relatively simple final waste profile.

The facility license requires an undisturbed separation distance of at least 3 m between the base of the landfill, including the current waste disposal area and the highest known level of the water table aquifer. In addition, there is to be at least 100 m between previously landfill areas or current tipping areas and any surface water body.

As required by the facility operating license, the Shire monitors groundwater levels biannually; however, there are only groundwater monitoring bores in the north east and south west portions of the site. Hence, no data is available for the south east corner of the site; consequently, when expanding the landfill footprint into the eastern portion of the site, over the existing excavation, it is uncertain as to the exact level of the groundwater.

Based on available groundwater data (*Groundwater Contours – Figure 2, dated 17 October 2016, 360 Environmental*), it is estimated that the groundwater is at approximately RL 180 m. The bottom of the excavation is at RL 183 m. Due to the uncertainty of the actual groundwater level; the landfill design has incorporated backfilling of the excavation by an additional 2 m with clean fill to raise the base of the landfill. Although this backfill is not an “undisturbed” layer as required by the landfill license, it achieves the desired outcome of maintaining a minimum 3 m attenuation zone between the base of the landfill and the highest groundwater level. In reality, it is likely that after backfilling there will be in the order of 5 m attenuation zone in this area.

The proposed optimum landfill footprint covers most areas of previous waste placement, including the western edge of the landfill. In this area there is a man-made water storage dam immediately adjacent to the edge of the landfill. Although the landfill licence states that there is to be a minimum of 100 m from the landfill to any water body, because there is already waste in this separation zone and the fact that the water body is man-made, it is deemed acceptable to continue landfilling in this area. The proposed footprint does not expand into this area, but simply continues landfilling over existing areas of waste placement, with no new waste being placed closer than 35 m from the man-made water body.

A further restriction within the landfill license is to maintain a 35 m buffer zone around the site boundary within which no waste is to be placed. This has a slight impact on the filling of the existing void in the south-east corner of the site, where there is a small portion of the existing excavation that falls within the 35 m exclusion zone; consequently, the landfill footprint has been restricted in this area and the remaining small portion of the excavation will need to be filled with clean fill up to natural ground level. This could occur progressively as the adjacent waste height increases.

The optimal landfill footprint has been restricted to the areas of previous waste placement and the inclusion of an area of cleared natural vegetation to the east of the existing landfill. According to the landfill licence, it would be possible to landfill up to 35 m from the site boundary to the north and east of the landfill. This would enable the further expansion of the landfill footprint; however, would require the clearing of some native vegetation. The preference is not to be overly aggressive with the footprint expansion and retain all native vegetation around the landfill as a natural screen to reduce the visual impact of the facility and hence enable the optimisation of the height of the landfill over a smaller landfill footprint, which is a more cost and environmentally efficient solution.

3.5.2. Waste Profile

Within the waste industry the accepted minimum slope of the landfill cap is 1 vertical in 20 horizontal (5%) and the maximum reasonable slope is 1 in 5 (20%). A 1 in 3 slope can be achieved; however, there are erosion and landfill cap stability issues to consider.

Typically, the ideal slope on a landfill is a function of optimising the available landfill airspace on site while limiting the maximum height of the waste to a reasonable level so as not to be overly obvious to the surrounding land users.

Due to the width of the landfill footprint and a desire to not have a final waste profile being too high, the landfill has been designed with a slope of 1 in 10. This results in a maximum height of RL 209 m, which is 6 m higher than the current cap design (*Cardno 2008*); however, is only approximately 10 m above the highest natural ground level on site. The landfill high point is some 325 m to the south of the Gibbs Road site boundary and this boundary is well planted with tall trees; hence, it is unlikely that the proposed height of the landfill will be overly noticeable to the local community. In addition, progressive closure and rehabilitation of completed portions of the landfill would significantly reduce the visual impact. The advanced planting of strategically placed trees and shrubs could further reduce visual impact.

Increasing the height of the landfill beyond RL 209 m and hence the waste slope above 1 in 10 would increase the available landfill airspace proportionally. This is not a problem from a landfill operation and closure point of view; however, may be a concern as a result of the visual impact. Attaining a maximum height of RL 209 is seen as a reasonable compromise between landfill optimisation and visual impact.

3.5.3. Landfill Airspace

Based on the optimal landfill footprint and the proposed waste profile, there is approximately 726,000 m³ of available landfill airspace. This is as of 11 March 2017 (date of the site survey).

3.5.4. Landfill Lifespan

As with the calculation of the current landfill lifespan, this is a function of waste density, which is primarily a function of site operations and the annual quantity of waste being received on site. Consequently, the lifespan has been calculated on a range of potential waste densities.

Table 3.5.1 – Optimal Landfill Lifespan provides the optimal landfill lifespan based on 8,200 t/yr and a range of waste densities.

Table 3.5.1 – Optimal Landfill Lifespan

Available Airspace	Waste Density			
	0.40 t/m ³	0.50 t/m ³	0.70 t/m ³	0.90 t/m ³
726,000 m ³	35 yrs	45 yrs	62 yrs	80 yrs

As can be seen, the greater the waste density, the longer the landfill lifespan. Based on reasonable waste operation practises, there should be at least 45 years to 50 years of available landfill on site. With good operational control, this could be extended out to approximately 60 years to 70 years.

3.6. Comparison of Available Landfill Airspace

The current landfill design results in 550,000 m³ of available landfill airspace and the proposed optimum design achieves an airspace capacity of approximately 726,000 m³.

Table 3.6.1 – Landfill Design Comparison sets out the basic differences between the two landfill waste profile designs by comparing the optimal design to the current design.

Table 3.6.1 – Landfill Design Comparison

Description	Current	Optimal	Optimal Benefit/Dis-Benefit
Airspace	550,000 m ³	726,000 m ³	32% increase in landfill available airspace.
Reasonable Lifespan	35 to 40 yrs	45 to 50 yrs	Significant increase in landfill lifespan.
Possible Lifespan	45 to 50 yrs	60 to 70 yrs	Significant increase in landfill lifespan.
Height	RL 203 m	RL 209 m	6 m additional height may require concentration on progressive closure and strategic tree planting.
Footprint	Only over existing waste	Over existing waste and cleared areas on site	Better utilisation of cleared areas on site. Optimises the use of the existing void in the eastern portion of the site.
Vegetation Clearing	Nil	Nil	No additional native vegetation clearing.
Waste Slope	Variable 1 in 4 to 1 in 15	1 in 10	Easier waste profile to set out and achieve. Significantly less steep in some areas.

The proposed optimum landfill waste profile design better utilises the available space on site without requiring any clearing of native vegetation. The resultant landfill profile provides reasonable available landfill airspace and corresponding lifespan, while resulting in a finished profile that blends into the natural surrounds and has a stable slope that is easy to cap, rehabilitate and maintain.

3.7. Review of Landfill Airspace Consumption

In order for the Shire to be aware of the rate at which landfill airspace is being consumed, it is recommended that the Shire undertake regular surveys of the landfill surface for comparison against previous surveys.

Due to the relatively long estimated life of the landfill it is recommended that a survey of the immediate area being landfilled be undertaken every two years, with a full survey of the complete landfill undertaken every four years.

The localised survey of the active portion of the landfill will provide an interim estimation of landfill airspace consumption. This will not enable a true representation of the remaining landfill airspace to be calculated, as the localised survey will not pick up the settlement occurring over the full extent of the landfill. This localised survey will however enable the calculation of the typical airspace consumption and waste density being achieved over the period between subsequent surveys. Settlement that has occurred in the lower surface being modelled between the times of the two surveys will increase the actual volume of airspace being filled in comparison to the calculated volume. The difference will be a marginally higher calculated waste density in comparison to the actual waste density being achieved on site; however, for the purpose of assessing airspace consumption is somewhat irrelevant.

The four-yearly survey of the complete landfill allows for settlement across the whole landfill to be included in the airspace calculations, and hence a more realistic remaining landfill airspace volume calculated. Again, there will be the impact of settlement in the lower surface that will marginally distort the airspace calculations, but this cannot be prevented, as there is no survey of the base of the landfill (which is ultimately the only surface that does not settle).

4. Operational Improvements

4.1. On Site Observations

Comments from observations on site and discussions with Shire staff include:

- The landfill has progressively grown horizontally and vertically in a somewhat random manner. There does not appear to be any forward planning on how to efficiently achieve the current landfill waste profile;
- The landfill tipping areas are moved around to accommodate seasonal change (winter – high ground; summer - low ground);
- Multiple tipping areas are utilised;
- The landfill compactor (Tana G400, 40 tonnes) is broken down and very expensive to repair. The Shire's tracked loader is also broken and in the process of being repaired. A dozer D9 (49t) or CAT 950H front-end loader (18t) are currently being used for waste placement and compaction;
- Occasional cover material application;
- Minimal litter fencing utilised;
- Shallow active tipping areas;
- Segregation of problematic waste (mattresses); and,
- Four staff members operate on a nine day fortnight (average 38 hour week) to cover all facility operations.

4.2. Proposed Improvements

Based on current landfill operations, the following are the proposed operational improvements that could be adopted:

4.2.1. Landfill Management Plan

In order to provide site staff with the necessary understanding and direction of how the landfill is to be developed, the Shire should have a landfill management plan setting out how the landfill is to be progressively developed and subsequently closed. Site staff need a landfill plan (drawing) identifying the area of landfill where waste is to be placed within the near future (1 to 2 years).

4.2.2. Waste Profile Setout

Based on the landfill plan, the Shire needs to set out the final waste profile to provide guidance to the site staff to enable them to place and compact waste to achieve the desired pre-settlement waste profile. Setting out of the waste profile could involve height markers on the landfill (settlement of the markers is a concern when they are placed on the waste mass), batter boards set out around the outside of the landfill perimeter (not on the waste) or GPS guided machines. (GPS guided machines are the preferred methodology, but are also the most expensive).

4.2.3. Single Tipping Area

Having numerous landfill tipping areas at one time results in additional operator effort, larger areas for litter generation, greater consumption of cover material and potentially increased generation of leachate. The preference is to have only one landfill tipping area. All waste that is disposed of to landfill should be placed in the same tipping area. The ideal is that light waste is covered with heavy waste. This acts as cover material, improving litter control and increases waste compaction. The exception to this is asbestos and clinical waste, which has to be a landfilled separately (a license requirement).

During daily receipt of waste, light/putrescible waste should be placed as close to the active tipping area as possible. Inert and bulky waste should be tipped to the side of the active tipping area. Either regularly during the day or at least at the end of the day, the light/putrescible waste material should be pushed up and compacted into the landfill, with the heavier/bulky waste spread out over the lighter material and again compacted.

4.2.4. Waste Compaction Equipment

Waste compaction is one of the most critical activities on the landfill. The Shire has a good sized waste compactor (Tana G400, 40 t); however, this machine has been unserviceable for many months. The reality is that this machine, although extremely effective in breaking up and compacting the Shire's waste, is far too large and expensive (operating and maintenance costs) for a landfill of approximately 8,000 tpa; consequently, this machine has proven to be unsuitable.

The Shire also has a tracked loader (traxcavator), which has been used in place of the unserviceable Tana. Recently, this machine has also broken down and the Shire has hired in a D9 dozer (48 t) to place and compact the waste. The dozer is highly effective for spreading and compacting waste; however, in comparison to the Tana, would achieve a lower waste density. Although the ground pressure is relatively similar (D9 = 110 kPa or 11.2 t/m² of track, Tana = 6.2 t/m of drum width, estimated 12.4 t/m² based on 0.5 m waste contact width), the tracks are significantly less efficient in breaking up the waste, which reduces the ability to achieve a higher waste density.

The transfer station operates a front-end loader (CAT 950H; 18 t), which is primarily used for loading trucks, pushing up greenwaste and scrap metal and occasionally as a back-up machine to push up and lightly compact waste on the landfill. The loader is adequate to compact the landfill waste (7.3 t/m of tyre width, estimated 14.6 t/m² based on 0.5 m waste contact width); however, being a wheeled machine, tyre punctures are always a concern and hence, the vehicle operators tend to push up the waste and not compact the material.

There needs to be a reasonable balance between achieving adequate compaction and the cost of the compactive effort. The Tana is too large and expensive to operate and should no longer be considered. Also, it is a purpose-built machine that is only useful for pushing up and compacting waste and at the end of the day, spreading cover material. It is ineffective for loading or moving cover material around the site or doing small earthworks activities.

A D9 dozer is a large machine, but achieves a comparatively low waste compaction. Again, as per the Tana, there are the operational limitations with regards to loading, cover material handling and minor earthworks.

The front-end loader is far more adaptable to general use around the site and has a reasonable ability to push up and compact waste; however, punctures are an issue. If the front-end loader is continued to be used as a back-up machine on the landfill, the Shire should consider fitting it with solid or soft-ride (semi-solid) tyres and training the operators to use the machine to spread the waste in thin layers and carefully compact the waste by repeatedly driving over it. The disadvantage with a wheeled machine is that the finished waste surface is generally rutted and hence, when covering the area with daily cover, a significant amount of cover material is wasted in filling ruts. However, with the front-end loader only being used as a short-term back-up machine, surface finish on the landfill is not a major concern.

The preferred scenario with regards to mobile plant would be the front-end loader to cover its current transfer station activities and a tracked loader to operate on the landfill to place and compact waste. The front-end loader would still be used as a back-up landfill machine.

A tracked loader (CAT 953 [16.5 t, 65.5 kPa, 6.7 t/m² or 84.6 kPa, 8.6 t/m²] or CAT 963 [20 t, 71.5 kPa, 7.3 t/m² or 85.5 kPa, 8.7 t/m²] or similar) is a relatively cost-effective solution for a small landfill and with tracks, is unaffected by punctures. The tracks do however apply a relatively lower ground pressure, which reduces compaction in comparison to specialist waste compactors or a large front-end loader, but the tracks do provide a reasonably smooth finish of the compacted surface. The tracked loader is also useful for general use around the site; however, it lacks the front-end loader's reach for loading large trucks. Tracked loaders range from \$400,000-\$500,000 for a new machine or approximately \$150,000 for a good condition second-hand machine. The running costs are estimated as being similar to that of a large front-end loader. They do however come with a "waste disposal arrangement" (equipment modifications to suit landfill operations) that cost in the order of \$50,000, which protects the machine from most damage that occurs on a landfill site.

4.2.5. Cover Materials

The application of cover material needs to be improved. From a compliance point of view, cover material needs to be applied in a 150 mm layer on a daily basis. However, the ineffective application of cover material simply wastes landfill airspace and does not meet licence conditions. Care needs to be taken to achieve a waste surface that is well compacted, relatively smooth and has minimal voids. Ideally the cover material should not be too rocky as this limits the operator's ability to apply a thin (150 mm) layer. If the landfill is operated efficiently with only one tipping area and good waste blending followed by effective compaction, the use of cover material can be minimised, whilst complying with licence conditions.

4.2.6. Litter Control

The Shire should place/install mesh litter screens/fencing in close proximity to the active tipping area to reduce litter generation. This becomes more important the higher the landfill rises above the natural ground level. Litter fencing will not stop litter generation, but can assist in controlling it. In addition, having grasses or shrubs growing on closed or temporarily close landfill areas helps trap litter and stops it from blowing off the landfill area.

4.2.7. Waste Depth

The landfill is currently operating with numerous shallow tipping areas. The license allows for a maximum tipping face of 2 m high. Landfill operations should be set up to achieve this maximum tipping face height, with multiple thin layers of waste spread and compacted on a daily basis to achieve the 2 m height (minimum 4 layers of 500 mm each, ideally up to 6 thinner layers). Increased thickness of waste placement decreases the surface area of the tipping area with a consequential reduction in litter generation, odour, cover material consumption and horizontal progression of the landfill.

4.2.8. Landfill Filling Plan

With effective landfill planning, the filling plan should strive to fill portions of the landfill to final design profile before moving on to other areas of the landfill site. The ideal is that the landfill fills up from the back of the site and progresses towards the site entrance where ultimately the last load of waste is placed before the site is finally closed.

During the filling process, as areas of the site achieve the final design profile, these areas are to be capped and rehabilitated as soon as reasonably possible. This progressively capping reduces the Shire's landfill closure liabilities, but also reduces leachate generation and improves landfill visual impact (along with other operational benefits). Should there be visual impact concerns with the proposed height of the finished landfill, the landfilling program can be adapted to reduced visual impact, including constructing bunds, capping and rehabilitating completed portions of the landfill, planting trees on the landfill perimeter, on bunds or even on areas of localised thickening of the landfill cap, which encourages the survival of taller plant species.

4.2.9. Problematic Waste

Problematic wastes such as mattresses are currently separated from the general waste and removed from site. If the mattresses are recycled at the offsite disposal location, then this is a beneficial outcome albeit at a cost; however, if the mattresses are simply shredded and landfilled, then the Shire should look at ways of landfilling these items on site, but in a manner that does not negatively impact on the landfill operations. An option with mattresses could be to place them (by hand) in a single layer on the floor of the landfill and then progressively spread waste over the top and hence limit contact with the waste placement equipment and holding down the mattresses.

4.2.10. Staffing

The Shire has recently increased the site staff from three to four to provide adequate coverage for all site activities. The concentration of activity being the transfer station during the weekends (three staff) and then managing the accumulated waste and recycling material on Mondays (four staff). The remainder of the week being covered by two staff members. With an average of 580 vehicles per week passing through the transfer station and the facility being open from 9.00 to 4.30 every day, the staffing levels appear to be adequate. The Shire could monitor facility utilisation to see if there are slow periods during the day in order to reduce facility operating hours. However, with the Shire looking at improved recycling, the preference would be to maintain the existing staffing levels and maximise staff efficiency to divert waste from landfill.

5. Recycling Improvements

5.1. Current Recycling Activities

Currently the Shire has an active recycling operation. **Table 5.1.1 - Current Recycling Activities** sets out the range of recycling activities within the Shire and the associated quantities thereof.

Table 5.1.1 - Current Recycling Activities

Activity	Quantity
Kerbside – Packaging Recycling	765 t/yr
Kerbside – Organics	921 t/yr
Scrap Metal	275 t/yr
Greenwaste – Self-Haul	1,360 t/yr
Cardboard	60 t/yr
Mattresses	140 t/yr
Used Oil	5.3 t/yr
Paints	2 x 6x4 Trailer/yr (tins not full)
Batteries – Wet Cell	5.8 t/yr
Batteries – Dry Cell	2.5 t/yr
Fluorescent Tubes and Globes	0.2 t/yr
Tyres	500 no. assorted sizes/yr
Gas Bottles	30 no./yr
DrumMuster	2,500 no./yr

5.2. Improved Recycling Activities

5.2.1. Decision Makings

One of the most significant benefits of recycling within the Shire is to reduce the quantity of waste going to landfill. This is a substantial driver to increase the quantity of material being recycled. There is however a need to balance the cost benefit thereof. In some cases the cost of the recycling activity is significantly greater than the cost of landfilling. Prior to venturing into increased recycling, the Shire needs to understand the decision-making driver(s). As described above, cost is a significant influencing factor; however, there are also other non-cost related drivers such as regulatory requirements, political or community expectation or environmental concern. All of these factors need to be considered when determining the future of recycling within the Shire.

5.2.2. Improved Existing Operations

With there being existing recycling activities, the easiest way to increase recycling is to ensure that the existing systems are operating efficiency. Efficient operation incorporates maximising the quantity of material of each type being recycled and minimising the amount of contamination within the recycled material.

5.2.3. Kerbside Recycling

The Shire is to emphasise to the community what can and can't be placed in the various kerbside wheelie bins. This is typically through brochures and education campaigns. It is important to note that education is an ongoing activity to continually reinforce the message, not a one-off activity when a new system is implemented.

When selecting the recycling bin downstream processors (light green or yellow lid), the Shire should consider those providers that are able to receive, process and recycle the widest range of materials. The greater the range of recycled materials that can be placed in the recycling bins, the less material that is placed in the general waste bin.

The Shire also needs to maximise the participation rate within the community, the more properties that have recycling bins, the more material that is diverting from landfill.

5.2.4. Cardboard

Currently there are two cardboard bins at the transfer station. This material is collected by *Cleanaway* and dropped off at Picton, where it is mixed in with other recycling materials, predominantly yellow bin recycling and transported to Perth where it is sorted. With this material being mixed with other recycling material, there is no benefit in only cardboard being collected at the transfer station. This service should be expanded to receive all yellow bin recycling materials as all the material ends up at the same sorting facility in a blended state. Consequently, the current "cardboard" recycling activity could be expanded to include glass, newspaper, mixed paper, steel and aluminium cans, PET plastic, HDPE plastic and other mixed plastics.

Many of these material types are in evidence on the concrete tipping pad at the transfer station. It may be possible to place additional recycling bins at the lower level in close proximity to the transfer station tipping area to make it more convenient for the community to recycle these types of materials. In addition site staff could also extract some of these materials from the transfer station waste and placed them in the recycling bin(s) as part of their usual activities. It is not proposed that this be a dedicated task, as the associated labour cost would likely be excessive to the overall environmental benefits gained. The preference is to encourage the community to “do the right thing”, with the site staff providing direction and supporting activities.

5.2.5. Yellow Bin Swap Facility

To try and increase the quantity of recyclable materials being diverted from landfill, the Shire could consider providing recycling bins to householders that are not on the kerbside recycling collection run. The residents would then collect recyclable materials in the bin and when they visit the Collie town site, they could deliver the full recycling bin to the Waste Management Facility and swap the full bin for an empty bin. The kerbside recycling collection contractor (currently Cleanaway) would then empty the MGB's as part of its regular collection run through Collie. Because this is part of a well-established collection and processing system, there would only be a minor cost for the inclusion of these bins in the kerbside recycling collection contract.

There will however be a need to manage the number of yellow lidded bins involved in this scheme as there is the likelihood that many bins could go missing.

5.2.6. Hazardous Household Waste

The Shire website states that hazardous household waste such as paint, cleaning products, pool chemicals, fluorescent tubes, pesticides and gas bottles can be dropped off for free at the Bunbury Harvey Regional Council facility at Stanley Road, Australind. Although this service is available to the community, due to the travel distance, it is highly unlikely that all but the most avid recyclers would use this facility and that the vast majority of the community would simply dispose of this type of material in the general waste stream, which ultimately ends up in the landfill.

The Shire does receive used paint and gas bottles at the Gibbs Road facility and fluorescent tubes and globes at the Shire's office; hence, is party involved in the management of the easier portion of this waste stream. However, without significant effort, the Shire could become a drop-off facility for a wide range of hazardous household waste and when sufficient volume of material has been accumulated, this could then be transported by the Shire to the Stanley Road facility and disposed of at no charge.

The ideal solution is for the Shire to purchase a dedicated, purpose-built trailer that has a number of separate compartments for the storage of different types of hazardous household waste. The material that is received from the community is immediately placed in the trailer and once the trailer or particular compartments within the trailer are full, the trailer can be towed to Australind and the material dropped off at Stanley Road. It is highly likely that funding may be available from the Waste Authority for this type of trailer; hence, further reducing the cost to the Shire.

Should the Shire opt to implement an improved hazardous household waste drop-off service, it needs to be aware that the subsequent transfer of hazardous household waste is a Controlled Waste activity and the vehicle (trailer and Ute) and the driver would need to be registered as Control Waste Carriers. The facility would also need to be registered as a Controlled Waste Transit Facility. If the Ute were not being used to transport hazardous house waste, then it would not need to be registered. If there were more than 200 kg of waste being transported, a Controlled Waste Tracking Form would be required. If the Ute and the trailer each had more than 200 kg of Control Waste, then the Ute and the trailer would both need a separate Controlled Waste Tracking Form. Once initially set up, the handling and transport of Control Waste is not overly complicated and there is significant environmental benefit in diverting these types of materials from landfill.

5.2.7. Construction and Demolition Waste

Construction and demolition waste is relatively easily separated and recycle; however, due to the low quantity of this type of material been received on site, it is not deemed reasonable to expend significant effort to divert this material from landfill. If this material is managed appropriately and placed on top of light waste within the landfill, it can significantly improve landfill operations by controlling litter, increasing waste density and improving the trafficability of the landfill surface.

The exception to the above is if there is a large-scale demolition project within the Shire. This has the potential to generate a one-off spike in construction and demolition waste quantity. This could be managed as a one-off project with the construction and demolition material being crushed and used for road material on site or elsewhere in the Shire. If this is to be considered, the Shire needs to confirm whether it is able to crush the material on site (licenced activity). If not, then the crushing needs to occur before the material is delivered to site. The special handling of a one-off spike of construction and demolition material should be managed through the appropriate Planning and Building License approvals relevant to the project generating the large quantity of construction and demolition material and not be left to the Shire to carry the cost of dealing with this material at the Waste Management Facility.

5.2.8. Energy From Waste

Due to the relatively small waste tonnage that is generated within the Shire it is not deemed economically viable for the Shire to develop an energy from waste (EfW) solution. Typically, based on current available technology, EfW solutions need large throughput tonnage (in excess of 100,000 t/yr) to make the facility economically viable. In time, there may be small-scale options that become available that could suit the Shire's waste type and waste generation capacity.

EfW is a favoured topic within Local Government at present and numerous shires and regional groupings of councils are currently considering EfW as a possible future waste management option. The Shire should be aware of the possible local development of EfW solutions and consider participation in these options.

EfW has the potential to manage a significant portion of the Shire's waste stream and hence, should an EfW solution become available, the Shire is to be aware that this will divert the vast majority of its waste away from landfill and consequently significantly change the landfill operations on site (typically become a majority inert landfill), which will have a significant impact on the landfill operating requirements, costs and lifespan.

It is highly unlikely that an EfW solution will consume all waste that is currently going to landfill; hence, the Shire will always need a landfill disposal option for a portion of its waste stream, albeit a small fraction of the current landfill tonnage. In this scenario, the Shire may consider closing its landfill and simply transferring the small quantity of landfill waste to an alternative disposal site. This will primarily be a financial decision as there is ample future landfill airspace on site.

6. Transport Options

For future potential considerations of transferring waste materials to an alternative landfill disposal location an assessment of the likely operational activities and associated costs has been undertaken. Due to the large number of variables associated with the transport of waste from site, a range of costs have been provided as an indication of the typical cost involved and how these costs change according to the variables.

The following are the various scenarios considered:

- Single and double trailer vehicle configurations;
- Large and medium volume trailers;
- Different transport distances - 50 km; 75 km; 100 km and 150 km; and,
- Different number of vehicle trips per day - 1 trip; 2 trips and 3 trips.

The following are the assumptions on which the modelling has been based:

- The Shire to utilise a contractor to transport the waste material, as opposed to an in-house operation;
- Large volume trailer = 65 m³;
- Medium volume trailer = 45 m³;
- Load density of 0.15 t/m³;
- Loading time = 20 minutes;
- Unloading time = 20 minutes;
- Vehicle paid for on hourly hire, with charges commencing when vehicle departs contractor's depot and ending when the vehicle returns to the contractor's depot;
- Contractor's depot being one hour's drive from the landfill site - Australind/Bunbury area (not aware of any waste transport compatible trailers in the Collie area);
- Annual waste quantity of 8,200 tonnes or 30 t/day;
- The vehicle drives past the landfill site on completion of the last load and then returns to the contractor's depot; and,
- Vehicles can be loaded in the existing load-out bay using the existing front-end loader (CAT 950).

The following are some of the influencing variables, which could change the modelled transport costs:

- The Shire could undertake the transport activity in-house; however, this may only be made cost-effective if the vehicle was used efficiently and had minimal downtime. Backup services in the event of a vehicle breakdown would be provided by contract hire;

- If a regular service was required, it is possible that a local transport contractor may purchase a waste compatible trailer(s) to service the Shire's needs. This could reduce the costs, as the vehicle(s) would not have to travel long distance between the contractor's depot and the landfill site. For small local service providers, the provision of backup equipment (spare trailer(s)) may reduce the local advantage in comparison to the larger regional transport service providers;
- The larger the volume of the trailer, the greater the tonnage of waste able to be transported in a single vehicle movement. There is minimal, if any cost difference between running large or medium sized trailers; hence, the preference for running the largest volume trailers possible. However, the ability to load the trailers needs to be considered;
- Increased load density dramatically decreases transport costs per tonne; however, is difficult to achieve without specialist infrastructure and/or equipment, which for a relatively small operation is not usually cost-effective;
- Fluctuation in waste quantities only influences number of loads departing the site, not the cost of transporting each load;
- The location of the disposal facility would have a significant cost impact, these being:
 - Travel distance - impacts travel time and number of trips per day per vehicle;
 - Travel route - impacts travel time (main roads or minor roads);
 - Relative location to contractor's depot - reduces or increases time from depot to site and/or disposal location; and,
- Waste type - impacts waste density in trailers.

The total cost of transporting waste to an alternative disposal location will be a function of the cost of operating the transfer station, the transport cost and the disposal cost at the alternative disposal location. Based on the assumption that the transfer trailers are able to be loaded using the existing transfer station facilities and loading equipment, there will be no change to the current loading cost. The transport cost will be an additional cost to the Shire and the alternative disposal location cost impact will be the net difference between the true cost of operating (and closing) the Gibbs Road landfill and the disposal fees at the alternative disposal location. Without this alternative disposal location being known, it is not possible to estimate the net impact. It is however likely that the alternate location will be a lined landfill and hence the disposal cost would be in the order of \$50/t - \$100/t depending on the size of the alternative disposal location, the larger site being the cheaper disposal location (economy of scale).

Table 6.1 – Waste Transport Cost Estimates provides a range of cost estimates based on various modelling scenarios.

Table 6.1 – Waste Transport Cost Estimates

Single and Double Trailer Transport Costs (\$/t)		
	Large Volume Trailer (65 m ³)	Medium Volume Trailer (45 m ³)
50 km Travel		
1 Trip/Day	\$57 and \$42	\$83 and \$60
2 Trips/Day	\$43 and # \$33	\$62 and \$48
3 Trips/Day	\$38 and ## \$30	\$55 and ## \$43
75 km Travel		
1 Trip/Day	\$67 and \$48	\$97 and \$69
2 Trips/Day	\$53 and ## \$39	\$76 and * \$56
3 Trips/Day	* \$48 and ## \$36	* \$69 and ## \$52
100 km Travel		
1 Trip/Day	\$72 and \$51	\$104 and \$73
2 Trips/Day	\$57 and ## \$42	\$83 and * \$60
3 Trips/Day	* \$53 and ## \$39	* \$76 and ## \$57
150 km Travel		
1 Trip/Day	\$89 and \$61	\$128 and \$89
2 Trips/Day	* \$74 and ## \$52	* \$107 and * \$76
3 Trips/Day	* \$69 and ## \$49	* \$100 and ## \$71

* Greater than 8 hours of travel/day

Greater than 30t/day transported

Based on the above scenarios and assumptions, typically it will cost in the order of \$50/t to \$90/t to use a single trailer vehicle to transport waste 50 km to 150 km and \$40/t to \$65/t using a double road train.

7. Reuse Shop Business Case

7.1. Reuse Shop Concept

An option for increased waste diversion from landfill is to develop a reuse shop on site to provide an opportunity to remove reusable items from the incoming waste stream and offering them for sale or giveaway to the local community. This type of recycling activity has successfully been developed in a number of shires throughout Western Australia. The scale of operations is dependent on the enthusiasm of the operators and the size of the local community generating and subsequently purchasing reusable items. The success of the operation is a function of the quantity of material diverted from landfill and the cost of operating the facility. There is also the social benefit of providing a popular service to the community.

The ideal scenario is for the Shire to provide and maintain the basic infrastructure (possibly through Waste Authority funding) and then to hand over the operation of the facility to a local community group, where the community provide personnel to operate the facility and any revenue from the operation is spent on community activities and facilities. The benefit to the Shire is a reduction in the quantity of waste going to landfill and reduced facility operating costs. It is unlikely that the revenue from the sale of reusable items would cover the operating costs for the Shire to operate the facility with Shire employees. Also, there is less community involvement in the Shire operated facility. This concept is however reliant on an active, long-term community involvement in the operation of the facility. It is important that the facility is operated and maintained in a neat, tidy and well-presented manner. This encourages community participation and subsequent success of the facility.

Typically the reuse shop would consist of a spacious shed with a front awning for the storage and display of reusable items as well as an unloading and loading area for the receipt and removal of material. Some of the items which are unaffected by weather could be displayed externally to the shed; however, after-hours security needs to be considered.

The range of items available for reuse will be dependent on the involvement of the local community in providing and purchasing items. Typically these would range from large furniture and house construction items down to small collectable items and trinkets. The selection of items would fluctuate depending on the demand. Ideally a wide range of items would initially be displayed and then as community utilisation develops, the operators will identify what items are more popular and thus become the point of focus.

Ideally the reuse shop would be located at the entrance to the site, before the weighbridge. This provides an opportunity for the community to drop off reusable items before entering the waste disposal area of the site. In addition, customers can access the facility without interacting with the waste management active area; hence, separating the two operations, which is highly beneficial if the community is operating the facility.

The business case for the development of the reuse shop is a combination of a financial assessment of the benefit or cost to the Shire and the social benefit to the community. The benefit to the Shire would primarily be the potential cost saving in landfill disposal costs and the environmental benefit of reduced waste to landfill, while the community benefit will be around participation in a community activity, reasonably priced shopping opportunity, environmental and recycling awareness and the opportunity to raise money for other community projects.

7.2. Cost Benefit

The cost benefit to the Shire in having a reuse shop is the comparison between the cost of developing and operating the facility and the saving in waste disposal costs. If the cost of the reuse shop is less than the saving in waste disposal costs, then the venture is cost beneficial and vice versa. The challenge is assessing the actual cost of waste disposal.

The true cost of waste disposal to the Shire is a combination of the following cost:

- Shire owned and operated landfill:
 - Administration costs:
 - Management;
 - Supervision;
 - Occupational health and safety
 - Governance;
 - Accounting;
 - Legal;
 - Other minor costs;
 - Landfill developing costs:
 - Investigations;
 - Design;
 - Environmental approval;
 - Progressive construction;
 - Landfill operating costs:
 - Staffing;
 - Equipment purchase, operations and maintenance;
 - Consumables;
 - Licence fees;
 - Groundwater and surface water monitoring;
 - Landfill planning;
 - Survey;
 - Environmental reporting;
 - General site cleaning maintenance;
 - Landfill closure and post-closure costs:
 - Site clean-up;
 - Landfill capping design;
 - Construction;
 - Site monitoring:
 - Cap integrity;
 - Cap vegetation;

- Cap performance;
- Groundwater and surface water;
- General site condition;
- Environmental reporting;
- Maintenance;
 - Cap;
 - Vegetation;
 - Fencing;
 - Monitoring points, including groundwater bores;
- External waste disposal (regional landfill, commercial landfill, energy from waste):
 - Administration costs:
 - Management;
 - Supervision;
 - Occupational health and safety;
 - Governance;
 - Accounting;
 - Legal;
 - Other minor costs;
 - Transfer station costs:
 - Staffing;
 - Weighbridge operations;
 - Equipment purchase, operations and maintenance;
 - Consumables;
 - Licence fees;
 - Environmental reporting;
 - General site cleaning maintenance;
 - Transport cost:
 - Contracted out; or,
 - In-house;
 - Disposal fee.

7.2.1. Waste Disposal Benefit

Administration Costs

These are typically extremely difficult to isolate in a mixed business such as Local Government. However, it is acknowledged that there is a component of the Shire's administration costs that should be attributed to the various activities that occur at the Gibbs Road Waste Management Facility. These costs will typically be proportional to the number of activities being undertaken and the associated administration effort required to manage and administer each activity.

With the potential addition of a reuse shop, there will be an additional activity to administer and hence, additional administration staff hours incurred. If this can be absorbed into the current Shire staff capacity there will be no direct cost increase in Shire staffing costs; however, some "spare capacity" would have been consumed, which ultimately should be allocated as a cost to the new reuse shop.

The potential marginal decrease in landfill tonnes is unlikely to result in a reduction in the landfill related administration activity and hence costs; consequently, the addition of a reuse shop will likely have a minor increase in administration activity and associated cost to the Shire.

From an accounting point of view, administration costs are included in the Shire's Labour Overheads component of the landfill and transfer station costs.

Landfill Development Costs

With the existing Gibbs Road landfill site, there are no development costs incurred by the Shire; however, in time, when the Gibbs Road landfill reaches maximum capacity, the Shire would be required to develop an alternative waste disposal option, be this a new landfill facility or a contract solution (regional landfill or commercial disposal option). With there being an estimated 50 year's of remaining landfill lifespan at Gibbs Road, it is not deemed relevant at this stage to consider an alternative disposal location within the context of the reuse shop business case; consequently, these costs have been ignored.

Facility Operating Costs

Landfill operating costs are currently being incurred by the Shire; however, there is no clear distinction between the landfill and transfer station operating costs. In addition, a minor change in one operation does not necessarily translate to a proportional change in operating costs to the Shire. Hence, it is difficult to accurately determine the true impact of diverting some waste tonnage away from landfill.

With the cost of operating the landfill being a combination of fixed and variable costs, it is predominantly the landfill variable costs that will be influenced by the reduction of waste to landfill. Fixed costs are not impacted by a minimal reduction in the quantity of waste going to landfill. As an example, if there is a 10% reduction in the waste to landfill, there is no reduction in weighbridge costs as the facility still needs to be staffed during all operating hours, it is simply that the weighbridge is less busy (lower facility efficiency). A similar scenario occurs with the waste compaction machine, currently a D9 dozer. This machine is still required, irrespective of the decrease in landfill tonnage; hence, there is no change in capital cost (fixed cost); however, there would be a marginal decrease in operating and maintenance costs (variable cost), primarily associated with marginally lower fuel consumption.

A further consideration of fixed costs is that by decreasing landfill tonnage and there being no associated decrease in fixed costs, then the fixed cost per tonne of waste being disposed to landfill will increase proportionally, as there are less tonnes to cover the fixed costs. Although there is no cost change to the Shire, the unit rate for landfilled tonnes increases.

Table 7.2.1 Waste Management Facility Costs provides a breakdown of the costs associated with the management of the facility.

Table 7.2.1 Waste Management Facility Costs

Financial Year	2013/14	2014/15	2015/16	2016/17	Average
<u>Landfill Costs</u>					
Tonnes Landfilled	*8,137 t	8,303 t	8,039 t	8,070 t	8,137 t
Employment Costs	\$27,189	\$24,625	\$37,229	\$67,907	\$39,237
Capital Expenditure	\$0	\$0	\$0	\$3,578	\$3,578
Materials & Contracts	\$827	\$18,126	\$19,685	\$68,169	\$26,702
Plant Direct Costs	\$50,566	\$65,095	\$70,028	\$87,956	\$68,411
Labour Overheads	\$37,221	\$33,712	\$50,912	\$92,867	\$53,678
Sub-Total	\$115,803	\$141,558	\$177,854	\$320,477	\$188,923
Cost/Tonne	\$14.23/t	\$17.05/t	\$22.12/t	\$39.71/t	\$23.22/t

Table 7.2.1 Waste Management Facility Costs (cont.)

Financial Year	2013/14	2014/15	2015/16	2016/17	Average
Transfer Station Costs					
Tonnes Processed	*14,186 t	14,040 t	11,256 t	17,263 t	14,186 t
Employment Costs	\$189,204	\$251,729	\$254,369	\$231,842	\$231,786
Utility Charges	\$1,454	\$3,361	\$3,679	\$3,400	\$2,974
Materials & Contracts	\$35,430	\$27,332	\$12,332	\$10,184	\$21,320
Plant Direct Costs	\$54,451	\$39,979	\$15,124	\$10,835	\$30,097
Labour Overheads	\$888	\$5,480	\$959	\$17	\$1,836
Sub-Total	\$281,427	\$327,881	\$286,463	\$256,278	\$288,012
Cost/Tonne	\$19.84/t	\$23.35/t	\$25.45/t	\$14.85/t	\$20.30/t
Total Waste Management Facility Costs					
Total WMF Costs	\$397,230	\$469,439	\$464,317	\$576,755	\$476,935
Cost/Tonne	\$28.00/t	\$33.44/t	\$41.25/t	\$33.41/t	\$33.62/t

* Annual tonnage not available. Average over the following three years used.

Due to the close interrelationship between the landfill and transfer station operations, it is difficult to accurately separate the costs between the two operations. Effectively, all material received on site is processed through the transfer station; hence, to assess a cost per tonne, this portion of the facility costs can effectively be divided by the total tonnage received on site; however, the landfill operating costs are only divided by the quantity of waste being landfilled, which excludes all recyclables and cover material received through the gate.

Based on the data provided, the average cost of landfill over the previous four years is approximately \$23/t. In the 2016/17 financial year, the cost is approximately \$40/t. This increase on past years is primarily associated with taking on an additional staff member and the cost of hiring in a dozer for placing and compacting the waste. This is seen as a more realistic future cost for operating the landfill as opposed to the lower cost incurred in previous years.

Should the reuse shop reduce the quantity of waste being landfilled, this will have minimal impact in reducing the landfill operating costs, as the vast majority are fixed costs; hence, are not impacted by minor fluctuations in landfill tonnage.

The transfer station costs would also be unaffected by a minor change in throughput tonnage.

Landfill Closure and Post-Closure Costs

Landfill closure and post-closure costs are a significant cost impost, which need to be accounted for when determining the true cost of landfilling. Too often landfills sites leave the closure of the landfill to the end of the life of the facility and due to the costs involved, tend to do very little and hence the site is never effectively capped and rehabilitated, which leaves an ongoing unaccounted liability for the Shire.

The landfill licence stipulates a minimum cap thickness of 1 m soil cover, which is the absolute minimum cap thickness that should be applied. The preference being for a 2 m cap to accommodate long-term erosion while still ensuring adequate waste cover and adequate growing medium to sustain vegetation. Ultimately, a thinner cap will require more maintenance and in the long-term, is highly likely to cost more than initially installing a thicker cap, with the most obvious impact being lesser vegetation survival and hence ongoing erosion.

The current landfill waste profile has a final surface area of 152,000 m² and the optimal design 140,000 m². The optimal design does not include areas of the landfill that have previously been filled to design level or areas within the 35 m buffer zone around the property boundary; hence, the true waste surface area that requires capping is likely to be in the order of 150,000 m² to 160,000 m². At an average depth of 1.5 m (average between licenced minimum 1 m and the preferred 2 m depth), there will be a need for approximately 230,000 m³ of good quality capping material. There will also be the need to build up the southern edge of the landfill to achieve a sustainable batter to cover the existing, steep, finished waste face. This will take between 5,000 m³ and 10,000 m³ of additional soil; however, this material is typically general fill (not inert waste) and hence, a less selective soil material.

With there being no additional areas of excavation on site, there will be a need to import this capping material. The timing of when the material is required and its availability will have a significant influence on the cost of the capping construction work. The best-case scenario being that the material is available from an existing construction project and hence delivered to site at no cost to the Shire. In this scenario, the soil laying and cap rehabilitation costs are likely to be in the order of \$5.00/m³ to \$10.00/m³. This excludes any stormwater drainage and access road works. In the more likely scenario, the Shire will be required to pay for the transport of the material delivered to site and potentially the purchase and loading of the soil material.

If the material was available within a 20-minute travel distance, the transport cost will be in the order of \$10/m³. Add to that the potential purchase and loading costs of \$5/m³ and the ultimate capping cost to the Shire could be in the order of \$20/m³ to 25/m³. With 240,000 m³ of capping soil being required, the total cost will be \$4.8 M to \$6.0 M.

In addition to the landfill capping costs, there will be the post-closure monitoring and maintenance costs for the landfill. With an unlined landfill and hence no leachate collection to manage, the closure period is likely to be approximately 10 years at a typical cost of \$1.0 M to \$2.0 M (highly dependent on the quality of the original cap and hence future maintenance costs).

Based on 8,200 tonnes of waste per year and a 50-year landfill lifespan, this equates to a capping cost of \$15/t to \$20/t of waste landfilled. The above costs are indicative only and have been based on "broad brush" assumptions; however, do represent the order of magnitude that the Shire will need to spend to properly close the landfill.

Summary of Landfill Facility Costs

The total cost of landfill is a combination of the cost of the following activities:

- Administration – Costs included in landfill operation costs;
- Landfill Development – Ignored at this stage as the landfill has many decades of future landfill airspace;
- Landfill Operating Costs – approximately \$40/t; and,
- Landfill Closure and Post Closure Costs – approximately \$20/t.

Based on the above, should the landfill properly account for its future closure and post closure costs, the typical cost per tonne of waste landfilled is approximately \$60. However, this does not include a component of the transfer station activities associated with receiving and transferring the waste to the landfill.

In the event that the landfill is closed, the landfill operating costs will cease; however, the Shire will continue to incur the transfer station costs as well future transport and disposal costs. Effectively, this will save approximately \$60/t landfill costs, but incur approximately \$50/t transport costs and a minimum of \$50/t landfill disposal fee (Cleanaway Dardanup). That is a net cost increase in the order of \$50/t.

7.2.2. Cost Comparison

To determine the potential cost saving in the reuse shop reducing waste to landfill, it is necessary to assess the current landfill cost and then determine the impact on these costs of reducing the quantity of waste to landfill. Based on an assumption of the quantity of waste reduction to landfill, a cost saving can be determined. This saving is then used as the perceived benefit to the Shire of the waste reduction and becomes the benchmark for the maximum operating cost of the new reuse shop for the Shire to breakeven between the two operations. Should the reuse shop cost less to operate; there is then the option of increasing the provision of services at this facility or for the Shire to retain the savings. If the reuse shop cost more than the landfill savings, the Shire has the option to change the operation of the reuse shop (reduced service/community personnel versus Shire staff) or except the additional cost as a community service.

An aspect of landfill disposal that is often forgotten is the cost of closing and monitoring of the landfill facility. This is a real cost that needs to be included in the overall facility costs. The diversion of waste from landfill will not reduce the closure and post-closure costs, but it will extend the life of the landfill and delay the incurring of these costs as well as delaying the need for a subsequent waste disposal location. Ideally, to determine the true impact of waste diversion there is a need to know what the alternative waste disposal cost would be, this includes material transfer (at the transfer station), transport and the alternative disposal location gate fee.

7.3. Facility Development and Operation

7.3.1. Facility Infrastructure

The primary infrastructure requirement is for a spacious shed within which to store and display reusable items. The size of the shed would be determined by the degree of utilisation of the facility by the local community. Due to this item of infrastructure being the largest single cost item, the preference is to initially construct a relatively small shed; however, design the facility layout such that the shed is modular and can easily be expanded by adding subsequent bays onto the existing shed. The preference being for a single large shed as opposed to numerous small sheds.

Traffic movements and parking also need to be considered, with adequate, easily accessible roadways and customer parking, with the design being based on functionality and safety. With there being community involvement in the facility, and that being in a typical shopping environment, consideration of for all ages needs to be included in the design and space allocation. With the shed being designed for potential expansion, the roadworks also need to consider this future possibility and be designed accordingly.

Services to the facility will also be a function of utilisation. Typically there will be a need to provide power, water and ablutions. Other infrastructure considerations include security and fire detection.

Conceptually, a small shed of dimensions 5 m x 10 m would cost in the order of \$30,000. Add to this the necessary roadworks and services, the total infrastructure cost would be approximately \$70,000. If the shed is increased in size to 10 m x 20 m, the total development cost would increase to approximately \$100,000.

There is the potential that the Shire or the community could source funding from the Waste Authority or other funding sources for the development of all or part of the initial infrastructure, which would consequently reduce the cost to the Shire.

7.3.2. Facility Operations

There are a number of staffing methodologies that could be utilised. These include:

- Shire employees only;
- Combination of Shire supervision and community volunteer assistance;
- Community volunteers only; or
- Contractor operation.

Each of these methodologies has benefits and dis-benefits. **Table 7.3.1 – Operational Methodology** sets out the various methodologies and provides comment on the benefits and dis-benefits thereof.

Table 7.3.1 – Operational Methodology

Operating Methodology	Benefits	Dis-Benefits
Shire Employees	Total control of operations. Influence to determine the extent of material extraction from the incoming waste stream. Flexibility to utilise transfer station staff spare capacity.	Expensive staffing costs. No staff incentive to optimise the operation efficiency, with a reliance on management supervision to achieve desired level of material reuse.
Shire Supervision and Community Volunteers	Reasonable control of operations and ability to determine the extent of material extraction from incoming waste stream. More community involvement and “community feel”. Community get some or all benefit from facility revenue; hence, incentivised to optimise reuse.	Relatively expensive staffing costs. Anticipated high turnover of community volunteers. Less commitment from volunteers cause absenteeism and lower reliability. Some or all of the facility revenue should be returned to community facilities or services as an incentive to optimise material reuse.
Community Volunteers	Cheapest staffing cost option. Minimal control of operations and material extraction. Maximum “community feel”. Community get all benefit from facility revenue.	Lack of facility control. All revenue returned to community projects. Heavily reliant on community commitment. Without this, the facility will not be operated well.
Contractor Operation - only a viable option if the contractor operates the landfill.	Shire determines the facility operational requirements and sets contract conditions (will impact contract cost). Has a degree of control through effective contract management. Minimal community benefit.	Minimal operational control. Relatively high contract cost. Contract administration requirements including tendering and governance. Generally all revenue retained by the contractor as an incentive to increase material reuse.

In all of the above operating methodologies, the Shire would need to provide the initial facility infrastructure as well as cover the facility maintenance costs.

7.4. Similar Facilities

Due to the number of variables associated with the development of a reuse shop and the associated cost benefit or dis-benefit thereof, a comparison with similar facilities has been undertaken. **Table 7.4.1 - Similar Facilities** provides information on a number of similar facilities.

Table 7.4.1 – Similar Facilities

Facility	Population Served	Staffing Structure	Revenue	Comments
Bunbury Harvey Regional Council	+30,000	In-house, using existing transfer station staff.	\$50,000/yr	Part of the transfer station operation. No dedicated staff.
Shire of Augusta Margaret River	7,000	In-house, using existing transfer station staff. Self-service style.	\$10,000/yr to \$15,000/yr	Part of the transfer station operation. No dedicated staff. Minimal staff involvement.
Shire of Harvey	3,000, but also get many customers from other surrounding shires.	Contractor, with landfill scavenging rights. 1 staff member 7days/week.	\$35,000 to \$40,000/yr	50% of what is sold could be sold as scrap metal. Dedicated staff and financial motivation to maximise opportunities.
Shire of Narrogin	4,500	Contractor, with landfill scavenging rights. 1 staff member 7days/week.	\$10,000/yr	No dedicated staff. Contractor uses landfill staff. Although there is financial motivation, there is minimal activity.

7.5. Potential Facilities Costs

The cost of developing and operating a reuse shop will be highly dependent on the staffing model adopted by the Shire. Ultimately, there would be the cost for the initial infrastructure development, which would be a one-off cost and beyond that, staffing and maintenance costs. Revenue received from the sale of reusable materials would then offset a portion of the costs incurred in operating the facility; however, the staffing model will determine whether the Shire was to receive the revenue or it was to go to the community or contractor.

Typically, for a Shire staffed facility, there would be a requirement for a full time employee (FTE) to be on site during all operating times. If the Shire were to supervise the community operation of the facility, then there would only be a need for part-time involvement from the Shire staff. With the full community operation of the

facility or a contractor operation, there would be no day to day operational requirements for the Shire; however, there would be a need for some managerial oversight to ensure that the operation was being carried out in accordance with the Shire expectation (functional and safety aspects) or contractual requirements.

Table 7.5.1 – Facility Costs provides a summary of potential costs for developing and operating a reuse shop.

Table 7.5.1 – Facility Costs

Infrastructure	Shire Cost	Shire Revenue	Net Shire Cost
Infrastructure – Small Shed	\$70,000	NA	\$70,000
Infrastructure – Medium Shed	\$100,000	NA	\$100,000
Annual Facility Maintenance	\$10,000	NA	\$10,000
Operating Methodology	Shire Cost	Shire Revenue	Net Shire Cost
Shire Employees – 1 FTE x 5 days/wk	\$75,000	\$20,000	\$55,000
Shire Supervision and Community Volunteers – 0.2 FTE x 5 days/wk	\$15,000	\$0 (revenue to community)	\$15,000
Community Volunteers	\$0	\$0 (revenue to community)	\$0
Contractor Operation – unlikely scenario if the contractor were to only operate the reuse shop.	\$75,000	\$0 (revenue to contractor)	\$75,000

FTE = Full Time Employee

Based on the above costs, it is estimated that a reuse shop is likely to cost the Shire between \$10,000/yr and \$75,000/yr, which excludes the initial infrastructure investment of between \$70,000 and \$100,000. If the Shire opted for a contractor-operated facility, the annual costs would be in the order of \$85,000; however, due to the additional costs involved at no perceived benefit, this is seen as an unlikely operating methodology.

An important point to note is that a significant portion of the materials that are sold through the reuse shop would consist of metal and hence, prior to the reuse shop being developed, these items would be diverted to the scrap metal stockpile and not end up in landfill. Consequently, the diversion of these items to the reuse shop would not reduce the quantity of waste going to landfill and depending on the revenue generated from the sale of the items and the revenue sharing arrangements, the reuse shop may generate less revenue for the Shire than the current situation where the items were sold as scrap metal and the Shire received 100% of the revenue (currently approximately \$70/t).

7.6. Potential Waste Diversion

In discussion with other similar facility operators, without there being an accurate means of assessing the quantity of material that is diverted through reuse shops, it is not possible to determine the amount of material that the shop recycles and hence diverts from landfill. In addition, there is the diversion of scrap metal, which has no impact on landfill tonnage. This scrap metal diversion has been estimated by some facility operators as being as high as 50% of the reuse shop throughput.

A reuse shop will divert waste from landfill; however, the actual quantity of material diverted is highly dependent on enthusiasm/incentive of the facility operators and the community utilisation. It is not possible to accurately determine the quantity of waste diversion from landfill; however, a rough estimate would be 100 t/yr (400 kg/day) to 200 t/yr (800 kg/day), of which up to 50% may be diverted from the scrap metal recycling activity and hence only 50 t/yr to 100 t/yr of waste material would be diverted from landfill. In the context of an 8,200 t/yr landfill, this represents 0.6% to 1.2% waste diversion. This is not seen as a significant impact on the future lifespan of the landfill. Even if the rough estimates are deemed overly conservative by a factor of 10, the maximum waste diversion may be in the order of 10% of the landfill tonnage (800 t/yr or 3 t/day); however, even this level of waste diversion is not overly significant for the amount of effort incurred.

7.7. Potential Landfill Cost Saving

With the uncertainty surrounding the true cost impact of diverting waste from landfill and the relatively minor quantity of waste that is likely to be diverted from landfill by a reuse shop, the potential cost saving in landfill operations is not seen as a significant influencing factor when deciding whether to develop a reuse shop.

7.8. Reuse Shop Decision Matrix

There are a number of aspects that would influence the Shire's decision-making process when considering the development of a reuse shop, these would include:

- Waste diversion from landfill;
- Landfill operating cost savings;
- Reuse shop development and maintenance costs;
- Reuse shop ongoing operating cost;
- Recycling environmental benefits; and,
- Community facility.

It is not possible to accurately determine the true benefit of the waste diversion from landfill and the impact on the landfill operating costs other than to say that there will be a slight decrease in the quantity of material going to landfill and a consequential decrease in landfill operating costs, albeit very minor.

The facility development, maintenance and operating costs can be accurately assessed once the Shire has determined what scale of operation it wishes to develop and what staffing methodology it will adopt.

Waste diversion from landfill is a fundamental environmental consideration and not necessarily carried out for financial gain; hence, a significant component of the Shire's decision making should be around its stance on recycling and waste diversion and to a lesser degree the cost benefit thereof. Having said that, there needs to be the economic consideration as to whether the costs that are likely to be incurred in developing and operating a reuse shop could be better utilised in another way and achieve more recycling and waste diversion than in a reuse shop.

A further important decision-making aspect is the overall community benefit that is gained by having a reuse shop. This is not necessarily limited to the community involvement and utilisation of the reuse shop facility and the subsequent revenue that can be used for community facilities and projects, but can also extend to enhancing the community awareness, perception and involvement of waste minimisation and recycling activities throughout the Shire. The more community awareness, the greater the success of all recycling activities and not just that of the reuse shop. From a community perspective, recycling should be a holistic approach to waste management, which could also include a reuse shop.

8. Conclusion

Current landfill available airspace has been calculated at 550,000 m³, which equates to approximately 35 to 40 years of landfill lifespan. With good operational control, this could be extended out to approximately 45 years to 50 years. Optimising the landfill available airspace by increasing the landfill footprint and waste height has increased the available landfill airspace to 726,000 m³, which equates to approximately 45 to 50 years of landfill lifespan and with good operational control, this could be extended out to approximately 60 years to 70 years. Consequently, for both the current and optimum final waste profiles, there is ample available landfill airspace to cater for the Shire's long-term waste disposal needs.

In order to ensure the efficient operation of the landfill and to minimise landfill airspace consumption, there are a number of improvements that could be implemented, these relate to landfill planning, operational and closure activities.

In striving to further divert waste from landfill, there is a range of improved recycling activities that the Shire should consider implementing. Some are simple improvements of existing recycling systems, while others relate to the implementation of new or substantially improved recycling systems.

The total cost of transporting waste to an alternative disposal location will be a function of the cost of operating the transfer station, the transport cost and the disposal cost at the alternative disposal location. Based on the assumption that the transfer trailers are able to be loaded using the existing transfer station facilities and loading equipment, there will be no change to the current loading cost. The transport cost will be an additional cost to the Shire and the alternative disposal location cost impact will be the net difference between the true cost of operating (and closing) the Gibbs Road landfill and the disposal fees at the alternative disposal location. Without this alternative disposal location being known, it is not possible to estimate the net impact. It is however likely that the alternate location will be a lined landfill and hence the disposal cost would be in the order of \$50/t - \$100/t depending on the size of the alternative disposal location, the larger site being the cheaper disposal location (economy of scale). Based on the modelling scenarios and assumptions, typically it will cost in the order of \$50/t to \$90/t to use a single trailer vehicle to transport waste 50 km to 150 km and \$40/t to \$65/t using a double road train.

The development of a reuse shop will have minimal impact on reducing the quantity of waste going to landfill and subsequently result in an insignificant reduction in landfill operating costs. These cost savings are insufficient to justify the development of a reuse shop; however, the Shire should also consider the community and environmental benefit of a reuse shop. Ultimately a reuse shop will cost the Shire money to develop and operate. It is for the Shire to determine whether these costs are justifiable or whether, for a similar financial outlay, there could be a better recycling, environmental and social outcome.

9. Recommendation

Based on the waste management review of a range of current and potential future activities at the Gibbs Road Waste Management Facility the Shire should:

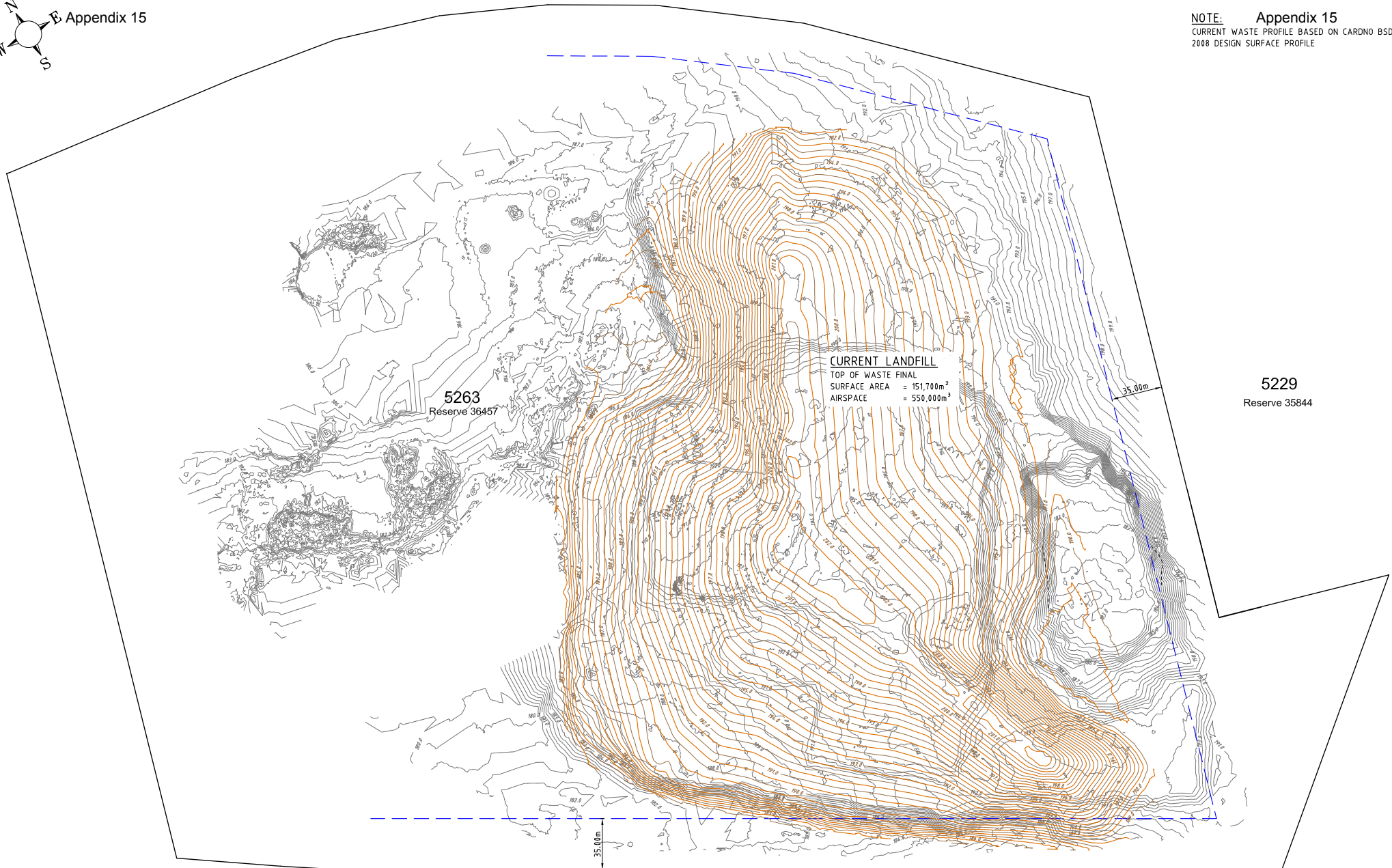
- Optimise the landfill footprint and height to increase the available landfill airspace and consequently the landfill lifespan;
- Improve the following landfill operations:
 - Develop an overall landfill management plan for the site;
 - Set out the agreed waste profile for site operators to use as a guide for future waste placement;
 - Operate the landfill with a single tipping area, the exception being asbestos and clinical waste;
 - Dispose of the dedicated waste compactor and old tracked loader and purchasing a good second-hand tracked loader for landfill waste placement and compaction;
 - Optimise the use of cover material;
 - Improve litter control;
 - Increase the depth of waste placement;
 - Provide guidance for site staff on the short to medium term landfill filling plan;
 - Monitor the consumption of landfill airspace by regular topographic survey;
 - Maintain the existing staffing levels and maximise staff efficiency to divert waste from landfill;
- Improve the following recycling activities:
 - Maximise involvement and participation in existing recycling activities;
 - Expand the current cardboard collection at the transfer station to include all recyclable packaging materials;
 - Consider implementing a yellow bin swap arrangement at the transfer station;
 - Implement a hazardous household waste collection system;
 - Use the Shire Planning and Building Licence process to manage large demolition projects that generate a significant quantity of waste material;
 - The Shire is to monitor the potential development of energy from waste projects in the region and assess the opportunities for participation in these projects;
- Not consider transporting waste to an alternative waste disposal facility as there is extensive available landfill airspace on site and the cost of waste transport and disposal is significantly more than the cost of on-site landfilling; and,
- Consider the development of a small community operated reuse shop at the entrance to the landfill, ideally with the initial infrastructure being funded by the Waste Authority or other community grant sources.

Appendices

- Appendix No. 1 – Current Landfill Airspace Layout Plan**
- Appendix No. 2 – Optimal Landfill Airspace Layout Plan**

Appendix No. 1 – Current Landfill Airspace Layout Plan

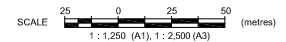
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CURRENT LANDFILL
TOP OF WASTE FINAL
SURFACE AREA = 151,700m²
AIRSPACE = 550,000m³

5263
Reserve 36457

5229
Reserve 35844



REVISIONS	REVISIONS			DRG. FILE	DATE	TECHNICALLY APPROVED:
	No.	BY	DATE	DESCRIPTION	DWG. CHK.	I.W.
A	S.B.Y.	15/16/17	Appendix 15 FOR REVIEW	DESIGN	I.W.	
				DRAWN	S.B.Y.	
				DES. CHK.	I.W.	
				DWG. CHK.	I.W.	



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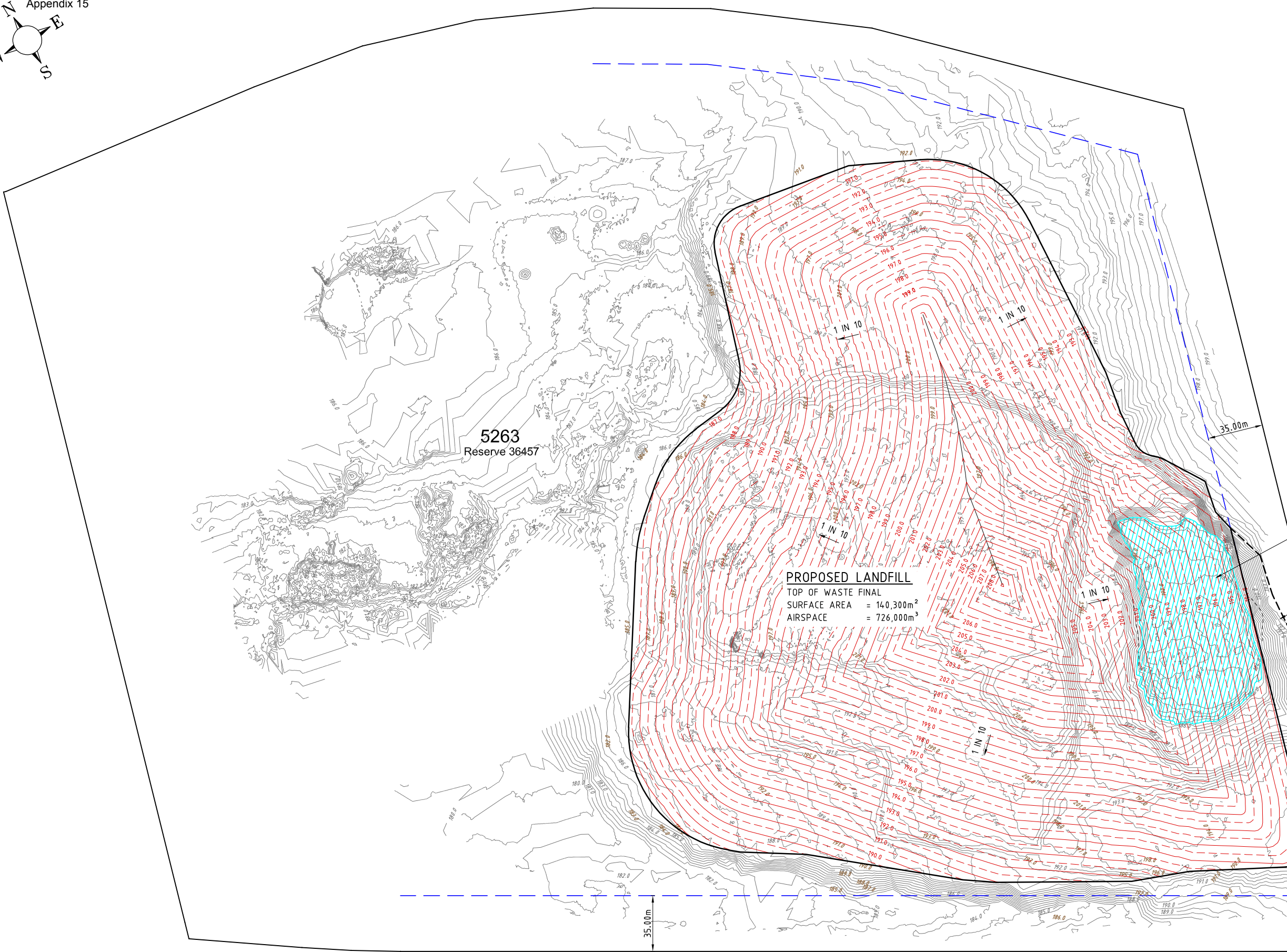
SHIRE OF COLLIE
GIBBS ROAD LANDFILL, COLLIE WA
LANDFILL FINAL LANDFORM
CURRENT LANDFILL AIRSPACE LAYOUT PLAN

SCALE	AS SHOWN
SHEET	Appendix 15
DRG No.	REVISION A GIBB-SK1

Appendix No. 2 – Optimal Landfill Airspace Layout Plan

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- NOTES:**
1. THIS PLAN IS ONLY SUITABLE FOR PLANNING PURPOSES.
 2. THE DESIGN SURFACE SHOWN ON THIS PLAN IS THE 'TOP OF WASTE' SURFACE PROFILE. LANDFILL CAP TO BE PLACED ON TOP OF THIS SURFACE.
 3. STORMWATER DRAINAGE AND ACCESS ROADS NOT CONSIDERED AS PART OF THIS WORK AND NEEDS TO BE INCORPORATED INTO ANY FINAL LANDFORM DESIGN SURFACE.



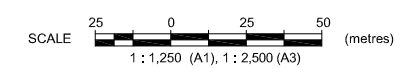
5263
Reserve 36457

5229
Reserve 35844

PROPOSED LANDFILL
TOP OF WASTE FINAL
SURFACE AREA = 140,300m²
AIRSPACE = 726,000m³

AREA TO BE FILLED UP TO
APPROX. R.L.185.0m.
(FILL = 13,800m³)

FILL VOID WITH CLEAN FILL
(APPROX. 8,000m³)



REVISED	No.	BY	DATE	DESCRIPTION	DRG. FILE	DATE	TECHNICALLY APPROVED:
					DRAWN	S.B.Y.	
A	S.B.Y.	15/16/17		PRELIMINARY ISSUE FOR REVIEW	DES. CHK.	I.W.	
					DWG. CHK.	I.W.	

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SHIRE OF COLLIE

GIBBS ROAD LANDFILL, COLLIE WA

LANDFILL FINAL LANDFORM

OPTIMAL LANDFILL AIRSPACE LAYOUT PLAN

SCALE	AS SHOWN
SHEET	
DRG	Appendix 15 - SK2