MWH

BUILDING A BETTER WORLD

REPORT

Akaroa Wastewater Selected Options 2008

Prepared for Christchurch City Council

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Christchurch City Council

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Contents

List of Tables

List of Figures

1 Introduction

This report considers two further options for the future development of wastewater treatment in Akaroa. These two options extend the number of options considered for Akaroa and should be considered along side the various options presented in the previous report Akaroa Water Management Strategy Part 6: Wastewater Treatment Options (MWH, February 2008).

The options investigated for this report are:

1. Potential alternative sites for a WWTP to serve Akaroa
2. An ocean outfall from the existing wastewater treatment plant (WWTP) site and extending 1.5km past the heads of the harbour.

The report presents assumptions made in assessing the two options considered, provides cost estimates and a comparison of the options considered.

1.1 Background

The previous report Akaroa Water Management Strategy Part 6: Wastewater Treatment Options (MWH February 2008) assessed the wastewater treatment and disposal options available for Akaroa. The issues with the current treatment and disposal system were identified and then options for alternative disposal routes and treatment plant upgrades to address these issues were presented.

The two further options considered in this report are required to provide a complete set of options that may be of interest to stakeholders, which will allow an informed decision to be made on the future development of Akaroa wastewater treatment and disposal. An ocean outfall was not considered in the previous report because it is less technically and economically feasible compared with other options available. However an outfall is presented in this report to provide a comparison with the other available options. Although the cultural and historical significance of the current WWTP site was noted in the part 6 report, relocation of the WWTP site was not considered because of the lack of obvious alternatives and because, from a technical and economic perspective, the current site is the most pragmatic option for the location of the WWTP.

The current location of the WWTP has been the subject of discussions between the Onuku Runanga, the district council and the government. Submissions on the recent short term resource consent application for the WWTP discharge have reiterated the issues over the treatment plant site and the need to consider alternative locations. This report presents potential alternative sites and assesses the technical and economic factors for each potential site.

2 Treatment Plant Site Options

2.1 Background

The area between Ōnuku and Akaroa known as Takapuneke (Red House Bay) that the WWTP is sited on has special historical, cultural and spiritual significance and is listed in the Register of Archaeological or Wahi Tapu Sites. The 2007 Christchurch City Council (CCC) Akaroa Harbour Basin Settlements Study sums up the significance of the area:

> *"A key historical event is that of the 1830 attack of the settlement of the Ngai Tahu chief, Te Maiharanui, by the Ngati Toa chief, Te Rauparaha, resulting in the deaths of many men, women and children at Takapuneke and later at Onawe. Some consider the involvement of the British Captain Stewart and the merchant ship Elizabeth in this event to be one of the reasons that led to the British authorities visiting the Bay of Islands in 1833 and, to the consequent signing of the Treaty of Waitangi. In 1840, the Treaty was signed by Ngai Tahu chiefs at Onuku, one of the few South Island signing locations, and the HMS Britomart was dispatched to raise the British flag at Green's Point, demonstrating British sovereignty to the arriving French and German settlers. The Britomart Memorial on Green's Point exists today to commemorate the raising of that flag on 11 August 1840. Therefore, these sites in close proximity to each other, Takapuneke, Green's Point and the Britomart Memorial, are nationally significant to the history of New Zealand."*

While the current WWTP site is in a desirable location from a technical point of view, options to relocate the WWTP are being considered because of the significance of the site.

2.2 Current Site

The existing WWTP is located in Red House Bay near the waterfront. The total site area is around 3,000 m2, while the structures and equipment are contained in an area approximately 58m by 40m (2,320 m2). The structures and equipment onsite include:

- Inlet screen and flow balancing tank
- Imhoff tanks
- Trickling filter
- Clarifier
- UV channel
- Outfall and outfall booster pump
- Operations building
- Sludge storage tank
- Blower shed and biofilter

From a technical perspective, the existing site is in an appropriate location because it is out of sight of the main community, approximately 1km from the urban area of Akaroa and within normal pumping heads. The future options for disposal all include some discharge of treated wastewater to the harbour (even if only for emergency use), and the existing outfall is located in a reasonable area for dispersion of treated wastewater.

The existing sewer[1] network has been constructed to deliver wastewater to the existing site. If a new site is to be used the network must be extended. There are also significant assets at the site that can be utilised for any future upgrades at the existing site.

As noted in the previous section, the existing site has special cultural and historical significance so options to relocate the WWTP are being considered. The location of the WWTP is a sensitive issue and consultation with the local runanga is required to find an appropriate solution for the treatment and disposal of wastewater in Akaroa.

2.3 Site Selection Criteria

Potential sites were identified using a set list of criteria, which were agreed in a meeting between CCC and MWH on 11 September 2008. These criteria were designed to limit the potential sites identified to those which were most likely to be a practical option for a new WWTP site. The selection criteria chosen are discussed below.

2.3.1 Technology and Construction

The selection criteria used to identify potential sites for a new WWTP have been limited to conventional technology and construction methods. Extraordinary measures such as camouflaging a WWTP within a building or completely burying it, while technically feasible, are not considered to be necessary or economically practical at this stage. This criterion has an affect on the site area and separation distances required, which must also be limited to conventional measures.

2.3.2 Site Area

The typical site area required is 2,500 to 3,000m^2 for a conventional treatment plant site with storage (flow balancing), inlet screening, secondary treatment with nutrient removal, clarification, UV disinfection and sludge treatment and dewatering facilities. If a site of this size is not available, the area required can be reduced by using a compact layout for the various structures required for treatment, although this would result in increased complexity in the design and construction phases and therefore increased costs. The use of membrane technology could also be considered to reduce the secondary treatment tank volume and eliminate the clarification process.

2.3.3 Slope

A moderately sloped or flat site minimises the costs for earthworks and site preparation during construction. Therefore potential sites should be moderately sloped, or able to be made flat with a minimum of earthworks.

2.3.4 Elevation

The elevation above sea level of the site should be within normal pumping heads, which is 30 to 40m for wastewater pumps. Although multiple pump stations can be used to reach higher elevations, it is preferable that the site is at a low elevation to minimise pumping capital and operating costs.

2.3.5 Odour and Noise Buffers

Although the treatment plant will include odour control and noise reduction, it is preferable that buffer distances between the plant and its neighbours are as large as possible to reduce the risk of disturbing neighbouring residences. For the purposes of this study buffer distances of 50m to an isolated house and 100m to a built-up area have been used as a minimum.

[1] Sewer refers to the pipe which conveys wastewater. Wastewater is also referred to as sewage, however the term wastewater has taken precedence in recent years.

In order to maintain buffer distances with respect to future residential development, the site should also be located in rural zoned land and preferably to the north or south of the main township (approximately Rue Grehan to Glen Bay).

2.3.6 Visual Impact

Ideally the site would be out of view from the main town and from the sea. The visual impact of the treatment plant on the surrounding area could be largely minimised by using earth embankments, bushes and trees to screen it from view.

2.3.7 Cultural Issues

Alternative locations for the WWTP are being considered because the current treatment plant is on a culturally significant site. Therefore any potential sites should be outside any other culturally sensitive areas to avoid similar issues.

2.3.8 Summary of Selection Criteria Adopted

The selection criteria adopted to identify potential sites were:

- Conventional construction methods only
- Site area suitable for a conventional treatment plant: 2,500 to 3,000 m2 is preferable
- Slope should be flat or able to be made flat with minimal earthworks
- Elevation limited to approximately 40m above sea level
- Minimum distance to an isolated house of 50m and 100m to built-up areas in rural zoned land
- Out of site from houses and sea, or able to be screened from view
- Outside culturally sensitive areas

2.4 Potential Sites

The number of potential sites for a conventional WWTP in the Akaroa area is limited. Five potential sites were identified using the selection criteria summarised above. Appendix A contains a map marking to approximate location of each of the five sites. All of the five sites had some characteristics which did not meet one or two of the selection criteria. The long list of potential sites includes:

1. Childrens Bay, on waterfront
2. Rue Grehan, approx. 800m back from waterfront
3. Onuku Rd, 200m north of the Kaik
4. Haylocks Rd, 500m back from waterfront
5. 1km south of the Kaik

A comparison of potential sites is shown below in Table 2-1. The selection criteria limit the number of potential sites to those to the north and south of the township. All of the sites identified are themselves below 40m elevation above sea level, but the access routes to the sites are over 40m in some cases. The sewer mains would therefore have to either follow the access road (requiring multiple pump stations) or a marine sewer pipe would be required.

Table 2-1 Potential Alternative Site Options for Akaroa WWTP

Option	1. Childrens Bay	2. Rue Grehan	3. Onuku Road	4. Haylocks Road	5. South of The Kaik
Description	On shoreline of Takamatua Hill, facing boat ramp/reserve	Around 0.8 to 1 km along Rue Grehan	Next to Onuku Rd on southern side of Kaik Hill	Along Haylocks Rd 0.5 to 0.8km back from water front in area of bush/forest	Moderately sloping site on coastline 1km south of The Kaik, elevation 20-40m
Cultural/Social Issues	Ngai Tahu Silent File over Childrens bay/Takamatua Hill area	Poor public perception from residences on same street	Outfall will pass near a significant cultural site at the Kaik (midden/burial)	Sewer main will pass near a significant cultural site at the Kaik (midden/burial)	Sewer main will pass near a significant cultural site at the Kaik (midden/burial)
Elevation	20-60m	20-40m	40-60m	20-40m	20-40m
Access route	30% of access road is existing, route elevation <40m	Existing access road route elevation <40m	Existing access road Route elevation >90m	Existing access road Route elevation >90m	Mostly existing access Route elevation >90m
Slope	Moderate	Gradual	Moderate	Moderate	Moderate
Visual Impact	High from town and sea, unless screened	Low	High from The Kaik and sea, unless screened	Medium from The Kaik, unless screened	Low from residences/High from sea, unless screened
Odour/noise buffers	>300m	50m	>300m from residences >50m from Onuku road	50m	>50m to isolated dwelling >700m to the Kaik
Site Area Available	2,000-3,000m^2 <40m >3,000 m^2 @ 40 to 80m	<2,500m^2	3,000m^2	3,000m^2	>3,000m^2
Outfall Length Required	In sheltered bay: long length required 1.5km	Back from water front, in sheltered bay: long length in ground 0.8km & water 2km	Close to the Kaik: long length to distance outfall from houses 0.5km	Back from water front, close to the Kaik: length in ground 0.3km & water 0.5km	South of virtually all dwellings: short length required 0.3km
Consenting Issues	• High visual impact, unless screened • Long outfall required • Cultural issues • Sewer main across bay or through length of town	• Close to residences • Possible urban development • Long outfall required • Sewer main through length of town	• Outfall will pass near significant cultural site and close to the Kaik settlement • High visual impact on the Kaik, unless screened • Sewer main along road or along coastline/through water	• Native forest/scrub to be cleared • Possible residential development • Outfall will pass near cultural site and close to settlement • Sewer main along road or along coastline/through water	• Moderate visual impact from sea, unless screened • Good position for outfall • Long sewer main required • Sewer main will pass near significant cultural site • Sewer along road or along coastline/through water

2.5 Short Listing of Potential Sites

The potential sites are grouped into two main areas; north of the main township and south of Kaik Hill. The long list of potential sites was reduced to two sites which represent the most practical option for each of the two areas.

The Childrens Bay site was considered the best option in the area to the north of the township because the other option, along Rue Grehan has poor separation distances to existing houses and a smaller available site area. The Childrens Bay site is more isolated, although it has a higher visual impact from the township and from the sea (unless appropriately screened). The Childrens Bay site also has the advantage of being near a potential irrigation site (the south slope of Takamatua Hill) for disposal of treated wastewater to land. A potential disadvantage is the Ngai Tahu silent file over the Childrens Bay/Takamatua Hill area.

All of the sites south of Kaik Hill have a disadvantage in that the access route is greater than 80m in elevation. The sewer main should follow the road (requiring multiple pump stations to lift the wastewater over 80m in elevation) to avoid the risks associated with a marine pipeline (which are discussed in the next section).

If the use of multiple pump stations is accepted then the number of potential sites would increase because sites above 40m in elevation could also be considered. The areas with most potential within 100m elevation are the areas to the north and south of Akaroa, because of the greater separation from existing residences. The exception is the existing water treatment plant (WTP) site on Aylmers Valley Rd, which may be decommissioned in the future – see the report Akaroa Water Management Strategy Part 4: Water Supply & Treatment Options (MWH, 2008) for details of water supply and treatment options (note Aylmers stream would still be used as a raw water source when required). The Aylmers WTP site could be suitable for a compact WWTP. However, it is around 1km from the coastline and from the closest potential land disposal area. If the WTP was decommissioned and the reuse of treated wastewater for supplementing the base flow of Aylmers Stream or for indirect potable reuse were preferred options (see the Part 6 report for details of wastewater disposal options) then the WTP site should be considered further. Notwithstanding this, the best areas for a new site are to the north or south of Akaroa.

The site on Onuku Rd was considered the most promising site to the south because it has existing access, is close to a potential irrigation area for disposal, and requires a shorter length of new rising main to reach than the other sites to the south. The site along Haylocks road has more difficult access, is closer to residences and would require clearing of native bush. The site approximately 1km south of the Kaik passes most of the selection criteria, however, it requires pumping a further 1.1km further south and the access to site is not as good. It is in a favourable position for an outfall into the harbour, but a long way from the potential land disposal area on Kaik Hill. Given the strong local interest in land disposal the site on Onuku Rd is a more practical option.

The two sites considered to have the most potential for a new WWTP were, in Childrens Bay on the lower slope of Takamatua Hill and along Onuku Rd 200m north of the Kaik (Figure 2-1 & Figure 2-2 below contain photographs of the potential sites and surrounding area, for comparison Figure 2-3 shows the existing WWTP site). These two options have been taken forward for further consideration. The changes required to the conveyance system and cost estimates to relocate the WWTP to each of these sites are discussed below.

The two short listed sites are considered the most practical option for each area (north and south of Akaroa). The cost estimates provided in the sections below are generally applicable to the other potential sites in each area. The main differences in cost would be due to slightly different pipe lengths and access routes for vehicles, power and water supply.

Figure 2-1 Potential WWTP Site at Kaik Hill on Onuku Rd

Figure 2-2 Potential WWTP Site at Takamatua Hill in Childrens Bay

Figure 2-3 Existing WWTP Site in Red House Bay

2.6 Wastewater Conveyance

The existing wastewater conveyance network comprises 5 collection catchments and 3 pump stations at the Recreation Reserve, the Fire station and the Glen. A map showing the wastewater collection catchments is contained in Appendix C. A schematic of the existing wastewater network showing approximate wet weather flow rates is presented in Figure 2-4 below. Each pump station receives wastewater via gravity from nearby catchments and then pumps south toward the next pump station. The Glen pump station, which is on Beach Rd in Glen Bay next to the access track to the Britomart monument, pumps into the inlet screen at the WWTP.

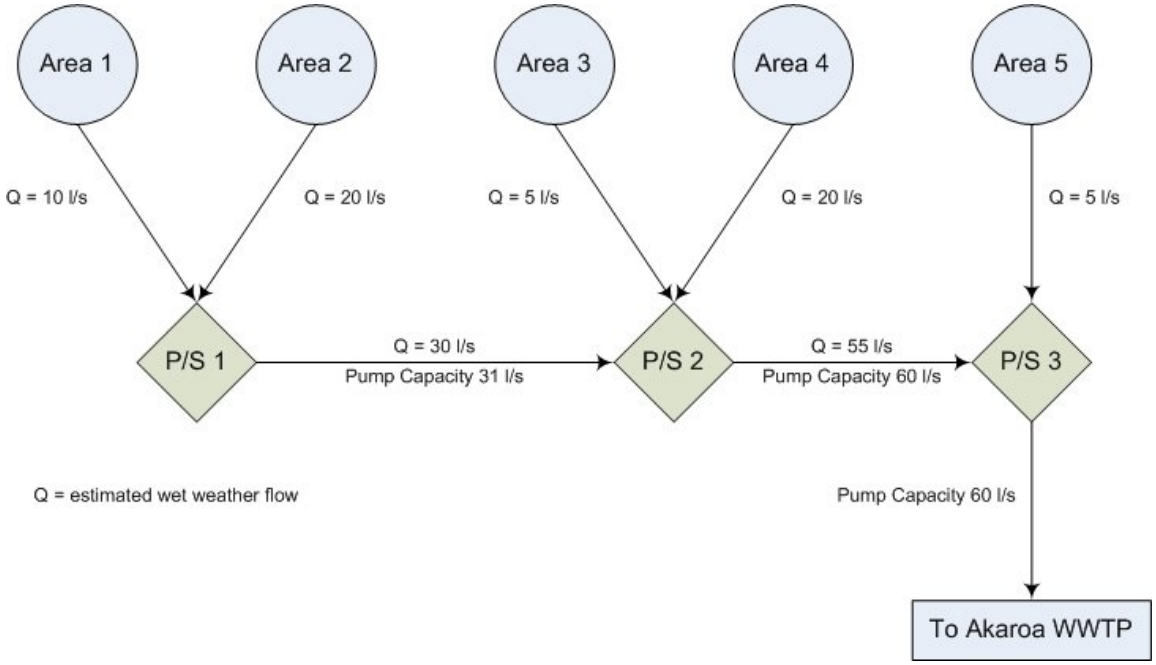


Figure 2-4 Schematic of the Existing Wastewater Conveyance Network

Relocating the WWTP to a new site will involve constructing new pumping mains in the wastewater network. The gravity pipelines from each catchment to the pump stations will be largely unaffected. The changes required to extend the conveyance network to either the north or south are discussed in the sections below.

For the assessment of the changes required to the conveyance network, it was assumed that all new pipelines would be laid in the ground rather than through the harbour to avoid the risks associated with marine pipelines. If marine pipelines were to be used it would most likely require two pipes on different alignments to minimise the risk of damage and to provide redundancy for maintenance (the use of two separate pipes would negate any reduction in pipe length available by taking a shorter route through the harbour). Marine pipelines would also have a higher risk to the environment in the event of damage or failure, and are more complicated and costly to maintain. Therefore it was assumed that land based pipelines would be preferred.

2.6.1 Extending Conveyance North

Extending the conveyance network to the north requires the most change to the existing network as the flow of wastewater from the north to the south would need to be reversed. The gravity feeds to each pump station would largely remain the same, however new pumping mains will need to be installed to deliver wastewater northwards.

The direction of the pumping will need to be reversed to extend the network to the north. This can be achieved by either installing new pumping mains or attempting to reverse the direction of flow in the existing pumping mains. While installing new pumping mains is preferable because it allows use of the existing network while construction occurs, reversing pumping mains would provide significant capital cost savings. But the amount of time the pumping mains can be taken out of service is short (less than 1 hour) even during dry weather, which increases the complexity of construction for reversing the mains. The number of pumping mains required is listed in Table 2-2.

Table 2-2 Extend Conveyance North: Pumping Mains Required

Pumping Main	Description	Approx. Length
1	Glen to Fire station	1.7km
2	Fire station to Reserve	800m
3	Reserve to Childrens Bay	1.4km

Reversing pumping mains could save significant capital cost if the existing main is of a suitable size for the volume of flow which would travel in the opposite direction. Of the two existing pumping mains, only the main between the fire station and reserve pump stations would be a possibility. The estimated wet weather gravity flow into the glen pump station is only around 5 l/s, so the existing main between the fire station and the glen (pumped capacity of 60 l/s) would be significantly oversized if it were reversed. The flow into the fire station is 25 l/s plus 5 l/s pumped from the glen, which the similar to the current pumped capacity of 31 l/s in the reserve to fire station main. Although reversing the main may be complex because the window of time available for switching the direction of flow would be short, the capital cost savings would make this an option worth further consideration.

The cost estimates for extending the network to the north have assumed that the main between the fire station and the reserve pump stations can be reversed and new pumping mains will be required from the Glen to the fire station and from the reserve to the new site.

2.6.2 Extending Conveyance South

Extending the conveyance network to the south is simpler as it leaves the existing network untouched, apart from the last pump station at the Glen. The difficultly in extending to the south is the elevation of Onuku Rd, which reaches 90 to 100m above sea level. The pumping main must either follow the road, requiring multiple pump stations and hence increased capital and operating costs, or follow the coastline (either above or below the waterline), which would be more complex to construct. Gaining resource consents to construct a pipeline carrying raw wastewater through the water or close to the water would also be more complex. It was assumed that following the road is the preferred option to reduce the risks associated with a marine pipeline.

To extend the conveyance along Onuku Rd, two additional pump stations will be required to lift the raw wastewater to the top of the hill. The Glen pump station would also need to be upgraded with larger pumps. Each pump station would be equipped with odour control and, in keeping with the existing network strategy, a standby generator rather than storage tanks because of the limited space available and to reduce capital costs. The additional pumping mains and pump stations required are listed in Table 2-3.

Table 2-3 Extend Conveyance South: Pumping Mains and Pump Stations Required

Pumping Main	Description	Approx. Length
1	Main from the Glen to 2nd lift pump station	330
2	Main from 2nd to 3rd lift pump station	440
3	Main to top of hill	1,100
4	Gravity main to site	1,100

Constructing additional pump stations to reach an elevation of 90 to 100 m then opens the possibility of higher sites for the WWTP, which would allow the site to be further back from the road and the coast. The cost to construct on a site further back from Onuku Rd would be somewhat higher due to the extra conveyance pipe length, access for vehicles, and power and water supply. At this stage only the site on Onuku Rd has been considered.

There is also an option of screening the wastewater at a low elevation to remove solids, which could block high head pumps. Screening out the solids would allow the use of higher head pumps and thereby reduce the number of pump stations required to reach the top of the hill. The main drawback of screening at a lower level is that the Glen pump station has a relatively small area and very short separation distances to houses (approx. 5m to the closest house) and public areas (it is located next to the access track from Beach Rd up to the Britomart Monument). Although there is room to install a screen and screenings bin in the area next to the pump station, the risk of nuisance odour from the screenings is high, especially during pickup for transportation to landfill. Installation of a screen would also increase the visual impact of the pump station, which is currently quite low as it is mostly hidden from view under trees, and would reduce access to the pump station itself. Figure 2-5 shows two images of the Glen pump station; the pump station wet well is concealed under the tree and the closest neighbour overlooks the clear area next to the pump station. For the above reasons, it was assumed that the full raw wastewater flow would be pumped to the WWTP site.

Figure 2-5 The Glen Pump Station (wet well under tree) & Closest Neighbour (wet well on right)

The cost estimates for extending the network to the south have been prepared assuming that following the road is the preferred option and that 3 pump stations will be required to lift the wastewater to a height of 90 to 100m. From the top of the hill a gravity main could deliver the wastewater to the top of the site along Onuku Rd.

2.7 Consenting Requirements

2.7.1 Conveyance

With both site options, the construction of new conveyance networks will require resource consents from both the Christchurch City Council and the Canterbury Regional Council (CRC). These will likely be as follows:

- Consent (CRC) to install pipes and structures over the bed of a waterway and install, operate and maintain a sewer network (this part of the Proposed Natural Resources Regional Plan (PNRRP) is currently not enforceable, however, it will likely be in an operative state before construction of a new conveyance system is required)
- Consent (CCC) to undertake earthworks of certain volume in the relevant zones and install any above-ground structures in the form of pump stations in the town-centre or residential conservation zones. Consent may also be required if the pipelines are to be placed along the waterfront as some of the area that will need to be crossed over is identified as interim coastal protection areas and the coastline is also a statutory acknowledgement area.

The key environmental issues for the regional council consents will be the potential effects on surface water quality and ecosystems, groundwater quality, erosion and flooding, and amenity values. For the city council consents, visual and amenity values will be the key considerations as well as noise and odour management.

2.7.2 Wastewater Treatment Plant

The construction of a new WWTP will likely require land use consent from the CCC for the structures in the Childrens Bay site, particularly as they would be located within a silent file area (Rule 14.2). In general, the erection of utilities in the relevant zones is permitted provided they comply with the rules in that zone relating to things such as height, setbacks and site coverage. Consent requirements could be addressed at a detailed design stage. For both sites, there are controls on the amount of earthworks that can be undertaken in specific zones which would also need to be addressed at a more detailed design phase. The creation of an access road may be permitted provided a number of conditions are met regarding size, parking, turning space, vehicle generation and sight distances are met.

Consents from CRC will depend on the amount of excavation required at the site, and may be required for the storage of effluent at the site before disposal.

2.7.3 WWTP Outfall

Any outfall is expected to trigger a consent requirement from CRC in relation to works in the coastal area.

2.8 Cost Estimates

Cost estimates for the two new site options and the existing site have been prepared for comparison. The cost estimate is broken down into capital costs for conveyance, WWTP and outfall. More detailed cost breakdowns are contained in Appendix D. The cost estimates provided have an accuracy of -10% to +30%. The assumptions made for the cost estimating are discussed below.

2.8.1 Conveyance

The cost estimates to extend the conveyance network were completed assuming that each pump station would have a standby generator rather than storage as per the existing conveyance system. In terms of power failure a standby generator would have a lower installation cost than a storage tank with sufficient volume to store wet weather flows for a nominal period, say 1 hour (60 L/s x 1 hour = 216m3 of storage). The advantage of a storage tank would be to provide a buffer so that the pumped flow rate could be reduced, which would result to some extent in reduced capital cost for the pumps and pumping main. However, the major capital costs would still be required, such as the pump station structure and pipe installation, and the additional cost of a storage tank to buffer wet weather flows would somewhat offset the potential savings. The best way forward should be determined when the preferred site option has been selected. For the purposes of this report it is assumed that the full wet weather flow will be pumped to the site.

The cost estimates for extending the network to the north have assumed that the main between the fire station and the reserve pump stations can be reversed with minimal construction works and that new pumping mains will be required from the Glen to the fire station and from the reserve to the new site.

The cost estimates for extending the network to the south have assumed that following the road is the preferred option and that 3 pump stations will be required to lift the wastewater to a height of 90 to 100m. From the top of the hill a gravity main could deliver the wastewater to the top of the site along Onuku Rd.

It was assumed that the full unscreened flow of wastewater would be pumped to site. Screening at a low elevation would allow higher head pumps to be used, which could reduce the number of pump stations required. However, a screening plant should have suitable odour and noise boundaries similar to those used for the selection criteria for a WWTP site (50m to an isolated house and 100m from built-up area), which sets significant restraints for where it could be constructed.

2.8.2 WWTP

The WWTP cost estimates were prepared assuming that the potential new sites would require extensive site works including an allowance for geotechnical ground improvement. Allowances for landscaping and planting, fencing, road access, power and potable water supply, and resource consents have also been included.

The WWTP cost estimate is based on a treatment plant including the following process units:

- Flow balancing/storage tank of 1,000m^3 (assumed to be for treated wastewater)
- Inlet screen and screenings compactor
- Activated sludge plant including nitrogen removal
- Clarifier
- UV disinfection

- Aerobic sludge digester
- Digested sludge dewatering (incl. polymer preparation)
- Auxiliary blowers, pumps, electrical (including standby generator) and control systems for above process units

2.8.3 WWTP Outfall

A cost estimate for a new outfall at each site has been included assuming that the full treated wastewater flow could be discharged. If land disposal is the preferred disposal option then the outfall would be for emergency use only, which would occur in the event there was a major plant failure or combination of failures, for example duty and standby pumps fail, or power failure and standby generator failure.

The outfall length has been assumed as 1,500m for the Childrens Bay site to allow the diffusers to be outside the Childrens Bay area and into the main harbour. The Onuku Rd outfall length has been assumed to be 500m to give a suitable separation from the Kaik.

The outfall cost was based on PE pipe with concrete weighting and installed by the float and sink method. There was no allowance for burying the pipe after installation.

2.9 Comparison of Options

The options for the location of the WWTP were compared using the site selection criteria and capital cost estimates. The upgrade of the existing WWTP has been included for comparison with the two potential new sites. A comparison of the three sites relative to the selection criteria is presented in Table 2-4, while capital cost estimates for two potential sites and upgrade of the existing site have been prepared and summarised in Table 2-5.

Table 2-4 Comparison of Site Options: Selection Criteria

Site Option	Site Area	Slope	Elevation	Buffer Distances	Visual Impact	Cultural	Comments
A. Childrens Bay	✓	✓	✓	✓	✗	✗	• Ngai Tahu Silent file over Childrens Bay/Takamatua Hill • Screening required – High visual impact
B. Onuku Rd	✓	✓	✗	✓	✗	✓	• Site elevation is 20 to 60m but access to site is 80 to 100m elevation by land • Screening required – High visual impact from the Kaik and from sea
C. Existing Site	✓	✓	✓	✓	✓	✗	• Significant cultural and historic site • Established access to site: sewer main, power, and water • Low visual impact from sea due to established screening

On the basis of the site selection criteria, the main shortcoming of the existing WWTP site is the cultural significance of the area it is located in. The Childrens Bay site potentially also has cultural significance, which

could possibly prevent relocation of the treatment plant to this area.. The main disadvantage of the Onuku Rd site is its elevation above sea level, which would require additional pump stations to deliver wastewater to. Both of the potential sites have issues with visual impact, however they can be overcome with effective screening, such as that at the existing plant. The elevation of the Onuku Rd site means it will always have a higher potential visual impact because it is harder to screen out of view, however it is out of view from the main township.

On a capital cost basis the existing site is the least costly because of its existing structures, site access, utilities, and no changes to the conveyance system. The two potential new sites have similar cost estimates for conveyance and WWTP construction (difference in WWTP construction costs are mostly due to site access requirements), but outfall costs differ because of the longer length required for the Childrens Bay site.

Table 2-5 Comparison of Site Options: Cost Estimates

Item	Description	Cost Estimates (excl. GST)		
		Childrens Bay	Onuku Rd	Existing Site
1.0	Conveyance	$2,348,000	$2,577,000	-
2.0	Land Purchase (not costed)[1]	-	-	-
3.0	WWTP Construction	$6,326,000	$6,332,000	$4,915,000
4.0	Outfall[2]	$1,334,500	$528,500	-
	Total Nett Cost	**$10,008,500**	**$9,437,500**	**$4,915,000**
	Preliminary & general (10%)	$1,000,850	$943,750	$491,500
	Contingency (20%)	$2,001,700	$1,887,500	$983,000
	Professional Services:			
	- Design[3] (15%)	$1,501,275	$1,415,625	$737,250
	- Construction monitoring (5%)	$500,425	$471,875	$245,750
	Total (excluding GST)[4]	**$15,012,750**	**$14,156,250**	**$7,372,500**

Notes:
1. Land purchase has not been included due to the difficultly of pricing land purchases for wastewater use. The purchase price would need to be negotiated between CCC and the landowner of the preferred site option.
2. The outfall from the Childrens Bay site requires a longer length (1,500m) to place the diffusers outside the sheltered Childrens Bay area. The outfall from the Onuku Rd site has assumed to be 500m off shore to separate it from the Kaik settlement.
3. Design costs include allowances for feasibility studies, detailed design, consenting and project management costs.
4. Estimated costs have an accuracy of -10% to +30%

With the exception of cultural significance of the site, the existing site remains a practical choice for the WWTP location because the existing infrastructure makes upgrading a much less costly exercise than shifting the plant to a new location. However, the other potential new sites have an advantage because they are located near potential land disposal areas. There is strong support for land disposal by the public and other stakeholders because it is seen to be the most practical method of removing treated wastewater discharge from the harbour. The harbour itself is the draw card of Akaroa and its protection is important from the local communities' point of view.

Consultation with the local stakeholders will be required for the use of any of the sites. The preferred technical option would be to negotiate the continued use of the existing site. If this is unacceptable to stakeholders then an alternative site should be chosen in conjunction with the potential land disposal options.

3 Ocean Outfall

This section discusses an ocean outfall from the existing WWTP site past the Akaroa heads and extending beyond the boundaries of the marine reserve around the eastern head of the harbour and provides an indicative cost estimate for comparison with other options.

An ocean outfall would provide improved dispersion of the treated wastewater and remove the disposal from the harbour. An outfall length of approximately 11km is required to ensure the outlet diffusers are located beyond the proposed marine reserve at the eastern head. Treated wastewater could be stored and then pumped with the outgoing tide to prevent any discharge being swept back into the harbour. Appendix B contains a map with a potential route for an ocean outfall from the existing WWTP site to the heads.

There are a number of uncertainties associated with constructing an ocean outfall in the Akaroa Heads area. The scope of this report included a desktop study only to provide an indicative cost estimate. If an ocean outfall is a preferred option then substantial further detailed studies and field work are required to ascertain the feasibility of construction around the heads and to increase the accuracy of the cost estimate.

There would also be a requirement for extensive technical investigations to support consent applications for construction of the pipeline and the discharge of treated wastewater. Consenting for an ocean outfall would be relatively complex compared with other options available for treatment and disposal of wastewater.

A major uncertainty is the nature of the sea bed and its suitability for construction of an outfall and securing it to the seabed. The Akaroa Harbour marine chart notes that the Harbour entrance has “generally heavy ground swell” and “Loose seabed, bad holding ground”. The heads of Akaroa Harbour face southward and are expected to experience significant water currents and swells, particularly during bad weather. Secondary uncertainties are the effects on the proposed marine reserve, expected lifetime of the outfall and maintenance requirements for inspection and clearing diffusers.

In addition, the currently proposed Dan Rogers marine reserve may affect the ability to construct a pipeline on the seabed. The Marine Reserves Act 1971 requires that a reserve shall be maintained in its natural state which includes no disturbance or placing of structures in, on, under or over the seabed.

In general, outfall construction involves a high degree of risk and complexity due to the nature of the environment (changeable sea and weather conditions, and underwater work in near zero visibility) and therefore has significantly higher construction costs than land based pipelines. It is common to experience long delays and unexpected costs from damage to the pipeline or equipment, difficulties with the placing the pipeline and with the underwater work involved. Construction of an ocean outfall would also have a longer timeframe to complete the necessary preliminary studies, detailed design and construction than the other wastewater treatment and disposal options available for Akaroa.

The cost estimate was prepared based on the cost of recent outfalls constructed within New Zealand, particularly the 1.5 km Waimakariri District Council (WDC) outfall near Kaiapoi, which was completed in 2006. The WDC outfall was constructed in a relatively calm area with an ‘easy’ seabed for trenching by water-jetting, while the Akaroa heads are an aggressive environment in comparison. Notwithstanding this the WDC outfall is relatively good comparison for the section within the harbour and a good starting point for the section through and beyond the heads. Similar equipment and methods would be employed for an ocean outfall for Akaroa, although the pipe length is longer and construction risks are significantly higher.

The construction methods assumed for cost estimating involve connecting the pipe into long strings which would then be floated and sunk individually and joined underwater by divers. The preferred pipe material is HDPE (high density polyethylene) due to its corrosion resistance, ability to bend to suit the contours of the seabed and watertight fusion welded pipe joints. Concrete weights would be attached or cast around the pipe at regular intervals to overcome the buoyancy of the PE pipe and the treated wastewater relative to seawater.

The area within the harbour is likely to have suitable conditions for burial by water jetting after the pipe is sunk (if required), while the length through the heads and beyond is likely to require a pre-dug trench which the pipe can be sunk into and then covered.

The cost estimate is summarised in Table 3-1 below. As noted above, the cost estimate is a starting point and substantial further studies and field work are required to determine the feasibility, construction methods and improve the accuracy of the cost estimate. The cost estimate below is indicative only with an expected accuracy of -10% to +50% to reflect the high uncertainty of the construction methods and risks involved, which corresponds to a total cost of $28M to $47M.

Table 3-1 Ocean Outfall Cost Estimate

Item	Description	Cost Estimate (excl. GST)
1.0	Pump Station & Storage Tank Construction	$1,368,000
2.0	Outfall Pipeline Construction	$18,575,000
	Total Nett Cost	**$19,943,000**
	Preliminary & general (10%)	$1,994,300
	Contingency (30%)	$5,982,900
	Design:	
	- Preliminary studies & consenting (5%)	$997,150
	- Design (10%)	$1,994,300
	- Construction monitoring (2.5%)	$498,575
	Total (excluding GST)[1]	**$31,410,225**

Notes: 1. Estimated cost is indicative only with an approximate accuracy of -10% to +50%

4 Conclusions

This report investigates two further options for wastewater treatment and disposal in Akaroa; options to relocated the WWTP to a new site and the disposal of treated wastewater via an ocean outfall.

There are two main areas for potential new sites which meet most of the site selection criteria, one to the north of Akaroa in Childrens Bay and one to the South of Kaik Hill. The Childrens Bay site is within a Ngai Tahu silent file area and would require consultation to determine the possibility of a WWTP site in that area. The potential site to the south requires multiple conveyance pump stations to pump over a hill 90 to 100 m in elevation in order to reach the site. The current cost estimates for relocating the WWTP to either area are similar, $15.0M and $14.2M for the north and south respectively.

In comparison, the existing WWTP site meets all the site selection criteria with the exception that it is located in an area that is culturally and historically significant. Upgrading the existing WWTP takes advantage of the existing infrastructure in the conveyance network and at the current site, which is reflected in the current cost estimate to upgrade the existing WWTP being around half that of the options for relocating ($7.4M). If the existing site can be retained then it offers a simpler and significantly less costly option for the development of the wastewater treatment and disposal in Akaroa.

Consultation with the all stakeholders is required to find an appropriate solution for the location of the WWTP.

Disposal of treated wastewater via an ocean outfall discharging beyond the Akaroa Heads would have an advantage in removing the discharge from the harbour, however, the capital costs for this option (estimated cost is $28M to $47M) is significantly higher than the other disposal options available. Land disposal is currently the most technically and economically feasible option for removing the discharge from the harbour and should be investigated further.

5 References

MWH (Feb 2008): Akaroa Water Management Strategy Part 4: Water Supply & Treatment.

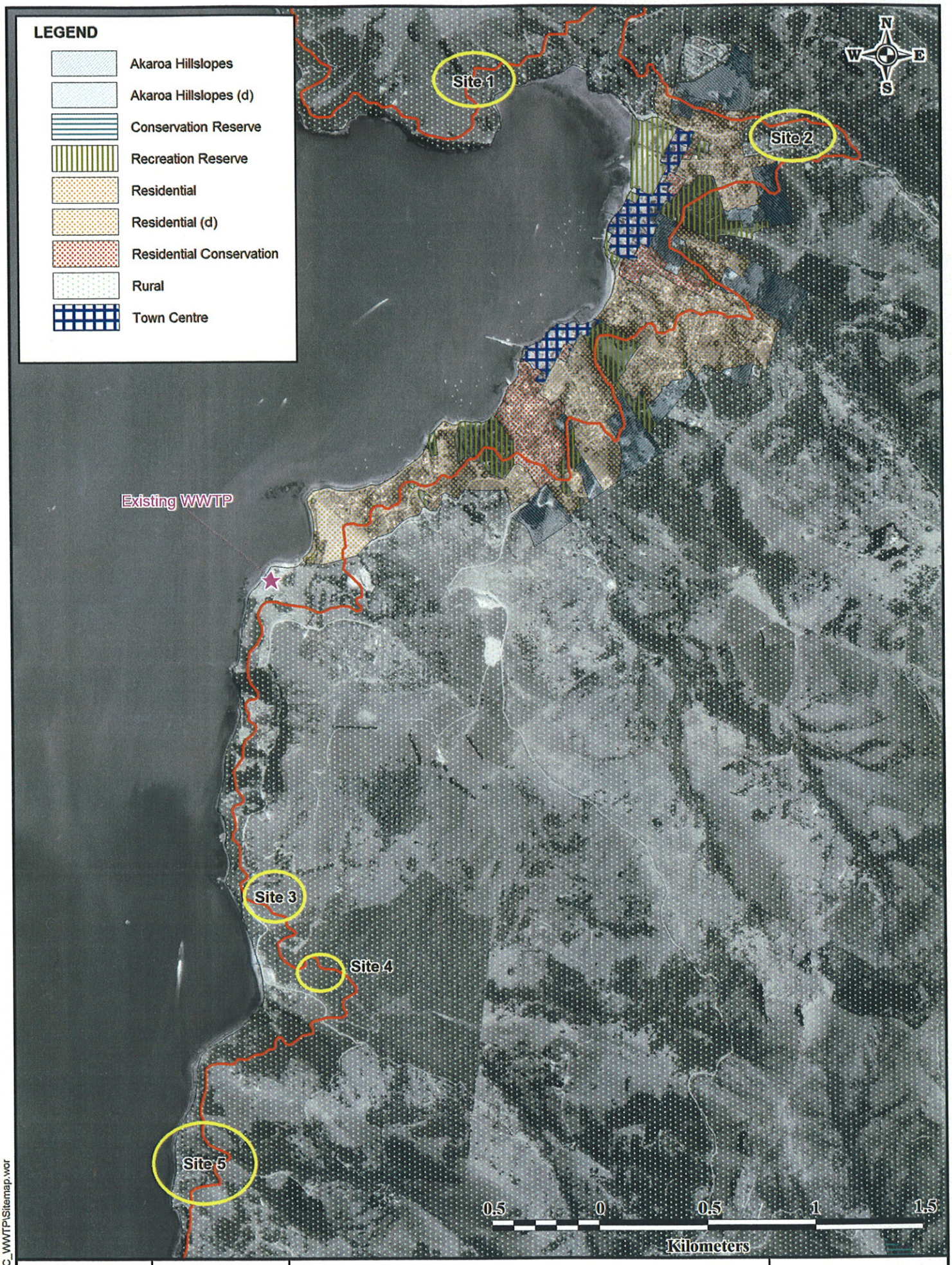
MWH (Feb 2008): Akaroa Water Management Strategy Part 6: Wastewater Treatment Options.

Christchurch City Council (2007): Akaroa Harbour Basin Settlements Study.

New Zealand Historic Places Trust Pouhere Taonga: The Register of Historic Places, Historic Areas, Wahi Tapu and Wahi Tapu Areas.

Land Information New Zealand (Jan 1999): Chart NZ6324 Akaroa Harbour.

Appendix A Map of Potential WWTP Sites



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Potential WWTP Sites

1:22,500

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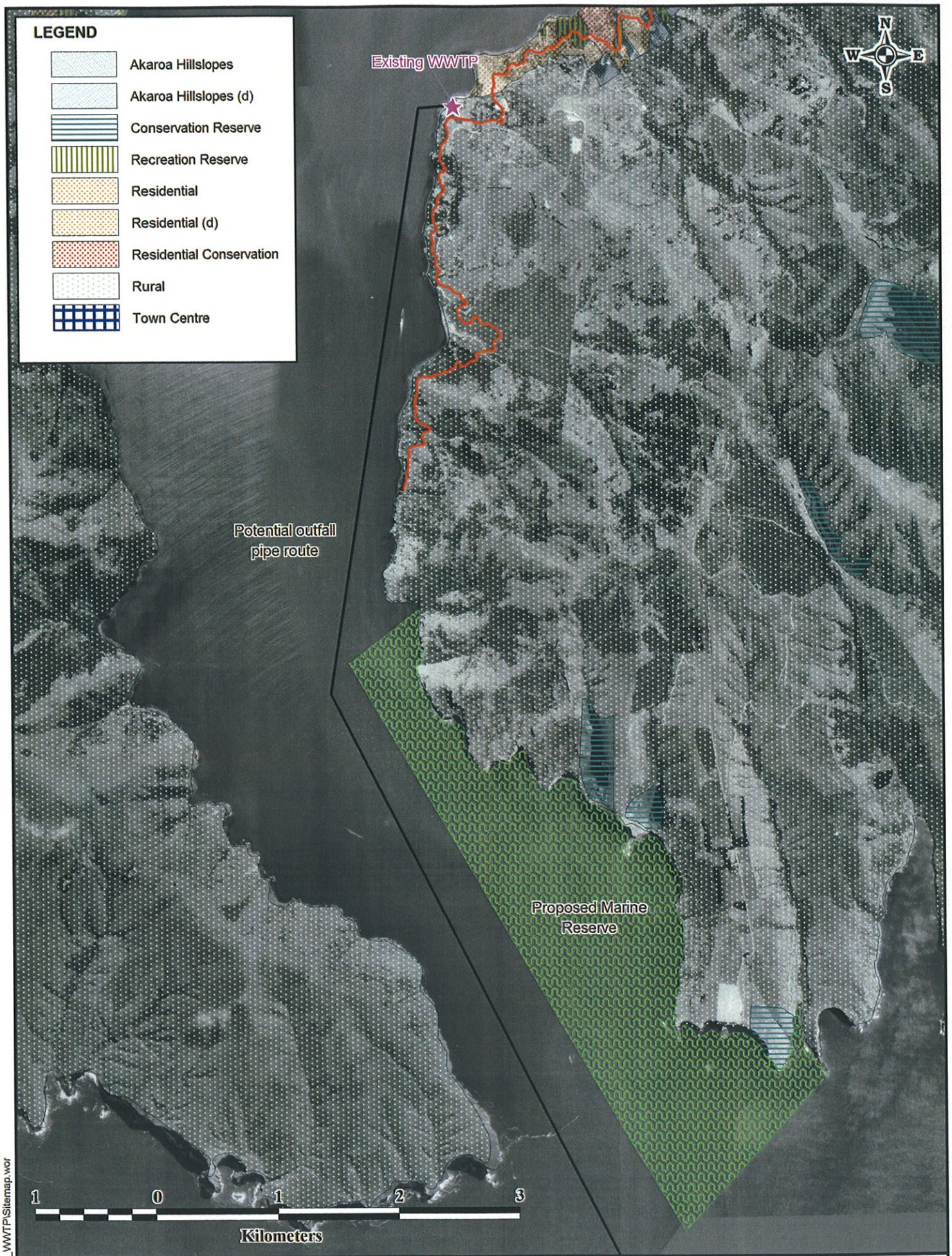
Appendix B Map of Potential Ocean Outfall Route



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Potential Ocean Outfall Route

SCALE 1:40,000

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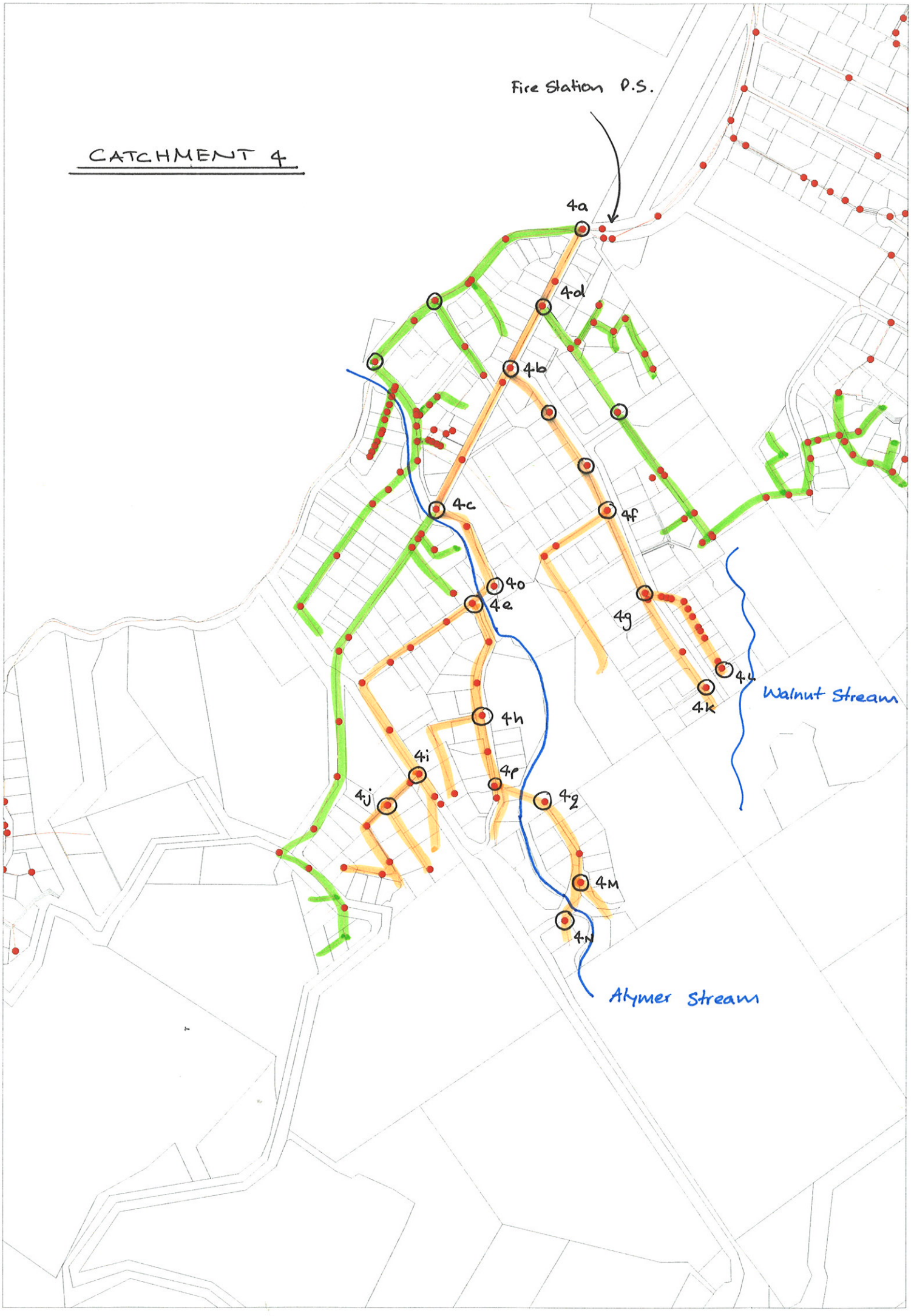
Appendix C Existing Conveyance Network Maps


Catchment 1
Catchment 2
Catchment 3
Catchment 4
Catchment 5


CATCHMENT 1
1d
1c
Grehan Stream
1f
1j
1k
1b
1a
1e
1g
1h
Recreation Reserve P.S.
1l
1i


CATCHMENT 2
2g
2f
2e
2a
2d
Butchery
2c
2b
3b
3a
3a
Fire Station
P.S.
3d
CATCHMENT 3


CATCHMENT 4
Fire Station P.S.
4a
4d
4b
4c
4f
4o
4e
4g
4l
4k
Walnut Stream
4h
4i
4p
4j
4q
4m
4n
Alymer Stream

CATCHMENT 5

Appendix D Detailed Cost Estimates

Budget Cost Estimate – Childrens Bay Option

Item	Description	Cost Estimate (excl. GST)	Sub-totals (excl. GST)
1.0	Conveyance		
1.1	Upgrade Reserve Pump Station	$ 522,000	
1.2	Inlet Pump Station (to top of site)	$ 432,000	
1.3	Supply and install pressure main	$ 1,394,000	
			$ 2,348,000
3.0	Land Purchase		
3.1	Not included in estimate[1]	-	
			$ -
3.0	WWTP Construction		
3.1	Site Works	$ 848,000	
3.2	Site Access & Utilities	$ 227,000	
3.3	Buildings	$ 501,000	
3.4	Civil Structures	$ 1,484,000	
3.5	Mechanical Equipment	$ 2,028,000	
3.6	Electrical	$ 680,000	
3.7	Storage Tank	$ 558,000	
3.8	Outfall (1,500m)	$ 1,334,500	
			$ 7,660,500
	Total nett cost		$ 10,009,000
	Preliminary & general (10%)		$ 1,000,900
	Contingency (20%)		$ 2,001,800
	Professional Services:		
	- Design (15%)		$ 1,501,350
	- Construction monitoring (5%)		$ 500,450
	Total (excluding GST)		$ 15,013,500

Notes

1. Land purchase has not been included due to the difficultly of pricing land purchases for wastewater use. The purchase price would need to be negotiated between CCC and the landowner of the preferred site option.

Budget Cost Estimate – Onuku Rd Option

Item	Description	Cost Estimate (excl. GST)	Sub-totals (excl. GST)
1.0	Conveyance		
1.1	Upgrade Glen PS	$ 462,000	
1.2	New Pump Station: 2nd Lift	$ 502,000	
1.3	New Pump Station: 3rd Lift	$ 502,000	
1.4	New Manhole at top of Hill	$ 47,000	
1.7	Supply and install pressure main	$ 1,064,000	
			$ 2,577,000
2.0	Land Purchase		
2.1	Not included in estimate[1]	$ -	
			$ -
3.0	WWTP Construction		
3.1	Site Works	$ 848,000	
3.2	Site Access & Utilities	$ 246,000	
3.3	Buildings	$ 501,000	
3.4	Civil Structures	$ 1,484,000	
3.5	Mechanical Equipment	$ 2,015,000	
3.6	Electrical	$ 680,000	
3.7	Storage Tank	$ 558,000	
3.8	Outfall	$ 528,500	
			$ 6,860,500
	Total nett cost		$ 9,438,000
	Preliminary & general (10%)		$ 943,800
	Contingency (20%)		$ 1,887,600
	Professional Services:		
	- Design (15%)		$ 1,415,700
	- Construction monitoring (5%)		$ 471,900
	Total (excluding GST)		$ 14,157,000

Notes

1. Land purchase has not been included due to the difficultly of pricing land purchases for wastewater use. The purchase price would need to be negotiated between CCC and the landowner of the preferred site option.

Budget Cost Estimate – Upgrade Existing WWTP

Item	Description	Cost Estimate (excl. GST)	Sub-totals (excl. GST)
1.0	Conveyance		
1.1	Not required	$ -	
			$ -
2.0	Land Purchase		
2.1	Not required	$ -	
			$ -
3.0	WWTP Construction		
3.1	Site Works	$ 424,000	
3.2	Site Access & Utilities	$ 36,000	
3.3	Buildings	$ 501,000	
3.4	Civil Structures	$ 971,000	
3.5	Mechanical Equipment	$ 1,734,000	
3.6	Electrical	$ 691,000	
3.7	Storage Tank	$ 558,000	
3.8	Outfall	$ -	
			$ 4,915,000
	Total nett cost		$ 4,915,000
	Preliminary & general (10%)		$ 491,500
	Contingency (20%)		$ 983,000
	Professional Services:		
	- Design (15%)		$ 737,250
	- Construction monitoring (5%)		$ 245,750
	Total (excluding GST)		$ 7,372,500

Notes

1. Land purchase is not required to upgrade the existing WWTP.