Waitaki DISTRICT COUNCIL
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Ohau Village Water Supply

Issues and Options Report

August 2018

Fluent SOLUTIONS

Ohau Village Water Supply
Issues and Options Report

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Issue Date	Revision No.	Author	Checked	Approved
10 August 2018	A	MKS	MKS	MKS
21 November 2018	B	MKS	MG	MG

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Job No.: 000442
Date: 10 August 2018
Reference: RP 18-08-10 MKS 000442(RevB)

Ohau Village Water Supply
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EXECUTIVE SUMMARY

The Ohau Village Water Supply services Ohau Village which is a 136 lot alpine subdivision adjacent Lake Ohau, in the McKenzie Basin. Currently there are 60 houses connected to the water supply which are a combination of on-demand and restricted connections to both permanent and holiday houses.

Key issues identified with the existing water supply are:

- The water source experiences drought and is unlikely to meet future demands from the village.
- The source water experiences high levels of E.coli contamination and is untreated.
- The community is reliant on boiling their own water and there is a high risk that holiday makers are not aware of the boil water notice and drink unsafe water.
- The intake and storage is on private land with uncertainty over future access.
- The system has been designed as a restricted supply but there are currently a mixture of on-demand connections and restricted supplies. Restricted units are 600L/day and is not considered to be an adequate volume for most households.
- Drinking water regulations are expected to change in the near future with chlorine disinfection becoming mandatory.

The current and predicted future water demand for the system are as follows:

Description	Unit	Current	Future	
		On-demand	Restricted	On-demand
Average daily flow	m^3/day	47	116	123
Peak daily flow	m^3/day	110	184	390
Instantaneous flow	L/sec	7	2.2	12.1

Upgrade options have been identified to provide a water supply that will meet the Health (Drinking Water) Amendment Act 2007 and that meets future demand with either restricted or on-demand connections.

There are two main options that have been developed. These are:

Option 1: New bore supply with new treatment plant treatment and storage located at existing storage site.

Option 2: New bore supply with new treatment plant treatment, storage and reticulation pumps.

Each option has sub options which are:

- With chlorine and without chlorine
- Restricted and On-demand flow

Both options involve the development of a new bore supply. The most viable option is considered to be adjacent Lake Ohau, in WDC reserve land.

The most cost effective treatment process is considered to be cartridge filtration followed by UV disinfection, with chlorine disinfection (to be added now or later). Cartridge filtration will rely on high quality water from the bore supply to ensure rapid fouling of the cartridge does not occur. The water treatment would be located adjacent bores, also in WDC reserve land.

Storage can be located at the existing site (private property) (Option1) or adjacent the water treatment plant, which requires additional reticulation pumping and power generation (Option 2).

Costs Estimates for the various options range from $919,000 for a restricted unchlorinated supply, to $1,250,000 for an on-demand, chlorinated supply.

Option	Description	Chlorine Disinfect	Flow Type	Capital ($)
1	New bores and water treatment plant adjacent lake. Elevated storage in current location.	No	Restricted	919,900
		No	On-demand	1,045,700
		Yes	Restricted	1,119,500
		Yes	On-demand	1,250,900
2	New bores, water treatment plant and storage with reticulation pumps adjacent lake.	No	Restricted	964,000
		No	On-demand	1,089,600
		Yes	Restricted	1,044,800
		Yes	On-demand	1,172,800

It is recommended that Council:

- develops funding options to make upgrade affordable to the community
- present options to the Community Board to confirm preference:
  - for restricted or on-demand flow
  - for chlorine now or chlorine later
  - to maintain location of existing storage or construct new storage
  - for location for bores
- engages a hydrogeologist to confirm best location for bores and extent of community drinking-water protection zone
- following confirmation of preference, discuss changes with landowner
- water quality of Lake Ohau should be tested for particle size, turbidity and UV transmittance to get an idea of possible worst case scenarios for the bore

1.0 Introduction

Ohau Village is a small primarily holiday community located near the western edge of Lake Ohau in the Mackenzie Basin. The water is supplied to the village from an adjacent mountain catchment which is untreated. The Ohau Village water supply does not meet the current drinking water legislation.

Fluent Solutions has been engaged by the Waitaki District Council to investigate and report on issues and options to upgrade the Ohau Village Water Supply to meet current drinking water regulations and meet current and future demands of the community.

The results of the investigation are presented in this report.

2.0 Existing Supply

2.1 Overview of existing System

The Ohau Village Water Supply services Ohau Village as shown in Figure 2.1 and 2.2 below.

The Ohau Village Water Supply draws water from a shallow infiltration gallery that is sourced from an un-named stream that is assumed to be a minor branch of the Freehold Creek, approximately 2km west of Ohau Village. The water is then gravity fed from the infiltration gallery to a series of eight concrete storage tanks (total storage 180m^3) from where it is supplied by gravity to the township.

The Ohau Water Supply was designed as a restricted supply, however, there are a number of on-demand connections within the village.

Customers on **restricted supply** have individual storage tanks and restrictors that allow the customer to receive a maximum allocated volume (600L) of water over each day. The customer is responsible for a minimum of 3 days storage and a pump system that provides flow and pressure to the house. During power outages water supply cannot be provided to the houses unless they have their own power generator.

On-demand customers receive water directly from the water supply mains in an uncontrolled and unmetered manner. The pressure in the reticulation provides the house with the flow it needs without the need for additional pumps. Water can be supplied to the customer during power outages.

The reticulation around the village is primarily through a looped DN 100 PVC main. Fire fighting protection is provided by a number of fire hydrants and fire hoses housed in cabinets spread around the village.

The water supply system was constructed during the development of the village in 1981. There is no treatment and there is a permanent boil water notice in place.

Waitaki District Council holds a water take consent for the Ohau Village Water Supply:

- **CRC001915** to take water from the unnamed creek for public water supply at a maximum of 2.2L/s. The consent expires on 21 June 2035.
- It is noted that an extraction rate of 2.2L/s is equivalent to a maximum daily volume of 190m^3/day.

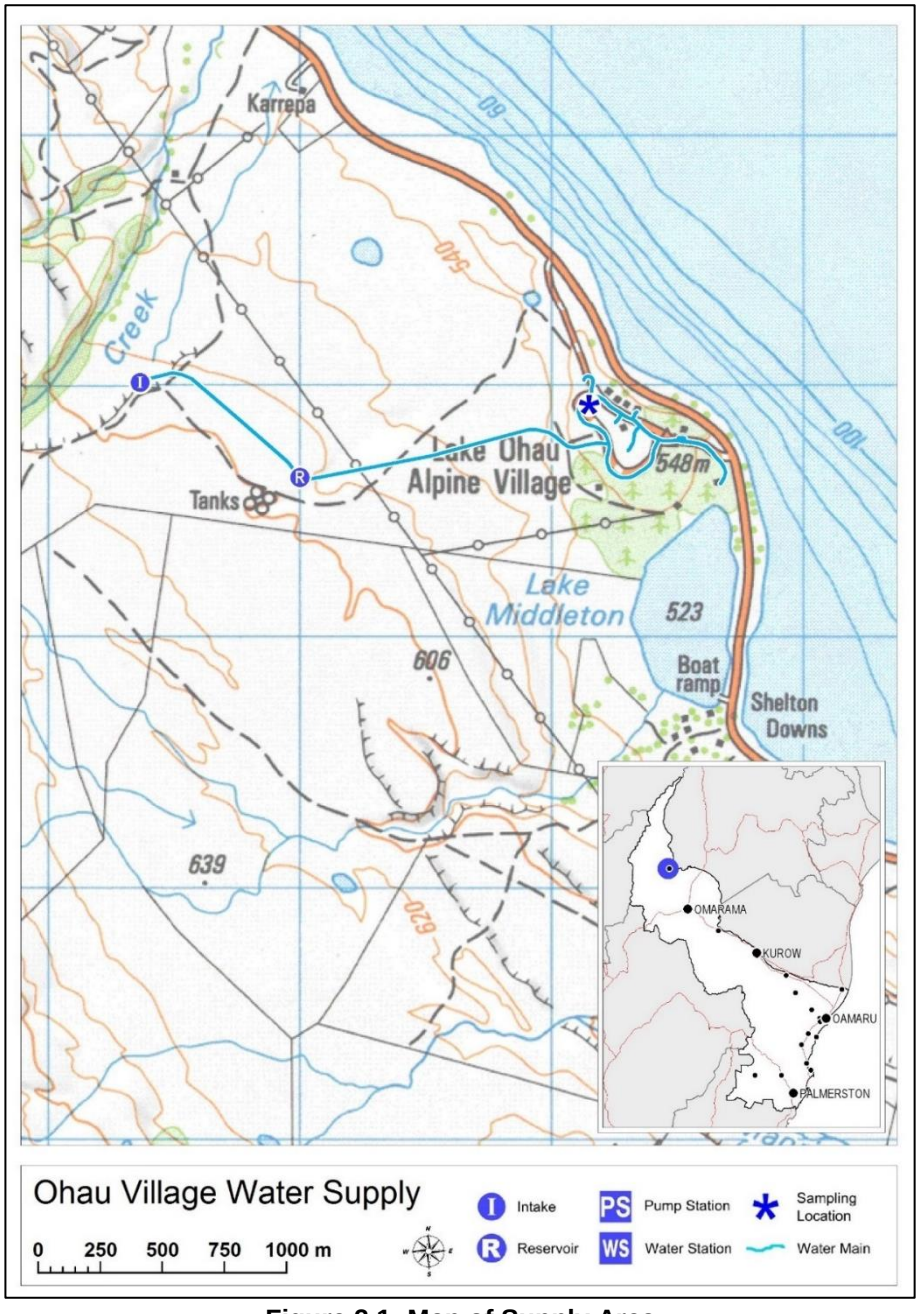


Figure 2.1: Map of Supply Area

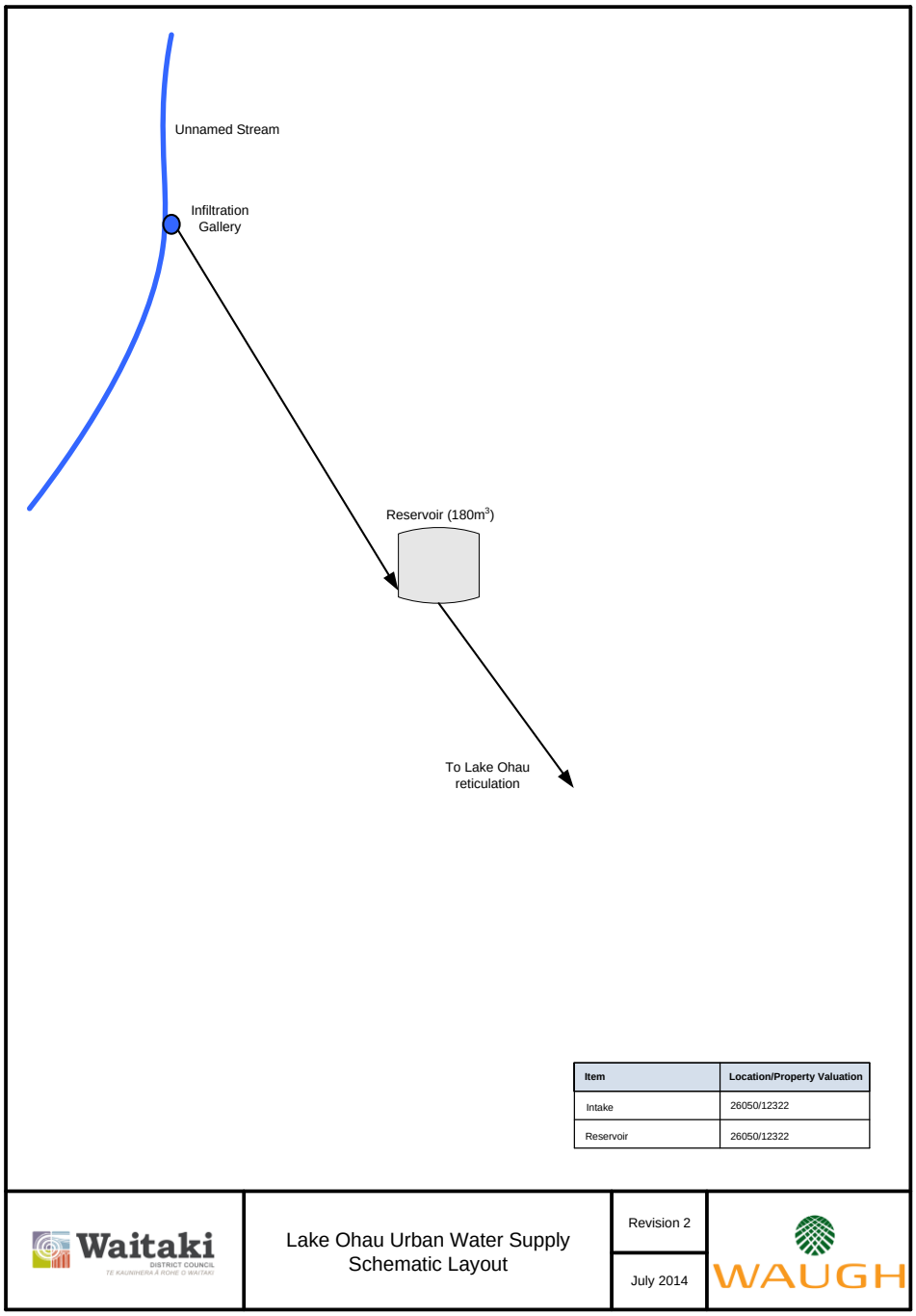


Figure 2.2: Schematic of Water Supply System

2.2 Identified Issues

The key identified issues for the Ohau Village Water Supply are:

2.2.1 Source

- The existing water source is remote and on private land with 4WD access only.
- Access to the intake is through private land with uncertainty over future access.

- The intake is within a community water supply protection zone and therefore requires all grazing stock to be excluded from waterways and banks within a142 Ha zone. No stock holding areas can be established within the zone.
- The water source experiences drought and is unlikely to meet future demands from the village.
- The resource consent is for a maximum of 2.2L/sec which is unable to meet future demands from the village.
- The source water is of variable quality.
    - E.coli averages 10 MPN/100ml with recorded counts of 580 MPN/100ml[1]
    - Measured turbidities show that turbidity varies from 0.1NTU to 56 NTU[2].
- The catchment may become more contaminated due to an increase in farming or more tourists using the Alps to the Ocean track.

2.2.2 Treatment

- There is currently no treatment of the water. The community is reliant on boiling their own water or having their own point of use treatment.
- There is a high risk that holiday makers are not aware of the boil water notice and drink unsafe water.

2.2.3 Storage

- The existing storage tanks are on private land with access by 4WD only.
- There is no way of measuring level in the storage tanks.
- The tanks are 35 years old and are showing signs of deterioration. To meet best practice standards for holding treated water, the tanks require upgrading to ensure they are adequately sealed from vermin, runoff and that they are secured.

2.2.4 Distribution

- The system has been designed as a restricted supply, however there are still a number of on-demand connections.
- Restricted connections are able to take 600L/day over 24 hours. 600L/day is less than standard design guidelines for domestic demand (which is a minimum of 250L/person/day – NZS4404:2010 – 1,000L/connection based on 4 people per house).
- Restricted connections are unable to obtain water during power black outs unless they have their own power generator.

[1] Drinking Water Standards require E.coli to be <1MPN/100ml
[2] Turbidity should be stable at <1NTU for effectiveness of disinfection processes such as chlorination and UV disinfection.

- On-demand connections take water in an uncontrolled manner. On-demand systems require water infrastructure to meet peak instantaneous flow rates, which are typically 2.5 to 3 times the flow of restricted systems.

2.2.5 Drinking Water Legislation

- The current water supply does not meet current drinking water legislation. Namely:
  - Drinking Water Standards for New Zealand 2005 (revised 2008)
  - Health (Drinking Water) Amendment Act (2007)
- An inquiry into the 2016 Havelock North gastroenteritis outbreak, has resulted in a number of recommendations for changes to the drinking water regulations which will likely make treatment requirements more stringent than current standards.

2.2.6 Other Issues

- Ohau Village is remote from operational staff whom are based in Oamaru. Currently Ohau is visited 3 monthly. A new treatment plant would need to be automated, and remotely monitored and visited on a weekly basis.
- The topography of the land is such that there are limited sites that are adequately elevated to provide gravity supply. The location of the existing storage tanks is best.
- Ohau village experiences variable power quality (brown outs) which can affect the performance of some water treatment equipment (e.g. UV disinfection). The village also experiences power black outs that can last for up to a week.

3.0 Drinking Water Regulations

3.1 Health (Drinking Water) Amendment Act 2007

The Health (Drinking Water) Amendment Act 2007 (the Act) was passed in October 2007 and took effect from 1 July 2008. The Act imposes a range of duties on drinking water suppliers, the three most important duties being:

- Monitor drinking water; and
- Take all practicable steps to comply with the drinking-water standards; and
- Implement water safety plans for supplies serving greater than 500 people.

These requirements are mandatory for water suppliers and are legally enforceable with heavy penalties prescribed in the Act for non-compliance.

In the Health (Drinking Water) Amendment Act 2007, the Ohau Supply is defined as a Neighbourhood Supply[3]. The date for compliance with the Act was 1 July 2016. Compliance with the drinking water standards has not occurred.

3.2 Drinking Water Standards for New Zealand

The quality of drinking water in New Zealand is currently measured against the Drinking Water Standards for New Zealand 2005 (Revised 2008) [referred in this report as DWSNZ2005(Rev2008)]. Drinking water standards detail how to assess the quality and safety of drinking water using water quality standards and compliance criteria. The standards are applicable to water intended for drinking irrespective of its source, treatment or distribution.

There are two key areas of compliance criteria for a water supply; namely bacterial compliance and protozoal compliance.

Bacterial compliance criteria relates to the protection against human pathogens. The DWSNZ (2008) stipulate a range of monitoring and operational requirements in order to minimise risk of contamination against human pathogens. Bacteria can be removed by treatment with processes such as chlorination and UV disinfection.

Protozoal compliance criteria relates to the protection against protozoa such as Cryptosporidium and Giardia. Their (oo)cysts are found in the faeces of humans and animals. To determine compliance with the standards the DWSNZ2005(rev2008) first require that Protozoal Log Credit Requirements are determined. This assessment determines the amount of protozoa removal log credits required for the treatment process. To achieve the log credits, the treatment process must meet certain operational and monitoring criteria as set out in the DWSNZ2005(rev2008).

The DWSNZ2005(rev2008) also have chemical compliance criteria which can include chemical determinants introduced to the water by treatment chemicals or those that may be in the raw water, disinfection by-products and cyanotoxins. Monitoring of these determinants is established by the Ministry of Health following identification of risk to the supply.

3.3 Possible Changes to Regulations Since the Havelock North Enquiry

In August 2016, there was a widespread outbreak of gastroenteritis in Havelock North during which more than 5000 people were estimated to have fallen ill, with up to four deaths associated with the outbreak.

An inquiry into the outbreak resulted in 51 recommendations to improve the safety of our drinking-water. Major changes to the drinking water regulations are now being considered.

[3] **neighborhood drinking-water supply** means a drinking-water supply that is used to supply drinking water to between 25 and 100 people (inclusive) for at least 60 days per year.

These are:

- all water supplies are to be treated**, including with a residual disinfectant** in the reticulation. A letter from the Ministry of Health has requested Council investigate this now.
- compliance with the Drinking-water Standards to be mandatory (not only taking all practical steps)
- a dedicated drinking-water regulator to be established
- dedicated water suppliers to be aggregated

One of the key impacts that the above proposed changes to the drinking water legislation will have on the upgrade to the Ohau water supply is that the level of treatment required may become more stringent than current drinking water standards and that provision of the chlorination is likely to become mandatory.

4.0 Water Demand Assessment

4.1 General

In order to size the infrastructure associated with a water supply, it is imperative that a thorough analysis of both current and future water use is completed. A description of the analysis and resulting water demand used in the preliminary designs of the water supply components is presented below.

Peak daily demand calculations are usually the most critical when designing water treatment processes, while instantaneous flows are used to help design treated water storage and pipework leaving reservoirs and in the reticulation.

4.2 Current Demand

Water demand for the Ohau Village Water supply is based on actual flows taken from the flowmeter sited at the outlet of the storage tanks.

Flow data covers the period 1 May 2016 to 30 April 2017. Results indicate:

- Average daily flow is 47m^3/day
- Peak daily demand is 110m^3/day (occurred over New Year 2016/17)
- Peak instantaneous flow has been recorded as 7L/s (30 December 2016).

As assessment of flow usage during off peak periods when the village primarily comprises of permanent residents on on-demand connections, indicate that water consumption is around 1,100L/day. This is almost double the volume from a restricted take (600L/day).

4.3 Future Demand

The future demand assessment assumes two different supply scenarios:

1. All restricted connections with a supply of 1,000L/day[4] per connection
2. All on-demand connections

The number of future connections assumes:

- All available136 Lots are connected to the water supply comprising 50 permanent residents and 86 holiday makers
- The DoC camping ground maintains its existing connection
- 20 additional restricted connections are made in the future (outside village boundary)
- Leakage and flow to the oxidation pond has a constant supply to it of 0.25L/sec (21.6m^3/day) [current night time flows]
- The average daily demand from the on-demand connection is 1,100m^3/day

Future demand calculations result in the following:

Table 4.1: Future Demand Flows

Description	Unit	Connection Type	
		Restricted	On-demand
Average daily flow	m^3/day	116	123
Peak daily flow	m^3/day	184	390
Instantaneous flow	L/sec	2.2	12.1

As shown in Table 4.1 above, the water use on average is similar for both restricted and on-demand, however, during peak conditions, the on-demand flow is substantially greater. This impacts the sizing of infrastructure.

4.4 Design Flows

For the purposes of developing options, the design flows are the assessed future demand for fully restricted and full on-demand connections as shown in Table 4.1 above.

[4] 1,000L/day is considered a reasonable allocation for Ohau based on the current average on-demand usage and design standards of 250L/day per person assuming a 4 people per household.

5.0 Upgrade Options

5.1 General

Currently the water source is of variable quality and quantity and there is no treatment in place to address contamination issues. The water supply system does not comply with the Health (Drinking Water) Amendment Act 2007.

The following section discusses options for upgrading the supply to meet the Health (Drinking Water) Amendment Act 2007 and provides cost estimates for a supply that meets future demand with either restricted or on-demand connections.

5.2 Source

5.2.1 General

As discussed in Section 2.2.1, the existing source has several issues associated with it, making the source not favoured for further development as part of the upgraded system. The main issues are related to:

- the variable quality of the water resulting in the need for a more complex and expensive treatment process.
- Remote site with likely future access issues due to private land ownership.
- Limited flow during drought conditions to meet both current and future demand.

Alternative options are:

- A new Lake Ohau intake
- A new take from Freehold Creek
- Bore supply

An initial assessment of alternative sources determined that the most cost effective option for further development are the bore supplies. A bore supply typically has a more consistent water quality that is easier to treat and is less affected by drought conditions.

5.2.2 Bore Location

Two areas have been identified for locating bores. These are:

- adjacent Lake Ohau (in WDC reserve land to the north east of the village)
- adjacent Lake Middleton (in the Lake Middleton Recreation Reserve managed by DoC to the south of the village)

Possible bore locations are indicated in Figure 5.1 below.

Figure 5.1: Possible Bore Location

Initial desk top investigations to assess feasibility (carried out by Environmental Associates Ltd) indicate that bores located within 100-200m from the lakes would provide the estimated future demand of the community (4-6L/sec), with around 80% of the flow being drawn through the groundwater from the adjacent lakes.

With the adjacent lake water likely to be a large portion of recharge water, the quality of the lake water needs to be taken into consideration. A review of 3-monthly water quality data from Lake Ohau and Lake Middleton (obtained from Environment Canterbury) shows that Lake Ohau has low levels of nutrients (TN <0.1mg/L), chlorophyll (<0.002mg/L) with the maximum turbidity <10NTU. Lake Middleton on the other hand, is more susceptible to higher nutrient loadings (TN 0.2-0.5mg/L), chlorophyll (up to 6.8 mg/L) and has experienced cyanobacteria algae growth (*Draft Lake Middleton Catchment Report*[5]). Lake Middleton, however, has lower levels of turbidity recorded; most likely due to it being more sheltered than Lake Ohau.

While the gravels will provide treatment of the lake water through filtration and bacteria die off, the site adjacent Lake Ohau is considered as the preferred option for development due to a lower risk of contamination from nutrient loading, cyanobacteria and any e.coli that may be in the lake water.

It should be noted however that the proposed site for the Lake Ohau bores are 500-800m away from the Ohau Oxidation Pond. While the groundwater flow from the oxidation pond should be away from the bores, a defined recharge zone needs to the confirmed with the hydrogeologist.

5.2.3 Community Drinking-water Protection Zone

Development of a new water source will require the establishment of a Community Drinking-water Protection Zone. This limits the discharge of contaminants from such things as wastewater, stormwater, and farming practices in the protection zone. This is managed through the consenting process.

The area of the protection zone is determined by a number of factors, including:

- Aquifer confinement
- Direction of groundwater flow
- Level of treatment
- Rate of take

It is recommended that the Community Drinking-water Protection Zone be well defined prior to finalising the bore location.

[5] Department of Conservation December 2014

5.2.4 Log Credit Assessment for Proposed New Source

Due to the proximity of the lake and the new groundwater source being drawn from an unconfined aquifer 10 to 30m deep, it is considered appropriate that a **4 log protozoal treatment** is designed for. This may be able to be reduced to a 3 log credit with a detailed catchment risk assessment and consideration of groundwater flow.

5.3 Treatment

5.3.1 General

The key requirements for a water treatment system at Ohau are considered to be:

- compliance with DWSNZ2005 (Rev 2008) which is provision of 4 log protozoal treatment plus bacterial treatment
- provide a system that is upgradable with likely future changes to the Drinking Water Standards and Regulations
- provides preventative measures that address high potential risk to public health
- has sufficient capacity to meet current and future demands
- provide redundancy and flexibility in design to allow demands to be met when maintenance is being undertaken
- provide a treatment system that is both cost effective to construct and to operate and maintain
- provide a treatment process that is reliable and can consistently provide good quality water

5.3.2 Comparison of Treatment Technologies

Water treatment plants vary in type and extent, from those providing only basic screening and disinfection to sophisticated systems designed to reliably provide potable water of high quality, that is safe to drink and pleasant to the taste.

Different treatment methods target different stages of the treatment process. Broadly speaking these processes fall into one of two categories:

1. The removal of particulate and dissolved materials to achieve water of high clarity, chemical safety and acceptable taste; and
2. Disinfection to kill pathogenic bacteria, viruses and protozoa such as Cryptosporidium and Giardia.

Disinfection can be achieved through physical removal of fine particulate matter, as well as by chemical means, and thus some processes target both categories.

The treatment options that are potentially available to Ohau to address a 4 log credit protozoa removal and provide bacterial compliance are summarised and discussed below. It should be noted that some treatment systems can be combined to achieve higher protozoa log credit removal ratings.

Table 5.1: Treatment Processes

Treatment Option	Protozoal Log Credits	Bacterial Compliance	Pros and Cons	Comment
Coagulation plus Sand Filtration ***Description:*** *addition of coagulant, followed by flocculation and then filtration though sand media*	Up to 3.5	None	**Pros** ▪ Able to treat highly turbid and coloured water **Cons** ▪ Backwash water with chemical discharge ▪ High operator input ▪ Complex	Not considered for Ohau as costly to construct and operate and associated chemical discharge difficult to manage.
Direct filtration with Back-washable Filter ***Description:*** *pressure vessel with media which is used to filter out particles in the water down to 3 um*	Up to 2 log (if approved by MoH)	None	**Pros** ▪ Backwashable so no need for replacement of cartridges etc **Cons** ▪ Backwash water which needs management ▪ High Capital Cost ▪ Break through of dirt can occur when overloaded	Not considered for Ohau as costly to install and associated discharge difficult to manage.
Membrane Filtration ***Description:*** *membrane allows water to pass through tiny pores in the membrane fibre wall (usually below 0.2 microns) while leaving bacteria and protozoa on the outside of the fibre.*	Up to 4 log	None	**Pros** ▪ Absolute barrier to protozoa **Cons** ▪ Backwash water which needs management ▪ Very High Capital Cost ▪ High operational cost	Not considered for Ohau as very costly to install and operate and associated discharge difficult to manage.

Treatment Option	Protozoal Log Credits	Bacterial Compliance	Pros and Cons	Comment
Cartridge Filtration ***Description:*** *cartridge filters consist of cylinders through which water flows from the outside of the filter to a central collection duct. The aperture size of the material determines the size of the particles removed. Aperture sizes vary from 500 microns to 1 micron and smaller depending on the stage of the treatment process that the cartridge filters are employed*.	0-3 log credit depending on pore size and whether using Section 5 or Section 10 (Small Water Supplies) of the DWSNZ.	None	**Pros** ▪ No backwash requirements ▪ Low capital cost ▪ Compact with small footprint **Cons** ▪ When cartridge fouls up the cartridge needs replacement. If the raw water is dirty this can occur quickly ▪ Not suitable for dirty water – Turbidity >2NTU	This is considered as part of a cost effective upgrade solution for Ohau and is considered in the upgrades. The pore size of the cartridges will depend on the water quality from the bores and the other treatment processes employed. As cartridges can be prone to blocking up with dirty water, space should be allowed for the addition of bag filters upstream as a lower cost sacrificial filter to keep operational cost down.
Bag Filtration ***Description:*** *bag filters consist of a porous bag through which water flows from the inside to the outside. The pore size determines the size of the particles removed.*	0-1 log credit depending on pore size and stage in the process.	None	**Pros** ▪ No backwash requirements ▪ Bag replacement is significantly lower than cartridge ▪ Compact with small footprint **Cons** ▪ Not very robust ▪ Not suitable for dirty water – Turbidity >2NTU	Bag filtration can be used as a sacrificial pre-filter to cartridges as they are lower cost than cartridges. Space should be allowed for the addition of bag filters upstream of the cartridges.
Ultraviolet Disinfection **Description*:*** *water passes through a reactor which consists of UV lamps inside quartz sleeves. The UV rays act to inactivate protozoa and bacteria by affecting the DNA so they cannot replicate and affect a subsequent host.*	Up to 3 log if turbidity < 1 NTU or ≤5um cartridge filter upstream and turbidity <2 NTU.	Yes – if dosed at 40mJ/cm^2	**Pros** ▪ A cost effective treatment system for both protozoa and bacterial compliance ▪ Simple to operate **Cons** ▪ Can be effected by power brown outs ▪ Water quality needs to be highly consistent and good quality water for UV to be effective ▪ Does not provide residual disinfection	This is considered a cost effective upgrade solution for Ohau and is considered in the upgrades. UV lamps can be affected by poor quality power and therefore requires a UPS system to be installed with it.

Treatment Option	Protozoal Log Credits	Bacterial Compliance	Pros and Cons	Comment
Chlorine Disinfection ***Description:*** *chlorine is added to the water protection against harmful bacteria and viruses. Chlorine can be dosed as a gas or as a liquid (for example sodium hypochlorite) and provides a long lasting disinfecting residual in the reticulation system.*	None	Yes	**Pros** ▪ Provides long lasting disinfection residual in reticulation **Cons** ▪ High Capital Cost compared with UV disinfection	This is considered as part of the upgrade solution for Ohau. Chlorine disinfection is not mandatory as part of the DWSNZ2005(2008) however new regulations may require chlorine to be added. Chlorine also treats for viruses which are likely to be part of future drinking water standards.
Ozone Disinfection ***Description:*** *ozone is a colourless, poisonous gas generated on-site using proprietary generators. It is a strong disinfectant, and an effective oxidant of many organic chemicals and organic colour.* *Ozone is also often used to help control taste and odours.*	Up to 3 Log Credits	Yes	**Pros** ▪ Can provide protection against protozoa and bacteria ▪ Can be used to treat taste and odours **Cons** ▪ Hazardous gas ▪ Does not provide residual disinfection	Not considered for Ohau due to management of hazardous gas and costs.

Treatment Option	Protozoal Log Credits	Bacterial Compliance	Pros and Cons	Comment
Point of Use Treatment ***Description:*** *point of use treatment is treatment at the connection to the household. It usually comprises of cartridge filtration followed by UV disinfection.*	NA	NA	**Pros** ▪ Capital cost for Ohau likely to be less expensive than a full upgrade **Cons** ▪ Reliant on customers to ensure system is working ▪ High operational costs as Council would need to check and maintain system at all connections ▪ Does not work during power outage ▪ Not compliant with drinking water standards	Not considered for Ohau due to ongoing operational cost and unable to meet drinking water legislation.

5.3.3 Proposed Treatment for Ohau Village Water Supply

Bacterial compliance and a 4-log protozoal treatment process is the proposed level of treatment for a new bore water at Ohau for compliance with the DWSNZ2005(Rev 2008) and the Health (Drinking Water) Amendment Act 2007 (see Section 3.0).

Protozoal compliance can be met with a number of the discussed treatment processes, however cartridge and UV disinfection is considered to be the most cost effective treatment process for Ohau. Both of these systems are relatively easy to install and operate and has a small footprint in comparison to other technologies.

Bacterial compliance can be achieved with UV disinfection or chlorine disinfection. If UV disinfection is installed then no additional treatment system is required to meet the current standards, provided a 40mJ/cm^2 dose is dosed. If however, a residual disinfection is required or that changes to the drinking water regulations are made that make chlorine disinfection mandatory, then chlorine will need to be installed.

The treatment proposed for Ohau are:

- Cartridge Filtration – 1um to provide 2-3 log credits (with allowance to add bag filtration in the future should cartridge fouling become an issue)
- UV Disinfection – to provide dose of 40mJ/cm^2 that provides 3 log credit and bacterial compliance
- Chlorine gas disinfection – 2 x 70kg cylinders with dosing equipment for bacterial compliance, provision of a residual disinfectant and future proofing.

There is the option of staging works. This would involve the installation of the cartridge and UV disinfection initially with design consideration given to adding chlorine at a later time, if required. Upgrade options with and without chlorine are presented in section 6.0.

5.3.4 WTP Location

It is proposed that the water treatment plant building be constructed nearby the bores, on reserve land and away from houses. If chlorine gas is installed on site then there is a risk, albeit very small, of chlorine leakage. It is therefore recommended that chlorine gas is installed downhill and away from houses.

The preferred site for the WTP is adjacent Lake Ohau Road as indicated in the Figure 6.1 and 6.2. This site can be easily viewed by passers by and given the scenic and natural environment, the WTP and associated infrastructure will need to be a sympathetic design with appropriate landscaping to fit within the environment.

5.4 Storage

5.4.1 General

Treated water reservoir storage is required for several reasons:

- Operating Storage
  - to supply water during peak demands in excess of treatment plant flow (diurnal peaks). This allows the treatment plant capacity to be reduced to cover peak daily flow rather than peak hourly demand.
  - taken as 6 hours at peak instantaneous demand.
- Emergency Storage
  - to supply stored water in case of source or treatment plant breakdown or power outage.
  - taken as 24 hours at average daily flow.
- Fire fighting Storage
  - to supply stored water for fighting fires.
  - Taken as 45m^3 – Fire Risk Classification – FW2 (SNZ PAS 4509:2008).
- Chlorine Contact Time
  - 30 minute at peak treated water design flow.

5.4.2 Storage Volume Calculations

Storage volume calculations have been completed to estimate the volume of storage required. The resulting storage is presented in Table 5.3 below:

Table 5.3: Storage Requirements for Ohau Village (Future Flows)

Connection Type	Chlorine Contact Time – 30min (m^3)	Operational Storage (m^3)	Emergency Storage (m^3)	Fire Storage (m^3)	Total Storage (m^3)	No. of 30m^3 tanks
Restricted	4.6	1	116	45	166	6
On Demand	9.8	164	123	45	342	12

5.4.3 Reservoir Location

Two main locations have been identified to storage location.

Option 1 is locating the reservoirs at the current site. This is at an elevation of around 580m, some 35m above the village reticulation. At this site, the reservoirs would act as a balance tank connected by the existing watermain that would act as a rising falling main. Given the condition of the existing reservoirs, full reservoir replacement is recommended.

Option 2 is locating the reservoirs adjacent the water treatment plant. The reservoirs would store treated water from the adjacent WTP. As the reservoirs will be below the elevation of

the village reticulation, reticulation pumps will be needed to provide flow and pressure to the water. A power generator would be required to maintain flow and pressure during power outages for this option.

5.5 Reticulation

There are no major changes proposed for the existing reticulation which is a 100mm diameter ringmain around the village. However, as there is a combination of on-demand and restricted flow connections, changes will need to be made to make these consistent, depending upon what option is chosen.

5.6 Fire Fighting

As discussed in section 2.1, fire fighting protection is provided by a number of fire hydrants and fire hoses housed in cabinets spread around the village. Following discussions with the Otago Rural Fire Service (pers. comm Graham Still), the fire hoses are for immediate use by residents for small controlled fires. Under the current system, these 41mm hoses are expected to be able to discharge about 10L/sec.

The installed fire hydrants would be utilised by fire appliances that would come from Twizel and Omarama within about 15-20min. With the existing system, these should be able to provide 25L/sec from up to 2 hydrants. The fire service could also obtain water from Lake Ohau or Lake Middleton and they also arrive on site with 2,200L in each fire appliance.

Helicopters are also sent to a fire callout and can arrive within 15 minutes from Twizel.

For the purposes of this options report, it is assumed that the current fire fighting protection remains. Where the storage is adjacent the WTP (Option 2), there will need to be a fire pump and larger generator to provide the same level of service for fire protection as is currently in place.

6.0 Concept Design and Cost Estimates

6.1 General

This section outlines the concept design and cost estimates for upgrading the Ohau Village water supply.

There are two main options that have been developed. The main options are as follows:

Option 1: New bore supply with new treatment plant treatment and storage located at existing storage site.

Option 2: New bore supply with new treatment plant treatment, storage and reticulation pumps.

Each option has sub options which are:

- With chlorine and without chlorine
- Restricted and On-demand flow

The location of the bore pumps and treatment plant is assumed the preferred option adjacent Lake Ohau (discussed in Section 5.0). If Lake Middleton bore option is developed the costs will be similar.

Table 6.1 below summarises the key identified options.

Option	Description	Treatment	Flow Type	Option Ref
1	New bores plus treatment and new storage at existing location	Cartridge/UV Disinfection	Restricted	1a-R
		Cartridge/UV Disinfection	On Demand	1a-OD
		Cartridge/UV Disinfection **plus Chlorination**	Restricted	1b-R
		Cartridge/UV Disinfection **plus Chlorination**	On Demand	1b-OD
2	New bores plus treatment, New storage and reticulation pumps (adjacent bores)	Cartridge/UV Disinfection	Restricted	2a-R
		Cartridge/UV Disinfection	On Demand	2a-OD
		Cartridge/UV Disinfection **plus Chlorination**	Restricted	2b-R
		Cartridge/UV Disinfection **plus Chlorination**	On Demand	2b-OD

Overall location plans for each option are shown in Figure 6.1 and 6.2 and process flow diagrams for each option are presented in the appendices.

6.2 Design Assumptions

The following design assumptions have been made:

- For the restricted flow option the design flows are:
  - Treatment plant and bore design – peak daily over 20 hours = 2.6L/sec
  - Reticulation design – instantaneous flow is based on all connections taking restricted flow simultaneously
- For the on-demand flow option the design flows are:
  - Treatment plant and bore design – peak daily over 20 hours = 5.4L/sec
  - Reticulation design – instantaneous flow is based on Probable Simultaneous Demand calculations from ASNZS 3500:2015 for all connections
- The water quality from the bore supply has:
  - UV transmittance $\geq$85%
  - Turbidity <2 NTU
- 2 bores are installed in a duty/assist operation for peak flow and duty/standby at average flow

- The cartridge design allows for duty/standby for peak flow
- The UV reactors are designed as duty/assist at peak flow but will operate as duty/standby for average flow
- The UV system requires UPS (uninterruptible power supply) to address brown out power conditions which can make UV unreliable
- Back-up generators are required for on-demand flow scenarios and for option 2, where storage is adjacent water treatment plant
- All options allow for the installation of chlorine gas disinfection (either at the time of construction or at a later date)
- The target pressure for restricted flow is 15m and for on-demand flow is 25m
- The fire flow requirements are based around:
    - A water supply classification of FW2 requiring 45m^3 storage
    - The reticulation is to have a capacity for 60% of peak flow plus 25L/sec – SNZ PAS 4509:2008
- The reticulation pumps are hydrovars with at least 2 pumps to operate as a duty/assist.

6.3 Option 1: New Bores plus Treatment and New Storage at existing Location

6.3.1 Description

This option is for the construction of 2 new bores, a new treatment plant and new storage tanks to replace the existing tanks at the current location.

The bores will pump water through the treatment process directly into the reticulation and up to the storage tanks, elevated about 35m above the village. The storage tanks will act as a balance tank to provide flow for peak instantaneous demand, emergency storage, and fire storage. To ensure adequate turn-over of the storage tanks, the pipework will have to allow for a separate inlet and outlet and have level monitored with telemetry to communicate with the bore pumps to turn on/off.

Given the condition of the existing storage tanks, demolition of these tanks plus new replacement tanks have been allowed for.

The minimum proposed treatment system to meet DWSNZ 2005(Rev 2008) is a 1um cartridge filter with UV reactors. This would be housed in a small (10m^2) water treatment plant building.

An additional treatment barrier is the installation of chlorine gas dosing for disinfection. This would also be housed within the treatment plant building but would require the addition of 30 minutes contact time. This could be provided by installing a pressurised chlorine tank or a length of large diameter pipework.

This option can be constructed to supply either restricted and on-demand flow connections. For on-demand flow, a power generator has been allowed as 1day of storage is not considered adequate to arrange the delivery and connection of a plug in back up generator.

An overall site plan for Option 1 is shown in Figure 6.1 below and a process flow diagram Option 1 is provided in the appendices.

Figure 6.1: Option 1 Site Plan

6.3.2 Cost Estimate

Estimated costs for Option 1 scenarios are provided in the table below. More detailed costing is provided in the Appendices.

Table 6.2: Preliminary Cost Estimates for Option 1, with and without chlorine disinfection, and for Restricted and On-demand flow scenarios.

Description	Bore supply, treatment (cartridge, UV) and new storage in current location		Bore supply, treatment (cartridge, UV and CHLORINE) and new storage in current location	
	Restricted	On Demand	Restricted	On Demand
	Option 1 a -R	Option 1 a - OD	Option 1 b-R	Option 1 b - OD
Source	165,500	166,500	165,500	166,500
Treatment	255,700	265,800	402,300	412,300
Reticulation	37,600	37,600	37,600	37,600
Storage	185,600	238,800	181,600	238,800
Fire Protection	12,600	12,600	12,600	12,600
Generator		25,600	-	25,600
P&G, Design and Contingency	262,800	298,776	319,900	357,400
Capital cost	**919,900**	**1,045,700**	**1,119,500**	**1,250,900**
Annual Cost	38,200	38,200	38,400	38,400
NPV 20 years at 8%	1,294,900	1,420,700	1,496,500	1,627,900

Operating Costs are based on average flows and include labour charges for weekly visits from Oamaru (with sharing travel costs with other Waitaki Valley supplies).

An assessment of the preliminary costs indicate that, as expected, the least capital expenditure is associated with a restricted connection without chlorine. Increasing the level of service to on-demand connections adds a further $125,800 and adding chlorine will increase costs by another $205,000.

Please note that fire protection is as currently provided. Costs associated with the Fire Protection in Table 6.2 above, are related to 45m^3 storage.

6.3.3 Pros and Cons

Pros and Cons for Option 1 are:

Pros

- Elevated storage provides supply during power outage without the need for a generator.
- A smaller footprint is required adjacent the lake as storage is at the existing site. This results in reduced landscaping and screening requirements.
- This existing storage could be maintained if it was preferred to stage the works (replace the tanks at a later time).
- Able to abandon intake and associated pipework to storage tanks.
- The private land owner is able to utilise land around intake.

Cons

- The storage is on a remote site so there will be additional operational cost with travel time to site.
- Due to the location of storage, there are also likely to be more issues with the communication between the storage and the pumps resulting in addition maintenance.
- Future access issues are likely due to private land ownership.

6.4 Option 2: New Bores plus Treatment, New Storage and Reticulation Pumps that Pump Directly to Reticulation

6.4.1 Description

This option is for the construction of 2 new bores, a new treatment plant and new storage tanks connected to reticulation pumps that pump directly into the Village reticulation. The bore pumps, water treatment plant and storage would all be located adjacent the lake edge.

The bores will pump water through the treatment process directly into storage tanks. The storage tanks will feed reticulation pumps that are controlled to maintain a set pressure in the village reticulation. The size of the pumps and the pressure set point would depend upon whether the flow scenario is for restricted or on-demand connections.

The storage tanks will be of capacity to provide flow for operational demand, emergency storage, and fire storage. The level in the storage tanks control the operation of the bore pumps.

As in Option 1, the proposed treatment system to meet DWSNZ 2005(revised 2008) is a 1um cartridge filter with UV reactors with chlorine gas used for disinfection. Contact time (30minutes) can be provided with a small polyethylene tank.

Restricted and on-demand flow scenario options have been developed and are presented.

An overall site plan for Option 2 is shown in Figure 6.2 below and a process flow diagram Option 2 is provided in the appendices.

Figure 6.2: Option 2 Site Plan

6.4.2 Cost Estimate

Estimated costs for Option 2 scenarios are provided in the table below. More detailed costing is provided in the Appendices.

Table 6.3: Preliminary Cost Estimates for Option 2 (with and without chlorine disinfection) for Restricted and On-demand flow scenarios.

Description	Bore supply, treatment (cartridge, UV), new storage at WTP and reticulation pumps		Bore supply, treatment (cartridge, UV and CHLORINE), new storage at WTP and reticulation pumps	
	Restricted	On Demand	Restricted	On Demand
	Option 2 a -R	Option 2 a - OD	Option 2 b-R	Option 2 b - OD
Source	164,200	166,500	164,200	166,500
Treatment	340,900	380,100	398,500	439,500
Reticulation	56,700	59,800	56,700	59,800
Storage	33,750	75,000	33,750	75,000
Fire Protection	67,500	71,300	67,500	71,300
Generator	25,600	25,600	25,600	25,600
P&G, Design and Contingency	275,400	311,300	298,500	335,100
Capital cost	**964,000**	**1,089,600**	**1,044,800**	**1,172,800**
Annual Cost	33,000	36,400	33,200	36,500
NPV 20 years at 8%	1,288,000	1,447,000	1,370,800	1,531,200

Operating Costs are based on average flows and include labour charges for weekly visits from Oamaru (with sharing travel costs with other Waitaki Valley supplies). Further detail is provided in the Appendices.

An assessment of the preliminary costs indicate that Option 2 has a higher capital expenditure than Option 1 with the differential without chlorine being in the order of $200,000 and with chlorine being around $70-80,000. The smaller differential for chlorine is related to the 30 minute contact time which requires a pressure cylinder or pipe for Option 1 but only a small contact tank for Option 2.

Costs associated with the Fire Protection in Table 6.3 above, are related to 45m^3 volume of storage tanks, a fire pump (20L/sec) and the additional cost associated with a larger backup generator.

6.4.3 Pros and Cons

Pros and Cons for Option 2 are:

Pros

- The water bores, water treatment plant and storage will be in WDC reserve land with easy access.
- The water intake, storage and associated pipework can be abandoned.
- The private land owner is able to utilise land around intake and storage.
- It is easier to upgrade this option to include chlorine disinfection in the future (if and when required).

- Fire protection is provided with an in-line fire pump, storage and generator.

Cons

- Storage is lower than the village and will require reticulation pumps to meet demand. A generator is required to provide supply during power outage.
- Landscaping and screening will be required to hide water treatment plant and storage adjacent lake. The storage requirements are significant for on-demand flows but these could be reduced by increasing the capacity of the bores and treatment.

6.5 Summary of Options

Table 6.4 summarises the options for Lake Ohau Village Water Supply, the associated costs for each option.

Table 6.4: Summary of Options and Costs

Option	Description	Option Code	Chlorine Disinfect	Flow Type	Cost			Comment
					Capital	Operational	NPV	
1	New bores and water treatment plant adjacent lake. Elevated storage in current location.	1a-R	No	Restricted	919,900	38,200	1,294,900	▪ Able to meet current drinking water standards but not future proofed for anticipated changes to drinking water regulations ▪ No need for back up power generator ▪ Infrastructure on private land with likely future access issues ▪ Cannot provide water supply to houses during black out
		1a-OD	No	On-demand	1,045,700	38,200	1,420,700	▪ Able to meet current drinking water standards but not future proofed for anticipated changes to drinking water regulations ▪ Houses can take more than restricted allocation day when required ▪ Can provide water supply to houses during black out. A generator would provide protection against black outs lasting more than 1 day ▪ Infrastructure on private land with likely future access issues
		1b-R	Yes	Restricted	1,119,500	38,400	1,496,500	▪ Same as option 1a-R however, this is a more robust treatment that is future proofed for anticipated changes to drinking water regulations
		1b-OD	Yes	On-demand	1,250,900	38,400	1,627,900	▪ Same as option 1a-OD however, this is a more robust treatment that is future proofed for anticipated changes to drinking water regulations
2	New bores, water treatment plant and storage with reticulation pumps adjacent lake.	2a-R	No	Restricted	964,000	33,000	1,288,000	▪ Able to meet current drinking water standards but not future proofed for anticipated changes to drinking water regulations ▪ Back-up power generator required as low level storage and reticulation pumps ▪ Water intake, WTP and storage all in close proximity to each other making operation easier ▪ Key water infrastructure out of private land and in reserve area ▪ Cannot provide water supply to houses during black out
		2a-OD	No	On-demand	1,089,600	36,400	1,447,000	▪ Able to meet current drinking water standards but not future proofed for anticipated changes to drinking water regulations ▪ Houses can take more than restricted allocation day when required. ▪ Can provide water supply to houses during black out with a generator ▪ Water intake, WTP and storage all in close proximity to each other making operation easier ▪ Key water infrastructure out of private land and in reserve area
		2b-R	Yes	Restricted	1,044,800	33,200	1,370,800	▪ Same as option 2a-R however, this is a more robust treatment that is future proofed for anticipated changes to drinking water regulations
		2b-OD	Yes	On-demand	1,172,800	36,500	1,531,200	▪ Same as option 2a-OD however, this is a more robust treatment that is future proofed for anticipated changes to drinking water regulations

7.0 Discussion

The existing source water is not considered as an option for development for the upgrade to the Ohau Village water supply is recommended that 2 bores be developed for supplying the village. The new bores will provide the community with a more reliable water source, that is out of private land, and that can meet the future demands of the community.

The preferred location of the bores is adjacent Lake Ohau which is considered to be at less risk from contamination than the alternative location adjacent Lake Middleton. However, prior to finalising the location of the bores, the extent of the recharge zone, the resulting community drinking-water protection zone and any potential risk of contamination from the oxidation pond needs to be defined.

A new treatment plant is necessary to provide safe drinking water water to the community and comply with drinking-water standards. It is recommended that this provides 4 log protozoa treatment plus bacterial treatment. The most cost effective treatment option is cartridge filtration and UV disinfection. 1 um cartridge filtration can provide up to 3 log credits (for small supplies) with UV disinfection providing a further 3 log credits. Depending on the quality of the bore water, it may be necessary to add a bag filter prior to the cartridge to reduce operational costs of replacement cartridges. The final design of the treatment plant should allow for adding bag filtration in the future.

Chlorine disinfection is proposed for Ohau as it provides a residual disinfectant in the water. This means that any contamination that enters the water supply system after the treatment plant can be treated. This is particularly important for water that is sitting around in storage tanks.

Chlorine is also likely to become mandatory following the impending changes to drinking water regulations and therefore, at a minimum, allowance should be provided in the design to add chlorine at a later stage.

The lowest capital cost option for the storage and associated reticulation is Option 1. This option maintains storage at the existing location and provides 1 day back up storage without the need for power generator. It also maintains the existing fire protection without the need for additional infrastructure. However, the most significant issue with Option 1 is the addition of chlorine contact time. This would need to be a pressurised tank or pipeline to enable the bore pumps to pump directly to the storage tanks. This option also has higher operational costs and a higher NPV due to additional operations and maintenance associated with the remote location of the storage.

Option 2 has storage and reticulation pumps at the WTP which requires a power generator. This option simplifies operation as the main infrastructure is in one place, however the quantity of storage on site requires significant landscaping to camouflage the site from passers by. This is a particular issue for on-demand flow. Storage could however be reduced by increasing the capacity of the bore and treatment plant.

Provision of restricted or on-demand flow has an impact on the cost of the upgrade, with on-demand connection options being more expensive for the upgrade. However, on demand connections negate the need for residents to supply, install and maintain storage tanks and domestic pumps and it allows houses to receive water during power outages.

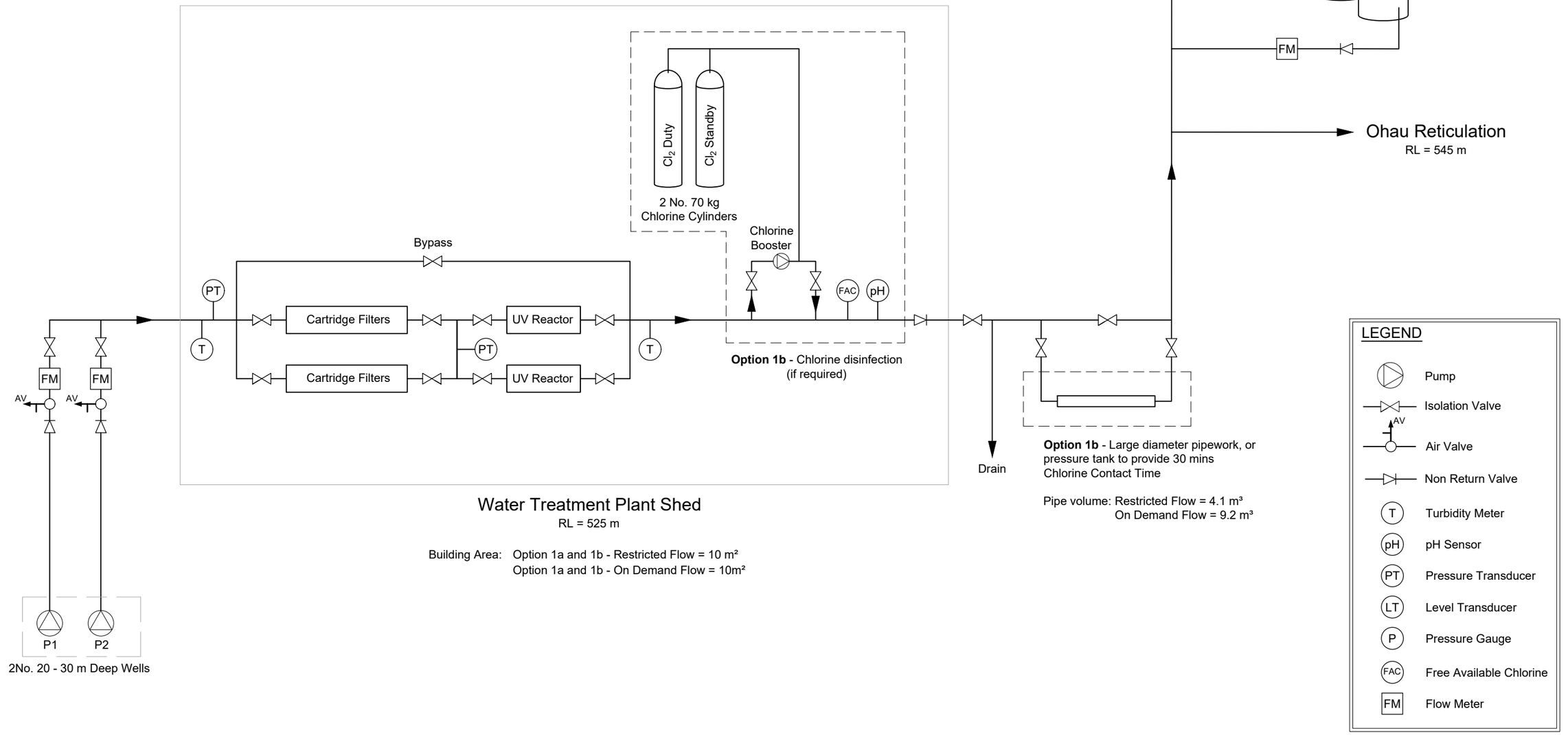
8.0 Recommendations

It is recommended that Council:

- develops funding options to make upgrade affordable to the community
- present options to the Community Board to confirm preference:
  - for restricted or on-demand flow
  - for chlorine now or chlorine later
  - to maintain location of existing storage or construct new storage
  - for location for bores
- engages a hydrogeologist to confirm best location for bores and extent of community drinking-water protection zone
- following confirmation of preference, discuss changes with landowner
- water quality of Lake Ohau should be tested for particle size, turbidity and UV transmittance to get an idea of possible worst case scenarios for the bore

APPENDIX 1

Process Flow Diagrams



Revision		App	Date
A	Concept Design	MKS	31/07/18

Surveyed	-	-
Designed	MKS	Jul '18
Drawn	EJC	Jul '18
Reviewed	MKS	Jul '18
Approved	-	-

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Client: Waitaki DISTRICT COUNCIL TE KAUNIHERA Ā ROHE O WAITAKI

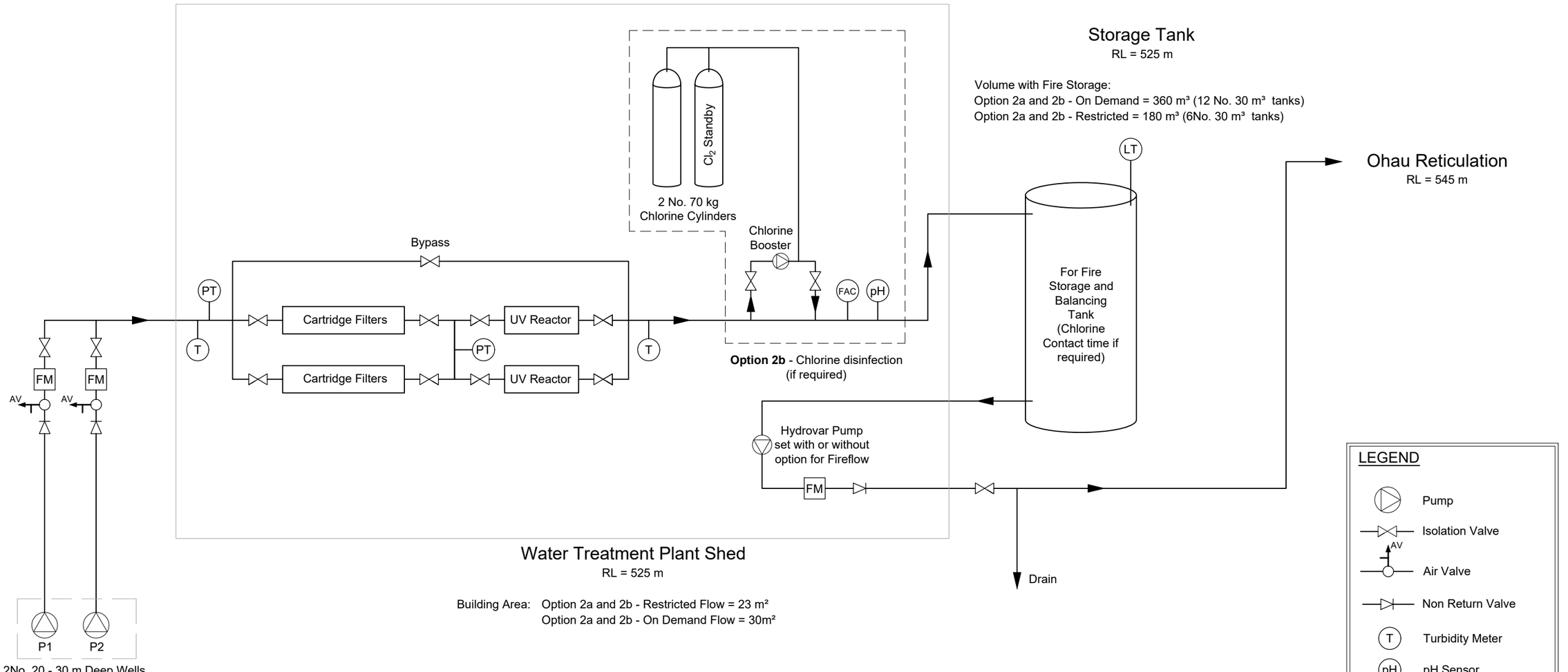
Project Title: Ohau Alpine Village Water Supply

Sheet Title: Process Flow Diagram Option 1a and Option 1b Utilise Existing Storage as Balance Tank

Scale (A1 Original): NTS

Issue: Concept Design

Project No	Sheet	Revision
000442	P01	A



Revision		App	Date
A	Concept Design	MKS	31/07/18

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Project Title: Ohau Alpine Village Water Supply

Sheet Title: Process Flow Diagram Option 2a and Option 2b New Storage and Reticulation Pumps

Scale (A1 Original): NTS

Issue: Concept Design

Project No	Sheet	Revision
000442	P02	A

APPENDIX 2

Detailed Cost Estimates

Option 1 a OD- New bores, WTP, Storage in Existing Location - ON DEMAND FLOW				
Description	**Unit**	**Quantity**	**Rate**	**Cost**
Source Water				
Application to work in reserve	With WDC	1	$ 5,000	$ 5,000
ECAN Consent	consent to take groundwater	1	$ 25,000	$ 25,000
Bores drilling and headworks		2	$ 30,000	$ 60,000
Bore Pumps	2.8 L/sec at up to 90m allowed for	2	$ 2,500	$ 5,000
VFD	VFD for pumps	2	$ 3,500	$ 7,000
Raw water turbidimeter	Hach 1720E	1	$ 7,000	$ 7,000
Flow meter	DN80 yokogawa mag flowmeter	2	$ 4,600	$ 9,200
Electrical and Control	level switches electrical cabinet, install	1	$ 15,000	$ 15,000
Installation and Construction		25%	$ 133,200	$ 33,300
SUBTOTAL				***$ 166,500***
Water Treatment				
Filtration, UV, Building, Civil				
Cartridge	1 HF40H304 (duty/standby) 1 um nominal - will treat up to 5 L/sec	2	$ 8,250	$ 16,500
Ultraviolet Disinfection	UV Pro 50 (up to 3.15 L/sec) Duty assist	2	$ 10,000	$ 20,000
UPS for UV	UPS - for management of brown outs 30min	1	$ 3,000	$ 3,000
Pressure Transducer	For monitoring pressure across cartridges	3	$ 500	$ 1,500
Turbiditmeter	For treated water	1	$ 7,000	$ 7,000
Flow meter	DN80 yokogawa mag flowmeter	1	$ 4,600	$ 4,600
Pipes, valves and fittings	50 to 100 mm	1	$ 10,000	$ 10,000
Water Treatment Plant Building	Alpine style m2	10	$ 4,000	$ 40,000
Landscaping/Access	Landscaping/ Access Road	1	$ 30,000	$ 30,000
Telemetry	RTU and Aerial, programming etc	1	$ 20,000	$ 20,000
Electrical and Switchboard		1	$ 40,000	$ 40,000
Power Upgrade	Upgrade to provide service fuse box on boundary of 13 Ohau Drive	1	$ 20,000	$ 20,000
Installation and Construction		25%	$ 212,600	$ 53,150
SUBTOTAL				***$ 265,750***
Reticulation				
Flow meter	DN80 yokogawa mag flowmeter	1	$ 4,600	$ 4,600
Bores to WTP	DN100 PVC/PE	90	$ 150	$ 13,500
WTP to Retic	DN100 PVC/PE	80	$ 150	$ 12,000
Installation and Construction		25%	$ 30,100	$ 7,525
SUBTOTAL				***$ 37,625***
Storage				
Replacement of existing tanks				
Demolition of tanks	Demolition of existing tanks (20% replacement cost)	20%	$ 130,000	$ 26,000
Telemetry (to talk to pumps and provide data, alarms)	RTU and aerial, pole, solar panel, battery and repeater	1	$ 15,000	$ 15,000
New Flow meter	DN80 yokogawa mag flowmeter	1	$ 4,600	$ 4,600
New tanks	24 Hours emergency storage, operational storage = 287m3	10	$ 6,000	$ 60,000
Access Road Improvements	alowance for improvement to access road	1	$ 50,000	$ 50,000
Pipework	Allowance for pipework	1	$ 15,000	$ 15,000
Installation and Construction		40%	$ 170,600	$ 68,240
SUBTOTAL				***238,840***
Fire Protection				
Fire Tanks	30,000 L tanks with fittings (45m3)	1.5	$ 6,000	$ 9,000
Installation and Construction		40%	$ 9,000	$ 3,600
SUBTOTAL				***12,600***
Add- ons				
Generator	30 KVA generator	1	20,500	$ 20,500
Installation and Construction		25%	$ 20,500	$ 5,125
SUBTOTAL				***25,625***
SUBTOTAL				**746,940**
Preliminary and General		10%		74,694
Design		20%		149,388
Contingency		10%		74,694
Total Estimated Capital Cost:			-	**1,045,700**
Annual Operational Costs	*assumed average daily flow (m3/day)*	*50*		
Compliance and Management	per hour (5.5 hours monthly) extra 1.5 hours as reservoir on private land	66	180	**11,880**
Labour	per hour (weekly visits for 5 hours) plus additional 4 hours /monthly to address issues with storage	308	70	**21,560**
UV Disinfection	kWhr (assumes 0.23 kw operating 24 hours per day)	2014.8	0.4	**806**
Lamp Replacement	Assumes yearly reaplacement of 1 lamp (1 lamp per unti)	1.0	433.0	**433**
Cartridges	per cartridge (assume quarterly)	3	500	**1,500**
Electricity for Bore Pumps	kWhr (assumes 2kw pump operating at 2 L/sec)	5,069	0.4	**2,028**
SUBTOTAL				*$ 38,206.70*
Total Estimated Annual Operational Costs				**$ 38,200**
NPV of Operating Costs (20 yr @ 8%)				**$ 375,000**
NPV Capital plus Operating Costs				**$ 1,420,700**

Option 1 a R - New bores, WTP, Storage in Existing Location - RESTRICTED FLOW				
Description	**Unit**	**Quantity**	**Rate**	**Cost**
Source Water				
Application to work in reserve	With WDC	1	$ 5,000	$ 5,000
ECAN Consent	consent to take groundwater	1	$ 25,000	$ 25,000
Bores drilling and headworks		2	$ 30,000	$ 60,000
Bore Pumps	1.3L/sec at up to 90m allowed for	2	$ 2,100	$ 4,200
VFD	VFD for pumps	2	$ 3,500	$ 7,000
Raw water turbidimeter	Hach 1720E	1	$ 7,000	$ 7,000
Flow meter	DN80 yokogawa mag flowmeter	2	$ 4,600	$ 9,200
Electrical and Control	level switches electrical cabinet, install	1	$ 15,000	$ 15,000
Installation and Construction		25%	$ 132,400	$ 33,100
SUBTOTAL				***$ 165,500***
Water Treatment				
Filtration, UV, Building, Civil				
Cartridge	1 HF40H304 (duty/standby) 1 um nominal - will treat up to 5 L/sec	2	$ 8,250	$ 16,500
Ultraviolet Disinfection	UV Pro 30 (up to 1.89 L/sec) (Duty Assist)	2	$ 5,990	$ 11,980
UPS for UV	UPS - for management of brown outs 30min	1	$ 3,000	$ 3,000
Pressure Transducer	For monitoring pressure across cartridges	3	$ 500	$ 1,500
Turbiditmeter	For treated water	1	$ 7,000	$ 7,000
Flow meter	DN80 yokogawa mag flowmeter	1	$ 4,600	$ 4,600
Pipes, valves and fittings	50 to 100 mm	1	$ 10,000	$ 10,000
Water Treatment Plant Building	Alpine style m2	10	$ 4,000	$ 40,000
Landscaping/Access	Landscaping/ Access Road	1	$ 30,000	$ 30,000
Telemetry	RTU and Aerial, programming etc	1	$ 20,000	$ 20,000
Electrical and Switchboard		1	$ 40,000	$ 40,000
Power Upgrade	Upgrade to provide service fuse box on boundary of 13 Ohau Drive		$ 20,000	$ 20,000
Installation and Construction		1 25%	$ 204,580	$ 51,145
SUBTOTAL Treatment				***$ 255,725***
Reticulation				
Flow meter	DN80 yokogawa mag flowmeter	1	$ 4,600	$ 4,600
Bores to WTP	DN100 PVC/PE	90	$ 150	$ 13,500
WTP to Retic	DN100 PVC/PE	80	$ 150	$ 12,000
Installation and Construction		25%	$ 30,100	$ 7,525
SUBTOTAL				***$ 37,625***
Storage				
Replacement of existing tanks				
Demolition of tanks	Demolition of existing tanks (20% replacement cost)	20%	$ 130,000	$ 26,000
Telemetry (to talk to pumps and provide data, alarms)	RTU and aerial, pole, solar panel, battery and repeater	1	$ 15,000	$ 15,000
New Flow meter	DN80 yokogawa mag flowmeter	1	$ 4,600	$ 4,600
New tanks	24 Hours emergency storage = 116m3	4.5	$ 6,000	$ 27,000
Access Road Improvements	alowance for improvement to access road	1	$ 50,000	$ 50,000
Pipework valving		1	$ 10,000	$ 10,000
Installation and Construction		40%	$ 132,600	$ 53,040
SUBTOTAL				***185,640***
Fire Protection				
Fire Tanks	30,000 L tanks with fittings (45m3)	1.5	$ 6,000	$ 9,000
Installation and Construction		40%	$ 9,000	$ 3,600
SUBTOTAL				***12,600***
Add- ons				
Generator	Not required for restricted flow - allow to bring in plug in generator			
SUBTOTAL				**657,090**
Preliminary and General		10%		65,709
Design		20%		131,418
Contingency		10%		65,709
Total Estimated Capital Cost:			**-**	**919,900**
Annual Operational Costs	*assumed average daily flow (m3/day)*	*50*		
Compliance and Management	per hour (5.5 hours monthly) extra 1.5 hours as reservoir on private land	66	180	**11,880**
Labour	per hour (weekly visits for 5 hours) plus additional 4 hours /monthly to address issues with storage	308	70	**21,560**
UV Disinfection	kWhr (assumes 0.23 kw operating 24 hours per day)	2014.8	0.4	**806**
Lamp Replacement	Assumes yearly reaplacement of 1 lamp (1 lamp per unti)	1.0	433.0	**433**
Cartridges	per cartridge (assume quarterly)	3	500	**1,500**
Electricity for Bore Pumps	kWhr (assumes 2kw pump operating at 2L/sec)	5,069	0.4	**2,028**
SUBTOTAL				*$ 38,206.70*
Total Estimated Annual Operational Costs				**$ 38,200**
NPV of Operating Costs (20 yr @ 8%)				**$ 375,000**
NPV Capital plus Operating Costs				**$ 1,294,900**

Option 1 b OD - New bores, WTP with Chlorine, Storage in exisiting location - ON DEMAND FLOW				
Description	**Unit**	**Quantity**	**Rate**	**Cost**
Source Water				
Application to work in reserve	With WDC	1	$ 5,000	$ 5,000
ECAN Consent	consent to take groundwater	1	$ 25,000	$ 25,000
Bores drilling and headworks		2	$ 30,000	$ 60,000
Bore Pumps	2.8 L/sec at up to 90m allowed for	2	$ 2,500	$ 5,000
VFD	VFD for pumps	2	$ 3,500	$ 7,000
Raw water turbidimeter	Hach 1720E	1	$ 7,000	$ 7,000
Flow meter	DN80 yokogawa mag flowmeter	2	$ 4,600	$ 9,200
Electrical and Control	level switches electrical cabinet, install	1	$ 15,000	$ 15,000
Installation and Construction		25%	$ 133,200	$ 33,300
SUBTOTAL				***$ 166,500***
Water Treatment				
Filtration, UV, Building, Civil				
Cartridge	1 HF40H304 (duty/standby) 5 um nominal - will treat up to 5 L/sec	2	$ 8,250	$ 16,500
Ultraviolet Disinfection	UV Pro 50 (up to 3.15 L/sec) Duty assist	2	$ 10,000	$ 20,000
UPS for UV	UPS - for management of brown outs 30min	1	$ 3,000	$ 3,000
Pressure Transducer	For monitoring pressure across cartridges	3	$ 500	$ 1,500
Turbiditmeter	For treated water	1	$ 7,000	$ 7,000
Flow meter	DN80 yokogawa mag flowmeter	1	$ 4,600	$ 4,600
Pipes, valves and fittings	50 to 100 mm	1	$ 10,000	$ 10,000
Water Treatment Plant Building	Alpine style m2	10	$ 4,000	$ 40,000
Landscaping/Access	Landscaping/ Access Road	1	$ 30,000	$ 30,000
Telemetry	RTU and Aerial, programming etc	1	$ 20,000	$ 20,000
Electrical and Switchboard		1	$ 40,000	$ 40,000
Power Upgrade	Upgrade to provide service fuse box on boundary of 13 Ohau Drive	1	$ 20,000	$ 20,000
Installation and Construction		25%	$ 212,600	$ 53,150
SUBTOTAL				*$ 265,750*
Chlorine Disinfection, Contact Time				
Chlorine Gas Dosing	Gas Cylinders and Dosing -	1	$ 72,735	$ 72,735
Carry water Pump	Carry water Pump	1	$ 2,000	$ 2,000
Chlorine Analyser	MFC with Depolox 5	1	$ 25,000	$ 25,000
Chlorine Contact Time 30 min	DN450 pipeline added length of pipeline (4.1 m3)	25	$ 700	$ 17,500
Installation and Construction		25%	$ 117,235	$ 29,309
SUBTOTAL				*$ 146,544*
SUBTOTAL Treatment				***$ 412,294***
Reticulation				
Flow meter	DN80 yokogawa mag flowmeter	1	$ 4,600	$ 4,600
Bores to WTP	DN100 PVC/PE	90	$ 150	$ 13,500
WTP to Retic	DN100 PVC/PE	80	$ 150	$ 12,000
Installation and Construction		25%	$ 30,100	$ 7,525
SUBTOTAL				***$ 37,625***
Storage				
Replacement of existing tanks				
Demolition of tanks	Demolition of existing tanks (20% replacement cost)	20%	$ 130,000	$ 26,000
Telemetry (to talk to pumps and provide data, alarms)	RTU and aerial, pole, solar panel, battery and repeater	1	$ 15,000	$ 15,000
New Flow meter	DN80 yokogawa mag flowmeter	1	$ 4,600	$ 4,600
New tanks	24 Hours emergency storage, operational storage 287 m3	10	$ 6,000	$ 60,000
Access Road Improvements	alowance for improvement to access road	1	$ 50,000	$ 50,000
Pipework	Allowance for pipework	1	$ 15,000	$ 15,000
Installation and Construction		40%	$ 170,600	$ 68,240
SUBTOTAL				***238,840***
Fire Protection				
Fire Tanks	30,000 L tanks with fittings (45m3)	1.5	$ 6,000	$ 9,000
Installation and Construction		40%	$ 9,000	$ 3,600
SUBTOTAL				***12,600***
Add- ons				
Generator	30 KVA generator	1	20,500	$ 20,500
Installation and Construction		25%	$ 20,500	$ 5,125
SUBTOTAL				***25,625***
SUBTOTAL				**893,484**
Preliminary and General		10%		89,348
Design		20%		178,697
Contingency		10%		89,348
Total Estimated Capital Cost:			-	**1,250,900**
Annual Operational Costs	*assumed average daily flow (m3/day)*	*50*		
Compliance and Management	per hour (5.5 hours monthly) extra 1.5 hours as reservoir on private land	66	180	**11,880**
Labour	per hour (weekly visits for 5 hours) plus additional 4 hours /monthly to address issues with storage	308	70	**21,560**
UV Disinfection	kWhr (assumes 0.23 kw operating 24 hours per day)	2014.8	0.4	**806**
Lamp Replacement	Assumes yearly reaplacement of 1 lamp (1 lamp per unti)	1.0	433.0	**433**
Cartridges	per cartridge (assume quarterly)	3	500	**1,500**
Chlorine Dosing	per kg (based on 70kg cylinder assume 1.5g/m3	27.4	5	**145**
Electricity for Bore Pumps	kWhr (assumes 2kw pump operating at 2 L/sec)	5,069	0.4	**2,028**
SUBTOTAL				*$ 38,351.79*
Total Estimated Annual Operational Costs				**$ 38,400**
NPV of Operating Costs (20 yr @ 8%)				**$ 377,000**
NPV Capital plus Operating Costs				**$ 1,627,900**

Option 1 b R - New bores, WTP with Chlorine, Storage in Existing Location - RESTRICTED FLOW				
Description	**Unit**	**Quantity**	**Rate**	**Cost**
Source Water				
Application to work in reserve	With WDC	1	$ 5,000	$ 5,000
ECAN Consent	consent to take groundwater	1	$ 25,000	$ 25,000
Bores drilling and headworks		2	$ 30,000	$ 60,000
Bore Pumps	1.3L/sec at up to 90m allowed for	2	$ 2,100	$ 4,200
VFD	VFD for pumps	2	$ 3,500	$ 7,000
Raw water turbidimeter	Hach 1720E	1	$ 7,000	$ 7,000
Flow meter	DN80 yokogawa mag flowmeter	2	$ 4,600	$ 9,200
Electrical and Control	level switches electrical cabinet, install	1	$ 15,000	$ 15,000
Installation and Construction		25%	$ 132,400	$ 33,100
SUBTOTAL				***$ 165,500***
Water Treatment				
Filtration, UV, Building, Civil				
Cartridge	1 HF40H304 (duty/standby) 5 um nominal - will treat up to 5 L/sec	2	$ 8,250	$ 16,500
Ultraviolet Disinfection	UV Pro 30 (up to 1.89 L/sec) (Duty Assist)	2	$ 5,990	$ 11,980
UPS for UV	UPS - for management of brown outs 30min	1	$ 3,000	$ 3,000
Pressure Transducer	For monitoring pressure across cartridges	3	$ 500	$ 1,500
Turbiditmeter	For treated water	1	$ 7,000	$ 7,000
Flow meter	DN80 yokogawa mag flowmeter	1	$ 4,600	$ 4,600
Pipes, valves and fittings	50 to 100 mm	1	$ 10,000	$ 10,000
Water Treatment Plant Building	Alpine style m2	10	$ 4,000	$ 40,000
Landscaping/Access	Landscaping/ Access Road	1	$ 30,000	$ 30,000
Telemetry	RTU and Aerial, programming etc	1	$ 20,000	$ 20,000
Electrical and Switchboard		1	$ 40,000	$ 40,000
Power Upgrade	Upgrade to provide service fuse box on boundary of 13 Ohau Drive	1	$ 20,000	$ 20,000
Installation and Construction		25%	$ 204,580	$ 51,145
SUBTOTAL				*$ 255,725*
Chlorine Disinfection, Contact Time				
Chlorine Gas Dosing	Gas Cylinders and Dosing -	1	$ 72,735	$ 72,735
Carry water Pump	Carry water Pump	1	$ 2,000	$ 2,000
Chlorine Analyser	MFC with Depolox 5	1	$ 25,000	$ 25,000
Chlorine Contact Time 30 min	DN450 pipeline added length of pipeline (4.1 m3)	25	$ 700	$ 17,500
Installation and Construction		25%	$ 117,235	$ 29,309
SUBTOTAL				*$ 146,544*
SUBTOTAL Treatment				***$ 402,269***
Reticulation				
Flow meter	DN80 yokogawa mag flowmeter	1	$ 4,600	$ 4,600
Bores to WTP	DN100 PVC/PE	90	$ 150	$ 13,500
WTP to Retic	DN100 PVC/PE	80	$ 150	$ 12,000
Installation and Construction		25%	$ 30,100	$ 7,525
SUBTOTAL				***$ 37,625***
Storage				
Replacement of existing tanks				
Demolition of tanks	Demolition of existing tanks (20% replacement cost)	20%	$ 130,000	$ 26,000
Telemetry (to talk to pumps and provide data, alarms)	RTU and aerial, pole, solar panel, battery and repeater	1	$ 15,000	$ 15,000
New Flow meter	DN80 yokogawa mag flowmeter	1	$ 4,600	$ 4,600
New tanks	24 Hours emergency storage = 116m3	4.5	$ 6,000	$ 27,000
Access Road Improvements	alowance for improvement to access road	1	$ 50,000	$ 50,000
Pipework valving		1	$ 10,000	$ 10,000
Installation and Construction		40%	$ 122,600	$ 49,040
SUBTOTAL				***181,640***
Fire Protection				
Fire Tanks	30,000 L tanks with fittings (45m3)	1.5	$ 6,000	$ 9,000
Installation and Construction		40%	$ 9,000	$ 3,600
SUBTOTAL				***12,600***
Add- ons				
Generator	Not required for restricted flow - allow to bring in plug in generator			
SUBTOTAL				**799,634**
Preliminary and General		10%		79,963
Design		20%		159,927
Contingency		10%		79,963
Total Estimated Capital Cost:			**-**	**1,119,500**
Annual Operational Costs	*assumed average daily flow (m3/day)*	*50*		
Compliance and Management	per hour (5.5 hours monthly) extra 1.5 hours as reservoir on private land	66	180	**11,880**
Labour	per hour (weekly visits for 5 hours) plus additional 4 hours /monthly to address issues with storage	308	70	**21,560**
UV Disinfection	kWhr (assumes 0.23 kw operating 24 hours per day)	2014.8	0.4	**806**
Lamp Replacement	Assumes yearly reaplacement of 1 lamp (1 lamp per unti)	1.0	433.0	**433**
Cartridges	per cartridge (assume quarterly)	3	500	**1,500**
Chlorine Dosing	per kg (based on 70kg cylinder assume 1.5g/m3	27.4	5	**145**
Electricity for Bore Pumps	kWhr (assumes 2kw pump operating at 2L/sec)	5,069	0.4	**2,028**
SUBTOTAL				*$ 38,351.79*
Total Estimated Annual Operational Costs				**$ 38,400**
NPV of Operating Costs (20 yr @ 8%)				**$ 377,000**
NPV Capital plus Operating Costs				**$ 1,496,500**

Option 2 a OD - New bores, WTP, Storage, Reticulation pumps (adjacent lake) - ON-DEMAND FLOW				
Description	**Unit**	**Quantity**	**Rate**	**Cost**
Source Water				
Application to work in reserve	With WDC	1	$ 5,000	$ 5,000
ECAN Consent	consent to take groundwater	1	$ 25,000	$ 25,000
Bores drilling and headworks		2	$ 30,000	$ 60,000
Bore Pumps	2.75L/sec at up to 55 m allowed for	2	$ 2,500	$ 5,000
VFD	VFD for pumps	2	$ 3,500	$ 7,000
Raw water turbidimeter	Hach 1720E	1	$ 7,000	$ 7,000
Flow meter	DN80 yokogawa mag flowmeter	2	$ 4,600	$ 9,200
Electrical and Control	level switches electrical cabinet, install	1	$ 15,000	$ 15,000
Installation and Construction		25%	$ 133,200	$ 33,300
SUBTOTAL				***$ 166,500***
Water Treatment				
Cartridge	1 HF40H304 1 um - will treat up to 5 L/sec (Duty assist)	2	$ 8,250	$ 16,500
Ultraviolet Disinfection	UV Pro 50 (up to 3.15 L/sec) Duty assist	2	$ 10,000	$ 20,000
UPS for UV	UPS - for management of brown outs 30min	1	$ 3,000	$ 3,000
Pressure Transducer	For monitoring pressure across cartridges	6	$ 500	$ 3,000
Turbiditmeter	For treated water	1	$ 7,000	$ 7,000
Flow meter	DN80 yokogawa mag flowmeter	1	$ 4,600	$ 4,600
Pipes, valves and fittings	50 to 100 mm	1	$ 10,000	$ 10,000
Water Treatment Plant Building	Alpine style m2	25	$ 4,000	$ 100,000
Building Consent	Building consent for WTP	1	$ 10,000	$ 10,000
Landscaping/Access	Landscaping/ Access Road	1	$ 50,000	$ 50,000
Telemetry	RTU and Aerial, programming etc	1	$ 20,000	$ 20,000
Electrical and Switchboard		1	$ 40,000	$ 40,000
Power Upgrade	Upgrade to provide service fuse box on boundary of 13 Ohau Drive	1	$ 20,000	$ 20,000
Installation and Construction		25%	$ 304,100	$ 76,025
SUBTOTAL				***$ 380,125***
Reticulation				
Hydrovar Pump set (12 L/sec at 50m)	Lowara Twin Pac Dual 15SV06F055T5.5 KW	1	$ 11,000	$ 11,000
Flow meter	DN80 yokogawa mag flowmeter	1	$ 4,600	$ 4,600
Bores to WTP	DN100 PVC/PE	90	$ 150	$ 13,500
WTP to Storage	DN100 PVC/PE	5	$ 150	$ 750
Storage to Retic	DN150 PVC/PE	100	$ 180	$ 18,000
Installation and Construction		25%	$ 47,850	$ 11,963
SUBTOTAL				***$ 59,813***
Storage				
Storage (operational and emergency)	30,000 L tanks with fittings (operational and emergency - 287m3)	10	$ 6,000	$ 60,000
Installation and Construction		25%	$ 60,000	$ 15,000
SUBTOTAL				***75,000***
Fire Protection				
Fire Tanks	30,000 L tanks with fittings	2	$ 6,000	$ 12,000
Added building space		5	$ 4,000	$ 20,000
Additional Generator Cost	increase in size of generaotr for Fire pump	1	$ 6,000	$ 6,000
Fire Pump		*1*	19,000	$ 19,000
Installation and Construction		25%	$ 57,000	$ 14,250
SUBTOTAL				***71,250***
Add- ons				
Generator	30 KVA generator	1	20,500	$ 20,500
Installation and Construction		25%	$ 20,500	$ 5,125
SUBTOTAL				***25,625***
SUBTOTAL				**778,313**
Preliminary and General		10%		77,831
Design		20%		155,663
Contingency		10%		77,831
Total Estimated Capital Cost:			**-**	**1,089,638**
Annual Operational Costs	*assumed average daily flow (m3/day)*	*50*		
Compliance and Management	per hour (4 hours monthly)	48	180	**8,640**
Labour	per hour (weekly visits for 5 hours)	260	70	**18,200**
UV Disinfection	kWhr (assumes 0.23 kw operating 24 hours per day)	2014.8	0.4	**806**
Lamp Replacement	Assumes yearly reaplacement of 1 lamp (1 lamp per unti)	1.0	433.0	**433**
Cartridges	per cartridge (assume quarterly)	3	500	**1,500**
Electricity for Bore Pumps	kWhr (assumes 2kw pump operating at 2L/sec for about 7 hours per day)	5,069	0.3	**1,521**
Electricity for Reticulation Pumps	kWhr (assumes4kw pump operating at 1.5 L/sec for 12 hours per day)	17,520	0.3	**5,256**
SUBTOTAL				*$ 36,355.75*
Total Estimated Annual Operational Costs				**$ 36,400**
NPV of Operating Costs (20 yr @ 8%)				**$ 357,400**
NPV Capital plus Operating Costs				**$ 1,447,038**

Option 2 a R - New bores, WTP, Storage, Reticulation pumps (adjacent lake) - RESTRICTED FLOW				
Description	**Unit**	**Quantity**	**Rate**	**Cost**
Source Water				
Application to work in reserve	With WDC	1	$ 5,000	$ 5,000
ECAN Consent	consent to take groundwater	1	$ 25,000	$ 25,000
Bores drilling and headworks		2	$ 30,000	$ 60,000
Bore Pumps	2 x 1.3L/sec at up to 55 m allowed for	2	$ 1,580	$ 3,160
VFD	VFD for pumps	2	$ 3,500	$ 7,000
Raw water turbidimeter	Hach 1720E	1	$ 7,000	$ 7,000
Flow meter	DN80 yokogawa mag flowmeter	2	$ 4,600	$ 9,200
Electrical and Control	level switches electrical cabinet, install	1	$ 15,000	$ 15,000
Installation and Construction		25%	$ 131,360	$ 32,840
SUBTOTAL				***$ 164,200***
Water Treatment				
Cartridge	1 HF40H304 (duty/standby only) 5 um - will treat up to 5 L/sec	2	$ 8,250	$ 16,500
Ultraviolet Disinfection	UV Pro 30 (up to 2 L/sec) Duty Standby	2	$ 5,990	$ 11,980
UPS for UV	UPS - for management of brown outs 30min	1	$ 3,000	$ 3,000
Pressure Transducer	For monitoring pressure across cartridges	6	$ 500	$ 3,000
Turbiditmeter	For treated water	1	$ 7,000	$ 7,000
Flow meter	DN80 yokogawa mag flowmeter	2	$ 4,600	$ 9,200
Pipes, valves and fittings	50 to 100 mm	1	$ 10,000	$ 10,000
Water Treatment Plant Building	Alpine style m2	18	$ 4,000	$ 72,000
Building Consent	Building consent for WTP	1	$ 10,000	$ 10,000
Landscaping/Access	Landscaping/ Access Road	1	$ 50,000	$ 50,000
Telemetry	RTU and Aerial, programming etc	1	$ 20,000	$ 20,000
Electrical and Switchboard		1	$ 40,000	$ 40,000
Power Upgrade	Upgrade to provide service fuse box on boundary of 13 Ohau Drive	1	$ 20,000	$ 20,000
Installation and Construction		25%	$ 272,680	$ 68,170
SUBTOTAL				***$ 340,850***
Reticulation				
Hydrovar Pump set	6L/sec at 40m	1	$ 8,500	$ 8,500
Flow meter	DN80 yokogawa mag flowmeter	1	$ 4,600	$ 4,600
Bores to WTP	DN100 PVC/PE	90	$ 150	$ 13,500
WTP to Storage	DN100 PVC/PE	5	$ 150	$ 750
Storage to Retic	DN150 PVC/PE	100	$ 180	$ 18,000
Installation and Construction		25%	$ 45,350	$ 11,338
SUBTOTAL				***$ 56,700***
Storage				
Storage (femergency)	30,000 L tanks with fittings (116m3)	4.5	$ 6,000	$ 27,000
Installation and Construction		25%	$ 27,000	$ 6,750
SUBTOTAL				***33,750***
Fire Protection				
Fire Tanks	30,000 L tanks with fittings	1.5	$ 6,000	$ 9,000
Added building space		5	$ 4,000	$ 20,000
Additional Generator Cost	increase in size of generaotr for Fire pump	1	$ 6,000	$ 6,000
Fire Pump	18.5KW in line fire pumps	1	19,000	$ 19,000
Installation and Construction		25%	$ 54,000	$ 13,500
SUBTOTAL				***67,500***
Generator				
Generator	30 KVA generator	1	20,500	$ 20,500
Installation and Construction		25%	$ 20,500	$ 5,125
SUBTOTAL				***25,625***
SUBTOTAL				**688,600**
Preliminary and General		10%		68,860
Design		20%		137,720
Contingency		10%		68,860
Total Estimated Capital Cost:			-	**964,000**
Annual Operational Costs	*assumed average daily flow (m3/day)*	*50*		
Compliance and Management	per hour (4 hours monthly)	48	180	**8,640**
Labour	per hour (weekly visits for 5 hours)	260	70	**18,200**
UV Disinfection	kWhr (assumes 0.23 kw operating 24 hours per day)	2014.8	0.4	**806**
Lamp Replacement	Assumes yearly reaplacement of 1 lamp (1 lamp per unti)	1.0	433.0	**433**
Cartridges	per cartridge (assume quarterly)	3	500	**1,500**
Electricity for Bore Pumps	kWhr (assumes 2kw pump operating at 2L/sec for about 7 hours per day)	5,069	0.3	**1,521**
Electricity for Reticulation Pumps	kWhr (assumes1.1kw pump operating at 1L/sec for 16 hours per day)	6,424	0.3	**1,927**
SUBTOTAL				*$ 33,026.95*
Total Estimated Annual Operational Costs				**$ 33,000**
NPV of Operating Costs (20 yr @ 8%)				**$ 324,000**
NPV Capital plus Operating Costs				**$ 1,288,000**

Option 2 b OD - New bores,WTP with Chlorine,Storage and reticulation pumps - ON DEMAND FLOW				
Description	**Unit**	**Quantity**	**Rate**	**Cost**
Source Water				
Application to work in reserve	With WDC	1	$ 5,000	$ 5,000
ECAN Consent	consent to take groundwater	1	$ 25,000	$ 25,000
Bores drilling and headworks		2	$ 30,000	$ 60,000
Bore Pumps	2.75L/sec at up to 55 m allowed for	2	$ 2,500	$ 5,000
VFD	VFD for pumps	2	$ 3,500	$ 7,000
Raw water turbidimeter	Hach 1720E	1	$ 7,000	$ 7,000
Flow meter	DN80 yokogawa mag flowmeter	2	$ 4,600	$ 9,200
Electrical and Control	level switches electrical cabinet, install	1	$ 15,000	$ 15,000
Installation and Construction		25%	$ 133,200	$ 33,300
SUBTOTAL				***$ 166,500***
Water Treatment				
Cartridge	1 HF40H304 1 um - will treat up to 5 L/sec (Duty assist)	2	$ 8,250	$ 16,500
Ultraviolet Disinfection	UV Pro 50 (up to 3.15 L/sec) Duty assist	2	$ 10,000	$ 20,000
UPS for UV	UPS - for management of brown outs 30min	1	$ 3,000	$ 3,000
Pressure Transducer	For monitoring pressure across cartridges	6	$ 500	$ 3,000
Turbiditmeter	For treated water	1	$ 7,000	$ 7,000
Flow meter	DN80 yokogawa mag flowmeter	1	$ 4,600	$ 4,600
Pipes, valves and fittings	50 to 100 mm	1	$ 10,000	$ 10,000
Water Treatment Plant Building	Alpine style m2	25	$ 4,000	$ 100,000
Building Consent	Building consent for WTP	1	$ 10,000	$ 10,000
Landscaping/Access	Landscaping/ Access Road	1	$ 50,000	$ 50,000
Telemetry	RTU and Aerial, programming etc	1	$ 20,000	$ 20,000
Electrical and Switchboard		1	$ 40,000	$ 40,000
Power Upgrade	Upgrade to provide service fuse box on boundary of 13 Ohau Drive	1	$ 20,000	$ 20,000
Installation and Construction		25%	$ 304,100	$ 76,025
SUBTOTAL				***$ 380,125***
Chlorine Disinfection, Contact Time				
Chlorine Gas Dosing	Gas Cylinders and Dosing -	1	$ 30,749	$ 30,749
Carry water Pump	Carry water Pump	1	$ 2,000	$ 2,000
Chlorine Analyser	MFC with Depolox 5	1	$ 11,300	$ 11,300
Contact tank	10000L	1	$ 3,500	$ 3,500
Installation and Construction		25%	$ 47,549	$ 11,887
SUBTOTAL				*$ 59,400*
SUBTOTAL Treatment				***$ 439,525***
Reticulation				
Hydrovar Pump set (12 L/sec at 50m)	Lowara Twin Pac Dual 15SV06F055T5.5 KW	1	$ 11,000	$ 11,000
Flow meter	DN80 yokogawa mag flowmeter	1	$ 4,600	$ 4,600
Bores to WTP	DN100 PVC/PE	90	$ 150	$ 13,500
WTP to Storage	DN100 PVC/PE	5	$ 150	$ 750
Storage to Retic	DN150 PVC/PE	100	$ 180	$ 18,000
Installation and Construction		25%	$ 47,850	$ 11,963
SUBTOTAL				***$ 59,813***
Storage				
Storage (operational and emergency)	30,000 L tanks with fittings (operational and emergency - 287m3)	10	$ 6,000	$ 60,000
Installation and Construction		25%	$ 60,000	$ 15,000
SUBTOTAL				***75,000***
Fire Protection				
Fire Tanks	30,000 L tanks with fittings	2	$ 6,000	$ 12,000
Added building space		5	$ 4,000	$ 20,000
Additional Generator Cost	increase in size of generaotr for Fire pump	1	$ 6,000	$ 6,000
Fire Pump		*1*	19,000	$ 19,000
Installation and Construction		25%	$ 57,000	$ 14,250
SUBTOTAL				***71,250***
Add- ons				
Generator	30 KVA generator	1	20,500	$ 20,500
Installation and Construction		25%	$ 20,500	$ 5,125
SUBTOTAL				***25,625***
SUBTOTAL				**837,713**
Preliminary and General		10%		83,771
Design		20%		167,543
Contingency		10%		83,771
Total Estimated Capital Cost:			-	**1,172,798**
Annual Operational Costs	*assumed average daily flow (m3/day)*	*50*		
Compliance and Management	per hour (4 hours monthly)	48	180	**8,640**
Labour	per hour (weekly visits for 5 hours)	260	70	**18,200**
UV Disinfection	kWhr (assumes 0.23 kw operating 24 hours per day)	2014.8	0.4	**806**
Chlorine Dosing	per kg (based on 70kg cylinder assume 1.5g/m3	27.4	5	**145**
Lamp Replacement	Assumes yearly reaplacement of 1 lamp (1 lamp per unti)	1.0	433.0	**433**
Cartridges	per cartridge (assume quarterly)	3	500	**1,500**
Electricity for Bore Pumps	kWhr (assumes 2kw pump operating at 2L/sec for about 7 hours per day)	5,069	0.3	**1,521**
Electricity for Reticulation Pumps	kWhr (assumes4kw pump operating at 1.5 L/sec for 12 hours per day)	17,520	0.3	**5,256**
SUBTOTAL				*$ 36,500.84*
Total Estimated Annual Operational Costs				**$ 36,500**
NPV of Operating Costs (20 yr @ 8%)				**$ 358,400**
NPV Capital plus Operating Costs				**$ 1,531,198**

Option 2 b R - New bores,WTP with Chlorine,Storage and reticulation pumps - RESTRICTED FLOW				
Description	**Unit**	**Quantity**	**Rate**	**Cost**
Source Water				
Application to work in reserve	With WDC	1	$ 5,000	$ 5,000
ECAN Consent	consent to take groundwater	1	$ 25,000	$ 25,000
Bores drilling and headworks		2	$ 30,000	$ 60,000
Bore Pumps	2 x 1.3L/sec at up to 55 m allowed for	2	$ 1,580	$ 3,160
VFD	VFD for pumps	2	$ 3,500	$ 7,000
Raw water turbidimeter	Hach 1720E	1	$ 7,000	$ 7,000
Flow meter	DN80 yokogawa mag flowmeter	2	$ 4,600	$ 9,200
Electrical and Control	level switches electrical cabinet, install	1	$ 15,000	$ 15,000
Installation and Construction		25%	$ 131,360	$ 32,840
SUBTOTAL				***$ 164,200***
Water Treatment				
Filtration plus UV Civil				
Cartridge	1 HF40H304 (duty/standby only) 1 um - will treat up to 5 L/sec	2	$ 8,250	$ 16,500
Ultraviolet Disinfection	UV Pro 30 (up to 2 L/sec) Duty Standby	2	$ 5,990	$ 11,980
UPS for UV	UPS - for management of brown outs 30min	1	$ 3,000	$ 3,000
Pressure Transducer	For monitoring pressure across cartridges	6	$ 500	$ 3,000
Turbiditmeter	For treated water	1	$ 7,000	$ 7,000
Flow meter	DN80 yokogawa mag flowmeter	2	$ 4,600	$ 9,200
Pipes, valves and fittings	50 to 100 mm	1	$ 10,000	$ 10,000
Water Treatment Plant Building	Alpine style m2	18	$ 4,000	$ 72,000
Building Consent	Building consent for WTP	1	$ 10,000	$ 10,000
Landscaping/Access	Landscaping/ Access Road	1	$ 50,000	$ 50,000
Telemetry	RTU and Aerial, programming etc	1	$ 20,000	$ 20,000
Electrical and Switchboard		1	$ 40,000	$ 40,000
Power Upgrade	Upgrade to provide service fuse box on boundary of 13 Ohau Drive	1	$ 20,000	$ 20,000
Installation and Construction		25%	$ 272,680	$ 68,170
SUBTOTAL				*$ 340,900*
Chlorine Disinfection, Contact Time				
Chlorine Gas Dosing	Gas Cylinders and Dosing -	1	$ 30,749	$ 30,749
Carry water Pump	Carry water Pump	1	$ 2,000	$ 2,000
Chlorine Analyser	MFC with Depolox 5	1	$ 11,300	$ 11,300
Contact tank	5000L	1	$ 2,000	$ 2,000
Installation and Construction		25%	$ 46,049	$ 11,512
SUBTOTAL				*$ 57,600*
SUBTOTAL Treatment				***$ 398,500***
Reticulation				
Hydrovar Pump set	Retic pumps 6 L/sec @40m	1	$ 8,500	$ 8,500
Flow meter	DN80 yokogawa mag flowmeter	1	$ 4,600	$ 4,600
Bores to WTP	DN100 PVC/PE	90	$ 150	$ 13,500
WTP to Storage	DN100 PVC/PE	5	$ 150	$ 750
Storage to Retic	DN150 PVC/PE	100	$ 180	$ 18,000
Installation and Construction		25%	$ 45,350	$ 11,338
SUBTOTAL				***$ 56,700***
Storage				
Storage (femergency)	30,000 L tanks with fittings	4.5	$ 6,000	$ 27,000
Installation and Construction		25%	$ 27,000	$ 6,750
SUBTOTAL				***33,750***
Fire Protection				
Fire Tanks	30,000 L tanks with fittings	1.5	$ 6,000	$ 9,000
Added building space		5	$ 4,000	$ 20,000
Additional Generator Cost	increase in size of generaotr for Fire pump	1	$ 6,000	$ 6,000
Fire Pump	18.5KW in line fire pumps	1	19,000	$ 19,000
Installation and Construction		25%	$ 54,000	$ 13,500
SUBTOTAL				***67,500***
Generator				
Generator	30 KVA generator	1	20,500	$ 20,500
Installation and Construction		25%	$ 20,500	$ 5,125
SUBTOTAL				***25,625***
SUBTOTAL				**746,300**
Preliminary and General		10%		74,630
Design		20%		149,260
Contingency		10%		74,630
Total Estimated Capital Cost:			-	**1,044,800**
Annual Operational Costs	*assumed average daily flow (m3/day)*	*50*		
Compliance and Management	per hour (4 hours monthly)	48	180	**8,640**
Labour	per hour (weekly visits for 5 hours)	260	70	**18,200**
UV Disinfection	kWhr (assumes 0.23 kw operating 24 hours per day)	2014.8	0.4	**806**
Lamp Replacement	Assumes yearly reaplacement of 1 lamp (1 lamp per unti)	1.0	433.0	**433**
Cartridges	per cartridge (assume quarterly)	3	500	**1,500**
Chlorine Dosing	per kg (based on 70kg cylinder assume 1.5g/m3	27.4	5	**145**
Electricity for Bore Pumps	kWhr (assumes 2kw pump operating at 2L/sec for about 7 hours per day)	5,069	0.3	**1,521**
Electricity for Reticulation Pumps	kWhr (assumes1.1kw pump operating at 1L/sec for 16 hours per day)	6,424	0.3	**1,927**
SUBTOTAL				*$ 33,172.04*
Total Estimated Annual Operational Costs				**$ 33,200**
NPV of Operating Costs (20 yr @ 8%)				**$ 326,000**
NPV Capital plus Operating Costs				**$ 1,370,800**