Watercare Services Ltd

Huia WTP Site Selection

DRAFT Addendum to the Shortlist Site Development Report (2016)

May 2017

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1. Introduction

1.1 Background

Watercare has been planning to replace or significantly upgrade aging infrastructure at Huia Water Treatment Plant since 2008 and although previous work on the siting of the replacement Huia WTP has focused on either the existing or Manuka Road (immediately to the East of the existing WTP) sites, Watercare Services Limited (Watercare) has undertaken a first principles approach to investigate and provide adequate consideration to siting options – the Huia WTP Site Selection Study which commenced in late 2015.

The site selection study has since progressed through the following stages:

1. Selection Preparation
2. Site Identification
3. Longlisting
4. Shortlisting (current stage)

Site design development has been undertaken for the four shortlisted sites and documented in "Shortlist Site Development Report" (GHD, 2016) for the purpose of site evaluation. Since the preparation of that report, certain operational requirements have been refined by Watercare.

1.2 Purpose of this report

This report is an addendum to the "Shortlist Site Development Report" (GHD, 2016) and is intended to be read as a supplement to that report.

This report serves to fulfil three main purposes:

1. To document changes to the design criteria,
2. Describe any changes to the site layouts presented in the "Shortlist Site Development Report", and
3. Highlight any key changes that might affect site evaluations.

1.3 Assumptions

It is assumed that the reader has read in full and understood the contents of the "Shortlist Site Development Report" (GHD, 2016).

Where there is information presented within this addendum that contradicts the "Shortlist Site Development Report", this addendum is to take precedence.

1.4 Scope and limitations

This report: has been prepared by GHD for Watercare Services Ltd and *may only be used and relied on by Watercare Services Ltd for the purpose agreed between GHD and the Watercare Services Ltd.*

GHD otherwise disclaims responsibility to any person other than Watercare Services Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

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The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

GHD has prepared this report on the basis of information provided by Watercare Services Ltd and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

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2. Treatment Plant

2.1 Plant Processes

The proposed site of the new Huia Water Treatment Plant will house the following processes:

1. Pre-Screening
2. Clarification (assumed to be Dissolved Air Flotation)
3. Oxidation (assumed to be Ozonation)
4. Filtration (assumed to be Biological Activated Carbon)
5. Chlorination and Chlorine Contact
6. Treated Water Storage

Additional ancillary processes include:

7. Washwater Recycling
8. Residuals Handling
9. Overflow Detention Basin

While treatment processes have been assumed for #2 to 4 above for this site selection study based on recommendations from previous investigations, it should be noted that many other suitable treatment technologies exist which can be accommodated within the current footprints identified, should future investigations identify other preferred treatment processes.

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2.2 Design Criteria

Following the preparation of the "Huia WTP Site Selection Study – Shortlist Site Development Report" (GHD, 2016), certain operational requirements have been refined by Watercare. These requirements are:

- 160 MLD treatment capacity (increased from 140 MLD)
- Storage Reservoir top water level (TWL) of 120 mRL
- Possible future additional treatment process block to provide contingency in case of future raw water quality deterioration.

The changes to the hydraulic design criteria of the plant are summarised in Table 1 below:

Table 1 - Huia WTP Design Criteria

Criteria	New Requirement	Shortlist Development Requirement
Treatment Capacity	160 MLD	140 MLD
Incoming Flow	160.2 MLD	140.2 MLD
Incoming Flow Hydraulic Grade	115 mRL	115 mRL
Ultimate Storage Capacity	50 ML 2 x 60 m dia. reservoirs	50 ML 2 x 60 m dia. reservoirs
Reservoir Top Water Level	120 mRL	115-128 mRL
Reservoir Low Water Level	112 mRL	103-120 mRL
Additional Treatment Process	Yes	No

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2.3 Revised Process Sizing

To accommodate the increased treatment capacity, sizing of the process units has been revised. Details of the updated process sizing can be found in Appendix A.

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3. Layout Options

Further to the preliminary layouts developed in preparation of the "Huia WTP Site Selection Study – Shortlist Site Development Report" (GHD, 2016), layouts for the four shortlisted sites were revised to account for changes to the design criteria as outlined in Section 2.2 above.

A complete updated drawing set of the shortlisted sites can be found in Appendix B.

3.1 Parker Road North

In addition to the revised requirements summarised in Section 2.2 above, the revised Parker Road North layout has provided for:

- Minimum 20m offset from all boundaries to provide for buffer planting/screening.
- Heritage building/site located at 132 Parker Road

Figure 1 below shows an entirely different layout to that developed for the Shortlist Site Development Report, highlighting again the flexibility available on the site.

The plant is oriented such that it largely aligns with the existing slope of the site, allowing flows to gravitate all the way through the plant. In this layout however, the reservoirs are located away from the road, adjacent to the plant at TWL 120 mRL.

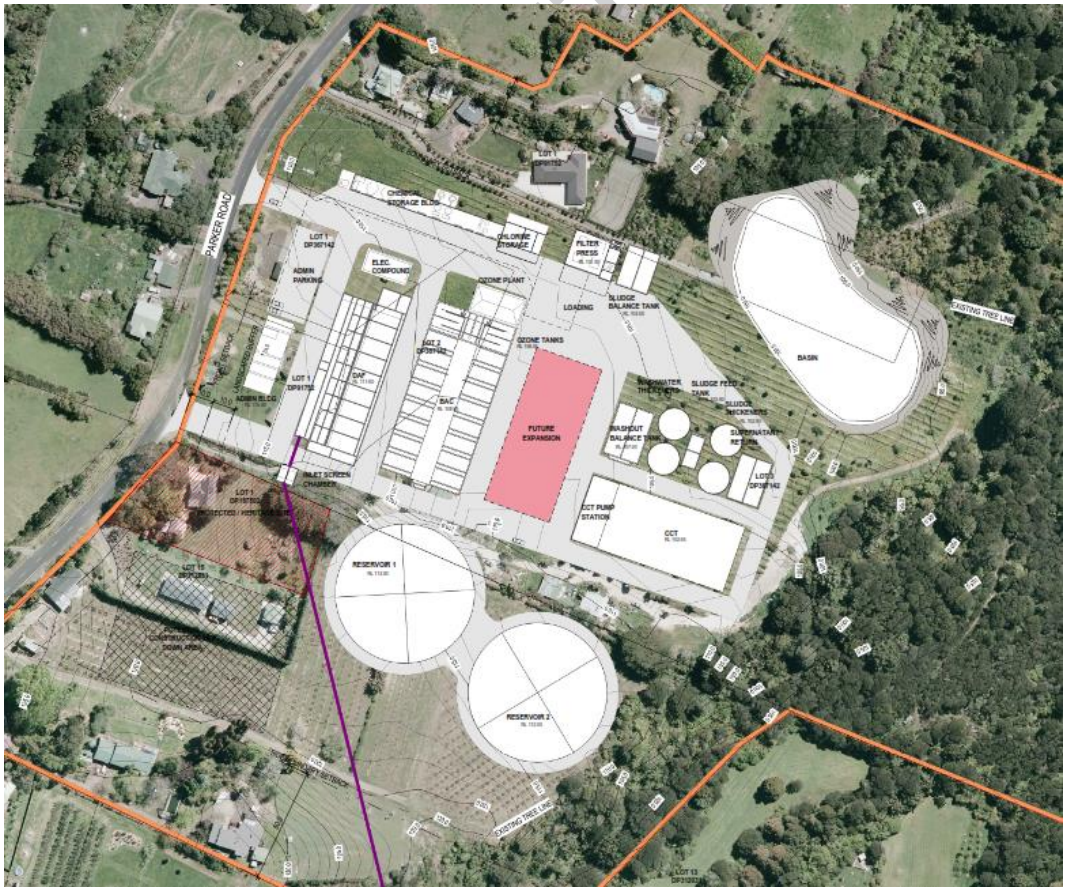

Figure 1 – Parker Rd North Revised Layout

The revised design criteria and additional restrictions are accommodated with sufficient space between the plant and site boundaries for buffer zones to provide screening for neighbours.

While the layout of the plant has changed significantly from that presented in the Shortlist Development Report, the overall footprint is largely unchanged. Thus, the assessments presented in that report are still applicable.

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3.2 Parker Road South

Figure 2 below shows a layout largely similar to that developed for the Shortlist Site Development Report, albeit with minor adjustments to optimise the layout.

The plant is oriented such that it largely aligns with the existing slope of the site, allowing flows to gravitate all the way through the plant.

Figure 2 – Parker Rd South Revised Layout

The revised design criteria are accommodated, though the revised reservoirs TWL of 120 mRL necessitates locating them nearer Allen Swamp.

Due to the elevations required, there is reduced scope for maintaining large buffer zones between the plant and site boundaries to provide screening for neighbours.

While there have been some changes to the plant layout and footprint from what was presented in the Shortlist Development Report, the overall effect of these changes is relatively minor with respect to the assessments carried out in the previous report and as such are still relevant.

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3.3 Manuka Road

As shown in Figure 3 below, the increased capacity is accommodated on the site, however it is too constrained to provide an allowance for an additional future treatment process block.

The layout remains largely unchanged from that presented in the Shortlist Development Report as the site slopes steeply along the west, south and east sides – constraining layout options.

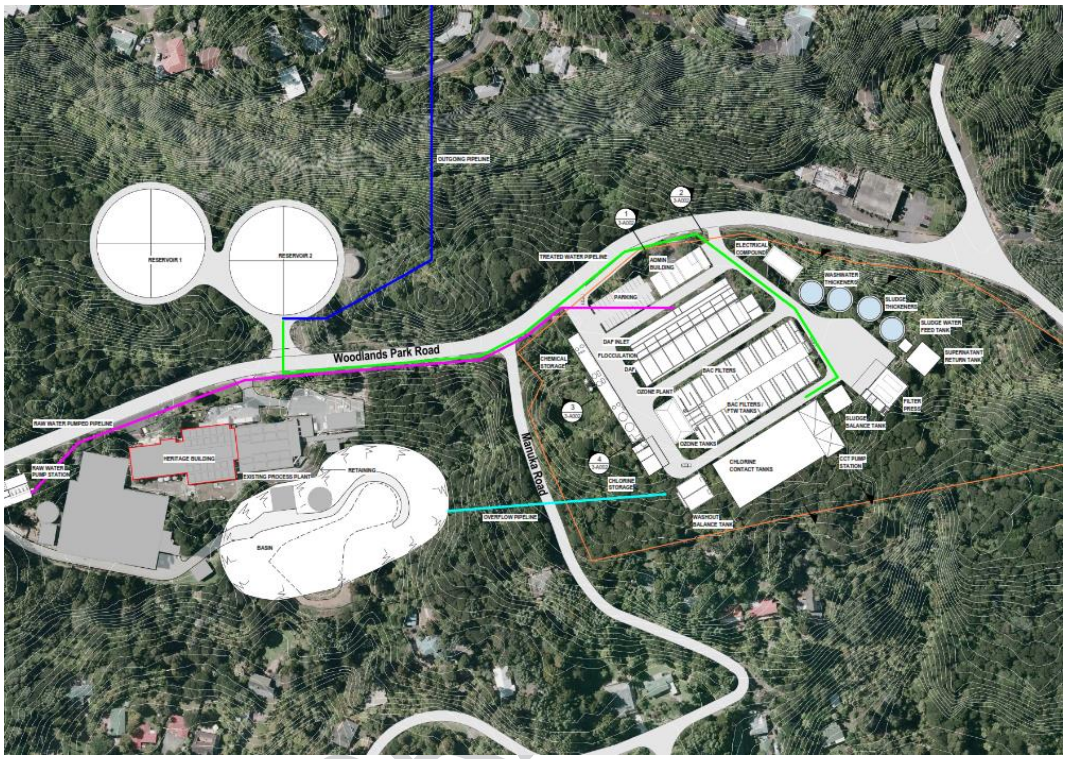

Figure 3 – Manuka Rd Revised Layout

While the lowering the reservoirs TWL to 120 mRL (from 128 mRL), reduces pumping power consumption for sites requiring treated water pumping, the Manuka Road site will not see any benefit in lowering the TWL of the reservoirs due to requiring raw water pumping . Lowering the reservoirs would only increase construction costs due to the additional depth of the reservoirs and valve chambers.

Due to limited site area and challenging topography, there is reduced scope on site to provide buffer zones/separation

Overall, the design criteria changes that can be accommodated and/or are applicable, result in little change to the site as presented in the Shortlist Development Report. Thus, the assessments presented in that report are still applicable.

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3.4 Existing Site

As shown in Figure 4 below, the increased capacity is accommodated on the site, however as with Manuka Road the site is too constrained to provide an allowance for an additional future treatment process block.

The layout remains largely unchanged from that presented in the Shortlist Development Report as the site slopes steeply along the south and east sides – constraining layout options.

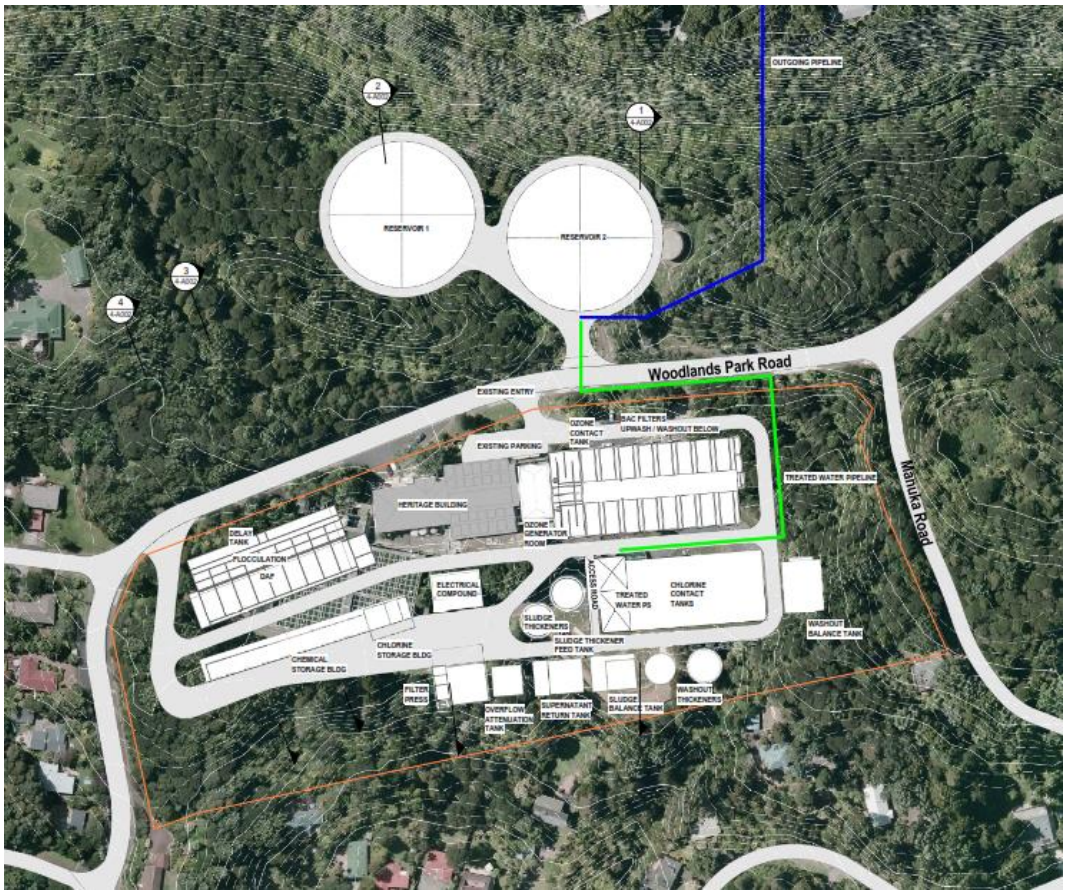

Figure 4 – Existing Site Revised Layout

Lowering the reservoirs TWL to 120 mRL (from 128 mRL) would reduce pumping power consumption. However, due to the constraints of the sites the reservoirs cannot be located elsewhere and thus a reduction of TWL would require the reservoirs to be largely constructed below ground level. Aside from the cost implications, below ground reservoirs have additional health and safety implications associated with deep pipework/valves and their access chambers.

Due to limited site area and challenging topography, there is reduced scope on site to provide buffer zones/separation

Overall, the design criteria changes that can be accommodated and/or are applicable, result in little change to the site as presented in the Shortlist Development Report. Thus, the assessments presented in that report are still applicable.

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Appendices

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Appendix A - Process Flow Sheet and Major Unit Sizing

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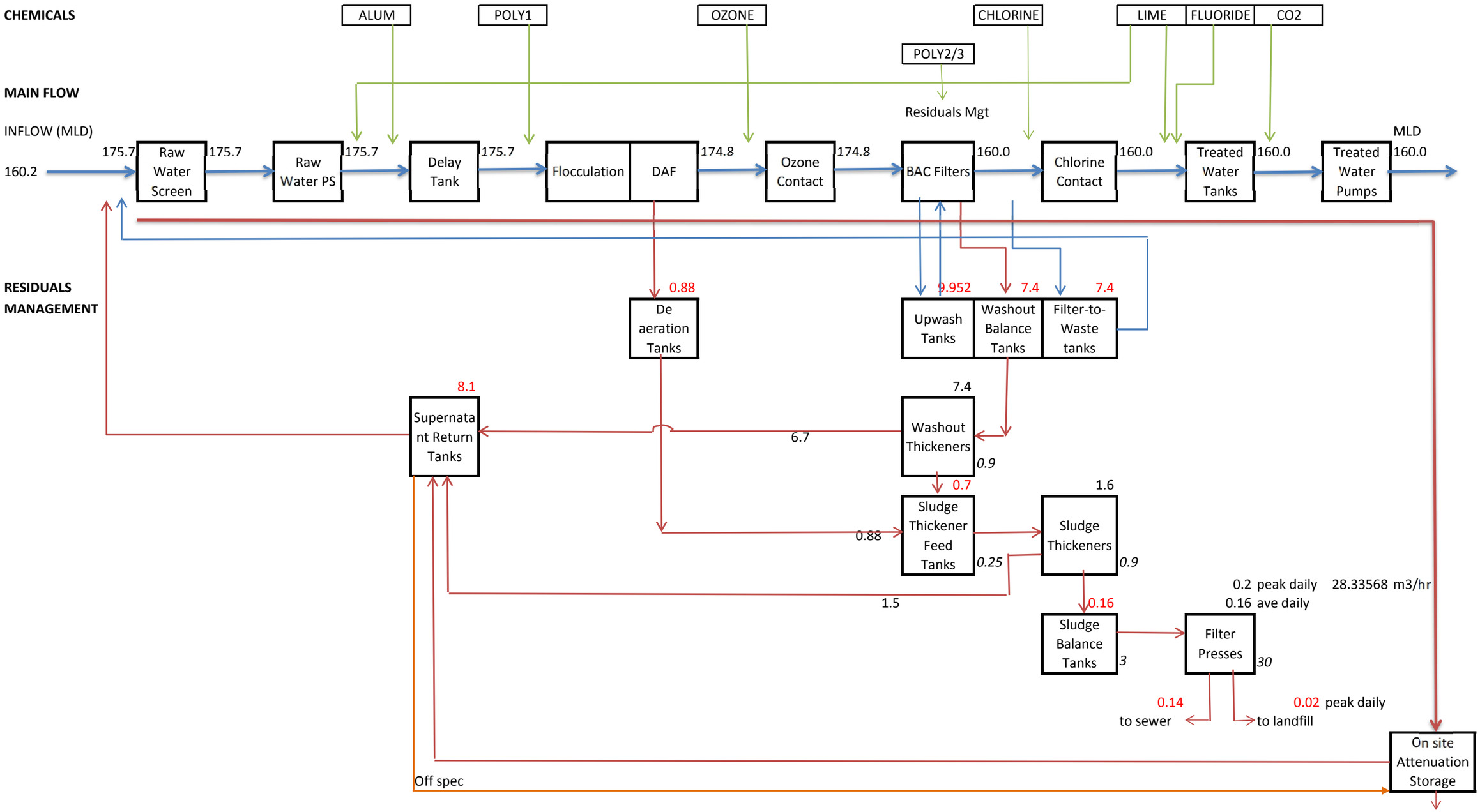
GHD	CLIENT: Watercare Services Ltd.	**Calculations**	
	PROJECT: Huia WTP Site Selection Study	JOB No.: 51-33575	Rev: 2
			Calc. By: C Gamst
	SUBJECT: Process Flow Sheet (160MLD)	CALCULATION No.:	Date: 19-Jan-17
			Checked: M Muntisov

HUIA WATER TREATMENT PLANT



	CLIENT: Watercare Services Ltd.	**Calculations**
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	SUBJECT: Major Unit Sizing (160MLD)	CALCULATION No.:
	Rev: 2 — Date:	19-Jan-17
	Calc. By: C Gamst — Checked:	M Muntisov

Unit Sizing

Sources:

MWH	*Huia Water Treatment Plant, Upgrade Implementation Strategy, November 2013 (MWH)*
Watercare	*Huia WTP Replacement - Basis of Design Framework Rev 13 (BODF)*
Hunter H2O	*Huia Pilot Plant Trial Stage 2. Draft Report Rev A (Pilot)*

Process Unit	No	Criteria/Dimensions	Unit	Comments
MAIN FLOW				
Design Inflow		176	MLD	From Flow Sheet tab (rounded)
Delay Tanks	2	No		Two trains, each capable of accommodating 100% flow (BODF 8.2)
		5	minutes	Total based on Pilot Report 6.2.5 (minimum 2 minutes). 2.5 minutes at N-1 and 100% flow Note: contrary to BODF 7.1.5.2 which requires 5 minutes at N-1 and 75% flow
		305.1	m^3	Per delay tank
	Unit Dimensions	2.2	m D	Depth
		30.7	m L	Length
		4.5	m W	Width
Flocculation	9	No		As per MWH + extra train to achieve 160MLD instead of 140MLD
		15	minutes	As per MWH. 13 minutes at N-1. Conservative based on Pilot Report(7.5 minutes) but allows for design switch from a flotation to a high rate settling technology
		2	stages	
		101.7	m^3/stage/unit	
	Unit Dimensions	7.0	m W	Width
		4.1	m D	Depth (as per MWH)
		3.5	m L	Length
DAF	9	No		As per MWH + extra train to achieve 160MLD instead of 140MLD
		9.2	m/h	N units in service incl 10% recycle
		10.4	m/h	N-1 units in service. Pilot report suggests up to 12 m/h
		88.2	m2 per unit	
	Unit Dimensions	12.6	m L	Length
		7.0	m W	Width
		3.0	m D	Depth (as per MWH)
	Saturators	9	No	As per BODF (7.1.7.3)
	Plant Room	200	m^2	As per MWH
Ozone Contact	2	No		
		15	minutes	HRT, N units in service (Pilot Report Table ES-1, 7.2.2, 7.7 (ozone alone))
		7.5	minutes	N-1 (Approx equivalent to 75% flow@0.7 Baffle Factor BODF 7.1.8.2)
	Flow rate	175	MLD	From Flow sheet tab
		911	m^3 per contactor	
		5.9	m D	As per MWH
		154.4	m^2	Required active contact area
	Unit Dimensions	12.1	m W	Width
		5.9	m D	Depth (as per MWH)
		12.8	m L	Length
	Ozone Dose	3.3	mg/L max	Pilot Table ES -1: 3.0 mg/L max (transferred) x 90% transfer efficiency
		1.65	mg/L typ	Pilot Table ES -1: 1.5 mg/L typ (transferred) x 90% transfer efficiency
	Ozone Generators	24.0	kg/hr total	
		3	No	N+1 (BODF 7.1.8.3)
		12.0	kg/h each	Assume oxygen feed via VSA
	Ozone Generation Room	200	m^2	As per MWH

BAC Filters	16	No		
		15	min EBCT	As per MWH. Pilot Report suggests > 15 minutes (Table ES-1). This is at the high end of typical ozone/BAC plants
		485.7	m^3/hr	per Filter. N-1 condition (BODF 7.1.9.3)
		6.0	m/h	At N-1. As per MWH. Pilot report suggest <9.5 m/h (Table ES-1)
	Unit Dimensions	14.5	m L	Length
		5.6	m W	Width
		1.5	m	GAC depth. As per MWH and Pilot range
		0.4	m	Sand media depth. As per MWH and Pilot
		0.35	m	Support media depth. As per Pilot
		2.00	m	Water depth over media. As per MWH
		463	m^3	backwash volume per wash. Equal to 3 bed volumes to waste as per MWH
		625	m^3	upwash volume required per wash incl refilling filter. As per MWH
		463	m^3	Filter to waste volume per wash. Based on 3 bed volumes as per MWH
Chlorine Contact	2	No		
		30	minutes	Chlorine contact time
		120.0	MLD	Design Flow per contactor = 75% of total flow at N-1(BODF 7.1.10.2)
		4167.7	m^3	Volume per contact tank @ 60% baffle factor as per MWH. More conservative than BODF 7.1.10.2
		7	m D	Water depth as per MWH
		595	m^2	Required active contact area per contactor
	Unit Dimensions	85.1	m L	Length
		7	m W	Width
Treated Water Tanks				
	2	No		
		15	minutes	"nominal" contact time at 75% total flow (BODF 7.1.13.2)
		120.0	MLD	75% of total flow at N-1 (BODF 7.1.13.2)
		1250	m^3	Volume per tank
		7	m D	Water depth as per MWH
		179	m^2	Active area per tank
	Unit Dimensions	25.5	m L	Length
		7	m W	Width
RESIDUALS MANAGEMENT				
DAF De-aeration Tanks				
	2	No		BODF 7.3.3.2
		4	hours	capacity per tank to hold float
		0.88	MLD	daily float discharge. From Flow sheet tab.
		146	m^3	capacity per tank
		0.6	m	freeboard
		4.4	m W	Width
		11.0	m L	Length
		3.0	m D	Depth
BAC Upwash Tanks				
	2	No		BODF 7.1.9.3
		625.2	m^3	Upwash volume per wash. As per MWH
		937.9	m^3	Volume per tank. Equal 1.5 washes - equiv to 75% requirement elsewhere.
	Unit Dimensions	14.5	m	Width
		36.3	m	Length
		1.8	m	Depth
		0.3	m	Freeboard
Washout Balance Tanks				
	2	No		BODF 7.3.1.2
		462.8	m^3	Backwash volume per wash. As per MWH
		694.3	m^3	Volume per tank. Equal 1.5 washes - equiv to 75% requirement elsewhere.
		7.6	m	Width
		21.8	m	Length
		4.2	m	Depth
		0.3	m	Freeboard

Filter-to-waste tanks

2	No		BODF 7.3.2.2
	462.8	m^3	FTW volume per wash. As per MWH
	694.3	m^3	Volume per tank. Equal 1.5 washes - equiv to 75% requirement elsewhere.
Unit Dimensions	14.5	m	Width
	26.9	m	Length
	1.8	m	Depth
	0.3	m	Freeboard

Washout Thickeners

2	No		BODF 7.3.1.2
	7.4	MLD	Daily Design Flow from Flow sheet tab
	231.4	m^3/h	Flow per thickener based on 75% of daily flow. N-1. As per MWH
	1.5	m/h	Loading rate
	14	m	Diameter

Supernatant Return Tanks

2	No		
	8.1	MLD	Daily Design Flow from Flow Sheet tab
	2	hours	Capacity per tank
	676.8	m^3	Volume per tank
Unit Dimensions	7.7	m	Width
	20.0	m	Length
	4.4	m	Depth
	0.6	m	Freeboard

Sludge Thickener Feed Tanks

2	No		
	0.7	MLD	Daily Design Flow from Flow Sheet tab
	4	hours	Capacity per tank
	123.4	m^3	Volume per tank
Unit Dimensions	6.0	m	Width
	6.9	m	Length
	3.0	m	Depth
	0.6	m	Freeboard

Sludge Thickeners

2	No		
	1.6	MLD	Daily Design Flow from Flow Sheet tab
	6857	kg/d	Max Solids Load per day at 160MLD. Pro-rata from 6000kg/d at 140MLD as per MWH
	50.6	m^3/h	Flow per thickener based on 75% of daily flow. N-1. As per MWH
	214.3	kg/h	Solids per thickener based on 75% of daily solids . N-1. As per MWH
	1.2	$kg/m^2.h$	Solids loading rate (limiting criteria vs hydraulic loading rate)
	15	m	Thickener diameter

Sludge Balance Tanks

2	No		
	0.16	MLD	Daily Design Flow from Flow Sheet Tab
	64	hrs	Capacity per tank, based on BODF 7.3.4.1
	431.8	m^3	Volume per tank. 100% N-1
Unit Dimensions	7.0	m	Width
	20.6	m	Length
	3.0	m	Depth
	0.6	m	Freeboard

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	SUBJECT: Major Equipment Items (160MLD)	CALCULATION No.:
	Rev: 2 Date:	19-Jan-17
	Calc. By: C Gamst Checked:	M Muntisov

MAJOR EQUIPMENT ITEMS

Main Process	No.	Nominal Sizing/Type	Comments
Raw Water Screens	2	Band Screens. Automatic operation and cleansing.	Aperture size to match existing raw water screening aperture sizing. Manuka Road Site only
Raw Water Pumps	5	215 kW pumps 450L/s @ 25m head each	Manuka Road Site only
Recirculating Pump Mixers	2	sets of duty/stdby 5 kW pumps reinjecting back into main through orifice jets	Alum dose points
Flocculators	18	2 kW each	9 trains x 2 stages
DAF			
DAF Injection System	9	Dispersion valve array	One per DAF tank
DAF Recycle Pumps	12	22 kW pumps 22L/s@60m head each	2 banks of 5 pumps plus 1 standby per bank. Gives turndown to 25% and satisfies intent of BODF 7.1.7.3
DAF Compressed Air Supply	2	50 kW compressors	Duty/Standby
DAF Saturators	9	5000L pressure vessels rated at 1000 kPa	One per DAF tank. Loading rate **10 l/m2.s**. Recycle Flow 10% x 175.7 MLD / 9 DAFs = 22.6L/s. Saturator area = 2.2m2. Water depth 1.5m. = Detention time 2.5 minutes. Total height 2.5 m. Overal vessell volume 5.5m3
DAF Sludge scraper	9	One chain and flight scraper per DAF tank	
BAC Filters 16 No x 81m2 each	Total		
Media *BAC*	1948.8 m3	1.5m media depth; prewashed GAC; ES 1.1-1.3mm ; UC<1.4	As per Pilot
Sand	520 m3	0.4m media depth; ES 0.6mm; UC <1.4	
Gravel	455 m3	0.35 m gravels; 1 x coarse sand + 2 x garnet gravel layers	
Plenum Floor and nozzles	16 x 81m2	150mm spacing on nozzles	
Upwash Launders	Typical arrangement		Depends on vendor/design
Upwash Pumps	3	75 kW duty/duty/standby	For 50 m/hr @10m head
Air Scour Blowers	2	175 kW duty/standby	MWH
Ozone			
Oxygen Preparation System	2	Duty/Standby VPSA system complete each @7500kg/day O2 production	3.3mg/L x 174.8MLD /8% ozone concentration = 7200 kg O2 feed
Ozone Generators	3	x 12 kg/h each (2 duty/1 standby)	
Ozone Destruct	2	thermal catalytic units / duty/standby	
Ozone Sidestream injector system pumps	4	30 kW ea - 1 set of duty/standby pumps per injector	10% flow for O3 dose of 3.3mg/L, 8% O3, and G:L of 0.3 [Fig 4.46] 10% x 50% x 174.8MLD = 8.74MLD = 101L/s@25m
UV (Advanced Oxidation - Future)			
Treated Water Pumps			
Chemical Systems			
Alum			
Bulk Storage Tanks	2	x 120 kL tanks [30 mg/L x 160 MLD x 30d = 144t/46%/sg1.3= 240kL]	BODF 7.2.3.2
Day tanks	2	x 8 kL tanks [30 mg/L x 160 MLD = 4.8t/46%/sg1.3= 8kL]	
Dosing Pumps	2	duty/standby with dedicated dosing lines each	
Polymer			
Flocculant Aid	1	Powder Hopper plus two batch tanks, two day tanks; duty/stdby dosing pumps	
Thickening Aid	1	Powder Hopper plus two batch tanks, two day tanks; duty/stdby dosing pumps	
Dewatering Aid	1	Powder Hopper plus two batch tanks, two day tanks; duty/stdby dosing pumps	
Chlorine			
Drums	2	Rooms each with 4 x 900kg drums	BODF 7.2.6.2
Chlorinators	4	represents 2 x duty/standby chlorinators (total)	BODF 7.2.6.3

Lime			
Lime Silo	2	x 30t silos [12.5mg/L (BODF 7.2.1) x 160MLD x 30d = 60t]	BODF 7.2.2.2
Batch tank	2	x 30kL tanks [20mg/L x 140 MLD =2.8t/10% = 28t]	BODF 7.2.2.2
Dose Tanks	2	2 x 2 kL tanks for post lime; 2 x 0.5 kL for pre-lime	BODF 7.2.2.2
Dosing Pumps	4	represents 2 x duty/standby sets (1x pre, plus 1 x post)	
Fluoride			
Bulk tanks	2	x 10 kL[0.7mg/L x 160 MLD x 30d = 3360kg/16%/sg1.2 = 17.5kL]	BODF 7.2.7.3
Day tanks	2	x 600L [0.7mg/L x 160 MLD = 112kg/16%/sg1.2= 580L]	BODF 7.2.7.3
Dosing Pumps	2	duty/standby pumps	BODF 7.2.7.3
Carbon Dioxide			
Refrigerated Storage Vessel	1	x 14t [6 mg/L x 160 MLD x 14d = 13,440kg]	BODF 7.2.1; Depends on CO2 supplier
Evaporators	2	x 60 kg/hr duty/standby	Max dose 8.5 mg/L
Gas Feeders	2	x 60 kg/hr duty/standby	Max dose 8.5 mg/L
Bisulfite (if required)			
Hydrogen Peroxide (provision for future Peroxone)			
Bulk Storage Tanks		0.5mg/L x 153 MLD x 30d = 2300kg/35%/sg 1.15 = 6000L	Space only
Day tanks		200L	
Dosing Pumps			
Underground Chemical Spill Tank	1	12 kL - max tanker compartment size	
Residuals Management			
Washout thickeners	2	each thickener 13m diameter including, floc chamber, mixer paddles, floor rake, launders	
Sludge Thickeners	2	each thickener 14m diameter including, floc chamber, mixer paddles, floor rake, launders	
Filter Presses	2	x 25kL/hr max of 3% solids for screw presses (duty/standby) OR ~ 10 kL/hr of 3% solids for 24 hr/d operation of Ishigaki presses (duty/standby)	Equates to 6000 kg/d. Workhours operation only (BODF 7.3.4.1)
Other Residuals Management Pumps and Mixers			
			Mixers ~5W per m3
Washout Balance Tank Mixers	2	4 kW submersible mixers	One per tank
Washout thickener feed pumps	2	15 kW open impeller	1.5(peak) x 6.4MLD x 10m
Filter to Waste Return Pumps	2	22 kW centrifugal	1.5(peak) x 6.4MLD x 15m
De-aeration tank mixers	2	1 kW submersible mixers	One per tank
De-aeration tank pumps	2	3 kW progressive cavity	2 (peak) x 0.8 MLD x 10m
Supernatant return pumps	2	30 kW centrifugal	1.5(peak) x 7.1MLD x 20m
Sludge Thickener feed tank mixers	2	1 kW submersible mixers	One per tank
Sludge Thickener feed pumps	2	5 kW open impeller	1.5(peak) x 1.4MLD x 10m
Sludge Balance Tank Mixers	4	2 kW submersible mixers	Two per tank
Sludge Filter Press Feed Pumps	2	5 kW progressive cavity	1.5(peak) x 25m3/hr x 20m
Attenuation Storage return pumps	2	15 kW open impeller	6 MLD (2 days to empty) x 20m
Electrical			
Standby Diesel Generator	1	2.5 MW	Based on MWH report

Appendix B – Shortlist Site Layout Drawings

REFER APPENDIX F - SITE PLANS

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