# Southwest Wastewater Servicing – Wastewater Treatment Plant – Indicative Design and Operational Report

PREPARED FOR WATERCARE | AUGUST 2023

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Stantec

Revision schedule

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# Quality statement

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# Acronyms / Abbreviations

| Acronym | Description |
|---|---|
| ASR | Activated Sludge Reactor |
| ADWF | Average Dry Weather Flow |
| BGL | Below Ground Level |
| ECI | Early Contractor Involvement |
| FOG | Fats, Oils and Grease |
| m | meter |
| $m^3$ | Cubic meters |
| MBR | Membrane Bioreactor |
| NoR | Notice of Requirement |
| OCF | Odour Control Facility |
| PE | Population Equivalent |
| RAS | Return Activated Sludge |
| SCADA | Supervisory Control and Data Acquisition |
| UV | Ultraviolet |
| WAS | Waste Activated Sludge |
| WWTP | Wastewater Treatment Plant |

# Glossary

| Enter Term | Enter Definition |
|---|---|
| **Activated Sludge Reactor** | A multi-chamber reactor unit that uses highly concentrated microorganisms to degrade organics and remove nutrients from wastewater. |
| **Inlet Works** | A combination of pre-treatment processes located at the inlet of the treatment plant, typically including screening for removing large debris and particles, FOG (fat, oil, and grease), and grit. |
| **Permeate** | Refers to membrane-filtered wastewater in this report. |

# 1 Project Background

This indicative design and operational report has been prepared for Watercare Services Limited (**Watercare**) in relation to its proposed Southwest Wastewater Treatment Plant (WWTP), which will be a new sub-regional wastewater treatment facility to provide for predicted population growth in the Southwest Growth Area ( which includes the communities of Waiuku, Clarks Beach, Glenbrook Beach, and Kingseat).

# 2 Purpose of Report

This report describes the proposed WWTP activities, providing a foundation for technical assessments supporting the Notice of Requirement (NoR) to designate the land for the WWTP and associated activity at 372 Glenbrook Beach Road, Glenbrook, Auckland. The report provides an understanding of:

- Potential appearance of the facility – above ground;
- Typical operations generating traffic, noise and odour;
- How stormwater on the site is likely to be managed;
- Ecological impacts and mitigation thereof;
- Likely staging of the facility's development to cater for planned growth;
- Materials stored; and
- How the facility will be powered.

The concept drawing included in Figure 1 shows an indicative facility layout that includes the basic elements of the works. The basic elements of the works described in this report are based on assumed unit processes within the WWTP. The actual elements may change due to process selection and technology developments both in the initial stage and in the future. The identified site constraints are shown in Appendix A.

Indicative buildings and their potential height, areas of excavation, and changes in ground level are described.

The construction and operation of the facility interact with the environment and neighbouring community. Aspects of these relationships will be covered in this report to provide context for multi-disciplinary relationships of the technical specialist investigations.

The following topics are described in Sections 3 and 4 :

- Overview of the Concept Design and key requirements.
- Outline of its operation.
- Any technical considerations in relation to the site.
- Physical constraints that have been taken into consideration.
- Road and internal roading connection requirements.
- Lighting.
- Treated water storage.
- Safety, security, and environmental management.
- Landscaping.
- Construction outline - including key stages of work (earthworks, installation, establishment, commissioning) and what they will involve.

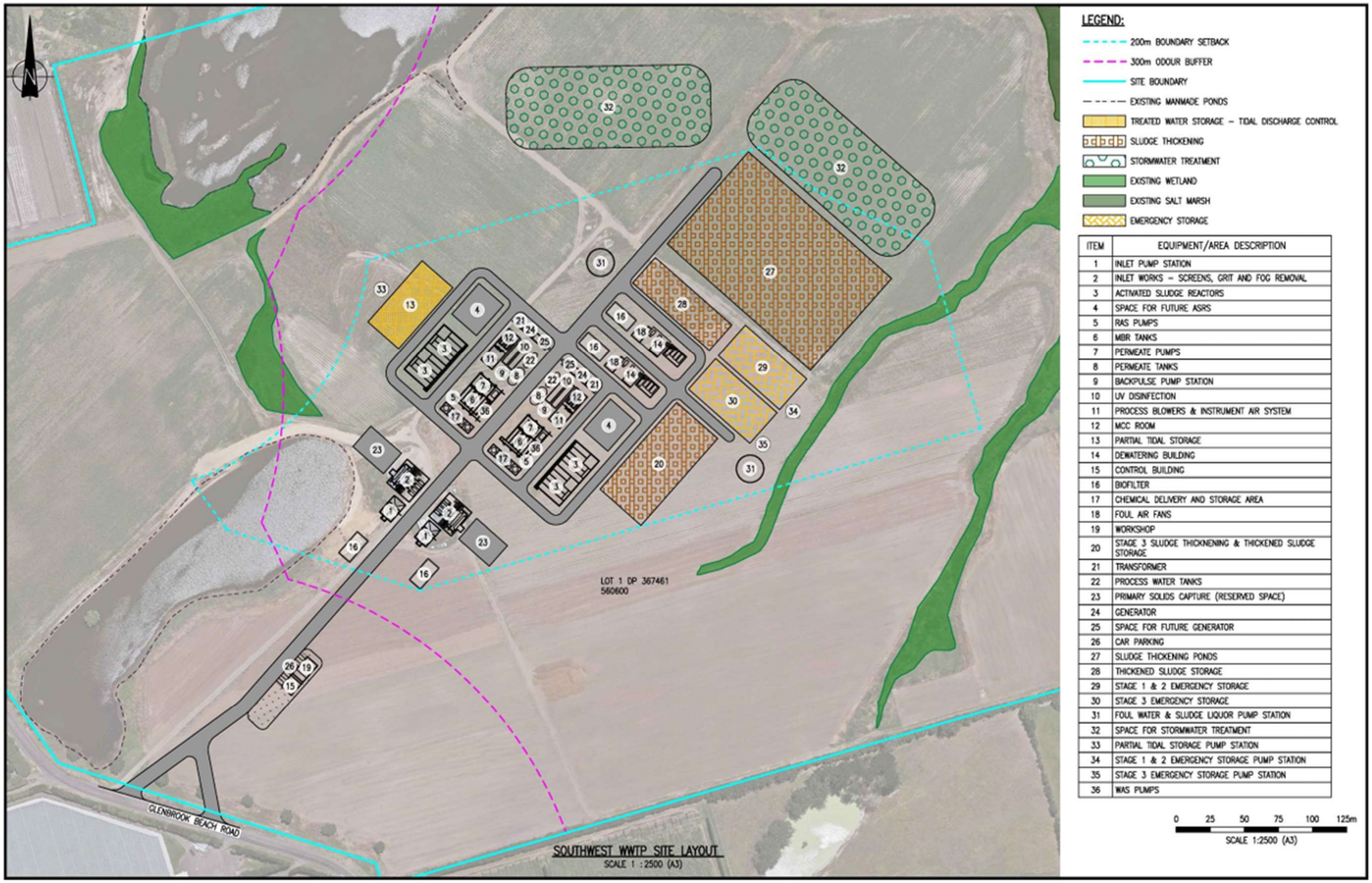


**Figure 1: Indicative Configuration of Southwest WWTP**

*Note: The boundaries of the site are not fully shown for clarity of the considered improvements. Please refer to Appendix A for the complete site boundaries and the constraints, e.g., 300m odour buffer, wetlands, etc.*

# 3 WWTP Activities

Activities associated with wastewater treatment are described briefly in this section. The general appearance of the site is described, while the activities of staff and support services are described to explain aspects of the plant management and operation.

## 3.1 Unit Process Areas

The WWTP comprises several unit processes, as shown in Figure 1. Wastewater from the served communities is pumped into the plant and undergoes pre-treatment, secondary and tertiary treatment. In this facility, the treated wastewater will be temporarily stored on-site and moved to additional storage located at the existing Clarks Beach WWTP site before being discharged at the consented tidal outfall in the Waiuku River mouth.

One option for processing sludge generated by the biological process is for it to be stored in new covered lagoons on-site and dewatered periodically on-site, and while the option is discussed in this report, other options for processing sludge will be considered as part of the detailed design process.

Dewatered sludge will be removed from the site to a suitable reuse or disposal location. This may include Hampton Downs landfill or a vermicomposting facility. The liquid separated out from the sludge dewatering processes will be returned to the plant inlet to receive full treatment.

There are several services that support the treatment process, such as chemical dosing, odour treatment, electrical supply, and fire-fighting water storage. These services form part of the overall facility management.

## 3.2 Description of Activities

### 3.2.1 Staging of the Facility

Stage 1 of the Southwest WWTP will be constructed to service a Population Equivalent (PE) of 20,000, followed by an upgrade to increase the capacity of the Southwest WWTP to 30,000 PE as Stage 2 (predicted to be in around 2032), with Stage 3 increasing capacity to 60,000 PE estimated for around 2050.

Internal access roads and other core essential services to operate the plant will be provided in Stage 1, and as growth occurs, additional assets will either be constructed or replaced at the end of asset life to meet higher operating duties.

The legend for Figure 1 identifies where proposed components relate to Stages 1, 2 and 3.

### 3.2.2 Power, Chemicals, and Materials Stored

#### 3.2.2.1 Power Supply

There is no existing networked power supply at the site. Power will be provided from the Glenbrook feeder with redundancy from the Waiau Pa feeder. For Stage 2, a separate feeder from a new substation in Kahawai Point will be installed. This provides a high resilience power for the treatment process. On-site generation backup will be provided to keep the plant operational during a power failure.

#### 3.2.2.2 Chemicals

Reverse pulse backwashing and air scouring will be used to prevent solids from adhering to the membrane fibres and extend the periods between chemical cleans. The treatment process requires specific chemicals to maintain process performance. Membrane fouling is managed with two chemicals, usually citric acid for membrane fibre acid washes and sodium hypochlorite for membrane disinfection.

Sodium hypochlorite will be used when recycled water is required for on-site washdown or for beneficial reuse. The recycled water will be taken from UV-disinfected membrane permeate (filtered water) before being injected with sodium hypochlorite to minimise the risk of generating disinfection by-products. The residual hypochlorite in the recycled water will be consumed by the wastewater within the treatment process.

Potentially, acetic acid will be used in Stage 2 as a food source for the biological nitrogen removal process.

## 3.2.3 Constraints: Traffic, Noise, and Odour

### 3.2.3.1 Traffic

Once operational, the facility will have a small number of operational staff who attend the site daily or whenever maintenance is required, while less frequent deliveries of chemicals are needed, usually on monthly cycles. Screenings and grit removal occurs on a more regular basis and is usually weekly.

It is anticipated that traffic movements generated by these staff will take place during working hours (7:30 am – 4:30 pm) on weekdays to avoid weekend site activities. It is anticipated that night maintenance will only occur when emergency attendance is required and cannot wait until daytime working hours.

Operational staff complement varies, but a WWTP of this size (all stages) and complexity would usually have two duty operators supported by process engineers and a plant manager. Small vehicular traffic movements would be in the order of ten to twenty a day, while chemical deliveries would be planned for once-a-month delivery of the two main chemicals held on site. The chemical trucks are of the 10 to 20-tonne capacity and require surfaced roads with adequate turning circles to manage chemical off-loading.

Maintenance staff will attend the site at irregular intervals but wouldn't increase traffic flow above the expected numbers.

### 3.2.3.2 Noise

To minimise noise levels and ensure compliance with permitted activity noise levels in the Auckland Unitary Plan (AUP) large equipment, such as aeration blowers, will be housed within acoustic enclosures inside buildings. Mixers will be submerged. Pumps will either be low-noise types or submerged or housed in buildings. Other types of mechanical equipment (especially centrifuges) will be housed in buildings to limit ambient noise pollution.

Table 1 shows the noise level limits included in the AUP. Noise limits are applied to the facility, and the design and selection of equipment will ensure compliance with the statutory requirements.

**Table 1: Noise Levels in the Rural – Mixed Rural Zone or the Rural – Rural Coastal Zone**

| Time | Noise Level |
|---|---|
| Monday to Saturday 7am – 10pm | 55 dB $L_{Aeq}$ |
| Sunday 9am – 6pm | |
| All other times | 45 dB $L_{Aeq}$<br>75 dB $L_{AFmax}$ |

### 3.2.3.3 Odour

Following the initial assessment of the site through the Alternative Site Location Assessment process, a constraints plan has been developed that demarcates the 200-m site boundary separation distance and the 300-m distance from potential odour receptors (existing dwellings) that are around the WWTP site. Please refer to Appendix A for the odour buffer lines.

Odour will be managed through the design and management of the network and treatment plant. Chemical dosing within the network ensures that sulphides remain in the liquid phase and are only released at the inlet works.

Adverse odour missions associated with wastewater activities will be managed and mitigated to ensure that no odour gas reaches the existing dwellings. The highest risk of the unit process causing odour issues is the inlet works. It will be managed by covering all channels and openings and ventilating the polluted air space (negative pressures are achieved in the air space) so that all odorous air is removed and treated in an Odour Control Facility (OCF). Intermittent sewage flows associated with high sulphide emissions will be treated with biological filters, avoiding high chemical demand associated with chemical scrubbers.

## 3.2.4 Stormwater Management

The Southwest WWTP facility will have large areas of impervious surfaces, which will increase localised runoff. Any polluted surfaces will be bunded with flows diverted into the secondary treatment process. Chemical delivery areas will be bunded and isolatable to reduce the risk of stormwater runoff being contaminated by chemical spills. Stormwater from remaining hard surfaces will be collected and diverted to an artificially constructed wetland prior to being released to the natural streams and wetlands. The two areas shown as item 32 in Figure 1 are alternative locations for the artificial wetland, i.e., only one artificial wetland will be constructed.

Parts of the site have under-drains that were previously used to prevent water-logging on arable land. With the change in land use activity, it will be necessary to manage the flow from these drains where construction takes place. To support seasonal stream flows, subsoil drainage will be redirected to natural drainage channels on the site.

### 3.2.5 Ecological Features

An initial ecological assessment of the site shows that there are natural inland wetlands, salt marshes and, in certain instances, areas that could support a wetland environment. These areas have been mapped and factored into decision-making on treatment plant location. The development of the treatment facility will avoid these features and ensure that a suitable separation distance is maintained between the existing wetlands and the coastal edge.

### 3.2.6 Appearance of the Facility

The treatment facility will include structures, plants, equipment, and water and sludge storage lagoons. The operational requirement for structures is that they are constructed above ground to facilitate safe access into the structures for maintenance and asset renewal work. The inlet works could be 6-m above ground level, the highest structure on site, followed by the activated sludge reactors (ASRs) that would be around 5.6-m above ground level. The control building and other equipment buildings will be of similar height.

Following an initial assessment of the site, it was confirmed that the WWTP, especially the inlet works and ASRs, are visible from the north side and the section of Glenbrook Beach Road adjacent to the site. Screening by planting trees in certain areas will be provided to mitigate the visual impact. There is sufficient space around the boundary of most of the site for planting.

## 3.3 Services

### 3.3.1 Control Building, Workshop, and Reception

The control building will be the reception facility for all visitors and contractors arriving on site. It will be the operational staff facility (control room, office, lunchroom, and bathroom). All activities and the treatment process are controlled from the control room. A workshop is provided for maintenance of equipment that can be done on-site.

### 3.3.2 Power Supply and Controls

Power will be provided from the Glenbrook feeder with redundancy from the Waiau Pa feeder. The power supplier (Counties Energy) has confirmed there is sufficient capacity for Stage 1 from the power grid. For Stage 2, a separate feeder from a new substation in Kahawai Point will be installed.

Transformers fed from the power grid will reduce voltage and distribute it within the treatment plant switchboards, with electrical control rooms managing the distribution of power across the site. All switchboards will be in the switch room, while subsidiary distribution boards will be in associated plant rooms. Site lighting will be necessary for attending to maintenance at night for the control equipment areas with automatic switches. Monitoring, control, and telemetry requirements for the plant Supervisory control and data acquisition (SCADA) system will be housed in the control building.

## 3.4 Pre-treatment

### 3.4.1 Inlet Facility

The proposed inlet facility at the Southwest WWTP includes an inlet pump station to receive wastewater from communities and pump it to the inlet works. From there, the wastewater will gravitate through a set of primary screens to remove larger solids. The wastewater then gravitates to a grit removal unit to take out finer grit and inert solids, then to a set of fine screens before the biological nutrient removal unit processes. The solids taken out from the grit and screening units will be washed, compacted, and sent to a local landfill for disposal.

### 3.4.2 Emergency Storage Facility

Covered emergency storage tanks will be located on-site to receive emergency overflows or temporarily bypassed flows should the treatment processes experience an unexpected breakdown. The emergency storage tanks will be covered with air being sucked into the on-site odour treatment system to avoid odour emission.

## 3.5 Secondary Treatment

### 3.5.1 Biological Nutrient Removal

The secondary treatment process aims to remove nutrients, such as nitrogen from wastewater to protect the receiving environment. It takes place within Activated Sludge Reactors (ASR), divided into four zones, with pre-anoxic and post-anoxic zones being unaerated to promote nitrate uptake. The aeration zones oxidise ammonia to nitrite and nitrite to nitrates, while the internal recycle from the aeration zones to the pre-anoxic zone recycles nitrate-rich wastewater back to the anoxic zones to promote nitrogen removal.

### 3.5.2 Blowers

Blowers will provide oxygen in the aeration zones. The blowers will be housed in soundproof buildings with acoustic enclosures to limit noise to within normal speech levels, i.e., less than 74dB.

### 3.5.3 Odour

Odour may be expected from the anoxic zones if conditions become anaerobic. These emissions will be assessed to determine the odour profile of the treatment process. Mitigation measures may be recommended.

### 3.5.4 Membrane Filtration

The membrane bioreactors (MBR) will comprise a series of tanks containing hollow fibre membrane cassettes, which reduce solids content in wastewater by separating sludge from the treated wastewater. Treated wastewater will pass through the hollow fibres and be discharged as permeate to the outfall storage tanks, while the sludge remains in the MBR tank as concentrated mixed liquor, which is recycled periodically as return activated sludge (RAS) to the ASRs. Maintenance cycles such as backwashing, relaxation scouring, and recovery cleaning will also be conducted. Backwashing will involve reverse pumping permeate (filtered wastewater) through the membrane hollow fibres to dislodge solids from the surface, while the membrane fibres are scoured by diffused aeration and coarse bubbles to dislodge solids and maintain aerobic conditions.

## 3.6 Tertiary Treatment

### 3.6.1 Disinfection

Ultraviolet (UV) disinfection will be the final treatment process to disinfect the filtered wastewater before it is conveyed to the outfall in the Waiuku Channel. UV light will be dosed at a specific UV intensity proportional to the measured wastewater flow and transmittance to destroy remaining pathogens. The discharge consent for the outfall, as outlined below, will dictate the maximum daily volume of treated wastewater that can be discharged.

### 3.6.2 Process Water Facility

A small portion of the UV-disinfected membrane permeate (filtered wastewater) will be dosed with sodium hypochlorite to provide residual disinfectant for process water uses, such as flushing the screens and washdowns.

## 3.7 Sludge Handling

### 3.7.1 Sludge Thickening Ponds

Waste activated sludge (WAS) derived from the MBRs will be stored in covered sludge storage ponds to accumulate, thicken, and stabilise prior to mechanical dewatering. The proposed handling of sludge at Southwest WWTP is to store the sludge in a series of lagoons to store and buffer waste sludge and allow thickening to occur. The process of thickening in consecutive ponds reduces the time to dewater the sludge and allows a higher dewatered product to be achieved. This will result in fewer truck movements being required to manage sludge at this site.

### 3.7.2 Sludge Dewatering Centrifuges

Thickened sludge from the sludge thickening ponds will be pumped to centrifuges for dewatering to reduce the volume and weight of the sludge (residual biosolids).

The centrifuges will be installed inside a dewatering building. The centrifuges will be connected to the odour abstraction fans to create a negative pressure inside the centrifuges to avoid odour emission.

The dewatered sludge will be stored in storage bins (~20m$^3$ each) sized to accommodate three days of sludge production at the peak month loading rate before being issued to landfill. The bins will have a low profile (lower than 2.5m) and can be lifted and transported with a waste collection truck.

The liquid separated from the sludge by the centrifuges will be returned to the inlet of the WWTP to undergo full treatment.

# 4 Construction Methodology

## 4.1 General

In constructing the WWTP, it is the intention to minimise earthwork volumes and reduce time on-site wherever practical. Recommended measures are listed below (not exhaustive):

- Utilise the natural ground profile and locate the treatment processes at appropriate contours to minimise earthworks and eliminate retaining walls whenever practical.
- Prefabricate panels, tanks, equipment skids, and building components off-site.
- Locate all the odour-prone processes outside the 300-m odour buffer zone and at least 200-m away from the property/site boundary. See Appendix A and Figure 1.
- Retain the northern artificial pond for farming use.
- Retain all or most of the southwest artificial pond.
- Retain all the existing natural wetlands and include stormwater design to enable sustainably feeding the wetlands.

## 4.2 Geotechnical

Based on the Tonkin and Taylor Southwest Wastewater Pump Station Options Study dated May 2022, the following will be considered:

### 4.2.1 Geological Context

The findings from the preliminary desktop geotechnical assessment show that the overall geology presents the following risks:

- Soft compressible soils in shallow layers with variable depth to rock for structures to be founded on competent material.
- Ash in the upper soil material has the potential to be sensitive and require drying out prior to emplacement and compaction.
- Pumice in the soil will degrade with a potential volume loss when trafficked.
- Sands and silts, once remoulded, will turn to silty clays, which will change the engineering behaviour of the material.
- High water table in low permeability soils.
- Possibility of lava rocks in the vicinity of the WWTP.

The design of all underground structures and pipelines should aim to limit any hydrogeological impacts hence the importance of groundwater monitoring and the assessment of different permeability profiles during the geotechnical investigation.

### 4.2.2 Surface Structures (Pump Stations, Ponds, and Storage)

Targeted geotechnical investigations will be completed for each structure.

- Conventional excavation down to 3m will be possible with the management of sidewall stability, water ingress and residual porewater pressure.
- The design of civil structures will have to balance the low bearing capacity of the upper layer of ground and potential buoyancy from the high groundwater table.
- The network layout, hydraulics and industrial constraints will dictate the base level of most civil structures and pipelines. However, when there is flexibility, a base level of around 2-3m BGL would likely constitute a good compromising guideline for balancing foundation requirements in soft soils and buoyancy considerations.
- For structures deeper than 3 m, the following will need to be considered:
    a) Sheet piles if the investigations confirm that appropriate embedment will not be an issue.
    b) Secant piles are often a misleading compromise as leakage is higher than with sheet piles, and subsequent internal walls are needed as with sheet piles.
    c) Diaphragm walls can provide good water tightness with finished concrete structures and should be economically viable in such geology. Shafts can be hexagonal or square.
    d) For depths down to 7m, a slurry wall or traditionally trenched-based D-wall can be considered as a more cost-efficient alternative or even a slurry trench with prefabricated concrete panels.

e) Base seepage can be controlled by way of deeper cut-offs (Sheet-piles, D-wall), and a grouted (or Jet-grouted) slab could also be envisaged. These options can be validated with a hydrogeological assessment.
f) The deepening of the peripheral Secant piles or D-wall will offer a good way of controlling buoyancy instead of anchors.
g) Anchors or micro-piles should be otherwise considered for buoyancy control, as concrete piles would be less economical.
h) Early Contractor Involvement (ECI) would be a good way to manage risks and optimise the design and costs.

### 4.2.3 Trenched Pipework

Trenching activities will be possible with the management of sidewall stability, water ingress and residual porewater pressure.

# Appendices

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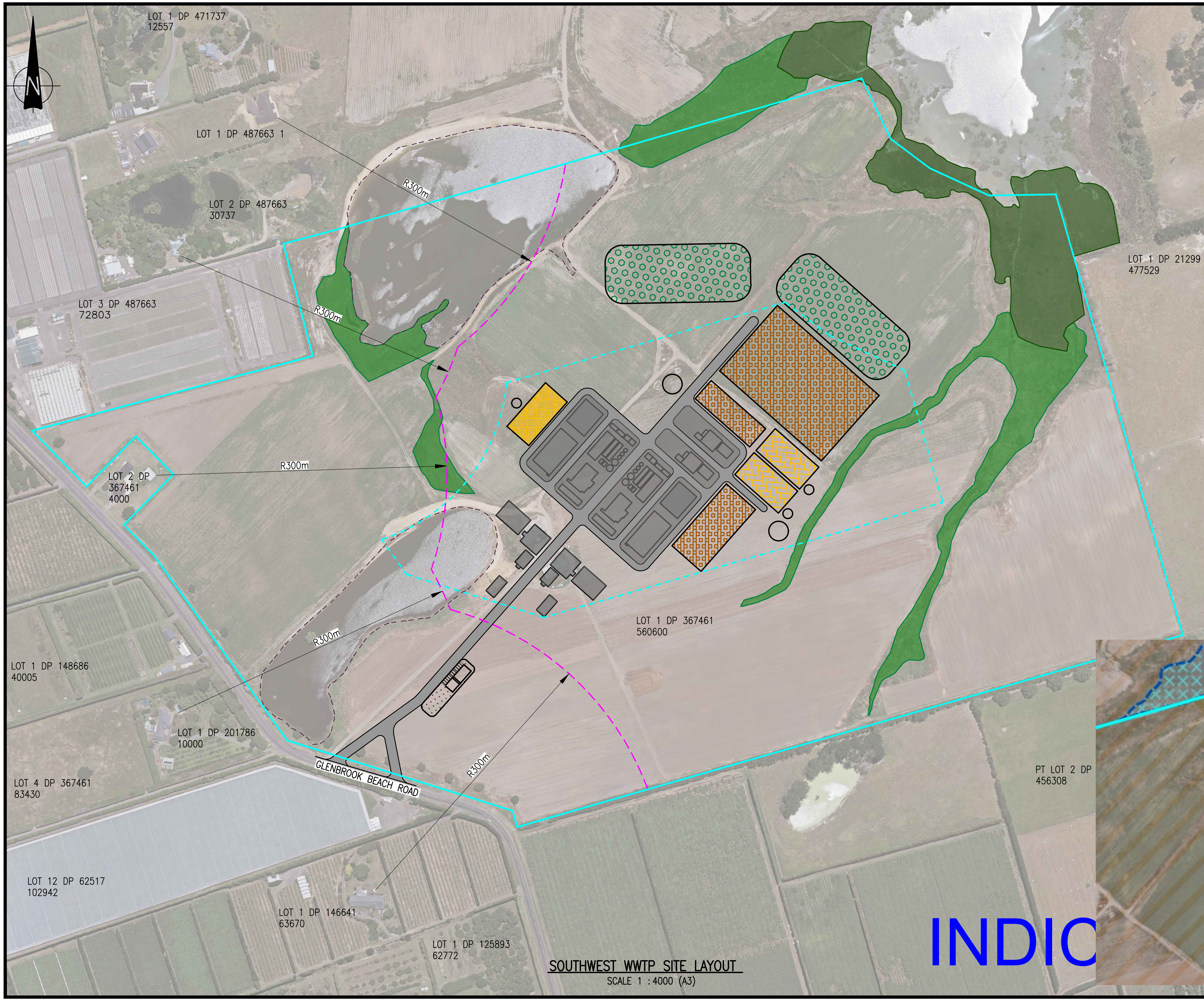
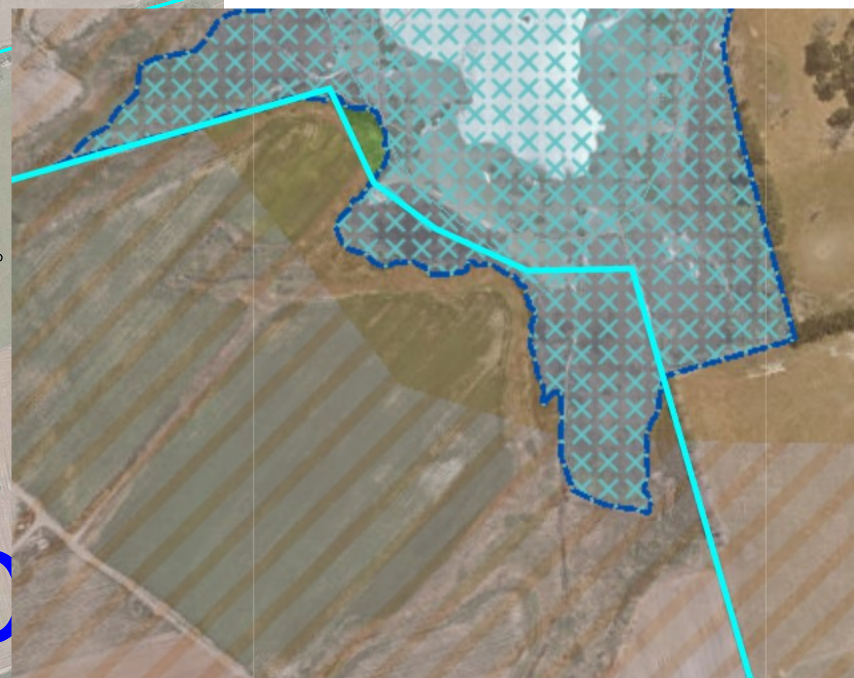
# Appendix A Identified site constraints



SOUTHWEST WWTP SITE LAYOUT
SCALE 1 : 4000 (A3)

## NOTES:

1. THE DIFFERENCES BETWEEN DRAWING 2200001.107 AND DRAWING 2200001.108 ARE THE SITE IMPROVEMENTS.

## LEGEND:

- 200m BOUNDARY SETBACK
- 300m ODOUR BUFFER
- SITE BOUNDARY
- EXISTING MANMADE PONDS
- EXISTING WETLAND
- EXISTING SALT MARSH
- EMERGENCY STORAGE

SITE IMPROVEMENTS

- TIDAL STORAGE
- SLUDGE THICKENING STORAGE
- STORMWATER TREATMENT / PONDS
- ROADING / PAVED AREAS
- PUMP STATIONS

| ISSUE | DATE | AMENDMENT | BY | APPD. |
|---|---|---|---|---|
| B | 19.04.23 | FOR INFORMATION | PG | EM |
| A | 13.04.23 | FOR INFORMATION | PG | EM |

| | | |
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| DESIGN CHECK | C. Wang | 04.23 |
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| CAD REVIEW | C. Wang | 04.23 |
| DESIGN REVIEW | C. Wang | 04.23 |
| STANTEC APPROVED | C. Mellish | 04.23 |

Watercare



Stantec

SOUTHWEST WWTP CONCEPT DESIGN
GLENBROOK BEACH ROAD
PROPOSED DESIGNATION SITE LAYOUT

CAD FILE 2200001.107.dwg
DATE 19.04.23
ORIGINAL SCALE A3 AS SHOWN
CONTRACT No.
REF No.
DWG No. 2200001.107
ISSUE B

# DESIGN WITH COMMUNITY IN MIND

Communities are fundamental. Whether around the corner or across the globe, they provide a foundation, a sense of place and of belonging. That's why at Stantec, we always design with community in mind.

We care about the communities we serve—because they're our communities too. This allows us to assess what's needed and connect our expertise, to appreciate nuances and envision what's never been considered, to bring together diverse perspectives so we can collaborate toward a shared success.

We're designers, engineers, scientists, and project managers, innovating together at the intersection of community, creativity, and client relationships. Balancing these priorities results in projects that advance the quality of life in communities across the globe.

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