WATERCARE SERVICES
HUIA WTP REPLACEMENT & WOODLANDS PARK ROAD RESERVOIR PROJECT

INDICATIVE CONSTRUCTION METHODOLOGY

CONTENTS

FIGURES

REVISION HISTORY

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1 IN BRIEF

Alta has been engaged by Watercare Services Limited (Watercare) to prepare an indicative construction methodology for the Huia Replacement Water Treatment Plant (WTP) and two new reservoirs. Watercare has identified that the existing WTP at Huia has reached the end of its service life and requires replacement to assure continued supply of potable water to the Western Auckland region. The purpose of the methodology is to support Watercare's resource consent application and Outline Plan of Works (OPW), and to provide indicative construction methodologies to inform and assist other specialist reports for environmental impact assessments.

The structures are to be built across three different sites near the intersection of Woodlands Park Road and Manuka Road, Titirangi. The new plant is to have a maximum capacity of 140 mega-litres per day (MLD) and is to be situated adjacent to the existing WTP. A new reservoir of 25 mega-litres (ML) is to be located on the opposite side of Woodlands Park Road (Reservoir 1). After the new plant has become operational, the existing plant is to be decommissioned, partially demolished and another 25ML reservoir is to be constructed on the site (Reservoir 2).

An indicative methodology has been developed within this report outlining a possible construction methodology based on the concept designs that have been developed to date by GHD and Beca. The methodology presented includes description of clearing, site preparation, bulk earthworks, soil retaining structures, construction of water retaining structures, conventional structures, civil works, demolition and commissioning activities.

An indicative programme has also been developed. Construction of the project works, as scoped within this document, is expected to take between 7 and 8 years. This includes approximately 18 months advanced works to enable the North Harbour 2 (NH2) pipeline project[1], four years for construction of the replacement WTP[2] and approximately two years for commissioning of the new plant, demolition of the existing plant, construction of the second reservoir on the existing WTP site, and commissioning of that reservoir.

The methodology and programme have been used to build a schedule of expected construction plant on site and develop a forecast of heavy vehicle movements to and from the site over the duration of the project. These documents have been used to develop traffic and noise assessments by relevant 3rd party specialist technical consultants.

Methods described in this document are representative of probable construction activities based on the current conceptual design. Specific methodology details may change subject to design revision, contractor experience and preferences, industry constraints, and other factors.

[1] The NH2 pipeline project is outside of the scope of this report but enabling works and shaft construction are contained within this construction methodology document.

[2] Reservoir 1 is constructed over a two-year period concurrently with the replacement WTP

2 INTRODUCTION

Alta has been engaged by Watercare to prepare an indicative construction methodology for the Huia Replacement WTP project. Included in the scope of the report is construction of the WTP, shafts to support the installation of a new aqueduct for the NH2 project, a treated water storage reservoir, and partial demolition of the existing WTP and construction of a second storage reservoir on that site.

The structures are to be built across three different sites near the intersection of Woodlands Park Road and Manuka Road in Titirangi. The purpose of this document is to support Watercare's resource consent application and OPW, and to provide indicative construction methodologies to inform and assist other specialist reports for environmental impact assessments.

The indicative methodology provided in this report outlines a possible construction methodology based on the GHD concept design and subsequent design work provided by Beca. This methodology addresses construction of the replacement Huia WTP and reservoirs at a high level for the purpose of providing an indication of construction impacts. It includes an indicative programme, typical sections for construction staging and forecasts for construction plant and traffic movements. While actual construction methods and durations of the project may vary, this report is representative of construction impacts for the purposes stated.

The forecasts, methodology and programme developed for this report have been used as inputs for traffic and noise assessments by relevant technical specialists.

2.1 Project Overview

As identified by Watercare, the existing WTP at Huia has reached the end of its service life and requires replacement to ensure continued supply of potable water to the West Auckland region.

The new plant is to have a maximum capacity of 140MLD and is to be situated adjacent to the existing WTP on the south side of Woodlands Park Road. One new reservoir of 25ML is to be located on the opposite side of Woodlands Park Road (Reservoir 1). This reservoir is required to be operational in order to enable commissioning of the new plant.

After the new plant has become operational, the existing plant is to be decommissioned. Once decommissioned, some structures on the plant are to be demolished and another 25ML reservoir (Reservoir 2) is to be constructed on the site. The two reservoirs together will give the capacity increase of 50ML over the current capacity.

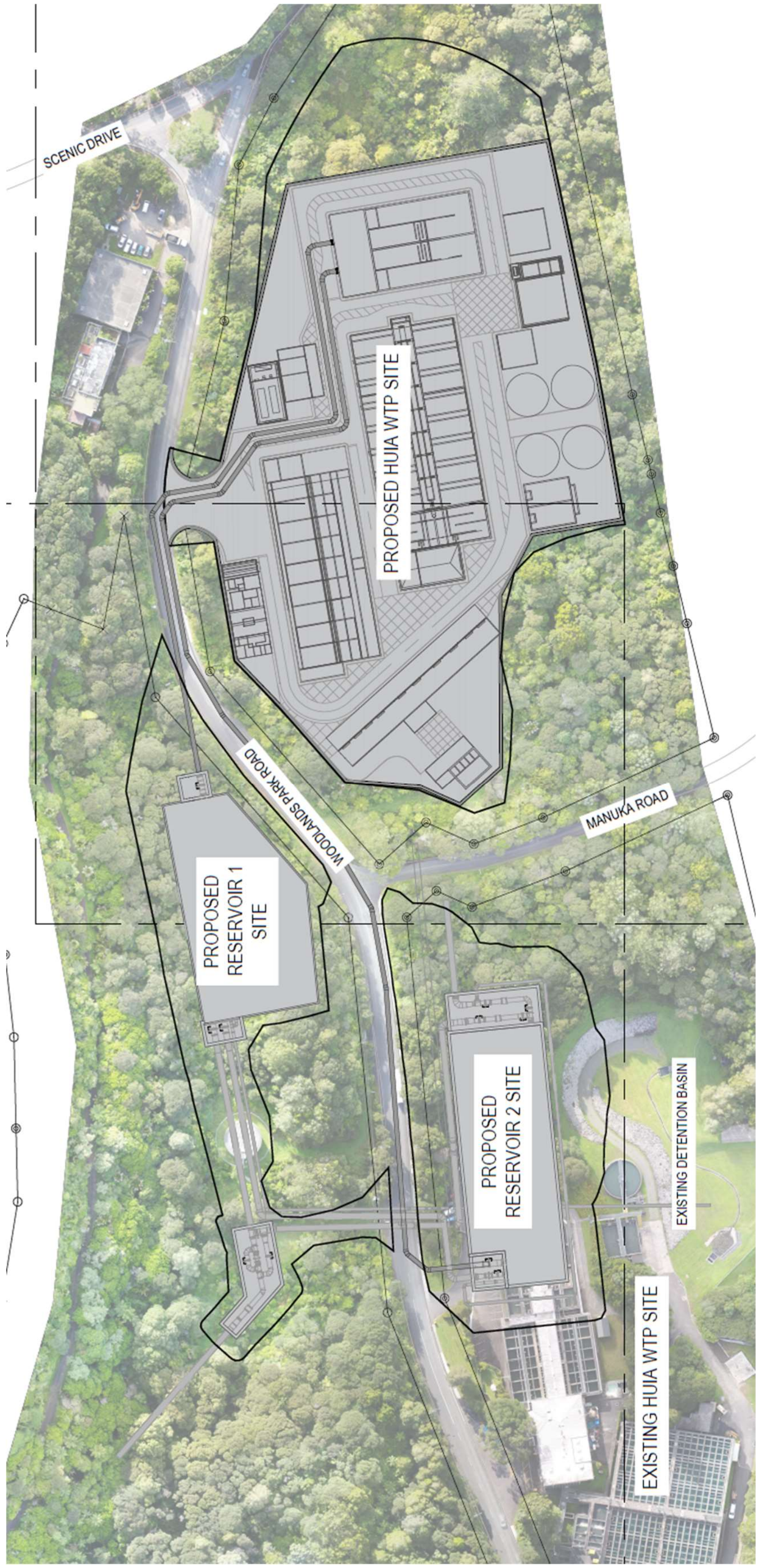


Figure 1 - General Arrangement of Proposed WTP and Reservoirs (Source: GHD dwg: 51-3357505-G001 [2])

3 GENERAL CONSTRUCTION OVERVIEW

This section describes the indicative sequence for construction of the Replacement Huia WTP and Reservoirs. The construction methodology and sequence described in this report is for the purposes of application for resource consents and to provide information required for the Outline Plan of Works (OPW). The final construction methodology and sequence will ultimately be determined by the Contractor once the detailed design has been completed.

3.1 Scope of Works

The indicative methodology is based on the GHD and Beca Concept layouts for the WTP and Reservoirs as per the drawing list in 1.1 Appendix 1 – Document Reference

The construction scope includes the following activities:

- Tree and vegetation removal.
- Site establishment including erosion and sediment control, access and haul roads.
- NH2 pipeline tunnel shafts (at the future Reservoir 1 site).
- Construction shaft for a new raw water intake pipeline.
- Valve chamber construction.
- Retaining wall construction.
- Bulk excavation.
- Engineered fill placement.
- Stream diversion (WTP site).
- Construction of water retaining structures.
- Installation of underground pipework including between the WTP and Reservoir Sites.
- Construction of conventional structures and buildings.
- Installation of specialist mechanical and electrical items.
- Civils, access roads and finishing works.
- Commissioning new WTP.
- Demolition of part of the existing WTP.
- Construct Reservoir 2.

3.2 Construction Sequence

A possible sequence for construction has been prepared based on the concept layouts provided. This is captured within the indicative programme attached to this document in Appendix 2 – Indicative Construction Programme. Below is an outline of the sequence used to develop the programme.

3.2.1 Initial Works

Prior to commencing construction of the Replacement Huia WTP and Reservoirs, the following activities will be completed:

- Survey of WTP and Reservoir sites with the works ecologist and works arborist to define areas to be cleared of vegetation and to identify trees immediately outside of the project footprint which require specific protection measures.
- Vegetation clearance and site establishment of both the new WTP and Reservoir 1 sites.
- Establishment of erosion and sediment controls including clean water diversions.
- Removal and relocation of the existing backwash tank located on the Reservoir 1 site to maintain the existing plant's operation.

- Construct NH2 shaft on the Reservoir 1 site. The shaft will be constructed from bored piles, sheet piles or possibly a concrete caisson.
- NH2 pipeline tunnel constructed via a shaft within the Reservoir 1 site.
- New raw water intake tunnel to Mackie's Rest to be constructed via a shaft within the new WTP site.

Note: this project scope does not include the NH2 or raw water pipeline tunnels. It only includes the shafts / connections associated with the NH2 project (on the Reservoir 1 site) and the raw water pipeline tunnel (on the existing WTP site), as the tunnels themselves form part of a separate project outside of the scope of the Replacement Huia WTP project and is therefore, outside the scope of this document.

3.2.2 WTP Sequence

Construction of the Replacement Huia WTP is expected to occur in the following sequence:

- Site clearing at excavation and fill sites, bulk excavation and any temporary retaining structures are expected to occur first in the project programme.
    - Initial programme focus is expected to be on the excavation at the centre of the site, which is required to enable commencement of construction of the Biologically Activate Carbon (BAC) Filter and Dissolved Air Flotation (DAF) structures.
- Construction of the BAC and DAF commences while the remainder of the excavation is completed for the peripheral structures.
- Perimeter retaining walls and bulk fill progress simultaneously with bulk cut earthworks.
- Inter-process pipework installed concurrently as structures are constructed, and during staged backfill.
- Construction of the main water-retaining process structures[3] progresses as each of the conventional structures[4], offices and process building structures begin.
- Once the conventional structures are completed and most of the main process structures construction has progressed, construction crews will re-distribute resources to construct the ancillary treatment structures[5].
- Mechanical and electrical fitout works across the WTP will begin once there are enough structures completed to allow for continuous work for the mechanical and electrical crews.
- Civil and finishing works such as service installation, roading, stream diversion and landscaping will commence in parallel with commissioning of the WTP.

3.2.3 Reservoir 1 Sequence

Construction of Reservoir 1 is expected to occur in the following sequence:

- Bulk earthworks of the site to create a level construction site. Soil retaining structures constructed as required.

[3] Water-retaining process structures are structures that are watertight and handle large volumes of water, they are typically partially buried and have large amounts of pipework and mechanical and electrical equipment. The structures are principally constructed from concrete elements, precast or cast insitu.
[4] Conventional structures are built for primarily for people to work in. They are usually constructed as a slab on ground with concrete block walls. These structures are for offices and process control equipment and do not handle significant quantities of processed water.
[5] Ancillary treatment structures are water process structures that handle recirculated water off the main process circuit. They are smaller than the main process structures, but there are many to be constructed.

- Perimeter retaining structure is installed (likely to be bored piles).
- Bulk excavation commences, staged as required to allow installation of soil anchors and shotcrete as required.
- Installation of under slab pipework and services.
- Construction of the reservoir concrete base slab.
- Once the reservoir slab works are completed, construction of the reservoir's cast-insitu (or pre-cast with infill stitch poured) walls will commence.
- When the walls have sufficiently progressed, internal columns, beams and roof deck will be installed.
- Finishing works around the reservoir such as fencing, landscaping and construction of access tracks will be undertaken simultaneously with tank commissioning.

3.2.4 Reservoir 2 (located at Existing WTP site) Sequence

The new Reservoir on the existing WTP site is to be constructed following commissioning of the replacement plant. Construction of this new Reservoir is expected to follow the sequence described below.

- Construction and commissioning of the new WTP completed.
- Decommissioning of the existing WTP so that demolition can safely commence.
- Clearing of vegetation in the area required for Reservoir 2.
- Demolition of structures required to make space for the new reservoir construction.
- Bulk excavation and filling of the site to make a level pad for the reservoir.
- Installation of retention structures to support the excavation.
- Ground Improvement to support tank foundation if required. This may include piled foundations.
- Installation of buried pipework.
- Construction of base slab.
- Installation of pre-cast or cast insitu tank walls.
- Construction of internal structure columns, beams and roof slab (likely a mixture of precast and insitu concrete).
- Mechanical fitout and connection to pipelines linking the new Reservoir to the new WTP
- Commissioning of reservoir tank.

3.3 Activity Descriptions

For brevity, the following section relates to the methodology for construction of both the WTP and Reservoirs. Activities specific to each WTP and Reservoir site are identified and discussed in Sections 4-7.

3.3.1 Vegetation Clearance and Tree Protection

The proposed WTP and reservoir sites are currently covered with vegetation which is required to be removed to allow for construction of the NH2 reception shaft, two reservoirs and replacement WTP. Specific measures are proposed below to ensure the retention and protection of vegetation outside of the clearance boundary required for the project.

A vegetation clearance envelope has been prepared for construction. The envelope has been established based on the concept layout of the WTP, Reservoirs, NH2 shaft, and connecting pipework, as well as access requirements to reach the structures during construction, and space required to support construction. For the Reservoir 1 site, the minimum clearance boundary has been shown in the diagram below. This boundary allows access around the structures, as will be required for construction.

The vegetation clearance envelope at the Reservoir 1 site has been determined according to the following logic. The envelope is based on the use of a 70T crawler crane working at the reservoir, which requires a 7m wide access track. This width allows space to enable the crane to track and to slew. The cut into the hillside is assumed to be inclined at 70 degrees to the horizon until it daylights with existing grades. This is a steep batter and will require slope retention to remain stable. Beyond the top of the batter, a further 3m wide clearance area is required to establish a perimeter site fence and a cut-off v-drain at the top of the retaining wall to manage stormwater at the project site.

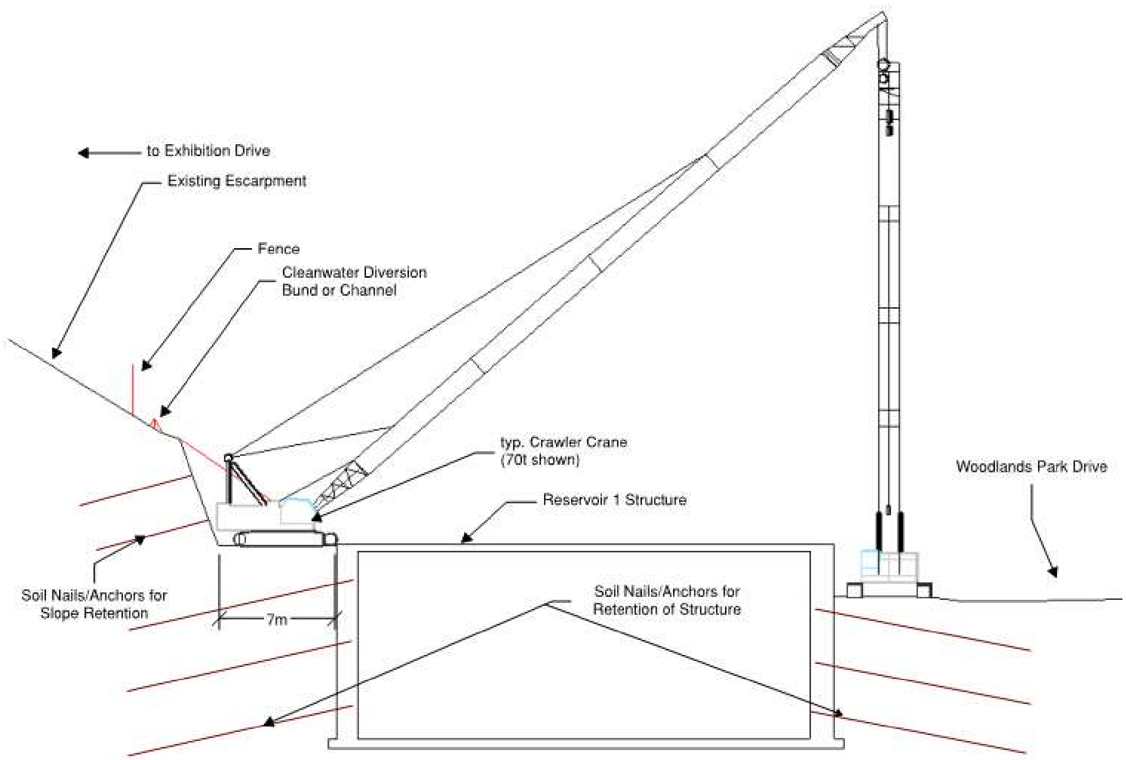


Figure 2 – Reservoir 1 Crawler Crane and Access Track Northern Side Section

To the south-western corner of the Reservoir 1 site, it is assumed that there will be a lesser requirement for access, given that this area will not form part of the main haul route. The retaining walls for the excavation can therefore be built closer to the canopies of the vegetation in this location.

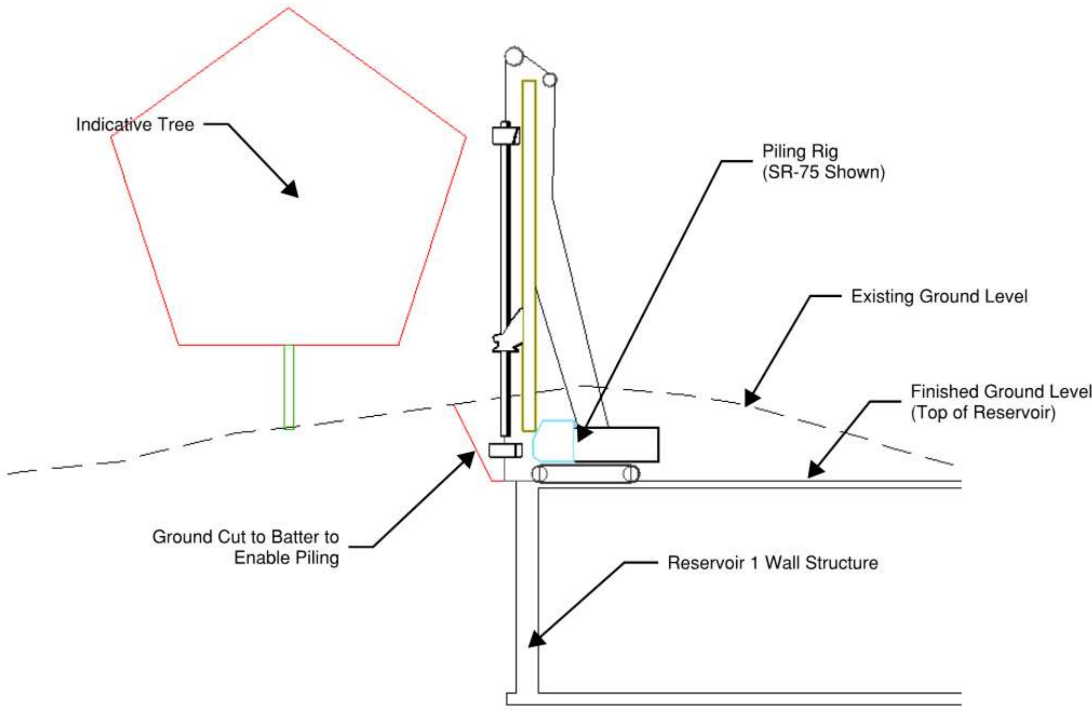


Figure 3 - Piling at Western Side of Reservoir 1 Section

Given that there is limited access around the western side of the reservoir, due to the reason above, larger cranes may be required to construct this corner of the reservoir from an area setback on the site. Refer to section: 0

Reservoir Structure for discussion of possible cranage options.

To the west of the site an area around the NH2 shaft will also need to be cleared. The clearance boundary for this site has been generated based on a 3m offset from the external edge of the permanent structure with a fill grading of 1:1 to the existing ground level.

On the Reservoir 2 site, vegetation will also need to be cleared to enable construction of the pad and associated retaining walls. A 7m wide haul road around the exterior of the structure has been shown with a battered retaining wall and offset similar to Reservoir 1.

Vegetation clearance will be required prior to mobilisation to site to enable establishment of the Contractor's haul roads, site compounds, laydown areas and stockpiles. Due to the density and size of the existing vegetation, large plant such as 20T diggers and large chippers will be required on site to carry out the clearance work.

Plant will mobilise to site on low loaders and trucks. Selected trees will be cleared to establish access tracks around the site. Once the access routes have been constructed, chippers will be established on site to process shrubs and branches. Tree trunks will likely be hauled off site with logging trucks. Stumps will be ground on site and removed, topsoil will be excavated and disposed off-site. All materials leaving site are to be handled in accordance with Kauri Dieback quarantine requirements. Refer to section 3.3.3 Kauri Dieback Hygiene Protocols for details.

3.3.2 Tree Protection Controls

Suitable controls will be required to protect vegetation to be retained outside of the construction footprint. These controls are likely to include:

- Surveyors will set out the extents of the site.
- A suitably qualified and experienced works arborist will be engaged. The site extent will be determined on site in conjunction with the works arborist so that wherever possible individual trees that will not conflict with construction will be retained.
- Trees to be cleared and trees to remain are to be clearly demarcated.
- The works arborist will supervise works near trees that will be retained. The works arborist will be experienced in tree protection systems, and construction methodologies and will coordinate site works to ensure that tree protection controls are correctly implemented.
- Any existing trees adjacent or close to the proposed construction footprint are to be protected throughout the construction works using mesh fencing or similar placed around the drip zones.
- Prior approval from the works arborist is to be obtained for any work required within the root zone or drip line of any tree which is to be retained. This work is to be supervised by the works arborist.
- No material is to be stored in or around the root zone of any trees without the approval of the works arborist. Any material which is stored in or around the root zone of any of the trees will be stored on a temporary hard surface such as plywood sheets or similar.
- When plant or vehicle access/manoeuvring is required in or around the root zone of a tree which is to be retained, detrimental effects to the tree resulting through compaction, physical damage, spillage of lubricants and fuels or discharge of waste emissions is to be avoided. If these activities cannot be avoided, it may be necessary to cover the area with a suitable protective overlay to protect the root zone from disturbance. This is to be assessed

by the works arborist. Protective overlays may include swamp mats, a layer of mulch or sand/SAP7, timber planks, plywood or similar.

- Excavation work required within or in the proximity of the root zones of trees to be retained is to be carried out under the guidance and supervision of the works arborist. Every effort is to be made to retain roots which are 35mm or greater in diameter which are exposed during excavation work. Cutting of any root less than 35mm diameter will only be carried out at the discretion of the works arborist.
- Where roots to be retained remain exposed, those roots will be covered with a suitable protective material (such as moist Hessian cloth, or a wool mulch) to protect them from damage, until such time as the area around the root can be backfilled with the original soil. The wrapping or covering of any roots is to be undertaken by the works arborist, or under their direct supervision.
- If at any point during the works it is necessary to place surfacing materials (e.g. aggregates or asphalt) directly over exposed tree roots, all exposed roots are to be covered with a layer of fine sand (minimum 75mm thick) and a layer geotextile fabric prior to placing the surfacing.
- Site personnel will be briefed on the requirement to adhere to the tree protection protocols as part of the site induction process.

3.3.3 Kauri Dieback Hygiene Protocols

Additional to the Tree Protection Controls, it will be necessary for the contractor to comply with the requirements as defined within the project ecology report. Requirements may need to be updated prior to works commencing to ensure protocols are in line with the latest research and guidelines regarding containment of Kauri dieback.

3.3.4 Site Establishment

After vegetation clearance has been completed, the following establishment activities will be required prior to starting any bulk earthworks or construction of retaining structures on site:

- Establish suitable fencing to delineate the construction footprint.
- Existing services will need to be located, identified, protected and diverted as required.
- Suitable stabilised temporary construction accesses will be formed for each site.
- Initial perimeter sediment and erosion control measures will be put in place (as per Cook Costello ESCP).
- A temporary site compound, storage and laydown area will be set up on both the Reservoir 1 and WTP sites (and later, within the existing WTP site) within the identified construction footprints. Site compounds will likely include a site office, lunch room, portable toilet facilities and lockable storage containers at a minimum.
- Temporary power and water connections to the site facilities will be established.
- Haul roads will be established for the access and movement of construction traffic and plant within the WTP and reservoir site construction footprints.
- Agreed traffic management and controls will be established.
- Emergency spill kits will be stationed on site for use in the event of any oil, grease or chemical spills on site.

3.3.5 Existing Services

There are existing overhead power lines on the Northern side of Woodlands Park Road that will need to be protected throughout the works. Liaison will be required with the utility management organisation to establish any protocols for plant access below the lines and for working within the vicinity of the lines. There may be a requirement to establish an exclusion zone for plant operations along the overhead line corridor.

Auckland Council GIS indicates three services along Woodlands Park Road. These services shall remain live but may need to be relocated or protected during installation of the pipelines for the future WTP to the new reservoir, or for connections between the new WTP and the municipal services.

Other buried services may be present within or adjacent to the sites which the contractor will need to identify, protect or divert during the enabling works. Non-destructive location is to be done using electro-magnetic cable location and ground penetrating radar. The location and identification of all services within construction areas will be required to be identified by pot holing using a small excavator, hand digging or hydro excavation. Existing services affected by the works will be relocated/diverted prior to commencing any retaining or excavation works.

An underground aqueduct currently conducts water from the current Huia WTP, underneath the future water treatment plant site to the Nihotupu filter station. This service will need to be protected during all earthworks and piling to prevent damage.

3.3.6 Initial Access and Stripping

Specific strips of vegetation will be cleared to enable the installation of the initial erosion and sediment control measures and rough access routes. Following installation of erosion and sediment controls, the remaining vegetation clearance will be completed. After the vegetation has been cleared, the contractor will establish site accesses and haul road routes in and out of the proposed reservoir and WTP sites to allow for safe access of construction traffic. Site accesses will be established from the Woodlands Park Road frontage for each site.

Due to the varying contours on both sites, initial earthworks will be required to level the sites to enable the formation of haul roads to a suitable width and gradient for plant and equipment access. Topsoil and any other material unsuitable for reuse will be stripped and disposed of off-site.

3.3.7 Parau Tip Site

Excess spoil may be disposed of at Watercare’s existing sludge disposal site, located approximately 3km by road to the south-west of the WTP site in Parau. Use of the tip site would reduce haulage distances and reduce the number of vehicles passing through the Titirangi township. The volume of spoil that the tip-site is expected to be able to receive is approximately 75,000m3 which would account for a significant amount of spoil generated by both the replacement WTP and the Reservoir 1 excavations.

Indicative traffic counts for 6-wheeler rigid body trucks using the route to Parau have been calculated as part of our traffic demand modelling. Refer to Section: 11.1 - Traffic Demand Modelling

4 REPLACEMENT WTP CONSTRUCTION

The following section provides an indicative methodology for construction of the replacement WTP.

4.1 Raw Water Pipeline Tunnel Shaft

To connect the reservoirs to the WTP, a new raw water pipeline tunnel is required from Mackie's Rest to the WTP site. Construction of the pipeline tunnel itself falls outside of the scope of this document and the current resource consent application and OPW, but the shaft is discussed here as it interfaces with the construction of the WTP and is part of this consent application for the Replacement Huia WTP.

The proposed raw water pipeline tunnel will terminate within the WTP site. The pipeline tunnel is proposed to replace the existing aqueduct. It is proposed that the shaft be constructed prior to construction of the WTP. The pipeline tunnel is likely to be constructed using micro-tunnelling techniques. Once the site is cleared, access tracks and a stabilised area will be established. A shaft will be constructed on site to launch/receive the micro-tunnelling machine. The shaft may be constructed from bored piles, sheet piles or possibly a concrete caisson.

To support tunnel construction, supporting facilities will need to be established around the shaft. As the tunnel is to be constructed before the WTP, there will be ample room available for a hardstand area to support the tunnelling operation. The shaft and associated hardstand area will be constructed within the proposed WTP footprint.

4.2 WTP Site Access & Haul Roads

It is envisaged that the WTP permanent site access way will be established early and used for construction access for the duration of construction. A haul road is to be established following the alignment of the main loop of the permanent access road. This would allow single direction construction traffic circulation within the site during enabling works minimising the need for turning and reversing of construction traffic. Additional to the primary route, the haul road will be extended and adjusted within the proposed WTP footprint during the works to enable the staged construction of the WTP site.

Figure 2 below shows an indicative haul road route for the WTP site. The haul routes provide a one-way circuit and establishes haul routes to most of the site without limiting access to any main process building foundations.

4.3 WTP Site Excavation

Following establishment of a haul road around the site, bulk excavation can commence. For the proposed WTP site it is estimated that 41,500m^3 of topsoil and unsuitable cut material is to be taken off site for disposal during bulk earthworks with 30,400m^3 of imported fill required (Source: GHD: Cut and Fill Thematic Map Platform with Buried Structures Ref # 51-3357505-SK002 [rev. A]). These quantities may be reduced if cut material is determined to be suitable for reuse as engineered fill on site. Should this be the case then suitable excavated cut material will be either stockpiled or moved directly around the site with dump trucks or other suitable plant. Lime or cement may be used for stabilising the retained material.

Earthworks is expected to focus on levelling out the centre of the site to enable construction of the BAC Filter and DAF. These structures are expected to be the longest duration and most intensive to construct, and are therefore likely to fall on the project critical path. In some areas where benching or battering the excavation is not practical, temporary retaining structures (sheet piles or soldier piles) may be used to support the edge of the excavation. Once the initial excavation has been completed the excavation resource will progress to excavation at the periphery of the site.

Figure 4 - WTP Site Layout Plan

4.4 Retaining Structures

The design has been developed to use retaining walls around the perimeter of the WTP site. This minimises tree removal and site clearance outside of the construction footprint that would otherwise be required if batter slopes, as originally proposed, were to be used instead.

It is anticipated that construction of the retaining walls will progress outward from the south eastern corner. Construction of the retaining walls is expected to occur simultaneously with the earthworks.

Retaining wall structural types will vary depending on whether the retaining wall is constructed in fill or cut. The following structure types and methods may vary from the final options selected but are provided to illustrate the general methodology.

4.4.1 Fill Retaining Walls

Fill retaining structures for the WTP site are assumed to be formed by either:

- Mechanically stabilized earth (MSE) walls (with bored piles or soil mix columns below), or
- Bored piles with cast in universal columns (UCs) and precast panels, or similar

Retaining wall construction will commence once the site has been excavated to formation level and suitable site access has been established. The installation of subsoil drainage and backfilling behind retaining walls will be carried out in conjunction with overall bulk filling activities.

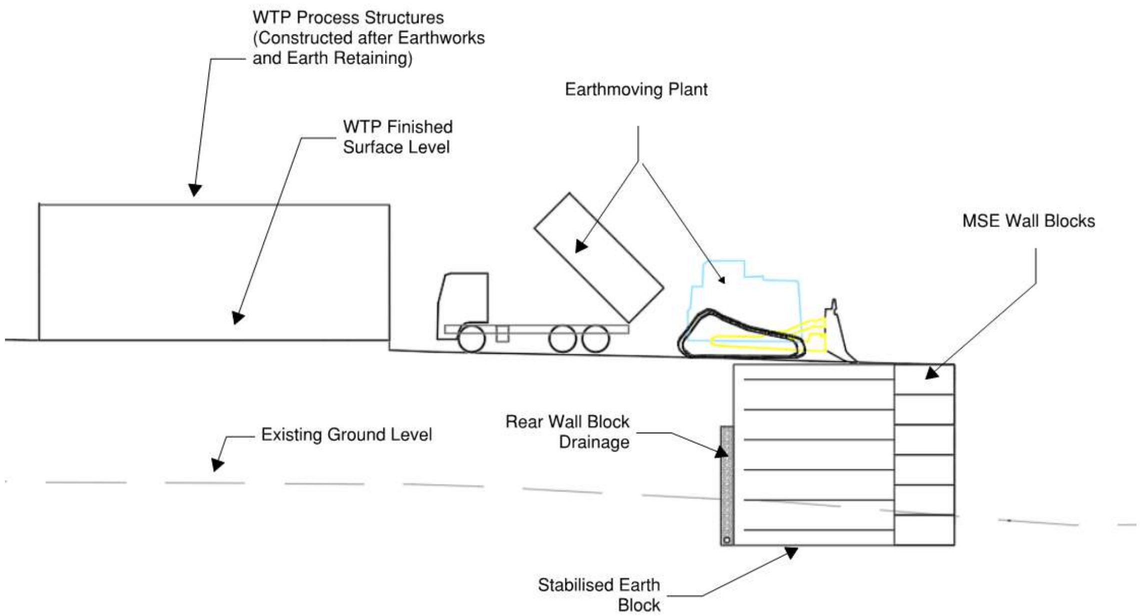


Figure 5 – Typ. MSE Wall Construction Section

4.4.2 Cut Retaining Walls

In the north eastern corner of the site, the existing ground level is higher than the final level. The retaining walls will need to be constructed in a top down method. This method will involve a piling rig working from a temporary access track. The method employed will likely utilise sheet piles or soldier piles, like the reservoir piling method discussed in section 5.4 Earth Retaining Structures.

4.5 Water Retaining and Process Structures

Once a suitable area of earthworks has been progressed the main process structures are to commence. These are water retaining structures, and a large portion of these structures are buried below finished ground level. To construct the below-ground portion of the structures, large excavations will be required. These excavations may require ground improvements or piling for foundation support. Buried pipework will also need to be installed once final levels to the underside of the structures are achieved and will need to be coordinated with the foundation works. This group of structures includes (in order of processing):

- Raw Water Pumping Station
- DAF tank
- Ozone Contact Tank
- BAC filter
- Chlorine Contact Tank

As water is processed through the plant some water is re-circulated to secondary treatment process structures, these include:

- Washwater Clarifiers/Thickeners
- Sludge Clarifiers/Thickeners

These structures also have balancing tanks supporting their function. These are:

- Supernatant Tank
- Washwater Balance Tank
- Sludge Balance Tank

In general, each of these structures will be built using the same construction methods. The main point of difference between each structure is the size, complexity of the individual structural elements, and mechanical plant fitted into each structure at a later stage. Although the construction sequence for each structure is very similar, these factors will affect the duration of construction for each structure.

It is anticipated that a large portion of these structures primary wall systems are to be built using precast tilt-up panel construction techniques. Pre-cast is expected to be selected due to reduced requirements for working area, number of deliveries, and duration of constructionAs such, the major structural components will likely be constructed as follows:

- The base slab (floor) of these structures are to be cast in situ.
- Tilt up precast wall panels are stood on top to form the sides of the tanking structure.
- Walls panels are stitched together and to the base slab with a cast in-situ concrete perimeter beam to complete the wall structure system.

For reference, Figure 6 below shows two typical walls being constructed. One using cast in-situ methods and the other by precast tilt up.

Figure 6 - Example typical slab and cast insitu wall construction (left) and pre-cast panel (right)

Concrete panels are expected to be delivered on flatbed trucks several times per week for each structure. The infill stitches (that connect the pre-cast units) will then be formed and poured on a regular cycle during the week, requiring deliveries of ready-mix concrete to the site.

Following construction of the concrete structural base slab and wall elements, structural steel will be erected to support the roofing and cladding. Structural steel will be delivered to site in long lengths (generally 12-15m, sometimes longer as required for the specific structure), pre-assembled as required on ground and lifted in segments into position above the structure using the site crane. Riggers in elevated working platforms (EWPs) will bolt together the sections of structural steel.

Some mechanical plant may be installed prior to completion of the roof to take advantage of greater access. Purlins, cladding, windows and doors will then be installed to close the building envelope.

These will all be installed from scaffold or EWPs and may require use of the site crane to lift into place. Figure 7 below shows a structure with some of the cladding applied over the strucutural steel frame.

Figure 7 - Example Building Construction

4.6 Conventional Ancillary Buildings

This group of structures are those that do not handle main process water and do not need to retain water within the structure itself. These structures are all constructed at grade (above ground) and their function is to support operation of the main components of the treatment plant. These structures include:

- The administration building – This building holds all control equipment, meeting rooms, offices, parking, workshop and staff amenities for operation of the plant.
- The chlorine facility – A large shed for storage of chlorine and housing of dosing equipment for the chlorine contact tank.
- The chemical shed - A large shed for storage of several chemicals used in the water treatment process. The shed also houses the tanks, pumps, valves and telemetry for dosing of the chemicals into the water treatment process.
- Electrical Compound – This structure receives high voltage power supply and distributes power for operation of the plant. The electrical compound also contains a 2.5MW Diesel generator for emergency power.
- Filter Press – The filter press takes sludge from the sludge thickeners and forces the sludge through screens using hydraulic presses. Water filtered out is recirculated and the remaining solids are trucked off site.
- Ozone Plant – Ozone plant adds ozone gas to the ozone contact tank to sterilise water – This structure will be built integrally with the ozone contact tank.

The size of these structures is generally much smaller than the main process structures but are still expected to have 9 to 12 month construction durations due the large number of finishing trades required to complete each structure. These structures will follow standard construction methods for industrial type buildings with a concrete base slab poured at grade, steelwork craned and bolted into position for the wall and roof structural supports, followed by envelope works (side wall panels and roof panels), followed lastly with internal fitout works.

4.7 Mechanical and Electrical Fitout

The Mechanical and Electrical fitout is expected to commence early in the construction programme, with the volume of work steadily increasing as structures are advanced/completed. A portion of the mechanical and electrical pipework and ducting is expected to be installed during the construction of each of the structures. This includes buried, difficult to access, and critical components in and around the underground structures.

Large equipment such as large diameter pipe, fittings, valves, generator, mixers, and pumps will need to be handled by cranes and lifted into position within the structures. This work will need to be staged appropriately with the advancement of structural works. Permanent gantry cranes within some of the structures could be used to assist with installation, but it is likely that temporary mobile or crawler cranes will be required to install some mechanical equipment prior to completion of the building structure.

4.8 Main Process Pipes

Pipework connecting the process structures and any chambers will be installed as soon as practical in parallel with the construction of below ground structures. Early installation will avoid repeated excavation at the building sites (i.e. excavation for the structure, and again for pipework). The final construction programme will carefully consider the sequence of pipework and structures along the main process circuit to avoid inefficiencies of repeated excavation of areas where it can be avoided.

4.9 WTP to Reservoirs Connection Pipework

Pipelines will be installed between the new WTP and the new Reservoirs. Due to the depth and diameter of the pipes, it is likely that micro tunnelling will be used to install pipework between sites. This approach will avoid the need for Traffic management and lane closures that would be required on Woodlands Park Road if conventional open trench installation was used.

The construction team may take advantage of subcontract resources used to install the NH2 pipeline tunnel to install the main pipes connecting the reservoirs to the WTP. Conventional open trench excavation may be used to install bends or wherever the pipeline is shallow enough to warrant open trenh excavation.

4.10 Ancillary Utilities

Smaller diameter pipes, ducting and chambers for electricity, lighting, communications and stormwater around site are to be trenched and installed during construction works, prior to civil finishing works. These services will also include power, water and sewer. Joint trenching will be utilised where possible to reduce disturbance and promote efficiency of installation of these utilities. There will also need to be works within Woodlands Park Road for the conveyance of these ancillary utilities, and these works will require appropriate temporary traffic management.

4.11 Stream Diversion

Approximately 53m of the Yorke Gully Stream will be reclaimed and diverted to allow for the construction of the replacement WTP. This section of the Yorke Gully Stream includes an ephemeral section and then intermittent section. To avoid long term stream loss, a permanent stream diversion to the east of the WTP site will be constructed late in the project programme as part of the civil finishing works. Initially, a clean water diversion will be established using clean water diversion bunds to divert water around the north-eastern and eastern side of the WTP and to divert clean water from entering the existing stream that encroaches on the site. Localised erosion and sediment controls measures will be installed to contain and treat runoff (refer to Cook Costello Report).

Following completion of bulk earthworks and building structures, the temporary diversion will be modified such that it is formed into a permanent stream that will mimic the intermittent nature of the existing Yorke Gully Stream. The shape of the permanent stream will be formed using an excavator. Placement of any required geotextile, riprap, soil and planting will follow, prior to final reinstatement.

4.12 Lagoon outlet in existing WTP

The existing lagoon at the existing WTP site will be used to capture and treat stormwater and off-specification discharges from the construction of the new WTP. To facilitate this run-off collection, a pipeline connecting the two treatment plants is required. The pipeline will run below Manuka Road and a wing wall outlet will be built in the side wall of the existing WTP lagoon. In preliminary planning, Costello Cook has also indicated a stormwater service connecting the new Reservoir to the existing lagoon. The existing lagoon is generally expected to be in a dry condition during these works.

To construct the pipeline that will connect the sites, trenchless construction is likely to be the preferred methodology, as it limits the disturbance to the surrounding vegetation. Micro-tunnelling over horizontal directional drilling is likely to be selected due to the anticipated required diameters of the services.

To launch/receive the micro-tunnelling boring machine (MTBM), a shaft will be required on both sites of the pipeline. On the existing WTP outlet site the shaft required for MTBM launching/receiving could be used as a coffer dam to isolate the shaft from the lagoon, so that the outlet worksite is protected from water ingress in the event of discharge from the existing plant. After the coffer dam at the lagoon is established, the shaft and bank of the lagoon can be excavated to suit the incoming pipes. Once the pipelines from the new WTP and from the new Reservoir 1 to the shaft are constructed, a manhole would be constructed to combine flows from the Reservoir 1 and new WTP. An outlet wing wall on the bank of the lagoon would be constructed and connected to the manhole, which will commission the system. The installation of the manhole and headwall is to be constructed within the extents of the coffer dam. Once the outlet is completed, the side of the pond can be reinstated, and anti-scour measures reinstated. The coffer dam can then be removed to allow incoming flows to reach the lagoon.

A drainage system for the new Reservoir 2 structure will also be installed that discharges into the lagoon. This would likely be constructed using conventional open trench techniques during construction of the Reservoir 2 pad.

Treated water will be discharged into the Armstrong gully.

5 RESERVOIR 1 CONSTRUCTION

5.1 Reservoir Site Access & Haul Roads

Site access to the Reservoir 1 site will be established at the east and west sides of the site to enable through movements for earthwork plant. Site access tracks/haul roads will likely follow the perimeter of the proposed tank. The formation of the tracks will provide access for plant to construct the ground retaining structure prior to commencing bulk excavation.

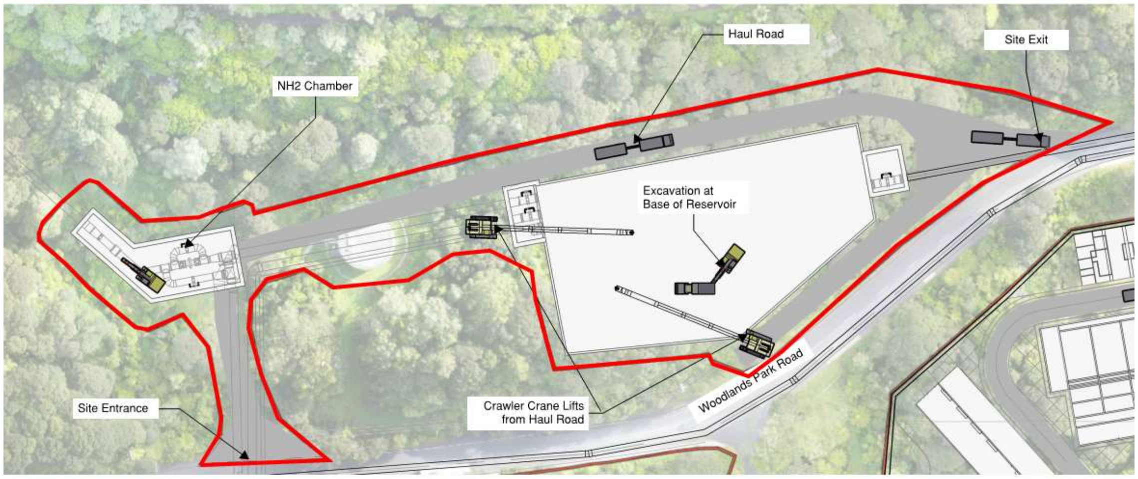


Figure 8 - Reservoir 1 Site Layout Plan

Piling plant will be required to construct the ground retaining structures outside of the reservoir's footprint. This plant will need level platforms to work from. Due to the existing steep topography on the reservoir site, access tracks and working platforms will likely need to be formed with steep cuts and batters. There is a possibility that part of the site will require installation of temporary retaining works (sheet piling or similar) to form the access tracks. It will also be necessary to modify the access tracks and work platforms as the works progress to create level working areas.

The objective will be to minimise vegetation clearance around the perimeter of the site. Due to the topography in some locations, a working zone will need to be cleared past the line of the retaining walls so that the plant has space required to perform the work. Where possible, this clearance will be limited to 3m or less from the retaining wall leading edge, as per the GHD site clearance drawing. In the event that a large tree's drip line or root system cross into the retaining structure, the tree clearance boundary may need to extend locally to ensure the retaining structure can be constructed safely. In this instance, the tree removal would be agreed on site and supervised by the site arborist and ecologists.

5.2 North Harbour 2 (NH2) Pipeline Shaft

The reservoirs for the Replacement Huia WTP will be connected to the NH2 Pipeline. The pipeline will run in a tunnel that originates at the Reservoir 1 site. While the NH2 pipeline is a separate project, the shaft to for the NH2 pipeline is included within the Replacement Huia WTP project and associated suite of consent applications. The final tunnel alignment is still being developed, and the shaft location is expected to be located on the western side of the reservoir.

It is proposed that the shaft be constructed prior to Reservoir 1 . Once the site is cleared, access tracks and a stabilised area will be established. The shaft may be constructed from bored piles, sheet piles or possibly a concrete caisson.

The shaft could be circular or rectangular, depending on design and installation constraints. The current preliminary design of the shaft is around 26m by 24m and approximately 7m deep. Final geometry and location of the shaft will be driven by:

- Requirements of the permanent valve chamber.

- Tunnel diameter and TBM size/type.
- Working room requirements for the carrier pipe installation.

As the shaft must connect the NH2 pipeline to the new Reservoir 1 and Reservoir 2, and the terrain of the site is steep, the location of the shaft has been placed on the west of the Reservoir 1 site. Clearance and earthworks for the shaft is likely to encroach into the Armstrong Gully stream buffer to the west and north of the shaft. The stream section to the north is ephemeral, while the stream to the west is permanent and the channel is well defined. It is likely that works will need to encroach into the 10m buffer but are not expected to affect the channel.

The area around the worksite will be cleared, and erosion and sediment controls will be installed to protect the stream from runoff. Exposed earthworks will be stabilised with geotextiles, hydroseed or compacted hardfill to reduce potential erosion. Following completion of the shaft installation, crews will place any required geotextile, riprap, and soil, followed by any planting as required for final reinstatement.

Supporting facilities will need to be established near to the shaft. This will include tunnel jacking pipe storage, and handling plant and tunnel spoil handling facilities. Depending on the tunnelling method selected, a separation plant may be located on the site, within the hardstand area. As the tunnel is expected to be constructed before Reservoir 1, the footprint for future Reservoir 1 could be cleared and used for laydown of the pipes and separation plant during NH2 Pipeline installation works.

Cranage to service the site will be difficult given the grades of the site and the proximity of trees to be retained. Some additional tree clearance/pruning and levelling of crane sites may be required. However, should the need arise for any additional site clearance and tree clearance/pruning, these works will be coordinated with the works arborist prior to commencement.

5.3 North Harbour 2 (NH2) Pipeline Tunnel

Although the method for installation of the NH2 tunnel falls outside of the scope of the document the following general comments are made.

Given the surrounding terrain, vegetation and working space, cranage to service the NH2 tunnel will be tightly constrained. Handling of pipes will need careful consideration to ensure that the plant selected can satisfactorily manoeuvre materials around the site.

Based on the concept design presented in the MWH report 10561- Huia WTP Upgrade Implementation Strategy Stage 2 - Woodlands Park Road Watermain - Preliminary Concept Design (April 2015), this project is expected to generate a further 6,000 m3 nett of spoil to be transported from the site.

5.4 Earth Retaining Structures

The Reservoir 1 structure is largely buried and will require extensive excavation within the reservoir footprint. The site clearance, ground retention structures and excavation will need to be completed before any part of the permanent structure can commence.

5.4.1 Cut Slope Retention

To create the level working pad for the site, it will be necessary to make a cut into the escarpment on the site. The largest cut will be along the northern edge of the reservoir. To retain the slope, it will be necessary to install an engineered retaining structure. This will likely consist of a soil-anchor, mesh and shotcrete construction, but could be a piled retaining structure. Selection of the retention structure would be confirmed during design development following geotechnical investigations and assessments. The ground anchors will need to extend outside of the reservoir perimeter but will be below ground level and will not require any additional vegetation clearance.

5.4.2 Reservoir Excavation Retaining Walls

Retaining walls for supporting the excavation of the reservoir tanks will be required around the perimeter of the permanent structure. The retaining walls would likely be used as the rear form to pour the reservoir internal walls against.

The retaining walls could utilise a range of solutions, including spaced contiguous piles with shotcrete infills, interlocked secant piles or diaphragm panels. Other solutions might include sheet piles or soldier piles with timber or precast infill panels, or some other system. The final methodology for retaining wall structures will largely be determined by the contractor at the detailed design stage based on detailed geotechnical investigations, assessments and recommendations.

Once the retaining structure walls are installed, excavation for the reservoir structures will be carried out in stages. If required, ground anchors and shotcrete, or internal whalers and struts, can be installed as the excavation progresses.

5.5 Bulk Excavation

Prior to commencing the excavation, monitoring systems for settlement, retaining wall stability and groundwater levels will be established. The retaining walls positioning, settlement and groundwater can influence the structures stability and are to be routinely monitored in order to detect any slight variations. If any of the monitoring shows movements outside of the predicted or safe threshold, contingency measures are to be undertaken to stabilise the excavation.

For the Reservoir 1 site, it is estimated that 37,000m^3 of cut material is to be taken off site for disposal during bulk earthworks with 2,000m^3 of imported fill required. If the excavated material is found to be suitable, a portion may be used for filling on the Reservoir 1 and WTP sites. At this stage it has been assumed all excavated material will be disposed off-site.

As sections of the retaining structure are completed, excavation of the reservoir can commence. Excavation would be carried out by 20 to 40T excavators loading directly into trucks or truck and trailers for disposal offsite. Excavation would likely be staged to maintain one-way access across the site (i.e. entry at the eastern gate and exit from the western gate) for as much of the excavation duration as possible. Ramps would be progressively constructed to reach the base of the excavation as the excavation progressed downwards. When ramps become too steep, or turns too tight, for truck and trailers, 6-wheeler trucks will be used to reach the base of the excavation. Figure 9 - Example Ground Retention and Bulk Excavation below shows two excavators working at removing spoil against a piled retaining structure.

Long reach excavators or telescopic grabs could also be utilised to complete the excavation when greater depth is achieved, which would remove the requirement for temporary ramps to the base of the excavation.

Under-slab pipework and drainage will be installed prior to construction of the base slab.

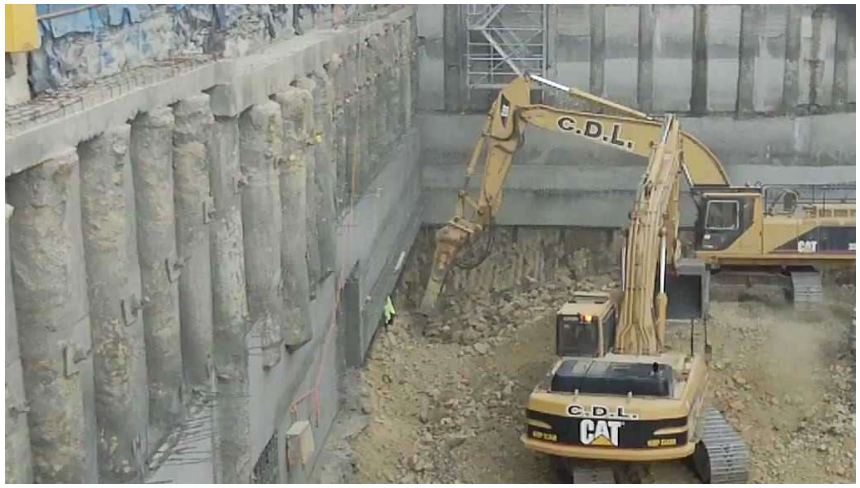


Figure 9 - Example Ground Retention and Bulk Excavation

5.6 Dewatering

Tonkin & Taylor Ltd.'s Groundwater and Settlement Effects Report (Sept. 2018) identified that there are two groundwater systems present within the Reservoir 1 site: a shallow groundwater table with a level of approximately 6m below existing ground, and a deeper groundwater system at approximately 9m below existing ground level. It can be expected that these groundwater systems will permeate into the excavation and will need to be managed during excavation works.

During the excavation works stormwater and groundwater entering the excavation will be directed to temporary low point sumps formed in the base of the excavation. Dewatering pumps connected to float switches will be placed in the sumps to provide continuous pumping as required. Water will be pumped out of the excavation to a sediment retention pond or 'silt buster' type self-contained treatment plant (or similar) to remove the silt before discharging into one of the natural watercourses on the site. Any water that has been in contact with fresh concrete will need to be diverted and stored separately so that it can be pH treated before it is discharged.

5.7 Reservoir Structure

5.7.1 Cranage

Cranage for construction of the structure could follow a wide range of options and will vary depending on the contractor's available plant and site constraints. Some likely cranage options are described below.

1. 70T Crawler cranes that can move around the edge of the tank (7m wide haul road required around the perimeter of the Reservoir).
2. Two crawler cranes positioned semi-statically, located at either end of the tank. A larger (~200T) crawler crane could be located on the western side of the reservoir and a smaller (~70T) crane could be located on the eastern side, such that the larger crane could feed components to the smaller crane.
3. A central tower crane, which would require a large mobile crane during mobilization/ demobilisation.
4. A large crawler crane located at the Western Side of the site with a small mobile crane (~30T) lifted into the base of the reservoir to service the eastern side of the structure.

When developing clearance plans, the group of trees located to the south west of the reservoir were identified as being particularly valuable. In order to reduce the proximity of construction activities to this group of trees, initial construction plans have been prepared without a haul road in this area. Because of this, the south-western corner will likely be the most difficult for crane access. The cranage option selected by the contractor will need to consider access to this point and may need to make allowance for short term use of high capacity mobile cranes reaching from either the eastern or western crane pad.

5.7.2 Slab

Once a suitable area of earthworks has been completed, under slab works such as ground improvements, basecourse, any buried pipework and under-slab drainage will be completed. The reservoir slabs will then have reinforcing, and formwork installed. The base slab pours will be large pours most likely in the order of 30m3 to 100m3 each. The pours will start in the early morning to make use of cooler hours of day (particularly in summer) and to allow suitable time for concrete placement and finishing. The slab will likely be cast over several weeks. Concrete boom pumps will be setup at ground level with the concrete boom supporting hoses down to the base level of the reservoir.

5.7.3 Walls

Once the base slab has been cast, the reservoir walls can commence. The reservoir walls could be constructed using precast or insitu concrete. Considering the dimensions of the reservoirs, wall thickness and the need to reduce the number of joints, the preferred construction method is likely to be cast in-situ concrete. Whilst pre-cast construction could decrease the duration of installation and the amount of temporary works, this option would require working room behind the wall to enable stitch jointing formwork to be installed. In-situ concrete construction would allow casting with a single sided form system tight against the ground retention structure. The in-situ wall methodology has been adopted as the base case method for the reservoir walls for the purpose of this document.

Reinforcing for the walls will be installed in sections from elevated work platforms or scaffolding off the reservoir slab. The single sided form system will be erected, and once fixed in place, the concrete can be placed. The height of the walls and casting as a single sided wall will require a heavy formwork and falsework system similar to that shown in Figure 10 - Example of single-sided formwork system. To minimise the falsework requirements the walls can be cast in two stages vertically, to minimise hydrostatic pressures during concrete placement.

Figure 10 - Example of single-sided formwork system

5.7.4 Internal Structure and Roof

Once the walls have progressed, internal columns and beams can progressively be installed. Due to the speed of installation and access constraints within the reservoir, pre-cast elements would likely be used. Columns are craned into position and temporary props are used to hold them in place. Beams are then placed onto the corbels of the columns. At the joints, local formwork is placed around the node which is cast with a small quantity of concrete to make the connection rigid. Temporary props can be removed, and the next layer of the structure can be constructed.

Once the internal structure is completed to the top of the reservoir, decking units are to be placed over the top of the tank to form the roof. These will again likely be made of precast elements. The deck will have a concrete topping slab to finish the structure.

5.7.5 Fitout and Pipework

Pipework connecting the Reservoir to the NH2 Pipeline and to the WTP will be installed as the reservoir structures progress. It is envisaged that the shaft used to construct the NH2 tunnel will become the permanent chamber for connecting pipework and valves. The reservoir structure itself may be used as the shaft to jack large diameter pipe segments to other sites for inlet and outlet pipework.

Once the reservoir concrete works are complete, any hatches, access platforms, steps, and baffle curtains will be installed within Reservoir 1.

6 RESERVOIR 2 CONSTRUCTION

Reservoir 2 which Is located on the existing WTP site can only be constructed after the replacement WTP is fully operational and the existing WTP is decommissioned and demolished.

On the proposed site, there are several structures that would require demolition. As the site is sloping, there would need to be a combination of cut and fill, and resultant retained earth structures to provide a level pad for the base of the reservoir at this location.

6.1 Enabling Works

6.1.1 Reservoir 2 Site Access & Haul Roads

Access to the site will be via the current gates of the Huia WTP. A one-way circuit would likely be created between the Western and Eastern gates.

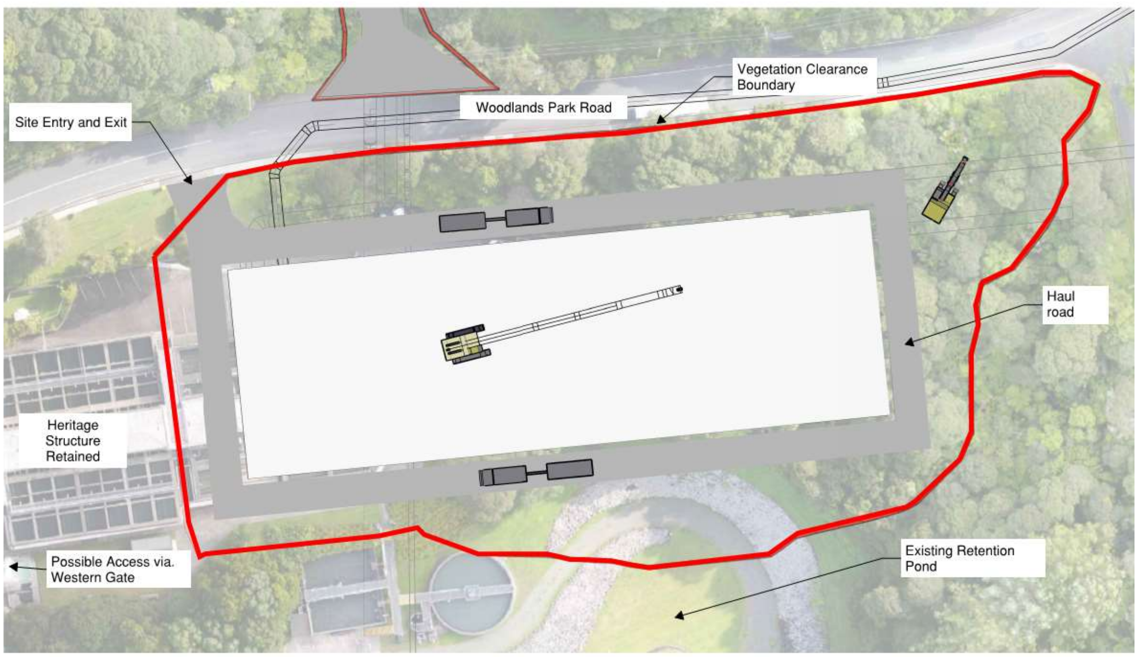


Figure 11 - Reservoir 2 Site Layout

6.1.2 Existing WTP Demolition

The existing water retaining structures will need to be drained. Mechanical and electrical plant is to be stripped and recycled, or disposed of as appropriate. All pipework is to be removed. Access metalwork (handrails, gantries and stair cases) will then be removed. Non-water retaining structures will then be removed including metal cladding, window frames, door frames and brickwork. Demolition of the concrete structural elements will then follow.

There may be up to three large excavators operating during structural demolition works (one to break down structures, one to grab and handle debris, and the other to load out the structural elements into rock-body trucks). The contractor may elect to use a crusher on site to process the demolished structural elements prior to load out. Alternatively, the crushed concrete could be recycled on site as fill for the foundation of the reservoir.

6.1.3 Site Clearing

A vegetation clearance envelope has been prepared for construction. The envelope has been established based on the concept layout of Reservoir 2. The boundary proposed allows for a 7m haul road around the structure with a retained slope and a cut-off drain at the top of the bank. On this basis, clearance for Reservoir 2 comes up to the northern cadastral boundary of the existing WTP site.

Trees will need to be felled, handled and chipped similar to as has been described earlier for Reservoir 1. All clearing works will need to follow the Hygiene protocols for Kauri die-back established earlier (Section 3.3.3).

6.1.4 Earthworks and Retaining Works

The site will need to be levelled to build the reservoir. The site slopes from north to south and will require the northern side of the pad to be excavated and fill placed to the southern side. If the site-won material is suitable for fill, the cut material can be placed into the fill side. Otherwise, excavated material will need to be transported off site for disposal and engineered fill imported.

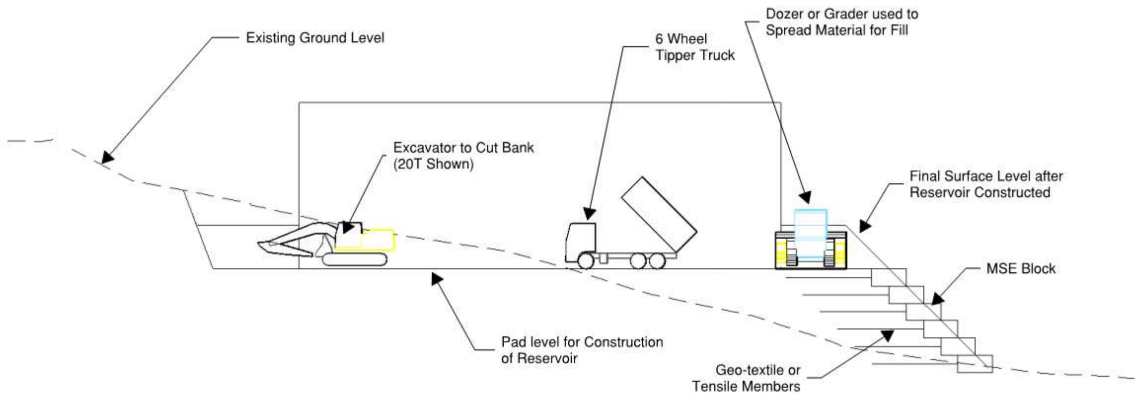


Figure 12 - Reservoir 2 Typ. Earthworks Section

Some form of retaining structure will be required to support the cut side of the excavation. This will likely be similar to the system employed on the Reservoir 1 site. It is likely that ground anchors with mesh and shotcrete would be used to retain the cut face, progressively installed as the excavation progressed downwards.

On the fill side, a MSE system could be used to retain the slope. An MSE wall is a system of earth retention where tensile members such as geotextile or galvanised steel are placed into layers of the fill to enable fill to distribute loads more effectively. This would allow the fill side to have a steeper batter face, reducing the amount of fill required for the pad.

There are many proprietary MSE wall systems in the market. Walls are constructed by installing concrete facing blocks, connecting a tensile membrane and layering fill over the top to create a stabilised earth block.

6.2 Reservoir Structure

6.2.1 Slab

Similar to Reservoir 1, under slab pipework is to be installed prior to pouring the slab. The base slab will be cast from multiple large pours. Pouring of the slab would likely progress from the eastern side of the reservoir to the western side. Concrete boom pumps would be used with a queue of concrete trucks feeding the pump.

6.2.2 Walls

Dissimilarly to Reservoir 1, the walls for Reservoir 2 will be constructed above grade. As such, both sides of the walls will be accessible and not poured against retaining structures. It is likely precast panels would be chosen for the walls. One or more cranes would be mobilised to the site to aid in installation of precast panels. Stitch pours between panels and at the base of the panels would be required for structural stability and water tightness. If wall thickness means precast panels become unpractical in terms of weights then insitu walls may be chosen. These would follow a traditional method using a double sided formwork system.

6.2.3 Internal Structure and Roof

The internal structure will likely be designed to utilise precast beams and columns with cast-insitu stitch joints. The roof is likely to be made of precast decking units with a topping slab. Similar to the installation of the internal structure and roof of Reservoir 1, several cranage options may be employed by the contractor to supply materials to the structure crews during construction. The contractor may choose the use large crawler cranes working from the perimeter of the structure, mobile cranes deployed on the base slab, a tower crane in the centre of the structure or some other configuration.

6.2.4 Fitout and Pipework and commissioning

Pipework will be connected to link Reservoir 2 to the NH2 shaft on the opposite side of Woodlands Park Road. The installation of this pipework is described in section 4.9 above, and once installed, will allow Reservoir 2 to be commissioned.

7 SITEWIDE FINISHING AND COMMISSIONING WORKS

After the completion of the structural, mechanical and electrical works at the Replacement Huia WTP Site, and prior to final completion being achieved, final site civils, landscaping, commissioning and other finishing works will be completed.

7.1 Civil and Finishing Works

Civil and finishing works will be undertaken in stages as areas are ready for reinstatement. Seasonal restrictions will also influence the programme for civil and finishing works. The civil and finishing works at the project site include:

- Electrical and communications ducting for power and control of treatment plant processes.
- Local stormwater collection and pipework.
- Lighting and other services.
- Permanent access around the reservoirs.
- Roading including kerbing and pavements around the site as designed.
- Reinstatement of final levels and landscaping.
- Permanent perimeter fencing.

- Landscaping.

Civil works around structures are likely to be undertaken after buildings are complete and this work may extend into the commissioning phase.

7.2 Commissioning

Commissioning of the plant will involve testing of all equipment to validate the performance of all processes of the plant. During this period, there will be operational and commissioning staff onsite and small numbers of tradespersons completing outstanding minor works. Significant construction activities will have been completed.

8 LAYDOWN

The WTP site is constrained and will require careful sequencing of works to provide short term laydown for materials immediately prior to its incorporation into the works. To facilitate efficient site activity, an additional area to the east of the main WTP footprint is required for marshalling of materials and temporary laydown during construction.

This laydown area will be used for:

- Unloading materials in an area near the road and separate from work faces, which allows trucks to get off the road, minimises traffic effects to local roads, ensures efficient offload, and minimises tracking out material from the greater project site onto the roads.
- Storing formwork, plant and materials (reinforcing steel, mechanical equipment, pipework and general building materials that may be used across multiple structures on the project).
- Site facilities and secure storage for specialist subcontractors.
- Worker welfare facilities.
- Emergency equipment and space for activities including segregated muster area, staff safety briefing area, first aid room, storage of spill kits, firefighting equipment and man cages.

Further laydown areas would normally be provided to support the level of construction activity expected on a project of this scale and complexity. However, due to Watercare's intention to minimise vegetation clearance as much as practicable on the site, this will not be possible. The limitations on laydown areas will limit storage and preparation areas on the site, and could potentially increase the overall construction duration. Limited storage will require careful logistics planning, requiring just-in-time deliveries, and increases the need for more offsite assembly of certain elements, and could increase construction traffic to and from the site.

The area to the east of the WTP has moderately steep terrain and will need to be terraced to create useable flat areas. The south eastern corner of the site could be used to locate a sediment treatment pond. This is the natural low point of the existing topography. The current Cook Costello Report has a sediment treatment pond located at this point.

9 INDICATIVE PROGRAMME

The indicative programme associated with this methodology was developed to establish a credible sequence of construction works, and determine the probable activity durations and associated impacts over the duration of the project.

The programme is built up using first principles and is based on GHD's preliminary design information and quantities. These first principles have been verified using historic data from other similar projects.

The programme follows a logical sequence of works and provides best estimate for durations of works, based on available information. The final construction programme may vary in sequence and overall durations, as the design and construction method is developed.

Commencement of the clearing activity of the project has been set to October of the first year of works to coincide with Lizard peak activity, as required by the consultant ecologists.

Construction of the project is expected to take between 7 and 8 years. At a conceptual level the programme is broken down as follows:

- 6 months early works: clearing the site and construction of the NH2 shaft
- 1 year of tunnelling for the NH2 pipeline tunnel project in advance of the WTP project works
- 1 year for enabling and earthworks on the WTP site
- 2 years for the main structures and buildings of the WTP and Woodland Park Reservoir
- 1 year for finishing, commissioning and programme contingency of the WTP
- 2 years for existing plant decommissioning, demolition and construction of the Reservoir 2.

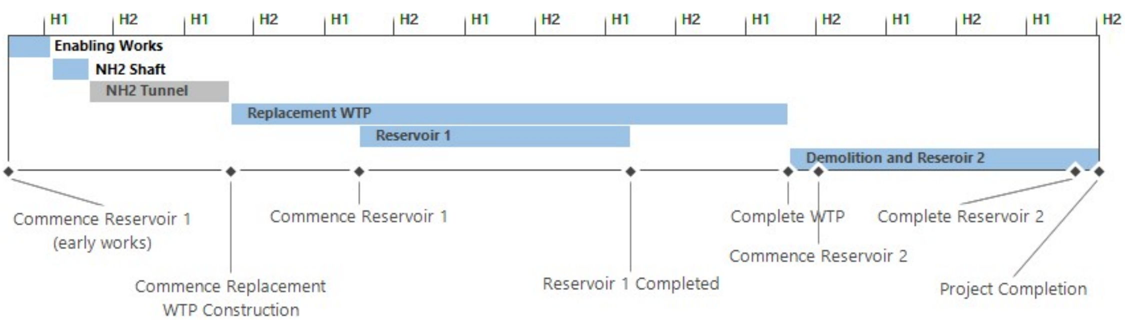


Figure 10 - Programme timeline

The high-level programme is included in Appendix 2 – Indicative Construction Programme

10 CONSTRUCTION ENVIRONMENTAL MANAGEMENT

The effects to the environment during the construction of the Replacement Huia WTP have been considered. These include erosion, sediment, noise and vibration, and dust. The following mitigations measures are to be undertaken by the contractor during construction of the WTP to manage the impacts of construction to the environment.

10.1 Earthworks Management

This methodology aligns with the approach to erosion and sediment control set out in the Cook Costello report. The construction is staged to enable diversions and long-term environmental controls to be established prior to bulk earthworks commencing. Any run-off from the site will be contained on site in the existing WTP lagoon to protect the surrounding receiving environment.

10.2 Noise and Vibration Impact

Marshall Day Acoustics Limited (MDA) has been engaged by Watercare to assess the potential noise and vibration effects of construction activities at the Replacement Huia WTP on the surrounding environment. Alta has provided MDA with an indicative schedule of construction plant likely to be used during construction of the project. Each group of construction plant that would be operational concurrently is shown on a construction programme so that simultaneous effects can be assessed.

The programme with plant descriptions are attached to this document in Appendix 3 – Construction Traffic and Plant Forecast.

10.3 Dust Control

In dry conditions, there is the potential for earthworks activities to produce dust, which could migrate from the site. Adequate dust control measures will need to be in place to minimise potential effects on adjacent properties. Typical control measures for earthworks of this type include:

- Early stabilisation of cut areas (to minimise area from which dust can be generated).
- Placing coarse aggregates on haul roads.
- Using water carts to wet down exposed parts of the site.

11 CONSTRUCTION TRAFFIC IMPACTS

11.1 Traffic Demand Modelling

Beca has been engaged by Watercare to assess the effects of construction traffic associated with the construction of the Replacement Huia WTP and Reservoirs. Alta has supplied Beca with a preliminary forecast of expected vehicle movements for the project, based on the outline method and programme detailed within this document.

The forecast traffic volumes have been built up from a first principles model. Each typical construction activity on the project has been assigned a heavy vehicle demand. For example, the bulk earthworks cut at the WTP site is expected to generate an average of 24 heavy vehicle movements per day consisting of 12 trips into site and 12 trips out of site. The number of vehicle movements on any given day are then calculated by aggregating the individual average heavy vehicle demand for all construction activities occurring within that period. This is done using the indicative programme provided in Appendix 2 – Indicative Construction Programme.

Beca has provided advice on acceptable windows for construction vehicle movements outside of normal peak times. Refer to Beca's traffic effects report for details of these periods. The above construction method and traffic forecast has been generated considering these restrictions.

Similarly, light vehicle demands are calculated as an aggregate of different estimated workforce sizes over different periods depending on the phase of the project. The forecast movements for light and heavy vehicles over the duration of the project is provided in Appendix 3 – Construction Traffic and Plant Forecast.

11.2 Exceptions - Concrete Pours

Concrete pours require continuous supply of concrete trucks during days where concrete is being poured to avoid structural issues arising from cold joints where different batches of concrete cure inconsistently. Concrete slabs are typically the largest single concrete pours on a project, and require uninterrupted supply. Pours like this typically commence early in the morning with placement of concrete concluding in the afternoon. Vibration and finishing of the slab can continue until late in the afternoon or early evening.

It will not be possible to stop concrete truck movements during the AM peak (0730-0900 hrs) for construction of these elements. Exceptions for limiting truck movements in the AM peak will therefore be required in these cases. These pours are likely to occur approximately once a week during the peak structure construction phase. Approximately 10-20 additional heavy vehicle movements (both directions) would be required during the AM peak.

11.3 Temporary Traffic Management

A detailed Traffic Management Plan (TMP) will need to be prepared by the appointed contractor which reflects the proposed work sequence programme. A copy of the TMP will be provided to Council to grant a Corridor Access Permit prior to commencing work.

Some lane closures along Woodlands Park Road may be required during the works to allow for any services diversions and pipeline installation within the existing carriageway, or for the formation of site accesses.

The following requirements will need to be met by the appointed contractor:

- Traffic Management operations will need to be planned and carried out in accordance with the Code of Practice for Temporary Traffic Management (CoPTTM).
- Work areas will need to be securely isolated from pedestrian and vehicle access using fencing and approved barrier systems.
- A temporary speed limit will be put in place where a lane closure is required and when construction activities are to take place within the road reserve.
- Heavy vehicle movements to take place (generally) during the agreed periods outlined by Beca.
- Should the existing footpath on the south side of Woodlands Park Road need to be closed during the works, a suitable alternative access will need to be established..

12 CONCLUSIONS

An indicative methodology for construction of the Replacement Huia WTP and Reservoirs has been presented based on the concept designs that have been developed to date by GHD and Beca. An indicative programme has been also developed and presented to link methodology with potential impacts. From our assessment, the scope of works as described can be expected to take between 7 and 8 years.

Third party specialist technical consultants have been provided with representative methodology, including plant and heavy vehicle traffic demand forecasts. These forecasts will help quantify the magnitude of construction impacts, including impacts to the environment and public, associated with the project.

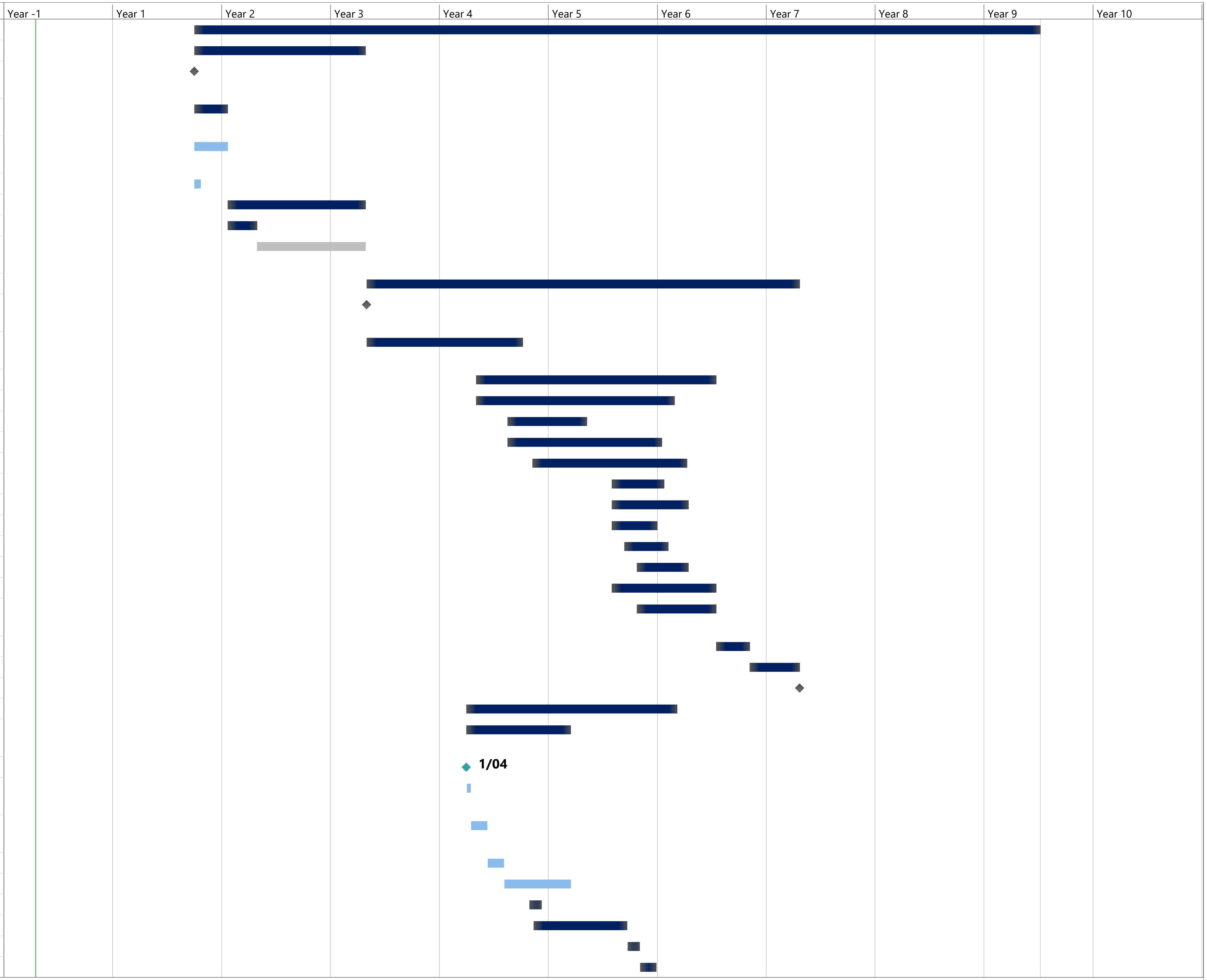
Methods described in this document are representative of probable construction activities based on the current conceptual design developed to date and general industry practices. Specific details may change subject to design revision, contractor experience, plant availability, and other factors.

12.1 Appendix 1 – Document Reference

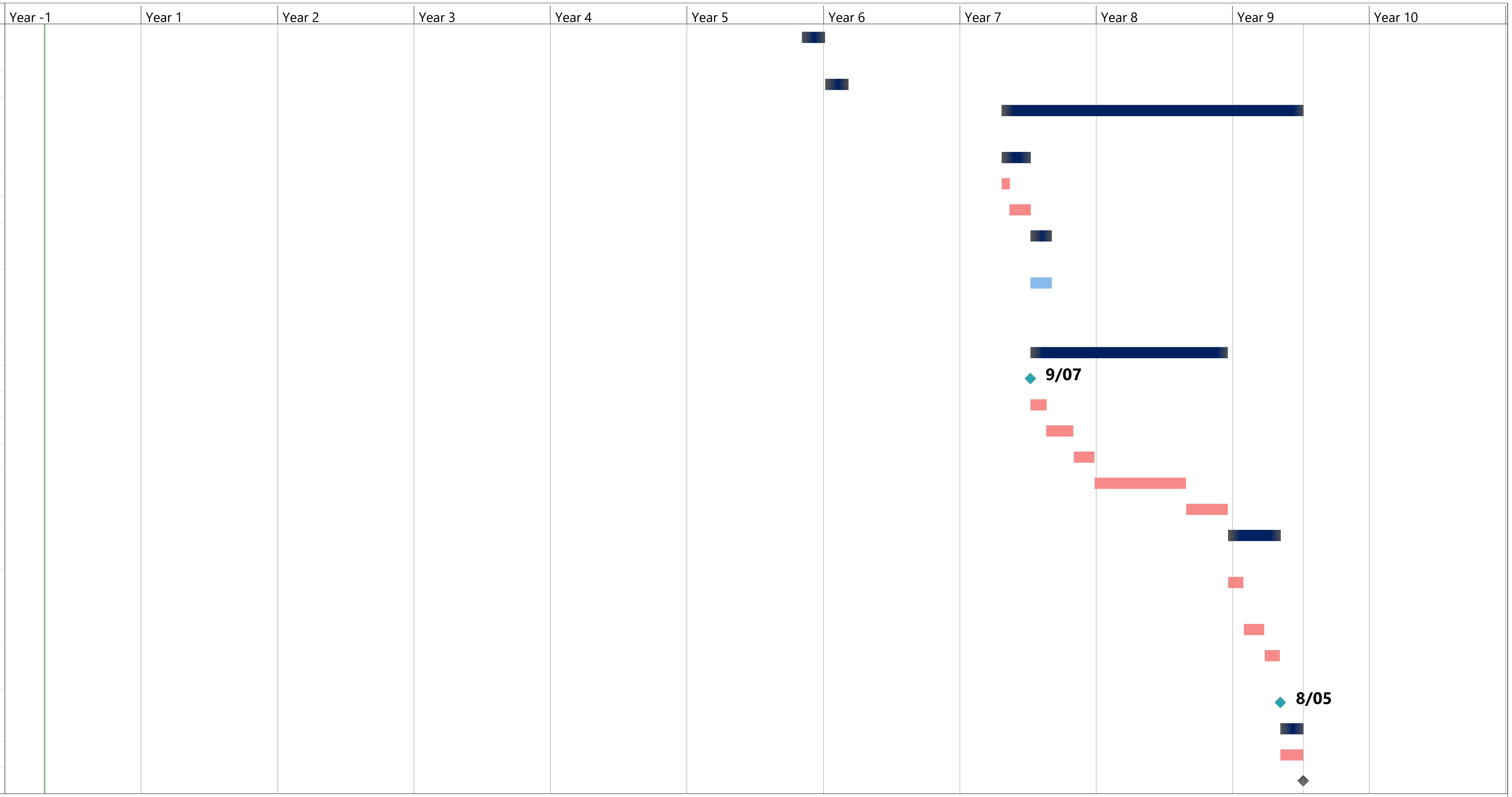
Title
GHD Drawings 51-3357505-G001 [2], 51-3357505-G002 [1], 51-3357505-G003 [2], 51-3357505-C001 [2], 51-3357505-C002 [2], 51-3357505-C003 [2], 51-3357505-C004 [2], 51-3357505-C005 [1], 51-3357505-C007 [1], 51-3357505-C008 [1], 51-3357505-C009 [1], 51-3357505-C010 [1], 51-3357505-C011 [1], 51-3357505-C012 [1], 51-3357505-C013 [1], 51-3357505-C014 [1], 51-3357505-C015 [0], 51-3357505-C016 [1]
GHD structure sizing drawings 51-33575-A100 [A], 51-33575-A102 [A], 51-33575-A103 [A], 51-33575-A104 [A], 51-33575-A106 [A], 51-33575-A110 [A], 51-33575-A115 [A], 51-33575-A120 [A], 51-33575-A121 [A], 51-33575-A130 [A], 51-33575-A150 [A], 51-33575-A160 [A], 51-33575-A170 [A], 51-33575-51-33575-A171 [A], 51-33575-A200 [A], 51-33575-A201 [A]
Cook Costello CIVIL INFRASTRUCTURE REPORT 14191-RPT-CIV- 002-REV 0
BECA Drawings 3255336 – K110 [0B], 3255336 – K111 [0B], 3255336 – K112 [0B], 3255336 – K113 [0B], 3255336 – K114 [0B], 3255336 – K115 [0B], 3255336 – K116 [0B]

12.2 Appendix 2 – Indicative Construction Programme

ID	Task Name
1	**Project**
91	**Reservoir 1 Indicative Program**
92	**Commence Reservoir 1 (early works)**
93	**Reservoir 1 Enabling Works & Clearing**
94	Vegetation Removal, Ersed controls
95	Site Establishment
96	**NH2 Shaft and Tunneling**
97	**NH2 Shaft**
102	NH2 Tunnelling - (different consent)
2	**Replacement WTP**
3	**Commence Replacement WTP Construction**
5	**WTP Enabling Works & Bulk Earthworks**
16	**WTP Structures**
17	**BAC and Ozone Contact Tank**
26	**Chlorine Contact Tanks**
74	**Conventional structures**
33	**DAF Tank**
40	**Raw water pump station**
47	**Ancillary Tanks**
48	**Supernatant Tank**
54	**Sludge Balance Tank**
60	**Washout Balance Tank**
67	**Thickener/Clarifiers**
81	**Civils (SW/Pipes/Ducts/Cables/Roading)**
86	**Commissioning**
89	**Contingency**
4	**Complete WTP**
103	**Reservoir 1 Construction**
104	**Retaining wall and Bulk Earthworks**
105	Commence Reservoir 1
106	Site Establishment Reservoir 1
107	Retaining Wall Construction / Slope Stabilisation
108	Piling works
109	Bulk Earthworks
110	**Piping Pipework and Ducting**
112	**Structure**
116	**Electrical and Mechanical**
118	**Commissioning**



ID	Task Name
120	**Civils (SW/Pipes/Ducts/Cables/Roading)**
122	**Contingency**
125	**Existing WTP Demolition and new Reseroir 2**
126	**Site Establishment**
127	Site Establishment
128	Decomission existing plant
129	**Demolition of Existing Structure**
130	Demolish existing structures on site to make way for Reservoir 2
131	**Reservoir 2**
132	Commence Reservoir 2
134	Ground improvements
133	Build 4m Pad for Reservoir
135	Slab
136	Reservoir Walls
137	Reservoir Roof Structure
138	**Reservoir 2 Mechanical and Commissioning**
139	Electrical and Mechanical Fitout 2
140	Commissioning Reservoir 2
141	All Civil Works around Structures
142	Complete Reservoir 2
143	**Contingency**
144	Contingency
145	Project Completion



12.3 Appendix 3 – Construction Traffic and Plant Forecast

Replacement Huia Water Treatment Plant and Reservoirs - Forecast HV Movments

Huia Water Treatment Plant and Woodlands Reservoir - Forecast HV and LV Movments
Date: 14-04-2019
Version Changes: HV vehicles broken into rigid-body, articulated, truck and trailer and over-dimensioned

Task Name	Start date.	End date.	Plant on-site (Noise) (Ex. deliveries/vehicles and minor plant (hand tools)) / Month	1 Apr-20	2 May-20	3 Jun-20	4 Jul-20	5 Aug-20	6 Sep-20	7 Oct-20	8 Nov-20	9 Dec-20	10 Jan-21	11 Feb-21	12 Mar-21	13 Apr-21	14 May-21	15 Jun-21	16 Jul-21	17 Aug-21	18 Sep-21	19 Oct-21	20 Nov-21	21 Dec-21	22 Jan-22	23 Feb-22	24 Mar-22	25 Apr-22	26 May-22	27 Jun-22	28 Jul-22	29 Aug-22	30 Sep-22	31 Oct-22	32 Nov-22	33 Dec-22	34 Jan-23	35 Feb-23	36 Mar-23	37 Apr-23
Task Name			Telehandler, 400kVa Generator, Hiab (site),																																					
Project	1/06/2020	10/03/2028				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reservoir Indicative Program	1/06/2020	24/12/2021				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																
Commence Reservoir (early works)	1/06/2020	1/06/2020																																						
Reservoir Enabling Works & Bulk Earthworks	1/06/2020	18/09/2020				0	0	0	0																															
Vegetation Removal, Ersed controls	1/06/2020	18/09/2020	20T Excavator, Chipper, Chainsaw, Chainsaw,			13	13	13	13																															
Site Establishment	1/06/2020	19/06/2020	8T Excavator, 20-30T Excavator, 12T Construction roller, Franna (Yard Crane),			20																																		
NH2 Shaft and Tunneling	21/09/2020	24/12/2021								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																
NH2 Shaft	21/09/2020	25/12/2020								0	0	0																												
Piling for 13m diameter shaft	21/09/2020	30/10/2020	45T Piling Rig, 12T Excavator, 25T Mobile Crane, Concrete Vibrator,							16																														
Shaft Excavation	2/11/2020	11/12/2020	30T Excavator , 20T Excavator , 12T Excavator ,								24																													
Base slab	14/12/2020	18/12/2020	28m Concrete Boom (20% usage) , Concrete Vibrator (20% usage), ,									10																												
Shaft fitout	21/12/2020	25/12/2020	12T Excavator, 12T Excavator, 8T Roller, 6m3 Watercart,																																					
NH2 Tunnelling - (different consent)	28/12/2020	24/12/2021											0	0	0	0	0	0	0	0	0	0	0	0																
Replacement WTP	1/01/2022	24/12/2025																							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commence Replacement WTP Construction	1/01/2022	1/01/2022																																						
WTP Enabling Works & Bulk Earthworks	3/01/2022	9/06/2023																							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vegetation Removal	3/01/2022	13/04/2022	20T Excavator, Chipper, Chainsaw, Chainsaw,																						13	13	13													
Site Establishment	14/04/2022	11/05/2022	8T Excavator, 20-30T Excavator, 12T Construction roller, Franna (Yard Crane),																									20												
E&SC Install	14/04/2022	11/05/2022	12T Excavator, 12T Excavator, 8T Roller, 6m3 Watercart,																									8												
Earthworks Cut	12/05/2022	29/03/2023	30T Excavator , 20T Excavator , 12T Excavator ,																										24	24	24	24	24	24	24	24	24	24	24	
Temporary Retention for Buried Structures	7/07/2022	26/10/2022	Sheet Piling Rig/Crane (50T), Vibratory Hammer,																												2	2	2	2						
Place Imported Fill to Platform Level	27/10/2022	9/06/2023	Dozer D6, 20T Excavator, 12T Excavator, 12T Vibratory/Static Construction roller, 10m3 Water cart,																																24	24	24	24	24	24
Retaining Wall Piles	10/11/2022	1/02/2023	45T Piling Rig, 12T Excavator, 25T Mobile Crane, Concrete Vibrator,																																16	16	16			
Retaining Wall Construction (Backfill in EWKs)	10/11/2022	7/06/2023	25T - 35T Mobile crane, 12T Excavator, ,																																2	2	2	2	2	2
SW Detention/Treatment/Pond Link	1/05/2023	9/06/2023	12T Excavator, 12T Excavator, 8T Roller, 6m3 Watercart,																																					
Earthworks and Earth Retaining Structures Complete	9/06/2023	9/06/2023																																						
WTP Structures	5/01/2023	19/03/2025																																			0	0	0	0
BAC and Ozone Contact Tank	5/01/2023	30/10/2024																																			0	0	0	0
Foundations and Slab	5/01/2023	19/04/2023	28m Concrete Boom (20% usage) , Concrete Vibrator (20% usage), ,																																		10	10	10	10
Walls/Suspended Floors	9/03/2023	13/12/2023	50T Crane, EWP All-terrain 16m, EWP All-terrain 16m, 28m Concrete Boom (20% usage) , Concrete Vibrator (2																																				4	4
Backfill Underground Structure	14/12/2023	10/01/2024	12T Excavator, 12T Excavator, 8T Roller, 6m3 Watercart,																																					
Building	11/01/2024	1/05/2024	50T Crane, EWP All-terrain 16m, EWP All-terrain 16m,																																					
Mechanical and Electrical Fitout	2/05/2024	24/07/2024	50T Mobile Crane (20% usage),																																					
Pre-commissioning	25/07/2024	4/09/2024																																						
Import Filter Media to BAC	5/09/2024	30/10/2024	8T Excavator ,																																					
BAC and Ozone Dosing Complete	30/10/2024	30/10/2024																																						
Chlorine Contact Tanks	20/04/2023	10/01/2024																																						
Foundations and Slab	20/04/2023	12/07/2023	28m Concrete Boom (20% usage) , Concrete Vibrator (20% usage), ,																																					
Walls	1/06/2023	18/10/2023	50T Crane, EWP All-terrain 16m, EWP All-terrain 16m, 28m Concrete Boom (20% usage) , Concrete Vibrator (2																																					
Building	7/09/2023	29/11/2023	50T Crane, EWP All-terrain 16m, EWP All-terrain 16m,																																					
Backfill Underground Structure	19/10/2023	15/11/2023	12T Excavator, 12T Excavator, 8T Roller, 6m3 Watercart,																																					
Mechanical and Electrical Fitout	30/11/2023	10/01/2024	50T Mobile Crane (20% usage),																																					
Chlorine Contact Tanks Complete	10/01/2024	10/01/2024																																						
Conventional structures	20/04/2023	18/09/2024																																						
Filter Press	20/04/2023	3/04/2024	50T Crane (20% usage) , EWP All terrain-16m (40% usage) , 28m Concrete Boom (5% usage) ,																																					
Administration Building	1/06/2023	15/05/2024	50T Crane (20% usage) , EWP All terrain-16m (40% usage) , 28m Concrete Boom (5% usage) ,																																					
Electrical Plant	13/07/2023	20/03/2024	50T Crane (20% usage) , EWP All terrain-16m (40% usage) , 28m Concrete Boom (5% usage) ,																																					
Chlorine Storage Facility	24/08/2023	1/05/2024	50T Crane (20% usage) , EWP All terrain-16m (40% usage) , 28m Concrete Boom (5% usage) ,																																					
Chemical Building	5/10/2023	18/09/2024	50T Crane (20% usage) , EWP All terrain-16m (40% usage) , 28m Concrete Boom (5% usage) ,																																					
Completion of Conventional Structures	18/09/2024	18/09/2024																																						
DAF Tank	13/07/2023	11/12/2024																																						
Foundations and Slab	13/07/2023	4/10/2023	28m Concrete Boom (20% usage) , Concrete Vibrator (20% usage), ,																																					
Walls/Suspended Floors	19/10/2023	3/04/2024	50T Crane, EWP All-terrain 16m, EWP All-terrain 16m, 28m Concrete Boom (20% usage) , Concrete Vibrator (2																																					
Backfill Underground Structure	4/04/2024	5/06/2024	12T Excavator, 12T Excavator, 8T Roller, 6m3 Watercart,																																					
Building	4/04/2024	26/06/2024	50T Crane, EWP All-terrain 16m, EWP All-terrain 16m,																																					
Mechanical and Electrical Fitout	27/06/2024	11/12/2024	50T Mobile Crane (20% usage),																																					
DAF Tank Complete	11/12/2024	11/12/2024																																						
Raw water pump station	4/04/2024	25/09/2024																																						
Foundations and Slab	4/04/2024	15/05/2024	28m Concrete Boom (20% usage) , Concrete Vibrator (20% usage), ,																																					
Walls	16/05/2024	26/06/2024	50T Crane, EWP All-terrain 16m, EWP All-terrain 16m, 28m Concrete Boom (20% usage) , Concrete Vibrator (2																																					
Backfill Underground Structure	27/06/2024	9/07/2024	12T Excavator, 12T Excavator, 8T Roller, 6m3 Watercart,																																					
Building	27/06/2024	24/07/2024	50T Crane, EWP All-terrain 16m, EWP All-terrain 16m,																																					
Mechanical and Electrical Fitout	25/07/2024	25/09/2024	50T Mobile Crane (20% usage),																																					
Raw Water Pump Station Complete	25/09/2024	25/09/2024																																						
Ancillary Tanks	4/04/2024	16/12/2024																																						
Supernatant Tank	4/04/2024	2/09/2024																																						
Foundations and Slab	4/04/2024	15/05/2024	28m Concrete Boom (20% usage) , Concrete Vibrator (20% usage), ,																																					
Walls	16/05/2024	26/06/2024	28m Concrete Boom (20% usage) , Concrete Vibrator (20% usage), ,																																					
Backfill Underground Structure	27/06/2024	8/07/2024	12T Excavator, 12T Excavator, 8T Roller, 6m3 Watercart,																																					
Building	9/07/2024	5/08/2024	50T Crane, EWP All-terrain 16m, EWP All-terrain 16m,																																					
Mechanical and Electrical Fitout	6/08/2024	2/09/2024	50T Mobile Crane (20% usage),																																					
Sludge Balance Tank	16/05/2024	9/10/2024																																						
Foundations and Slab	16/05/2024	26/06/2024	28m Concrete Boom (20% usage) , Concrete Vibrator (20% usage), ,																																					
Walls	27/06/2024	7/08/2024	28m Concrete Boom (20% usage) , Concrete Vibrator (20% usage), ,																																					
Backfill Underground Structure	8/08/2024	14/08/2024	12T Excavator, 12T Excavator, 8T Roller, 6m3 Watercart,																																					
Building	15/08/2024	11/09/2024	50T Crane, EWP All-terrain 16m, EWP All-terrain 16m,																																					
Mechanical and Electrical Fitout	12/09/2024	9/10/2024	50T Mobile Crane (20% usage),																																					
Washout Balance Tank	27/06/2024	16/12/2024																																						
Foundations and Slab	27/06/2024	7/08/2024	28m Concrete Boom (20% usage) , Concrete Vibrator (20% usage), ,																																					
Walls	8/08/2024	9/10/2024	28m Concrete Boom (20% usage) , Concrete Vibrator (20% usage), ,																																					
Backfill Underground Structure	10/10/2024	21/10/2024	12T Excavator, 12T Excavator, 8T Roller, 6m3 Watercart,																																					
Building	22/10/2024	18/11/2024	50T Crane, EWP All-terrain 16m, EWP All-terrain 16m,																																					
Mechanical and Electrical Fitout	19/11/2024	16/12/2024	50T Mobile Crane (20% usage),																																					
Ancillary Tank Completion	16/12/2024	16/12/2024																																						
Thickener/Clarifiers	4/04/2024	19/03/2025																																						
Sludge Thickener 2	4/04/2024	18/09/2024	50T Crane (20% usage) , EWP All terrain-16m (40% usage) , 28m Concrete Boom (5% usage) ,																																					
Sludge Thickener 1	16/05/2024	30/10/2024	50T Crane (20% usage) , EWP All terrain-16m (40% usage) , 28m Concrete Boom (5% usage) ,																																					
Washwater Thickener 2	27/06/2024	11/12/2024	50T Crane (20% usage) , EWP All terrain-16m (40% usage) , 28m Concrete Boom (5% usage) ,																																					
Washwater Thickener 1	8/08/2024	22/01/2025	50T Crane (20% usage) , EWP All terrain-16m (40% usage) , 28m Concrete Boom (5% usage) ,																																					
Thickener/Clarifiers Completed	22/01/2025	22/01/2025																																						
Pre-commissioning	23/01/2025	19/03/2025																																						
Civils (SW/Pipes/Ducts/Cables/Roading)	27/06/2024	19/03/2025																																						
Civils Around Main Structures	27/06/2024	11/12/2024	12T Excavator, 12T Excavator, 8T Roller, 6m3 Watercart,																																					
Civils Conventional Structures	19/09/2024	13/11/2024	12T Excavator, 12T Excavator, 8T Roller, 6m3 Watercart,																																					
Civils Ancillary Area	23/01/2025	19/03/2025	12T Excavator, 12T Excavator, 8T Roller, 6m3 Watercart,																																					
Civil Finishing Works Complete	19/03/2025	19/03/2025	12T Excavator, 12T Excavator, 8T Roller, 6m3 Watercart,																																					
Commissioning	20/03/2025	9/07/2025																																						
Plant Commissioning	20/03/2025	9/07/2025																																						
Replacement Plant Commissioning Complete	9/07/2025	9/07/2025																																						
Contingency	10/07/2025	24/12/2025																																						
Contingency	10/07/2025	24/12/2025																																						
Complete WTP	24/12/2025	24/12/2025																																						
Woodlands Park Reservoir Construction	1/12/2022	6/11/2024																																		0	0	0	0	0
Retaining wall and Bulk Earthworks	1/12/2022	15/11/2023																																		0	0	0	0	0
Commence woodlands park reservoir	1/12/2022	1/12/2022																																						
Site Establishment (reservoir)	1/12/2022	14/12/2022	8T Excavator, 20-30T Excavator, 12T Construction roller, Franna (Yard Crane),																																					
Retaining Wall Construction / Slope Stabilisation	15/12/2022	8/02/2023	25T - 35T Mobile crane, 12T Excavator, ,																																	2	2			
Piling works	9/02/2023	5/04/2023	45T Piling Rig, 12T Excavator, 25T Mobile Crane, Concrete Vibrator,																																			16	16	
Bulk Earthworks	6/04/2023	15/11/2023	Anchor Drill Rig , Shotcrete Rig, 30T Excavator , 20T Excavator , 12T Excavator , , ,																																					36
Reservoir Piping Pipework and Ducting	29/06/2023	9/08/2023																																						
Reservoir Under slab	29/06/2023	9/08/2023	12T Excavator, 12T Excavator, 8T Roller, 6m3 Watercart,																																					
Woodlands Park Reservoir	13/07/2023	22/05/2024																																						
Slab	13/07/2023	6/09/2023	28m Concrete Boom (20% usage) , Concrete Vibrator (20% usage), ,																																					
Reservoir Walls	10/08/2023	10/04/2024	28m Concrete Boom (20% usage) , 25T Crane, Concrete Vibrator (20% usage), ,																																					
Reservoir Roof Structure	1/02/2024	22/05/2024	50T Crane, EWP All-terrain 16m, EWP All-terrain 16m, 28m Concrete Boom (20% usage) , Concrete Vibrator (2																																					
Electrical and Mechanical	23/05/2024	3/07/2024																																						
Electrical and Mechanical Fitout 1	23/05/2024	3/07/2024	50T Mobile Crane (20% usage),																																					
Commissioning	4/07/2024	28/08/2024																																						
Commissioning Reservoir 1	4/07/2024	28/08/2024																																						
Civils (SW/Pipes/Ducts/Cables/Roading)	4/07/2024	4/09/2024																																						
All Civil Works around Structures	4/07/2024	4/09/2024	12T Excavator, 12T Excavator, 8T Roller, 6m3 Watercart,																																					
Contingency	5/09/2024	6/11/2024																																						
Contingency	5/09/2024	6/11/2024																																						
Woodlands Park Reservoir Completed	6/11/2024	6/11/2024																																						
Existing WTP Demolition and new Reservor	25/12/2025	10/03/2028																																						
Site Establishment	25/12/2025	14/01/2026	8T Excavator, 20-30T Excavator, 12T Construction roller, Franna (Yard Crane),																																					
Decomission existing plant	15/01/2026	11/03/2026	50T Mobile Crane (20% usage),																																					
Demolition of Existing Structure	12/03/2026	6/05/2026																																						
Demolish existing structures on site to make way for	12/03/2026	6/05/2026	Truck and Trailer - Rock Bins, 30T Excavator with nibbler, 30T Excavator with Grab, 20T Excavator Support,																																					
Existing WTP Reservoir	12/03/2026	20/08/2027																																						
Ground improvements	12/03/2026	22/04/2026	45T Piling Rig, 12T Excavator, 25T Mobile Crane, Concrete Vibrator,																																					
Build 4m Pad for Reservoir	23/04/2026	3/07/2026	Dozer D6, 20T Excavator, 12T Excavator, 12T Vibratory/Static Construction roller, 10m3 Water cart,																																					
Slab	6/07/2026	28/08/2026	28m Concrete Boom (20% usage) , Concrete Vibrator (20% usage), ,																																					
Reservoir Walls	31/08/2026	30/04/2027	28m Concrete Boom (20% usage) , 25T Crane, Concrete Vibrator (20% usage), ,																																					
Reservoir Roof Structure	3/05/2027	20/08/2027	28m Concrete Boom (20% usage) , Concrete Vibrator (20% usage), ,																																					
Existing WTP Reservoir Mechanical and Commissioning	23/08/2027	7/01/2028																																						
Electrical and Mechanical Fitout 2	23/08/2027	1/10/2027	50T Mobile Crane (20% usage),																																					
Commissioning Reservoir 2	4/10/2027	26/11/2027																																						
All Civil Works around Structures	29/11/2027	7/01/2028	12T Excavator, 12T Excavator, 8T Roller, 6m3 Watercart,																																					
Contingency	10/01/2028	10/03/2028																																						
Contingency	10/01/2028	10/03/2028																																						
Project Completion	10/03/2028	10/03/2028																																						
			TOTAL HV Movements/day (both directions)	0	0	33	13	13	13	16	24	10	0	0	0	0	0	0	0	0	0	0	0	0	13	13	13	28	24	24	26	26	26	26	67	69	79	77	81	76

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HV Movements/day T&T EWKS CUT	0	0	0	0	0	0	0	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	24	24	24	24	24	24	24	24	24	24	36
HV Movements/day 6W EWKS CUT	0	0	0	0	0	0	0	61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	61	61	61	61	61	61	61	61	61	61	61	91
HV Movements/day NON EWKS	0	0	33	13	13	13	16	0	10	0	0	0	0	0	0	0	0	0	0	0	0	13	13	13	28	0	0	2	2	2	2	43	45	54	52	56	40

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Rigid body	0	0	14	12	12	12	8	1	8	0	0	0	0	0	0	0	0	0	0	0	0	12	12	12	3	1	1	1	1	1	1	9	9	18	18	20	10
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Truck and Trailer	0	0	12	0	0	0	6	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	24	24	25	25	25	25	54	54	54	54	54	56
Overdimension	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0

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62	32	38	32	32	32	32	0	0	0	0	0	0	0	12	12	6	12	6	0	0	6	6	0	0	0	0	0	0	0	0	0	0	0	6	6	24	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0
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