# Design and Construction Statement

## Queen Street Wastewater Diversion Project – Part 3

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| Document Title: | Design and Construction Statement, Queen Street Wastewater Diversion Project – Part 3 |
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# 1 Introduction

The Design and Construction Statement (DCS) has been prepared with input from Fulton Hogan (FH) and McConnel Dowell (MCD) and is provided to support a resource consent application.

Watercare Services Limited (Watercare) are proposing to upgrade the wastewater network within the upper catchment of Auckland City Centre. It has been established by Watercare that the existing network does not have sufficient capacity to meet future needs.

To enable upgrade works, the wider project works have been split into parts for the purpose of consenting and construction. This DCS has been prepared to support the resource consent application for Part 3 (Queen Street Alignment) of the project works. Figure 1 shows the relationship of Part 3 works with the wider Queen Street Wastewater Diversion Project.

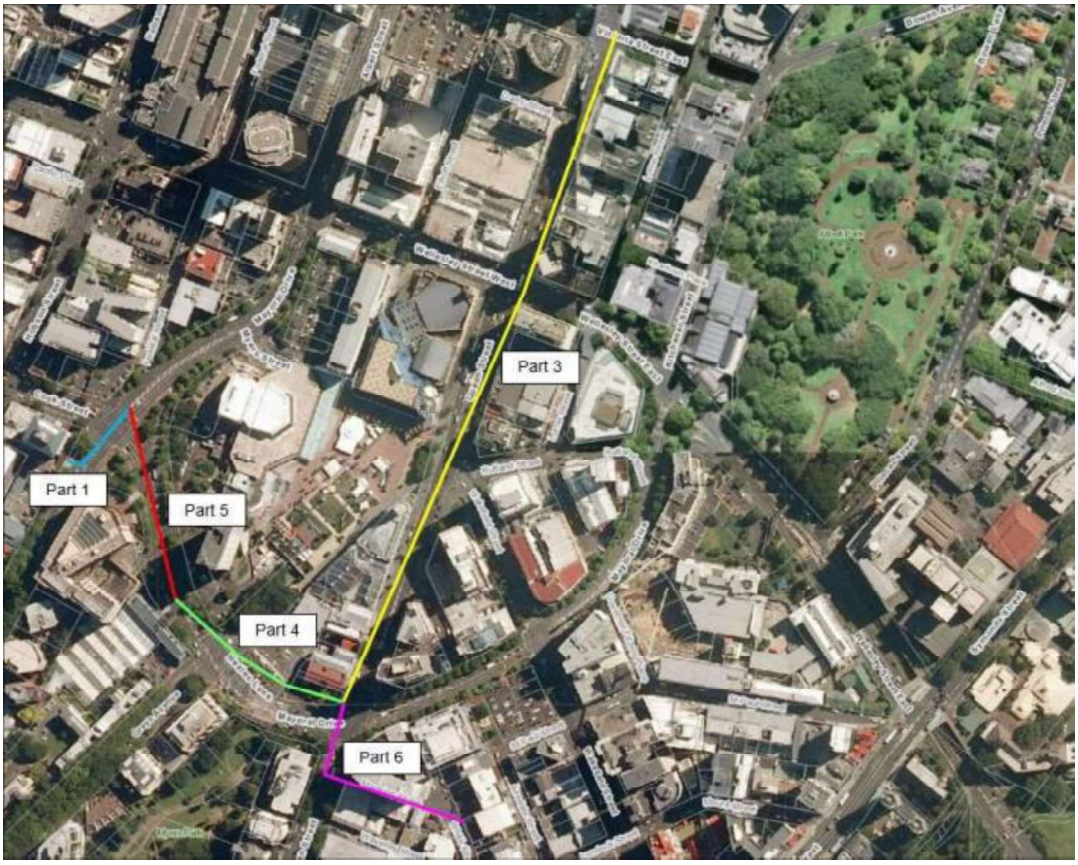



*Figure 1 Queen Street Wastewater Diversion Project (Part 3 shown in Yellow)*

This DCS outlines the design and construction method for the project which involves a new wastewater pipe running under Queen Street from Mayoral Drive, north to Victoria Street. The new pipe will connect into the existing network, providing additional wastewater capacity.

The following supporting information has been attached to this statement (Table 1).

*Table 1 Supporting information to DCS*

| Supporting Information | |
|---|---|
| Attachment A | Abbreviations and Definitions |
| Attachment B | Drawings |

## 1.1 Summary of Construction works

Prior to tunnelling works commencing, three temporary construction shafts are to be formed along Queen Street. These will be located near the Queen Street intersection of Mayoral Drive, Wellesley Street and Victoria Street. The shaft at Mayoral Drive will be used to launch the micro tunnel boring machine (mTBM) with the Victoria Street shaft being used to recover the mTBM following completion of tunnelling works. If necessary, the Wellesley Street shaft may be used to change the mTBM cutter head. This would require the use of a 25t mobile crane.

Each shaft is expected to take 21-23 weeks to construct. It is yet to be determined if excavation of each shaft will occur concurrently. Start dates will be influenced by timeframes for network utility diversions.

A Construction Support Area (CSA) will be established in the Greys Avenue Car Park and will be used to house ancillary equipment to support tunnelling operations. Similarly, a CSA will be established at each shaft location.

It is anticipated that tunnelling works on site will take approximately 19 weeks to complete. This timeframe includes site setup and equipment recovery. Once tunnelling works are complete, each shaft will be backfilled and converted to a manhole for future access to the new wastewater mainline.

# 2 Design Overview

Part 3 of the Queen Street Wastewater Diversion Project will result in the formation of a new wastewater mainline under Queen Street, running from Mayoral Drive to Victoria Street. At Victoria Street, the new pipe will connect and discharge into the Orakei Main Sewer.

Figure 2 shows the proposed alignment of the pipeline along Queen Street.

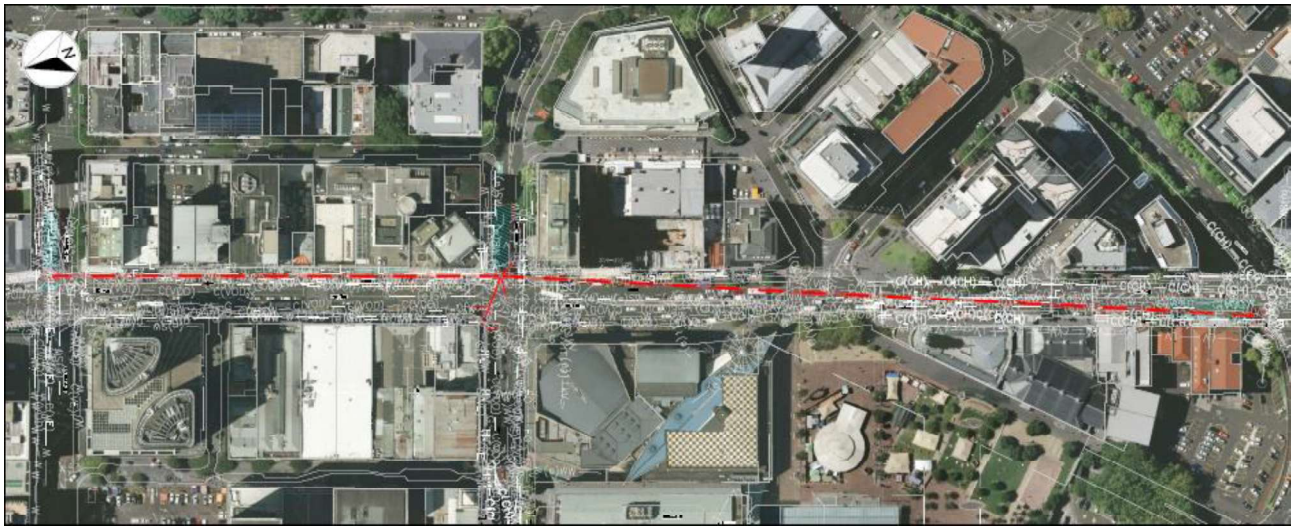


*Figure 2 Proposed pipeline alignment along Queen Street*

A set of design drawings are provided in Attachment B that detail the pipe alignment. depth of manholes and longitude sections.

The section of pipe from Victoria Street to Wellesley Street will have a distance of 216.5m, with a gradient of 1.75% upwards when heading south. The section of pipe from Wellesley Street to Mayoral Drive will have a distance of 364.3m with a gradient of 1.95% upwards when heading south. The proposed pipe will have a diameter of 1.2m.

At each of the shaft locations, a manhole is to be provided once tunnelling works are completed. The proposed depth of each manhole from finished ground level to pipe invert will be:

- Victoria Street: 6.87m
- Wellesley Street: 7.21m
- Mayoral Drive: 13.79m

# 3 Construction Footprint

The surface footprint of construction activities will be focused in three locations, being at or adjacent to the intersections of:

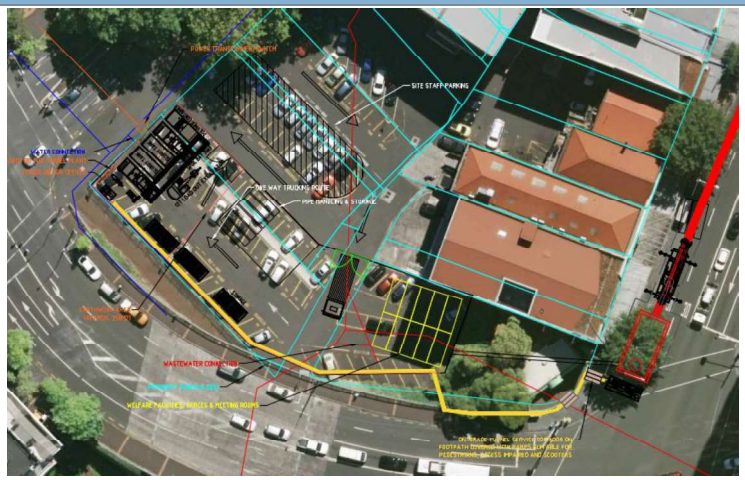
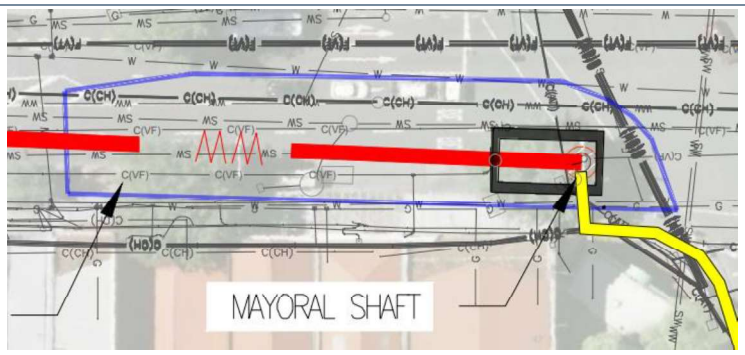
- Queen Street and Mayoral Drive
- Queen Street and Wellesley Street
- Queen Street and Victoria Street

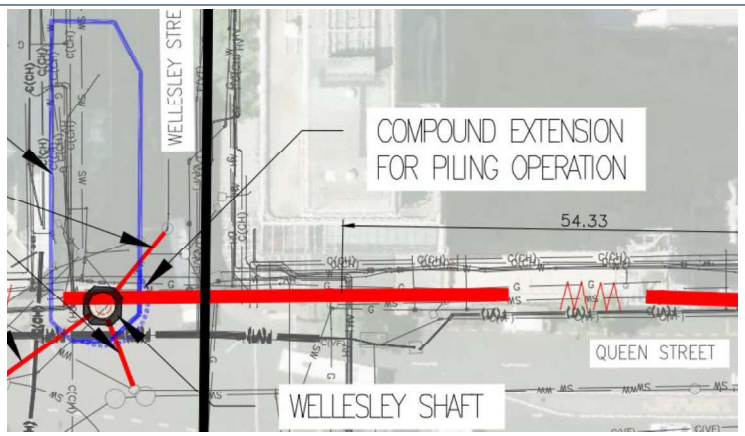
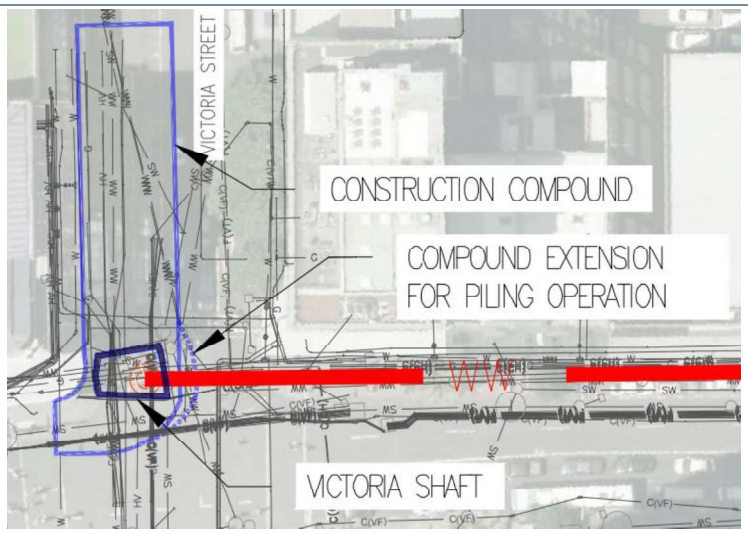
At each location a temporary shaft will be created along with an associated construction support area (compound). At Mayoral Drive, an additional compound area will be established in the surface carpark which can be accessed from Greys Ave.

## 3.1 Construction Support Areas

Table 2 notes the proposed Construction Support Areas (CSA) to be established for the project works. Earthworks are required at the Greys Avenue CSA to level the site near the western boundary with Greys Avenue. An estimated cut earthworks volume of 840m$^3$ over an area of 370m$^2$ has been allowed for.

*Table 2 Construction Support Areas*

| Construction Support Areas | | |
|---|---|---|
| Name and location | Figure | Additional Info |
| **Greys Ave CSA**<br>Occupies land at 38 Greys Avenue and 329 Queen Street. |  | Established from June 2024 to December 2024.<br>Site area of 1255m$^2$.<br><br><u>Use/ equipment</u>:<br>• Support tunnelling works<br>• Tunnelling support equipment<br>• Site office<br>• Pipe storage<br>• Spoil removal during tunnelling |
| **Mayoral Drive CSA**<br>Occupies section of Queen Street, outside 323 Queen Street. |  | Established April 2024 to December 2024.<br>Site area of 720m$^2$.<br><br><u>Use/ equipment</u><br>• Shaft construction<br>• Tunnel lunch site<br>• Material inputs for tunnelling works<br>• Crane<br>• Short term material storage during tunnelling works. |

| | | |
|---|---|---|
| **Wellesley Street CSA**<br>Occupies section of Wellesley Street outside of 290 Queen Street. |  | Established April 2024 to December 2024.<br>Site area of 315m$^2$.<br><br><u>Use/ equipment</u><br>• Shaft construction |
| **Victoria Street CSA**<br>Occupies section of Victoria Street outside of 210 Queen Street. |  | Established April 2024 to December 2024.<br>Site area of 540m$^2$.<br><br><u>Use/ equipment</u><br>• Shaft construction<br>• Retrieval of tunnelling equipment |

# 4 Construction Activity

The following sets out the construction activities and methods to be used for the project works. Construction works can be separated into two distinct parts, being temporary shaft construction and tunnelling activity.

## 4.1 Construction Hours and Duration

Table 3 notes the proposed hours for construction works. Please note that in some circumstances, work may be required outside the noted hours due to operational requirements. The separation plant at the Greys Avenue CSA site will operate from 0700hrs to 2000hrs.

*Table 3 Construction hours*

| | |
|---|---|
| Shaft Construction | Monday to Saturday – 0700hrs to 1800hrs<br>Sunday and night work will only be caried out if required by traffic management restrictions or Watercare operational requirements for tie ins/ connections to existing network |
| Tunnelling works | Monday to Saturday – 0700hrs to 1900hrs |

Specific timeframes for construction works are still to be confirmed, however it is anticipated that physical works would commence from Q1 2024 and would finish around Q1 2025. Table 4 notes the anticipated duration of key construction works.

*Table 4 Construction activity duration*

| Queen Street / Mayoral Drive Shaft | Queen Street/ Wellesley Street Shaft | Queen Street/ Victoria Street Shaft | Tunnelling Activity (including site establishment etc) |
|---|---|---|---|
| 2 to 3 months to construct shaft (Q2 to Q3 2024) | 2 to 3 months to construct shaft (Q2 to Q3 2024)<br>Queen Street pipe work connections (x3) – 1 month (Q3 2024) | 3 to 4 months to construct shaft (Q2 to Q3 2024) | Site Establishment:<br>2 months (Q2 2024)<br>Tunnelling works:<br>4 months (Q3 to Q4 2024)<br>Equipment Recovery<br>Less than 1 months (Q4 2024) |

## 4.2 Network Utility Relocation Works

***NOTE**: due to limited information at present, relocation of network utilities does not form part of the resource consent application for Part 3 works. Resource consent for these activities will be applied for separately.*

Existing network utilities will need to be relocated prior to the shaft construction and commencement of tunneling works. The exact services that will be relocated are still to be confirmed.

The relocation works will most likely be staged in short sections to minimise traffic disruption. Network utility relocation works will generally include:

- Set up of temporary traffic management with site fencing
- Hydro-excavation to confirm the new diversion route is clear of other unknown services
- Open trench excavation to lay down new ducts or pipe work. Trench shields to be used for all trenches over 1.5m in depth.
- Hand cable pulling through new duct work
- Cutover period where new diversion will be made active and old routes decommissioned.

## 4.3 Shaft Construction Works

A total of three construction shafts will be formed as part of the project. The staging of each shaft's construction will be dependent on the timeframe of network utility diversions. Following completion of the tunnelling works, the shafts will be backfilled and become manholes.

Table 5 details the area and volume of earthworks associated with the construction of each shaft. The quantities below are subject to final shaft designs and diversion of services.

*Table 5 Earthworks for shaft construction*

| Earthworks Shaft Construction | | | Internal Dimension | |
|---|---|---|---|---|
| Location | Area | Volume | Width | Length |
| Queen Street/ Mayoral Drive Shaft | 60.5m$^2$ | 968m$^2$ | 4.5m | 10m |
| Queen Street/ Wellesley Street Shaft | 12.6m$^2$ | 126 m$^2$ | 3.5m | Circle |
| Queen Street/ Victoria Street Shaft | 32m$^2$ | 240m$^2$ | 3m | 7m |

Below is additional detail on the construction of each shaft.

### *4.3.1 Queen Street/ Mayoral Drive Shaft*

The internal measurements of the shaft, once constructed, will be 4.5m in width and 10m in length. The shaft will have a total depth of 16m. To construct the shaft the following steps outlined in Table 6 will be followed.

*Table 6 Construction of Queen Street/ Mayoral Drive shaft*

| Shaft Construction<br>Queen Street/ Mayoral Drive | | |
|---|---|---|
| STAGE | ACTIVITY | EQUIPMENT/ MATERIALS |
| 1 | Shaft extent will be saw cut and an 8t to 14t excavator used to remove pavement layers and other shallow level obstructions. | • Concreate cutter<br>• 8 to 14t Excavator |
| 2 | A GEAX EX40/60 piling rig will be used to bore 400 to 600mm diameter holes to a depth of 2m below shaft base<br>If ground conditions require, the bores maybe temporarily cased with steel casings. | • Piling rig (GEAZ EX40/ 60) |
| 3 | Steel UC posts will be lowered into each bore using a 14t excavator and the bores backfilled with sand or pea gravel. | • 14t Excavator |
| 4 | Shaft extent will be excavated using a 5 to 20t excavator and workers with compressor powered hand held air tools.<br>A 25t crane and skip will be used to remove hand excavated materials when the excavator runs out of reach.<br>Shaft spoil will be removed from site using a 6 or 8 wheeler truck with sealed bins. | • 5 to 20t Excavator<br>• Hand held power tools<br>• 25t Crane<br>• Skip<br>• 6 or 8 wheeler truck |
| 5 | Timber lagging will be cut to fit and installed between UC posts as the excavation progresses to retaining surrounding ground.<br>Steel waler beams will be installed and welded together within the shaft to support the UC posts. | • Timber lagging<br>• Steel waler beams |
| 6 | Shaft will require 24/7 dewatering and a submersible pump will be used to pump water into clarifying tank(s) for treatment, before discharging into the local wastewater network.<br>The pump will be powered by a diesel generator which will run continuously while the shaft is open (subject to water ingress rates). Please note that if possible, connection to local power network would be used over a generator.<br>Forced air ventilation will be required using a fan at surface level with ventilation ducting into the shaft. | • Submersible pump<br>• Diesel generator (90kW)<br>• Ventilation fan |
| 6 | Following completion of tunnelling works, an in situ concrete manhole will be formed and poured within the shaft using a concrete skip and 25t crane at road level or with concrete pump.<br>Precast concrete riser manhole sections will be installed using a 25t crane at road level.<br>Shaft will be backfilled with compacted GAP65 or low strength concrete. | • 25t crane<br>• Concrete skip<br>• Concrete pump |
| 7 | Temporary works will be progressively removed using a 5t to 20t excavator as the shaft is backfilled. | • 5 to 20t Excavator |
| 8 | Road pavement (GAP65 and AC) will be reinstated using a 5 to 20t excavator and plate compactor. | • 5 to 20t Excavator<br>• Plate compactor |

Figure 3 shows the layout of the Mayoral Drive CSA during shaft construction works.

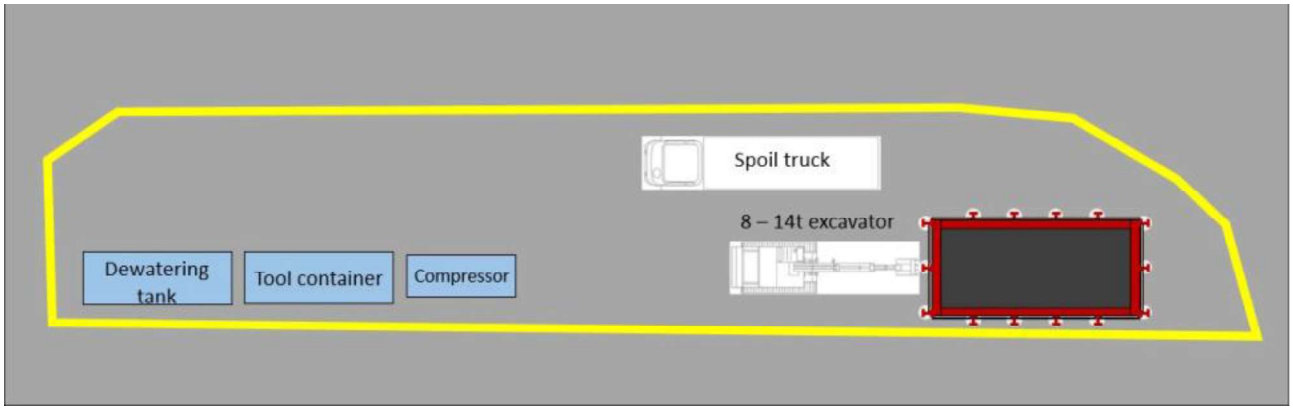



*Figure 3 Mayoral Drive CSA layout during shaft construction*

As noted in Table 6, due to the construction method of the shaft, ongoing dewatering will be required. Dewatering will be required for up to 12 months, all day and night. This is expected to be the only activity requiring night works.

During tunnelling works, the layout and equipment within the Mayoral Drive CSA will change.

### *4.3.2 Queen Street/ Wellesley Street Shaft*

The shaft once constructed will have an internal diameter of 3.5m with a total depth of 10m. To construct the shaft, the following steps outlined in Table 7 will be followed.

*Table 7 Construction of Queen Street/ Wellesley Street shaft*

| Shaft Construction<br>Queen Street/ Wellesley Street | | |
|---|---|---|
| STAGE | ACTIVITY | EQUIPMENT/ MATERIALS |
| 1 | Shaft extent will be saw cut and a 5t to 20t excavator used to remove pavement layers and other shallow level obstructions. | • Concrete cutter<br>• 5 to 20t excavator |
| 2 | Concrete ring beam will be formed.<br>If required by temporary work design, hydraulic jacks will be fixed to the top of the ring beam.<br>Precast shaft/ manhole rings will be lifted to inside ring beam. | • Hydraulic jack |
| 3 | A combination of 8t excavator digging and jacks will be used to sink the precast shaft rings.<br>As the depth increases workers will access the shaft and hand excavate the shaft into a skip lifted by 25t crane.<br>Shaft spoil will be removed from the site using 6 or 8 wheeler trucks with sealed bins. | • 8t Excavator<br>• Hydraulic jacks<br>• Hand held power tools<br>• Skip<br>• 25t Crane<br>• 6 or 8 wheeler trucks |
| 4 | In situ concrete foundation plug will be poured using a concrete boom pump or skip. | • Concrete pump (or skip) |
| 5 | Following completion of tunnelling works, an in situ concrete manhole will be formed and poured within the shaft using a concrete skip and 25t crane at road level or with concrete pump.<br>Precast concrete riser manhole sections will be installed using a 25t crane at road level.<br>Shaft will be backfilled with compacted GAP65 or low strength concrete. | • 25t crane<br>• Concrete skip<br>• Concrete pump |
| 6 | Temporary works will be progressively removed using a 5t to 20t excavator as the shaft is backfilled. | • 5 to 20t Excavator |
| 7 | Road pavement (GAP65 and AC) will be reinstated using a 5 to 20t excavator and plate compactor. | • 5 to 20t Excavator<br>• Plate compactor |

Figure 4 provides a typical photo of jacked caisson shaft sinking method.

*Figure 4 Typical photo of jacked caisson shaft sinking method*

As shown in the drawings within Section 3.1 above, the CSA for this shaft will need to be extended a short distance to the south during piling works. It is estimated that these works will take place over two weeks.

### *4.3.3 Queen Street/ Victoria Street Shaft*

The internal measurements of the shaft, once constructed, will be 3m in width and 7m in length. The shaft will have a total depth of 7.5m. To construct the shaft the following steps outlined in Table 8 will be followed.

*Table 8 Construction of Queen Street/ Victoria Street shaft*

| Shaft Construction<br>Queen Street/ Victoria Street | | |
|---|---|---|
| STAGE | ACTIVITY | EQUIPMENT/ MATERIALS |
| 1 | Shaft extent will be saw cut and a 5 to 20t excavator used to remove pavement layers and other shallow level obstructions. | • Concreate cutter<br>• 8 to 14t Excavator |
| 2 | GEAX EX 40/60 piling rig will be used to bore 400 to 600mm diameter holes to the top of basalt level.<br>If ground conditions require the bores maybe temporarily be cased with steel casings. | • Piling rig (GEAZ EX40/ 60) |
| 3 | Steel UC posts will be lowered into each bore using a 5 to 20t excavator and the bores backfilled with sand or pea gravel. | • 5 to 20t excavator |
| 4 | The shaft extents will be excavated using an 8 to 14t excavator and workers with compressor powered hand held air tools.<br>A 25t crane and skip will be used to remove hand held excavated materials when the excavator runs out of reach.<br>Shaft spoil will be removed from site using a 6 to 8 wheeler trucks with sealed bins. | • 8 to 14t excavator<br>• Hand held power tools<br>• 25t crane<br>• Skip<br>• 6 or 8 wheeler truck |
| 5 | Timber lagging will be cut to fit and installed between UC posts as the excavation progresses to retaining the surrounding ground.<br>At least two steel waler beams will be installed and welded together within the shaft to support the UC posts. | • Timber lagging<br>• Steel waler beams |
| 6 | Solid basalt is likely to be found within this shaft at approximately 5.5m below road level. | • Excavator<br>• Rig mounted core drill<br>• Hand held core drill |

| | | |
|---|---|---|
| | The basalt layer will be fractured using a stitch core line of holes to nominated lift depth in the basalt, adjacent and parallel to the OMS to provide a relief gap.<br>Rows of holes will be drilled adjacent and parallel to the stitch cored row.<br>Plug and feather wedges or expanding mortar methods will be used to fracture the basalt until the final excavation depth is achieved.<br>See Figure 6 below for a sketch of the rock fracturing methodology. | • Plug and feather wedges |
| 7 | Shaft will require 24/7 dewatering and a submersible pump will be used to pump water into clarifying tank(s) for treatment, before discharging into the local wastewater network.<br>The pump will be powered by a diesel generator which will run continuously while the shaft is open (subject to water ingress rates). Please note that if possible, connection to local power network would be used over a generator.<br>Forced air ventilation will be required using a fan at surface level with ventilation ducting into the shaft. | • Submersible pump<br>• Diesel generator (90kW)<br>• Ventilation fan |
| 7 | After TBM extraction, an in situ concrete manhole will be formed and poured within the shaft using a concrete skip and 25t crane at road level or with concrete pump.<br>Precast concrete riser manhole sections will be installed using a 25t crane at road level.<br>Shaft will be backfilled with compacted GAP65 or low strength concrete. | • Concrete skip<br>• 25t crane |
| 8 | Temporary works will be progressively removed using a 5t to 20t excavator as the shaft is backfilled. | • 5t to 20t excavator |
| 9 | Road pavement (GAP65 and AC) will be reinstated using a 5t to 20t excavator and plate compactor. | • 5t to 20t excavator<br>• Plate compactor |

Figure 5 shows the proposed layout of the Victoria Street CSA during construction of the shaft. As noted in Table 8, due to the construction method of the shaft, ongoing dewatering will be required.

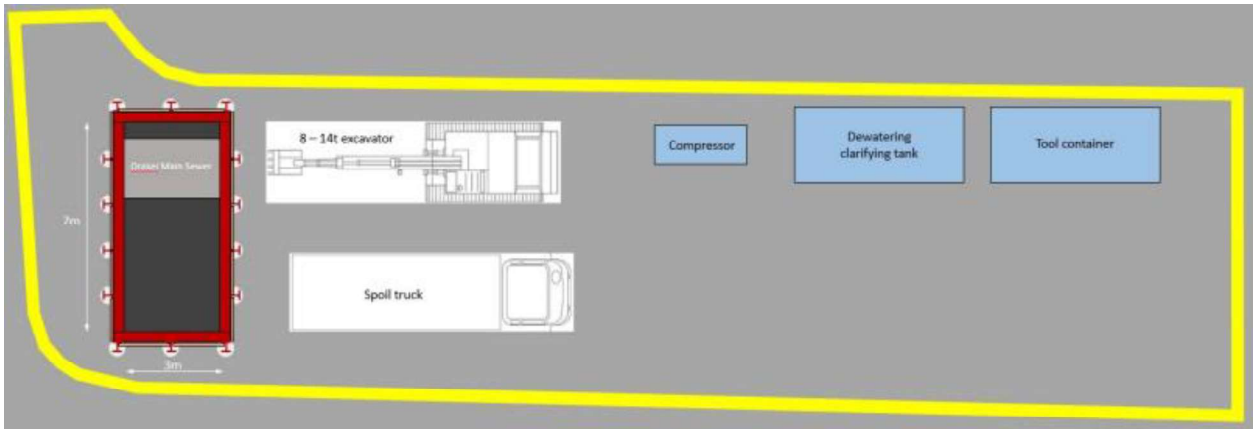



*Figure 5 Victoria Street CSA layout during shaft construction*

As shown in the drawings within Section 3.1 above, the CSA for this shaft will need to be extended a short distance to the south during piling works. It is estimated that these works will take place over two weeks.

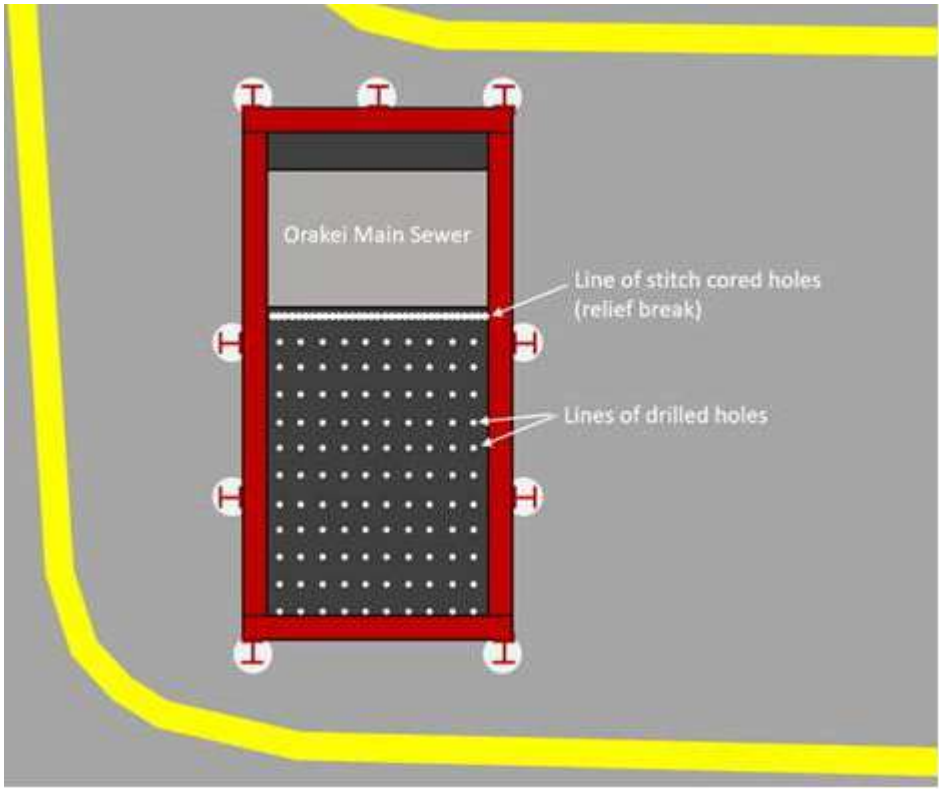



*Figure 6: Rock fracturing methodology*

## 4.4 Tunnelling Works

Trenchless construction will be used to construct the 600m length of pipe under Queen Street between Mayoral Drive and Victoria Street. The trenchless method proposed to be used is pipe jacking because it is a non-disruptive method for the installation of utility tunnels. The method will balance ground pressures, with surface effects being negligible or nil.

Tunneling works on site are expected to take approximately 19 weeks to complete. This timeframe includes site establishment and separation plant removal. The following provides details of the key stages undertaken during tunnelling works.

### *4.4.1 Site Establishment and Equipment Compound*

The Micro Tunnel Boring Machine (mTBM) will be launched from the Queen Street/ Mayoral Drive Shaft (located within the Mayoral Drive CSA) with the ancillary equipment to support tunnelling works being located within the Grey Avenue CSA.

Figure 7 shows the proposed site layout during tunnelling works.

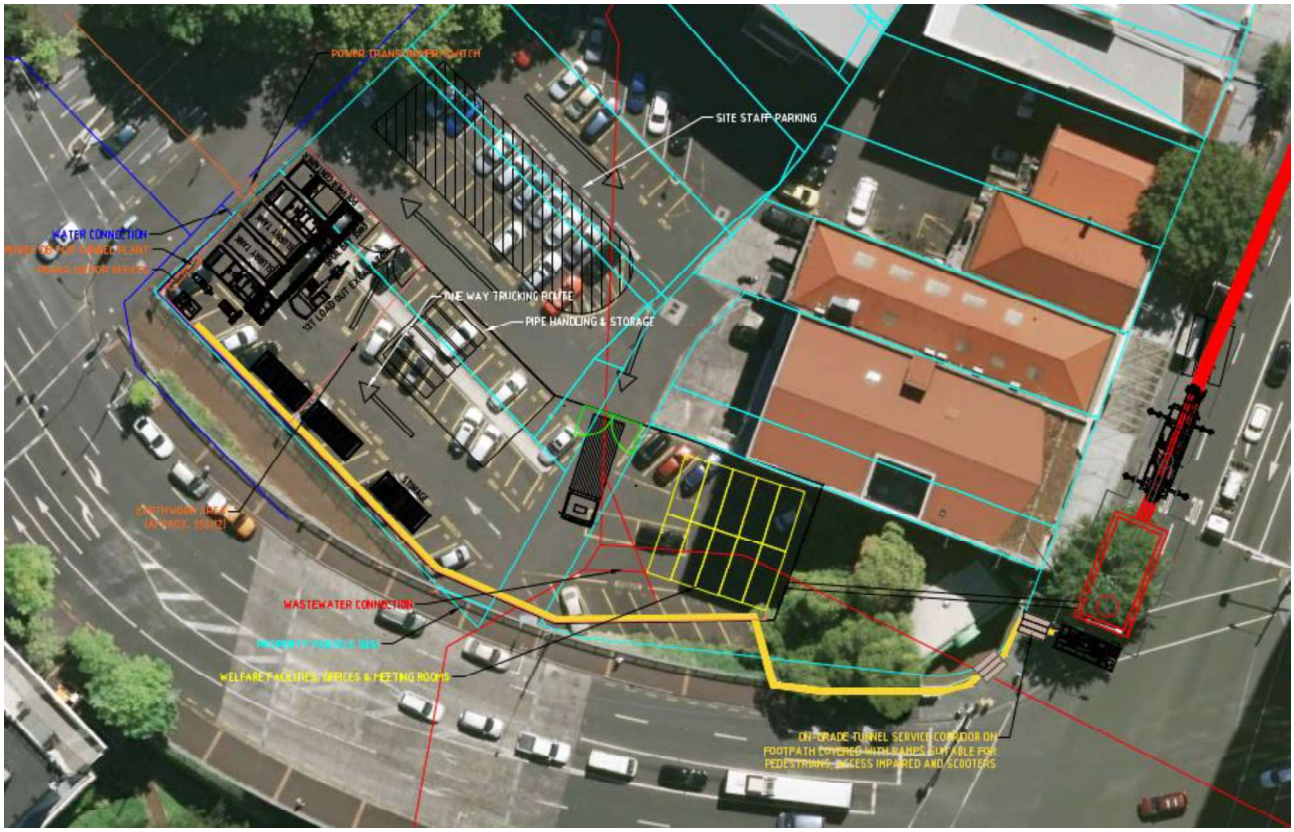



*Figure 7 Greys Ave CSA and Mayoral Drive CSA during tunnelling works*

The Greys Avenue CSA will be established from around June 2024 and will be used to house key ancillary equipment, and materials needed for the project works. The equipment contained within the CSA to support tunneling includes:

- Project site office
- Staff welfare facilities
- 12t excavator (for removing spoil from site, loading onto trucks)
- Separation plant
- Slurry tanks
- Electrical container
- 800kW diesel generator (only required if connection to electrical mains cannot be established)
- Pumps
- Site laydown area/ material storage area
- Pipe fit out area

Following shaft construction, the Mayoral Drive CSA will be used to support tunnelling activity. The equipment contained within the CSA will be:

- Tunnelling control cabin
- In-shaft jacking equipment
- 50t mobile crane
- Pipe laydown area

Between the two CSAs will be a 2m wide service corridor, connecting the operations at the two sites together. The services will be laid on the ground and covered with a walkway to maintain pedestrian access between Queen Street and Mayoral Drive.

### 4.4.2 *Tunnelling Operations*

Once operational, the mTBM will drive from the Queen Street/ Mayoral Drive shaft towards the Queen Street/ Victoria Street shaft. As the mTBM progresses, extracted material is transported in a slurry medium to the separation plant in pipes where the separation plant is used to separate the solid material from the liquid. Once separated, the spoil (solid material) is loaded onto trucks for off-site disposal. The remaining fluid is returned to the slurry circuit in a 'closed loop' system to pick up more material from the mTBM. The separation plant will operate from 0700hrs to 2000hrs.

As the mTBM progresses, 6m long sections of pipe will be installed. As the jacking rig is retracted, the next pipe section is lowered by a crane from the surface and placed into position. The cycle continues until the drive is complete.

Approximately 970m$^3$ of spoil is to be excavated during tunnelling activities.

As the drive continues, a natural clay bentonite is injected at the rear of the mTBM to fill the overcut annulus supporting the ground and providing lubrication to reduce jacking forces.

### 4.4.3 *mTBM Recovery at Queen Street/ Victoria Street Shaft*

Once tunnelling works are completed, the mTBM will be recovered from the Queen Street/ Victoria Street shaft. To do this the mTBM will be progressively dismantled in discrete parts to allow the machine to be extracted from the shaft.

As the mTBM components are heavy, a 25 to 30t mobile crane will be required to lift components to the surface.

Once the mTBM has been recovered, and the temporary works within the shaft removed, the shaft will be backfilled and become a manhole (as per Table 8 above).

## 4.5 Other Construction Works

The following construction works will also be undertaken as part of the Project.

### 4.5.1 *Orakei Main Sewer (OMS) Internal Support Works and Tie-in*

Prior to excavations taking place above Orakei Main Sewer (OMS) and unloading its arch shaped blockwork structure, internal support will be required to avoid its potential collapse.

A staged approach is required to ensure that the OMS can be exposed and a connection from the shaft at Victoria Street made without collapsing the existing structure.

- Stage One – The OMS structure is supported externally by a reinforced concrete shell, dowelled into the existing OMS blockwork arch.
- Stage Two – Excavations below the manhole base slab level will be required to enable to connection to the southern side of the OMS. A staged cut and break methodology will be developed to limit vibration into the OMS from rock breaking. The exposed wall of the OMS will be externally supported with an in-situ concrete wall fixed to the OMS with dowels, which will be poured in stages.
- Stage Three – A new connection will be made into the side of the OMS with a seal core barrel. An enclosed 'hot tap' machine, with 1000mm diameter concrete-cutting core barrel, would be bolted to the gate valve Z brackets (see Figure 8 below). Once sealed the hot tap machine would core the opening through the OMS wall. Upon removal of the hot tap machine, a permanent new concrete manhole would be formed, incorporating the new OMS wall.

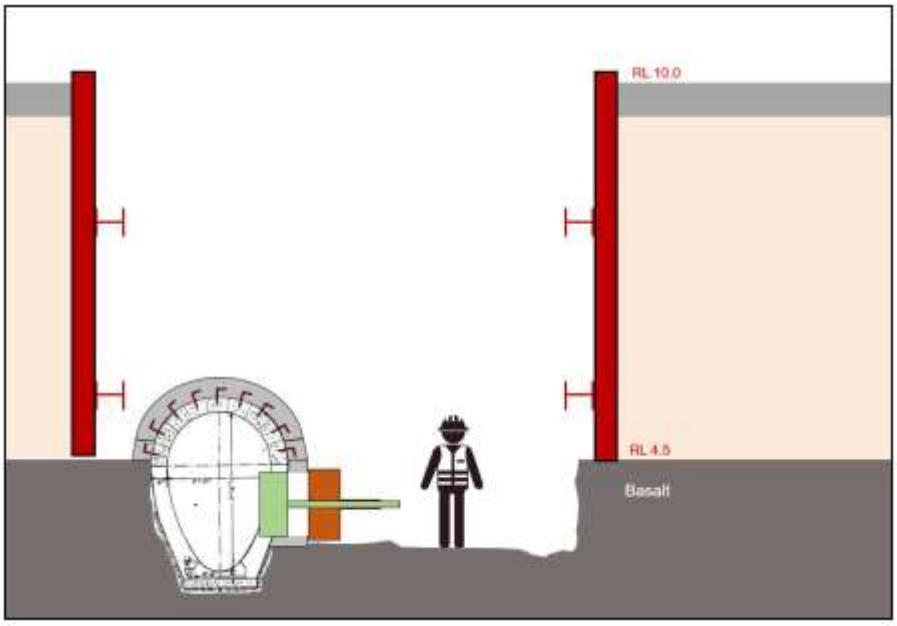



*Figure 8: Section view of a hot tap machine coring through the OMS wall*

### 4.5.2 Open Cut Pipe Laying for Local Connections

Local wastewater connections will be required into the Wellesley Street shaft as part of the project works. The following outlines the steps to be undertaken for the construction of the open cut pipe laying. The excavations required to create these connections is estimated to 1m in width by 1.5m depth for each pipe.

*Table 9 Open Cut Pipe Laying at Wellesley Street*

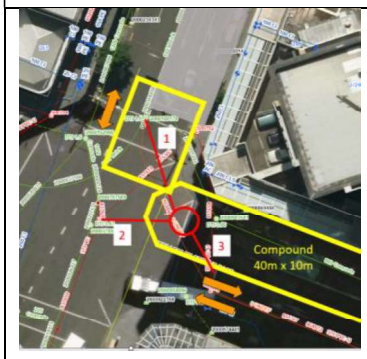
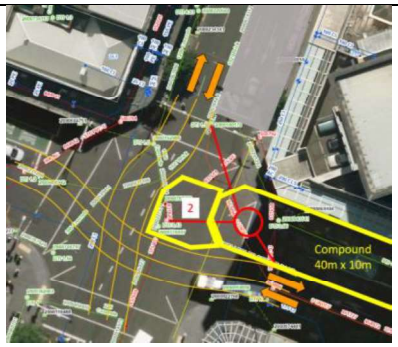
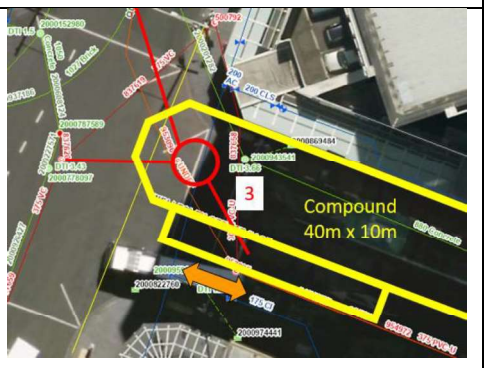
| Open Cut Pipe Laying<br>Queen Street/ Wellesley Street | | |
|---|---|---|
| STAGE | ACTIVITY | EQUIPMENT/ MATERIALS |
| 1 | Temporary traffic management set up in accordance with approved Traffic Management Plans (TMPs).<br>TMPs will be staged, allowing only short sections of pipeline to be constructed at any one time. | • Traffic management equipment |
| 2 | Approximately 20 to 30m of trenching will be open at any one time. Open earthworks would be up to 300m$^3$.<br>Depth of trenches are not known, however for any trench deeper than 1.5m, a trench shield will be used. | • Trench shield |
| 3 | Pipe lengths and precast manholes will be delivered to site on flatbed trucks and unloaded within the site using HIAB or excavators. | • Flatbed truck<br>• Excavator |
| 4 | Excavator will be used to trench to the required depth and install trench shields as the excavations advance.<br>Wider trench boxes will be provided at manhole locations.<br>Excavated material will be cut to waste as clean, managed or contaminated fill subject on contamination testing results. | • Trench shield<br>• Excavator |
| 5 | If dewatering is required (subject to ground investigation outcome), a two-inch submersible pump and hole will be used to remove water from excavations.<br>Water will be pumped into clarifying tanks/ containers for treatment before discharge.<br>The pumps will be powered by a diesel generator which will run continuously while the trench is open, dependent on water ingress rates. | • Submersible pump<br>• Diesel generator |

| | | |
|---|---|---|
| | Dewater is not anticipated to be required in a single location for more than three weeks. | |
| 6 | Pipe bedding material will be carted to the worksite directly from source in 6 or 8 wheeler trucks, spread into the trench using an excavator and compacted using 300kg plate compactors.<br>Excavators will be used to lift 2.4m pipe lengths into the trench. | • 6 to 8 wheeler truck<br>• Excavator |
| 7 | Side haunch, overlay bedding and hard fill to pavement level will be constructed as per pipe bedding material (refer above).<br>Pavement layer will be stepped out from trench excavation to provide key into the existing pavement layers.<br>Pavement aggregates will be spread using excavators and compacted using drum rollers. | • Excavator<br>• Drum roller |

These construction works will require some short-term temporary land closures and bus detours at the Wellesley Street / Queen Street intersection, as detailed in Section 7.5 of the TIA (**Appendix M**). Connection 1 will require the southbound lane on Queen Street to be closed, while Connection 3 will require the eastbound lane of Wellesley Street to be closed, see Table 4-8 below.

These connections are proposed to be constructed over long weekends or the Christmas shutdown (ie Christmas week and the first week of January) to minimise disruption on public transport services.

*Table 4-10: Location and Length of Three Wastewater Connections*

| Connection 1 | Connection 2 | Connection 3 |
|---|---|---|
| 14.76m in length | 10m in length | 11.4m in length |
| Adjacent to the north approach on Queen Street | In the middle of the intersection | Adjacent to the east approach on Wellesley Street |
|  |  |  |

## 4.6 Earthworks Summary

The earthworks required for the construction of the project are summarised below:

*Table 4-11: Summary of earthworks required*

| Location | Earthworks | |
|---|---|---|
| | Area ($m^2$) | Volume ($m^3$) |
| Mayoral Drive/ Queen Street | 60.5 | 968 |
| Wellesley Street/ Queen Street | 12.6 | 126 |

| | | |
|---|---|---|
| Victoria Street/ Queen Street | 32 | 240 |
| Works within Greys Avenue CSA | 370 | 840 |
| Local network connections into shafts | 37 | 55 |
| mTBM excavations | 804 | 970 |

# 5 Vehicles and Equipment

Table 10 provides a list of vehicles and equipment to be used on the project. Please note that some items will be used multiple times during construction works.

*Table 12 Vehicles and equipment*

| Vehicles and equipment used for project works | |
|---|---|
| VEHICLES AND EQUIPMENT | STAGE OF WORKS |
| Hydrovac | Utility relocation |
| Excavators (5 to 20t) | All stages of works |
| 6 or 8 wheeler trucks | All stages of works |
| GEAZ EX40/ 60 piling rig | Shaft construction |
| Submersible pump | Dewatering |
| Diesel generator | All stages of works |
| Ventilation fan | Shaft construction, some tunnelling works |
| Air powered handheld tools | Shaft construction |
| Crane | All stages of works |
| Skips | All stages of works |
| Boom pump | Shaft construction |
| Micro-Tunnel Boring Machine | Tunnelling works |
| Plate compactor | Open cut connections and road reinstatement |
| Drum roller | Open cut connections |
| Slurry Machine | Tunnelling works |
| Separation Plant | Tunnelling works |
| mTBM control cabin including cooling fan system | Tunnelling works |
| | |

## 5.1 Vehicle Movements

Vehicles movements will be occurring to and from the CSAs during the project works. The following outlines the likely vehicle movements anticipated to occur.

| Stage of Works | Likely vehicle movements (daily – average) | |
|---|---|---|
| Shaft Construction | Mayoral Drive CSA | • Light vehicles: 10 per day<br>• Flatbed delivery trucks: 2 per day<br>• Spoil/ aggregate trucks: 8 per day (peak) |
| | Wellesley Street CSA | • Light vehicles: 10 per day<br>• Flatbed delivery trucks: 2 per day<br>• Spoil/ aggregate trucks: 8 per day (peak) |
| | Victoria Street CSA | • Light vehicles: 10 per day |

| | | |
|---|---|---|
| | | • Flatbed delivery trucks: 2 per day<br>• Spoil/ aggregate trucks: 8 per day (peak) |
| Tunnelling Works | Spoil removal from Greys Avenue CSA: 10 trucks per day (peak) | |
| | Material delivery trucks to Greys Avenue CSA: 6 trucks per day (peak) | |

Please note that other vehicle movements will occur during site establishment and disestablishment.

# 6 Document Change Log

The following table notes the changes and updates to this document.

| Version | Date | Changes to document | Approved by Fulton Hogan |
|---|---|---|---|
| V0-1 | 11 April 2023 | Statement developed based on information provided by Fulton Hogan and McConnel Dowell. | |
| V0-2 | 24 April 2023 | New information issued and statement updated with the following changes made:<br>- Earthworks information provided<br>- Internal shaft sizes provided<br>- Minor text edits<br>- Updated drawings provided in Attachment B. | |
| V1 | 29 May 2023 | Update to methodology of OMS tie-in and support works, as provided by Fulton Hogan | |
| V2 | 13 July 2023 | Methodology updates, update CSA and construction drawings. |  |

# ATTACHMENT A – Abbreviations and Definitions

The abbreviations and definitions listed below that those used in this document.

| | |
|---|---|
| A | |
| AC | Auckland Council |
| AEE | Assessment of Environmental Effects |
| AT | Auckland Transport |
| AUP | Auckland Unitary Plan (Operative in Part) |
| B | |
| Bgl | Below ground level |
| C | |
| CSA | Construction Support Areas |
| D | |
| DCS | Design and Construction Statement (this document) |
| F | |
| FH | Fulton Hogan |
| M | |
| MCD | McConnel Dowell |
| mTBM | Micro Tunnel Boring Machine |
| O | |
| OMS | Orakei Main Sewer |
| T | |
| TMPs | Traffic management plans |
| W | |
| Watercare | Watercare Services Limited |
| WSP | WSP New Zealand Limited |

# ATTACHMENT B - Drawings