Construction Methodology

Queen Street Wastewater Diversion – Package B

Contract No: CT7754

Project Manager:	Dominic Wakeland	Date:	28 November 2024
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Revision Details

Revision	Details
00	Draft methodology
01	Updated as per WSP comments
02	Updated to reflect change to alignment
03	Updated to clarify items as requested by WSP Planning Team
04	Shaft sizes updated by WSP post WSL Operations/WSL/WSP/FH Mayoral Drive Workshop
05	Shaft and compound sizes updated to reflect current Package B alignment

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Author:	D Wakeland

Contents

1. Introduction

The purpose of this high-level construction methodology statement is to provide an understanding of how the Project (Mayoral Drive section of the Queen Street Wastewater Diversion Project) will be implemented by Fulton Hogan (FH) for consent purposes under the Resource Management Act 1991.

The Project works generally comprise the construction of a new wastewater pipe to collect flows from the north end of Vincent Street and convey them to southern of Part 3 of the project, adjacent to the intersection of Mayoral Drive and Queen Street.

The Mayoral Drive Alignment is made up of 3 sections (Part 1, Part 4 and Part 5) as shown in Figure 1 below. The scheme also includes making connections to and taking wastewater flows from several existing Engineered Overflow Points (EOPs)along the alignment.

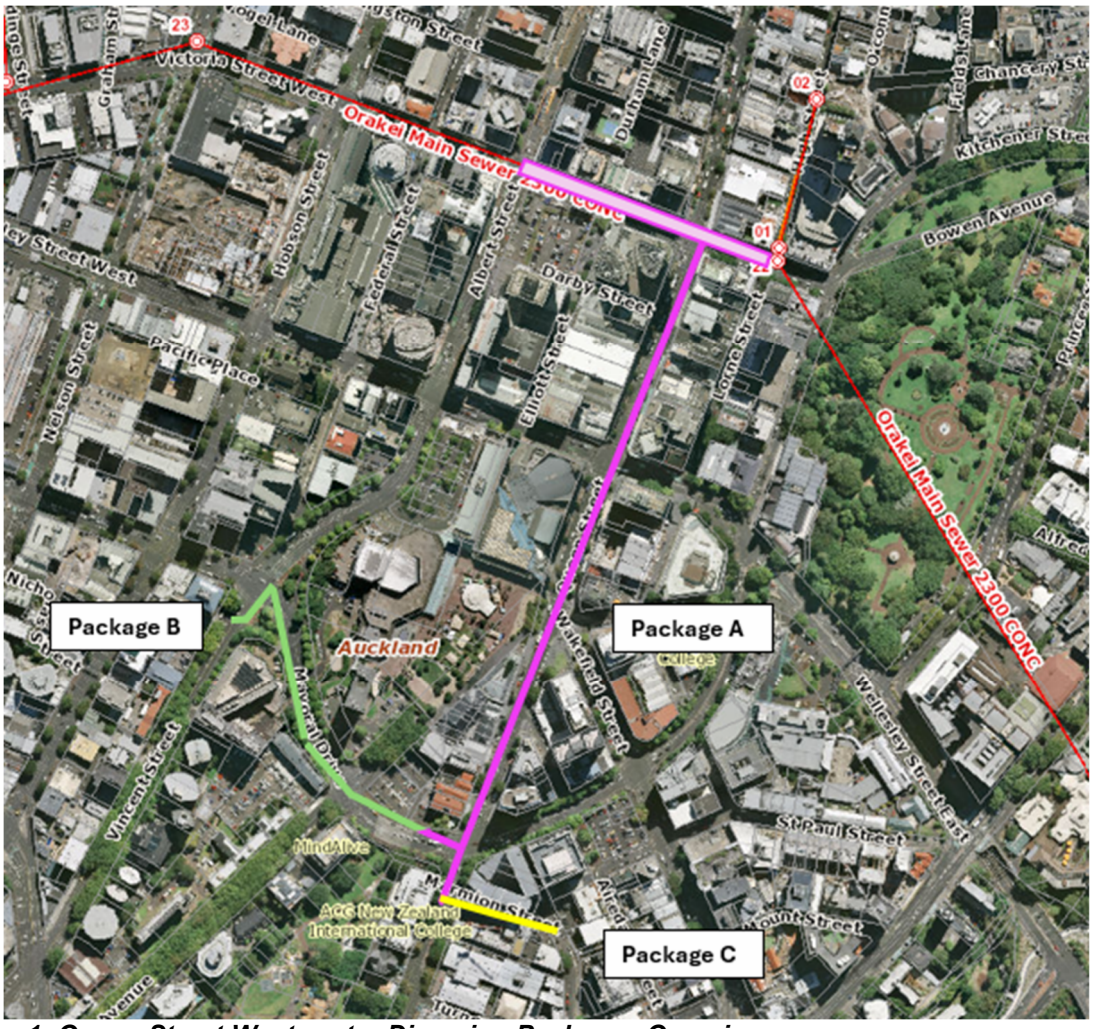

Figure 1: Queen Street Wastewater Diversion Packages Overview

This document has been created prior to issue of GFR, GIR, GBR or detailed design. Likewise, various stakeholder impacts will need to be assessed, and their constraints accommodated including assets, street trees, traffic needs, services, etc. As such, broad assumptions have been made and this methodology is subject to change as a result of new information becoming available.

This document covers the general sequencing and methodology for the construction of temporary shafts, pipelines, connections, manholes and associated works. It should be reviewed in conjunction with the FH high level construction programme (refer **Appendix A**).

2. Site Set Up and Enabling works

A construction support area (CSA) will be located within the Greys Avenue Carpark and will utilise the space previously established during the Part 3 (package A) works. Some office/cabin reconfiguration may be required (refer Figure 2 below).

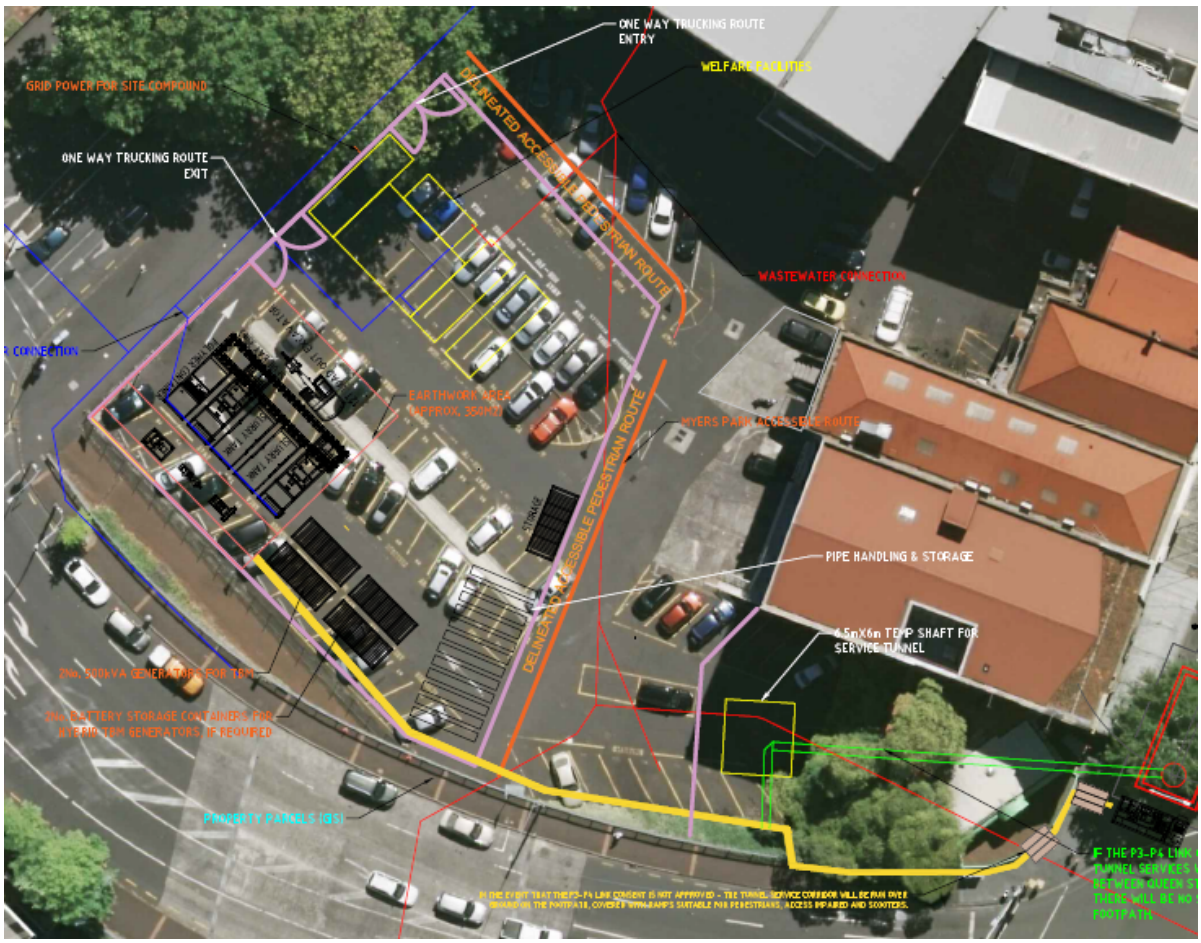

Figure 2: Layout for Construction Support Area

Limited site laydown/materials storage will be accommodated within the CSA. Most excavated materials and construction materials (pipes, aggregates, etc.) will be removed/delivered to the site on a “just-in-time” basis.

Traffic management will be setup in advance of compound construction ensuring all agreed vehicle, pedestrian and property access requirements are adhered to.

Four long-term site compounds (6 to 8 months) will be established within Mayoral Drive and Vincent St traffic lanes to allow construction of temporary shafts and tunnelling works. For these compounds, temporary steel barriers and temporary fencing/hoarding will be constructed around the perimeter of each, with access gates one or both ends. Indicative site compound layout plans are provided below and are subject to final design, traffic impact assessments and TMP’s. The traffic restrictions required to accommodate these compounds are also indicatively shown in Figures 3 and 4 below. The compound widths have been driven by the shaft temporary works requirements and the barrier protections required for these deep shafts (refer Figure 5).

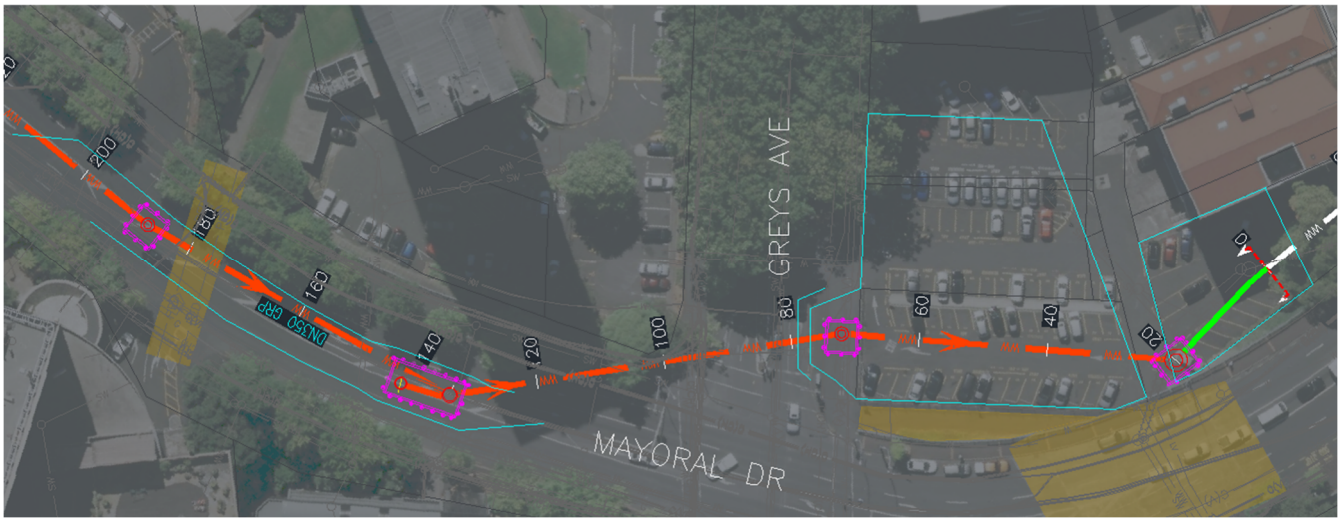

Figure 3: Two long-term compounds on Mayoral Drive/Greys Avenue (compound extents shown with blue line)

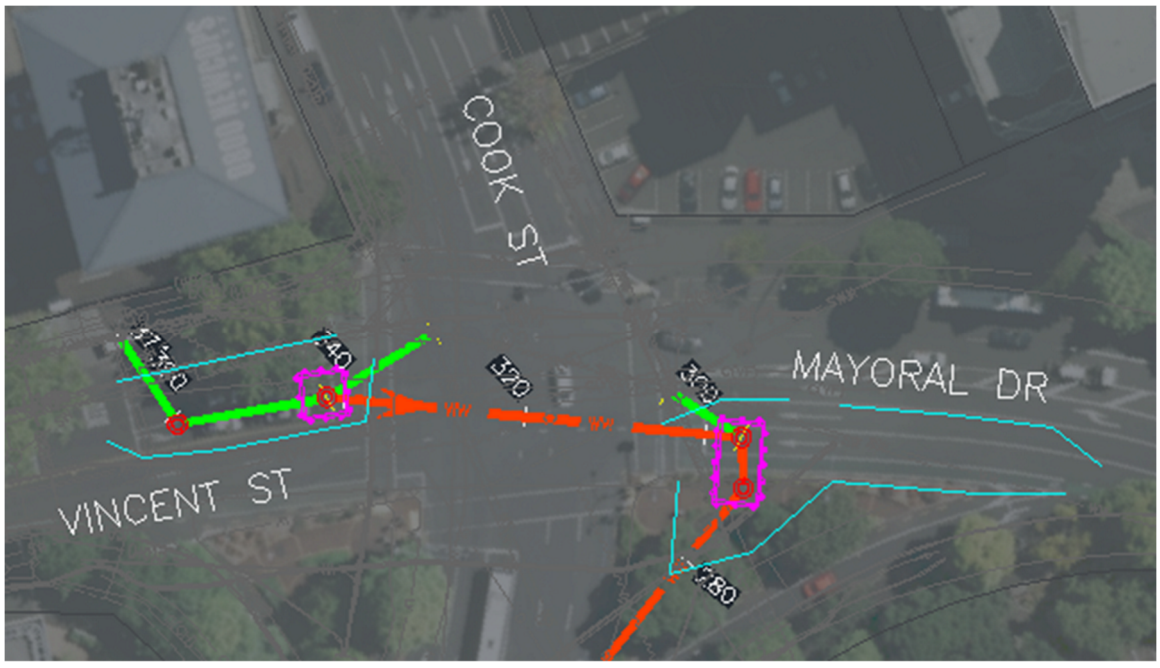

Figure 4: Two long-term compounds at Cook St/Mayoral Drive/Vincent St intersection (compound extents shown with blue lines)

General site working hours will be Monday-Saturday 7 am-6 pm. Sunday and night work will only be carried out if required by traffic management or WSL operational restrictions such as for tie-ins/connections to existing pipe work.

Heavy vehicle movements between the compounds and Greys Avenue CSA will be 40 movements per day at peak.

2.1. Utility Diversions

There will be a need for utility diversions to enable shaft construction ahead of main works start. NUOs have been engaged early in the design to assist with the diversion planning process. The depth and geotech conditions of the existing and proposed underground service diversions will guide the need for any trench shoring. Based on the diversions required, some

trenches will need to remain open longer than 10 days. Service locations will be marked out for any existing services prior to any intrusive works, and then the trench will be opened up for diversion works to begin. A hydro or air vac will be used to safely uncover all underground utilities within the trench. Dewatering may be required within the trench. Necessary utilities will be diverted, the trench will be backfilled, and area returned to its original condition.

Table 2.2.1 – Diversion Plant Summary

Activity	Plant List
Excavating trench	8-15t excavator with breaker attachment
	6-wheeler truck
	Hydro or Air Vacuum Truck
Dewatering	Submersible pump & lamella clarifier tank
	Silenced Generator 60kVA
Backfilling	6-wheeler truck
	8-15t excavator
	Plate compactor
Reinstatement	Asphalt truck, concrete truck and pump

3. Main Construction Works Overview

Construction methodologies are outlined in Figure 5 below and details for each are provided within the subsections below.

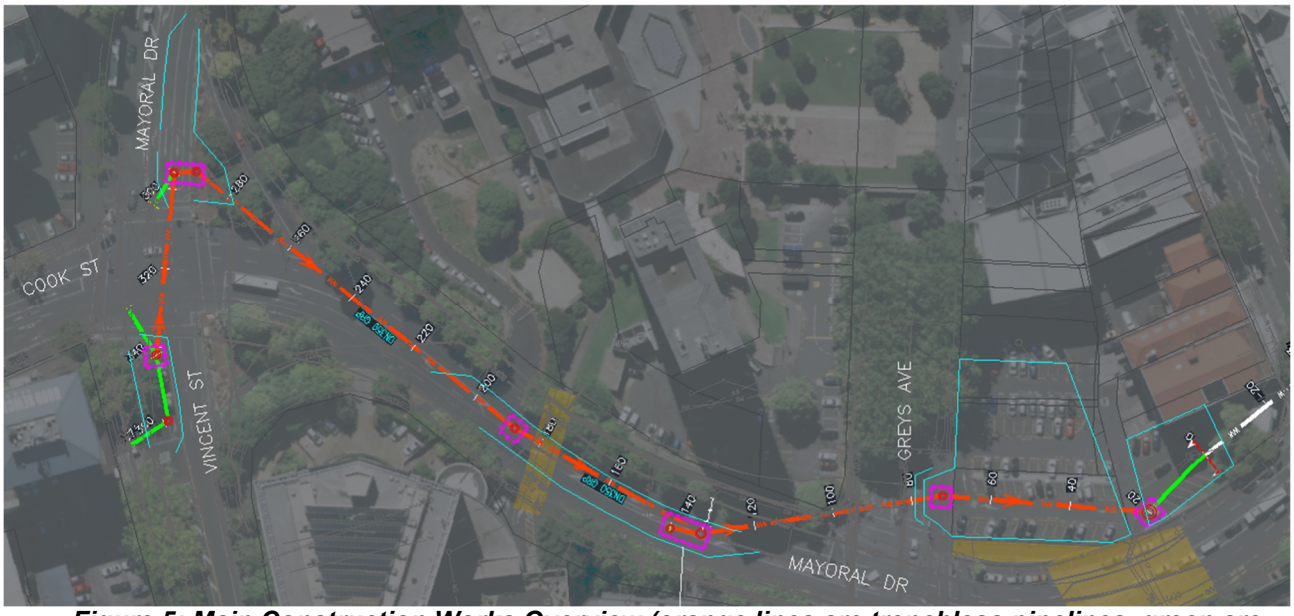

Figure 5: Main Construction Works Overview (orange lines are trenchless pipelines, green are trenched pipelines)

3.1. Shaft Construction

Most manhole locations on this alignment will be used as launch/reception pits for the trenchless construction method (axis/pilot bore). The trenchless method requires shafts with minimum internal dimensions of 4.5m x 4.5m; however, some shafts will contain two manholes and / or existing EOP infrastructure and will need to be oversized. The shoring technique required to support these shafts will be subject to geotechnical conditions and shaft temporary works design but will most likely be a post and panel-type construction method. The shaft sizes for each location are shown in Table 3.1.2 below. The basic steps required to construct temporary post and panel shafts are outlined below and in Figure 6.

- An auger attachment on a 10 – 35t excavator or small piling rig (GEAX EK60) will be used to drill 600mm dia holes. Piles will typically be drilled 4m below pipe inverts. Steel H-columns will be set into each with sand or concrete backfill. A mobile crane will likely be required to pitch and install the steel columns, depending on pile depth
- The shaft will be excavated from the top using an excavator at surface level to a depth of approximately 1m below pipe invert. Six-wheeled trucks will be used to remove spoil off site. Shaft excavations are expected to occur over 1 – 2 weeks, depending on the size and depth of the shafts.
- Steel road plates or timber lagging will be cut and installed between H-columns as the excavation advances.
- Forced air ventilation may be required using a fan at surface level with ventilation ducting into each shaft during work hours.
- The shaft base will be lined out with 300 to 500mm of aggregate and/or 100mm of blinding concrete to provide a solid and level working platform.
- If dewatering is required, a submersible pump will be used to remove water from the excavation. The water will be pumped into a clarifying tank for treatment before discharging to stormwater. The pumps will run continuously while the shaft is open (6-8 months) and will be powered by a silenced diesel generator.
- Once the shaft has been used for tunnelling, a manhole will be constructed, and the shaft reinstated.

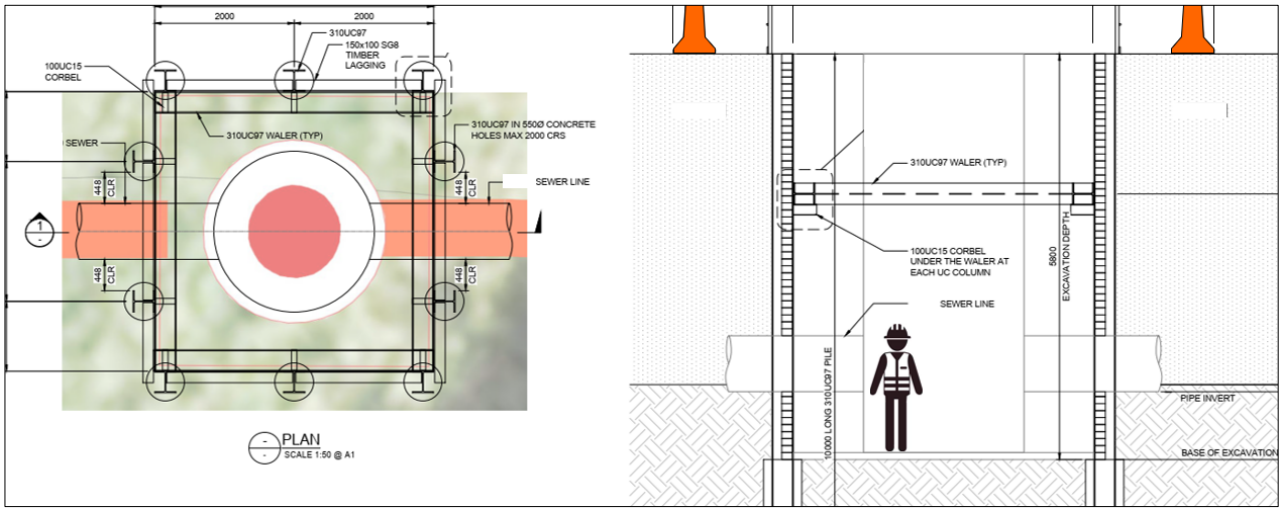

Figure 6 – Typical temporary works detail for shafts (A. O'Sullivan & Associates)

Table 3.1.1 - Shaft Plant Summary

Activity	Plant List
Drilling and installing steel posts	10 – 35t excavator/GEAX EK60, 30-35T mobile crane
Excavating shaft	20 – 35t excavator
Spoil removal	6-wheeler or artic trucks
Concrete base	Concrete truck/concrete pump truck
Dewatering	Submersible pump & lamella clarifier tank
Dewatering	Silenced Generator 60kVA
Ventilation	Fan

Table 3.1.2 - Shaft Earthworks Summary

	Shaft Details (internal dimensions)				
Manhole ID	**Width (m)**	**Length (m)**	**Depth (m)**	**Volume (m3)**	**Duration Shaft Open**
P4MH3	7	14.5	6	609	6 to 8 months
P4MH2	4.5	4.5	8.4	170	6 to 8 months
P4MH1A and B	6.5	11.2	8.3	605	6 to 8 months
P5MH2	4.5	4.5	8.1	165	6 to 8 months
P5MH1 and P1MH3	4.5	8.6	6.5	252	6 to 8 months
P1MH2	4.5	4.5	6	122	6 to 8 months

3.2. Trenchless Construction – Pilot Guided Auger Bore

Due to the pipe depths and shallow grades for this alignment, the most appropriate pipe laying methodology will be a trenchless pilot guided auger (or vacuum) bore rig. It has been assumed that this methodology will be used for the five pipe runs between P4MH3 and P1MH2.

The basic steps for this trenchless methodology are outlined below:

- Setup power pack, pump, vacuum truck, and water tank on surface adjacent to launch pit.
- Lift pilot bore rig into pit and survey into position.
- Drill pilot hole to reception pit using laser guided steering head.
- Install cutting reamer and pull back to launch pit.
- An auger (or vacuum) with sucker truck will be used to remove spoil from the drive and it will be disposed of offsite using 6-wheelers or sucker trucks. Approx wet tunnel spoil volume will be 0.3 m^3/m of DN450 pipe (0.6 m^3/m for DN700 pipe). For a DN450 pipe between P4MH4 and P1MH2, this equates to 95 m^3 (15 to 25 return six-wheeler truck trips).
- Simultaneously jack glass reinforced plastic (GRP) pipes between shafts.
- Clean up and flush drill slurry out of pipe by jetting and vacuum truck.
- CCTV inspection and low-pressure air test on completion.

It has not been decided which exact pilot bore rig will be used, therefore it should be assumed that any of the six shafts could be used as either a launch or reception shaft (or both).

Refer to Figures 7, 8 and 9 below of a typical pilot bore operation (note that exact methods vary between different machines).

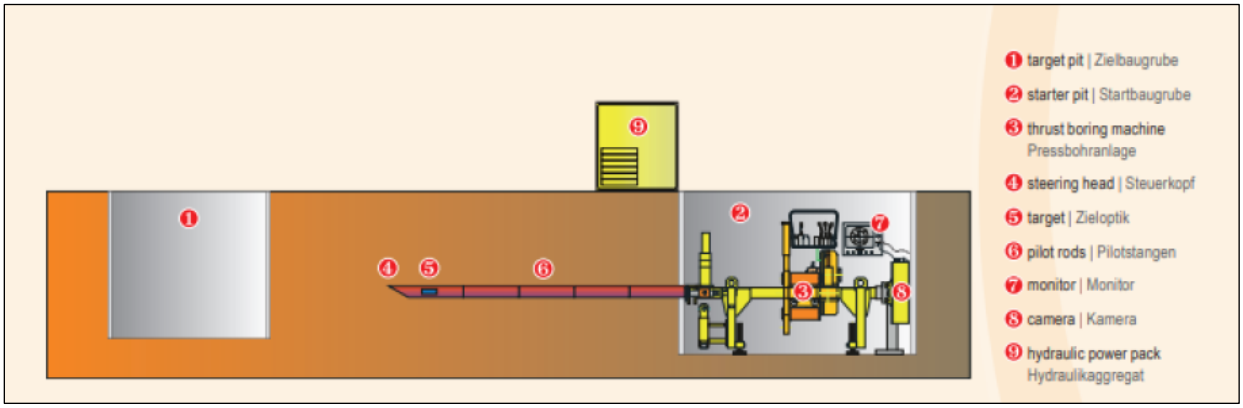

Figure 7 – Typical pilot bore – pilot process

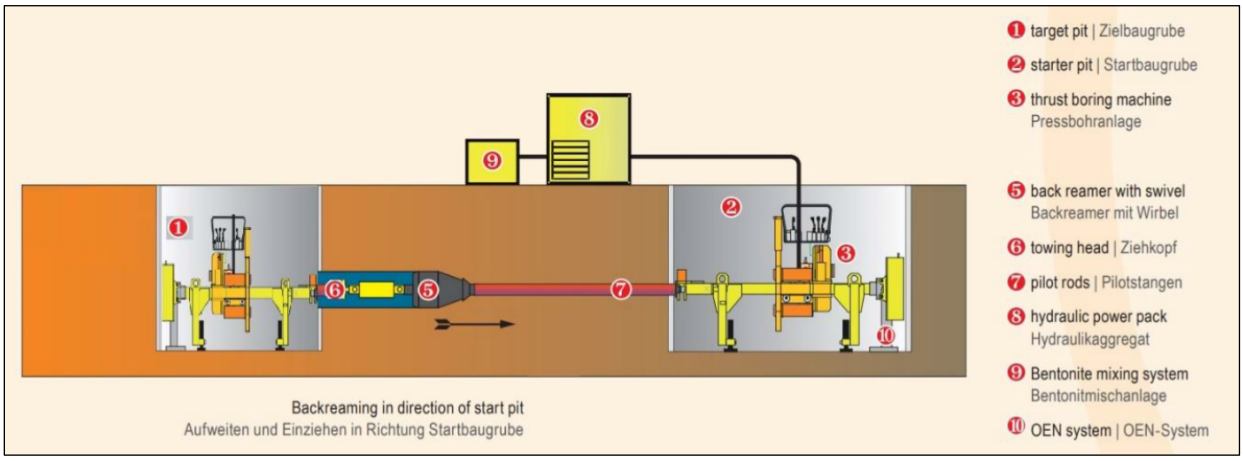

Figure 8 – Typical pilot bore – cutting back

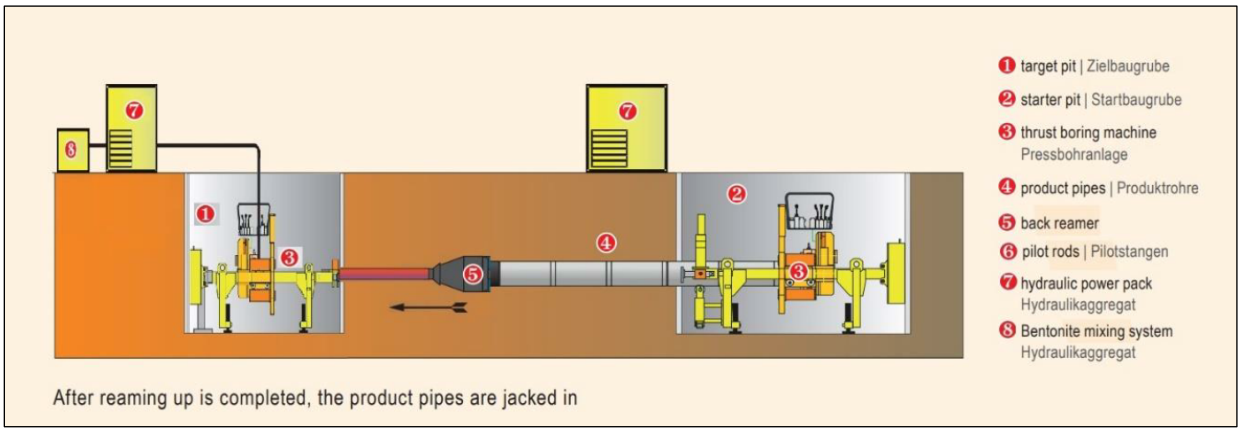

Figure 9 – Typical pilot bore – jacking pipes in

Table 3.2.1 - Tunnelling Plant Summary

Activity	**Plant List**
Pilot Boring – Launch Shafts	Crane HIAB truck
	10 – 20t excavator
	Power pack container
	Pilot boring machine
	6-wheeler or artic trucks truck (or vacuum truck)

	Tool truck
Pilot Boring – Reception Shafts	Crane HIAB truck
	10 – 20t excavator
	Power pack container
	Pilot boring machine
	Tool truck

4. Open Cut Pipe Laying & EOP Connections

For shallow or short pipe runs for existing/EOP connections, an open-cut pipe laying methodology will be used. The steps for this method are listed below:

- For any sections of pipeline outside of the temporary compounds, short-term traffic management will be setup in accordance with approved TMPs, which will likely be staged to allow only short sections of pipeline to be constructed at one time.
- Trench shields and manhole boxes will be used for all trenching over 1.5m depth, which will be most pipeline and connections (refer Figure 11 below). Approximately 10 to 25m of trench will be open at any one time for up to 4 weeks at a time. **NOTE:** *Where existing services cross the trench, the shoring method will change to a driven steel H-pile support method with vertical timbers to accommodate existing services.*
- Expected total trench volumes are:
  - $90m^3$ (P1MH2 to EX MH 522964)
  - $62m^3$ (P5MH1 to EX MH500717)
  - $71m^3$ (P1MH2 – P1MH1)
  - $38m^3$ (P1MH1 – EX MH4845867)
- The total estimated earthworks volume for open-cut trenching is $261m^3$.
- Pipe lengths and precast manholes will be delivered to site on flatbed trucks and unloaded within the site using HIAB trucks or excavators.
- A leading excavator will be used to trench to the required depths and install trench shields as the excavation advances. Wider trench boxes will be provided at manhole locations.
- Excavated materials will be cut to waste as clean, managed or contaminated fill (dependent on contamination testing results).
- If dewatering is required (to be determined by ground investigations), a submersible pump will be used to remove water from excavations. The water will be pumped into a clarifying tank for treatment before discharging to stormwater. The pumps will run continuously while the shaft is open and will be powered by a silenced diesel generator. Noise mitigation will be used such as barrier screens for overnight dewatering if required.
- Pipe bedding material will be carted to the worksite directly from source in 6 or 8-wheeled trucks, spread into the trench using an excavator and compacted using 300 to 800kg plate compactors in specified layers.
- Excavators will be used to lift pipe lengths into the trench.
- Side haunching, overlay bedding and hard fill to pavement level will be constructed as per pipe bedding material (refer to item above).

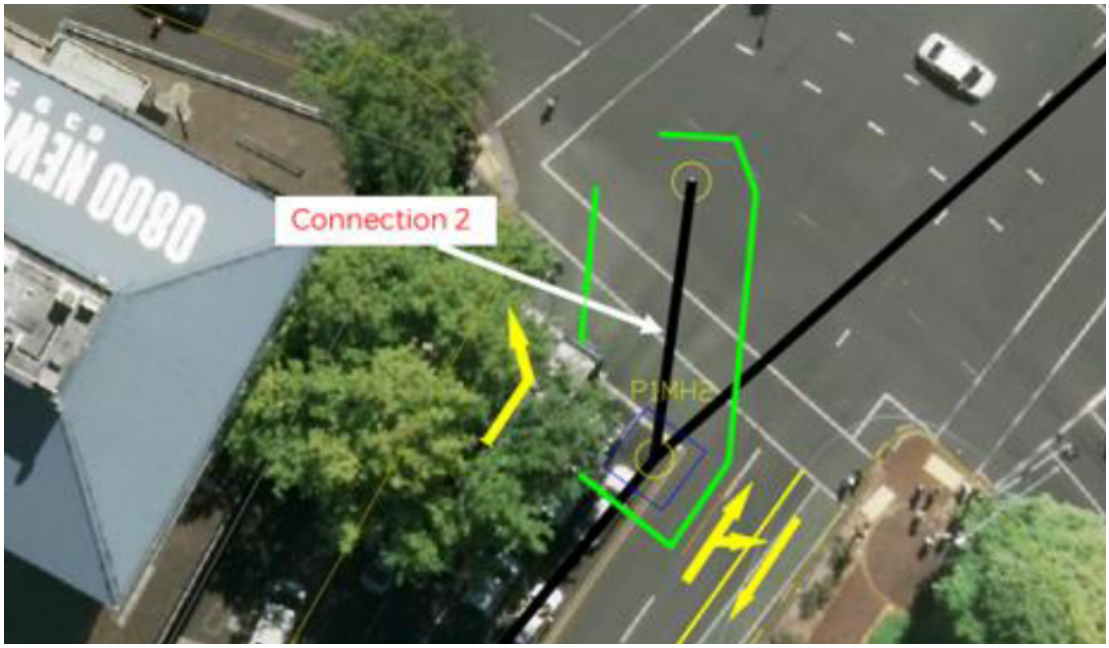

Figure 10 – Plan view of short-term TM for an EOP connection using opencut method

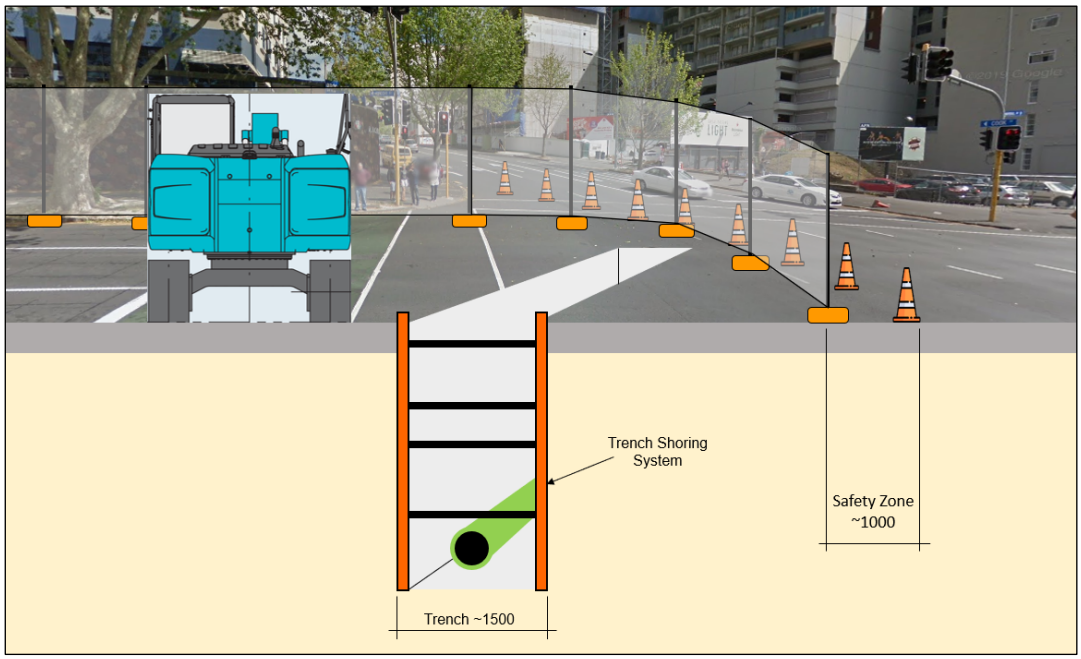

Figure 11 – Trench shoring system for EOP connection using the opencut method

Open Cut Pipe Laying Plant Summary Table

Activity	Plant List
Open cut pipe work / manholes	14 – 35t excavator
	Excavator Movax/Vibro
	Trench shoring/H-Piles
	Six-wheelers or artic trucks
	Hydro excavator
	Concrete truck
	Plate compactor

5. Manhole Construction (at shafts) and Road Pavement Reinstatement

The basic construction steps for manhole construction are detailed below.

- Form and pour concrete manhole base using concrete pump truck or excavator located adjacent to shaft. Alternatively, install a flanged precast manhole base and riser with the excavator.
- Lift in precast manhole riser sections using HIAB or excavator.
- Form and pour connection corbels on outside of precast riser using concrete pump truck or excavator located adjacent to shaft.
- Form and pour manhole benching using concrete pump truck or excavator located adjacent to shaft.
- Lift in and fix any pipe droppers within manholes.
- Backfill void between shaft and manhole with plate compacted aggregates or low strength concrete.
- Cut and abandon shaft temporary works 1.5m below road level as backfill progresses.
- Construct road pavements layers using excavator, plate compactor and vibratory roller.

Manhole and Pavement Plant Summary Table

Activity	Plant List
Manholes	14 – 35t excavator
	Trench shoring/H-Piles
	Excavator Movax/Vibro
	Six-wheeler trucks
	HIAB crane
	Concrete truck
	Concrete pump truck
Road Pavement Reinstatement	14 – 35t excavator
	Plate compactor
	Vibratory roller
	Pilot boring machine
	Tool truck

6. Sequence of work & Programme Durations

Refer Appendix 1 for high level construction programme.