Appendix N

Erosion and Sediment Control Plan - Aurecon
Document control record

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<td><strong>Client contact</strong></td>
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<td>9 January 2018</td>
<td>Draft for Comment</td>
<td>J. Gribble</td>
<td>C. Mountfort</td>
<td>D. Hughes</td>
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<td>16 March 2018</td>
<td>Final</td>
<td>J Gribble</td>
<td>C. Mountfort</td>
<td>D Hughes</td>
<td>M Cobeldick</td>
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Current revision 2

### Approval

<table>
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<tr>
<td>John Gribble</td>
<td>Margaret Cobeldick</td>
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<tr>
<td>John Gribble</td>
<td>Graduate Civil Engineer</td>
</tr>
<tr>
<td>Margaret Cobeldick</td>
<td>Associate</td>
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## Appendix A

Erosion and Sediment Control Plans

## Appendix B

Auckland Council GD05 - Erosion and Sediment Control Design Drawings

## Appendix C

Erosion and Sediment Control Calculations
1 Introduction

1.1 Project Description

The St Marys Bay and Masefield Beach Water Quality Improvement Project is an Auckland Council (AC) project being undertaken to mitigate the frequent combined wastewater/stormwater overflows (CSOs) that occur at St Marys Bay and Masefield beaches, by providing CSO storage within a proposed new storage pipeline located from Pt Erin park to London/New Street. This pipeline will store the CSOs from the local catchment, and return these to Watercare’s Branch 5 sewer when this existing pipeline has capacity.

The project includes the construction of three shafts (one in Pt Erin park, one in St Marys Road park, and one on the intersection of New Street / London Street) and the installation of the new storage pipeline by way of tunnelling. The main construction site will be located within the Pt Erin Park, where the majority of spoil will be extracted, with some open trenching required along Curran Street and Sarsfield Street to connect Engineered Overflow Points (EOPs). Further trenching or jacking will be used to install the marine discharge pipeline across Curran Street and past the seawall west of Curran Street, with the marine pipeline discharging via an outlet structure some 450m from shore to the west of the Auckland Harbour Bridge.

The project specifically involves the construction of a the 1km long storage pipeline with an internal diameter of 1.8m. To implement the proposed storage pipeline from Pt Erin park through St. Marys Bay to the corner of London/New St (as shown in Figure 1), a feasible construction methodology is required. The preferred construction methodology for this project is a pipejacking technique using a tunnel boring machine (TBM) on slurry or earth pressure balance machine (EPBM).

![Figure 1: Location of St Marys Bay storage pipeline with shaft locations](image)

In addition, a small pump station will be installed at the lower end of the storage pipeline at Pt Erin park that pumps to Branch 5 of the Orakei Main Sewer (OMS). The new marine discharge pipeline will
discharge excess overflows from the storage pipeline via an overflow weir to the Waitemata Harbour west of the Auckland Harbour Bridge.

To facilitate the tunnel construction, the three vertical access shafts will be built along the length of the storage pipeline alignment. These shafts are expected to be installed at the start of the project and each will likely take 3-4 months to construct.

The tunnel is expected to be excavated from Point Erin in the west in an easterly direction to London / New Streets. The tunnel will be excavated and constructed using a TBM. It is anticipated all excavated materials from the tunnelling will temporarily be stored at Pt Erin park to allow continuous progress of works. It is currently envisioned that the total duration of the construction works will be 24 months although the tunnel boring process itself is likely to take up to 6 months.

1.2 Scope of the report

This erosion and sediment concept control report has been prepared by Aurecon New Zealand Limited (Aurecon) in support of a resource consent application for the construction of three shafts, the storage pipeline, marine pipeline and associated connection pipelines, and the proposed pump station. This report should be read in conjunction with the Erosion and Sediment Concept Control Plan drawings (Appendix A). Once consents have been granted, the successful Contractor will submit a more detailed site-specific Erosion and Sediment Control Plan (ESCP) in-line with this report, the project resource consent conditions and in compliance with Council requirements for erosion and sediment control during construction including GD05.

The ESCP for the St. Mary’s Bay Project consists construction works in four main areas:

1. New vertical shaft at the London St. intersection with New St, at the eastern end of the project.
2. New vertical shaft at the northern end of St Marys Road park near State Highway 1 (SH1).
3. New vertical shaft (and permanent pump station) in Pt Erin park, also including associated civil works for the pump station (access road, pump station utilities, air treatment structure).
4. Pipeline trench along Curran and Sarsfield Streets.

1.3 Site Descriptions

1.3.1 General Site Descriptions

The sites for the proposed works (listed in Section 1.1) are within land of various ownership and management. The Pt Erin park and St Marys Road park shaft sites are within public reserve areas and the New St shaft and Sarsfield St EOP connections are within a residential road. The storage tunnel is to be constructed in private land but at a sufficient depth as to not cause disturbance.

The topography of the existing sites is variable, with most areas being generally flat and outside of any major overland flow paths or floodplain areas as identified using Auckland Council GEOMAPS. The Pt Erin park and St Marys Road park sites are identified as being within flood prone areas, which are natural topographical depressions where Auckland Council have identified that water could pond up to in a 1% AEP extreme rainfall event, assuming the outlet from the topographical depression is blocked. Refer to Figures 2 to 6.

The Pt Erin park and St Marys Road park sites are open, flat grassed areas with steep, vegetated banks immediately adjacent, and they have no notable existing site surface features or underground services within the vicinity of the works areas, with the exception of the known historical/archaeological areas of interest along the original waterfront in this area. There are stormwater catchpits located within each of the parks which are connected to the existing SW network for St Marys Road park site but do not appear to be connected to the stormwater network at the Pt Erin park site.

The New Street site is in a residential area at the intersection with Harbour Street and London Street and includes the carriageway and pavement. It holds a moderate slope heading north following the bend of the road. There are numerous services within the carriageway including wastewater and potable water.
Sarsfield Street is located on a moderate slope, with steep, vegetated banks immediately adjacent in Pt Erin park that drop down to a localized low area within the park itself. The residential properties on the south side of Sarsfield Street are typically sitting higher than the adjacent carriageway. Curran Street is also moderately sloped down towards the sea to the north. Both roads have underground and above-ground utilities, and a number of large trees that overhang the carriageway, noted in more detail within the project Arboricultural report, and the project design drawings.

Figure 2: Pt Erin Park – Weir Structure and jacking shaft location (Aerial Photo Source: Auckland Council GEOMAPS)
Figure 3: St Marys Road Park – Access shaft location (Aerial Photo Source: Auckland Council GEOMAPS)

Figure 4: New Street / Harbour Street – Receiving shaft location (Aerial Photo Source: Auckland Council GEOMAPS)
Figure 5: Curran Street – Pipeline trench location (Aerial Photo Source: Auckland Council GEOMAPS)

Figure 6: Sarsfield Street – Pipeline trench location (Aerial Photo Source: Auckland Council GEOMAPS)
1.3.2 Geology and Soil Conditions

Geology at the sites have been investigated, the main stratigraphic units (from oldest to youngest) are East Coast Bays formation, Tauranga group and construction fill material used in the reclamation of the waterfront area for the motorway construction. The make-up of the fill material varies greatly across the project areas.

In borehole logs gathered as part of the site investigation, the following soil conditions were found. The Pt Erin park site has a 0.2m sandy organic clay topsoil with grass cover and sandy clay fill material below up to 1.2m. The St Marys Bay park site has a grass cover with an organic silt topsoil of 0.2m. Below the topsoil is a silty gravel construction fill down to 1.6m in some parts.
2 Erosion & Sediment Controls

2.1 USLE Calculation

The Universal Soil Loss Equation calculation was completed for both the Pt Erin and St Marys Bay sites with site areas of 0.31 ha and 0.21 ha respectively. Both catchments are located on flat areas hence, slope of 1% has been used for calculations. A sediment control efficiency of 75% has been assumed.

The Pt Erin site was calculated to currently produce 0.01 tonnes of sediment during a 6-month period. Without sedimentation controls 0.42 tonnes of sediment would be produced over the estimated construction length of 6 months. With the prescribed controls 0.05 tonnes of sediment is yielded.

Table 1: USLE Calculation for Pt Erin Site

<table>
<thead>
<tr>
<th>Area (Ha)</th>
<th>Time (years)</th>
<th>Sediment Yield (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior to Works</td>
<td>0.31</td>
<td>0.5</td>
</tr>
<tr>
<td>Works Without Sediment Control Procedures</td>
<td>0.31</td>
<td>0.5</td>
</tr>
<tr>
<td>Works With Sediment Control Procedures</td>
<td>0.31</td>
<td>0.5</td>
</tr>
</tbody>
</table>

The St Marys Bay site currently produces 0.01 tonnes over a 6-month period. Using sediment controls the sediment produced is reduced from 0.34 tonnes to 0.04 tonnes over the estimated construction length of 4 months.

Table 2: USLE Calculation for St Marys Site

<table>
<thead>
<tr>
<th>Area (Ha)</th>
<th>Time (years)</th>
<th>Sediment Yield (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior to Works</td>
<td>0.21</td>
<td>0.33</td>
</tr>
<tr>
<td>Works Without Sediment Control Procedures</td>
<td>0.21</td>
<td>0.33</td>
</tr>
<tr>
<td>Works With Sediment Control Procedures</td>
<td>0.21</td>
<td>0.33</td>
</tr>
</tbody>
</table>

Full USLE calculation can be found in Appendix B.

2.2 Erosion and Sediment Control Principals

The main sources of erosion for the site will be splash and sheet erosion. To minimise the generation and discharge of sediment the following key principals will be applied to each of the works sites in accordance with GD05:

- Diversion of ‘clean’ water from the upstream catchment runoff around work areas; and
- Minimise the areas of disturbance (both duration of works and physical area).

The works will be constructed in stages in conjunction with the overall construction sequencing to ensure that it accommodates the contractor’s requirements. By exposing only those areas that are required to be exposed for active earthworking at any one time, the duration of exposure and risk of erosion/sediment discharge can also be minimised. The control methods used will ensure:

- Stabilisation and cover of exposed areas;
- Installation of perimeter controls to protect the receiving environment from the earthworks; and
- Capture and treatment of sediment laden water generated by the site works.

Appropriate controls along the perimeter of each of the works sites will ensure that any sediment that is generated from within the construction areas will be captured by sediment decants / filtered to prevent contaminants from entering the receiving environment.

Open shafts and trenches will be dewatered using pumps to remove collected runoff and elevated bunds constructed to prevent sediment laden runoff from entering.

A clean water diversion bund is proposed to be constructed on the upside of each construction zone to direct runoff away from exposed works areas.
2.3 Design of erosion and sediment control devices

Indicative ESCPs are included in Appendix A of this report. As a summary, the following control devices are proposed for the site:

- Clean Water diversion bunds (section E2.1 of GD05)
- Dirty water diversion channels (section E2.2 of GD05)
- Silt fences (section F1.3 of GD05)
- Geotextile and Erosion control blankets (section E3.5 of GD05)
- Decanting earth bund (section F1.2 of GD05)
- Catchpit inlet protection (section F1.6 of GD05)
- Stabilised construction entranceways (section E2.6 of GD05)

### 2.3.1 Clean Water Diversions

Runoff diversion channels will be constructed around the perimeter of the site. The channels will be constructed to intercept and divert ‘clean’ water around the works area. All channels have sufficient capacity to convey the additional discharge from the sediment decants inside the works areas (typically 5% AEP flows from adjacent properties in accordance with GD05).

Diversion bunds will be constructed at the Pt Erin site and St Mary’s Bay Park site where clean water runoff from the steep vegetated cliff/bank will be fed to stormwater catchpits within each of the parks. The diversion bund on the eastern side of the Hackett St EOP connection at St Marys Road park site is designed to feed runoff towards the flat grassed area and further towards the motorway channel. These bunds have been sized to carry the design 5% AEP flow of 0.05 m$^3$/s and with sufficient capacity to carry the 1% AEP flow. Extra capacity has been allowed for in the case of an extreme rainfall event in addition to the 300mm freeboard.

The New Street site will incorporate a 300mm hot mix bund diversion along the southern site boundary leading run-off to catch pits and stormwater channels. EOP connection shafts at Sarsfield St will also use 300mm hot mix diversion bunds as a protection from flooding risk.

### 2.3.2 Dirty Water Diversions

Dirty water diversion bunds will be constructed within the site at the eastern perimeter of the Pt Erin park site. The bunds will feed into the sediment retention pond constructed within the site. The New Street site will incorporate a hot mix bund around the shaft excavation. Hot mix bund protections will also be used to protect existing catchpits for works within the carriageway at Sarsfield St.

### 2.3.3 Silt Fences

Silt fences will be provided at certain sections of the site perimeter (refer to Appendix A). Silt fences will also be placed along the Pt Erin park boundary during trenching works due to flooding risk on Curran St and Sarsfield St. Refer to Table 3 for the silt fence design requirements. Due to the size of the site, the length limitations of the silt fences are not restrictive.

Table 3: Silt Fence Design Criteria reproduced from GD05 (F1.3)

<table>
<thead>
<tr>
<th>Ground surface slope steepness %</th>
<th>Slope length (m) (maximum)</th>
<th>Spacing of returns (m)</th>
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<tr>
<td>Flatter than 2%</td>
<td>Unlimited</td>
<td>N/A</td>
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<td>2 – 10%</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>10 – 20%</td>
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<td>50</td>
</tr>
<tr>
<td>20 – 33%</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>33 – 50%</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>&gt; 50%</td>
<td>6</td>
<td>20</td>
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</table>
2.3.4 **Geotextile and Erosion control blankets**
Slope and soil stabilisation procedures will be used to protect vulnerable slopes on the St Marys Road park site during the construction of the EOP connection. Clearance of vegetation for the EOP connection is to be staged and slopes are to be protected by mulching or geotextile cover to prevent erosion in accordance to GD05 E3.5. Temporary erosion control covers are to be used for exposed areas in anticipation for rainfall events and at end of daily operations for trenching works along Curran/Sarsfield St.

2.3.5 **Decanting Earth bund (DEB)**
A decanting earth bund will be used as a sediment control facility during earthworks in the Pt Erin park site. Depending upon the soil material encountered a flocculation will need to be applied via batch dosing to assist in sediment settlement as per GD05 F2.0. The retention bund is to be sized at 21m by 7m at its top length, side slopes of 2:1 and a pond depth of 1.4 m. The expected minimum pond volume is to be 62 m³ based off 2% of the contributing catchment area. The bund has been designed to hold a volume of 72 m³. The sediment decants will be designed in accordance GD05 (F1.2) and details can be seen on the ESCP drawings (Appendix A). The sediment decants are spaced regularly along the length of the works area as required.

The DEB will discharge to existing catchpits within the Pt Erin park. Investigations as to the capacity and pipe network of these catchpits has not revealed any information from Auckland Council nor the Motorway Authority. It is assumed, at this stage of the design, that the catchpits will be suitable for receiving the treated flows from the DEB.

The Pt Erin park construction site is located in a flood plain and has a flooding depth of 1.29 m in a 1% AED rainfall event. In this scenario, preparation is required to protect the decanting earth bund prior to this rare event.

2.3.6 **Stabilised Construction vehicle paths and wheel wash**
Three stabilised construction entrances (refer to Appendix A for plan and details) will be constructed as per GD05 E2.6 requirements. Stabilised sections will be constructed using GAP65 aggregate or with geotextile to allow vehicles to move within the site without disturbing sediment. A wheel wash station is to be installed at the Pt Erin park site and connected to a suitable water supply to prevent sediment from entering Curran St on-ramp.

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<td>Aggregate Size</td>
<td>50-150 mm washed aggregate</td>
</tr>
<tr>
<td>Minimum thickness</td>
<td>150mm</td>
</tr>
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<td>Minimum length</td>
<td>10 m</td>
</tr>
<tr>
<td>Minimum width</td>
<td>4 m</td>
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2.3.7 **Stormwater Inlet protection**
A silt sock (refer to GD05 section F1.5) will be placed around inlets to any catchpits that are immediately adjacent to the works site to act as a small sediment trap immediately up-slope of the catchpit. The silt sock will completely 'ring fence' the catchpit. Certain stormwater inlets will be temporarily disconnected at the Pt Erin park and St Marys Road park sites. Catchpits within the New St site are to be plugged and used as dirty water pump wells as required.

2.3.8 **Dust Control**
Dust will be managed onsite using water trucks to damp exposed areas, and covering of any stockpiled materials. Ponding water in the trench may also be used for dust control measures. Construction of stabilised entrances and pathways will minimise dust generation. Regular monitoring of dust emissions and minimising areas of exposed soils to wind through construction staging is proposed.
2.3.9 Stockpiled Material
The works area at each shaft location will have spoil material that will have to be stored during construction, prior to be respersed or removed from site. These stockpiles will be managed in accordance with GD05 and will be suitably compacted, covered with geotextile and protected by silt fences. Indicative locations for material storage areas are shown on the ESCP drawings in Appendix A.

2.3.10 Dewatering
Removal of water from excavations will be required during the construction of the access shafts, new pipeline trenching works and preparation of the foundation for the proposed pump station. Length of open trenches will be minimised to reduce the volume of water required for dewatering. Dewatering procedures are to be maintained throughout the trenching works along Curran/Sarsfield St. Excess water will be managed by either pumping through a filter cloth and sump and discharging to the nearest catchpit or alternatively, collected by a mobile dewatering unit for disposal. Further, staging of the works will be undertaken to ensure excavated / open areas are minimised during construction.

2.4 Indicative Maintenance and monitoring
Auckland Council GD05 sets out the indicative maintenance procedure for each of the selected control measures which the successful Contractor will review. As a minimum, each device should be inspected weekly to check whether there has been any sediment build-up. Each device should also be inspected prior to and following any significant rain event. Works at or near paved surfaces will need to be actively managed through regular inspection to prevent sediment leaving the site through vehicle movements.

The following is an indicative outline of the inspection and maintenance regime that will discussed with the Contractor prior to construction to ensure the erosion and sediment controls for the development are maintained appropriately during construction:

- The Contractor shall inspect all control measures at the end of week as a minimum and after every rainfall and periods of prolonged rainfall;
- Thorough consideration and inspection of control measures shall be undertaken prior to any forecast rain and immediately following rain;
- During a severe rainfall event, the Contractor shall arrange for the Engineer to inspect the works during the rainfall to ensure that all erosion and sediment control devices are working as expected, and to carry out any remedial works to the ESC measures;
- All measures will be maintained in good working order;
- Stabilised areas including entrances, diversion bund covers and spillways are to be maintained.
- Silt fences are to be regularly inspected for depth of sediment, tears, if the fabric is securely attached to the fence posts, and to see that the fence posts are firmly in the ground;
- Diversion channels are to be inspected for low spots, water ponding, blockages and reinstated if damaged.
- Accumulated sediment in diversion channels are to be removed to prevent overtopping due to a lack of freeboard;
- The Engineer will be advised by the Contractor of any maintenance or remedial works undertaken, or any changes required to the ESCP to accommodate changes in conditions or work programme;
- Any change in the work programme requiring a significant change in the ESCP shall be approved by the Engineer and Auckland Council prior to installation;
- The Contractor shall maintain records on site of erosion inspections and will make available any reports at the request of the Engineer.

2.5 Indicative Programme of works
Prior to the commencement of works, a detailed Construction Management Plan (including a programme for works) will be provided by the Contractor clearly identifying the phases and timing of construction works. The programme will clearly indicate timing for items of work critical to the erosion and sediment control plan such as stabilising surfaces at the completion of earthworked areas to ensure all runoff from the site is controlled and the site is stabilised.
The Contractor will confirm to the Engineer and Auckland Council that the approved erosion and sediment control measures are installed prior to undertaking any ground works.

2.6 Construction Works & Staging

The following table is an indicative sequence of construction activities and ESC measures proposed for the site clearance and earthworks associated with the construction works. Each site will be constructed at different periods within the whole works. Refer to Appendix A for the ESC drawings.

**Table 1: Indicative Earthworks Construction Sequence for the construction works**

<table>
<thead>
<tr>
<th>1. Site Establishment:</th>
<th>Construct the stabilised vehicle entrances, movement areas and vehicle bays as per section E2.6 of GD05. This will mitigate sediments being tracked from the construction zones onto the road.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Site Excavation and ESC controls:</td>
<td>Clear the existing site and remove vegetation, including the removal of topsoil / pavements. Any excavated material retained on site during the clearance is to be covered to prevent erosion. Silt fences are to be erected around the site prior to the commencement of stripping/clearing works. Catchpits must be protected, ‘ring-fenced’ by a silt sock device. Certain catchpits in the St Marys Road park and Pt Erin park site are to be temporarily disconnected specified in Appendix A. Catchpits within the New St site are to be plugged and used as dirty water pump wells as required. Construct clean water diversion bunds along the Pt Erin park site boundary facing the adjacent embankment slope. Diversion flows are to be led to catchpit located on the western side of the site. The decanting earth bund shall be constructed with dirty water diversion bunds along the eastern and northern site boundaries feeding the pond. Channel leading to nearby catchpit located on western side of boundary will also be constructed.</td>
</tr>
<tr>
<td>3. At the St Marys Road park site, clean water diversions along the hill bank shall be constructed prior to jacking shaft works. Two clean water bunds will be constructed with one leading towards the catchpit on the western side of the site, adjacent to St Marys Road. The other diversion will send runoff towards the grassed area and motorway stormwater channel. Dirty water hot mix diversion bunds are to be constructed at the New St shaft location prior to shaft excavation. Vegetable clearance adjacent to the motorway embankment for St Marys Road park shaft and Point Erin park jacking shaft is to be carried out in stages with specific measures put in place (mulching or covering with geotextile) to ensure the slope is stabilised and protected from erosion and clean/dirty water diversions are kept separated. No water from the site (clean of otherwise) shall be directed towards the existing motorway embankments unless it is controlled (flow is reduced to below pre-development levels) using check dams, level spreaders or other methods to dissipate flow.</td>
<td></td>
</tr>
</tbody>
</table>

| Stage 1 Construction: Site clearance | Maintain and relocate sediment control measures on site as required to enable access and management of spoil material during the site clearance and piling works. Regular inspection of controls should be completed. |
| Stage 2 Construction: Pit excavation for the shafts and foundation prep for the pump station | All material from the excavations not required for fill is to be removed from site immediately, and all surfaces will be stabilised with aggregate or completed as per the final design treatment, as soon as possible. Protections must be maintained to prevent mixing of clean and dirty waters. Regular inspection i.e. pavement cleaning, fixing damaged silt fences; need to be applied to prevent sediment laden runoff escaping the site area. Open shafts and excavations are to be protected with standard controls and shafts are to be raised above ground level for protection from runoff. |
**Stage 3 Construction:** Trenching for the open cut works and Curran St and Sarsfield St EOP connections.

Stormwater catchpits near the works will be protected by a silt sock prior to work commencing.

Due to sections of the Curran St on-ramp and Sarsfield St open cut trenching works being within a floodplain, ‘Cut and cover’ methodology and stabilising exposed areas at the end of daily operations is proposed as recommended in G3.1 and G3.2 of GD05. Trenches and open shafts should be closed in situations of high rainfall risk.

Backfilling and compacting trenches and excavations during the continuation of works is proposed for open cut trenching works. Trenches should not be open for any longer than three days and stabilisation should be completed within two days of backfilling.

Dewatering procedures are to be maintained throughout the works period. Dewatering can consist of either sediment laden water either pumped through a silt sock into the nearest catchpit or collected by a mobile dewatering unit for disposal.

Dirty water hot mix diversion bunds will be used to protect stormwater catchpits along Sarsfield St due to flooding potential.

Silt fences are to be erected on the Pt Erin park side of the open trenching works in the flood plain areas along Curran St and cutting through the park at the corner or Curran and Sarsfield St.

EOP connection shafts on Sarsfield St are to be protected with a clean water hot mix diversion bund to divert runoff from the open area.

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**Decommissioning:**

Decommission sediment control measures when ground works are nearing completion and the exposed areas have been stabilised. The Contractor shall ensure sediment procedures are in place (and a staged approach is adopted) while decommissioning works are being undertaken.

Decommission sediment control measures for trenching works in the pavement once open trenches are backfilled and asphalt is laid/sealed.

Silt fence and accumulated sediment are to be removed once appropriately stabilised. Sediment needs to be correctly disposed and disturbed area backfilled, regraded and stabilised.

Remove clean water diversions once site area has been stabilised, shape the disturbed area to meet finished landform and stabilise.

Decanting earth bund (DEB) should be dewatered as specified in GD05 G1.0, water must have 100mm clarity to be discharged offsite. Correctly dispose of sediment and remove construction materials. Backfill the DEB, compact soil and stabilise.

Note, no sediment control measures are to be decommissioned until conformation / approval is provided from the Engineer and Auckland Council.

---

**Final Reinstatement:**

Remove catchpit protections and clean out the sump (if required). Reconnect temporarily disconnected catchpits.
2.7 Safety in Design

The design of the proposed erosion and sediment control systems has considered the risks and safety elements required under Aurecon’s Safety in Design (SiD) policy.

Minimising open earthworks areas should be exercised as to limit exposed sediment. This measure will reduce soil loss and pooling of runoff. In addition, dust generation will be reduced. For trenching works, cut and cover methodology recommended in GD05 G3.1 and G3.2 should be used. Open excavations should be covered in anticipation of a storm event.

Pt Erin and St Marys Road park sites located in flood prone areas can become a considerable issue in an extreme weather event. Clean water diversion bunds in critical areas, diverting runoff from the adjacent slopes have been designed to carry a capacity greater than the 1% AEP storm runoff. To mitigate potential flooding from an extreme weather event.

Flood plains on Curran St and Sarsfield St pose a high risk. To mitigate the effects of a flood event, consideration of construction methodologies is required alongside erosion and sediment control devices. ‘Cut and cover’ methodology and other practices to minimise open areas have been proposed.

Maximum 1:5 traversable side slopes (with safety benching and fencing around waterbodies).

All sites will need to be adequately fenced at site boundaries to restrict public access. Site gates should be closed at days end. Site offices are to be situated in an area away from works and allow safe movement of foot traffic around the site. Vehicle access shall be well designated and vehicle parking/movement paths defined to prevent collisions.

Attempts should be made to minimise the depth of excavations. Correct procedure should be followed when working in excavations. Sides of the excavations should be checked for stability and battered, shored or benched if necessary. In addition, dewatering processes should be prepared prior to excavation to prevent instability.
Appendices
Appendix A – ESC Plans

ESC Plans
1. **All dimensions are in metres unless otherwise shown.**
2. **Site layout is indicative only, and is to be confirmed at detailed design stage.**
3. **Background survey information (existing contours) has been extracted from Auckland Council Geomaps.**
4. **Any stockpile of material onsite should be converted to minimize losses and not be located in overland flow paths or site low points.**
5. **All rubbish, vegetation, debris etc should be removed from the earthworks area and disposed of off site by the contractor prior to commencement of site clearance.**
6. **All erosion and sediment control measures must be operational prior to any other work commencing on site. The contractor shall arrange for and attend a preliminary sediment control meeting on site with the engineer and a representative from Auckland Council.**
7. **The contractor shall ensure council best management practices are in place during the construction period of the development including at the site entrance to control all dust, slurry and sediment generated by the works as to not discharge from the site and enter Auckland Council stormwater system.**
8. **Further sediment control, maybe required by the engineer as project advances, these will be installed as and where directed by the engineer. The contractor is solely responsible for ensuring that the site has effective silt detention facilities operating at all times.**
9. **All sediment and erosion control features shall be in accordance with Auckland Council, GSD.**
10. **All existing catchpits located immediately adjacent to Curran Street and Sarsfield Street shall be protected.**
11. **This plan is to be read in conjunction with erosion sediment control report 255303-ESC-001.**

**NOTES:**

**ACCORDANCE TO GD05 E2.1**

- DISCONNECTED EXISTING CATCHPIT TO BE PROTECTED.
- PROPOSED SEDIMENT POND IN ACCORDANCE TO GD05 E2.6
- CLEARANCE OF VEGETATION FOR EOP CONNECTION TO BE STAGED AND SLOPES PROTECTED BY MULCHING OR GEOTEXTILE COVER TO PREVENT EROSION IN ACCORDANCE TO GD05 E3.5

**ACCORDANCE TO GD05 F1.3**

- PROPOSED DIRTY WATER DIVERSION BUND IN ACCORDANCE TO GD05 E2.1
- PROPOSED CLEAN WATER DIVERSION BUND IN ACCORDANCE TO GD05 E3.3
- PROPOSED SECURITY FENCE IN ACCORDANCE TO GD05 F1.3

**LEGEND**

- PROPOSED CLEAN WATER DIVERSION BUND
- PROPOSED DIRTY WATER DIVERSION BUND
- EXISTING OVERLAND FLOW PATH
- PROPOSED SILT FENCE
- PROPOSED SEDIMENT POND
- NEW WATER MAIN
- PROPOSED WASTEWATER RISING MAIN
- PROPOSED GRAVITY WASTEWATER MAIN
- ACCOMMODATION / STORAGE
- ROAD PARK SHAFT
- PROPOSED SECURITY FENCE
- EXISTING SURFACE CONTOURS
- PROPOSED WATER MAIN
- PROPOSED SECURITY FENCE
- PROPOSED INLET PROTECTION
-rotsy EXISTING STORMWATER PIPELINE
- PIPE STORAGE MIN 1 SHIFT
- PROPOSED WASTEWATER RISING MAIN LEVEL MONITORING AND POWER SUPPLY CABLES
- PROPOSED CATCHPIT TO BE COVERED AND PROTECTED

**REVISION DETAILS**

- **DATE**
  - 06.03.18 UPDATED CONCEPT DESIGN
  - 14.02.18 CONCEPT DESIGN - DRAFT FOR COMMENT
- **PRELIMINARY **
  - **ST MARY'S ROAD PARK SHAFT**
- **APPROVED **
  - **M. COBDELICK**
  - **H. ARSHAD**
  - **D. HUGHES**

**CLIENT**

- **ST MARY'S BAY - MASEFIELD BEACH WATER QUALITY IMPROVEMENT PROJECT**

**еньким качеством**

- **NOT FOR CONSTRUCTION**
- **PAGE 1/2**
- **PROJECT**
  - **D.R.G.**
  - **CC**
  - **1082**
- **DRAWING NO.**
  - **255303**
- **DRAWING DATE**
  - **16/3/2018 10:43:15 AM NZAKL**

**IMAGE: COURTESY AUCKLAND COUNCIL. ALL COPYRIGHT IN THE MATERIAL IS OWNED BY OR LICENSED TO AUCKLAND COUNCIL.**
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9. All sediment and erosion control features shall be in accordance with Auckland Council’s Erosion and Sediment Control Report and/or GD05.
10. All existing catchpits located immediately adjacent to Curran Street and Sarsfield Street shall be protected.
11. This plan is to be read in conjunction with Erosion and Sediment Control Report of any other.

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Appendix B - Design Drawings
Decanting Earth Bund (DEB) Design

DEB at the Pt Erin park site designed in accordance to GD05 F1.2.

Decanting earth bund cross-section from GD05 F1.2 pg 117
- DEB minimum volume - 62 m³ (2% of the contributing catchment area)
- DEB volume - 72m³
- DEB dimensions: 21x7 m (top) 15.4x1.4 m (bottom)
- Emergency spillway size: 6 m wide by 0.3 m deep

T-bar Decant Design
Design per GD05 F1.1 figure 66 pg 105 - Schematic of Standard T-bar design
- Single decant
- 150mm outlet pipe
- 150mm upstand primary spillway
- 42 x 10 mm holes evenly spaced along standard 2m decant (standard 2m decant has 200 holes, holes sealed to achieve 42 evenly spaced holes)
Clean Water Bund Design

Pt Erin park clean water bund as shown in Appendix A has been designed in a trapezoidal shape with a 100mm base width and a height of 550mm (250mm + 300mm freeboard) with 2:1 side slopes. The longitudinal slope is 1%, less than 2% therefore lining is not required. This has been designed to comfortably carry the 5% AEP design.
storm flow of 0.05 m³/s event. Overdesign has been considered to mitigate effects of any extreme rainfall event due to the bund being positioned in a flood-prone area. All other specifications are as shown in the figure shown above.

St Marys Road park clean water bund as shown in Appendix A has been designed in a trapezoidal shape with a 100mm base width and a height of 550mm (250mm + 300mm freeboard) with 2:1 side slopes. The longitudinal slope is 1%. This has been designed to comfortably carry the 5% AEP design storm flow of 0.03 m³/s comfortably. Overdesign has been considered to mitigate effects of any extreme rainfall event due to the bund being positioned in a flood-prone area. All other specifications are as shown in the figure shown above.

Dirty Water Bund Design

Dirty water bund design specification retrieved from GD05 E2.2 pg 48

The dirty water bund to be constructed at the Pt Erin park site has been designed as per GD05 E2.2 - figure 18 CS. The bund is to have a height of 350mm (50mm design flow depth + 300mm freeboard) and a bottom with of 100mm. The longitudinal slope is 1%, less than 2% therefore lining is not required. The bund has been designed to a capacity of 0.15 m³/s and can carry the 5% AEP design storm flow of 0.05 m³/s. All other specifications are as shown in the figure above.
Appendix C – ESC Design Calculations
# USLE Calculations – Pt Erin Park

**Author:** JSG  
**Verified:**  
**Date:** 25/1/18

<table>
<thead>
<tr>
<th>Soil Yield (tonnes)</th>
</tr>
</thead>
</table>
| Prior to Construction | 0.01  
| Without Sediment Control Procedures | 0.43  
| With Sediment Control Procedures | 0.05  

## Estimation of Sediment Yield by the Universal Soil Loss Equation

### Required Inputs

- A = soil loss (tonnes/hectare/year)
- R = Rainfall Factor  
- K = Soil erodibility Index  
- LS = slope length and steepness factor  
- C = vegetative cover factor  
- P = erosion control practice factor

### Description

- **Soil %**  
  - SILT 10  
  - CLAY 50  
  - SAND 40  
  - ORG 2

- **Correction based on organic content**
- **Correction existing (2% organics)**

- **Construction Time**  
  - 12 Months  
- **Construction Earthworks Area (Catchment A)**  
  - 0.31 Ha

### LS Parameters

<table>
<thead>
<tr>
<th>Section</th>
<th>Period</th>
<th>Area (hectares)</th>
<th>Slope (a) %</th>
<th>Length (m)</th>
<th>R</th>
<th>K</th>
<th>L</th>
<th>C</th>
<th>P</th>
<th>Yield (tonnes)</th>
<th>Sediment Control Effciency (%)</th>
<th>Net Sediment Loss (Prior and Post) (tonnes)</th>
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<tbody>
<tr>
<td>Prior</td>
<td></td>
<td>0.31</td>
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<td></td>
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<td>0.18</td>
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<table>
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<tr>
<th>Notes:</th>
</tr>
</thead>
</table>
| (i). The catchment area for the restoration period based on 55 % of the total catchment area to be reinstated in topsoil and grass.  
| (ii) Assume Sediment delivery ratio is 0.5 for slopes less than 10% and 0.7 for slopes greater than 10%.

### Summary

- Due to sedimentation and erosion control practices, sediment yield over the period of construction can be reduced from 0.42 tonnes to 0.05 tonnes.
- Construction causes the soil yield over a 6 month period to increase from 0.01 tonnes (prior natural state) to 0.42 tonnes (construction and restoration states including ESC). This results in a net increase of 0.04 tonnes of soil loss from the site.
### Estimation of Sediment Yield by the Universal Soil Loss Equation

<table>
<thead>
<tr>
<th>Required Inputs</th>
<th>K Factor Parameters</th>
<th>Description</th>
<th>Soil %</th>
</tr>
</thead>
<tbody>
<tr>
<td>A = soil loss (tonnes/hectare/year)</td>
<td>K = 0.41 (from nomograph)</td>
<td>Correction based on organic content</td>
<td>SOIL 50</td>
</tr>
<tr>
<td>R = Rainfall Factor</td>
<td></td>
<td></td>
<td>CLAY 20</td>
</tr>
<tr>
<td>K = Soil erodibility Index</td>
<td></td>
<td></td>
<td>SAND 30</td>
</tr>
<tr>
<td>LS = slope length and steepness factor</td>
<td></td>
<td></td>
<td>ORG 2</td>
</tr>
<tr>
<td>C = vegetative cover factor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P = erosion control practice factor</td>
<td></td>
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</tbody>
</table>

### LS Parameters

<table>
<thead>
<tr>
<th>Section</th>
<th>Period</th>
<th>Area (hectares)</th>
<th>Slope (%)</th>
<th>Length (m)</th>
<th>R</th>
<th>K</th>
<th>L&lt;sub&gt;s&lt;/sub&gt;</th>
<th>C</th>
<th>P (years)</th>
<th>Sediment Yield (tonnes)</th>
<th>Sediment Delivery Efficiency (%)</th>
<th>Prior (tonnes)</th>
<th>During (tonnes)</th>
<th>Restoration (tonnes)</th>
<th>Net Sediment Loss (Prior and Post) (tonnes)</th>
<th>Difference (Prior and Post) (tonnes)</th>
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</thead>
<tbody>
<tr>
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<td>0.04</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Restoration</td>
<td>0.12</td>
<td>0.10</td>
<td>1.00</td>
<td>0.33</td>
<td>0.34</td>
<td>50.0</td>
<td>50.0</td>
<td>0.01</td>
<td>0.04</td>
<td>0.04</td>
<td>0.01</td>
<td></td>
<td></td>
<td>0.04</td>
<td>0.00</td>
</tr>
</tbody>
</table>

### Notes:

(i). The catchment area for the restoration period based on 55% of the total catchment area to be reinstated in topsoil and grass.

(ii) Assume Sediment delivery ratio is 0.5 for slopes less than 10% and 0.7 for slopes greater than 10%.

### Summary:

Due to sedimentation and erosion control practices, sediment yield over the period of construction can be reduced from 0.34 tonnes to 0.04 tonnes.

Construction causes the soil yield over a 4 month period to increase from 0.01 tonnes (prior natural state) to 0.34 tonnes (construction and restoration states including ESC). This results in a net increase of 0.04 tonnes of soil loss from the site.
# SEDIMENT POND DESIGN: (in general accordance with GD05)

**Hackett Diversion - Pt Erin Site**

Prepared by CDM  
Date 25/1/2018

## Catchment contributing to Sediment Pond

<table>
<thead>
<tr>
<th>Total Catchment area</th>
<th>0.31</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approx slope of earthworks</td>
<td>1%</td>
</tr>
</tbody>
</table>

| Minimum Volume of pond | 62 m³ |
| Dead Storage Volume | 19 m³  |
| Live storage | 43 m³  |

Total (check) 62 m³  
30% of min volume of pond  
70% of min volume of pond

## Shape of pond

- **Inlet side of pond**: 2 to 1 Gradient max
- **General side slopes**: 2 to 1 Gradient

Length to width ratio  
3  
no less than 3:1 no greater than 5:1 or 2:1 if total pond depth less than a 1m high

| Pond depth (water depth) | 1.4 m |
| RL of pond base | 1.60 m |
| Depth of dead storage | 2.02 m |
| Depth of live storage | 3.00 m |

| Width (top) | 7 m |
| Length (top) | 21 m |

## Freeboard dimensions

Freeboard depth 300 mm minimum 300mm

## Calculated storage

| Calculated storage |  |
| Volume from calcs sheet | 72 m³ |
| Dead Storage Volume | 21.6 m³  PASS |
| Live storage Volume | 50.4 m³  PASS |
| TOTAL Storage | 72 m³ |

## Decants

- **Max outflow rate**: 3 l/sec/Ha  
  recommended decant rate
- **Max flow for each decant**: 4.5 l/sec  
  (200 holes per decant) if less than 1.5ha seal off the required number of holes to obtain the 3 l/s/ha
- **Number of decants required**: 0.21 round up 1 required
- **flow required for the decant**: 0.93 l/sec

## Emergency Spillway

(Trapezoidal shape with minimum of 6m or the base width of the pond floor whichever is greater)

| Base width | 6 m  |
| Depth | 0.3 m  |
| Side slopes | 4 to 1 Gradient |
CWB01 - Pt Erin Park Clean Water Bund calculation

Pt Erin Site

Clean Water Bund design: (in general accordance with GD05)

Hackett Diversion - Pt Erin Site
Prepared by John Gribble
Date 30/1/2018

- less than 2% longitudinal slope
- >1m/s channel liner required
- Design estimation based off trapezoidal channel

Trapezium Channel Capacity

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>0.25 m</td>
</tr>
<tr>
<td>b</td>
<td>0.1 m</td>
</tr>
<tr>
<td>z</td>
<td>2 1/2 side slopes</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>0.03</td>
</tr>
<tr>
<td>A</td>
<td>0.525 m²</td>
</tr>
<tr>
<td>wetted P</td>
<td>1.05 m</td>
</tr>
<tr>
<td>R (hydraulic radius)</td>
<td>0.5</td>
</tr>
<tr>
<td>Sf</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Q (Channel Capacity) \[ 1.102431 \text{ m}^3/\text{s} \]

Runoff Flow

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.4</td>
</tr>
<tr>
<td>I</td>
<td>100.8 mm/hr</td>
</tr>
<tr>
<td>A</td>
<td>0.45 ha</td>
</tr>
</tbody>
</table>

Q (Peak Runoff Flow) \[ 0.05044 \text{ m}^3/\text{s} \]
CWB02 – St Mary’s Road Park Clean Water bund

CWB02 Clean Water Bund design: (in general accordance with GD05)

Hackett Diversion - St Marys Bay Park
Prepared by John Gribble
Date 30/1/2018

less than 2% longitudinal slope
>1m/s channel liner required
Design estimation based off trapezoidal channel

Trapezium Channel Capacity

<table>
<thead>
<tr>
<th>y (height)</th>
<th>0.25 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>b (bottom width)</td>
<td>0.3 m</td>
</tr>
<tr>
<td>z (side slopes)</td>
<td>2 1/2</td>
</tr>
</tbody>
</table>

n = 0.03  \text{ Manning's coefficient - natural environment}

A = 0.525 m²

wetted P = 1.65 m

R (hydraulic radius) = 0.5

Sf = 0.01  \text{ 2% slope of bund}

\[ Q = \frac{1}{n} AR_b^{1/3} S_f^{1/2} \]

Q (Channel Capacity) = 1.102431 m³/s

Runoff Flow

C = 0.4  \text{ Cliffbank, vegetation and roof}

I = 138.4 mm/hr  \text{ 5% AEP 20 yr, 10 min design storm}

A = 0.28 ha

\[ Q (Peak Runoff Flow) = 0.043082 \text{ m}^3/\text{s} \]

\[ Q_P = C_i A \]

Volumetric inflow

[Map of St Mary's Road Park with marked area]
Dirty Water Bund design: (in general accordance with GD05)

Hackett Diversion - Pt Erin Site
Prepared by John Gribble
Date 26/1/2018

less than 2% longitudinal slope
>1m/s channel liner required
Design estimation based off trapezoidal channel

Trapezium Channel Capacity

<table>
<thead>
<tr>
<th>y (height)</th>
<th>0.05 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>b (bottom width)</td>
<td>0.1 m</td>
</tr>
<tr>
<td>z (side slopes)</td>
<td>3 1/z</td>
</tr>
</tbody>
</table>

n = 0.03 manning coefficient - natural environment
A = 0.155 m²
wetted P = 1.01 m
R (hydraulic radius) = 0.153465
Sf = 0.01 1% slope of bund

Q (Channel Capacity) = 0.148098 m³/s

Runoff Flow

C (Runoff coefficient) = 0.6 Uncovered ground
I (RF intensity) = 100.8 mm/hr 5% AEP 20 yr, 10 min design storm
A (Catchment Area) = 0.31 ha

Q (Peak Runoff Flow) = 0.052122 m³/s

\[ Q = \frac{1}{n} AR_n^{2/3} S_f^{1/2} \]

\[ Q_P = C_i A \]
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Swaziland, Tanzania, Thailand, Uganda,
United Arab Emirates, Vietnam.