LUC60321424 ESCP

Approved Resource Consent Document

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RidleyDunphy
environmental & planning consultants

Auckland Council

Western Springs Pine Clearance –Erosion and Sediment Control Plan

Prepared for

Auckland Council -
Community Facilities

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Prepared by

Ridley Dunphy Environmental Limited
PO Box 100
Waitakere
Auckland

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1. EXECUTIVE SUMMARY

Auckland Council is proposing to harvest approximately 200 pine trees from within the Western Springs Park. The operation is expected to commence March 2021 should the consultation and consenting process be completed, and last up to a maximum of three months. The work is being undertaken to address issues of public safety, protection of property, infrastructure and landscape values. The harvest proposal would significantly reduce an ongoing liability and provide additional resources for weed and animal pest control, in addition to replanting native species within the logged area. In order to fulfil the requirements of condition 38 of LUC60321424, this document sets out the erosion and sediment control methodology to manage the effects of the tree clearance operation on waterways and soil surface erosion. This document also supports the resource consent application and should form the basis of the contractor's actions throughout the project with respect to erosion and sediment control measures.

The ESCP report has been amended from the original ESCP to reflect the most up to date removal methodology provided by Treescape following a public hearing, mediation and granting of consent through the Environment Court for the related resource consent application.

It is important to note that the most recent changes to extraction methodology outlined by the Contractor have resulted in a vastly reduced earthworks footprint and disturbance level across the extraction area. This has resulted in the removal of Earth Bunds, Decanting Earth Bunds and chemical treatment from the proposal. This updated ESCP should be read in conjunction with the Contractor's most recent methodology, the Specification of Work and any other updated reports such as the ecological management plans and construction management plans required by resource consent conditions.

Further, this report also supports – in the context of the erosion and sediment control methodology - the resolutions agreed by the Waitemata Local Board on 03 November 2020, being:

> Resolution *b) 'confirm that the Board's objectives for the Western Spring's Forest are: to protect the existing and regenerating ecology; to enable public access to the forest; and to ensure the health and safety of forest users and workers'*
>
> Resolution *f) 'approve option one, to proceed with the consented works to remove all pine trees in the stand using the lower impact technology methods identified by Professor Visser to the extent legally possible within the existing resource consent, because overall it best meets the Board's objectives for the forest'*

2. INTRODUCTION

RidleyDunphy Environmental Ltd has been commissioned by Auckland Council's Community Facilities Department to prepare an Erosion & Sediment Control Plan (ESCP) to support the application for Resource Consent, for the removal of pine trees at Western Springs Park. This report details the methodologies to be adopted as part of the tree removal operation to minimise the impact from erosion and sediment discharge into the receiving environments, in this case Motions Creek and ultimately the Waitemata Harbour. In addition, this ESCP details the erosion and sediment control devices that may be feasible to accommodate the intended works whilst minimising discharges to watercourses that run through the site.

The existing park (subject site) comprises of a large area of pines with regenerating indigenous vegetation, being classified as a Significant Ecological Area (SEA) under the Auckland Unitary Plan, Operative in Part (AUP:OP). It has been noted in a report by Wildlands (2014) that "*the pines were planted in 1923 and once comprised a densely stocked forest. However, over time, the pines have thinned significantly, becoming increasingly vulnerable to windfall. As such, the risk to public safety is an increasing concern. Due to increasing H&S concerns, the removal of pines has been recommended by different parties*".

The finalised methodology, , involves a combination of direct felling and processing of logs in situ and potential removal of selected logs from the site; all as directed by the Project Ecologist with the enhancement of the SEA through a revegetation programme in mind. In all cases, stumps will be left in situ with some stump/trunks being left as "totem poles". This combination of methods balances the unique location of the site next to residential areas and the Auckland Zoo, whilst also protecting soil from excessive disturbance and therefore minimising the risk of sediment discharge to the receiving environment from the land disturbance required to undertake the work. Access to the harvest area and the harvesting itself will require the creation of a 4m wide access track through the site for machinery access. No truck access is required for log removal as part of the revised methodology with the access for the associated excavator and mulching equipment only.

In order to undertake these activities, vegetation removal and limited soil excavation will be required to allow access for machinery such as excavators and mulching equipment. It is expected that the activities that have the potential to generate the greatest amount of sediment will occur in association with the site setup and felling activities, such as creation of the access track and overland log movements (where these may occur as directed by the Project Ecologist or as a result of natural movement of the log during felling). No other earthworks or land disturbance is proposed.

The park runs adjacent to Motions Creek, which is recognised as an important stream that contributes to the Waitemata Harbour and forms the immediate receiving environment for overland flows from the project area. Around the site, there are several watercourses (three overland flowpaths and one identified "intermittent" stream) that discharge into the main Motions Creek. Based on the "Erosion and Sediment Control Guide for Land Disturbing

Activities in the Auckland Region" (GD05) and "Forestry Operations in the Auckland Region – A Guideline for Erosion and Sediment Control" (TP223); this ESCP proposes that elements of both guideline documents are combined to ensure the receiving environment is not impacted during activities and until site stabilisation is achieved following tree felling activities.

This ESCP should be read in conjunction with the full set of resource consent application documents. Specific references to plans or documents are noted within this report.

This ESCP is a "living" document and it is anticipated that it may need to be updated, with changes submitted to Auckland Council as required for approval as the project progresses.

3. SITE DESCRIPTION AND SURROUNDING ENVIRONMENT

The site is located on the north-eastern boundaries of the Auckland Zoo, between Old Mill Road (north and north-west), Motions Road (west) and Great North Road (south). The site is also west, southwest and south of No's 28 -34 Westview Rd, Westmere, Auckland.

The red outline in Figure 1 (below) illustrates the boundaries of the site, which is approximately 32,000m^2 and is mostly vegetated with a mixture of pine, exotic species and regenerating native understorey. The park comprises of a large area of local vegetation that is scheduled as Significant Ecological Area (SEA) SEA_T_5288 under the AUP:OP.

Figure 1: Location of Proposed Work (see further information on this in section 4 below).

Please refer to the latest "Overall Site Plan" prepared by CLC Consulting Group Ltd, dwg. 21159-L101-C for most up to date works proposal

There are four identified watercourses (three overland flowpaths and one intermittent stream) running through the project area and two catchments which drain away from the project area (Catchment 5 and Site Entrance Catchments) that are covered in the scope of this ESCP (refer to Figure 4 in section 5 of this report). During times of heavy rainfall, the overland flowpaths (Catchment 1, 2 & 3) and intermittent streams (Catchment 4) ultimately discharge to Motions Creek. The contributing catchment to the various stream systems is approximately 44,800m^2 (4.48 ha) and mostly pervious. The impervious section (houses and roads), which is approximately 15% of the whole catchment area drains through stormwater pipes and two catch-pits located in the lower sections of West View Road, and then are transported south-west and south-east. The south-west stormwater drain runs underground for approximately 50m and then discharges into the intermittent stream outlined in Catchment 4. The south-eastern catch pit discharges into a catchment outside the proposed working area and into Western Springs Stadium.

Environmental water quality data indicates that Motions Creek is in good condition considering its urban location (2012, Environmental Monitoring Strategy). The park is used for informal recreational purposes, such as walking. A largely informal walkway crosses through the project area and this is currently in poor condition. Recent storm events have resulted in further tree fall over the track. The watercourses across the site flow downhill toward Motions Creek and naturally dissipate energy over a 20m wide flat and well vegetated riparian margin and floodplain buffer. In this section, natural sediment deposition is evident.

A full ecological review of the site has been undertaken by Wildland Consultants in 2016 with revision in 2018 and most recently in January 2019. The Wildland Consultants report and January 2019 advice sets out the ecological considerations for the project. It identifies six areas of vegetation that contain examples of native species worthy of protection efforts during the works. In these Priority Areas for Protection (PAPs), Auckland Council have advised that a combination of methods will be employed to protect the vegetation in place, where it is practical to do so. This is discussed in further detail in Section 4 of this report – in so far as it relates to erosion and sediment control - and in the applicant's response to Commissioners dated 25 January 2019 ("applicant's response, Jan 2019"). This is further outlined in Wildlands Consultants' most up to date management plan.

The topography of the site is moderately steep with an average slope of around 25%. The soil does not have records of contamination and has been identified according to GNS Science as Waitemata Group, described as "Alternating sandstone and mudstone with variable volcanic content and interbedded volcaniclastic grits". (2018, GNS Science). Based on the borehole logs contained in the report "Geotechnical Investigation Report – Western Springs Pine Removal" dated 01/06/16 by Geoconsult, we infer that the soil is comprised of approximately 5% sand, 15% silt and 80% clay for the purposes of considering soil loss calculations using the USLE method.

Figure 2: Motions Creek looking downstream with the subject site to the right and rear of the photo (2018).

4. WORKS PROPOSED

A stand of approximately 200 Pine trees planted in the late 1920s are in decline and now pose a risk to private property, the Zoo and the park/track users due to their ongoing failure. The site is identified in the AUP:OP as a Significant Ecological Area, and in the Western Springs Lakeside Te Wai Orea park development plan, is noted as an area for ecological restoration. Given this is the case, the overall objective of the project is to fell all identified standing pine trees present within the site as more accurately defined in the applicant's response Jan 2019 and most recently in the contractor's methodology forming part of the Specification of Works; following with a native restoration planting programme. The applicant's position is that in removing the pines and undertaking native restoration planting, the site's ecological values will be increased, whilst removing a significant public health and safety risk which is currently a significant barrier to the public's continued use of the Western Springs Park.

The project is programmed to begin in March 2021. Subject to weather, the project is planned to run for approximately 30 working days as outlined in the applicant's response Jan 2019 and as further outlined in the contractor's methodology forming part of the Specification of Works; the works may now extend beyond 30 April 2021 dependant on progress. However, this ESCP allows for contingencies to be implemented if timeframes change and works are delayed in to the traditionally wetter months. The Erosion and Sediment Control (ESC) measures are to be implemented prior to any felling work commencing and ESC measures are proposed to be maintained until final revegetation of the full project area is completed.

The tree removal methodology is best described in the applicant's response to commissioners dated 25 January 2019 and in the contractor's methodology forming part of the Specification of Works. The site can be separated in to three broad works areas as shown in Figure 3 below:

Figure 3: Works Areas – Area 1 (yellow), Area 2 (blue) and Area 3 (numbered) based on "*Priority Areas for protection in Western Springs pine block, Western Springs Park*" (2019, Wildlands).

Area 1 (yellow) – The majority of the pines will be felled as per the applicant's response to commissioners 25 January 2019 and the contractor's most recent methodology.

Area 2 (blue) – North-west of the intermittent watercourse. It is proposed that all pine trees are felled in situ. The Principal, Community Facilities, Auckland Council have confirmed that no machinery access is required across this stream. Further detail is outlined in the applicant's response to commissioners 25 January 2019 and the contractor's most recent methodology.

Area 3 – As noted by Wildlands (2018), six areas of higher quality native vegetation have been tagged for increased protection during the felling works. In these locations, directional felling away from these sites will be the preferred method as further described in the applicant's response to commissioners 25 January 2019, the contractor's most recent methodology and as per the most recent Wildlands Consultants' management report.

Consideration of soil erosion is mostly related to the creation of the access track. The actual pine felling will not result in large scale land disturbance in itself, as the stumps and tree roots will be left in the ground, avoiding any excessive land disturbance. The focus of this ESCP, however, is to mitigate effects associated with land disturbance caused by the felling of the pine trees in the project area.

In order to allow for the controlled felling of the trees, a 4m wide access way connecting the operational areas in Area 1 will be created (see "Overall Site Plan" prepared by CLC Consulting Group Ltd, dwg. 21159-L101-C for most up to date works proposal). Each staging area allows machinery to be located in safe areas to assist in felling of trees in a directional manner. Wood will be broken down on site as per the contractor's most recent methodology forming part of the Specification of Works.

The access track will be formed by excavator with minimal cuts and fills of approximately 0.5m across a 4m wide width required. The access track will be formed on the contour as best as possible to minimise earthworks. Five staging areas will be utilised, however no earthworks will be required for these. It is important to note that the site is undulating and the exact excavation depths will depend on the local conditions and access gradients required for machinery. However, the applicant proposes a conservative approach to earthworks as the access is temporary in nature and significant earthworks will be avoided to limit the disturbance to the SEA.

The areas noted as staging areas are intended for the majority of the canopies of the felled trees to land on, so they can be efficiently processed in situ. It is intended for the majority of the identified areas and access way to be installed along as gentle a contour as possible to limit cut and fill and to aid in safe excavator access. The earthworks proposed would equate to less than 5% of the project area overall and will involve localised clearance and excavation to maintain appropriate contours for safe machinery access and operation only.

Access to the site will be from the old City Parks Depot on Stadium Road, located near the south-eastern boundary of the site. Accessing the site from this location may require limited earthworks to create the entranceway up the slope within the subject site beyond the hole in

the wall. However, outside the site on the eastern side of the wall, access areas are largely existing. This may require a localised excavation within the footprint of the existing track and installation of a stabilised hardfill accessway to create a suitable gradient for machine access up into the site to approximately staging area 1. Erosion and sediment control measures to prevent sediment from entering the stormwater system and the receiving waterways (Motions Creek and Western Springs Lake) will be required in this location and are further outlined below.

Upon completion of the harvesting works, the access track and staging areas will be returned back to suitable gradients to meld with the surrounding land and fully stabilised. Auckland Council have advised that the restoration and amenity plans for the Park design are still under design and consultation with the public.

For the purposes of this ESCP, any disturbed areas of land will be fully stabilised against surface erosion on completion of the tree felling project through either hay/straw mulch, wood chip / slash or through full native revegetation.

Do we have any details of actual area of EW ? Be good to put a one liner in here saying EW are expected over x ha in total ?

5. EROSION AND SEDIMENT CONTROL

A comprehensive erosion and sediment control methodology is proposed to ensure that any potential effects resulting from land disturbance are appropriately avoided, remedied and/ or mitigated. Both structural (physical measures) and non-structural (methodologies and strategies) control measures are proposed and have been designed in accordance with (and will be implemented to meet) the guideline standards of Auckland Council Technical Publication GD05 - Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region, March 2016 and Auckland Council Technical Publication 223 – Forestry Operations in the Auckland Region – A Guideline for Erosion and Sediment Control.

This methodology has been revised in February 2021 to take in to account the change in tree felling and site access methodology. Some structural controls have been amended or removed due to the significant decrease in proposed land disturbance associated with the revised proposal as outlined in the contractor's most up to date methodology forming part of the Specification of Works.

5.1 Responsibilities for Project Team

As with all projects, success will be achieved through the various specialists working together as a team to achieve the goals of the Principal. Each team member brings their own specialist skills to the project. With respect to the Erosion and Sediment Control Methodology the following parties are deemed to be the most important in ensuring that the plan is appropriate

achievable and implemented successfully. With that in mind, each parties responsibilities are outlined below:

Principal: Auckland Council Community Facilities
Auckland Council Community Facilities is committed to undertaking the works in an environmentally responsible manner. The Principal manages the project team engaged to design and supervise the works. The Principal will also be responsible for selection and engagement of the Contractor and liaison with the Statutory Authorities / Regulator throughout the process.

Contractor: Treescape
The contractor will be responsible for implementation, management and maintenance of erosion and sediment control measures. The Contractor will liaise with the Project Ecologist, Erosion and Sediment Control Consultant and Statutory Authorities to ensure all erosion and sediment control measures are operating effectively.

Project Ecologist: Wildland Consultants
The Project Ecologist will ensure that the Ecological considerations associated with the tree removal proposal are respected. Specific recommendations from the Wildlands reports and revised methodology relating to the setup of the erosion and sediment control measures will be directed by the Project Ecologist.

Erosion and Sediment Control Consultant: Ridley Dunphy Environmental
The Principal has appointed RDE as an appropriately qualified and experienced specialist to provide erosion and sediment control advice, ongoing education of contractors and other project team members and monitoring services. Monitoring data and reporting will provide a systematic review of the effectiveness of site environmental management and controls.

Planning: Mt Hobson Group
Mt Hobson Group were engaged by the Principal to provide planning services associated with the Western Spring's pine removal project. Mt Hobson Group were responsible for applying for consents and managing the consenting process for these works.

Consulting Geologist/Geotechnical Engineers: GeoConsult
The appointed Geotechnical Engineer (as and when required) is responsible for the design, provision of advice and supervision of geotechnical works where this is required by the Principal. The Geotechnical Engineer may provide certification of the earthworks where required.

Statutory Authorities / Regulator: Auckland Council
The Principal and their contractors will liaise with representatives of the AC and its Council Controlled Organisations (eg. Community Facilities) to ensure that erosion and sediment control measures are implemented, maintained and monitored in accordance with consents granted. Compliance inspections undertaken with the AC's representative are expected prior to works commencing and during the project.

5.2 Pre-Construction and Progress Meetings

A pre-construction meeting to discuss this ESCP will be scheduled before works commence. The meeting will comprise with the Principal, Project Ecologist, ESC Consultant, Contractor and Regulator. In this meeting, the allocation of responsibilities will be raised, as well as clear definition of the communication required during the project. The ESC methodology will be finalised, and any items of discussion or points of difference agreed upon. A record of the pre-construction meeting will be kept and circulated to the project team.

Record keeping of weekly and post rain-event monitoring of devices will also take place during the works. Progress meetings may be required during the works to discuss and review the ESCP methodology and the involvement of the Regulator will be sought where amendments to the ESCP may be required.

5.3 Erosion and Sediment Control Devices and Measures

The proposed works will involve different activities that may generate erosion and exposure of sediment on site. These can be summarised as:

- Vegetation clearance
- Earthworks
- Watercourse Crossings
- Tracking
- Revegetation

The following are designed to maximise sediment control and minimise the extent of erosion (sediment generation) and discharge of sediment (sediment yields) to the receiving environment. The proposed erosion and sediment control measures have been designed to meet or exceed the guideline standards of GD05 and TP223 and combine the appropriate selection of measures for the work proposed. Utilising a treatment train approach, the key erosion and sediment control devices and measures designed to accommodate the contractor's activities on this project were divided between the different catchments (refer to Figure 4 below), but a summary of techniques are as follows:

5.3.1 Summary of Erosion and Sediment Control approach:

- Minimise Disturbance and divert clean water away from the disturbed catchments where possible. For typical details, refer to drawings in Appendix A.
- Staging of works and progressive and rapid stabilisation of disturbed areas. Cut and cover will be utilised during any earthworks. Disturbed ground associated with vegetation clearance will be mulched on a daily basis.
- Stabilised accessways and entrances will reduce sediment leaving the site from tracking by any vehicles. For typical details, refer to drawings in Appendix A.
- Mulching and aggregates will be used to provide immediate stabilisation wherever necessary. Mulching will be straw or hay, free of weeds and will be applied to soil surfaces at the rate required by GD05.

- Geotextile coverings and fabrics may be used as a mechanism to protect any steeper cuts that may be temporarily required and provide emergency stabilisation of disturbed areas if required.
- Silt and Super Silt Fences will assist in impounding and treating sediment-laden flows from the works. For typical details refer to drawings in Appendix A.
- All earthworks will be limited to periods of dry weather and is proposed to occur during the Auckland Council earthworks season (01 October to 30 April) with the ability to work outside this period with agreement from Auckland Council..

In order to assess the requirements for the various measures needed, the work area was divided into six sub-catchments (see Figure 4 below). Universal Soil Loss Equation analysis was run on the five catchments of most concern where vegetation removal will be undertaken, to help determine the risk factor for each area with overall environmental risk considered to be very low with only 0.2 tonnes of sediment yield expected with the implementation of the erosion and sediment control measures outlined in this report.

A range of ESC measures are proposed for each catchment and these can be described as:

<u>Site Entrance (Max 0.32Ha)</u>

- Stabilised construction entrance (GD05) and compacted aggregate to accessway;
- A temporary water supply will be made available to the areas so that vehicle wheels can be washed prior to leaving the site if required;
- Woven geotextile to be placed beneath aggregate to minimise heaving and punching;
- Culvert 1 - 1 x 300mm storm boss pipe culvert crossing under the access road by the fence wall for ephemeral, overland flows;
- Silt fence at each side of the created access way that connects the site entrance to the site to prevent flows from leaving the works area;
- Rock check dams or geotextile lining to be placed in the channel, to reduce scour alongside the wall if necessary;
- Standard silt fence on the downstream side of the stockpile and supply area, alongside Motions Creek if stockpiling is to occur in the depot area only;
- Stockpiles surrounded by standard silt fence and/or covered by geotextile fabric.

<u>Catchment 1 (Max 0.71Ha)</u>

- Culvert 2 - 1 x 300mm storm boss pipe culvert in overland flowpath;
- Silt fences by culvert pipe to protect from track runoff if necessary;
- Super silt fences at selected locations alongside Motions Creek to be confirmed;
- Compacted aggregate to accessway to first staging area; 4m wide, woodchip and slash covered track thereafter;
- Staging areas covered in chip mulch, slash and exposed topsoil;
- Daily rapid stabilisation of disturbed clearance areas through mulching.

<u>Catchment 2 (Max 0.93Ha)</u>

- Culvert 3 - 1 x 300mm storm boss pipe culvert in overland flowpath;
- Silt fences by culvert pipe to protect from track runoff if necessary;

- Super silt fences at selected locations alongside Motions Creek;
- Staging areas covered in chip mulch, slash and exposed topsoil;
- 4m wide, woodchip and slash covered track;
- Daily rapid stabilisation of disturbed clearance areas through mulching;

Catchment 3 (Max 0.76Ha)

- Super silt fences at selected locations alongside Motions Creek;
- Staging areas covered in chip mulch, slash and exposed topsoil;
- 4m wide, woodchip and slash covered track;
- Daily rapid stabilisation of disturbed clearance areas through mulching;

Catchment 4 (Max 1.4Ha)

- Daily rapid stabilisation of disturbed clearance areas through mulching
- Super silt fences at selected locations alongside Motions Creek;
- Staging areas covered in chip mulch, slash and exposed topsoil;
- 4m wide, woodchip and slash covered track;

Catchment 5 (Max 0.36Ha)

- Daily rapid stabilisation of disturbed clearance areas through slash and mulching;
- Super silt fence alongside Motions Creek;

Figure 4: Approximate location of catchments in proposed area of works

5.3.2 Sediment Control at the Site Entrance

The access from Stadium Road to the processing areas will include the movement of excavators and limited machinery to the site. Machines or vehicles entering the site will be required to exit the area via a defined site entrance with the facility having a water supply for

wheel washing, if required. The following further outlines erosion and sediment control practices to be undertaken in this section of the site.

- **Defined Site Entrance** - A formed construction entrance will be installed in accordance with GD05 to prevent sediment transport from the site out onto Stadium Road. The proposed construction entrance will be a minimum of 10m long and 4m wide and join the existing access road located by the Western Springs Speedway, refer to the "Overall Site Plan" prepared by CLC Consulting Group Ltd, dwg. 21159-L101-C for most up to date works proposal. Beyond this, compacted aggregate will be laid on the access route in to the site to the extent shown on the Overall Site Plan.
- **Standard Silt Fences -** Standard silt fence will be used at the downstream boundaries of this area of the construction site if earthworks are necessary. The length of the fence will be designed to contain all sediment-laden water flowing from any stockpile, laydown and access areas. See Appendix A for further details.
- **Stormwater Inlet Protection** The primary means of protecting stormwater inlets will be the implementation of the stabilised construction entrance and regular sweeping of any dirt, debris or sediment deposited on the roadway. Any stormwater inlets that may receive sediment- laden runoff will be protected with heavy duty filter socks. Specifications can be found in GD05 and Appendix A.
- **Stockpile** Any stockpiles required will be located within silt fenced areas. Stockpiles can be covered in geotextile or mulch during periods of heavy rain if required.
- **Geotextile Cloth & Aggregates** The stabilised construction entrance area shown on the most recent Overall Site Plan will be constructed to GD05 guidelines. The basecourse level will first be covered with woven geotextile cloth, with a minimum of 150mm of compacted aggregate placed on top. The geotextile cloth will prevent the aggregate from punching in to the soil below in addition to preventing water egress, from the soil below, in to the aggregate. A clean, hardstand accessway will be maintained at all times.
- **Culvert Crossing** Culverts are the most commonly used type of temporary watercourse crossing and can be easily adapted to most site conditions. A culvert crossing is proposed at the wall crossing point to channel storm flows form upslope of the accessway underneath it and downhill with the channel being stabilised against erosion with geotextile fabric or rock check dams if necessary.
- **Super Silt Fence** Super silt fences may be placed on both sides of the access way near the culvert crossing depending on access requirements. This would only be implemented in order to avoid sediment from tracking along the accessway and in to the culvert alongside.

5.3.3 Sediment from Access Track

The first step in gaining access to the works area is the construction of the access track. This will be undertaken in a staged fashion. Any excavation required for formation of the access areas will be minimised to the extent possible while allowing for safe machinery access to the site. Silt fences may be installed at selected locations to prevent runoff from the formed access track reaching any overland flowpaths dependant on site conditions. Slash and woodchip will also be placed alongside the track to filter any runoff.

Vegetation clearance along the alignment of the access track will be required during this first stage of works. The contractor will fell those trees along this alignment in a staged fashion and process the felled material quickly to allow the access to be established. As much as possible, logs are not intended to be dragged over the ground to ensure that land disturbance is minimised. Where disturbance occurs, this will be covered on a daily basis through the application of slash, woodchip or hay mulch.

This stage of the works will be undertaken during periods of fine weather only.

During the main vegetation removal phase, any minimal runoff generated from the access track will be filtered by felled foliage, mulch and small branches (slash). In reality, through a combination of progressive stabilisation with slash and hay mulch across the access track and cleared areas, the effective disturbed catchment will be very minimal. Contingencies are provided in section 5.4 below should monitoring of the controls result in the need for increased controls.

- **Super Silt Fence** Super silt fences are used to intercept runoff, reduce its velocity, filter and impound sediment to keep it from entering a clean stormwater channel. These will be used at selected locations along the downstream boundaries of the clearance site, alongside Motions Creek. The Super Silt Fences will be installed along the base of the site with set out confirmed in consultation with the Erosion and Sediment Control Consultant, Contractor, Project Ecologist and Regulator to deal with high risk, localised catchments such as near where culverts flow under any access tracks or by Motions Creek.
- **Staging of Earthworks** Any earthworks will be undertaken in a staged manner and progressively stabilised across the site. On any given day, rapid stabilisation of disturbed areas with aggregate, woodchip, slash or hay mulch will be undertaken to reduce the potential of erosion of soil surfaces.
- **Slash Bunds** Slash bunds may be in place to slow and filter any dirty water flows from the staging areas.

5.3.4 Sediment Generation Near Watercourses

Where pine removal is undertaken near the watercourses flowing through the site, disturbance will be minimised by the contractor by ensuring that excavators are not used within 10m of the intermittent stream to the northern portion of the site or Motions Creek. Excavator use should be limited to the access track shown on the Overall Site Plan in Appendix A. Logs will be felled away from watercourses and on to staging areas if necessary. Where disturbance occurs from log fall or due to dragging of the any logs or debris, these areas will be stabilised with hay mulch (or slash if available/appropriate) on a daily basis. If, due to unforeseen circumstances, excess soil disturbance is required or necessary, proprietary controls such as silt fences will be installed to protect watercourses. Logs shall not be felled over watercourses or dragged through watercourses at any time and a buffer of 10m from the channel of the intermittent watercourse on site will be maintained free of disturbance, except where tree stump locations render this buffer impossible to maintain.

Temporary culverts will be installed where the access way traverses the overland flowpaths flowing through the site. Due to the small catchments involved, culverts will utilise a single 300mm stormwater boss pipe. The culvert pipes will be protected with a layer of compacted

drainage aggregate to ensure they are not crushed, prior to being filled over. Provision of upstream and downstream erosion protection may be required through the use of geotextile covering or rip-rap rock dependant on flows encountered during periods of heavy rain.

- **Culvert Crossings** Culvert crossings will be installed where overland flowpaths traverse the site along the proposed access track route. Details for these are outlined above.
- **Directional Tree Felling** The harvest should be designed to minimise trees being felled across streams or logs being dragged through stream beds because of the disturbance created by the activity.

5.4 Contingency Plans

If the proposed erosion and control measures are found to not be effective or if site conditions or methodology changes dictate, then other urgent erosion and sediment control approaches will be applied. The proposed contingency measures include, but should not be limited to:

a) Should weather conditions rapidly deteriorate, all disturbed areas of the site will be rapidly stabilised with hay mulch, wood chip, slash or geotextile fabrics if required to protect Motions Creek;
b) Should disturbance of soils adjacent to overland flowpaths or intermittent watercourses be identified as excessive with resultant potential for sediment runoff from those areas affecting water quality downstream, further sediment control devices will be installed in consultation with the Erosion and Sediment Control consultant, Contractor and Regulator;
c) Slash bunds, logs and haybale barriers may be employed if land disturbance and wet weather results in slurry flows on the site;
d) As much as possible, all works will be limited to dry weather breaks only;
e) Rapid stabilisation of any problem areas with hay mulch, with stockpiles of mulch kept on site for use at short notice;
f) If the staging areas deteriorate due to soil conditions, the contractor may install a log corduroy to assist in maintaining a solid working surface and avoiding excessive erosion.
g) Upstream and downstream sampling in Motions Creek for Total Suspended Solids and Turbidity levels should serious sediment discharges occur.

5.5 Universal Soil Loss Equation

To assess risk for the proposed works, the Universal Soil Loss Equation (USLE) has been utilised for the individual catchments across the site. The primary purpose of the USLE was to provide a measure of the risk of sediment generation and yields, and to assist in identifying controls required for managing this risk to the environment from sediment yields from earthworks sites.

N.B. Whilst the USLE provides a useful benchmark to consider the erosion and sediment control aspects of the land disturbance proposed, it should also be noted that the calculated net sediment yield is an indicator and not a guaranteed outcome. The full suite of actions outlined in this report need to be considered when managing the sedimentation effects of the project. Further, the activity proposed does not necessarily result in full exposure of the soils

on the site as with a normal earthworks proposal – as discussed in the proposed works section of this report. Please also note that the most recent contractor's methodology has further reduced the area of earthworks proposed and as such, it is expected that the sediment yields noted below would be an absolute maximum.

Three key aspects of erosion and sediment control are related sediment yield risk:

- Sediment generating potential - based on slope, slope length, soils, rainfall and erosion control factors;
- Sediment delivery – relates to the amount of eroded material that is generated and "delivered" to the site controls;
- Sediment yields – the amount of sediment that actually leaves the site and enters the receiving environment. This is the key measure in any USLE assessment and can be drastically affected due to the erosion and sediment control methodology employed.

$$A = R*K*LS*C*P$$

where: R = Rainfall Erosion Index

K = Soil Erodibility Factor

LS = Slope Length and Steepness Factor

C = Ground Cover Factor

P = Roughness Factor

For the purposes of this USLE, earthworks have been considered in terms of the maximum expected contributing catchment, as would best reflect the highest expected sediment yield generation. During earthworks, slope angles and lengths will, however, be reduced primarily through the use of diversions, soil stabilisation and contour drains. Consequently, the USLE assessment reflects this. The USLE results are outlined in Table 1 below.

Table 1: Summary of USLE calculated Net Sediment Yield

USLE - Estimated Net Sediment Yield (tonnes)						
	Catchment 1	Catchment 2	Catchment 3	Catchment 4	Catchment 5	**TOTAL**
Tonnes of Soil (Before Sediment Controls Implemented)	0.08	0.17	0.71	0.23	0.02	**1.21**
Tonnes of Soil (With Sediment Controls Implemented)	0.01	0.03	0.12	0.04	0	**0.2**
Maximum Days Exposed	5	3	5	7	2	22

The duration of earth works (in days) used in the USLE calculation is different at each catchment. This is because the actual land disturbance time is envisaged to be staged and different working areas will be cleared for different periods of time.

Nevertheless, the total sediment yield calculated for the worst scenario (no erosion and sediment controls) would be of 1.21 tonnes for the 22 days of the expected maximum 50 days of work. This is reduced substantially through the implementation of ESCs with a resultant sediment yield of 0.2 tonnes of sediment (200kgs). This volume would be the absolute maximum yield and is considered to be minimal and well within the expected levels for a project of this type. The number of "days exposed" used in the calculation is conservative and it is expected that the overall Net Sediment Yield will be further limited as the areas will be only excavated in dry weather and soil surfaces will be stabilised before the end of each day. Full calculations are provided in Appendix B.

As a result of the USLE assessment, we conclude that the overall risk associated with the proposed work in terms of sediment yield to the receiving environment is low.

It is further noted that the reduction in earthworks as a result of the revised contractor's methdology discussed in the applicant's response to commissioners 25 January 2019 and the most up to date methodology forming part of the Specification of Works will further reduce the expected sediment yield. This is due to the reduction in timeframe and overall exposed areas.

5.6 Monitoring & Maintenance

5.6.1 Regular Monitoring and Maintenance

The monitoring and maintenance of erosion and sediment control measures is essential for those controls to be effective on a continual basis. The Contractor will be responsible for daily checks to ensure that all erosion and sediment control measures are installed and operating correctly.

A weekly site walkover will be recorded by the Contractor detailing any sediment and erosion control works that need to be undertaken. Periodic audits should be undertaken by the appointed Erosion and Sediment Control Consultant, with formal audit reports produced as a record of actions required.

The checks are expected to cover:

- Noticeable discolouration of downstream waters
- Construction Entranceway and Access track in good condition
- Staging area surfaces in good condition
- Stabilisation of exposed areas of soil across the site
- Super Silt Fences and Silt Fences are operational and do not need maintenance
- Cleanwater diversions are in place if required
- Culverts are clear and erosion of the upstream and downstream soils is not evident
- Erosion of any downstream watercourses is not evident within the works area

Further reference to normal maintenance tasks for the erosion and sediment control measures proposed can be found in both the GD05 and TP223 guideline documents.

5.6.2 Weather Watching and Heavy Rainfall Response

Heavy rain events have the potential to overwhelm erosion and sediment controls. Weather-watching and being informed of daily and weekly weather forecasts is the most important factor in ensuring the severe weather events do not compromise the controls on the site.

In the Auckland area, rainfall in excess of 25mm in a 24 hour period, or 15mm in a 1 hour period is considered to be indicative of rainfall amounts that can affect the ongoing operation of erosion and sediment control measures for land disturbance activities. As part of the ongoing management of the ESC measures, following a rainfall event that meets the trigger level noted above, both the Contractor and the ESC Consultant should visit the site within 24 hours of the trigger to ensure that all ESCs are in place and working effectively. Any issues can be identified and actioned so that discharges to the environment are minimised.

Sampling of upstream and downstream flows for TSS and Turbidity in Motions Creek may be undertaken to help inform the overall effect of any heavy rainfall events. However, due to the short timeframe for the proposed works and the relative small scale of any land disturbance, this is not part of this proposal and would be considered a contingency to be implemented in the event of a serious breach of the erosion and sediment controls during a severe weather event only.

A “serious discharge to the environment” from the proposed land disturbance works would be considered to have occurred if, after reasonable mixing, any of the following effects are noted in the receiving waters:

- the production of conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
- any conspicuous change in the colour or visual clarity;
- any emission of objectionable odour;
- the rendering of fresh water unsuitable for consumption by farm animals; or
- any significant adverse effects on aquatic life.

In the event of any of the above occurring, works should immediately cease on the site and the Contractor should take such steps as are required to immediately cease the cause of those effects. Auckland Council’s Pollution Hotline should be contacted (09 377 3107) to ensure that the Regulator is aware of the steps being taken to address the issue causing the discharge. The Contractor should address any actions that the Regulator requires immediately and the Principal should be informed.

6. GD05 and TP223

As previously noted in the introduction to this report, the ESCP is a combination of standard erosion and sediment controls selected from both the GD05 "*Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region*" and TP223 "*Forestry Operations in the Auckland Region - A Guideline for Erosion and Sediment Control*".

The rationale for the selected devices, controls and methods is due to the unique nature of both the site, and the project. The pine trees in question are not being harvested for commercial gain, nor are they in good condition to be treated as such. The purpose of the pine removal is to facilitate the safe use of the Western Springs Park by removing the health and safety risk of falling trees and vegetative debris as well as using the opportunity to restore the native biodiversity of the site in the long term.

With that in mind, the felling of pine trees will be controlled to ensure that the long term ecological sustainability of the site is enhanced and maintained. While there will be some areas of the site where soil disturbance occurs to form access tracks, for the most part, soil disturbance will be limited to surface scraping due to tree felling and excavator operations. It is expected that for the majority of the site area, the soil surface will remain largely intact and vegetated, while areas that are exposed, will be stabilised straight away.

The land disturbance associated with the access track is extremely limited and will end up covered in slash and mulch quickly. The best analogy for the site is that of a Forestry operation. Even then, the manner in which this work will be completed will be less invasive than that undertaken on a normal Forestry site.

Given the sensitivity of the receiving environment, the Principal and Contractor have agreed that the selected devices, controls, methodology and contingency plans are appropriate.

7. SITE REHABILITATION AND ESC REMOVALS

On completion of the pine removals, the access track will be disestablished, and the areas stabilised against erosion. Any soil surfaces that remain disturbed at the end of the project will be stabilised through vegetative means. This may be in the form of mulch prior to planting commencing at a later date, or the Principal may proceed rapidly with the native revegetation and restoration project.

The erosion and sediment control measures will be removed in a staged fashion. Once the decommissioning of the access track is complete, any disturbed areas must first be stabilised against erosion through vegetative means. It is likely that this may involve the use of hay mulch and wood chip to achieve a rapid ground cover within the main site. Once this has occurred, any localised silt fencing can be removed if this has been utilised. Alternately, should revegetation planting commence immediately, once planting is completed, any silt fencing utilised along the access track route could then be removed.

Where the construction entranceway from Stadium Road is removed, this area should be regressed to Auckland Council Community Facility standards for Parks development. This may involve grass seeding and it is recommended that straw mulch is applied to this area to aid in the rapid stabilisation of the soil surfaces.

Any Super Silt Fences utilised may need to remain in place alongside Motions Creek until such time as the entire site has been revegetated – either through grassing, native revegetation or natural regrowth. This may mean that the Super Silt Fences remain in place for a period of 6 to 12 months following completion of the harvesting operation. Appropriate Health and Safety considerations will need to be made to ensure the silt fences do not become a hazard to the public and appropriate overland flows to Motions Creek will need to be maintained.

Once the site is fully revegetated, the Super Silt Fence should be removed as the final act.

8. CONCLUSION

The subject pine removal site is located in a Significant Ecological Area, an area considered to be of high significance in terms of habitats for indigenous species. Its location is of importance locally in terms of amenity value, being near the Auckland Zoo, Motions Creek and the within the wider Western Springs Park.

The proposed pine removal in the park seeks to reduce health and safety hazards to the public, as well as provide for a native biodiversity restoration programme. Land disturbance resulting from the pine removal and earthworks associated with formation of the access track and skid site areas will be undertaken across an approximate area of less than 5% of the subject portion of the Park. This ESCP has appointed the best methodology for erosion and sediment control to comply with the requirements of GD05 and TP223. A comprehensive erosion and sediment control methodology is proposed to ensure that any potential effects resulting from land disturbance activities are appropriately avoided, remedied and/ or mitigated.

As tree roots and stumps will remain in the ground, the main earthwork disturbance is expected to be associated with the creation of the access track. However, those concerns are addressed by limiting earthworks areas, emphasising a cut and cover methodology for excavation operations and stabilising disturbed areas at the end of each day of operation. The stabilisation will be undertaken with good quality aggregate at the site access entry, slash and mulch on the skid sites and straw mulch across the wider removal area where machinery access is not required. Given that there will be a modest vegetative cover remaining across the majority of the site, significant sediment runoff is not expected. For sediment that is generated from the disturbed areas of the site, super silt fences will be placed at selected locations alongside Motions Creek in consultation between the Contractor, Erosion and Sediment Control consultant, Project Ecologist and Council Compliance Officer. Further, contingency measures are in place to ensure that adequate actions are taken if these measures do not achieve the required outcomes.

In addition to the methodology adopted, a monitoring programme will be implemented to ensure the effective ongoing operation of erosion and sediment control methods. As part of this monitoring programme, routine checks combined with heavy rainfall response actions will ensure that adverse effects on the receiving environment will be monitored, as well as appropriate measures taken to reduce any impacts as a result of sediment-laden runoff from the works. The results of this monitoring programme may inform the need for changes to this ESCP, which will be discussed with the Regulator with relevant approvals sought.

Implementation of this ESCP will ensure that the environmental effects from sediment runoff associated with the land disturbance activity on the environment will be less than minor.

9. REFERENCES

Auckland Council (2016) Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region - GD05 *Auckland Council*.

Auckland Council (2012). Environmental Monitoring Strategy: Year One Auckland Central Streams Results *Auckland Council*.

Auckland Regional Council (1999). Auckland Regional Council Technical Publication *Auckland Regional Council Technical Publication No*, *90*.

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Waitemata Local Board (2018) *Waitemata Local Board – Auckland Council* Draft "Western Springs Lakeside Te Wai Orea park development plan" Feb 2018.

Treescape (2021). *Treescape.* Western Springs – Tree Removal Methodology. 26 Feb 2021

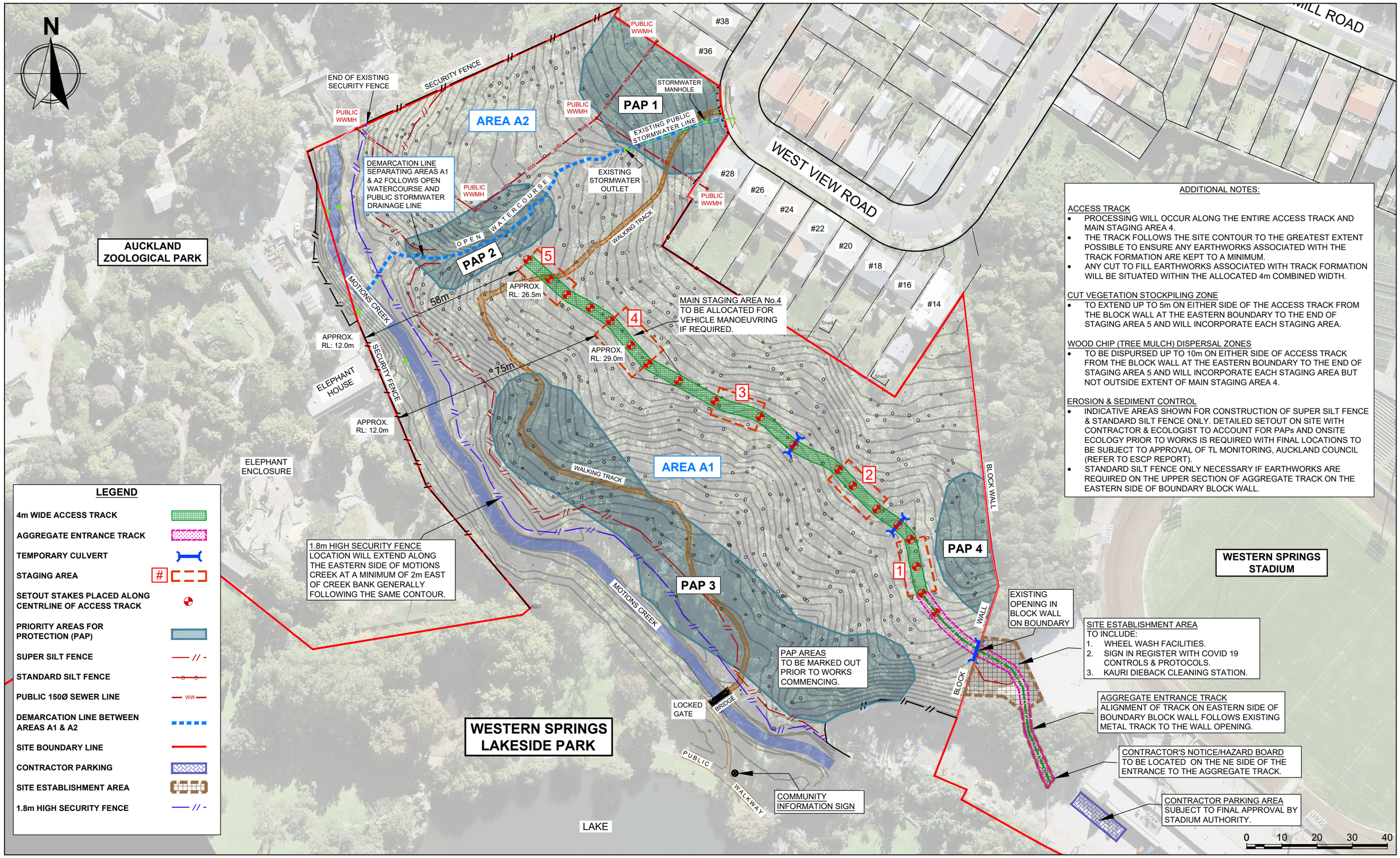
10. APPLICABILITY

This ESCP report has been prepared for the sole benefit of Community Facilities Department, Auckland Council as Ridley Dunphy Environmental Limited's client with respect to the brief. It is not to be relied upon or used out of context by any other person without reference to Community Facilities Department, Auckland Council. The reliance by other parties on the information or opinions contained in the report shall, without prior review and agreement in writing, be at such party's sole risk.

Glenn Pope
Environmental Consultant
Ridley Dunphy Environmental Limited

APPENDICES

APPENDIX A – Erosion and Sediment Control Plan and Standard Details



ADDITIONAL NOTES:

ACCESS TRACK
- PROCESSING WILL OCCUR ALONG THE ENTIRE ACCESS TRACK AND MAIN STAGING AREA 4.
- THE TRACK FOLLOWS THE SITE CONTOUR TO THE GREATEST EXTENT POSSIBLE TO ENSURE ANY EARTHWORKS ASSOCIATED WITH THE TRACK FORMATION ARE KEPT TO A MINIMUM.
- ANY CUT TO FILL EARTHWORKS ASSOCIATED WITH TRACK FORMATION WILL BE SITUATED WITHIN THE ALLOCATED 4m COMBINED WIDTH.

CUT VEGETATION STOCKPILING ZONE
- TO EXTEND UP TO 5m ON EITHER SIDE OF THE ACCESS TRACK FROM THE BLOCK WALL AT THE EASTERN BOUNDARY TO THE END OF STAGING AREA 5 AND WILL INCORPORATE EACH STAGING AREA.

WOOD CHIP (TREE MULCH) DISPERSAL ZONES
- TO BE DISPURSED UP TO 10m ON EITHER SIDE OF ACCESS TRACK FROM THE BLOCK WALL AT THE EASTERN BOUNDARY TO THE END OF STAGING AREA 5 AND WILL INCORPORATE EACH STAGING AREA BUT NOT OUTSIDE EXTENT OF MAIN STAGING AREA 4.

EROSION & SEDIMENT CONTROL
- INDICATIVE AREAS SHOWN FOR CONSTRUCTION OF SUPER SILT FENCE & STANDARD SILT FENCE ONLY. DETAILED SETOUT ON SITE WITH CONTRACTOR & ECOLOGIST TO ACCOUNT FOR PAPs AND ONSITE ECOLOGY PRIOR TO WORKS IS REQUIRED WITH FINAL LOCATIONS TO BE SUBJECT TO APPROVAL OF TL MONITORING, AUCKLAND COUNCIL (REFER TO ESCP REPORT).
- STANDARD SILT FENCE ONLY NECESSARY IF EARTHWORKS ARE REQUIRED ON THE UPPER SECTION OF AGGREGATE TRACK ON THE EASTERN SIDE OF BOUNDARY BLOCK WALL.

LEGEND

- 4m WIDE ACCESS TRACK
- AGGREGATE ENTRANCE TRACK
- TEMPORARY CULVERT
- STAGING AREA
- SETOUT STAKES PLACED ALONG CENTRLINE OF ACCESS TRACK
- PRIORITY AREAS FOR PROTECTION (PAP)
- SUPER SILT FENCE
- STANDARD SILT FENCE
- PUBLIC 150Ø SEWER LINE
- DEMARCATION LINE BETWEEN AREAS A1 & A2
- SITE BOUNDARY LINE
- CONTRACTOR PARKING
- SITE ESTABLISHMENT AREA
- 1.8m HIGH SECURITY FENCE

CLC CONSULTING GROUP LTD
CIVIL & STRUCTURAL ENGINEERS, PLANNERS & LAND SURVEYORS
PHONE: 09-576 3276
EMAIL: clc@clcgroup.co.nz
WEB: www.clcgroup.co.nz
4 JOHNS LANE, PAKURANGA AUCKLAND 2010
PO BOX 51-547, PAKURANGA AUCKLAND 2140

Revision Notes:

Rev:	Date:	Notes:
A	24-02-2021	Issued for review & comment.
B	25-02-2021	Additional features and comments added.
C	25-02-2021	Minor amendments.

Notes:
- Underlying topographical survey information by others.
- Levels are in terms of Auckland vertical Datum 1946.
- Horizontal datum in terms of Mt Eden 2000.

Client: TREESCAPE

Project: WESTERN SPRINGS PARK
859 Great North Rd, Grey Lynn

Drawn By: OH 23-02-2020

Checked By: OH 25-02-2020

Drawing Title: OVERALL SITE PLAN

Date: FEBRUARY 2021

Scale @ A3: 1:1000

21159-L101-C

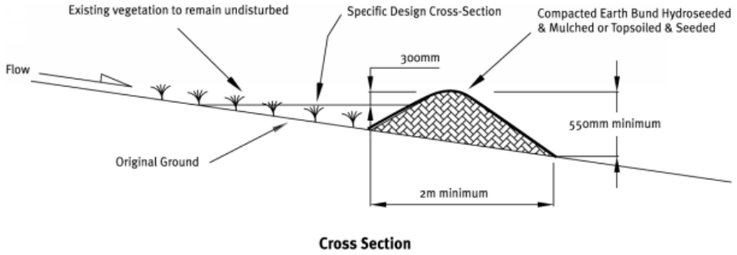


Figure 16: Cross-section of clean water diversion

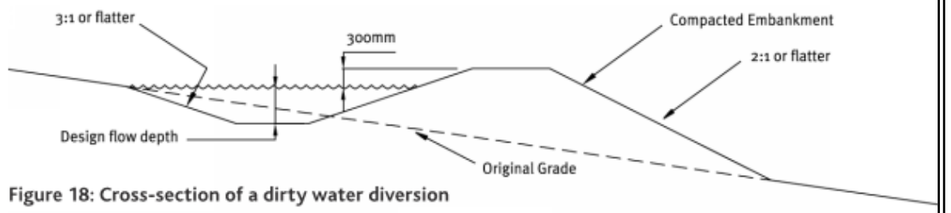
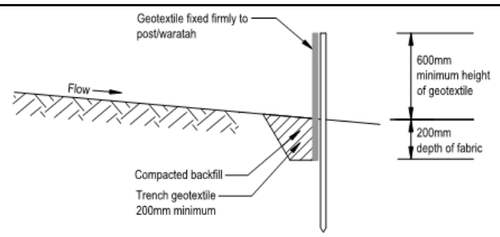
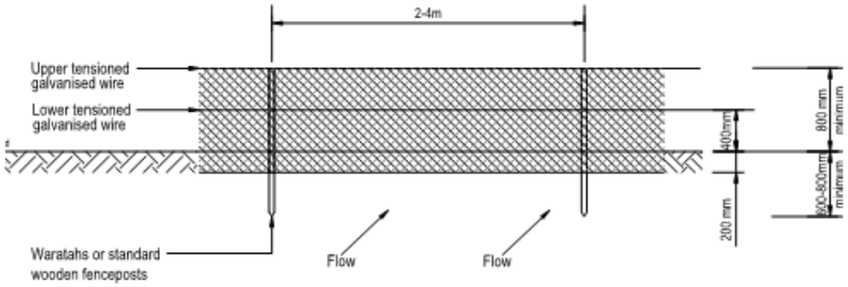


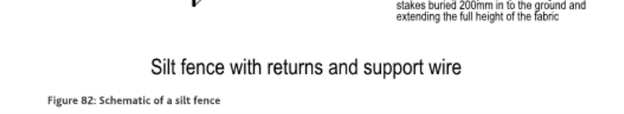
Figure 18: Cross-section of a dirty water diversion



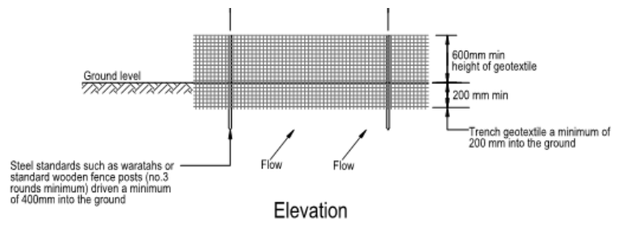
Cross - section



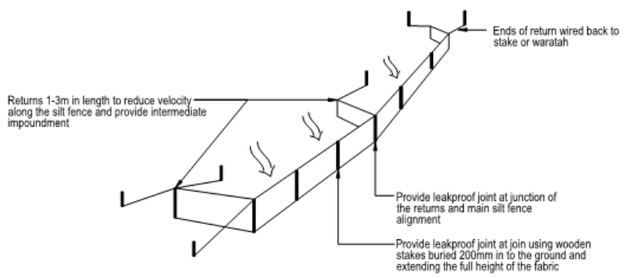
Elevation



Standard fabric joint

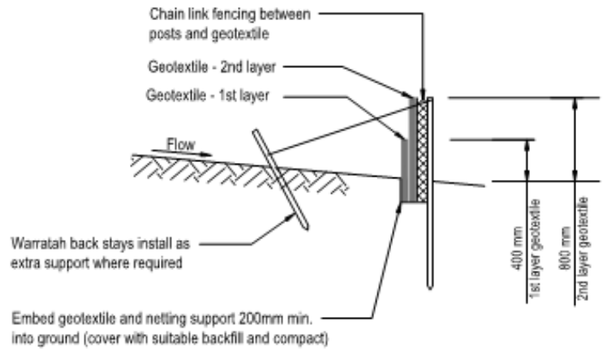


Elevation



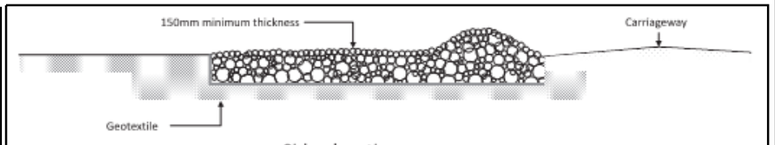
Silt fence with returns and support wire

Figure 82: Schematic of a silt fence

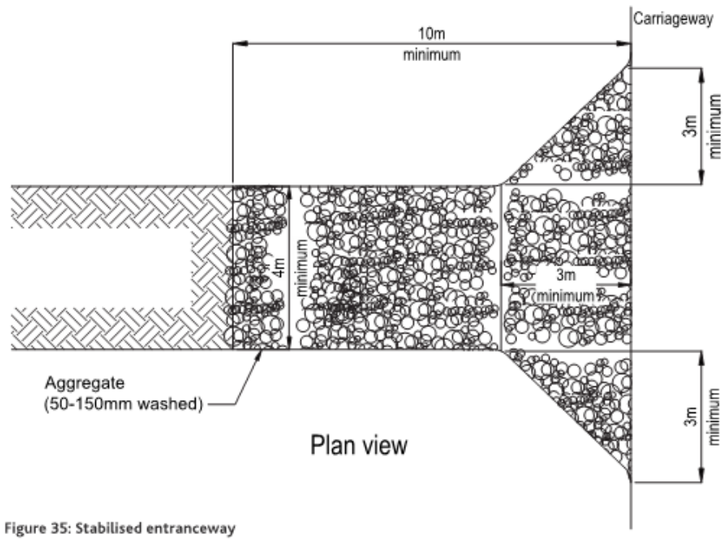


Cross - section

Figure 88: Schematic of a super silt fence



Side elevation



Plan view

Figure 35: Stabilised entranceway

Table 8 Stabilised entranceway specifications

Design parameter	Specification
Aggregate size	50 – 150 mm washed aggregate
Minimum thickness	150mm
Minimum length	10 m
Minimum width	4 m

Table 14: 300 mm diameter silt sock

Slope steepness (%)	Maximum slope length (m)	Spacing of returns (m)
Flatter than 2%	100	N/A
2%-10%	40	30
10%-20%	30	25
20%-33%	10	10
33%-50%	5	10
>50%	2	5

GD05 - Silt Sock specification - refer Section F1.5 (GD05)

DWG NO: ESCP 01 Sheet 2 of 3
REV: A
Date: 30.05.2018
Scale @A3: 1:1000
Drawn: GP
Checked MD

FINAL - FOR RESOURCE CONSENT
PROJECT DESCRIPTION
WESTERN SPRINGS PINE TREE REMOVAL
PROJECT ADDRESS
STADIUM ROAD, WESTERN SPRINGS
DRAWING TITLE
ESCP STANDARD DETAILS

APPENDIX B – Universal Soil Loss Equation (USLE) Calculations

K. USLE (Universal Soil Loss Equation) Calculations

Project:	**Western Springs Pine Removal**		
Calculations By:	Glenn Pope	**Date:**	27/04/2018
Checked By:	Mike Dunphy	**Date:**	28/04/2018
Element:			

USLE (Universal Soil Loss Equation) Mitigated Calculation

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41 \times s^2}{s^2 + 10{,}000} + \frac{4.56 \times s}{\sqrt{s^2 + 10{,}000}} + 0.065\right) \times \left(\frac{l}{22.1}\right)^m$$

LS = topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness
0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	
	0.2 for slopes < 1%
	0.3 for slopes 1 to 3%
	0.4 for slopes 3.5 to 4.5%
	0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
50.0	10.0	Catchment 1	0.7	2500.0	12500.0	111.8	20.0	6.1	0.5	14.4
40.0	8.0	Catchment 2	0.061	1600.0	11600.0	107.7	20.0	6.1	0.5	10.3
50.0	10.0	Catchment 3	0.107	2500.0	12500.0	111.8	20.0	6.1	0.5	14.4
45.0	9.0	Catchment 4	0.029	2025.0	12025.0	109.7	20.0	6.1	0.5	12.3
25.0	5.0	Catchment 5	0.025	625.0	10625.0	103.1	20.0	6.1	0.5	4.8

Calculate R (Erosion Index)

$R = 0.00828p^{2.2}*1.7$

R = 216.41 J/ha *Based on HIRDS data

p = 80 mm *6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

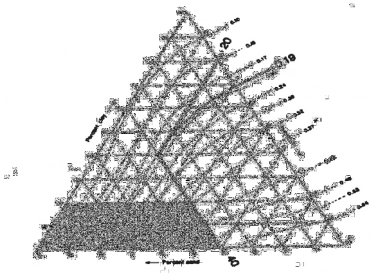
	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	80	15	5	0	0

Table 1

K Value	Correction factor when percent organic matter is 0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et.al. 1986

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.16	3	-0.03	0.13	0.17

*Refer to Table 1 and Figure 1

Calculate Net Sediment Loss (tonnes)

Device	Description	USLE Parameters A = R*K*LS*C*P								Time	Estimated Gross Sediment Yield (tonnes)		Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
	Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	(Years)	Construction Period	Re-estab Period			
	Catchment 1	0.012	216	0.17	20.0	50.00	14.45	1	0.90	0.01	**0.08**		0.70	0.75	**0.01**
	Catchment 2	0.061	216	0.17	20	40.00	10.26	1	0.90	0.01	**0.17**		0.70	0.75	**0.03**
	Catchment 3	0.107	216	0.17	20	50.00	14.45	1	0.90	0.01	**0.71**		0.70	0.75	**0.12**
	Catchment 4	0.029	216	0.17	20	45.00	12.32	1	0.90	0.02	**0.23**		0.70	0.75	**0.04**
	Catchment 5	0.025	216	0.17	20	25.00	4.77	1	0.90	0.01	**0.02**		0.70	0.75	**0.00**
	Total Area	**0.2340**	**Total Estimate Gross Sediment Yield (tonnes)**								**1.21**	**Total Mitigated Sediment Loss (tonnes)**			**0.21**

***Refer to Table 3 for C factor and P factor**

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil	0.15 (3 month period only)	1.0
Mulch – on topsoil	0.05 (3 month period only)	1.0

APPENDIX C – Updated Methodology, Treescape Feb 2021