Appendix H of the CEMP

Erosion and Sediment Control Plan

NZ TRANSPORT AGENCY
WAKA KOTAHI

1 MacKays to Peka Peka Expressway

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Action	Name	Signed	Date
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Approved by	Andrew Goldie		26 March 2012
on behalf of	Fletchers Construction Limited		

Table of Contents

Appendices

1 Introduction and Project Description

The purpose of this report is to describe the methods and practices to be implemented to minimise the effects of sediment generation and yield on the aquatic receiving environments associated with the MacKays to Peka Peka Project (the "Project"). This Erosion and Sediment Control Plan (ESCP) is prepared to support the assessment of environmental effects (AEE) and to provide guidance to the Mackays to Peka Peka Project Team[1]. Further this ESCP, while referred to as an ESCP, also provides environmental guidance on a number of other activities associated with the Project including but not limited to dust management, concrete works and the use of bentonite.

The Project sector diagram is included in Appendix H.A of this ESCP, and provides an overview of the extent and works for the Project. This ESCP covers all sectors of the Project. For the purposes of the construction methodology and this ESCP, the Project is split into 4 specific sectors referred to as follows:

Sector One Raumati South

This sector includes chainage 1900 to 4500 and includes the following specific construction stages:

- Poplar Avenue (POP)
- Poplar Avenue-Raumati Road (POP-RAU)

Sector Two Raumati / Paraparaumu

This sector includes chainage 4500 to 8300 and includes the following specific construction stages:

- Raumati Road/Wharemauku Stream/Ihakara Street (RAU-IHA)
- Ihakara Street/Wharemauku Stream-Kāpiti Road (IHA-KAP)
- Kāpiti Road-Mazengarb Road (KAP-MAZ)
- Mazengarb Road-plus 300m (MAZ-OT)

Sector Three Otaihanga / Waikanae

This sector includes chainage 8300 to 12400 and includes the following specific construction stages

- Mazengarb Road-plus 300m to-Otaihanga Road (MAZ-OT)
- Otaihanga Road-Waikanae River (OT-WAI)
- Waikanae River-Te Moana Road (WAI-TEM)

[1] This Management Plan refers to the Project team as carrying out works on behalf of and as contracted by NZTA. The NZTA is the requiring authority and the consent holder.

- Te Moana Road-plus 600m (TEM-NGA)

Sector Four Waikanae North

This sector includes chainage 12400 to 18050 and includes the following specific construction stages

- Te Moana Road-plus 600m to Ngarara Road
- Ngarara Road-Peka Peka (NGA-PP)
- Peka Peka Interchange (PP)

For more detailed Project description reference should be made to Part D, Chapters 7 and 8, Volume 2 of the the AEE that supports the Project. Further, when reading this ESCP, key reference should also be made to the Construction Methodology Report (Technical Report 4, Volume 3).

The construction methodology and ESCP for the Project is intended as a realistic and feasible methodology from which the anticipated effects on the environment of these activities can be identified. It is important that this ESCP is read in conjunction with the construction methodology with the methodology itself also providing a critical feature of the erosion and sediment control methodology.

The Project has been developed as an Alliance Project (refer to Part A, Chapter 1, Volume 2 of the AEE for further information) and hence contractor input into this ESCP has occurred from early in the consenting process. This has ensured that the ESCP provides for an achievable approach while also ensuring environmental objectives are achieved. The Project team consists of the NZ Transport Agency (NZTA), Kāpiti Coast District Council (KCDC), Fletcher Construction Limited, Higgins Contractors Limited and Beca Carter Hollings and Ferner Limited. Sub-partners of the Project team include Goodman Contractors Limited, Boffa Miskell Limited and Incite Limited.

The Project is anticipated to take 5 years to construct, and will be able to be undertaken on a number of fronts or work faces, such that many elements of the Project will be undertaken concurrently. During construction, erosion and sediment control measures will be put in place to minimise potential adverse effects by utilising measures which meet industry best practice guidelines such as reflected by Greater Wellington Regional Council's Erosion and Sediment Control Guidelines for the Wellington Region, September 2002 (Wellington Guidelines). The draft NZTA Erosion and Sediment Control Standard for State Highway Infrastructure dated August 2010 (NZTA Draft Standard) has also been considered. It is expected, as is the case for projects of this size and nature, that site and activity specific erosion and sediment control plans will be further enhanced which will follow the general principles of this ESCP. These are referred to as Construction Erosion and Sediment Control Plans (CESCPs). This will enable the Project Team and Greater Wellington Regional Council to have further input into the methodologies implemented.

The ESCP provides for an overview of the erosion and sediment management techniques and measures that will be used within the Project, provides specific examples throughout and also outlines methodologies and management techniques that will apply and will achieve the necessary environmental objectives. This ESCP also includes details on dust management techniques to be utilised within the Project.

Once the erosion and sediment controls are in place, ongoing site monitoring by the Project team and the NZTA representatives will occur to ensure that the proposed erosion and sediment control measures have been installed correctly, and are functioning effectively throughout the duration of the works.

Stormwater management during the construction phase is a separate and unique stage in the water management of the Expressway. It occurs after earthworks activities have ceased in an area, and erosion and sediment controls are no longer appropriate, but before long term operational stormwater controls are in place. Stormwater management measures are proposed for impervious construction areas and the pavement of the constructed Expressway. Reference should be made to the Construction Methodology Report (Technical Report 4, Volume 3).

There are 9 construction yards proposed along the route of the Project with the details of these provided within the Construction Methodology Report (Technical Report 4, Volume 3) and also outlined in Section 7.14 of this ESCP.

Site establishment activities will include site clearance, ground preparation, and establishing erosion and sediment control measures prior to any construction activities occurring. Upon completion of the works, it is expected that the erosion and sediment controls will be removed and any rehabilitation undertaken as necessary.

During construction, a variety of measures will be used to manage construction activities and ensure that construction is being undertaken in a way that avoids, minimises or mitigates effects on the environment. This will include specific mitigation measures, environmental monitoring and environmental auditing. To assist this process, and ensure that the Project team meets both the Designation and resource consent requirements and the NZTAs requirements, in addition to this ESCP a Construction Environmental Management Plan (CEMP, Volume 4 of the AEE) has been prepared for the Project.

The CEMP (Volume 4 of the AEE) is an overarching document which supports the applications for resource consents and designations and is intended to be used by the construction contractors to manage the environmental effects of the Project. The principles and general approach to managing the environmental effects are set out in the main body of the document. The management of specific effects (e.g. construction air quality, noise, vibration etc.) are detailed more particularly within a suite of environmental management plans (sub-plans) that form the appendices to the CEMP (Volume 4 of the AEE).

The Project team will be required to undertake all construction activities on site in accordance with the provisions of the relevant management plans as part of their contractual arrangements.

The CEMP (Volume 4 of the AEE) will be reviewed after confirmation of the resource consent and designation conditions and will be revised in accordance with these conditions. The CEMP (Volume 4 of the AEE) and the sub-plans will be updated, with the necessary approval, throughout the course of the Project to reflect material changes associated with changes to construction techniques or the natural environment.

The Project team will also be required to develop a CESCP, as a subset of the ESCP as detailed above, for each specific package of work, that is consistent and in accordance with the CEMP (Volume 4 of the AEE) and this ESCP, and submit to the Greater Wellington Regional Council for certification prior to undertaking the construction work. Importantly, the Ecological Impact Assessment (Technical Report 26, Volume 3) should also be referenced when reading this ESCP.

2 Design philosophy and principles

The following section outlines a generic site description and sets a context for the development of this ESCP.

The site generally has peat soils overlaying sand layers in addition to areas of sand dominant soils. Peat is essentially an accumulation of partially decayed vegetation matter that has formed when plant material is inhibited from decaying fully by the acidic conditions. Peat is soft and easily compressed and under pressure, water in the peat is forced out. From this ESCP perspective it is important to recognise that the peat has a high water table which can limit the type of the erosion and sediment controls utilised. Further the areas of sand dominant soils in many locations along the Alignment create an environment that requires specific management from an erosion and sediment control perspective.

The receiving environment values associated with the site include a range of both fresh water and coastal ecological and amenity values. It is important that erosion and sediment control options recognise these values and manage the discharge of sediment accordingly. This ESCP builds on the areas of significance as identified within the Ecological Impact Assessment (Technical Report 26, Volume 3).

Higher risk areas are identified as those locations adjacent to, or connected to, freshwater streams. These higher risk areas are protected through the minimisation of discharges and implementation of erosion and sediment control measures over and above those typically implemented. These areas focus around the existing values of the freshwater stream systems along the Project and in particular focuses on the Waikanae River and the Te Harakeke/Kawakahia Wetland. The Te Harakeke/Kawakahia wetland is the ultimate receiving environment for any discharge from the

Paetawa Drain, Ngarara Drain, Kakariki Stream and Ngarara Stream with this wetland considered to be ecologically nationally important. The Waimeha Estuary and Wharemauku Stream Estuary are also recognised as high value receiving environments. Reference should be made to the Ecological Impact Assessment (Technical Report 26, Volume 3) for specific and full details.

The Waikanae River is defined in detail within the Ecological Impact Assessment (Technical Report 26, Volume 3) and is recognised as interacting with the underlying gravel aquifer where there are large flow losses to groundwater and gains from groundwater along certain reaches.

As detailed within Section 1.0 of this ESCP more specific and enhanced erosion and sediment control plans, referred to as CESCPs, will be developed for each specific area and activity prior to construction activities commencing.

On most earthwork sites including Expressway development, sediment generally arises from the bulk earthworks phase of operations because of the area exposed by these works and the time required to undertake the works. For this Project, bulk earthworks will be undertaken and accordingly the soil types and the construction methodology are both considered of significant influence. There are also other land disturbing activities proposed by the Project that need to be taken into account when considering the potential generation and discharge of sediment. In particular, these include stream diversion and culvert placement activities. Because of the extent of these types of works required as part of this Project, and because of the immediate delivery of any sediment yield into the aquatic environment, from an environmental perspective these works could be considered to be higher risk than the works confined directly to the land with effects wider than the Project footprint which need to be considered.

By way of background, it is important to recognise that erosion is the process whereby the land surface is worn away by the action of water, wind, ice or other geological processes. The resultant displaced material is known as sediment with sediment yields being the sediment which leaves a particular control measure. Sedimentation is the deposition of this eroded material. Accelerated erosion is primarily caused by human activities and is a much more rapid process then natural erosion.

Through the erosion process, soil particles are dislodged, generally by rainfall and increased surface water flow. As rain falls, water droplets concentrate and form small flows. The combined energy of the rain droplets and the concentrated flows has the potential to dislodge soil particles. The amount of sediment generated depends on the erodibility of the soil, the amount of energy created by the intensity of the rainfall event and the site conditions, for example the slope and the slope length of the site. In general, the steeper the site and the longer the flow lengths, the more energy will be created. Any reduction of energy will reduce the erosion and sediment generation. The Project slopes are considered very “gentle” and do not represent a significant issue from an erosion perspective. The Universal Soil Loss Equation (USLE) calculations and supporting plans

within Appendix H.F and H.G of this ESCP highlight the Project slope classifications. The peat soils contain a relatively high proportion of clay and silt particles and therefore once in suspension can be take long periods to settle out. With respect to the sand soils, while they erode easily, due to larger particle size they settle within the water column relatively quickly. Therefore it is important for both of these soil types that erosion is minimised in the first instance to ensure sediment generation and yield is also minimised.

Erosion and sediment control measures are used to minimise the effects of earthworks on receiving environments. Erosion control is based on the practical prevention of sediment generation in the first instance. If erosion control is effective and sediment generation is consequently minimised, then the reliance on the sediment control process is not as significant.

Sediment control, on the other hand, refers to management of the sediment after it is generated. It is inevitable that some sediment will be generated through earthworks, even with erosion control measures in place. Sediment control is designed to capture this sediment and minimise any resultant discharge.

Rather than only relying on sediment control measures alone, a significant reduction in erosion on site will result in far less sediment being generated, required to be treated and discharged from the control measures.

The erosion and sediment control measures for the Project are designed to minimise the extent of soil erosion and any resultant sediment yield. The proposed erosion and sediment control measures have been designed in accordance with the Wellington Guidelines and have also considered the NZTA Draft Standard. These measures are detailed later within this report. It is noted that the NZTA Draft Standard provides no specific management techniques or direction with respect to peat soils and while erosion and sediment control measures are to be implemented these have been adapted for the soil types that will be encountered. The NZTA Draft Standard outlines the issues associated with wind erosion and dust management and these have been considered, and incorporated as relevant, for the management of the sand soils. The approach taken with the erosion and sediment controls is that in many circumstances, measures exceeding the Wellington Guidelines are proposed where there is a greater perceived or recognised environmental risk associated with undertaking the works.

The following erosion and sediment control principles will apply.

General Principles

1. Erosion and sediment control measures will be undertaken and implemented with a hierarchy and priority order as follows:

a. Avoidance of effects will be the first priority. Any discharge locations will be carefully selected and any streamworks will only be undertaken where they are a necessary component of the Project construction.

b. Erosion control will be a priority in all circumstances by preventing sediment generation through a range of structural (physical measures) and non structural (methodologies and construction sequencing) means.

c. Sediment Retention Ponds (SRPs) will be utilised, but given the nature of the Project, the soil types, the flat contour and the generally high groundwater table, other alternative devices also provide viable and effective solutions. Chemical treatment will be utilised, however, this will be on a limited basis as a risk management tool. Based on research undertaken it is confirmed that there is the ability to chemically treat sediment laden water to help achieve the necessary water quality on an "as required" basis. Chemical treatment will therefore be utilised as a risk management tool and will be based around the use of polyacrylamide contained within flocculant socks. Priority of controls will then be decanting earth bunds, super silt fences and silt fences. Various innovative products may also be used and could include measures such as filter socks.

2. The earthwork methodologies are based on two key activities being peat replacement and peat preload. These two activities have specific methodologies and processes which will be followed. Drawings CV – CM 240 to 243 and CV – CM - 244 in Appendix H.C (Pre Load Drawing) and H.D (Peat Replacement Drawing), in the Management Plan Appendices, Appendix H, Volume 5 outline the details.

3. The erosion and sediment control methodologies and drawings provided within this ESCP are based upon methodologies and measures using the Wellington Guidelines and the NZTA Draft Standard as a minimum standard, but also incorporate some procedures and facilities that surpass these standards including items such as pumping and peat replacement methodologies. Through the implementation phase of the Project, it is recognised that there will be room for innovation and alternative means of achieving the same environmental objectives.

4. Preliminary design drawings are provided within this ESCP in Appendix H.I (ESCP Design Drawings). As mentioned in Section 1.0 of this ESCP, it is expected that site and activity specific erosion and sediment control plans will be developed which will follow the general principles of this ESCP and will include erosion and sediment control drawings.

5. Erosion and sediment control measures will be implemented in accordance with this ESCP and are based upon the appropriate approval of site specific erosion and sediment control measures referred to as CESCP's throughout the Project implementation. The principles and practices detailed within this ESCP will be reflected within the CESCPs and, as a result, will ensure that

any sediment yields, and associated effects, of the earthworks activities are negligible and are all managed within the earthworks footprint of the Project. The implementation of CESCPs will allow for future innovation, flexibility and practicality of approach to erosion and sediment control and in doing this will ensure that the Project continues to adapt appropriately to changing conditions. With the implementation of the CESCPs the construction related sediment controls must remain in place until all earthworks for that sub catchment are stabilised, and permanent stormwater facilities for the corresponding catchment must be in place and operational prior to the impervious area of that sub catchment area reaching 80%.

6. Greater Wellington Regional Council places emphasis on a number of principles that apply to erosion and sediment control. While not forming part of the specific principles within the ESCP they are acknowledged and are included within Appendix H.J (Greater Wellington Regional Council and NZTA ESCP Principles) of this ESCP for reference purposes. The erosion and sediment control principles from the NZTA Draft Standard are also included within this Appendix.

7. No specific discharge water quality standards are proposed; however, the discharge from the Project is designed to avoid conspicuous change in the colour or visual clarity of the discharge (after reasonable mixing) in the receiving environment.

8. All erosion and sediment control devices should be located outside the 5% AEP flood level unless no other viable alternative exists. During construction activity and where it is considered to be the only option and devices are required within this flood level, then the placement of such a device will be undertaken with consideration of minimising catchment areas and ensuring more regular maintenance activities. All stock will be excluded, through fencing, from the area of works and the erosion and sediment control measures.

9. Peat removed will be temporarily stockpiled as part of the peat replacement process and will be utilised within the final Project footprint or transferred to eventual peat disposal sites. The location of these sites is detailed within the Construction Methodology Report (Technical Report 4, Volume 3). Three specific sites have been identified with the erosion and sediment control aspects of these sites the subject of existing consents or agreements outside the scope of this ESCP.

Erosion Control Principles

10. Cleanwater diversion channels have not been anticipated for the Project. However, if necessary, the CESCPs may specify cleanwater diversion channels, designed to cater for the 1% AEP rainfall event. The topographic nature of the site is such that there are very few areas where specific upslope cleanwater catchments are required to be diverted away from the works area. This will, however, be subject to ongoing monitoring and checks and if required then cleanwater diversions will be installed to a 1% AEP design standard. The 1% AEP design standard exceeds that recommended by the Wellington Guidelines and provides a level of

certainty and risk management for these diversion channels which will operate to a much larger storm event.

11. Progressive and rapid stabilisation of disturbed areas utilising top soil (where necessary) and seed, mulch and geotextiles will be ongoing throughout the Project. Mulch will include hay/straw and wood which will be generated on site though the removal and mulching of existing vegetation as necessary. Stabilisation will apply particularly with respect to stockpiles and batter establishment. Stabilisation is designed for both erosion control and dust minimization. Where dust generation is the predominant issue then water carts will be utilised as the initial treatment option. This in particular applies to the batter slopes which will also be subject to stabilisation. For pre load activities short term batters (less than 6 months) will have a final layer of clean granular material, sub base course or mulch (straw, hay or wood) applied over sand to ensure no wind disturbance of the surface while longer term batter slopes (greater than 6 months) will have topsoil and grass established. For final cut slopes stabilisation using topsoil and grass from the top of the slope as the cut progresses will occur.

12. Flumes will be utilised in accordance with the Wellington Guidelines to safely transfer runoff from the top of batters to the bottom of the batter slopes and to ensure no scour of these batters occurs. These will be designed and implemented as per Drawings CV – CM 248-251 provided in Appendix H.I (ESCP Design Drawings), Management Plan Appendices, Appendix H, Volume 5.

13. While most site access will be from existing roads, stabilised entrance ways will be established at all ingress and egress points of the site. No vehicles will leave the site unless tyres are clean and will not contribute excessive sediment, such as deposited sediment (not dust), onto road surfaces. Wheel wash facilities will be established only if necessary.

Sediment Control Principles

14. All Sediment Retention Ponds (SRP) to be implemented will be based a minimum 2% volume criterion applied in relationship to catchment size (i.e. 2m3 SRP volume per 100m2 of contributing catchment). This criterion is consistent with the Wellington Guidelines and the NZTA Draft Standard.

15. Through the flocculation testing, it was recorded that the peat soils had fine colloidal particles which remained in suspension long enough to potentially create settling issues during treatment of sediment laden runoff. Flocculants were tested with effective results noted with the use of polyacrylamide which will be dosed via a “floc sock” where sediment laden water is passed over the sock to dissolve product and the floc sock size/number is customised for the flow rates. While this flocculant is proven to be successful, other chemical treatment options and design will continue to be explored throughout the Project as different conditions and in particular soil types are encountered.

16. Pumping of sediment laden runoff and groundwater during construction will be required at numerous periods during excavation works. These flows will be pumped to SRP's, to grass buffer zones or to temporary sediment retention devices such as turkey nests which will assist with retaining any sediment contained within the runoff. Further pumping will also be required with associated activities such as bridge construction. This pumping activity will also ensure discharges are to treatment devices. At all times the Project team will follow the "Permit to Pump system" as outlined in Appendix H.P (Permit to Pump System) of this ESCP. This is based on a standard audit process that ensures any dewatering and/or pumping is undertaken in accordance with appropriate Fletcher Construction procedures and environmental consideration.

17. Where established, SRP's for the treatment of construction related sediment laden runoff will be established as independent devices. The Project also includes the installation of a number of permanent stormwater wetland features (for permanent stormwater treatment from impervious surfaces) as detailed within drawings CV - SW – 100 to 394, Management Plan Appendices, Appendix H, Volume 5 and in Technical Report 22, Volume 3. Where practicalities allow, such permanent devices will be installed early in the Project and will be utilised to assist with the management of runoff from the Project. Where the permanent features are utilised, consideration will be given to pond depth and configuration to ensure that the eventual conversion of these to long term stormwater features can be undertaken appropriately. No existing natural wetlands will be used for primary treatment of construction related sediment discharge.

18. Any decanting earth bunds established will be based on a volume of 2% of the contributing catchment area with an ideal length to width ratio of 1:3. All spillways from the decanting earth bunds will be installed to ensure that they safely pass the 1% AEP rain event with low velocity and therefore minimal scour potential. Decanting earth bunds for the pre load activities will discharge to either a watercourse or a stabilised area where no erosion will eventuate.

19. All SRP's will be fitted with floating decants and all decanting earth bunds will be fitted with snorkel discharge arrangements, both with a mechanism to control (or cease) outflow during pumping activities to these structures. This mechanism could take the form of a manual decant pulley system or plug. In the circumstance where decants are manually plugged, discharge will cease and only once the standard of discharge quality, as per Principle 7 above, can be achieved will discharge occur. Pumping will be such that pump volumes will only be to the same level as that able to be fully captured within the retention structure.

20. All super silt fences and silt fences will be based upon the design criteria within Wellington Guidelines and the NZTA Draft Standard. Super silt fence will be used in those areas of work adjacent to, or in the immediate vicinity of watercourses. As a risk management tool for super silt fences the fabric will be installed with a minimum 200mm of fabric placed upslope at the

base of the trench. In circumstances where silt fences or super silt fences are proposed next to active roads, they will be installed only after traffic barriers have been installed, to ensure safe installation and also to provide further protection of the silt fence or super silt fence material from accidental damage.

21. Dirtywater runoff diversion channels will be sized, in accordance with the NZTA Draft Standard, to cater for the 1% AEP rainfall event which will ensure that all storm events up to this design will be diverted to control measures without overtopping. This will prevent uncontrolled runoff within the site boundaries. The design for all dirtywater runoff diversion channels will be based on the largest catchment areas within the Project and accordingly will result in overdesign. Dirtywater runoff diversion channels design will be based on the tables provided within section 7.1 of this ESCP. While, for risk management purposes, these dirtywater runoff diversion channels are "oversized" as recommended by the Wellington Guidelines there remains the potential for deposition within them, and where this is noted to be an ongoing issue, excavated pits or sumps will be positioned along the channels to retain sediment bed load.

Streamwork Principles

22. Stream works activities are considered high risk due to the potential for sediment generation and yield and will be undertaken in a manner that recognises this risk and the sensitivity of the receiving environment. At all practical times these activities, and any associated works within these environments will be undertaken in a "dry" environment. This will be based upon diversion of flows around the area of works or working directly above the stream with no formal stream diversion required. Drawings CV – CM 246 – 247 in Appendix H.E (Stream Crossing Methodology), Management Plan Appendices, Appendix H, Volume 5 show this detail. Consideration will also be given to the fish spawning and migration periods, during which time instream works will be restricted.

The NZTA has a proven track record with respect to erosion and sediment control associated with large infrastructure projects. Many of these previous projects demonstrate the effectiveness of the approach taken based on the ongoing certification of CESCPs, or the equivalent, throughout the Project.

3 Planning Framework

It is recognised that a range of earthworks and streamworks activities that will be undertaken as part of the Project have numerous requirements under the regional policy and planning documents. The detail of these is discussed within the AEE (Volume 2) that supports this Project. When considering these requirements, however, several key features of the Project are of importance in terms of erosion and sediment control:

- Proximity to sensitive waterbodies,
- Values of the receiving environments adjacent to, or downstream of, the Project,
- Site topography, and
- Areas of exposed soils.

These items have been considered in full in developing this ESCP and are reflected in the overall approach taken. Consents have been applied for which will authorise the necessary activities and associated discharges. Where activities are recognised as permitted activities, the conditions of these permitted activities have been taken into consideration. An example of this is vegetation removal and conditions have been assessed and methodologies incorporated to ensure the conditions can be achieved. This includes in particular the initial vegetation removal activity whereby gorse, the existing cover, will be mulched and remain on the ground as a protective cover until such a time as erosion and sediment controls are in place and earthworks commences.

In addition, the NZTA has adopted as part of its wider national Environmental Plan (NZTA EP), a series of erosion and sediment control objectives for roading projects. This part of the NZTA EP is attached as Appendix H.O of this ESCP with the key erosion and sediment management objectives outlined below:

1. Ensure construction and maintenance activities avoid, remedy or mitigate effects of soil erosion, sediment run-off and sediment deposition.
2. Identify areas susceptible to erosion and sediment deposition and implement erosion and sediment control measures appropriate to each situation with particular emphasis on high-risk areas.
3. Use bio-engineering and low-impact design practices where practicable.

These objectives have been fully considered and are reflected within this ESCP.

Further planning considerations associated with the Project are outlined in Section 8.0 of this ESCP.

Greater Wellington Regional Council adopts a “best practicable option” (BPO) approach to regulate earthworks. This policy recognises that earthworks can be well controlled by undertaking best management practices on site to control sediment generation and yields. Greater Wellington Regional Council recognise that there is a degree of risk associated with accepting a BPO approach and in accepting this risk carefully consider the time of the year within which the earthworks will be undertaken. This is primarily due to the expected increased risk of effects over high rainfall periods in particular with soils containing higher percentages of clay and fine silts, or when the slopes are steeper on the site.

The highest probability of storm events occurs in the winter months and as a general rule earthworks over the period May through to August are avoided where possible. When considering this Project, and in particular the nature of the sand soils and suspectibility to wind erosion when dry, it is recomended that no winter exclusion period is necessary and, in the contrary, working some of the soils over the winter months may well result in enviornmental benefits.

The activities asociated with stream diversions and culvert placement, however, are recognised as requiring periods of low stream flow to facilitate works. This low stream flow can occur at any particular time of the year, although it is more likely to occur during summer months. Therefore, prior to any streamworks, discussions will be held with Greater Wellington Regional Council to ensure the appropriateness of the time of the year and the conditions that may apply.

4 Assessment of risk

Estimating sediment yields for the Project has generally followed procedures within the Universal Soil Loss Equation (USLE). The primary purpose of the USLE is 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 discharges from earthworks sites. Further it has been used as a comparative tool to gain an appreciation of the expected increase in catchment wide sediment yields as a result of the earthworks activity. Discussions with Greater Wellington Regional Council have confirmed that USLE should be used as a risk assessment process and not necessarily as a specific sediment loading tool. The Project is lineal in nature and will involve works occurring on several fronts and will also be subject to ongoing stabilisation as works progress. It is considered that the key elements of risk for this Project are the exposure of bare land, the receiving environment locations and the value of these receiving environments.

Key recognised erosion and sediment control risks are:

- works within and adjacent to watercourses and wetlands such as culvert placement and extensions, stream diversions and bridge works;
- pumping of sediment laden water from excavations; and
- stockpiling of excess spoil material.

The Project is unique from the perspective that it is of flat contour and also is predominantly of sand and peat geology. Sand consists of large size particles and, while it erodes relatively easily it also settles very quickly in water reducing discharge quantities. These soil and contour factors are critical in concluding that the sediment generation and eventual sediment yields will be low as a result. Three key aspects of erosion and sediment control are related to risk of sediment yield

1. Sediment generating potential - this highlights the generation potential of the area in question and is based on slope, slope length, soils, rainfall and erosion control factors.

2. Sediment delivery – this relates to the amount of eroded material that is retained on site in depressions and within the site's natural contours prior to it entering any sediment treatment devices.

3. Sediment yields – the amount of sediment that actually leaves the site and enters the receiving environment. It is well recognised that this is the key area of interest.

The USLE allows for greater consideration to be given to the areas of higher sediment yields and for these areas to be targeted with more comprehensive control methodologies to reduce this potential. The USLE can provide for this risk assessment and specific USLE calculations have been included within this ESCP as detailed within Appendix H.G. These USLE figures highlight that, based on a range of assumptions as detailed within Appendix H.G, the pre earthworks yields from the site equates to approximately 4.2 tonnes of sediment over the Project footprint. During the earthworks phase, this is estimated to increase to a total yield of 16.64 tonnes of sediment.

When considered on a catchment wide basis, the USLE allows for a comparative analysis to be undertaken which demonstrates pre earthworks a yield of 753 tonnes and during earthworks an increase to 766 tonnes. This detail is provided within Appendix H.G and shows a sediment yield increase overall of 1.7 %. This is further analysed on a sub catchment basis with the following table showing the overall sediment yield calculation outcomes.

Sediment Yield (tonnes) Over a 2 Month Period	Project Footprint Pre Earthworks	Whole Catchment Pre Earthworks	Project Footprint During Earthworks	Whole Catchment Less Project Footprint Pre Earthworks	Whole Catchment Including Earthworks Area	% Increase – Pre Earthworks to Earthworks Whole Catchment
Whareroa	0.11	18.17	0.58	18.06	18.64	2.6
Wharemauku	0.87	38.02	4.50	37.15	41.65	9.5
Waikanae	1.16	644.72	3.96	643.57	647.53	0.4
Waimeha	0.16	2.37	0.77	2.20	2.97	25.3
Ngarara	1.90	50.56	6.83	48.66	55.49	9.8
Totals	**4.21**	**753.84**	**16.64**	**749.63**	**766.28**	**1.7**

For the purposes of the USLE, the Project has been considered in various slope classes (included in Appendix H.F, USLE Plans) and it can be stated that those areas of greater slope present a higher risk of sediment yield. During earthworks activities, these slopes will, however, be reduced

and batter slopes progressively stabilised. It is also important that these steeper areas receive a degree of focus to ensure the slope lengths are reduced and progressive stabilisation occurs on a proactive basis. Over the entire Project footprint it is assumed that each area will remain open for a maximum period of 2 months and this is considered realistic (and conservative) considering the progressive nature of the construction sequence and the need to manage dust through the provision of a stabilised surface.

The Project includes 4 sectors within which a range of earthworks activities are to occur. The predominant earthwork operations will include:

1. The preload and the removal and replacement with sand of peat material; and

2. Stockpiling and other earthwork related activities.

The erosion and sediment controls developed for works utilise a range of erosion and sediment control measures that represents the best practicable option for this sector. As detailed, progressive stabilisation will also be undertaken to ensure that areas that are completed from an earthworks perspective will not be subject to erosion. This is of particular importance when considering the establishment of batter slopes where progressive topsoil, sediment and mulching will prevent erosion and sediment generation and will also ensure dust is not generated from such areas.

The primary control measures to be utilised are based on non structural methodologies. These are outlined in Section 7.0 of this ESCP. These do, however, include the use of diversion channels, decanting earth bunds, super silt fences and sediment retention ponds in some locations. A distinctive feature of the Project from an earthworks perspective is the significant amount of sand and peat material and as a result traditional erosion and sediment control methodologies are not always practical with alternatives available. Emphasis will be placed upon the monitoring and maintenance of all controls installed and the methodologies utilised with particular attention paid to areas of higher risk prior to, during and after rain events.

While overall therefore the USLE provides a comprehensive overview of potential sediment yields, it is recognised as theoretical only and the maximum value is gained through the comparative analysis of the yields calculated. Further it is considered of value throughout the Project, as more specific detail of Project materials and location are obtained, that USLE calculations continue to be undertaken and continue to form part of the implementation risk assessment process.

USLE calculations have confirmed the following sediment yields during earthworks:

Whareroa Catchment	0.58 tonnes
Wharemauku Catchment	4.50 tonnes
Waikanae Catchment	3.97 tonnes

Waimeha Catchment	0.77 tonnes
Ngarara Catchment	6.83 tonnes

This equates to a total sediment yield of 16.64 tonnes for the total Project with an estimated exposed area of 138.8 ha over the Project duration. Pre earthwork yields are calculated as 4.20 tonnes. While the Waimeha Catchment sediment yields represent a 25% increase this is based on a 0.77 tonne sediment yield only from the Project area.

The more significant sediment yields are noted to be related to the steeper areas of the site which are clearly identified within the plans provided in Appendix H.F (USLE Plans) of this ESCP. In recognition of this increased risk that exists, comprehensive methodologies have been developed, progressive stabilisation of bare earth will be implemented and timing and duration of operations are key considerations. It is recognised that some earthworks areas will be open for only very short periods of time, for example peat excavation locations will be backfilled and stabilised with a sand layer on a daily basis. Best practice techniques have been employed during all works with particular emphasis on higher risk activities and locations.

With respect to the streamworks activities, the methodologies have taken risk into account and this is reflected in all works being undertaken in a “dry” environment wherever practicable, careful consideration of weather patterns prior to and during the works period, and also a relatively intense monitoring and audit programme of these activities. With the above in mind it is assessed that associated risk of these activities will be reduced.

For earthworks related activities chemical treatment is to be utilised as outlined within Section 7.0 of this ESCP and again this results in the associated risk of these activities greatly reduced.

5 Overall erosion and sediment control approach

The following section outlines the measures that will be implemented as part of the ESCP and builds on the principles outlined in Section 2.0 of this ESCP. There will be further detail and design required, which will be within the CESCP’s developed, through the Project lifetime which will result in a “fine tuning” of the methodologies shown. The aim of this ESCP is to demonstrate that negligible sediment-related effects will result from construction activities with appropriate measures put in place.

Specific erosion and sediment controls

The focus on the erosion and sediment control measures is based on:

1. Viewing the proposed Project works such that all construction activities, and the full effects of these construction activities, are considered as a package.

2. Minimising potential adverse effects by utilising measures which meet or exceed industry best practice guidelines (Wellington Guidelines and NZTA Draft Standard). In many circumstances due to the high water tables and soil composition, standard erosion and sediment control measures will not be suitable and innovative concepts will apply.

3. Implementation of an integrated approach (as outlined in Section 5.1 below) for design, implementation, maintenance and disestablishment of erosion and sediment control measures. This will ensure "ownership" of the erosion and sediment control measures and therefore better implementation and maintenance.

4. Undertaking pre-construction meetings for specific stages of work and having regular weekly meetings (toolbox meetings) on site with relevant personnel as part of the construction phase.

5. Maintaining a register of control measures and "As Built" information of key controls such as diversion bunds and sediment retention ponds to allow for quick referencing and understanding of erosion and sediment control measures. Appendix H.K of this ESCP contains a series of standard NZTA Checklists which will be adapted for this Project.

6. Including both structural and non-structural elements within the methodologies to be employed such as:

- Manually raised decant devices on SRPs;
- Chemical treatment utilising polyacryamide as a risk management tool;
- Proactive monitoring programme;
- Risk identification and management accordingly;
- Progressive stabilisation as works progress ;
- Weather response; and
- Ensuring contracting staff are aware of the erosion and sediment controls employed and do not remove them without seeking appropriate approval.

It is expected that the specific erosion and sediment control plans will follow the principles and details outlined within this report. This enables the Project team and the consent authority to have further input into the methodologies implemented.

5.1 Integrated approach

The Project consists of a four lane median divided expressway through the areas of Paraparaumu and Waikanae, and includes a new bridge over the Waikanae River and a number of interchanges providing connections with local roads.

The approach taken for erosion and sediment control includes a concept whereby planning and implementation of all the erosion and sediment control methodologies and measures are

undertaken by an experienced and involved team to ensure that all relevant aspects of the Project are taken into consideration as part of these decisions. This will ensure that adequate resources, commitment and expertise are provided to erosion and sediment controls from start to finish of the Project (design through to disestablishment). This will also ensure that all key stakeholders are involved and communicated with as necessary. The team, referred to as the "Erosion and Sediment Control Team", is expected to consist of representatives from the Project team, Erosion and Sediment Control Specialist(s), other specialists as necessary such as geotechnical engineers and the Councils.

Table One below outlines the responsibilities expected for erosion and sediment control.

Organisation	Responsibilities
NZTA	▪ Ensuring CESCPs are included in contract documentation as necessary to ensure sub contractor buy in. ▪ Reviews of CESCPs as required. ▪ Audits of Erosion and Sediment Control (E&SC) devices and methodologies. ▪ Record keeping as necessary.
Principal Civil Contractor	▪ Preparation with NZTA of CESCPs. ▪ Implementation of CESCPs. ▪ Installation of E&SC devices. ▪ Inspection and Maintenance of E&SC devices. ▪ Stabilisation activities. ▪ Training. ▪ Reporting.
Consent Authorities	▪ Certification of CESCPs. ▪ Certification of revised CESCPs. ▪ Auditing to ensure compliance with CESCPs.

Table One - Erosion and Sediment Control Responsibilities

All people working on site, or with site responsibilities, will be required to undertake a formal induction process. No one will be permitted to work on the site until they have completed the induction process. Part of this induction process will be based on environmental management including erosion and sediment control and will include familiarisation with the Wellington Guidelines and the NZTA Draft Standard.

A comprehensive environmental induction will be provided to all staff and subcontractors prior to starting work on site. The induction will include information on the ecology of the area, heritage issues including procedures in the case of unexpected finds, key environmental risks including areas of high environmental risk. Information will be provided on environmental controls such as

erosion and sediment control devices, noise and dust mitigation measures and waste management. Engineers responsible for writing work plans and job risk analysis will also be given guidance on how to assess and plan for environmental issues using the CEMP (Volume 4 of the AEE) as the key reference document.

Environmental issues will form a regular part of toolbox meetings to ensure all workers are aware of the key issues. Opportunities will also be made available for selected staff members to attend Greater Wellington Regional Council's Muddy Waters contractor education programme, Fletcher Construction Spill Response Training and other Industry Education Training programmes where they would benefit from this further training. A record shall be kept of all training including the information presented and a list of attendees.

Site staff will be made aware of the restrictions in operations when working near Designation boundaries, and areas of vegetation that are required to be protected as part of the work plan communication process.

CESCP's will be supported by an environmental toolkit based upon the "Fletcher Environmental Toolkit" as included within Appendix H.Q of this ESCP, which gives practical advice on the construction of typical site environmental controls and environmental management issues.

In addition, ongoing training opportunities will be identified throughout the course of the Project in response to issues or challenges identified. This training will take the form of an outside expert being utilised or skills already in existence within the projects resources being utilised.

Subcontractors, as a condition of their contract, will be required to actively manage environmental issues associated with the subcontract works and comply fully with the Project resource consents, all applicable statutory regulations and the overall CEMP (Volume 4 of the AEE). For significant aspects of work the Project team will require subcontractors undertaking high risk activities to provide their own Environmental Plan for review by the Environmental Manager.

Training as outlined above will be focused on:

- Understanding the resource consent conditions;
- Construction and maintenance of erosion and sediment control devices;
- Inspections; and
- Contingencies.

It is recognised that this ESCP may be administered over various contracts across the Project and it is important that the "ownership" of the ESCP and associated control measures is clear in terms of implementation and maintenance requirements. Table One above outlines the responsibilities associated with the ESCP and the associated contract documentation will include specific reference to these requirements.

5.2 Erosion and sediment control measures

The erosion and sediment control measures are designed to minimise the extent of soil erosion and sediment yield from the Project site. The proposed erosion and sediment control measures have been designed with the Wellington Guidelines and the NZTA Draft Standard as the minimum requirement.

It is assumed that any significant modifications to the erosion and sediment control drawings originally approved as part of any consent, may require further approval by the consent authority prior to implementation in the construction phase. This will take place where necessary through preparation of site and activity specific CESCPs and a pre-construction meeting on site with the consent authority as a precursor to installing any erosion and sediment controls prior to bulk earthworks activity. Appendix H.K contains the checklist that will form part of this pre construction process. Due to the methodologies for the erosion and sediment controls being largely similar for the specific activities is envisaged that pre construction meetings will be associated with specific activities and will generally not be required for each area of works. As an example the activity of peat replacement has a standard methodology associated with it and a pre construction meeting will be held for such an activity but will not need to be repeated unless conditions change, including a change of specific contractor involvement.

Upon completion of the installation of all approved structural erosion and sediment controls as-built certification plans will be provided.

5.3 Monitoring

As part of the erosion and sediment control methodology, ongoing site monitoring by the Project team will occur to ensure that the proposed erosion and sediment control measures have been installed correctly, methodologies are being followed and are functioning effectively throughout the duration of the works. Any measures requiring attention will be identified, and if necessary, relevant team members consulted to ensure continual improvement is sought. This may include undertaking further assessment of risk, including sediment yields. In the circumstance of higher risk areas being identified more stringent controls will be considered, in particular more progressive stabilisation.

Visual assessments of the receiving environment will continue to be undertaken during the works period by the Project team with particular attention during and after periods of rainfall and pumping activities. In the context of visual assessment the receiving environment is defined as the immediate receiving environment adjacent to the area of works. Any noticeable change in water clarity from that prior to the rainfall event, or upstream of the site of works, as a result of the earthworks activity will result in a review of the erosion and sediment control measures implemented and changes made as necessary.

Weather forecast monitoring will also ensure that critical works such as those associated with the stream diversion works only occur during a suitable weather window. The internet site www.metvuw.co.nz will provide one of the key tools in this regard with local weather forecasting also utilised as necessary.

5.3.1 Freshwater monitoring

The freshwater monitoring programme has two essential components, being "devices" monitoring and "habitat" monitoring. In addition baseline monitoring, scheduled monitoring and triggered monitoring will occur throughout the Project implementation.

Baseline surveys will define the antecedent conditions in the Project area by measuring pre-construction environmental (including ecological) variables. Scheduled monitoring will be undertaken according to a pre-determined schedule during the construction period. Triggered monitoring will occur when pre-determined thresholds are exceeded. Post-construction surveys will assess the medium term effects of the Project on the freshwater environments, and will be used to determine any need for remediation measures to counter adverse environmental effects.

Triggered monitoring for devices will involve an immediate re-check of the devices upstream of where the event occurred. If damage or malfunction of the device is observed, or the methodology for the specific works has not occurred as necessary, then it will be rectified immediately. Should the likely adverse effects have a reasonably high probability of being significant (ie. more than short-term, localised and/or minor), then ecological monitoring will be undertaken in order to determine the actual magnitude of these effects. Should significant adverse effects be detected as a result, the Project team will discuss appropriate changes to work practices and methodologies to prevent further similar events and will also consider appropriate mitigation for that particular event.

5.3.2 Devices monitoring

Environmental compliance for the Project during the construction period is based upon the appropriate installation, location, maintenance, and monitoring of control devices. Importantly the devices are not restricted to structures and may include work practices and methodologies. The design, installation, monitoring and maintenance of these devices are the responsibility of the Erosion and Sediment Control Team.

'Devices' monitoring comprises the monitoring of on-site construction activities, but more particularly the monitoring of on-site structures and devices designed to control the potential adverse effects of those site activities (in particular erosion and subsequent sedimentation).

The purpose of this monitoring is to ensure that all practices, control measures and devices are constructed, operated and maintained so they remain fully effective at all times. The devices monitoring will largely target erosion and sediment control activities as well as structures such as silt fences, erosion control mulching and sediment retention ponds.

This monitoring is aimed at the early detection of activities or problems that have the potential to result in a significant adverse environmental effect. Devices monitoring will be the main component of scheduled construction monitoring undertaken on-site. The devices monitoring will act as a trigger, together with the scheduled ecological monitoring, for more detailed ("trigger event") monitoring should this be required.

The frequency of the devices monitoring will vary throughout the year and will reflect areas of changing activity and risk along the Project. However, during the undertaking of activities considered higher risk such as those associated with in-stream works the monitoring of devices will be undertaken on a daily basis and more frequently during heavy rainfall. These inspections will be recorded within a weekly check-list as provided from the NZTA Draft Standard and as included within Appendix H.K of this ESCP (to be developed by the Project team) and any subsequent required actions noted. Any device problems will be recorded in a compliance report to the Councils which will comprise of a meeting with such parties and reporting of any issues identified and associated solutions. The information generated by the devices monitoring will help to determine whether any further action is necessary over and above that which is already implanted at that time.

It is essential that the monitoring of devices include inspections during storm events so that the success of the devices and controls can be reviewed and improved if appropriate.

Visual inspections of the integrity and efficiency of the erosion and sediment control devices will be the responsibility of the Erosion and Sediment Control Team. Qualitative inspections of the installation, operation and maintenance of the sediment controls will occur daily throughout the duration the devices are in place.

The visual inspections will include qualitative monitoring of the following:

- the integrity and effectiveness of all erosion control and sediment treatment devices,
- activities on site,
- general site conditions and other activities occurring within the catchment,
- general status of the immediate receiving environment.

The details of these visual (qualitative) inspections will be recorded on the check lists.

Prior to construction commencing photographs will be taken in the vicinity of the proposed discharge outlet points and any streams in the vicinity of the works. These records will show the visual state of the receiving environment at and within the vicinity of the discharge point. This photographic record will be compiled into a log book and will allow a visual comparison of before, during and at completion of the construction of the Alignment. Visual inspections of the discharge points and general stream conditions in the vicinity are part of the requirements of the devices monitoring.

Where actual problems with the integrity and/or effectiveness of the devices (ie. for both erosion & sediment control and other on-site activities) are observed these shall be rectified immediately. In addition, there will be more detailed inspections of devices, on-site practices and other catchment activities that will be undertaken in response to certain "triggers" identified over the course of the routine devices monitoring programme. The triggers for these more intensive / repeat investigations include observations such as:

- Activities observed to be happening on-site that are likely to compromise the effectiveness or integrity of that site's erosion and sediment controls;
- Bearing in mind antecedent climatic conditions, a conspicuous change of water colour at the downstream monitoring sites that is very different to the colour that is normally associated with stream conditions at the same site, and with such change in colour not evident at upstream locations above the construction zone;
- Obvious accumulation of sediment in the vicinity of the discharge points, or anywhere else within or in proximity to the active construction zones;
- Streambank collapse or obvious signs of channel erosion / instability in the immediate receiving environments;
- Visual reports / evidence of changes to downstream community structure (eg. fish kills, death or discolouration of instream plant communities, increased weed growth); and
- Spillage / accident reports by site personnel.

If the results of any devices monitoring suggest that adverse effects are likely to have occurred then "triggered" responses will be implemented. A "triggered" response is in recognition that an event associated with the Project has occurred that may result in a significant adverse effect. A triggered response follows the process below:

- ascertain that in all probability the issue is associated with the Project;
- inform and liaise with the consent authority;
- ascertain the magnitude of the adverse effects (this may involve undertaking immediate monitoring of the ecological variables);
- if the effects have been more than minor, ascertain what response is necessary;
- determine how to monitor the effectiveness of the response(s); and
- implement and monitor the response.

A continual feedback loop is included in this process until it has been verified that the implemented responses have been successful. Changes to construction site practices or to specific devices may also need to be implemented to avoid any future similar events.

5.3.3 Flocculation monitoring

Chemical treatment remains as an option that may be utilised in circumstances where discharge water quality is not considered appropriate for the receiving environment or in the case of specific pumping activities. Not all sediment retention ponds or decanting earth bunds established on the site will require chemical treatment; however, these devices are likely candidates for such treatment. The application of flocculants will be carried out in accordance with best practice principles, and will be undertaken in accordance with this ESCP.

A core part of flocculation management will be monitoring, in order to check that the systems are all working as anticipated and to provide data to facilitate management of the floc socks as they are utilised and manual batch dosing. The monitoring that will be carried out is as follows:

- Discharge and receiving environment pH levels at weekly intervals and during nominated storm events. It is expected that with the use of polyacrylamide no pH influence will result; and
- Periodic checks of final discharge suspended solids concentration, particularly during storm flows.

This monitoring will be undertaken by suitably trained members of the Erosion and Sediment Control Team.

5.3.4 Other checks and inspections

In addition to the devices and flocculation monitoring the other on-site activities such as storage of hazardous chemicals, refuelling facilities and practices, site offices, haul roads, stock-piles, dust control, noise control, etc will also all need to be regularly checked and inspected. The intention underlying these checks is to ensure that they are being properly maintained at all times, and that they remain within the specified standards including consent conditions.

The freshwater habitat monitoring programme is intended to:

- identify and quantify any adverse effects resulting from the high risk activities, and
- identify and evaluate corrective measures which may be required in the event of adverse ecological effects arising from these activities.

These high risk activities are focused around the proposed stream works and in this regard will be monitored by use of a Before-After Control-Impact (BACI) methodology. This refers to undertaking pre-construction (ie. baseline) surveys at selected sampling sites within the location of selected streamworks, and then periodically re-surveying these same sites following the streamworks activities, and continuing for a set period after their completion and comparing the results. It also utilises fixed sampling sites stationed outside and within the likely zones of impact.

Baseline data will provide a bench-mark against which to measure the construction and operational phase data sets. The scheduled monitoring will involve routine studies of prescribed ecological

parameters. The triggered monitoring will be in response to potential adverse effects having happened, as identified by pre-determined “triggers” having occurred.

A detailed Ecological Monitoring Plan (Technical Report 26, Volume 3) provides further details of freshwater habitat monitoring to be implemented.

5.3.5 Monitoring response to indicators of significant effects

In the event that adverse impacts on the receiving environments are detected by the ecological monitoring programme, a possible (cause-effect) association with the Project will be investigated in the first instance. Should this prove to establish linkages between the adverse effect and on-site practices then alterations to the operational methods (including modifications to environmental control measures and methodologies) will be investigated as a first order response. Greater Wellington Regional Council will be consulted in regard to any proposed changes to the on-site practices. Further monitoring would then be used to assess the effectiveness of the alterations in operational methods to alleviate / avoid adverse effects on the environment.

Factors to be considered in the decision chain relating to the above would include:

- the assessed likely cause(s) of the effect;
- whether the effect is on-going;
- the magnitude of the event;
- the sensitivity of the receiving environment; and
- the need for, and nature of, any remedial action.

The most likely cause of a significant adverse effect would be the incorrect installation of devices or sub-optimal performance of the measures and methodologies designed to avoid or minimise adverse environmental effects. The Erosion and Sediment Control Team are responsible for ensuring adequate provision for such devices, and the routine environmental inspections are aimed at minimising incorrect installation or failure to repair any observed damage.

This ESCP outlines a number of preventative measures that will prevent an adverse effect from occurring in the first instance. In addition to the ESCP the Project team will be preparing CESCPs which will be lodged with Greater Wellington Regional Council prior to construction activities.

Contingency measures (such as the requirement for spill kits to be present in re-fuelling areas) are also detailed in the CEMP (Volume 4 of the AEE) and form part of the responsibility of the Project team.

5.4 Dust

Earthworking activities on the Project have the potential to generate dust that may be considered to be a nuisance in times of dry and windy weather particularly when working in sand spoil

environments but also applicable to peat soils during dry periods. To manage the potential dust nuisance the standard procedure is to minimise, identify and acknowledge these effects. Implementing these measures and ongoing monitoring will occur at all times during construction.

Dust is the product of wind erosion, much as sediment is the product of erosion by water. Repeated tracking of soils with machinery not only breaks down the soil particles but also aerates the soils so that they become suspended as particulate material in the air. As the strength of the wind increases, the potential for dust problems increases exponentially. The rate of soil movement is proportional to the cube of the wind velocity.

Dust from problem sites can travel for kilometres and cause a range of problems to health and property. With respect to the Project, existing property locations can be immediately adjacent to the Expressway works and when downwind for the works area dust management will be critical. An example exists north of Kāpiti Road where with westerly winds as the predominant wind direction wind and sand blowing onto the properties in the east will need close monitoring.

The main practice to be used to control dust on the Project is the application of water to keep soil moisture high enough to prevent dust generation and sand blow. Water supply is detailed within the Construction Methodology Report (Technical Report 4, Volume 3).

For each area of works, consideration will be given to the following elements:

- The potential effects of dust problems if dust causes a nuisance off site.
- The soil characteristics of the site and whether the timing of operations will help or hinder dust control. This may influence undertaking works on sandy soils during wetter periods of the year.
- Considerations to the operational methodology to reduce the dust problems such as progressive stabilisation of batters and stockpile area as necessary.
- Provision for a 24 hour contact number for dealing with dust complaints that may arise from the Project (CEMP Appendix S, Volume 4).

The timing of works can be crucial for dust management and within the Project footprint if the earthworks can be carried out during the wetter winter season with minimal erosion and sediment control problems then dust control will be less of a problem.

In addition stabilised haul roads will be fully utilised and installed where construction traffic is likely to damage existing stabilised areas. These haul roads will be constructed by use of sand backfill with a progressive cover of clean granular material as works progress.

Mulch, including both the use of hay/straw mulch and wood mulch will be utilised to assist with dust management in particular with respect to stockpiles and batter establishment. Where dust generation is the predominant issue then water carts will be utilised as the initial treatment option. This in particular applies to the batter slopes which will also be subject to stabilisation. For pre load

activities short term batters (less than 6 months) will have a final layer of clean granular material applied over sand to ensure no wind disturbance of the surface while longer term batter slopes (greater than 6 months) will have topsoil and grass established. For final cut slopes, stabilisation will be through the use of topsoil and grass from the top of the slope as the cut progresses.

For further details on dust and odour management from the earthworks activities reference should be made to the Appendix G of the CEMP, Volume 4 (Construction Air Quality Management Plan).

6 Specific erosion and sediment control methodology

When considering this section of the ESCP, reference should be made to Appendix H.B which contains area specific erosion and sediment control plans for the Project. These plans have been drafted based on several site visits along the entire Alignment and also reflect the fact that CESCPs as outlined in Section 1 of this ESCP are to be established which will enable the Project team and Council to have further input into the methodologies implemented. The ESCP provides for an overview of the erosion and sediment management techniques and measures that will be used within the Project, provides specific examples throughout and also outlines methodologies and management techniques that will apply and will achieve the necessary environmental objectives.

It is also important to note that the Construction Methodology Report (Technical Report 4, Volume 3) provides details of staging, sequencing, overall methodology philosophy and confirms the requirements of the various activities and specific structures that will be established.

Reference should also be made to the Contaminated Soils and Groundwater Management Plan (Appendix K of the CEMP, Volume 4), which outlines the implementation and operation procedures to be followed when working within known areas of contamination. These aspects are all incorporated into the ESCP and CESCP.

Drawings CV – CM 200 – 231, Management Plan Appendices, Appendix H, Volume 5 outline the erosion and sediment control methodologies and devices that will be utilised.

6.1 Sector One

Sector One from chainage 1900 to 4500 includes preloading activity and a number of culvert extensions. Both preload and culvert extension methodologies will be followed.

At Poplar Avenue two separate SRPs (Sediment Retention Ponds 1, and 2) will be established for two discrete catchments associated with the new road configuration. These SRPs and associated catchment areas are detailed within Drawing Number CV – CM 201 and 202, Management Plan Appendices, Appendix H, Volume 5. In addition to the SRPs, silt fence will be established along batter boundaries where diversion channels cannot divert flows to the associated SRP. This is

expected to occur due to the flat contour within this location such that diversion channel will not be effective. Progressive stabilisation of all batters will also occur.

From chainage 2700 to 4100 the preload methodology as outlined within Section 7.4 of this ESCP will apply. This involves the establishment of topsoil bunds either side of the pre load activity and the installation of decanting earth bunds each with a maximum catchment area of 3000m2. Super silt fence is also established at chainage 3600 to protect an open channel environment which forms part of the long term stormwater management for the site.

At Raumati Road a further SRP will be established (SRP 3) to treat any runoff from discrete catchment areas as shown on Drawings CV – CM – 204, Management Plan Appendices, Appendix H, Volume 5. On the western side of the Alignment in this same location the permanent drainage swale and rock filters will also be utilised.

As noted throughout the entire Project where wetlands and flood storage facilities are to be developed they will be done so in accordance with the Technical Report 22, Volume 3 and the details within Section 7.16 of this ESCP.

Construction Yards will be established and will be managed from an erosion and sediment control perspective as per Section 7.14 of this ESCP

Plate One - Chainage 2500m Poplar Avenue Looking South Over Pre Load Area

6.2 Sector Two

Sector Two from chainage 4500 to 8300 includes pre load methodology up to Kāpiti Road north of which some peat replacement will occur. Both preload and peat replacement methodologies will be followed. In addition to these methodologies silt fence will be used with progressive stabilisation and a further 6 SRPs (Sediment Retention Ponds 4, 5, 6, 7, 8 and9) will be established with SRPs 5, 6, 8 and 9 all to be installed in the same location as the long term stormwater wetland facilities. In this circumstance it is expected that these long term stormwater wetland facilities will be established early in the Project to enable utilisation as outlined during construction activities. The drawings within Appendix H.B of this ESCP show these facilities and highlight the minimum volumes and design dimensions that will be required to achieve the necessary sediment management. Outlets for these devices will also be installed as per the Drawings CV – CM 248 – 251, Management Plan Appendices, Appendix H, Volume 5 which will be converted to the final stormwater management outlet device on completion of construction.

The construction related sediment controls must remain in place until all earthworks for that sub catchment are stabilised, and permanent stormwater facilities for the corresponding catchment must be in place and operational prior to the impervious area of that sub catchment area reaching 80%.

At chainage 5400, Ihakara Street is to be extended to allow access for the construction of the bridge over the Wharemauku Stream; the road construction will consist of a hard fill stabilised platform area. The Wharemauku Stream will be fully protected by super silt fence during construction. SRPs 5, 6 and 7 will discharge into the Wharemauku Stream.

From chainage 5400 to 6300 the eastern extent of the construction works will discharge into SRP number 8 while the western extent of the works will utilise the permanent drainage swale and rock filters.

From Kāpiti Road to the north the principle methodology changes to peat replacement with SRP 9 to be established as shown on Drawing Number CV – CM – 211, Management Plan Appendices, Appendix H, Volume 5. This area also involves significant works within sand environments and the peat replacement and sand methodologies involving the establishment of topsoil bunds and utilisation of pumping will occur. It is recognised that from Kāpiti Road north to Mazengarb Road that a significant dust issue could result if not managed appropriately and as a result specific management of this area is required. Works during the winter wetter period will be encouraged and in other times a programme of dust management using water carts will continue. Water source is as detailed within the Construction Methodology Report (Technical Report 4, Volume 3) with further water supply from SRP 9 as required. Further this area of works involves some large cut sand faces with progressive stabilisation of these batters as outlined in Section 5.4 of this ESCP as the batters progress.

At chainage 8000 the Mazengarb Drain will be crossed with the methodologies as outlined in Section 7.0 of this ESCP to be followed. Super silt fence will also be utilised. The rest of the sector to chainage 8300 involves pre load activity with the establishment of diversion channels and decanting earth bunds as required.

Plate Two - Approximate Chainage 4750 Location of SRP # 4

Plate Three - Looking South to Wharemauku Stream and SRP 7 Location

Plate Four - Looking north to Kāpiti Road Approximate Location of SRP 8

Plate Five - Approximate Chainage 7200 Looking South to Kāpiti Road

6.3 Sector Three

Sector Three runs from chainage 8300 to 12400. From Chainage 8300 to 10650 (Waikanae River) both peat replacement and preload methodologies will be utilised including the use of topsoil bunds and decanting earth bunds. Any pumping that is necessary because of peat replacement activities will be undertaken as detailed within Section 7.11 of this ESCP, with reference also given to the "Permit to Pump" system. No SRPs are proposed within this chainage. Progressive stabilisation will continue throughout. North of Otaihanga Road a large area of sand works will utilise the methodology associated with the permanent swale drainage system and the use of rock filters spaced at 100m centres.

A portion of the existing land fill and transfer station area will be utilised as a construction yard with Drawing Number CV-SP 159 as provided in Appendix H.B, Management Plan Appendices, Appendix H, Volume 5 showing this detail including the specific erosion and sediment controls for the establishment of this yard.

Further works are also proposed associated with the Otaihanga Roundabout. These works, while isolated from the main Alignment, will comprise some lane widening, traffic island establishment and general earthworks activity. Drawing CV – CM 231, Management Plan Appendices, Appendix H, Volume 5 shows the proposed erosion and sediment controls which consist of silt fence installation on the southern and eastern extent of work with 2 small decanting earth bunds to be established on the northern extent of work. These decanting earth bunds are designed to capture any runoff from the cut batter to be established with 2 small subcatchment areas. As part of these works, progressive stabilisation of both the finished road surface and the batter slope will occur to minimise erosion.

The Waikanae River is an area that is recognised as presenting a higher risk due to the location of the works associated with the bridge establishment. This methodology is detailed within the Construction Methodology Report (Technical Report 4, Volume 3) with the erosion and sediment controls detailed within Section 7.10 of this ESCP.

From chainage 10800 to 11300 it is proposed that the permanent stormwater wetland to be established will be used during the construction period for the purposes of sediment management. This is referred to as SRP 10. Immediately north of this to chainage 11800 a further permanent stormwater wetland will be established and will be used during the construction period for the purposes of sediment management. This is referred to as SRP 11.

Works around Te Moana Road will utilise super silt fence with the Waimeha Stream to be bridged and to be fully protected with the use of super silt fences and progressive stabilisation of batter slopes as they are established. Topsoil bunds, drainage swales and rock filters will be utilised north of this area.

Plate Six - Waimeha Stream – protected with Super Silt Fence

6.4 Sector Four

Sector Four from chainage 12400 to 18050 includes a large proportion of working directly in sand plus additional pre load and peat replacement methodologies. These will all be undertaken in accordance with the methodologies as outlined in Section 7.5 of this ESCP. Utilisation of the permanent drainage swales and rock filters features within this sector.

A relatively large stream diversion is required north of the Ngarara Road with this to be fully established in the "dry" and only once a fully stabilised channel is established will stream flows be directed to the new channel alignment. The methodology as outlined in Section 7.7 of this ESCP details this work. Once the stream diversion is operational, as an early part of the works in this location, it will be fully protected with super silt fence as shown on Drawing Number CV – CM 222, Management Plan Appendices, Appendix H, Volume 5. Further to this a permanent stream diversion of the Kakariki Stream is also required in this location with the methodology as outlined in Section 7.7 of this ESCP to also apply. This will involve some ground improvement work which will be undertaken outside of the stream channel and the stream flow diverted to the new channel once full stabilisation has occurred to allow for bridge construction.

Wetland and offset flood storage facilities are to be established and will be undertaken in accordance with the methodology as outlined in Section 7.16 of this ESCP. Two new SRPs (SRP 12 and 13) will be developed within the sector at chainage 14000 and 14200 which will utilise the proposed permanent stormwater wetlands and will be established early in the Project.

From chainage 15400 pre load activities will occur and will be managed through the construction period as per Section 7.4 of this ESCP including the installation of decanting earth bunds.

At Peka Peka Road the pre load methodologies will be followed and will be supported with the use of silt fences. No sediment retention ponds are planned in this location at present, although it is noted that, if necessary, they could be established and room availability is not considered an issue.

Plate Seven - Approximate chainage 13300 looking south – peat replacement and sand methodologies

Plate Eight - Approximate chainage 15300 looking North – sand methodology

Plate Nine - Approximate chainage 16600 looking South Over Alignment

7 Activity details and methodologies

7.1 Erosion and Sediment Control Devices

As detailed, above this ESCP provides the general principles and methodology for undertaking the necessary earthworks associated with the Project construction and ensures that environmental objectives can be achieved with minimal effects from earthworks. With innovation and more detailed design as the Project progresses, development of CESCPs will be prepared and submitted for certification prior to construction.

As detailed within Section 6.0 of this ESCP the Project includes the implementation of a range of erosion and sediment control measures. With respect to the SRPs, a total of 13 SRPs will be established. These SRPs are all sized based on a volume of 2% of the catchment area, length to width ratio of 3:1, side slopes of 2:1 and a depth of 1.0m. SRP 4 has been designed at a length to width ration of 5:1 to ensure it can be accommodated within the Designation boundary. Baffles may need to be installed in this SRP to achieve design criteria.

The details of the specific erosion and sediment controls to be implemented in each of the four sectors are detailed with the Erosion and Sediment Control Plans as provided in Appendix H.B of this ESCP. These plans also show the catchment areas which apply and are related to the specific erosion and sediment control measures. The plans provided outline the control measures that are expected to be used, and the methodology to be implemented within each sector. These methodologies refer to Section 7.0 of this ESCP and centre on the following key activities:

- Peat replacement;
- Works within sand environment;
- Pre load activities;
- Works in swales / overland flow paths and placing pipes away from watercourses;
- Culvert extensions;
- Bridge construction;
- Temporary and permanent stream diversions;
- Stone Columns;
- Rip rap placement;
- Wetland and Flood Storage Facilities;
- Pumping;
- Chemical Treatment;
- Bentonite/Polymer; and
- Construction Yards.

Further to the above, it is recognised that the sizing of the various erosion and sediment control measures is critical in achieving an overall effective approach to the Project. SRPs are designed based on a 2% volume criterion as shown in Table Two below.

Sediment Retention Pond	Maximum Catchment Area (ha)	Minimum Pond Volume (m^3)	Forebay Volume (m^3)	Top Dimension (m) 1.0m depth – all based on 3:1 length to width ratio except SRP # 4	Number of Decants	Side Slopes	Inlet Slope
SRP # 1	2.92	584	55	46.0 by 17.0	2	2:1	3:1
SRP # 2	2.12	424	45	39.5 by 15.0	2	2:1	3:1
SRP # 3	1.01	202	20	28.5 by 11.5	1	2:1	3:1
SRP # 4 – L:W = 5:1	3.35	670	70	62.0 by 14.0	3	2:1	3:1
SRP # 5 To utilise proposed perm S.Water Wetland	1.36	272	25	32.5 by 13.0	1	2:1	3:1
SRP # 6 To utilise proposed perm S.Water Wetland	1.89	378	40	37.5 by 14.5	2	2:1	3:1
SRP # 7	0.84	168	15	26.5 by 10.5	1	2:1	3:1
SRP # 8 To utilise proposed perm S.Water Wetland	2.43	486	50	42.0 by 16.0	2	2:1	3:1
SRP # 9 To utilise proposed perm S.Water Wetland	2.34	468	45	41.5 by 15.5	2	2:1	3:1
SRP # 10 To utilise proposed perm S.Water Wetland	2.72	544	55	44.5 by 16.5	2	2:1	3:1
SRP # 11	4.15	830	80	54.0 by 20.0	3	2:1	3:1

To utilise proposed perm S.Water Wetland							
SRP # 12 To utilise proposed perm S.Water Wetland	0.38	76	10	19.0 by 8.5	1	2:1	3:1
SRP # 13 To utilise proposed perm S.Water Wetland	3.92	784	80	52.5 by 19.5	3	2:1	3:1

Table Two - Sediment Retention Pond Volume and Size Analysis

Where the sediment retention pond is to form the same footprint as the permanent stormwater pond the permanent stormwater pond outlet will be established and isolated by a bund from the SRP feature. The SRP will then be established and discharge via a design outlet into the permanent stormwater outlet.

With respect to cleanwater diversion channels and dirtywater runoff diversion channels, it is recognised that within the Project there are a wide range of catchment sizes and characteristics that will require specific design for each area. Within this ESCP the approach taken for sizing diversion channels is based on provision of a conveyance system that will transfer up to the 1% AEP storm event to the treatment device. This forms part of the erosion and sediment control risk management framework for the Project. Cleanwater diversions are not anticipated as necessary for the Project; however, if required, they will be designed through the CESCPs to cater for the 1% AEP rainfall event. Table Three and Figure Two below provide an example of the sizing guidance which will be utilised within the Project.

As earthworks commence in each sector, the specific as built catchment will be determined and the diversion channel sizing calculated from this figure accordingly. Appendix H.M of this ESCP provides the full set of figures for dirtywater runoff diversion channel sizing.

Catchment Areas	100yr ARI Q (m3/s)	100yr ARI Site slope (5%) Depth (m)	100yr ARI Site slope (5%) Bund Height (m) (D+300mm)
0.50	0.1124	0.1520	0.4520
1.00	0.2248	0.1971	0.4971
1.50	0.3372	0.2295	0.5295
2.00	0.4496	0.2556	0.5556
2.50	0.5620	0.2779	0.5779
3.00	0.6744	0.2976	0.5976
3.50	0.7867	0.3153	0.6153
4.00	0.8991	0.3315	0.6315
4.50	1.0115	0.3465	0.6465
5.00	1.1239	0.3604	0.6604
5.50	1.2363	0.3736	0.6736
6.00	1.3487	0.3860	0.6860
6.50	1.4611	0.3977	0.6977
7.00	1.5735	0.4089	0.7089
7.50	1.6859	0.4196	0.7196
8.00	1.7983	0.4299	0.7299
8.50	1.9107	0.4398	0.7398
9.00	2.0231	0.4493	0.7493
9.50	2.1354	0.4585	0.7585
10.00	2.2478	0.4674	0.7674

Table Three - Dirty Water Diversion Channel Design

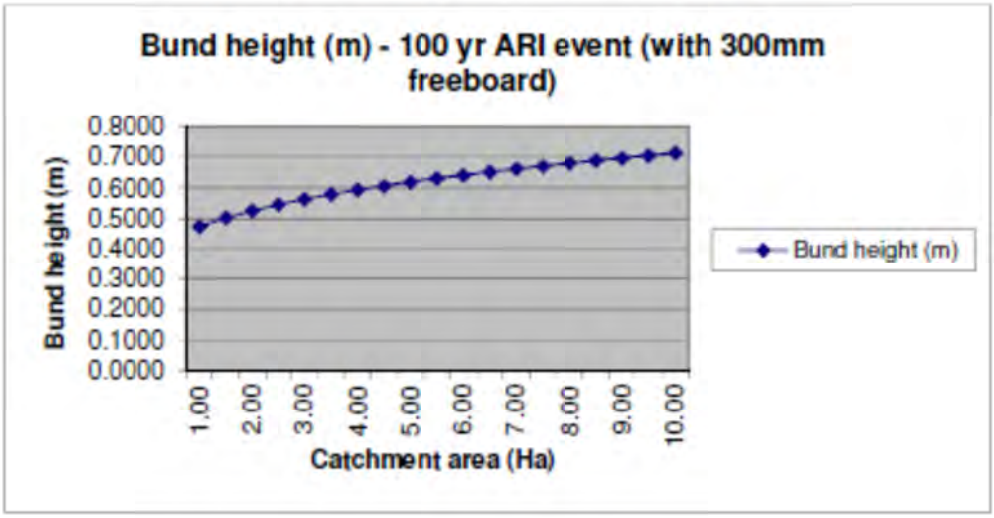


Figure Two - Dirty Water Diversion Channel Design

7.2 Peat Replacement

Where peat replacement is the designated approach for undertaking Alignment construction this will be undertaken in a series of steps as detailed within Drawings CV – CM 240 – 243 within Appendix H.D, Management Plan Appendices, Appendix H, Volume 5. This is summarised as follows:

1. Topsoil will be stripped from the total Alignment corridor width above. This will be utilised to form a stabilised bund which will function as a clean water diversion for water from outside of the

Alignment and will also function as a dirty water diversion for the Alignment works themselves. This will be sized as per Table 3 above. Effectively the topsoil bund also forms a clear and definitive boundary between the works area and those areas outside the works environment which will remain in their current state.

Water that collects within the works area will be either discharged via direct percolation into the soil profile and groundwater system, will be treated and discharged through a series of decanting earth bunds or will be pumped away from the Alignment to a turkeys nest and grass environment as per Drawing Number CV – CM 248 – 251, Management Plan Appendices, Appendix H, Volume 5. This pumping is temporary only and is designed to allow backfilling to occur after which groundwater levels will quickly re-establish themselves to original levels. Decanting earth bunds will be established at intervals along the corridor and will have maximum catchment areas of 3000m2 each and will be constructed to a volume that equates to 2% of the contributing catchment area.

2. Step 2 involves the use of a 50T excavator removing peat from the Alignment corridor and stockpiling this material between the topsoil bund previously established and the excavation. Pumping and or utilisation of decanting earth bunds will occur as necessary.

3. Step 3 involves the placement of sand within the excavation. This is expected to occur at the same time as the excavation and hence at any one time the open trench area will be minimised while also allowing for the required geotechnical inspection and approval of the surface conditions within the excavation prior to backfilling. This has the effect of ensuring that during works, and importantly at the end of the working day, the open trench area is minimised such that water infiltration through the peat material does not create unnecessary saturation and practical issues. At the end of each working day this sand backfill will need, as a minimum, to be to the same level as the water table.

   This step will be happening at the same time as the earlier step of peat excavation. From a sediment generation perspective the works involve an excavation below the ground surface and as a result minimal runoff from the excavation itself is expected. There is, however, expected to be the requirement to undertake some pumping activities and this will occur through the use of pumping to a turkeys nest and grass environment as per Drawings CV – CM 248 – 251, Management Plan Appendices, Appendix H, Volume 5 and as detailed in Section 7.11 below.

   Sand backfilled areas will then be able to be utilised as a stabilised all weather haul road providing access throughout the Alignment as works progress without unnecessary sediment generation created by tracking activities.

   During this stage of the process ongoing shaping and compaction of the temporary peat stockpile will also occur utilising a 20T excavator.

4. The final step, step 4 is essentially a repeat of step 3 except that the peat removal is then focused on the central part of the Alignment. Peat will therefore be placed within dumpers and transported via the stabilised sand haul road to the temporary peat stockpile location. Sand will again be backfilled as required ensuring the minimisation of open excavation, and hence groundwater infiltration.

From an erosion and sediment control perspective the same treatment methodology will apply throughout the entire peat replacement process with all works to occur within the bunded area. From a practical construction perspective this bund may have to be removed during specific times of activity such as the transfer of adjacent sand into the peat excavation. Where this is required to occur, the works outside the bunded area will be required to be managed (from an erosion and sediment control perspective) in an isolated manner and the bund re-established on a daily basis, or prior to rain events to ensure the integrity and purpose of the bund remains.

Based on the results of a peat replacement trial undertaken on site the main conclusion was that this methodology will be successful with excavation and then immediately backfill, pushing any water ahead of the front of sand. Some risk remains that this trial was not representative of the whole site and differing conditions can be expected to result.

Removal of the peat from the stockpiles will occur once the material is considered of a suitable dryness and will be transported along the Alignment with all vehicles manoeuvring on the sand haul road only.

7.3 Peat Replacement Trial

Appendix H.N of this ESCP contains the results of a peat replacement trial (the trial) undertaken in May 2011.

During the trial works groundwater was located at or less than 100mm below the ground surface for most of the site throughout the test. Groundwater seepage from the peat itself was, however, relatively minor and slow and where it did occur, it was typically adjacent to tree trunks or branches located within the soil profile. Most of the water flowing into the pit was either from ponded surface water draining into the pit or from water piping up through the sand. The water pumped from the pit after it had been dug was relatively turbid. For the purposes of the trial, erosion and sediment control methodologies consisted of pumping to a grass environment some 100m away from the nearest watercourse. No turkey nest or detention device was utilised at the pump discharge. However, during pumping activity, it is noted that the pump intake was subject to blockage and intake of sticks; to avoid this occurring a 100mm layer of hay and ballast material was utilised with the pump intake located within this layer. This in itself provided a filtering media where larger debris and particles were not sucked into the pump intake. This avoids physical blockages and damage but also avoids unnecessary sediment transfer to the pump outlet. This is discussed as part of the pumping methodologies within Section 7.11 of this ESCP.

There was no overland flow of pumped water into the drains beside the trial site with most water ponding within the paddock and entering the subsurface water over time. The peat stockpile itself was also noted to release water over time and with the surface ponding due to the wet conditions raised the surface water level behind the stockpile. This ponding issue has resulted in the need to further consider cross drainage, or physical gaps, through the stockpile locations and will be installed at approximately 50m intervals where the stockpile does not allow natural drainage. For drainage, PVC 200mm pipes will be utilised in this manner.

Of importance to note is that during the trial the drain upstream of the trial site appeared to have low water quality as it was discoloured and had an organic oily skin in stagnant areas, similar to that observed leaking from the peat stockpile.

The trial has further concluded that:

- There is no need for any drainage as part of the excavation itself. Peat can be excavated and backfilled with sand back to ground levels at which time the Alignment itself can be constructed which will include permanent drainage as necessary.
- Stockpiles will be established adjacent to the peat excavation along the entire Alignment where this methodology is to occur. The stockpiles will be temporary only and will be removed to permanent locations.
- Temporary drainage for the position of the stockpiles from the excavation may be required. Stockpiles will not be placed in, or immediately adjacent to, watercourses and ideally they will be placed where they do not interfere with natural surface drainage. If the positioning of the stockpiles are such that it does interfere with the natural surface drainage solid PVC pipes can be installed at a minimum 150mm diameter (to prevent blockage) at calculated intervals such that the drainage can continue in its natural form.

7.4 Pre Load

Sections of the proposed Alignment will be subject to pre load activities to assist with ground settlement and ensure that future settlement is minimised. This activity essentially involves the placement of sand or granular material over the position of the Alignment. This material will be trucked into the site utilising a fully stabilised access way to ensure no unnecessary erosion of this area occurs. The stabilised access way also provides a “buffer” between the works area and the existing road from which this material will enter the site and thus will prevent material being transported onto the existing road network. Drawing Number CV – CM – 244, Management Plan Appendices, Appendix H, Volume 5 shows the conceptual pre load activity.

Prior to placement of the pre load material the site will be prepared as follows:

1. Topsoil will be stripped from the location of the Alignment outside of the preload footprint. The pre load footprint itself will remain in its natural state. This area to be stripped will have the

topsoil removed and compacted in the form of a bund on either side of the Alignment location. This will act as a dirty water diversion channel and as such will be constructed to the design criteria.

It is noted that during pre load activities the permanent drainage swales will also be established on site. While these swales will form part of the permanent drainage, during the construction phase of the works they will be used as part of the sediment management techniques. Filter rocks can be established within the swale to assist with trapping sediment and preventing sediment discharge. In sand environments rock filters will be placed at 100 metre intervals due to the larger soil particle size and ease of settlement. It is not expected that significant amounts of sediment will actually reach the swale environment and, therefore, while maintenance is important, this is not expected as a major requirement.

2. Decanting earth bunds will also be established at intervals along the preload corridor. These will have maximum catchment areas of 3000m2 each and will be constructed to a volume that equates to 2% of the contributing catchment area. It is expected that based on a maximum of 3000m2 per decanting earth bund that the volume of these structures will be 60m3. The pre load corridor length per decanting earth bund will alter throughout the Project although it will typically be established at 60m intervals with diversion channels established across the corridor to limit the catchment area to 3000m2. All decanting earth bunds will be established with floating decants.

3. The preload material will be placed directly onto a geotextile blanket and once various sections are at the desired preload levels the preload area will be fully stabilised. This will serve two purposes associated with minimisation of erosion and hence sediment yields and also minimisation of any dust generation from the preload deposit.

Erosion and sediment controls are expected to remain in place throughout the entire pre load period and can act as the specific control measures, with associated maintenance, once the preload is completed and road formation commences.

7.5 Working in Sand

Sand soils present a unique situation whereby they have a very high infiltration rate and while they can be subject to scour and erosion issues the sand particles are of such a size that they settle very quickly within depressions and/or detention devices. These soils are, however, subject to significant wind blow erosion particularly when they are subject to drying and in windy conditions.

Soils dominated by sands are generally non-cohesive and are more susceptible to erosion than silts and clays. However, sands settle out easily and can be controlled using simple management practices on site. For the proposed Alignment there are many locations where sand soils will be the dominant material within which works are occurring. This material is very difficult to form water tight

and compact diversion channels and detention facilities and as a result these types of devices are not proposed in such areas.

The primary device to be used will include the use of formed diversion bunds which will act as an infiltration device and in combination with the high infiltration rates of the sand soils themselves will act as an appropriate control device. The bunds will also have a series of rock filters installed within them which assist with slowing water flow and hence minimising erosion and also capturing any movement of sand downstream. While it is unexpected, in circumstances where peat and/or other soil layers are encountered within the sand soil profile, then the devices will be amended and decanting earth bunds and formal runoff diversion channels can be created.

7.6 Culverts

Culvert installation, both temporary construction and permanent, is required in a number of locations with the key purpose of the culvert installations to allow for road construction, with the culverts providing for a dry environment over which the construction activity can then occur.

As with the stream diversion methodologies detailed below in Section 7.7, it is also important that the culvert activities are undertaken early in the construction program to ensure that the surrounding earthworks can be completed around these areas.

Fish migration and spawning is considered an important issue, and at all times during the fish migration period, fish migration will be able to continue in the normal manner with culvert construction creating no expected issues. This includes the methodology of physically transferring fish from upstream or downstream which shall be undertaken in accordance with the CESCP and any existing approved Council protocols. Appendix M of the CEMP, Volume 4 (Ecological Management Plan) outlines the detailed methodologies associated with fish migration and management.

Where culvert installation or extension is required within a stream channel this can be undertaken by two main methodologies, pumping around the area of works or establishment of a temporary diversion around the culvert footprint. For the methodology associated with a full stream diversion reference should be made to Section 7.7 below.

Prior to works commencing the specific methodology will need to be determined and will be detailed within the CESCP for the location. This determination, including specific culvert sizing, will be undertaken with endorsement of Greater Wellington Regional Council and will be based upon stream flows and upstream catchment areas, timing of works and the expected duration of works.

The typical methodology, for permanent flowing stream systems, for the culvert installation works allows for the entire stream works associated with the culvert installation to be undertaken in dry conditions, isolated from the existing stream flows.

1. A pump will be installed approximately 5m upstream of the extent of an upstream temporary bund. This pump will pump upstream flows around the work area to discharge back into the watercourse downstream of the culvert works. Sand bags or similar will be used to impound flows for this pump. The inlet of the pump will be supported above the base of the stream and will contain a fish grill such that no fish can enter the pump intake structure.

2. Where there is no practical ability to install a diversion channel as detailed below, pumping will remain as the primary methodology for stream diversion during the culvert works with the pump to have capacity for low flows only during which works will occur. This decision to pump as opposed to the installation of a diversion channel will be through the Project team and will form part of the CESCP's.

3. Where there is the ability to install a temporary diversion channel this methodology will be implemented as in Drawings CV – CM – 246 and 247 (Appendix H.E, Management Plan Appendices, Appendix H, Volume 5) and as detailed in Section 7.7 below.

4. With these controls in place, any fish observed in any of the pools within the work area will be removed by hand netting and released downstream of the work area. Any fish or eels discovered during excavation will also be captured and released downstream.

5. The initial excavation will remove the vegetation from the work area followed by the excavation of unsuitable material. This excavated material will be disposed of elsewhere on site within the catchment of other erosion and sediment controls.

6. Once all unsuitable material has been removed, the culvert area will be backfilled with structural material to an appropriate depth for culvert installation. The culvert will be installed with associated wingwalls, retaining walls and backfill as necessary. Rock rip-rap erosion control will also be installed at the inlet and outlet of the culvert. Care will be taken during the placement of this rip rap material so that a low flow channel for permanent fish passage purposes remains and will be maintained for the life of the culvert.

7. The associated activity over the culvert will occur (filling etc) with other erosion and sediment controls in place such as silt fences and super silt fences. When the works have been completed any disturbed area will be fully stabilised.

8. With the necessary ecological signoff stream flows can then be diverted through the new culvert structure.

9. Where the culvert works are associated with a culvert extension, at the outlet end of the existing culvert a plywood bulkhead with a 150mm diameter nova coil cut into and fixed into the bulkhead 100mm above the invert of the culvert will be installed. The bulkhead will be sealed to the base and sides of the culvert. A supplementary pump will be utilised if necessary to ensure a dry working environment. However, it is noted that a single 150mm diameter nova coil will pass

approximately 12 litres per second (full). With a head of 400mm (the height of the bulk head) a 150mm diameter nova coil will pass approximately 25 litres per second. The nova coils will be a sufficient length to allow low flows to discharge beyond the works area discharging below the lower bund feature. Figure Three below demonstrates this methodology.

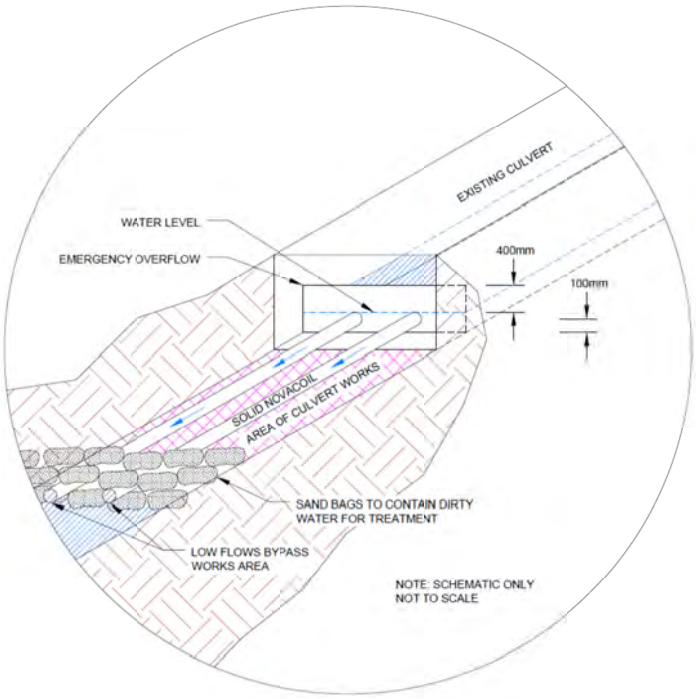


Figure Three – Schematic of Cleanwater Bypass

For all culvert works:

- Prior to any works commencing with the culvert installation, a suitable weather window will be confirmed, the Greater Wellington Regional Council's Compliance Officers will be advised, and any concerns or further clarification at the time, will be addressed immediately and prior to any works commencing on site.
- Culverts are expected to be installed in sections with that particular section fully completed and stabilised within the day works programme.
- Any water within the works area will be pumped to a decanting earth bund or equivalent device which will be located away from, and discharge away from the stream environment.
- On completion of the culvert extension, all plant and resources will be demobilised and the site will be permanently stabilised to as per Greater Wellington Regional Counsil's requirements. Should any rock armouring be required to be placed at the outlet of the culvert for stabilisation of the streambed and banks, this can be accommodated as required.

In the event of high rainfall during the course of construction, or prior to leaving the site for more than a 24 hour period, the Project team will ensure the following:

- Any lose material that could enter a watercourse is to be removed.
- Any downstream sand bag barriers will be checked and, if required removed for heavy discharge events.
- All existing and additional sediment control measures will be inspected and secured and maintained where required should a significant rainfall event be imminent.
- The streambed in the location of the culvert will be fully stabilised to ensure no flows overtopping the upstream cofferdams create scour issues. It is expected that this will be achieved through geotextile with the geotextile appropriately trenched in at the head and toe of the area.

Extended working hours will be considered if it is believed significant benefit with regard to programme and environment impact is either required or possible.

7.7 Temporary or Permanent Stream Diversions

Stream diversions are required for either the establishments of a dry environment within the original stream channel to facilitate works or for the establishment of a new channel Alignment. The proposed methodology for stream diversion allows for the stream diversion to be constructed in a dry environment isolated from the existing stream flows. The methodology to be employed is shown within Drawings CV – CM 246 – 247 within Appendix H.E, Management Plan Appendices, Appendix H, Volume 5 and is as follows:

1. Excavation of the diversion channel will occur, to design drawings, leaving a clay plug at each end so that the stream does not breach the diversion.

2. Stabilisation of the diversion channel will occur to ensure it does not become a source of sediment and this will be undertaken utilising geotextile and rip rap material. Technical consultation with Greater Wellington Regional Council will occur to ensure that the realignment is fully stabilised and can accept stream flows. Ecological sign off will also be necessary for identified high value streams.

3. Any water within the works area will be pumped to a decanting earth bund. Pumped volumes will be minor and the decanting earth bund will have the decant manually raised during this process to allow for settlement of sediment and chemical treatment if necessary.

4. Once the diversion channel is stabilised (refer to 2 above) the downstream plug will be removed to allow stream flows to flow up the diversion channel, keeping some water within the channel to reduce scour problems when the upstream plug is also removed. The upstream plug can also then be removed allowing stream flows through the diversion channel.

5. A non erodible dam will be immediately placed in the upstream end of the original channel. This dam will include formation of a sand bag barrier with an impermeable lining to avoid seepage. Clay will then be placed up to this barrier to allow the necessary filling or activity to occur.

6. A non erodible downstream dam will be immediately placed to prevent backflow into the construction area. Fish recovery from the original channel will then occur and the channel drained by pumping to a decanting earth bund where treatment of the ponded water can occur prior to discharge to the receiving environment.

7. The original channel can then be backfilled forming part of the Expressway construction or the specific activity, such as culvert installation, undertaken.

8. While it is considered unlikely to be required, if necessary cleanwater diversion bunds will then be installed above the area of work to ensure that no offsite cleanwater enters the site of the realignment during the works period.

9. Material excavated from the diversion itself will be placed in stockpiles away from the stream diversion and outside of the identified flood plain area. While works will not commence until a fine weather window is available, geotextile will be available on site to cover exposed areas as required during the works if flood conditions result in stream flows entering the newly-formed channel pre stabilisation. The works will be staged such that if flood conditions result the area can be fully stabilised in a few hours to ensure no adverse effects. Any sediment deposited within the newly formed channel will then be pumped and removed to a decanting earth bund.

10. Once the works within the original channel has been completed, other appropriate controls, such as silt fences, will be installed below the area of works.

It is likely that there will be some rainfall events encountered during the course of construction. In the event of forecast rain, or before leaving the site for more than 24 hours the following will occur:

- Any loose material that could enter a watercourse is to be removed.
- Where possible, all exposed areas will be covered with geotextile to ensure no flows overtopping the existing stream banks create scour issues. It is expected that this will be achieved through geotextile with the geotextile appropriately trenched in at the head and toe of the area.
- All existing and additional erosion and sediment control measures will be inspected and secured and maintained where required.
- Additional mulch and geotextile / polythene will be kept on site at all times.
- Extended working hours will be considered if it is believed significant benefit with regard to programme and environment impact is either required or possible.

7.8 Bridges

Bridge construction will typically involve piling operations and reinforced concrete column and crosshead construction. Bridge beams will be cast off-site in the precast concrete construction yard and then transported to site and placed in position with the top slab poured in situ to a depth of 180 to 200mm thick. Barrier, settlement slabs and wing walls are also all poured in situ. In addition in some cases construction of the bridge will involve structures with sheet piling on either side of the stream system and placement of a concrete slab over the stream without diverting the stream.

Sixteen bridges will be established as part of the Project with 7 of these crossing watercourses, namely the Waikanae River, Wharemauku Stream, Waimeha Stream, Kakariki Stream and the Paetawa Drain. Specific erosion and sediment control measures will be applied to each of these 7 bridge sites with the Waikanae River bridge, as detailed within section 7.10 of this ESCP, providing an example of the nature of these works. All other bridges associated with roads will utilise the erosion and sediment controls as shown for the main Alignment works within Drawings CV – CM 200 – 231 within Appendix H.B (ESCP Drawings), Management Plan Appendices, Appendix H, Volume 5.

7.8.1 Stone Column Installation

As part of the bridge establishment process there is the requirement to undertake ground improvement of the surrounding soils. This can be achieved by numerous engineering methodologies with the preferred methodology involving reinforcing the soils with densely compacted granular columns through the process of vibro - replacement. A vibrator is used to penetrate and displace the soil and to compact the clean stone in stages to form a dense column, as shown in Figure Four. Jetting water will be utilised to assist the penetration of the vibro head. The surrounding soil confines the granular columns and allows the columns to develop a higher bearing pressure relative to the surrounding ground. Overall the stone columns and surrounding soil form an integrated system with low compressibility and improved bearing capacity suitable for bridge placement.

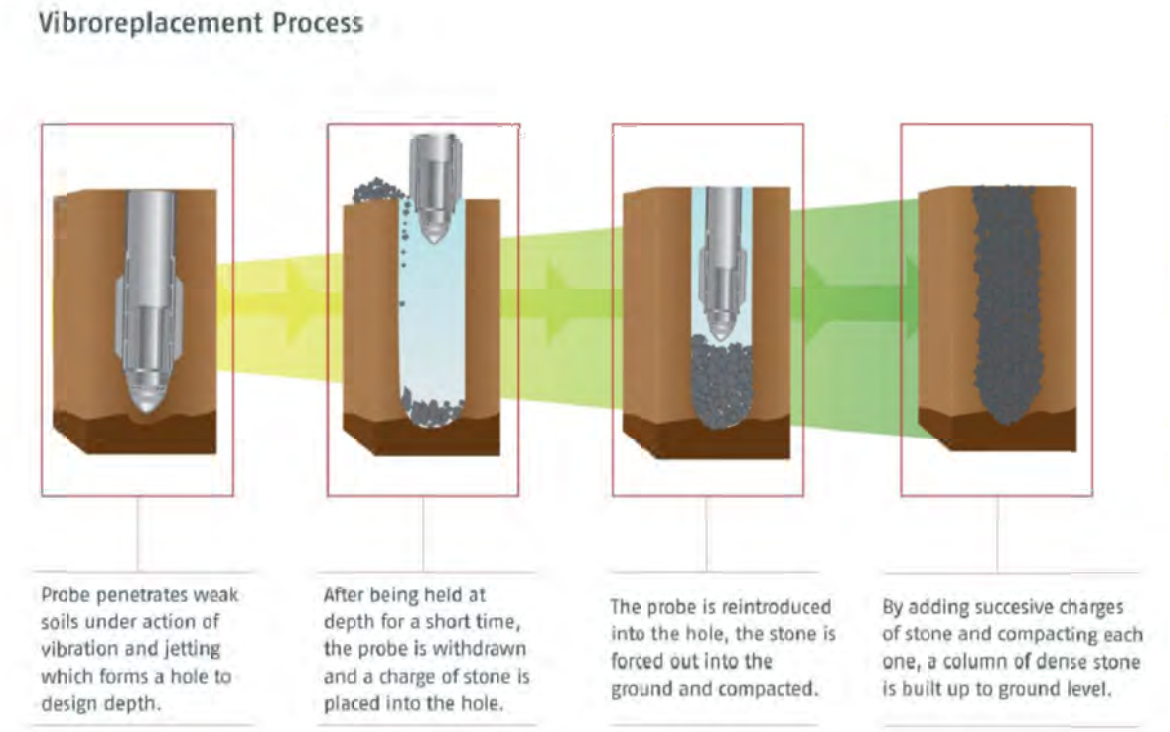


Figure Four - Vibroreplacement Process

It is proposed that the stone columns will be installed at the bridge abutments, will be of a 600mm diameter size and will be placed at 1.5m centres in a triangular grid. The stone columns will be located over an area of approximately 3000m2 at each bridge abutment.

The process for installation of the stone columns is as above and from an erosion and sediment control perspective these utilise a significant amount of water as part of the process. Approximately 150 to 200 m3 per day per operation will be utilised.

Drawing CV – CM - 245 (Appendix H.H, Stone Column Drawing), Management Plan Appendices, Appendix H, Volume 5 outlines the methodology for management of the water flow from the stone column works. Essentially the works area will be graded such that all runoff from the stone column installation and surface flows will be directed to an in-ground sump. Any stream edge of the works area will be protected with a super silt fence designed as per Drawings CV – CM 248 – 251, Management Plan Appendices, Appendix H, Volume 5. From the sump a construction pump will transfer the flows into a 70m3 container with an effective 63.5 m3 capacity. This will dewater into Container # 2 which will eventually dewater away from the works area or be recycled back to the stone column works area and supplement water supply. The level of the containers will be set up such that the first container will either be raised the second container lowered to allow the natural flows without the need for further pumping between container systems.

One baffle per container will be installed to assist with sediment settlement with the spacing of these baffles such that they will also enable cleaning with an excavator bucket as required without damaging the baffle system. It is envisaged that such maintenance will be focused within the first container system.

The addition of flocculant into the container system remains as an option and will be implemented as necessary. If required the water within the containers can be "held" by plugging the final outlet and allowing further settlement and potential for batch dosing with flocculant or utilisation at the discharge point.

For each area of stone column installation, the container system as outlined will be installed as a first priority and only after this is fully operational will the stone column installation itself commence. Availability of room to install such a system is critical. However, it has been assessed that a total area of 30m by 3m will be required for the treatment system and all of the sites assessed either can provide sufficient area under current contours or sites can be developed as part of the overall earthworks programme.

7.8.2 Bridge Pile Construction

All bridge pile construction, including the use of sheetpiles, will be undertaken outside of the stream channel (defined as the normal flow width of the stream) to which the bridge applies. Some of these works, however, will be within flood plain areas and as a result will be subject to inundation during periods of high stream flows.

The key erosion and sediment control methodology associated with the works is the use of non structural practices, and of particular importance is the use the following techniques:

- Weather forecasting will be undertaken using, for example, www.metvuw.co.nz which will provide an indication when high rain events are predicted and as such stream flows are also expected to be higher. For works adjacent to the Waikanae River, river level monitoring will also occur whereby Greater Wellington river level recordings will be monitored and as such will act as an indicator of high stream levels.
- Prior to predicted periods of high stream flows, all high environmental risk activities, such as the use of wet concrete, will cease within the flood plain area.
- While some temporary storage of fuels or storage of hazardous substances will be within the flood plain area they will be removed prior to and during flood events and all refuelling for activities in these locations will be via mobile units only.
- Prior to predicted periods of high stream flows, where practicable, all machinery, including mobile pumps will be moved to outside of the flood plain area.
- Any dewatering will be undertaken with particular care to ensure pH and water quality issues do not arise.

- Structural erosion and sediment controls will include the following measures:
- Utilisation of a fully stabilised surface, with compacted clean granular material or similar, over the entire working footprint adjacent to the stream system. This will ensure that any machinery working within this location does not generate sediment and during periods of high flow over these areas sediment is not generated or removed from the site.
- Any stockpiles of material, such as drill spoil material, will be removed from the site on sealed truck units. While it is envisaged that no stockpiles of spoil material will be located within the floodplain area, if this is required they will be temporary and short term only.
- Below any drilling or earthworks activities a super silt fence will be established in a horseshoe configuration which will capture any runoff from this activity. This will typically be located around the perimeter of the works and will ensure that the works area is fully isolated from the stream system itself. The super silt fence is designed for the capture and treatment of sediment only and is not designed for concrete contamination. As an alternative, or a backup to the super silt fence, filter socks may be appropriate and can be pegged to the ground surface below the works area. These will be bark or mulch filled filter socks which will assist with filtering sediment and also reducing the pH of concrete discharge if this results.

For concrete works in this location reference should be made to section 7.8.3 of this ESCP however the environmental controls are centred on the full removal of any slurry from the site. Housekeeping practices are critical in ensuring that concrete slurry is minimised. These practices include:

- Ensuring concrete spills are minimised;
- Cleaning up of any concrete spills that result; and
- Having a dedicated concrete wash area for items such as concrete tools and barrows.

For any concrete slurry generated this will be removed from the site with sucker trucks or will be discharged through a bark filled Filter Sock, removed the stream environment such that discharge can be checked for pH levels.

7.8.3 Concrete Work

During construction of the bridges, it is proposed to minimise the amount of in-situ concrete that will be required. Pre-cast beams will be utilised as necessary. Cement contaminated water will require treatment before discharge, and this will either be conducted on site using treatment tanks and the water pH tested before discharge, or the water removed from site and treated elsewhere through the use of sucker trucks. Concrete placement will be carefully controlled to ensure minimal loss to the environment using pumps and skips. Concrete truck wash and pumps will occur on site with a dedicated concrete wash facility.

7.8.4 Bentonite/Polymer

A mobile bentonite or polymer plant is required for permanent pile construction on the bridges and the option remains where polymer may be used as an alternative during the drilling of piles. The material is a dense liquid used to support the sides of the excavation, preventing the sand and gravels collapsing into the excavation. The bentonite or polymer is displaced by the concrete for the pile by tremie pouring the concrete with the displaced bentonite or polymer captured and recycled by passing through a series of screens and filters to remove foreign material.

With the use of bentonite, dry bentonite clay will be stored within a roofed area, mixed in a formal mixer and then transferred to the storage tanks as a bentonite slurry. From these bentonite tanks the slurry is pumped to the pile as required. After each pile construction the area surrounding the pile will also be cleaned to ensure material is not unnecessarily transferred via vehicles or foot traffic around the construction area. As mentioned above any bentonite (or polymer) slurry is passed through a desanding device with the "clean" product then pumped to the storage tanks for further use. Any sand or unsuitable material collected as a result of the desanding process is removed offsite to a cleanfill facility.

Important aspects of the use of bentonite or polymer are as follows:

- bentonite is a naturally occurring clay;
- the bentonite system is based on a fully recycled system with no planned discharge from the operation; and
- The bentonite/polymer mixing and pumping system is based on a mobile plant which will be fully bunded when in position. This will capture any unexpected flows or spills from the operation and allow for full clean up to ensure no discharge from the site.

Further to the above a risk management approach will occur with the use of bentonite whereby hose couplings will be carefully checked and sandbags will be available as a contingency should temporary containment be necessary for any small spills of material

Overall the bentonite / polymer plant is considered an activity that is easily managed and that will create no effects on the receiving environment.

Plate Ten – Mobile Polymer Mixing and Pumping Unit

7.9 Pumping

Based on the results of the trial the water pumped from the peat excavation after it had been dug was relatively turbid. For the purposes of the trial, erosion and sediment control methodologies consisted of pumping to a grass environment some 100 metres away from the nearest watercourse. No turkey nest or detention device was utilised at the pump discharge. During pumping activity, however, it is noted that the pump intake was subject to blockage and intake of sticks and to avoid this a 100mm layer of hay and ballast material was utilised with the pump intake located within this layer. This in itself provided a filtering media where larger debris and particles were not sucked into the pump intake. This avoids physical blockages and damage but also avoids unnecessary sediment transfer to the pump outlet.

For pumping methodologies from excavations the pump intake will sit on 100mm layer of hay and ballast material to provide a filtering media where larger debris and particles are not sucked into the pump intake. This acts as a pre treatment system and also avoids direct damage to the internal workings of the pump.

The pump discharge will be, where possible, to grass environments well away from any watercourse which will be fenced from stock along the Alignment of the Designation. The trial undertaken demonstrated that a pump discharge 150m distance from the watercourse was adequate to ensure no discharge occurred. This will be the desired circumstance and will continue to be monitored during the pumping activity.

Where a grass buffer zone is unavailable and /or the stream system is closer than desirable all pumping will be to a turkeys nest as shown within Drawing Numbers CV – CM 248 – 251, Management Plan Appendices, Appendix H, Volume 5. This will discharge though a series of floc socks which will consist of Polyacrylamide within a filter sock. These are placed in a horseshoe configuration to ensure that flows over the sock are maximised and provides for full contact with the flocculant hence maximum possible sediment deposition.

In addition to the pumping from peat excavations other pumping activities will be required associated with dewatering and specific activities. These pumping activities will also be subject to specific management and will be discharged through treatment devices. This includes treatment container systems, turkey nests and buffer zones.

At all times the "Permit to Pump" system will be followed as per Appendix H.P of this ESCP. This provides for a "check and balance" that the appropriate management is being undertaken.

7.10 Waikanae River Works

The works in and around the Waikanae River are considered higher risk and from this perspective specific environmental management aspects of the activity have been detailed within this ESCP. These same environmental considerations will also apply to the other bridge locations over stream systems. Reference should be made to Drawings CV – CM – 500 to 508 within Appendix H.R (Waikanae River Environmental Plans), Management Plan Appendices, Appendix H, Volume 5 which detail 8 specific stages that will occur associated with the Waikanae River works. These are as detailed below with various steps outlined within each stage.

7.10.1 Stage One Site Set Up

1. Step 1 involves ensuring the site is safe for pedestrians within the area and involves closing of the existing walkway. Alternative access provisions have been provided for as detailed within the Traffic Management Plan (Appendix O of the CEMP, Volume 4). No specific environmental controls are required during this activity.

2. Step 2 is critical in ensuring that the future works associated with the Waikanae River can occur without impacting on the Muaupoko Stream environment. This involves diverting the stream to a temporary alignment as shown on Drawing CV – CM – 501, Management Plan Appendices, Appendix H, Volume 5. Prior to these works commencing a super silt fence will be placed below the temporary diversion position to ensure that any sediment runoff that is created will be treated

through such a device prior to discharge into the Waikanae River. Section 7.7 of this ESCP outlines the stream diversion procedure that will be followed which essentially involves excavation of the new channel in a "dry" environment, full stabilisation of the new Alignment with geotextile and rock protection and then formally opening up the new diversion for stream flow.

During the construction process any water that collects within the diversion channel will be considered as dirty water and will be pumped to either a container treatment device that will be utilised for future stone column works or pumped to the long term wetland location at chainage 10250 which will provide adequate storage and treatment opportunities.

As part of this second step a super silt fence will be established along the Waikanae River edge which will remain in place during the backfilling and removal of the original stream alignment. Section 7.7 of the ESCP outlines this process whereby fish recovery, pumping and backfilling can occur. Once the original channel is backfilled the super silt fence will be extended along the Waikanae River bank for the full extent of works and return up the Muaupoko Stream channel to the Designation boundary.

Access for the works to be undertaken will be from the Project Alignment to the south.

3. Step 3 involves undercutting of an area of approximately 1000 m2 with this material to be placed outside of the identified flood plain area. This undercut will then be backfilled with clean granular material which has the purpose of long term flood protection. Environmental management will be provided for with the use of a clean granular material only and the placement of the super silt fence.

4. Step 4 involves the installation of a concrete retaining wall to protect the adjacent property. These works are outside of the identified flood plain area and will be managed by independent environmental controls likely to consist of topsoil bunds and decant systems. Any concrete waste will be removed from the site.

7.10.2 Stage Two Ground Improvement

1. Step 1 involves the excavation of the area subject to ground improvement such that this can then have stone column installation commence. Any material extracted, which is likely to be sand based, will be stored away from the flood plain area. During the excavation works the super silt fence installed along the Waikanae River boundary will remain as the primary environmental control. It is noted, however, that due to the sand nature of the soils in this environment that the runoff expected as a result of the works will be minor.

   Stone column installation in this area can commence on completion of the excavation with this activity fully detailed within Section 7.8.1 of this ESCP.

2. Step 2 involves the regrading of the ground adjacent to the ground improvement location which is designed to provide for a refuge area and laydown area during the works. This is located outside of the flood plain and will be a location whereby prior to and during flood events machinery and hazardous material that can be practically moved can be relocated to this area. The area will be covered with a clean granular fill and will also have a decanting earth bund which provides a dual purpose treatment. During the excavation of the refuge area the decanting earth bund will provide a treatment device for the excavation itself while after the excavation works in this location the decanting earth bund will provide a facility to pump sediment laden runoff for treatment. The decanting earth bund will have a capacity of 150 m3 and with the nature of the sand soils in this location may need to be lined with an impervious lining to ensure water does not infiltrate back into the works site. Discharge will be to the Muaupoko Stream.

   The super silt fence will be extended to the refuge area with the refuge area itself protected with a diversion channel on the eastern and northern boundaries.

3. Step 3 involves the undertaking of piling works where either polymer of bentonite will be utilised. The super silt fence in this location remains as the primary control measure; however, as detailed within Section 7.8.4 of this ESCP, independent controls for the bentonite / polymer plant will also be established.

7.10.3 Stage Three Sheet Piles

1. Step 1 involves the installation of sheet piles using vibration or jetting to enable the construction of the pile cap in this location. Dewatering of the area may be necessary during these works with this to occur to the decanting earth bund. The treatment containers also installed for the stone columns will provide a further back up for treatment during the dewatering process.

2. Step 2 also involves the completion of the piling works for the southern abutment. The super silt fence in this location remains as the primary control measure; however, as detailed within Section 7.8.4 of this ESCP, independent controls for the bentonite / polymer plant will also be established.

7.10.4 Stage Four Columns

1. Step 1 and 2 involves the construction of columns and also the cross heads at the southern embankment. During these works the super silt fence and the decanting earth bund remain in place as the primary control measures with the Muaupoko Stream fully protected from the works area. Clean granular fill will also be utilised to ensure that the platforms from which the works are to be undertaken remain clean.

7.10.5 Stage Five Re-profiling

1. Step 1 involves the construction of cross heads and then the MSE abutment wall as shown on Drawing Number CV - CM 505, Management Plan Appendices, Appendix H, Volume 5. Discharge from these activities is expected to be minor; however, if it does occur then this will be pumped to the decanting earth bund. During works that involves concrete activities any discharge will be checked for pH adjusted accordingly.

2. Step 2 involves the reprofiling of the river bank and the establishment of the new Muaupoko Stream channel. To achieve this, the super silt fence on the Waikanae River bank will be removed and relocated to below the ground improvement location. The Muaupoko Stream will remain protected by the existing super silt fence.

   The Waikanae River will be diverted by establishment of a geotextile blanket filled with rock from the river channel. This will ensure that no foreign material is introduced into the river system but will also ensure that the diversion will be established from clean material and will not be subject to scour or significant sediment discharge. Works will occur during low flow periods, however, the diversion is designed to divert all the flows away from the area of the proposed works. Some water is expected to collect within the works location from both leakage through the geotextile blanket over time and also through ground infiltration; this water will be pumped as necessary to the decanting earth bund for treatment and safe discharge. Where re profiling of the main Waikanae River bank is required this will also occur as above utilising a geotextile blanket filled with rock diversion which will allow works to occur in the dry with any dirty water that results within the diversion to be pumped to the decanting earth bund for treatment and safe discharge.

   The works include the establishment of the necessary rip rap material and the new Muaupoko Stream profile. These will be undertaken using clean rock and the new channel will be fully stabilised prior to allow any flows into this environment. Once the works are completed the Muaupoko Stream will be diverted, the Waikanae River diversion removed and the super silt fence re-established on the new river bank.

7.10.6 Stage Six Deck Placement

1. Steps 1 and 2 involve the construction of the settlement slab and the placement of the deck units at the southern location. Deck concrete pours will be undertaken to compete this part of the process. Concrete discharge is expected to be minimal but as with other stages the decanting earth bund remains in position and provides a easily accessible location for pumping contaminated water for treatment (or removal) as necessary.

7.10.7 Stage Seven Northern Embankment

1. Step 1 involves the opening of the footpath on the southern side of the river. At the same time the footpath on the northern side will be closed as described in the Construction Methodology

Report (Technical Report 4, Volume 3) and Construction Traffic Management Plan (Appendix O of the CEMP, Volume 4).

2. Step 3 to Step 6 is a repeat of the same process as followed on the southern side of the river. The refuge area location as shown on Drawing CV - CM 507, Management Plan Appendices, Appendix H, Volume 5 will be established and as with the southern location will have a decanting earth bund established for the same purpose. In addition the permanent stormwater wetland facility at chainage 10850 will be available as a backup facility in the circumstance that an additional treatment device is required.

   River bank reprofiling is again part of this process and will follow the same procedure as Stage 5 on the southern embankment.

7.10.8 Stage Eight Deck Placement

1. Steps 1 and 2 involve the use of cranes to place the deck units over the river. A topping slab is to be completed and the final road pavement established.

2. Once the full bridge deck is completed and the site is considered to be fully stabilised then environmental controls can be removed from both the southern and northern locations. The super silt fence will remain in place for a period of time to ensure that any associated Alignment works have this extra level of environmental protection in place.

   During all the works within the Waikanae River the issue of fish migration and spawning periods is acknowledged. At no time will the river flows be fully stopped and fish passage will remain throughout. The key environmental consideration is that associated with minimisation of discharge of contaminants and the controls measures as detailed above are designed to achieve this. During the fish spawning and migration periods particular care will be taken and ongoing monitoring will occur to ensure no effects result.

7.11 Works in Swales/Overland Flow Paths and Placement of Pipes away from Watercourses

Part of the Project earthworks activities will include the placement of pipe networks for stormwater management and other utility services. Where these are to be placed within, under or over watercourses the methodologies referred to above should be referenced. Where they are to be placed away from watercourses, the methodologies to be employed are as below. These works are typically lineal in nature and require removal of spoil and placement of pipe hardfill bedding and backfill.

The first step is to identify the specific location of the works and the nature of the environment within which it is to be undertaken. In particular, from an environmental perspective, note will be made of any specific stream systems or overland flow paths through which the works will occur.

For all works outside of the stream systems

- Provide cesspit protection for all adjacent cesspits as per Drawing Numbers CV – CM 248 – 251, Management Plan Appendices, Appendix H, Volume 5. Ensure this practice does not result in the full blockage of cesspits and result in localised flooding.
- If the works are adjacent to watercourses these will be protected by placement of either Filter Socks or Silt Fence between the works and the stream environment. These will be maintained to ensure capacity and functionality remains and can be moved with the works as they progress.
- Undertake the works with excavation, placement of pipes and backfilling as necessary and ensure that completed areas are fully stabilised at the completion of the day's work. This stabilisation will be achieved through the use of hay mulch, hardfill or temporary placement of geotextile.
- Stockpiles of any spoil material will be avoided by removal of this material offsite, however, where necessary they will be stockpiled in a compacted manner and will be protected from erosion and dust generation by the placement of geotextile over the stockpile. Any stockpile of hardfill material will be placed such that it is not subject to scour from surface runoff and is also protected during periods of rain with Filter Socks.

If works are to be undertaken within a swale or overland flow path care will be applied such that these can continue to operate as designed during the works themselves. Temporary coffer dams may be used within swales, both upstream and downstream during periods of flow, with connected solid novacoil pipes taking any swale water around the works area on a temporary basis. On completion of such works the coffer dams would be removed and a stabilised surface will remain.

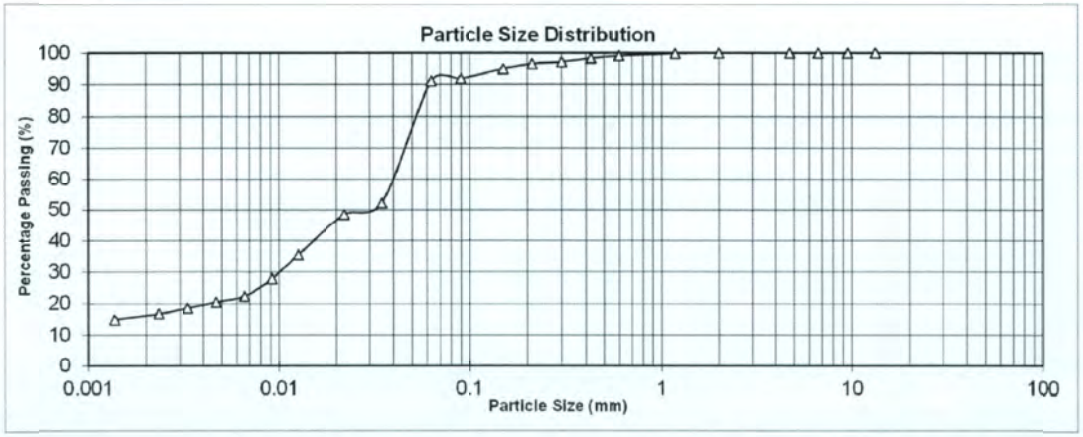
Within overland flow paths the key erosion and sediment control methodology revolves around ensuring material is not stockpiled within such flow paths and the flow path is stabilised on completion of works and during works when rain is forecast.

7.12 Chemical Treatment

Two peat soil samples were collected from the Alignment which were considered to represent the peat material expected to be encountered during the earthworks phase of the operation. These samples were collected during geotechnical investigations. These were tested by Envirolab Geotest Limited for soil particle size and were also subject to bench tests with numerous flocculants by Orica Chemnet Limited. The purpose of this sampling was to determine if water quality could be improved with the use of flocculants or if unassisted settlement was considered satisfactory in terms of erosion and sediment control.

Soil sample TP203 (J487) particle size analysis is detailed below. This soil represents organic silt with some clay and some fine to medium sand. Fibrous organic material was present in the soil sample.

Coarse & Intermediate Fraction		Fine Fraction	
Sieve Size	% Passing	Sieve Size	% Passing
75.0mm	100	2.00mm	100
63.0mm	100	1.18mm	100
53.0mm	100	600µm	99
37.5mm	100	425µm	98
26.5mm	100	300µm	97
19.0mm	100	212µm	96
13.2mm	100	150µm	95
9.50mm	100	90µm	92
6.70mm	100	63µm	91
4.75mm	100	<63µm	91

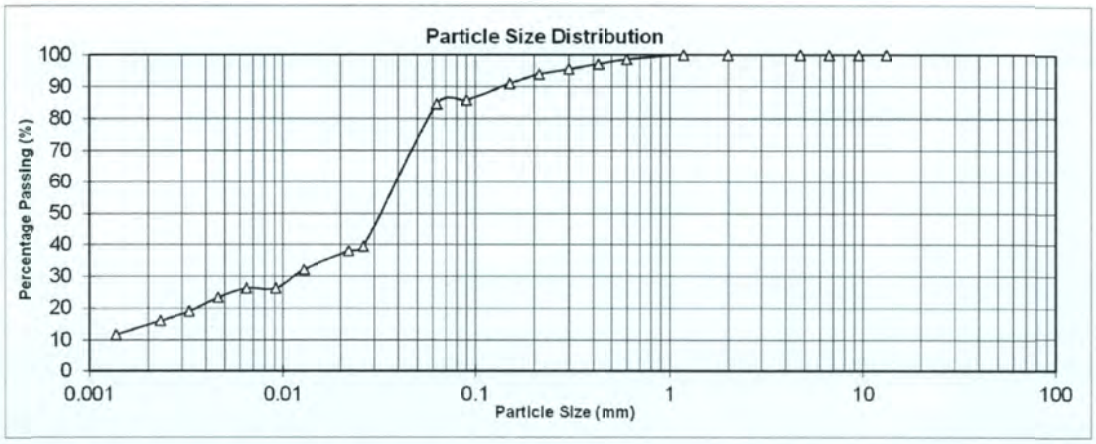


% Clay	% Silt	% Sand	% Gravel	Max. Particle Size
16	71	13	0	600µm

Figure Four – Particle Size Analysis TP203

Soil sample TP205 (J489) particle size analysis is detailed below. This soil represents an organic silt with some clay and some fine to medium sand. Fibrous organic material was also present in the soil sample with this sample containing more fibrous rootlets and spongy branches.

Coarse & Intermediate Fraction		Fine Fraction	
Sieve Size	% Passing	Sieve Size	% Passing
75.0mm	100	2.00mm	100
63.0mm	100	1.18mm	100
53.0mm	100	600µm	99
37.5mm	100	425µm	97
26.5mm	100	300µm	96
19.0mm	100	212µm	94
13.2mm	100	150µm	91
9.50mm	100	90µm	86
6.70mm	100	63µm	85
4.75mm	100	<63µm	85



% Clay	% Silt	% Sand	% Gravel	Max. Particle Size
15	66	19	0	600µm

Figure Five – Particle Size Analysis TP205

Flocculation testing was undertaken by Orica Chemnet Limited and through the flocculation testing it was recorded that both of the samples provided had fine colloidal particles which remained in suspension long enough to potentially create settling issues during treatment of sediment laden runoff. The pH of the samples tested were considered very low at 4.09 and 4.01.

It is recommended that the Project does not use an aluminium based coagulant (such as Poly Aluminium Chloride or Aluminium sulphate) for the soil types due to the relatively low starting point pH and relatively high dose rates required followed by post treatment pH correction, or pre treatment pH adjustment and then difficult subsequent treatment.

Other flocculants were tested with the samples with effective results noted with the use of polyacrylamide. B610 (Polyacrylamide) performed well on this sample (~6 to 12ppm) with relatively low settled water and no effect on pH. B610 can be dosed via a "floc sock" where sediment laden water is passed over the sock to dissolve product and the floc sock size/number is customised for the flow rates. If sufficient mixing energy can be engineered into the dosing regime the polyacrylamide option is considered the preferred option, and this erosion and sediment control plan reflects this methodology. Appendix H.L (Chemical Treatment Plans) of this ESCP provides the full bench test report and the associated material safety data sheet for polyacrylamide.

Unassisted settling data showing the turbidity readings for the soil samples is as follows:

Time	Sample J487	Sample J489
Start	>1000	>1000
1 hour	>1000	486
3 hours	>1000	482
5 hours	926	451
15 hours	683	386
24 hours (1 day)	615	298
48 hours (2 days)	498	230
72 hours (3days)	384	158
96 hours (4days)	343	128
192 hours (8days)	323	122

Table Four – Soil Settling Bench Tests

The results above shows sample J487 had the highest risk in terms of settled water turbidity vs time with sample J489 also showing a high risk in terms of settled water turbidity vs time.

Sample J487

L3RC ppm	pH	NTU at 10 min	610 ppm	pH	NTU at 10 min
0	4.09	>1000	0	4.09	>1000
5	4.08	>1000	3	4.09	>1000
10	4.07	987	6	4.09	486
20	4.05	709	9	4.09	43.7
30	4.01	516	12	4.09	39.2
40	3.98	4.57	15	4.09	69.5
50	3.97	2.42	18	4.09	129
60	3.96	2.67			
70	3.96	2.71			

Sample J489

L3RC ppm	pH	NTU at 10 min	610 ppm	pH	NTU at 10 min
0	4.01	>1000	0	4.01	>1000
5	4	>1000	3	4.01	512
10	4	846	6	4.01	99.6
20	3.98	493	9	4.01	22.3
30	3.97	86.1	12	4.01	14.6
40	3.96	8.79	15	4.01	87.4
50	3.96	1.66	18	4.01	216
60	3.94	5.69			
70	3.92	29.7			

Table Five – Soil Flocculant Bench Tests

These results clearly demonstrate the effectiveness of chemical treatment with Polyacrylamide demonstrating that at relatively low dosage rates turbidity levels can generally be significantly reduced.

7.13 Construction Yards

Establishing the construction yards will typically involve stripping of topsoil, contouring and placement of hardfill dependent upon the use of the yard area. Construction yards will be required to have adequate erosion and sediment control and due to the temporary nature of the exposed area, will be based upon super silt fences and during construction followed by a progressive cover of hard fill material. This hard fill will consist of clean granular metal compacted with a track roller.

A full set of drawings for the construction yards is contained within Construction, Construction Office and Yard Plans, Volume 5.

7.14 Rip Rap Placement

Rip rap will be placed below culvert outlets to avoid erosion of these areas and to ensure that undercutting of the culvert headwall does not result. The placement of this rip rap material is such that it will be undertaken at the same time as the culvert placement itself and therefore can be undertaken during a period when flows are fully diverted around the work area. This will also apply to any concrete works that may occur associated with the rip rap placement to ensure stability of the rip rap material. Where such concrete works are to occur they will be undertaken in a dry environment and the concrete fully cured and swept thoroughly prior to allowing water to pass over the finished surface.

Where rip rap material is to be placed to serve a function such as stream or river bank erosion protection, such as that proposed below the bridge over the Waikanae River, then again the works

will be undertaken such that the rip rap will be placed in a dry environment. From an erosion and sediment control perspective the sequence of works will be as follows:

- Operate all machinery from behind a super silt fence which is in place along the stream bank edge;
- Install sandbags within the stream system to isolate the area within which the rip rap works will occur. On the inside edge of the sandbags place a mulch filled filter sock to ensure that any sediment generated during the works is captured and or filter prior to discharge;
- Excavate the stream bank profile to the final contours and place the necessary geotextile and rip rap bedding on the excavated surface;
- Ensure the rip rap material is clean in nature and does not contain finer material and carefully place within the stream bank position as necessary;
- Remove any sediment that has accumulated within the sandbags and filter sock coffer dam and if necessary remove any ponded contaminated water via pump away from the stream system; and
- Remove the sandbags and filter sock coffer dam and allow the stream to flow back to normal flow conditions.

7.15 Wetland and Offset Storage Facilities

Wetland and offsetting storage facilities are to be constructed along the Expressway Alignment as detailed in Technical Report 22, Volume 3 and Drawings CV-SW-100 – 394, Management Plan Appendices, Appendix H, Volume 5. While these are relatively large footprints, they do not, however, involve significant volumes of earthworks. The areas form an important part of the Project, and, from an erosion and sediment control perspective, they will need to be constructed in an isolated manner. The works will involve the use of an excavator and motorscrapers removing the peat material from the location and then final contouring to be undertaken. No ground improvement works are expected through this operation.

Prior to these works commencing the perimeter of the excavation area will be marked with a topsoil or peat bund such that it is clear where the works boundary exists to prevent machinery moving outside of and disturbing unnecessary areas. Further the bund will be formed such that it can act as an impoundment area if necessary with decanting devices installed. Groundwater levels are expected to be high within these locations and as a result during excavation some pumping may be necessary. This will be achieved through the undertaking of the excavation on a cell by cell basis whereby the area will be worked within one cell and any water that requires pumping and/or disposal can be done so through an adjacent cell. It is expected that chemical treatment will not be necessary; however, if this is required it can be applied as per Section 7.12 of this ESCP.

For the development of the offsite wetlands reference should be made to Appendix M of the CEMP, Volume 4 (Ecological Management Plan) which outlines the specific works required. For each of these areas a CESCP will be developed and certified by GW prior to works commencing.

8 Planning Considerations

Section 3.0 of this ESCP provides an overview of the planning framework associated with the earthworks activity and the Project. This section that follows details the specific statutory provision of relevance to earthworks and places this ESCP in the context of these provisions.

Resource Management Act (RMA)

Section 104(1) of the RMA requires regard to be had to specific factors, subject to Part 2 of the RMA ("Purposes and Principles"). The purpose of the RMA is to promote the sustainable management of natural and physical resources. Sustainable management means the use, development and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while: sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and safeguarding the life-supporting capacity of air, water, soil, and ecosystems; avoiding, remedying or mitigating any adverse effects of activities on the environment.

With reference to Table Seven below, sections 105 and 107 requires regard to be had to additional matters associated with the discharge of contaminants. This ESCP outlines a comprehensive programme of implementation of erosion and sediment control measures which will be the subject of detailed design, implementation and ongoing monitoring to ensure effectiveness. All of these aspects confirm that the effects of any sediment yields associated with the construction activity will be negligible.

Overall Assessment of Earthworks and Streamworks Activities

Earthworks Assessment Criteria	Description
Erosion and Sediment Control and Environmental Management	Environmental control measures will be fully implemented as part of the Project implementation. These will be implemented in accordance with this ESCP and the CESCPs which will require future Council certification on an as-required basis.

Water Quality	All discharges will be treated to a minimum standard associated with Wellington Guidelines. This standard is exceeded in many circumstances and includes chemical treatment, comprehensive methodologies and stabilisation techniques.
Aesthetics and odour	After reasonable mixing, any sediment discharged will not give rise to: ■ Conspicuous oil or grease films, scums or foams, or floatable or suspended materials; ■ Any conspicuous change in the colour or visual clarity; and/or ■ Any emission of objectionable odour. Environmental controls are comprehensive and reflect the best practical option approach while also adopting standards and monitoring of discharges. With treatment and after mixing no conspicuous change to the receiving waters is expected. Similarly, no emission of objectionable odour is expected.

Table Seven – Earthworks Assessment

9 Conclusions

A range of earthworks and streamworks activities (including bridges) that will be undertaken as part of the Project have numerous requirements under regional policy and planning documents. Several key items are of importance in terms of erosion and sediment control:

- Proximity to sensitive stream systems,
- Values of the receiving environments adjacent to, or downstream of, the Project, and
- Areas of exposed soils.

These items have been considered in full in developing this ESCP and are reflected in the overall approach taken.

The NZTA has adopted as part of its wider national Environmental Management Plan (NZTA EMP), a series of erosion and sediment control objectives for roading projects. This part of the NZTA EMP is attached as Appendix O of this ESCP and is also detailed within Section 3 of this ESCP. These objectives have been fully considered and are reflected within this ESCP.

The following key points are noted for the erosion and sediment control methodologies for the Project.

- The statutory framework and policy guidance from Greater Wellington Regional Council and the NZTA require the Project team to be aware of, and ensure, implementation of appropriate erosion and sediment controls including construction and maintenance of these devices.
- A range of erosion and sediment control measures are proposed to be employed on the Project. These will be implemented and maintained and will at all times achieve as a minimum the requirements of the Wellington Guidelines.
- The erosion and sediment control methodology relies on a future erosion and sediment control plan (referred to as a CESCP) to be submitted at a later date, pre any earthworks activity, to allow for flexibility, Project team input and also input from various other bodies such as Greater Wellington Regional Council.
- Chemical treatment will be implemented on the site as a risk management tool and will be done so in accordance with the Chemical Treatment Plan provided with this report.

With these measures in place it is considered that overall, any adverse effects on the receiving environment will be no more than minor.

10 References

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Smith, G. Contaminated Soils and Groundwater Management Plan: Appendix K of the CEMP, Volume 4 of the MacKays to Peka Peka Expressway Project AEE.

Appendix H.A
Sector Diagram

M2PP-AEE-GPH-ZZ-GE-121 (M2PP Sector diagram A4) 2/2/2012

Appendix H.B
ESCP Drawings: Refer to Drawings CV-CM-200 - CV-CM-231 and CV-CM-234, Management Plan Appendices, Appendix H, Volume 5

Appendix H.C
Pre Load Drawing: Refer to Drawing CV-CM-244, Management Plan Appendices, Appendix H, Volume 5

Appendix H.D

Peat Replacement Drawing: Refer to Drawings CV-CM-240 – CV-CM-243, Management Plan Appendices, Appendix H Volume 5

Appendix H.E
Stream Crossing Methodology: Refer to Drawings CV-CM-246 - CV-CM-247, Management Plan Appendices, Appendix H, Volume 5

Appendix H.F
USLE Plans: Refer to Drawings CV-CM-260 - CV-CM-270 and CV-CM-272 - 282, Management Plan Appendices, Appendix H, Volume 5

Appendix H.G
USLE Calculations

USLE Calculation M2PP Pre Earthworks - Main Project Footprint

Catchment 1 Whareroa
Catchment 2 Wharemauku
Catchment 3 Waikanae
Catchment 4 Waimeha
Catchment 5 Ngarara

Assumptions

R factor based on NIWA HIRDS Data
K Factor based on soil samples and soils /gravels to be utilised - grass cover
LS Factor based on different slopes with a uniform 100m slope length - this is the worst case scenarion with the installation of contour drains reducing this value
C and P Factors based on a pastoral surface
Duration - for purposes of risk assessment has been based on 2 months total for each stage to provide comparison with earthworks scenario
Sediment Deilivery Ratio - based on a high infiltration rate and irregular surface capturing flow and sediment - 0.25 assumed figure
Efficiency - based on 0% as no control measures in place with existing situation
Assume pre earthworks surface is grass environment in all areas

CATCHMENT #		hectares	r	k	ls	c	p	time	sdr	sed eff.	Yield	Sed Yield (tonnes)	Sub Area (ha)	Area Catchment (ha)
1	**Area 1**													
	Slope 0-5%	6.66	71	0.132	0.3457401	0.02	1	0.16	0.25	0	0.017264191			
	Slope 5-10%	1.44	71	0.132	1.6420015	0.02	1	0.16	0.25	0	0.017727942			
	Slope 10-20%	0.54	71	0.132	4.6388912	0.02	1	0.16	0.25	0	0.018781497			
	Slope >20%	0.36	71	0.132	7.3920692	0.02	1	0.16	0.25	0	0.0199522		9	
	Area 2													
	Slope 0-5%	0.5122	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.005045395			
	Slope 5-10%	0.0592	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.002769498			
	Slope 10-20%	0.0596	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.007877099			
	Slope >20%	0.1002	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.021102777	**0.110520599**	0.7312	9.7312
2	**Area 1**													
	Slope 0-5%	4.426	71	0.132	0.3457401	0.02	1	0.16	0.25	0	0.011473169			
	Slope 5-10%	0.689	71	0.132	1.6420015	0.02	1	0.16	0.25	0	0.008482328			
	Slope 10-20%	1.5453	71	0.132	4.6388912	0.02	1	0.16	0.25	0	0.053746385			
	Slope >20%	2.7361	71	0.132	7.3920692	0.02	1	0.16	0.25	0	0.151642262		9.3964	
	Area 2													
	Slope 0-5%	0.5863	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.001367837			
	Slope 5-10%	0.2276	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.0025218			
	Slope 10-20%	0.4838	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.015144147			
	Slope >20%	1.8145	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.090508167		3.1122	
	Area 3													
	Slope 0-5%	2.8566	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.006664444			
	Slope 5-10%	0.0312	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.000345695			
	Slope 10-20%	0.1189	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.003721867			
	Slope >20%	0.1554	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.00775143		3.1621	
	Area 4													
	Slope 0-5%	0.3701	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.000863443			
	Slope 5-10%	0.0062	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	6.86958E-05			
	Slope 10-20%	0.0343	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.001073676			
	Slope >20%	0.2649	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.013213344		0.6755	
	Area 5													
	Slope 0-5%	0.0402	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	9.37866E-05			
	Slope 5-10%	0.0066	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	7.31278E-05			
	Slope 10-20%	0.0646	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.002022141			

	Slope >20%	0.2026	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.010105789		0.314	
	Area 6													
	Slope 0-5%	0.1491	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.00034785			
	Slope 5-10%	0.323	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.003578828			
	Slope 10-20%	0.1127	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.003527791			
	Slope >20%	0.1493	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.007447159		0.7341	
	Area 7													
	Slope 0-5%	0.2967	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.000692201			
	Slope 5-10%	0.0719	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.000796649			
	Slope 10-20%	0.2426	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.007593985			
	Slope >20%	0.3879	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.019348646		0.9991	
	Area 8													
	Slope 0-5%	1.119	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.002610626			
	Slope 5-10%	0.3714	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.004115098			
	Slope 10-20%	0.5687	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.017801729			
	Slope >20%	0.4171	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.020805157		2.4762	
	Area 9													
	Slope 0-5%	0.6771	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.001579673			
	Slope 5-10%	0.1415	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.001567815			
	Slope 10-20%	0.3093	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.009681862			
	Slope >20%	0.465	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.023194432		1.5929	
	Area 10													
	Slope 0-5%	0.7131	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.001663661			
	Slope 5-10%	0.0585	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.000648178			
	Slope 10-20%	0.1527	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.004779891			
	Slope >20%	0.1629	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.008125533		1.0872	
	Area 11													
	Slope 0-5%	0.5134	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.005057216			
	Slope 5-10%	0.0728	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.003405735			
	Slope 10-20%	0.2617	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.034587867			
	Slope >20%	0.1499	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.031569923		0.9978	
	Area 12													
	Slope 0-5%	0.8128	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.001896261			
	Slope 5-10%	0.346	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.003833667			
	Slope 10-20%	0.3469	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.010858836			
	Slope >20%	1.0737	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.053556693		2.5794	
	Area 13													
	Slope 0-5%	0.3989	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.00392934			
	Slope 5-10%	0.1825	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.008537727			
	Slope 10-20%	0.0805	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.010639371			
	Slope >20%	0.0959	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.020197169		0.7578	
	Area 14													
	Slope 0-5%	0.2864	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.000668171			
	Slope 5-10%	0.0959	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.001062569			
	Slope 10-20%	0.3364	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.01053016			
	Slope >20%	2.6097	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.130173141		3.3284	
	Area 15													
	Slope 0-5%	0.3664	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.003609201			
	Slope 5-10%	0	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0			
	Slope 10-20%	0.012	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.001585993			
	Slope >20%	0.0756	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.015921856	**0.872411194**	0.454	31.6671
3	**Area 1**													
	Slope 0-5%	1.6884	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.016631482			
	Slope 5-10%	0.3154	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.014755064			
	Slope 10-20%	0.5939	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.078493443			
	Slope >20%	1.1114	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.234068126		3.7091	
	Area 2													
	Slope 0-5%	0.2064	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.000481531			
	Slope 5-10%	0.0606	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.000671446			
	Slope 10-20%	0.1931	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.006044512			
	Slope >20%	0.4624	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.023064743		0.9225	

Area 3													
Slope 0-5%	0.1254	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.000292558			
Slope 5-10%	0.03	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.000332399			
Slope 10-20%	0.1213	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.003796993			
Slope >20%	0.3563	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.017772422		0.633	
Area 4													
Slope 0-5%	0.0226	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	5.27258E-05			
Slope 5-10%	0	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0			
Slope 10-20%	0.0194	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.000607268			
Slope >20%	0.1082	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.00539707		0.1502	
Area 5													
Slope 0-5%	0.3833	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.000894238			
Slope 5-10%	0.1459	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.001616567			
Slope 10-20%	0.188	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.005884869			
Slope >20%	0.2384	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.011891511		0.9556	
Area 6													
Slope 0-5%	0.1175	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.000274127			
Slope 5-10%	0.0185	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.000204979			
Slope 10-20%	0.2	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.006260499			
Slope >20%	0.4904	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.024461397		0.8264	
Area 7													
Slope 0-5%	0.1358	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.000316821			
Slope 5-10%	0.0038	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	4.21039E-05			
Slope 10-20%	0.0372	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.001164453			
Slope >20%	0.145	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.007232672		0.3218	
Area 8													
Slope 0-5%	1.5033	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.003507197			
Slope 5-10%	0.3173	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.003515672			
Slope 10-20%	0.5455	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.017075511			
Slope >20%	0.598	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.029828539		2.9641	
Area 9													
Slope 0-5%	0.0392	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	9.14536E-05			
Slope 5-10%	0.0001	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	1.108E-06			
Slope 10-20%	0.0968	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.003030082			
Slope >20%	0.2599	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.012963942		0.396	
Area 10													
Slope 0-5%	0.7927	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.001849368			
Slope 5-10%	0.0943	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.001044841			
Slope 10-20%	0.2878	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.009008858			
Slope >20%	0.3984	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.019872391		1.5732	
Area 11													
Slope 0-5%	0.1365	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.001344585			
Slope 5-10%	0.0069	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.000322796			
Slope 10-20%	0.062	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.008194298			
Slope >20%	0.1036	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.021818839		0.309	
Area 12													
Slope 0-5%	0.3648	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.000851078			
Slope 5-10%	0.1759	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.001948966			
Slope 10-20%	0.517	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.01618339			
Slope >20%	0.8386	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.041829787		1.8963	
Area 13													
Slope 0-5%	0.0408	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.000401898			
Slope 5-10%	0.0348	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.001628016			
Slope 10-20%	0.1562	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.020644344			
Slope >20%	0.1701	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.035824175		0.4019	
Area 14													
Slope 0-5%	0.8678	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.008548211			
Slope 5-10%	0.1449	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.006778722			
Slope 10-20%	0.1855	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.02451681			
Slope >20%	0.4904	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.103281455		1.6886	
Area 15													

	Slope 0-5%	0.9862	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.002300803			
	Slope 5-10%	0.0835	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.000925177			
	Slope 10-20%	0.3967	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.0124177			
	Slope >20%	2.3455	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.116994713		3.8119	
	Area 16													
	Slope 0-5%	0.5971	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.005881697			
	Slope 5-10%	0.1606	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.0075132			
	Slope 10-20%	0.1583	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.020921893			
	Slope >20%	0.0991	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.02087111		1.0151	
	Area 17													
	Slope 0-5%	0.6855	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.001599271			
	Slope 5-10%	0.0629	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.00069693			
	Slope 10-20%	0.1984	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.006210415			
	Slope >20%	0.3729	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.018600438		1.3197	
	Area 18													
	Slope 0-5%	0.4202	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.000980326			
	Slope 5-10%	0.2141	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.00237222			
	Slope 10-20%	0.182	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.005697054			
	Slope >20%	0.053	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.002643666		0.8693	
	Area 19													
	Slope 0-5%	0.9161	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.009023987			
	Slope 5-10%	0.0531	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.002484128			
	Slope 10-20%	0.1488	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.019666315			
	Slope >20%	0.1062	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.022366416		1.2242	
	Area 20													
	Slope 0-5%	0.1055	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.000246131			
	Slope 5-10%	0.0207	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.000229355			
	Slope 10-20%	0.0083	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.000259811			
	Slope >20%	0.004	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.000199522		0.1385	
	Area 21													
	Slope 0-5%	0.2541	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.002502997			
	Slope 5-10%	0.0598	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.002797568			
	Slope 10-20%	0.054	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.007136969			
	Slope >20%	0.0325	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.006844713	**1.15899688**	0.4004	25.5268
4	**Area 1**													
	Slope 0-5%	1.188	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.002771603			
	Slope 5-10%	0.1683	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.001864758			
	Slope 10-20%	0.3024	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.009465875			
	Slope >20%	1.2859	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.064141335		2.9446	
	Area 2													
	Slope 0-5%	2.5951	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.025562875			
	Slope 5-10%	0.1266	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.00592261			
	Slope 10-20%	0.0087	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.001149845			
	Slope >20%	0.0028	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.000589698		2.7332	
	Area 3													
	Slope 0-5%	1.3112	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.003059028			
	Slope 5-10%	0.2511	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.002782179			
	Slope 10-20%	0.4336	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.013572762			
	Slope >20%	0.6795	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.0338938	**0.164776367**	2.6754	8.3532
5	**Area 4**													
	Slope 0-5%	1.2918	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.012724797			
	Slope 5-10%	0.1114	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.005211522			
	Slope 10-20%	0.0235	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.003105903			
	Slope >20%	0.0193	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.004064707		1.446	
	Area 5													
	Slope 0-5%	2.2292	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.005200721			
	Slope 5-10%	0.1105	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.001224336			
	Slope 10-20%	1.1824	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.037012071			
	Slope >20%	5.1614	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.257453213		8.6835	
	Area 6													
	Slope 0-5%	0.0314	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.000309304			

Slope 5-10%	0.0319	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.001492348		
Slope 10-20%	0.1634	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.02159594		
Slope >20%	0.1014	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.021355505		0.3281
Area 7												
Slope 0-5%	0.1224	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.001205694		
Slope 5-10%	0.019	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.000888859		
Slope 10-20%	0.0647	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.008551146		
Slope >20%	0.2824	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.059475291		0.4885
Area 8												
Slope 0-5%	0.3886	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.003827881		
Slope 5-10%	0.0211	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.000987102		
Slope 10-20%	0.1842	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.024344994		
Slope >20%	0.5784	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.121814832		1.1723
Area 9												
Slope 0-5%	2.7681	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.006457974		
Slope 5-10%	0.8022	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.008888347		
Slope 10-20%	2.5318	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.079251659		
Slope >20%	5.6798	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.283311264		11.7819
Area 10												
Slope 0-5%	1.1832	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.01165504		
Slope 5-10%	0.3828	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.017908176		
Slope 10-20%	0.1868	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.024688626		
Slope >20%	0.0637	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.013415638		1.8165
Area 11												
Slope 0-5%	0.3045	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.000710398		
Slope 5-10%	0.1425	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.001578895		
Slope 10-20%	0.2114	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.006617348		
Slope >20%	0.1214	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.006055493		0.7798
Area 12												
Slope 0-5%	0.4734	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.004663198		
Slope 5-10%	0.0994	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.004650138		
Slope 10-20%	0.0965	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.012754028		
Slope >20%	0.0766	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.016132462		0.7459
Area 13												
Slope 0-5%	0.6494	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.001515049		
Slope 5-10%	0.1365	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.001512415		
Slope 10-20%	0.4554	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.014255157		
Slope >20%	0.191	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.009527175		1.4323
Area 14												
Slope 0-5%	0.0219	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.000215725		
Slope 5-10%	0.0733	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.003429126		
Slope 10-20%	0.0173	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.002286473		
Slope >20%	0.0063	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.001326821		0.1188
Area 15												
Slope 0-5%	0.8079	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.00795817		
Slope 5-10%	0.112	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.005239592		
Slope 10-20%	0.1693	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.02237572		
Slope >20%	0.135	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.028431885		1.2242
Area 16												
Slope 0-5%	0.6664	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.00155471		
Slope 5-10%	0.1529	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.001694126		
Slope 10-20%	0.2198	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.006880289		
Slope >20%	0.077	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.003840798		1.1161
Area 17												
Slope 0-5%	11.1025	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.025902119		
Slope 5-10%	1.2694	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.014064906		
Slope 10-20%	1.1628	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.036398542		
Slope >20%	0.6172	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.030786245		14.1519
Area 18												
Slope 0-5%	5.4906	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.054084822		
Slope 5-10%	0.4638	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.021697523		

Slope 10-20%	0.4787	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.063267909			
Slope >20%	0.5298	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.111579353		6.9629	
Area 19													
Slope 0-5%	6.3419	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.062470501			
Slope 5-10%	0.3299	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.015433404			
Slope 10-20%	0.2865	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.037865586			
Slope >20%	0.0648	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.013647305		7.0231	
Area 20													
Slope 0-5%	0.6919	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.001614202			
Slope 5-10%	0.235	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.002603791			
Slope 10-20%	0.0904	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.002829746			
Slope >20%	0.0234	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.001167204		1.0407	
Area 21													
Slope 0-5%	1.6663	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.016413787			
Slope 5-10%	0.5562	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.026020186			
Slope 10-20%	0.6075	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.080290902			
Slope >20%	0.3773	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.079461853	**1.900227962**	3.2073	63.5198

TOTAL 4.20693 tonnes

138.7981 Total Area (ha)

K Factor

Peat	Clay	Silt	Sand	Nomograph Value	Correction Factor Peat (4% Organic) Sand/Gravels (0% Organic)	Value	Metric Convert K Factor
Sample 1	16	71	13				
Sample 2	15	66	19				
Average	**15.5**	**68.5**	**16**	0.52	-0.14	0.38	0.5016
Sand Soils							
Sample 1	1	6	93				
Sample 2	2	8	90				
Average	**1.5**	**7**	**91.5**	0.15	-0.06	0.09	0.1188
Gravels	10	20	70	0.2	-0.1	0.1	0.132

Assumes a full grass cover over alignment in existing state

Sitename: M2PP Paraparaumu
Coordinate system: NZMG
Easting: 2679016
Northing: 6030188

Rainfall depths (mm)

		Duration									
ARI (y)	aep	10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
1.58	0.633	7	9.9	12.2	17.5	24.2	40.6	56.3	78	90.9	99.4
2	0.5	7.5	10.7	13.2	18.9	26.1	43.5	60	82.8	96.5	105.6
5	0.2	9.6	13.7	16.8	24	32.8	53.6	73.1	99.6	116.1	127
10	0.1	11.2	16	19.7	28.2	38.1	61.5	83.2	112.6	131.2	143.6
20	0.05	13	18.6	23	32.8	44.1	70.3	94.3	126.6	147.6	161.5
30	0.033	14.2	20.4	25.1	35.8	47.9	75.8	101.3	135.4	157.9	172.7
40	0.025	15.1	21.6	26.7	38.1	50.8	80	106.6	142	165.6	181.2
50	0.02	15.9	22.7	28	40	53.2	83.4	110.9	147.4	171.8	187.9
60	0.017	16.5	23.6	29.1	41.6	55.2	86.3	114.5	151.8	177	193.7
80	0.012	17.6	25.1	30.9	44.2	58.5	91	120.4	159.2	185.6	203
100	0.01	18.4	26.3	32.4	46.4	61.2	94.9	125.2	165.1	192.5	210.6

Extreme rainfall assessment with climate change

Projected temperature change: 2.0 ° C
Rainfall depths (mm)

		Duration									
ARI (y)	aep	10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
1.58	0.633	8.1	11.4	14	19.8	27.2	44.9	61.7	84.7	97.8	106.4
2	0.5	8.7	12.3	15.1	21.4	29.3	48.1	65.8	89.9	103.8	113
5	0.2	11.1	15.8	19.3	27.4	37.2	60.1	81.6	110.4	127.7	139.2
10	0.1	13	18.5	22.7	32.4	43.6	69.9	94	126.8	147.2	160.5
20	0.05	15.1	21.6	26.6	37.9	50.8	80.7	108.1	144.8	168.6	184.1
30	0.033	16.5	23.7	29.1	41.5	55.6	87.9	117.5	157.1	182.5	199.3
40	0.025	17.5	25.1	31	44.2	58.9	92.8	123.7	164.7	191.8	209.6
50	0.02	18.4	26.3	32.5	46.4	61.7	96.7	128.6	171	199.3	218
60	0.017	19.1	27.4	33.8	48.3	64	100.1	132.8	176.1	205.3	224.7
80	0.012	20.4	29.1	35.8	51.3	67.9	105.6	139.7	184.7	215.3	235.5
100	0.01	21.3	30.5	37.6	53.8	71	110.1	145.2	191.5	223.3	244.3

Sitename: M2PP PekaPeka
Coordinate system: NZMG
Easting: 2685968
Northing: 6038488

Rainfall depths (mm)

		Duration									
ARI (y)	aep	10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
1.58	0.633	7.7	10.7	13	18.3	24.7	39.9	54	73.2	88	98
2	0.5	8.3	11.6	14.1	19.7	26.5	42.7	57.6	77.7	93.5	104.1
5	0.2	10.4	14.5	17.7	24.8	33.1	52.4	70.1	93.7	112.6	125.4
10	0.1	12.1	16.9	20.6	28.8	38.3	60.1	79.8	106	127.4	141.9
20	0.05	14	19.6	23.9	33.4	44.1	68.4	90.4	119.3	143.4	159.8
30	0.033	15.3	21.3	26	36.3	47.8	73.8	97.1	127.7	153.5	171
40	0.025	16.2	22.6	27.6	38.5	50.6	77.8	102.1	134	161.1	179.4
50	0.02	16.9	23.7	28.8	40.3	52.8	81.1	106.2	139	167.2	186.2
60	0.017	17.6	24.6	29.9	41.9	54.8	83.8	109.6	143.3	172.3	192
80	0.012	18.7	26.1	31.8	44.4	58	88.3	115.2	150.3	180.7	201.3
100	0.01	19.5	27.3	33.2	46.5	60.5	92	119.8	156	187.5	208.9

Extreme rainfall assessment with climate change

Projected temperature change: 2.0 ° C
Rainfall depths (mm)

		Duration									
ARI (y)	aep	10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
1.58	0.633	8.9	12.3	14.9	20.8	27.8	44.1	59.2	79.5	94.7	104.9
2	0.5	9.6	13.4	16.1	22.3	29.8	47.2	63.1	84.4	100.6	111.4
5	0.2	12.1	16.7	20.3	28.3	37.5	58.8	78.2	103.8	123.9	137.4
10	0.1	14	19.5	23.7	33.1	43.8	68.3	90.2	119.4	142.9	158.6
20	0.05	16.2	22.7	27.6	38.5	50.8	78.5	103.6	136.5	163.8	182.2
30	0.033	17.7	24.7	30.2	42.1	55.4	85.6	112.6	148.1	177.4	197.3
40	0.025	18.8	26.2	32	44.7	58.7	90.2	118.4	155.4	186.6	207.6
50	0.02	19.6	27.5	33.4	46.7	61.2	94.1	123.2	161.2	194	216
60	0.017	20.4	28.5	34.7	48.6	63.6	97.2	127.1	166.2	199.9	222.7
80	0.012	21.7	30.3	36.9	51.5	67.3	102.4	133.6	174.3	209.6	233.5
100	0.01	22.6	31.7	38.5	53.9	70.2	106.7	139	181	217.5	242.3

Rainfall Erosion Index (J/ha) - Based on NIWA HIRDS Data

R = 0.00828p2.2*1.7

48.1 **p = 6 hour duration 2 year storm**

R Factor	71

LS Equation

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%

Slope (Av/Mid Slope)	Area	S2	S2+10000		L (m)	Weight L	*m*	LS
Area 1								
2.5	6.6	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	1.44	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.54	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.36	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 2								
2.5	0.5122	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0592	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0596	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1002	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 1								
2.5	4.426	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.689	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	1.5453	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	2.7361	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 2								
2.5	0.5863	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.2276	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.4838	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	1.8145	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 3								
2.5	2.8566	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0312	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1189	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1554	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 4								
2.5	0.3701	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0062	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0343	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.2649	400	10400	101.9803903	100	30.48	0.5	7.392069161

Area 5								
2.5	0.0402	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0066	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0646	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.2026	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 6								
2.5	0.1491	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.323	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1127	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1493	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 7								
2.5	0.2967	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0719	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.2426	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.3879	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 8								
2.5	1.119	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.3714	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.5687	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.4171	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 9								
2.5	0.6771	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1415	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.3093	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.465	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 10								
2.5	0.7131	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0585	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1527	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1629	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 11								
2.5	0.5134	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0728	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.2617	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1499	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 12								
2.5	0.8128	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.346	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.3469	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	1.0737	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 13								
2.5	0.3989	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084

7.5	0.1825	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0805	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0959	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 14								
2.5	0.2864	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0959	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.3364	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	2.6097	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 15								
2.5	0.3664	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.012	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0756	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 1								
2.5	1.6884	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.3154	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.5939	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	1.1114	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 2								
2.5	0.2064	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0606	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1931	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.4624	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 3								
2.5	0.1254	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.03	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1213	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.3563	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 4								
2.5	0.0226	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0194	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1082	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 5								
2.5	0.3833	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1459	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.188	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.2384	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 6								
2.5	0.1175	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0185	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.2	225	10225	101.1187421	100	30.48	0.5	4.638891224

20	0.4904	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 7								
2.5	0.1358	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0038	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0372	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.145	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 8								
2.5	1.5033	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.3173	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.5455	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.598	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 9								
2.5	0.0392	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0001	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0968	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.2599	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 10								
2.5	0.7927	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0943	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.2878	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.3984	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 11			10000	100	100	30.48	0.5	
2.5	0.1365	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0069	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.062	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1036	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 12								
2.5	0.3648	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1759	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.517	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.8386	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 13								
2.5	0.0408	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0348	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1562	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1701	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 14								
2.5	0.8678	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1449	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1855	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.4904	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 15								

2.5	0.9862	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0835	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.3967	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	2.3455	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 16								
2.5	0.5971	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1606	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1583	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0991	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 17								
2.5	0.6855	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0629	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1984	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.3729	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 18								
2.5	0.4202	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.2141	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.182	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.053	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 19								
2.5	0.9161	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0531	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1488	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1062	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 20								
2.5	0.1055	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0207	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0083	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.004	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 21								
2.5	0.2541	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0598	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.054	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0325	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 1								
2.5	1.188	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1683	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.3024	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	1.2859	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 2								
2.5	2.5951	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1266	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523

15	0.0087	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0028	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 3								
2.5	1.3112	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.2511	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.4336	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.6795	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 4								
2.5	1.2918	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1114	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0235	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0193	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 5								
2.5	2.2292	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1105	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	1.1824	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	5.1614	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 6								
2.5	0.0314	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0319	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1634	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1014	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 7								
2.5	0.1224	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.019	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0647	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.2824	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 8								
2.5	0.3886	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0211	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1842	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.5784	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 9								
2.5	2.7681	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.8022	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	2.5318	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	5.6798	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 10								
2.5	1.1832	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.3828	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1868	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0637	400	10400	101.9803903	100	30.48	0.5	7.392069161

Area 11								
2.5	0.3045	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1425	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.2114	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1214	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 12								
2.5	0.4734	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0994	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0965	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0766	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 13								
2.5	0.6494	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1365	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.4554	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.191	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 14								
2.5	0.0219	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0733	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0173	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0063	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 15								
2.5	0.8079	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.112	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1693	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.135	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 16								
2.5	0.6664	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1529	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.2198	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.077	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 17								
2.5	11.1025	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	1.2694	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	1.1628	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.6172	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 18								
2.5	5.4906	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.4638	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.4787	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.5298	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 19								
2.5	6.3419	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084

7.5	0.3299	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.2865	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0648	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 20								
2.5	0.6919	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.235	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0904	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0234	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 21								
2.5	1.6663	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.5562	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.6075	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.3773	400	10400	101.9803903	100	30.48	0.5	7.392069161

USLE Calculation M2PP During Earthworks - Project Footprint

Catchment 1	Whareroa	1600
Catchment 2	Wharemauku	1380
Catchment 3	Waikanae	14200
Catchment 4	Waimeha	120
Catchment 5	Ngarara	1690
		Total Catchment Area (ha)

Assumptions

R factor based on NIWA HIRDS data
K Factor based on soil samples and soils /gravels to be utilised
LS Factor based on different slopes with a uniform 100m slope length - this is the worst case scenarion with the installation of contour drains reducing this value
C and P Factors based on a bare site which has a rough and irregular surface
Duration - for purposes of risk assessment has been based on 2 months total for each stage however staging and progressive stabilisation will occur.
Sediment Deilivery Ratio - based on a high infiltration rate and irregular surface capturing flow and sediment - 0.25 assumed figure
Efficiency - based on 95% due to control measures exceeding guidelines and chemical treatment - all measures considered of equal efficiency

CATCHMENT #		Footprint hectares	r	k	ls	c	p	time	sdr	sed eff.	Yield	Overall Footprint Yield	Area	Project Footprint Area	Pro Rata Total Catchment Area	Slope % Total Catchment	Total Catchment Less Project Footprint	Pro Rata Total Catchment Area
1	**Area 1**																	
	Slope 0-5%	6.66	71	0.396	0.3457401	1	0.9	0.16	0.25	0.95	0.116533288				1095.034528	0.74	1088.374528	
	Slope 5-10%	1.44	71	0.396	1.6420015	1	0.9	0.16	0.25	0.95	0.119663606				236.7642223	0.16	235.3242223	
	Slope 10-20%	0.54	71	0.396	4.6388912	1	0.9	0.16	0.25	0.95	0.126775108				88.78658336	0.06	88.24658336	
	Slope >20%	0.36	71	0.396	7.3920692	1	0.9	0.16	0.25	0.95	0.13467735		9		59.19105557	0.04	58.83105557	1479.776389
	Area 2																	
	Slope 0-5%	0.5122	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.011352139				84.21571851	0.700492341	83.70351851	
	Slope 5-10%	0.0592	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.006231372				9.73364025	0.080962801	9.67444025	
	Slope 10-20%	0.0596	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.017723473				9.799408089	0.081509847	9.739808089	
	Slope >20%	0.1002	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.047481248	**0.580437584**	0.7312	**9.7312**	16.4748438	0.137035011	16.3746438	120.2236107
2	**Area 1**																	
	Slope 0-5%	4.426	71	0.396	0.3457401	1	0.9	0.16	0.25	0.95	0.077443894				192.9147369	0.471121708	188.4887369	
	Slope 5-10%	0.689	71	0.396	1.6420015	1	0.9	0.16	0.25	0.95	0.057255712				30.03123673	0.073340004	29.34223673	
	Slope 10-20%	1.5453	71	0.396	4.6388912	1	0.9	0.16	0.25	0.95	0.3627881				67.35452847	0.16448811	65.80922847	
	Slope >20%	2.7361	71	0.396	7.3920692	1	0.9	0.16	0.25	0.95	1.02358527		9.3964		119.2575716	0.291241777	116.5214716	409.4796176
	Area 2																	
	Slope 0-5%	0.5863	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.007181145				25.54998721	0.188387636	24.96368721	
	Slope 5-10%	0.2276	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.013239448				9.918432695	0.073131547	9.690832695	
	Slope 10-20%	0.4838	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.079506774				21.08320623	0.155452734	20.59940623	
	Slope >20%	1.8145	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.475167878		3.1122		79.07291795	0.583028083	77.25841795	135.6245441
	Area 3																	
	Slope 0-5%	2.8566	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.034988332				124.4859176	0.90338699	121.6293176	
	Slope 5-10%	0.0312	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.001814898				1.359644552	0.009866861	1.328444552	
	Slope 10-20%	0.1189	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.0195398				5.181465938	0.037601594	5.062565938	
	Slope >20%	0.1554	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.040695006		3.1621		6.772075751	0.049144556	6.616675751	137.7991038
	Area 4																	
	Slope 0-5%	0.3701	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.004533075				16.12834772	0.547890452	15.75824772	
	Slope 5-10%	0.0062	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.000360653				0.270185776	0.009178386	0.263985776	
	Slope 10-20%	0.0343	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.005636797				1.49473744	0.050777202	1.46043744	
	Slope >20%	0.2649	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.069370058		0.6755		11.54390519	0.39215396	11.27900519	29.43717612
	Area 5																	
	Slope 0-5%	0.0402	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.000492379				1.751849712	0.128025478	1.711649712	
	Slope 5-10%	0.0066	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.000383921				0.287617117	0.021019108	0.281017117	
	Slope 10-20%	0.0646	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.010616241				2.815161477	0.205732484	2.750561477	
	Slope >20%	0.2026	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.053055394		0.314		8.828973919	0.64522293	8.626373919	13.68360222
	Area 6																	
	Slope 0-5%	0.1491	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.001826213				6.497532139	0.203105844	6.348432139	
	Slope 5-10%	0.323	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.018788848				14.07580738	0.439994551	13.75280738	
	Slope 10-20%	0.1127	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.018520904				4.911280161	0.153521319	4.798580161	

	Slope >20%	0.1493	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.039097583		0.7341		6.506247809	0.203378286	6.356947809	31.99086749
	Area 7																	
	Slope 0-5%	0.2967	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.003634054				12.92969675	0.296967271	12.63299675	
	Slope 5-10%	0.0719	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.004182409				3.133283439	0.071964768	3.061383439	
	Slope 10-20%	0.2426	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.039868424				10.57210796	0.242818537	10.32950796	
	Slope >20%	0.3879	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.101580391		0.9991		16.90404237	0.388249424	16.51614237	43.53913052
	Area 8																	
	Slope 0-5%	1.119	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.013705784				48.76417481	0.451902108	47.64517481	
	Slope 5-10%	0.3714	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.021604267				16.18499957	0.149987885	15.81359957	
	Slope 10-20%	0.5687	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.093459079				24.78300823	0.229666424	24.21430823	
	Slope >20%	0.4171	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.109227072		2.4762		18.17653022	0.168443583	17.75943022	107.9087128
	Area 9																	
	Slope 0-5%	0.6771	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.008293286				29.50690148	0.425073765	28.82980148	
	Slope 5-10%	0.1415	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.008231028				6.166336671	0.088831691	6.024836671	
	Slope 10-20%	0.3093	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.050829775				13.47878397	0.194174148	13.16948397	
	Slope >20%	0.465	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.121770771		1.5929		20.26393323	0.291920397	19.79893323	69.41595536
	Area 10																	
	Slope 0-5%	0.7131	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.008734222				31.07572212	0.655905077	30.36262212	
	Slope 5-10%	0.0585	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.003402934				2.549333535	0.053807947	2.490833535	
	Slope 10-20%	0.1527	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.025094428				6.654414203	0.140452539	6.501714203	
	Slope >20%	0.1629	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.042659051		1.0872		7.098913383	0.149834437	6.936013383	47.37838324
	Area 11																	
	Slope 0-5%	0.5134	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.011378735				22.37312542	0.51453197	21.85972542	
	Slope 5-10%	0.0728	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.007662903				3.172503955	0.072960513	3.099703955	
	Slope 10-20%	0.2617	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.0778227				11.40445447	0.262277009	11.14275447	
	Slope >20%	0.1499	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.071032326		0.9978		6.53239482	0.150230507	6.38249482	43.48247866
	Area 12																	
	Slope 0-5%	0.8128	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.009955372				35.42048372	0.315112042	34.60768372	
	Slope 5-10%	0.346	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.020126754				15.07810946	0.134139722	14.73210946	
	Slope 10-20%	0.3469	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.057008888				15.11732997	0.134488641	14.77042997	
	Slope >20%	1.0737	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.281172637		2.5794		46.7900755	0.416259595	45.7163755	112.4059987
	Area 13																	
	Slope 0-5%	0.3989	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.008841015				17.38340423	0.526392188	16.98450423	
	Slope 5-10%	0.1825	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.019209887				7.953049064	0.240828715	7.770549064	
	Slope 10-20%	0.0805	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.023938584				3.508057258	0.106228556	3.427557258	
	Slope >20%	0.0959	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.045443629		0.7578		4.179163864	0.126550541	4.083263864	33.02367441
	Area 14																	
	Slope 0-5%	0.2864	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.003507897				12.48083974	0.08604735	12.19443974	
	Slope 5-10%	0.0959	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.005578485				4.179163864	0.028812643	4.083263864	
	Slope 10-20%	0.3364	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.055283338				14.65975729	0.101069583	14.32335729	
	Slope >20%	2.6097	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.683408989		3.3284		113.7264227	0.784070424	111.1167227	145.0461836
	Area 15																	
	Slope 0-5%	0.3664	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.008120702				15.96710782	0.807048458	15.60070782	
	Slope 5-10%	0	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0				0	0	0	
	Slope 10-20%	0.012	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.003568485				0.522940212	0.026431718	0.510940212	
	Slope >20%	0.0756	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.035824175	**4.5010508**	0.454	31.6671	3.294523338	0.166519824	3.218923338	19.78457137
3	**Area 1**																	
	Slope 0-5%	1.6884	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.037420834				939.2199571	0.455204767	937.5315571	
	Slope 5-10%	0.3154	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.033198895				175.4501152	0.085034105	175.1347152	
	Slope 10-20%	0.5939	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.176610246				330.3735682	0.160119706	329.7796682	
	Slope >20%	1.1114	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.526653283		3.7091		618.2474889	0.299641422	617.1360889	2063.291129
	Area 2																	
	Slope 0-5%	0.2064	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.002528037				114.8158014	0.223739837	114.6094014	
	Slope 5-10%	0.0606	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.00352509				33.71045333	0.065691057	33.64985333	
	Slope 10-20%	0.1931	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.031733688				107.4173026	0.209322493	107.2242026	
	Slope >20%	0.4624	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.121089902		0.9225		257.222997	0.501246612	256.760597	513.1665544
	Area 3																	
	Slope 0-5%	0.1254	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.00153593				69.75727471	0.198104265	69.63187471	
	Slope 5-10%	0.03	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.001745094				16.68834323	0.047393365	16.65834323	
	Slope 10-20%	0.1213	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.019934212				67.47653447	0.191627172	67.35523447	
	Slope >20%	0.3563	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.093305216		0.633		198.2018898	0.562875197	197.8455898	352.1240422
	Area 4																	
	Slope 0-5%	0.0226	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.00027681				12.57188523	0.150466045	12.54928523	
	Slope 5-10%	0	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0				0	0	0	
	Slope 10-20%	0.0194	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.003188159				10.79179529	0.129161119	10.77239529	
	Slope >20%	0.1082	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.028334618		0.1502		60.18929125	0.720372836	60.08109125	83.55297178
	Area 5																	
	Slope 0-5%	0.3833	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.004694752				213.2213987	0.401109251	212.8380987	
	Slope 5-10%	0.1459	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.008486975				81.16097592	0.152678945	81.01507592	
	Slope 10-20%	0.188	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.030895563				104.5802843	0.196735036	104.3922843	

Slope >20%	0.2384	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.062430434	0.9556	132.6167009	0.249476769	132.3783009	531.5793597
Area 6															
Slope 0-5%	0.1175	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.001439169		65.36267766	0.142182962	65.24517766	
Slope 5-10%	0.0185	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.001076141		10.29114499	0.022386254	10.27264499	
Slope 10-20%	0.2	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.032867621		111.2556215	0.242013553	111.0556215	
Slope >20%	0.4904	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.128422335	0.8264	272.798784	0.593417231	272.308384	459.7082282
Area 7															
Slope 0-5%	0.1358	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.001663311		75.54256703	0.422001243	75.40676703	
Slope 5-10%	0.0038	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.000221045		2.113856809	0.011808577	2.110056809	
Slope 10-20%	0.0372	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.006113377		20.69354561	0.115599751	20.65634561	
Slope >20%	0.145	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.037971531	0.3218	80.66032562	0.450590429	80.51532562	179.0102951
Area 8															
Slope 0-5%	1.5033	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.018412784		836.2528793	0.507169124	834.7495793	
Slope 5-10%	0.3173	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.01845728		176.5070436	0.10704767	176.1897436	
Slope 10-20%	0.5455	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.089646435		303.4497078	0.184035626	302.9042078	
Slope >20%	0.598	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.15659983	2.9641	332.6543084	0.201747579	332.0563084	1648.863939
Area 9															
Slope 0-5%	0.0392	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.000480131		21.80610182	0.098989899	21.76690182	
Slope 5-10%	0.0001	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	5.81698E-06		0.055627811	0.000252525	0.055527811	
Slope 10-20%	0.0968	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.015907928		53.84772083	0.244444444	53.75092083	
Slope >20%	0.2599	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.068060695	0.396	144.5766802	0.656313131	144.3167802	220.2861307
Area 10															
Slope 0-5%	0.7927	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.009709183		440.961656	0.503877447	440.168956	
Slope 5-10%	0.0943	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.005485413		52.45702556	0.05994152	52.36272556	
Slope 10-20%	0.2878	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.047296506		160.0968394	0.182939232	159.8090394	
Slope >20%	0.3984	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.104330054	1.5732	221.6211981	0.2532418	221.2227981	875.1367191
Area 11															
Slope 0-5%	0.1365	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.003025316		75.9319617	0.441747573	75.7954617	
Slope 5-10%	0.0069	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.000726292		3.838318943	0.022330097	3.831418943	
Slope 10-20%	0.062	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.01843717		34.48924268	0.200647249	34.42724268	
Slope >20%	0.1036	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.049092388	0.309	57.63041196	0.335275081	57.52681196	171.8899353
Area 12															
Slope 0-5%	0.3648	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.004468159		202.9302537	0.192374624	202.5654537	
Slope 5-10%	0.1759	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.010232069		97.84931915	0.092759584	97.67341915	
Slope 10-20%	0.517	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.084962799		287.5957817	0.272636186	287.0787817	
Slope >20%	0.8386	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.219606383	1.8963	466.4948211	0.442229605	465.6562211	1054.870176
Area 13															
Slope 0-5%	0.0408	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.00090427		22.69614679	0.10151779	22.65534679	
Slope 5-10%	0.0348	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.003663036		19.35847815	0.086588704	19.32367815	
Slope 10-20%	0.1562	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.046449773		86.89064042	0.388653894	86.73444042	
Slope >20%	0.1701	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.080604394	0.4019	94.62290612	0.423239612	94.45280612	223.5681715
Area 14															
Slope 0-5%	0.8678	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.019233475		482.7381419	0.513916854	481.8703419	
Slope 5-10%	0.1449	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.015252124		80.60469781	0.085810731	80.45979781	
Slope 10-20%	0.1855	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.055162823		103.189589	0.109854317	103.004089	
Slope >20%	0.4904	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.232383273	1.6886	272.798784	0.290418098	272.308384	939.3312127
Area 15															
Slope 0-5%	0.9862	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.012079218		548.6014698	0.258716126	547.6152698	
Slope 5-10%	0.0835	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.004857179		46.44922199	0.021905087	46.36572199	
Slope 10-20%	0.3967	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.065192925		220.6755253	0.104068837	220.2788253	
Slope >20%	2.3455	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.614222242	3.8119	1304.750302	0.61530995	1302.404802	2120.476519
Area 16															
Slope 0-5%	0.5971	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.013233819		332.1536581	0.58821791	331.5565581	
Slope 5-10%	0.1606	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.0169047		89.3382641	0.158211014	89.1776641	
Slope 10-20%	0.1583	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.047074258		88.05882445	0.155945227	87.90052445	
Slope >20%	0.0991	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.046959997	1.0151	55.12716047	0.09762585	55.02806047	564.6779071
Area 17															
Slope 0-5%	0.6855	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.008396171		381.3286428	0.519436236	380.6431428	
Slope 5-10%	0.0629	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.003658881		34.98989298	0.047662348	34.92699298	
Slope 10-20%	0.1984	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.03260468		110.3655766	0.150337198	110.1671766	
Slope >20%	0.3729	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.097652302	1.3197	207.4361064	0.282564219	207.0632064	734.1202188
Area 18															
Slope 0-5%	0.4202	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.005146712		233.7480609	0.48337743	233.3278609	
Slope 5-10%	0.2141	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.012454156		119.0991429	0.246290118	118.8850429	
Slope 10-20%	0.182	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.029909535		101.2426156	0.209363856	101.0606156	
Slope >20%	0.053	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.013879249	0.8693	29.48273971	0.060968595	29.42973971	483.572559
Area 19															
Slope 0-5%	0.9161	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.020303972		509.6063745	0.748325437	508.6902745	
Slope 5-10%	0.0531	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.005589288		29.53836752	0.043375265	29.48526752	
Slope 10-20%	0.1488	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.044249208		82.77418243	0.121548767	82.62538243	

	Slope >20%	0.1062	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.050324436			1.2242		59.07673504	0.086750531	58.97053504	680.9956595
	Area 20																		
	Slope 0-5%	0.1055	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.00129219					58.68734036	0.761732852	58.58184036	
	Slope 5-10%	0.0207	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.001204115					11.51495683	0.149458484	11.49425683	
	Slope 10-20%	0.0083	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.001364006					4.617108294	0.059927798	4.608808294	
	Slope >20%	0.004	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.00104749			0.1385		2.225112431	0.028880866	2.221112431	77.04451792
	Area 21																		
	Slope 0-5%	0.2541	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.005631742					141.3502672	0.634615385	141.0961672	
	Slope 5-10%	0.0598	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.006294527					33.26543084	0.149350649	33.20563084	
	Slope 10-20%	0.054	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.01605818					30.03901782	0.134865135	29.98501782	
	Slope >20%	0.0325	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.015400604	**3.968943853**	0.4004		25.5268	18.0790385	0.081168831	18.0465385	222.7337543
4	**Area 1**																		
	Slope 0-5%	1.188	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.014550913					17.06651343	0.403450384	15.87851343	
	Slope 5-10%	0.1683	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.009789979					2.41775607	0.057155471	2.24945607	
	Slope 10-20%	0.3024	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.049695842					4.344203419	0.102696461	4.041803419	
	Slope >20%	1.2859	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.336742008			2.9446		18.47292056	0.436697684	17.18702056	42.30139348
	Area 2																		
	Slope 0-5%	2.5951	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.057516468					37.28056314	0.949473145	34.68546314	
	Slope 5-10%	0.1266	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.013325872					1.818704209	0.046319333	1.692104209	
	Slope 10-20%	0.0087	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.002587151					0.124982043	0.003183082	0.116282043	
	Slope >20%	0.0028	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.001326821			2.7332		0.040224106	0.00102444	0.037424106	39.2644735
	Area 3																		
	Slope 0-5%	1.3112	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.016059897					18.83637408	0.490094939	17.52517408	
	Slope 5-10%	0.2511	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.014606439					3.607240339	0.093855124	3.356140339	
	Slope 10-20%	0.4336	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.071257001					6.228990088	0.162069223	5.795390088	
	Slope >20%	0.6795	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.177942449	**0.765400842**	2.6754		8.3532	9.761528516	0.253980713	9.082028516	38.43413303
5	**Area 4**																		
	Slope 0-5%	1.2918	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.028630794					34.3694722	0.893360996	33.0776722	
	Slope 5-10%	0.1114	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.011725925					2.963894723	0.077040111	2.852494723	
	Slope 10-20%	0.0235	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.006988282					0.625238115	0.016251729	0.601738115	
	Slope >20%	0.0193	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.00914559			1.446		0.51349343	0.013347165	0.49419343	38.47209846
	Area 5																		
	Slope 0-5%	2.2292	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.027303784					59.3098215	0.256716762	57.0806215	
	Slope 5-10%	0.1105	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.006427764					2.939949433	0.012725284	2.829449433	
	Slope 10-20%	1.1824	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.194313373					31.45878923	0.136166292	30.27638923	
	Slope >20%	5.1614	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	1.351629366			8.6835		137.3235747	0.594391662	132.1621747	231.0321349
	Area 6																		
	Slope 0-5%	0.0314	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.000695934					0.835424545	0.09570253	0.804024545	
	Slope 5-10%	0.0319	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.003357783					0.848727483	0.097226455	0.816827483	
	Slope 10-20%	0.1634	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.048590864					4.347400338	0.498018897	4.184000338	
	Slope >20%	0.1014	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.048049886			0.3281		2.69783595	0.309052118	2.59643595	8.729388317
	Area 7																		
	Slope 0-5%	0.1224	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.002712811					3.256559372	0.250562948	3.134159372	
	Slope 5-10%	0.019	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.001999933					0.505511667	0.038894575	0.486511667	
	Slope 10-20%	0.0647	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.019240079					1.721400256	0.132446264	1.656700256	
	Slope >20%	0.2824	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.133819405			0.4885		7.513499728	0.578096213	7.231099728	12.99697102
	Area 8																		
	Slope 0-5%	0.3886	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.008612732					10.33904389	0.331485115	9.950443889	
	Slope 5-10%	0.0211	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.002220979					0.561384009	0.017998806	0.540284009	
	Slope 10-20%	0.1842	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.054776237					4.900802584	0.157127015	4.716602584	
	Slope >20%	0.5784	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.274083371			1.1723		15.38883939	0.493389064	14.81043939	31.19006987
	Area 9																		
	Slope 0-5%	2.7681	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.033904363					73.64772874	0.234945128	70.87962874	
	Slope 5-10%	0.8022	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.046663821					21.34323471	0.06808749	20.54103471	
	Slope 10-20%	2.5318	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.416071209					67.36075995	0.21488894	64.82895995	
	Slope >20%	5.6798	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	1.487384134			11.7819		151.1160614	0.482078442	145.4362614	313.4677848
	Area 10																		
	Slope 0-5%	1.1832	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.026223839					31.48007393	0.65136251	30.29687393	
	Slope 5-10%	0.3828	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.040293395					10.1847298	0.21073493	9.801929801	
	Slope 10-20%	0.1868	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.055549409					4.969977865	0.102835122	4.783177865	
	Slope >20%	0.0637	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.030185185			1.8165		1.694794379	0.035067437	1.631094379	48.32957597
	Area 11																		
	Slope 0-5%	0.3045	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.00372959					8.101489614	0.39048474	7.796989614	
	Slope 5-10%	0.1425	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.008289198					3.791337504	0.182739164	3.648837504	
	Slope 10-20%	0.2114	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.034741075					5.624482445	0.271095153	5.413082445	
	Slope >20%	0.1214	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.031791337			0.7798		3.229953495	0.155680944	3.108553495	20.74726306
	Area 12																		
	Slope 0-5%	0.4734	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.010492195					12.59522228	0.634669527	12.12182228	
	Slope 5-10%	0.0994	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.01046281					2.644624196	0.133261831	2.545224196	
	Slope 10-20%	0.0965	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.028696563					2.567467152	0.129373911	2.470967152	

Slope >20%	0.0766	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.03629804		0.7459		2.038010195	0.102694731	1.961410195	19.84532382
Area 13																	
Slope 0-5%	0.6494	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.007954009				17.27785667	0.453396635	16.62845667	
Slope 5-10%	0.1365	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.007940179				3.631702241	0.095301264	3.495202241	
Slope 10-20%	0.4554	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.074839572				12.11631649	0.31795015	11.66091649	
Slope >20%	0.191	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.050017671		1.4323		5.08172255	0.133351951	4.89072255	38.10759795
Area 14																	
Slope 0-5%	0.0219	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.00048538				0.582668711	0.184343434	0.560768711	
Slope 5-10%	0.0733	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.007715533				1.9502108	0.617003367	1.8769108	
Slope 10-20%	0.0173	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.005144565				0.460281676	0.145622896	0.442981676	
Slope >20%	0.0063	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.002985348		0.1188		0.167617027	0.053030303	0.161317027	3.160778214
Area 15																	
Slope 0-5%	0.8079	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.017905882				21.49488821	0.659941186	20.68698821	
Slope 5-10%	0.112	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.011789081				2.979858249	0.091488319	2.867858249	
Slope 10-20%	0.1693	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.050345369				4.504375014	0.138294396	4.335075014	
Slope >20%	0.135	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.063971741		1.2242		3.591793425	0.110276099	3.456793425	32.5709149
Area 16																	
Slope 0-5%	0.6664	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.008162229				17.73015658	0.597079115	17.06375658	
Slope 5-10%	0.1529	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.008894164				4.068038627	0.136994893	3.915138627	
Slope 10-20%	0.2198	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.036121515				5.847971814	0.196935758	5.628171814	
Slope >20%	0.077	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.020164192		1.1161		2.048652546	0.068990234	1.971652546	29.69481957
Area 17																	
Slope 0-5%	11.1025	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.135986124				295.3917519	0.784523633	284.2892519	
Slope 5-10%	1.2694	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.073840755				33.77350055	0.089698203	32.50410055	
Slope 10-20%	1.1628	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.191092346				30.93731403	0.082165646	29.77451403	
Slope >20%	0.6172	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.161627784		14.1519		16.42114742	0.043612518	15.80394742	376.5237139
Area 18																	
Slope 0-5%	5.4906	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.121690849				146.0822295	0.788550748	140.5916295	
Slope 5-10%	0.4638	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.048819427				12.33980586	0.066610177	11.87600586	
Slope 10-20%	0.4787	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.142352795				12.73623343	0.06875009	12.25753343	
Slope >20%	0.5298	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.251053544		6.9629		14.09579375	0.076088986	13.56599375	185.2540625
Area 19																	
Slope 0-5%	6.3419	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.140558626				168.7318128	0.903005795	162.3899128	
Slope 5-10%	0.3299	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.03472516				8.777278896	0.046973559	8.447378896	
Slope 10-20%	0.2865	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.085197568				7.622583824	0.040793951	7.336083824	
Slope >20%	0.0648	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.030706436		7.0231		1.724060844	0.009226695	1.659260844	186.8557363
Area 20																	
Slope 0-5%	0.6919	71	0.2772	0.3457401	1	0.9	0.16	0.25	0.95	0.00847456				18.40860645	0.664840972	17.71670645	
Slope 5-10%	0.235	71	0.2772	1.6420015	1	0.9	0.16	0.25	0.95	0.013669905				6.252381147	0.225809551	6.017381147	
Slope 10-20%	0.0904	71	0.2772	4.6388912	1	0.9	0.16	0.25	0.95	0.014856164				2.405171301	0.08686461	2.314771301	
Slope >20%	0.0234	71	0.2772	7.3920692	1	0.9	0.16	0.25	0.95	0.006127819		1.0407		0.622577527	0.022484866	0.599177527	27.68873643
Area 21																	
Slope 0-5%	1.6663	71	0.5016	0.3457401	1	0.9	0.16	0.25	0.95	0.036931021				44.33337322	0.519533564	42.66707322	
Slope 5-10%	0.5562	71	0.5016	1.6420015	1	0.9	0.16	0.25	0.95	0.058545419				14.79818891	0.173416893	14.24198891	
Slope 10-20%	0.6075	71	0.5016	4.6388912	1	0.9	0.16	0.25	0.95	0.180654529				16.16307041	0.189411655	15.55557041	
Slope >20%	0.3773	71	0.5016	7.3920692	1	0.9	0.16	0.25	0.95	0.17878917	**6.825237487**	3.2073	63.5198	10.03839748	0.117637889	9.661097476	85.33303002

TOTAL 16.641 tonnes

138.7981 Total Area (ha)

K Factor

Peat	Clay	Silt	Sand	Nomograph Value	Correction Factor Peat (4% Organic) Sand/Gravels (0% Organic)	Value	Metric Convert K Factor
Sample 1	16	71	13				
Sample 2	15	66	19				
Average	**15.5**	**68.5**	**16**	0.52	-0.14	0.38	0.5016
Sand Soils							
Sample 1	1	6	93				
Sample 2	2	8	90				
Average	**1.5**	**7**	**91.5**	0.15	0.06	0.21	0.2772
Gravels	10	20	70	0.2	0.1	0.3	0.396

Sitename: M2PP Paraparaumu
Coordinate system: NZMG
Easting: 2679016
Northing: 6030188

Rainfall depths (mm)

		Duration									
ARI (y)	aep	10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
1.58	0.633	7	9.9	12.2	17.5	24.2	40.6	56.3	78	90.9	99.4
2	0.5	7.5	10.7	13.2	18.9	26.1	43.5	60	82.8	96.5	105.6
5	0.2	9.6	13.7	16.8	24	32.8	53.6	73.1	99.6	116.1	127
10	0.1	11.2	16	19.7	28.2	38.1	61.5	83.2	112.6	131.2	143.6
20	0.05	13	18.6	23	32.8	44.1	70.3	94.3	126.6	147.6	161.5
30	0.033	14.2	20.4	25.1	35.8	47.9	75.8	101.3	135.4	157.9	172.7
40	0.025	15.1	21.6	26.7	38.1	50.8	80	106.6	142	165.6	181.2
50	0.02	15.9	22.7	28	40	53.2	83.4	110.9	147.4	171.8	187.9
60	0.017	16.5	23.6	29.1	41.6	55.2	86.3	114.5	151.8	177	193.7
80	0.012	17.6	25.1	30.9	44.2	58.5	91	120.4	159.2	185.6	203
100	0.01	18.4	26.3	32.4	46.4	61.2	94.9	125.2	165.1	192.5	210.6

Extreme rainfall assessment with climate change

Projected temperature change: 2.0 ° C
Rainfall depths (mm)

		Duration									
ARI (y)	aep	10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
1.58	0.633	8.1	11.4	14	19.8	27.2	44.9	61.7	84.7	97.8	106.4
2	0.5	8.7	12.3	15.1	21.4	29.3	48.1	65.8	89.9	103.8	113
5	0.2	11.1	15.8	19.3	27.4	37.2	60.1	81.6	110.4	127.7	139.2
10	0.1	13	18.5	22.7	32.4	43.6	69.9	94	126.8	147.2	160.5
20	0.05	15.1	21.6	26.6	37.9	50.8	80.7	108.1	144.8	168.6	184.1
30	0.033	16.5	23.7	29.1	41.5	55.6	87.9	117.5	157.1	182.5	199.3
40	0.025	17.5	25.1	31	44.2	58.9	92.8	123.7	164.7	191.8	209.6
50	0.02	18.4	26.3	32.5	46.4	61.7	96.7	128.6	171	199.3	218
60	0.017	19.1	27.4	33.8	48.3	64	100.1	132.8	176.1	205.3	224.7
80	0.012	20.4	29.1	35.8	51.3	67.9	105.6	139.7	184.7	215.3	235.5
100	0.01	21.3	30.5	37.6	53.8	71	110.1	145.2	191.5	223.3	244.3

Sitename: M2PP PekaPeka
Coordinate system: NZMG
Easting: 2685968
Northing: 6038488

Rainfall depths (mm)

		Duration									
ARI (y)	aep	10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
1.58	0.633	7.7	10.7	13	18.3	24.7	39.9	54	73.2	88	98
2	0.5	8.3	11.6	14.1	19.7	26.5	42.7	57.6	77.7	93.5	104.1
5	0.2	10.4	14.5	17.7	24.8	33.1	52.4	70.1	93.7	112.6	125.4
10	0.1	12.1	16.9	20.6	28.8	38.3	60.1	79.8	106	127.4	141.9
20	0.05	14	19.6	23.9	33.4	44.1	68.4	90.4	119.3	143.4	159.8
30	0.033	15.3	21.3	26	36.3	47.8	73.8	97.1	127.7	153.5	171
40	0.025	16.2	22.6	27.6	38.5	50.6	77.8	102.1	134	161.1	179.4
50	0.02	16.9	23.7	28.8	40.3	52.8	81.1	106.2	139	167.2	186.2
60	0.017	17.6	24.6	29.9	41.9	54.8	83.8	109.6	143.3	172.3	192
80	0.012	18.7	26.1	31.8	44.4	58	88.3	115.2	150.3	180.7	201.3
100	0.01	19.5	27.3	33.2	46.5	60.5	92	119.8	156	187.5	208.9

Extreme rainfall assessment with climate change

Projected temperature change: 2.0 ° C
Rainfall depths (mm)

		Duration									
ARI (y)	aep	10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
1.58	0.633	8.9	12.3	14.9	20.8	27.8	44.1	59.2	79.5	94.7	104.9
2	0.5	9.6	13.4	16.1	22.3	29.8	47.2	63.1	84.4	100.6	111.4
5	0.2	12.1	16.7	20.3	28.3	37.5	58.8	78.2	103.8	123.9	137.4
10	0.1	14	19.5	23.7	33.1	43.8	68.3	90.2	119.4	142.9	158.6
20	0.05	16.2	22.7	27.6	38.5	50.8	78.5	103.6	136.5	163.8	182.2
30	0.033	17.7	24.7	30.2	42.1	55.4	85.6	112.6	148.1	177.4	197.3
40	0.025	18.8	26.2	32	44.7	58.7	90.2	118.4	155.4	186.6	207.6
50	0.02	19.6	27.5	33.4	46.7	61.2	94.1	123.2	161.2	194	216
60	0.017	20.4	28.5	34.7	48.6	63.6	97.2	127.1	166.2	199.9	222.7
80	0.012	21.7	30.3	36.9	51.5	67.3	102.4	133.6	174.3	209.6	233.5
100	0.01	22.6	31.7	38.5	53.9	70.2	106.7	139	181	217.5	242.3

Rainfall Erosion Index (J/ha) - Based on NIWA HIRDS Data

R = 0.00828p2.2*1.7

48.1 **p = 6 hour duration 2 year storm**

R Factor	71

LS Equation

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%

Slope (Av/Mid Slope)	Area	S2	S2+10000		L (m)	Weight L	*m*	LS
Area 1								
2.5	6.6	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	1.44	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.54	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.36	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 2								
2.5	0.5122	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0592	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0596	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1002	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 1								
2.5	4.426	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.689	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	1.5453	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	2.7361	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 2								
2.5	0.5863	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.2276	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.4838	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	1.8145	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 3								
2.5	2.8566	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0312	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1189	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1554	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 4								
2.5	0.3701	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0062	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0343	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.2649	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 5								
2.5	0.0402	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0066	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0646	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.2026	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 6								
2.5	0.1491	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.323	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1127	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1493	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 7								
2.5	0.2967	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0719	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.2426	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.3879	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 8								
2.5	1.119	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.3714	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.5687	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.4171	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 9								
2.5	0.6771	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084

7.5	0.1415	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.3093	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.465	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 10								
2.5	0.7131	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0585	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1527	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1629	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 11								
2.5	0.5134	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0728	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.2617	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1499	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 12								
2.5	0.8128	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.346	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.3469	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	1.0737	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 13								
2.5	0.3989	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1825	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0805	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0959	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 14								
2.5	0.2864	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0959	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.3364	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	2.6097	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 15								
2.5	0.3664	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.012	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0756	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 1								
2.5	1.6884	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.3154	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.5939	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	1.1114	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 2								
2.5	0.2064	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0606	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1931	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.4624	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 3								
2.5	0.1254	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.03	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1213	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.3563	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 4								
2.5	0.0226	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0194	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1082	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 5								
2.5	0.3833	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1459	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.188	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.2384	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 6								
2.5	0.1175	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0185	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.2	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.4904	400	10400	101.9803903	100	30.48	0.5	7.392069161

Area 7								
2.5	0.1358	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0038	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0372	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.145	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 8								
2.5	1.5033	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.3173	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.5455	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.598	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 9								
2.5	0.0392	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0001	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0968	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.2599	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 10								
2.5	0.7927	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0943	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.2878	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.3984	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 11								
2.5	0.1365	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0069	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.062	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1036	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 12								
2.5	0.3648	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1759	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.517	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.8386	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 13								
2.5	0.0408	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0348	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1562	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1701	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 14								
2.5	0.8678	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1449	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1855	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.4904	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 15								
2.5	0.9862	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0835	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.3967	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	2.3455	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 16								
2.5	0.5971	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1606	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1583	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0991	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 17								
2.5	0.6855	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0629	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1984	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.3729	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 18								
2.5	0.4202	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.2141	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.182	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.053	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 19								
2.5	0.9161	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0531	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523

15	0.1488	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1062	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 20								
2.5	0.1055	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0207	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0083	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.004	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 21								
2.5	0.2541	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0598	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.054	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0325	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 1								
2.5	1.188	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1683	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.3024	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	1.2859	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 2								
2.5	2.5951	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1266	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0087	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0028	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 3								
2.5	1.3112	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.2511	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.4336	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.6795	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 4								
2.5	1.2918	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1114	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0235	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0193	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 5								
2.5	2.2292	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1105	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	1.1824	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	5.1614	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 6								
2.5	0.0314	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0319	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1634	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1014	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 7								
2.5	0.1224	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.019	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0647	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.2824	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 8								
2.5	0.3886	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0211	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1842	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.5784	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 9								
2.5	2.7681	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.8022	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	2.5318	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	5.6798	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 10								
2.5	1.1832	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.3828	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1868	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0637	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 11								

2.5	0.3045	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1425	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.2114	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.1214	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 12								
2.5	0.4734	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0994	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0965	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0766	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 13								
2.5	0.6494	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1365	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.4554	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.191	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 14								
2.5	0.0219	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.0733	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0173	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0063	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 15								
2.5	0.8079	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.112	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.1693	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.135	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 16								
2.5	0.6664	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.1529	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.2198	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.077	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 17								
2.5	11.1025	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	1.2694	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	1.1628	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.6172	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 18								
2.5	5.4906	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.4638	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.4787	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.5298	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 19								
2.5	6.3419	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.3299	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.2865	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0648	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 20								
2.5	0.6919	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.235	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.0904	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.0234	400	10400	101.9803903	100	30.48	0.5	7.392069161
Area 21								
2.5	1.6663	6.25	10006.25	100.0312451	100	30.48	0.3	0.345740084
7.5	0.5562	56.25	10056.25	100.2808556	100	30.48	0.5	1.642001523
15	0.6075	225	10225	101.1187421	100	30.48	0.5	4.638891224
20	0.3773	400	10400	101.9803903	100	30.48	0.5	7.392069161

USLE Calculation M2PP Pre Earthworks - Whole Catchment Area

Catchment 1	Whareroa	1600
Catchment 2	Wharemauku	1380
Catchment 3	Waikanae	14200
Catchment 4	Waimeha	120
Catchment 5	Ngarara	1690
		Total Catchment Area (ha)

Assumptions

R factor based on NIWA HIRDS Data
K Factor based on soil samples and soils /gravels to be utilised - grass cover
LS Factor based on different slopes with a uniform 100m slope length
C and P Factors based on a pastoral surface
Duration - for purposes of risk assessment has been based on 2 months total for each stage to provide comparison with earthworks scenario
Sediment Deilivery Ratio - based on a high infiltration rate and irregular surface capturing flow and sediment - 0.25 assumed figure
Efficiency - based on 0% as no control measures in place with existing situation
Assume pre earthworkls surface is grass environment in all areas
Catchment Characteristics are based on project footprint and pro rata of specific areas (soil types and slope classes)

Pro Rata Sub Catchment Split		Footprint Hectares	Total Catchment Footprint Area	r	k	ls	c	p	time	sdr	sed eff.	Total Catchment Yield	Overall Catchment Yield	Area	Project Footprint Area	Pro Rata Total Catchment Area	Slope % Total Catchment	Total Catchment Less Project Footprint	Pro Rata Total Catchment Area
1	**Area 1**																		
	Slope 0-5%	6.66	1095.034528	71	0.132	0.3457401	0.02	1	0.16	0.25	0	2.838571335				1095.034528	0.74	1088.374528	
	Slope 5-10%	1.44	236.7642223	71	0.132	1.6420015	0.02	1	0.16	0.25	0	2.914821061				236.7642223	0.16	235.3242223	
	Slope 10-20%	0.54	88.78658336	71	0.132	4.6388912	0.02	1	0.16	0.25	0	3.088046277				88.78658336	0.06	88.24658336	
	Slope >20%	0.36	59.19105557	71	0.132	7.3920692	0.02	1	0.16	0.25	0	3.280532717		9		59.19105557	0.04	58.83105557	1479.776389
	Area 2																		
	Slope 0-5%	0.5122	84.21571851	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.829561817				84.21571851	0.700492341	83.70351851	
	Slope 5-10%	0.0592	9.73364025	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.455359824				9.73364025	0.080962801	9.67444025	
	Slope 10-20%	0.0596	9.799408089	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	1.295149483				9.799408089	0.081509847	9.739808089	
	Slope >20%	0.1002	16.4748438	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	3.469710104	**18.17175262**	0.7312	**9.7312**	16.4748438	0.137035011	16.3746438	120.2236107
2	**Area 1**																		
	Slope 0-5%	4.426	192.9147369	71	0.132	0.3457401	0.02	1	0.16	0.25	0	0.500077603				192.9147369	0.471121708	188.4887369	
	Slope 5-10%	0.689	30.03123673	71	0.132	1.6420015	0.02	1	0.16	0.25	0	0.369716676				30.03123673	0.073340004	29.34223673	
	Slope 10-20%	1.5453	67.35452847	71	0.132	4.6388912	0.02	1	0.16	0.25	0	2.342627602				67.35452847	0.16448811	65.80922847	
	Slope >20%	2.7361	119.2575716	71	0.132	7.3920692	0.02	1	0.16	0.25	0	6.609585883		9.3964		119.2575716	0.291241777	116.5214716	409.4796176
	Area 2																		
	Slope 0-5%	0.5863	25.54998721	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.059608089				25.54998721	0.188387636	24.96368721	
	Slope 5-10%	0.2276	9.918432695	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.109895873				9.918432695	0.073131547	9.690832695	
	Slope 10-20%	0.4838	21.08320623	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.659956974				21.08320623	0.155452734	20.59940623	
	Slope >20%	1.8145	79.07291795	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	3.944196681		3.1122		79.07291795	0.583028083	77.25841795	135.6245441
	Area 3																		
	Slope 0-5%	2.8566	124.4859176	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.290425492				124.4859176	0.90338699	121.6293176	
	Slope 5-10%	0.0312	1.359644552	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.015064812				1.359644552	0.009866861	1.328444552	
	Slope 10-20%	0.1189	5.181465938	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.162192816				5.181465938	0.037601594	5.062565938	
	Slope >20%	0.1554	6.772075751	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.337794524		3.1621		6.772075751	0.049144556	6.616675751	137.7991038
	Area 4																		
	Slope 0-5%	0.3701	16.12834772	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.037627415				16.12834772	0.547890452	15.75824772	
	Slope 5-10%	0.0062	0.270185776	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.002993649				0.270185776	0.009178386	0.263985776	
	Slope 10-20%	0.0343	1.49473744	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.046789012				1.49473744	0.050777202	1.46043744	
	Slope >20%	0.2649	11.54390519	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.575815762		0.6755		11.54390519	0.39215396	11.27900519	29.43717612
	Area 5																		
	Slope 0-5%	0.0402	1.751849712	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.004087063				1.751849712	0.128025478	1.711649712	
	Slope 5-10%	0.0066	0.287617117	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.003186787				0.287617117	0.021019108	0.281017117	
	Slope 10-20%	0.0646	2.815161477	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.08812158				2.815161477	0.205732484	2.750561477	
	Slope >20%	0.2026	8.828973919	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.440393633		0.314		8.828973919	0.64522293	8.626373919	13.68360222
	Area 6																		
	Slope 0-5%	0.1491	6.497532139	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.015158734				6.497532139	0.203105844	6.348432139	
	Slope 5-10%	0.323	14.07580738	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.155959433				14.07580738	0.439994551	13.75280738	
	Slope 10-20%	0.1127	4.911280161	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.153735326				4.911280161	0.153521319	4.798580161	
	Slope >20%	0.1493	6.506247809	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.324534894		0.7341		6.506247809	0.203378286	6.356947809	31.99086749
	Area 7																		
	Slope 0-5%	0.2967	12.92969675	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.030164967				12.92969675	0.296967271	12.63299675	
	Slope 5-10%	0.0719	3.133283439	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.034716666				3.133283439	0.071964768	3.061383439	

	Slope 10-20%	0.2426	10.57210796	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.330933365					10.57210796	0.242818537	10.32950796	
	Slope >20%	0.3879	16.90404237	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.843182085		0.9991			16.90404237	0.388249424	16.51614237	43.53913052
	Area 8																			
	Slope 0-5%	1.119	48.76417481	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.11376676					48.76417481	0.451902108	47.64517481	
	Slope 5-10%	0.3714	16.18499957	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.179329205					16.18499957	0.149987885	15.81359957	
	Slope 10-20%	0.5687	24.78300823	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.77577001					24.78300823	0.229666424	24.21430823	
	Slope >20%	0.4171	18.17653022	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.906654415		2.4762			18.17653022	0.168443583	17.75943022	107.9087128
	Area 9																			
	Slope 0-5%	0.6771	29.50690148	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.068839565					29.50690148	0.425073765	28.82980148	
	Slope 5-10%	0.1415	6.166336671	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.068322786					6.166336671	0.088831691	6.024836671	
	Slope 10-20%	0.3093	13.47878397	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.421919578					13.47878397	0.194174148	13.16948397	
	Slope >20%	0.465	20.26393323	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	1.010775121		1.5929			20.26393323	0.291920397	19.79893323	69.41595536
	Area 10																			
	Slope 0-5%	0.7131	31.07572212	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.072499621					31.07572212	0.655905077	30.36262212	
	Slope 5-10%	0.0585	2.549333535	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.028246523					2.549333535	0.053807947	2.490833535	
	Slope 10-20%	0.1527	6.654414203	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.208299772					6.654414203	0.140452539	6.501714203	
	Slope >20%	0.1629	7.098913383	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.354097349		1.0872			7.098913383	0.149834437	6.936013383	47.37838324
	Area 11																			
	Slope 0-5%	0.5134	22.37312542	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.220385112					22.37312542	0.51453197	21.85972542	
	Slope 5-10%	0.0728	3.172503955	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.148416297					3.172503955	0.072960513	3.099703955	
	Slope 10-20%	0.2617	11.40445447	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	1.507282192					11.40445447	0.262277009	11.14275447	
	Slope >20%	0.1499	6.53239482	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	1.375765172		0.9978			6.53239482	0.150230507	6.38249482	43.48247866
	Area 12																			
	Slope 0-5%	0.8128	35.42048372	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.082635945					35.42048372	0.315112042	34.60768372	
	Slope 5-10%	0.346	15.07810946	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.167064903					15.07810946	0.134139722	14.73210946	
	Slope 10-20%	0.3469	15.11732997	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.473210157					15.11732997	0.134488641	14.77042997	
	Slope >20%	1.0737	46.7900755	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	2.33391236		2.5794			46.7900755	0.416259595	45.7163755	112.4059987
	Area 13																			
	Slope 0-5%	0.3989	17.38340423	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.171234167					17.38340423	0.526392188	16.98450423	
	Slope 5-10%	0.1825	7.953049064	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.372060085					7.953049064	0.240828715	7.770549064	
	Slope 10-20%	0.0805	3.508057258	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.463646223					3.508057258	0.106228556	3.427557258	
	Slope >20%	0.0959	4.179163864	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.880159306		0.7578			4.179163864	0.126550541	4.083263864	33.02367441
	Area 14																			
	Slope 0-5%	0.2864	12.48083974	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.029117784					12.48083974	0.08604735	12.19443974	
	Slope 5-10%	0.0959	4.179163864	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.046304983					4.179163864	0.028812643	4.083263864	
	Slope 10-20%	0.3364	14.65975729	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.45888699					14.65975729	0.101069583	14.32335729	
	Slope >20%	2.6097	113.7264227	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	5.672730823		3.3284			113.7264227	0.784070424	111.1167227	145.0461836
	Area 15																			
	Slope 0-5%	0.3664	15.96710782	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.157283025					15.96710782	0.807048458	15.60070782	
	Slope 5-10%	0	0	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0					0	0	0	
	Slope 10-20%	0.012	0.522940212	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.069114965					0.522940212	0.026431718	0.510940212	
	Slope >20%	0.0756	3.294523338	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.693848212	**38.0201228**	0.454	**31.6671**		3.294523338	0.166519824	3.218923338	19.78457137
3	**Area 1**																			
	Slope 0-5%	1.6884	939.2199571	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	9.251729111					939.2199571	0.455204767	937.5315571	
	Slope 5-10%	0.3154	175.4501152	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	8.207919281					175.4501152	0.085034105	175.1347152	
	Slope 10-20%	0.5939	330.3735682	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	43.6641838					330.3735682	0.160119706	329.7796682	
	Slope >20%	1.1114	618.2474889	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	130.206974		3.7091			618.2474889	0.299641422	617.1360889	2063.291129
	Area 2																			
	Slope 0-5%	0.2064	114.8158014	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.267865123					114.8158014	0.223739837	114.6094014	
	Slope 5-10%	0.0606	33.71045333	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.373510594					33.71045333	0.065691057	33.64985333	
	Slope 10-20%	0.1931	107.4173026	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	3.362429659					107.4173026	0.209322493	107.2242026	
	Slope >20%	0.4624	257.222997	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	12.83041169		0.9225			257.222997	0.501246612	256.760597	513.1665544
	Area 3																			
	Slope 0-5%	0.1254	69.75727471	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.162743636					69.75727471	0.198104265	69.63187471	
	Slope 5-10%	0.03	16.68834323	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.184906235					16.68834323	0.047393365	16.65834323	
	Slope 10-20%	0.1213	67.47653447	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	2.112183934					67.47653447	0.191627172	67.35523447	
	Slope >20%	0.3563	198.2018898	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	9.886409357		0.633			198.2018898	0.562875197	197.8455898	352.1240422
	Area 4																			
	Slope 0-5%	0.0226	12.57188523	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.029330193					12.57188523	0.150466045	12.54928523	
	Slope 5-10%	0	0	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0					0	0	0	
	Slope 10-20%	0.0194	10.79179529	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.337810126					10.79179529	0.129161119	10.77239529	
	Slope >20%	0.1082	60.18929125	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	3.00227194		0.1502			60.18929125	0.720372836	60.08109125	83.55297178
	Area 5																			
	Slope 0-5%	0.3833	213.2213987	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.49744526					213.2213987	0.401109251	212.8380987	
	Slope 5-10%	0.1459	81.16097592	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.899260656					81.16097592	0.152678945	81.01507592	
	Slope 10-20%	0.188	104.5802843	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	3.273623904					104.5802843	0.196735036	104.3922843	
	Slope >20%	0.2384	132.6167009	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	6.614987344		0.9556			132.6167009	0.249476769	132.3783009	531.5793597
	Area 6																			
	Slope 0-5%	0.1175	65.36267766	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.152491046					65.36267766	0.142182962	65.24517766	
	Slope 5-10%	0.0185	10.29114499	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.114025511					10.29114499	0.022386254	10.27264499	
	Slope 10-20%	0.2	111.2556215	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	3.482578622					111.2556215	0.242013553	111.0556215	
	Slope >20%	0.4904	272.798784	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	13.60733974		0.8264			272.798784	0.593417231	272.308384	459.7082282
	Area 7																			
	Slope 0-5%	0.1358	75.54256703	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.176240716					75.54256703	0.422001243	75.40676703	

	Slope 5-10%	0.0038	2.113856809	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.023421456				2.113856809	0.011808577	2.110056809		
	Slope 10-20%	0.0372	20.69354561	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.647759624				20.69354561	0.115599751	20.65634561		
	Slope >20%	0.145	80.66032562	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	4.023377369		0.3218		80.66032562	0.450590429	80.51532562	179.0102951	
	Area 8																			
	Slope 0-5%	1.5033	836.2528793	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	1.950976935				836.2528793	0.507169124	834.7495793		
	Slope 5-10%	0.3173	176.5070436	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	1.955691611				176.5070436	0.10704767	176.1897436		
	Slope 10-20%	0.5455	303.4497078	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	9.49873319				303.4497078	0.184035626	302.9042078		
	Slope >20%	0.598	332.6543084	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	16.59296322		2.9641		332.6543084	0.201747579	332.0563084	1648.863939	
	Area 9																			
	Slope 0-5%	0.0392	21.80610182	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.050873609				21.80610182	0.098989899	21.76690182		
	Slope 5-10%	0.0001	0.055627811	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.000616354				0.055627811	0.000252525	0.055527811		
	Slope 10-20%	0.0968	53.84772083	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	1.685568053				53.84772083	0.244444444	53.75092083		
	Slope >20%	0.2599	144.5766802	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	7.211557092		0.396		144.5766802	0.656313131	144.3167802	220.2861307	
	Area 10																			
	Slope 0-5%	0.7927	440.961656	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	1.028762999				440.961656	0.503877447	440.168956		
	Slope 5-10%	0.0943	52.45702556	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.581221932				52.45702556	0.05994152	52.36272556		
	Slope 10-20%	0.2878	160.0968394	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	5.011430636				160.0968394	0.182939232	159.8090394		
	Slope >20%	0.3984	221.6211981	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	11.05457617		1.5732		221.6211981	0.2532418	221.2227981	875.1367191	
	Area 11																			
	Slope 0-5%	0.1365	75.9319617	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.747963174				75.9319617	0.441747573	75.7954617		
	Slope 5-10%	0.0069	3.838318943	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.179564499				3.838318943	0.022330097	3.831418943		
	Slope 10-20%	0.062	34.48924268	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	4.558308462				34.48924268	0.200647249	34.42724268		
	Slope >20%	0.1036	57.63041196	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	12.13734255		0.309		57.63041196	0.335275081	57.52681196	171.8899353	
	Area 12																			
	Slope 0-5%	0.3648	202.9302537	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.473436031				202.9302537	0.192374624	202.5654537		
	Slope 5-10%	0.1759	97.84931915	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	1.08416689				97.84931915	0.092759584	97.67341915		
	Slope 10-20%	0.517	287.5957817	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	9.002465737				287.5957817	0.272636186	287.0787817		
	Slope >20%	0.8386	466.4948211	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	23.26899491		1.8963		466.4948211	0.442229605	465.6562211	1054.870176	
	Area 13																			
	Slope 0-5%	0.0408	22.69614679	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.223567015				22.69614679	0.10151779	22.65534679		
	Slope 5-10%	0.0348	19.35847815	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.905629648				19.35847815	0.086588704	19.32367815		
	Slope 10-20%	0.1562	86.89064042	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	11.48399648				86.89064042	0.388653894	86.73444042		
	Slope >20%	0.1701	94.62290612	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	19.92820432		0.4019		94.62290612	0.423239612	94.45280612	223.5681715	
	Area 14																			
	Slope 0-5%	0.8678	482.7381419	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	4.755182731				482.7381419	0.513916854	481.8703419		
	Slope 5-10%	0.1449	80.60469781	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	3.770854483				80.60469781	0.085810731	80.45979781		
	Slope 10-20%	0.1855	103.189589	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	13.63816484				103.189589	0.109854317	103.004089		
	Slope >20%	0.4904	272.798784	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	57.45321222		1.6886		272.798784	0.290418098	272.308384	939.3312127	
	Area 15																			
	Slope 0-5%	0.9862	548.6014698	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	1.279886552				548.6014698	0.258716126	547.6152698		
	Slope 5-10%	0.0835	46.44922199	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.514655687				46.44922199	0.021905087	46.36572199		
	Slope 10-20%	0.3967	220.6755253	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	6.907694696				220.6755253	0.104068837	220.2788253		
	Slope >20%	2.3455	1304.750302	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	65.08159738		3.8119		1304.750302	0.61530995	1302.404802	2120.476519	
	Area 16																			
	Slope 0-5%	0.5971	332.1536581	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	3.271859424				332.1536581	0.58821791	331.5565581		
	Slope 5-10%	0.1606	89.3382641	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	4.179428778				89.3382641	0.158211014	89.1776641		
	Slope 10-20%	0.1583	88.05882445	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	11.6383908				88.05882445	0.155945227	87.90052445		
	Slope >20%	0.0991	55.12716047	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	11.61014138		1.0151		55.12716047	0.09762585	55.02806047	564.6779071	
	Area 17																			
	Slope 0-5%	0.6855	381.3286428	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.889639253				381.3286428	0.519436236	380.6431428		
	Slope 5-10%	0.0629	34.98989298	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.387686739				34.98989298	0.047662348	34.92699298		
	Slope 10-20%	0.1984	110.3655766	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	3.454717993				110.3655766	0.150337198	110.1671766		
	Slope >20%	0.3729	207.4361064	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	10.3470167		1.3197		207.4361064	0.282564219	207.0632064	734.1202188	
	Area 18																			
	Slope 0-5%	0.4202	233.7480609	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.545333937				233.7480609	0.48337743	233.3278609		
	Slope 5-10%	0.2141	119.0991429	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	1.319614163				119.0991429	0.246290118	118.8850429		
	Slope 10-20%	0.182	101.2426156	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	3.169146546				101.2426156	0.209363856	101.0606156		
	Slope >20%	0.053	29.48273971	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	1.470613797		0.8693		29.48273971	0.060968595	29.42973971	483.572559	
	Area 19																			
	Slope 0-5%	0.9161	509.6063745	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	5.019846623				509.6063745	0.748325437	508.6902745		
	Slope 5-10%	0.0531	29.53836752	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	1.381865928				29.53836752	0.043375265	29.48526752		
	Slope 10-20%	0.1488	82.77418243	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	10.93994031				82.77418243	0.121548767	82.62538243		
	Slope >20%	0.1062	59.07673504	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	12.44194767		1.2242		59.07673504	0.086750531	58.97053504	680.9956595	
	Area 20																			
	Slope 0-5%	0.1055	58.68734036	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.136917493				58.68734036	0.761732852	58.58184036		
	Slope 5-10%	0.0207	11.51495683	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.127585302				11.51495683	0.149458484	11.49425683		
	Slope 10-20%	0.0083	4.617108294	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.144527013				4.617108294	0.059927798	4.608808294		
	Slope >20%	0.004	2.225112431	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.110989721		0.1385		2.225112431	0.028880866	2.221112431	77.04451792	
	Area 21																			
	Slope 0-5%	0.2541	141.3502672	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	1.392362217				141.3502672	0.634615385	141.0961672		
	Slope 5-10%	0.0598	33.26543084	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	1.55622566				33.26543084	0.149350649	33.20563084		
	Slope 10-20%	0.054	30.03901782	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	3.970139629				30.03901782	0.134865135	29.98501782		
	Slope >20%	0.0325	18.0790385	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	3.807564024	**644.7245912**	0.4004	**25.5268**	18.0790385	0.081168831	18.0465385	222.7337543	
4	**Area 1**																			

	Slope 0-5%	1.188	17.06651343	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.039816155				17.06651343	0.403450384	15.87851343	
	Slope 5-10%	0.1683	2.41775607	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.026788649				2.41775607	0.057155471	2.24945607	
	Slope 10-20%	0.3024	4.344203419	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.135984409				4.344203419	0.102696461	4.041803419	
	Slope >20%	1.2859	18.47292056	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.921438513		2.9446		18.47292056	0.436697684	17.18702056	42.30139348
	Area 2																		
	Slope 0-5%	2.5951	37.28056314	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.367229922				37.28056314	0.949473145	34.68546314	
	Slope 5-10%	0.1266	1.818704209	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.085082745				1.818704209	0.046319333	1.692104209	
	Slope 10-20%	0.0087	0.124982043	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.016518388				0.124982043	0.003183082	0.116282043	
	Slope >20%	0.0028	0.040224106	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.00847146		2.7332		0.040224106	0.00102444	0.037424106	39.2644735
	Area 3																		
	Slope 0-5%	1.3112	18.83637408	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.043945237				18.83637408	0.490094939	17.52517408	
	Slope 5-10%	0.2511	3.607240339	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.039968092				3.607240339	0.093855124	3.356140339	
	Slope 10-20%	0.4336	6.228990088	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.194982936				6.228990088	0.162069223	5.795390088	
	Slope >20%	0.6795	9.761528516	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.486909923	**2.367136429**	2.6754	**8.3532**	9.761528516	0.253980713	9.082028516	38.43413303
5	**Area 4**																		
	Slope 0-5%	1.2918	34.3694722	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.338554397				34.3694722	0.893360996	33.0776722	
	Slope 5-10%	0.1114	2.963894723	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.138657126				2.963894723	0.077040111	2.852494723	
	Slope 10-20%	0.0235	0.625238115	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.082635279				0.625238115	0.016251729	0.601738115	
	Slope >20%	0.0193	0.51349343	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.108145083		1.446		0.51349343	0.013347165	0.49419343	38.47209846
	Area 5																		
	Slope 0-5%	2.2292	59.3098215	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.13836974				59.3098215	0.256716762	57.0806215	
	Slope 5-10%	0.1105	2.939949433	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.032574533				2.939949433	0.012725284	2.829449433	
	Slope 10-20%	1.1824	31.45878923	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.984738616				31.45878923	0.136166292	30.27638923	
	Slope >20%	5.1614	137.3235747	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	6.849768563		8.6835		137.3235747	0.594391662	132.1621747	231.0321349
	Area 6																		
	Slope 0-5%	0.0314	0.835424545	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.008229299				0.835424545	0.09570253	0.804024545	
	Slope 5-10%	0.0319	0.848727483	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.039705227				0.848727483	0.097226455	0.816827483	
	Slope 10-20%	0.1634	4.347400338	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.574578918				4.347400338	0.498018897	4.184000338	
	Slope >20%	0.1014	2.69783595	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.568181937		0.3281		2.69783595	0.309052118	2.59643595	8.729388317
	Area 7																		
	Slope 0-5%	0.1224	3.256559372	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.03207854				3.256559372	0.250562948	3.134159372	
	Slope 5-10%	0.019	0.505511667	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.023648881				0.505511667	0.038894575	0.486511667	
	Slope 10-20%	0.0647	1.721400256	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.227510747				1.721400256	0.132446264	1.656700256	
	Slope >20%	0.2824	7.513499728	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	1.582392297		0.4885		7.513499728	0.578096213	7.231099728	12.99697102
	Area 8																		
	Slope 0-5%	0.3886	10.33904389	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.101844124				10.33904389	0.331485115	9.950443889	
	Slope 5-10%	0.0211	0.561384009	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.026262705				0.561384009	0.017998806	0.540284009	
	Slope 10-20%	0.1842	4.900802584	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.647719931				4.900802584	0.157127015	4.716602584	
	Slope >20%	0.5784	15.38883939	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	3.240990455		1.1723		15.38883939	0.493389064	14.81043939	31.19006987
	Area 9																		
	Slope 0-5%	2.7681	73.64772874	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.17182006				73.64772874	0.234945128	70.87962874	
	Slope 5-10%	0.8022	21.34323471	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.236482263				21.34323471	0.06808749	20.54103471	
	Slope 10-20%	2.5318	67.36075995	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	2.108559903				67.36075995	0.21488894	64.82895995	
	Slope >20%	5.6798	151.1160614	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	7.537744698		11.7819		151.1160614	0.482078442	145.4362614	313.4677848
	Area 10																		
	Slope 0-5%	1.1832	31.48007393	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.310092555				31.48007393	0.65136251	30.29687393	
	Slope 5-10%	0.3828	10.1847298	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.476462726				10.1847298	0.21073493	9.801929801	
	Slope 10-20%	0.1868	4.969977865	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.656862558				4.969977865	0.102835122	4.783177865	
	Slope >20%	0.0637	1.694794379	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.356934806		1.8165		1.694794379	0.035067437	1.631094379	48.32957597
	Area 11																		
	Slope 0-5%	0.3045	8.101489614	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.018900765				8.101489614	0.39048474	7.796989614	
	Slope 5-10%	0.1425	3.791337504	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.042007881				3.791337504	0.182739164	3.648837504	
	Slope 10-20%	0.2114	5.624482445	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.176060338				5.624482445	0.271095153	5.413082445	
	Slope >20%	0.1214	3.229953495	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.161111695		0.7798		3.229953495	0.155680944	3.108553495	20.74726306
	Area 12																		
	Slope 0-5%	0.4734	12.59522228	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.124068472				12.59522228	0.634669527	12.12182228	
	Slope 5-10%	0.0994	2.644624196	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.12372099				2.644624196	0.133261831	2.545224196	
	Slope 10-20%	0.0965	2.567467152	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.339332103				2.567467152	0.129373911	2.470967152	
	Slope >20%	0.0766	2.038010195	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.429218307		0.7459		2.038010195	0.102694731	1.961410195	19.84532382
	Area 13																		
	Slope 0-5%	0.6494	17.27785667	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.040309218				17.27785667	0.453396635	16.62845667	
	Slope 5-10%	0.1365	3.631702241	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.040239128				3.631702241	0.095301264	3.495202241	
	Slope 10-20%	0.4554	12.11631649	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.379270945				12.11631649	0.31795015	11.66091649	
	Slope >20%	0.191	5.08172255	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.253478861		1.4323		5.08172255	0.133351951	4.89072255	38.10759795
	Area 14																		
	Slope 0-5%	0.0219	0.582668711	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.005739543				0.582668711	0.184343434	0.560768711	
	Slope 5-10%	0.0733	1.9502108	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.091234895				1.9502108	0.617003367	1.8769108	
	Slope 10-20%	0.0173	0.460281676	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.060833631				0.460281676	0.145622896	0.442981676	
	Slope >20%	0.0063	0.167617027	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.035301245		0.1188		0.167617027	0.053030303	0.161317027	3.160778214
	Area 15																		
	Slope 0-5%	0.8079	21.49488821	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.21173409				21.49488821	0.659941186	20.68698821	
	Slope 5-10%	0.112	2.979858249	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.139403932				2.979858249	0.091488319	2.867858249	
	Slope 10-20%	0.1693	4.504375014	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.595325648				4.504375014	0.138294396	4.335075014	
	Slope >20%	0.135	3.591793425	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.756455241		1.2242		3.591793425	0.110276099	3.456793425	32.5709149

Area 16																		
Slope 0-5%	0.6664	17.73015658	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.041364433				17.73015658	0.597079115	17.06375658	
Slope 5-10%	0.1529	4.068038627	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.04507372				4.068038627	0.136994893	3.915138627	
Slope 10-20%	0.2198	5.847971814	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.183056113				5.847971814	0.196935758	5.628171814	
Slope >20%	0.077	2.048652546	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.102187813		1.1161		2.048652546	0.068990234	1.971652546	29.69481957
Area 17																		
Slope 0-5%	11.1025	295.3917519	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.689148592				295.3917519	0.784523633	284.2892519	
Slope 5-10%	1.2694	33.77350055	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.374209155				33.77350055	0.089698203	32.50410055	
Slope 10-20%	1.1628	30.93731403	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.968415141				30.93731403	0.082165646	29.77451403	
Slope >20%	0.6172	16.42114742	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.819095043		14.1519		16.42114742	0.043612518	15.80394742	376.5237139
Area 18																		
Slope 0-5%	5.4906	146.0822295	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	1.438974124				146.0822295	0.788550748	140.5916295	
Slope 5-10%	0.4638	12.33980586	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.577281641				12.33980586	0.066610177	11.87600586	
Slope 10-20%	0.4787	12.73623343	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	1.683298214				12.73623343	0.06875009	12.25753343	
Slope >20%	0.5298	14.09579375	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	2.968666568		6.9629		14.09579375	0.076088986	13.56599375	185.2540625
Area 19																		
Slope 0-5%	6.3419	168.7318128	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	1.662082468				168.7318128	0.903005795	162.3899128	
Slope 5-10%	0.3299	8.777278896	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.410619261				8.777278896	0.046973559	8.447378896	
Slope 10-20%	0.2865	7.622583824	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	1.007447124				7.622583824	0.040793951	7.336083824	
Slope >20%	0.0648	1.724060844	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.363098516		7.0231		1.724060844	0.009226695	1.659260844	186.8557363
Area 20																		
Slope 0-5%	0.6919	18.40860645	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.042947256				18.40860645	0.664840972	17.71670645	
Slope 5-10%	0.235	6.252381147	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.069276155				6.252381147	0.225809551	6.017381147	
Slope 10-20%	0.0904	2.405171301	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.075287864				2.405171301	0.08686461	2.314771301	
Slope >20%	0.0234	0.622577527	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.031054478		1.0407		0.622577527	0.022484866	0.599177527	27.68873643
Area 21																		
Slope 0-5%	1.6663	44.33337322	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.436703199				44.33337322	0.519533564	42.66707322	
Slope 5-10%	0.5562	14.79818891	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.692289885				14.79818891	0.173416893	14.24198891	
Slope 10-20%	0.6075	16.16307041	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	2.136209871				16.16307041	0.189411655	15.55557041	
Slope >20%	0.3773	10.03839748	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	2.114152314	**50.55723185**	3.2073	**63.5198**	10.03839748	0.117637889	9.661097476	85.33303002

TOTAL 753.841 tonnes

USLE Calculation M2PP Whole Catchment Less Project Footprint

Catchment 1	Whareroa	1600
Catchment 2	Wharemauku	1380
Catchment 3	Waikanae	14200
Catchment 4	Waimeha	120
Catchment 5	Ngarara	1690
		Total Catchment Area (ha)

Assumptions

R factor based on NIWA HIRDS Data
K Factor based on soil samples and soils /gravels to be utilised - grass cover
LS Factor based on different slopes with a uniform 100m slope length
C and P Factors based on a pastoral surface
Duration - for purposes of risk assessment has been based on 2 months total for each stage to provide comparison with earthworks scenario
Sediment Deilivery Ratio - based on a high infiltration rate and irregular surface capturing flow and sediment - 0.25 assumed figure
Efficiency - based on 0% as no control measures in place with existing situation
Assume pre earthworkls surface is grass environment in all areas
Catchment Characteristics are based on project footprint and pro rata of specific areas (soil types and slope classes)

Pro Rata Sub Catchment Split		Footprint Hectares	Total Catchment Footprint Area Less Project Footprint	r	k	ls	c	p	time	sdr	sed eff.	Total Catchment Yield	Overall Catchment Yield	Area	Project Footprint Area	Pro Rata Total Catchment Area	Slope % Total Catchment	Total Catchment Less Project Footprint	Pro Rata Total Catchment Area
1	**Area 1**																		
	Slope 0-5%	6.66	1088.374528	71	0.132	0.3457401	0.02	1	0.16	0.25	0	2.821307145				1095.034528	0.74	1088.374528	
	Slope 5-10%	1.44	235.3242223	71	0.132	1.6420015	0.02	1	0.16	0.25	0	2.897093119				236.7642223	0.16	235.3242223	
	Slope 10-20%	0.54	88.24658336	71	0.132	4.6388912	0.02	1	0.16	0.25	0	3.069264779				88.78658336	0.06	88.24658336	
	Slope >20%	0.36	58.83105557	71	0.132	7.3920692	0.02	1	0.16	0.25	0	3.260580517		9		59.19105557	0.04	58.83105557	1479.776389
	Area 2																		
	Slope 0-5%	0.5122	83.70351851	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.824516423				84.21571851	0.700492341	83.70351851	
	Slope 5-10%	0.0592	9.67444025	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.452590325				9.73364025	0.080962801	9.67444025	
	Slope 10-20%	0.0596	9.739808089	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	1.287272384				9.799408089	0.081509847	9.739808089	
	Slope >20%	0.1002	16.3746438	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	3.448607327	**18.06123202**	0.7312	**9.7312**	16.4748438	0.137035011	16.3746438	120.2236107
2	**Area 1**																		
	Slope 0-5%	4.426	188.4887369	71	0.132	0.3457401	0.02	1	0.16	0.25	0	0.488604434				192.9147369	0.471121708	188.4887369	
	Slope 5-10%	0.689	29.34223673	71	0.132	1.6420015	0.02	1	0.16	0.25	0	0.361234349				30.03123673	0.073340004	29.34223673	
	Slope 10-20%	1.5453	65.80922847	71	0.132	4.6388912	0.02	1	0.16	0.25	0	2.288881217				67.35452847	0.16448811	65.80922847	
	Slope >20%	2.7361	116.5214716	71	0.132	7.3920692	0.02	1	0.16	0.25	0	6.457943621		9.3964		119.2575716	0.291241777	116.5214716	409.4796176
	Area 2																		
	Slope 0-5%	0.5863	24.96368721	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.058240251				25.54998721	0.188387636	24.96368721	
	Slope 5-10%	0.2276	9.690832695	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.107374073				9.918432695	0.073131547	9.690832695	
	Slope 10-20%	0.4838	20.59940623	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.644812826				21.08320623	0.155452734	20.59940623	
	Slope >20%	1.8145	77.25841795	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	3.853688514		3.1122		79.07291795	0.583028083	77.25841795	135.6245441
	Area 3																		
	Slope 0-5%	2.8566	121.6293176	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.283761048				124.4859176	0.90338699	121.6293176	
	Slope 5-10%	0.0312	1.328444552	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.014719117				1.359644552	0.009866861	1.328444552	
	Slope 10-20%	0.1189	5.062565938	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.158470949				5.181465938	0.037601594	5.062565938	
	Slope >20%	0.1554	6.616675751	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.330043095		3.1621		6.772075751	0.049144556	6.616675751	137.7991038
	Area 4																		
	Slope 0-5%	0.3701	15.75824772	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.036763972				16.12834772	0.547890452	15.75824772	
	Slope 5-10%	0.0062	0.263985776	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.002924953				0.270185776	0.009178386	0.263985776	
	Slope 10-20%	0.0343	1.46043744	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.045715337				1.49473744	0.050777202	1.46043744	
	Slope >20%	0.2649	11.27900519	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.562602418		0.6755		11.54390519	0.39215396	11.27900519	29.43717612
	Area 5																		
	Slope 0-5%	0.0402	1.711649712	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.003993277				1.751849712	0.128025478	1.711649712	
	Slope 5-10%	0.0066	0.281017117	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.003113659				0.287617117	0.021019108	0.281017117	
	Slope 10-20%	0.0646	2.750561477	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.086099439				2.815161477	0.205732484	2.750561477	
	Slope >20%	0.2026	8.626373919	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.430287844		0.314		8.828973919	0.64522293	8.626373919	13.68360222
	Area 6																		
	Slope 0-5%	0.1491	6.348432139	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.014810884				6.497532139	0.203105844	6.348432139	
	Slope 5-10%	0.323	13.75280738	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.152380605				14.07580738	0.439994551	13.75280738	
	Slope 10-20%	0.1127	4.798580161	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.150207535				4.911280161	0.153521319	4.798580161	
	Slope >20%	0.1493	6.356947809	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.317087735		0.7341		6.506247809	0.203378286	6.356947809	31.99086749

	Area 7																		
	Slope 0-5%	0.2967	12.63299675	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.029472766				12.92969675	0.296967271	12.63299675	
	Slope 5-10%	0.0719	3.061383439	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.033920017				3.133283439	0.071964768	3.061383439	
	Slope 10-20%	0.2426	10.32950796	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.323339379				10.57210796	0.242818537	10.32950796	
	Slope >20%	0.3879	16.51614237	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.823833439		0.9991		16.90404237	0.388249424	16.51614237	43.53913052
	Area 8																		
	Slope 0-5%	1.119	47.64517481	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.111156134				48.76417481	0.451902108	47.64517481	
	Slope 5-10%	0.3714	15.81359957	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.175214107				16.18499957	0.149987885	15.81359957	
	Slope 10-20%	0.5687	24.21430823	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.757968281				24.78300823	0.229666424	24.21430823	
	Slope >20%	0.4171	17.75943022	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.885849258		2.4762		18.17653022	0.168443583	17.75943022	107.9087128
	Area 9																		
	Slope 0-5%	0.6771	28.82980148	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.067259891				29.50690148	0.425073765	28.82980148	
	Slope 5-10%	0.1415	6.024836671	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.066754971				6.166336671	0.088831691	6.024836671	
	Slope 10-20%	0.3093	13.16948397	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.412237716				13.47878397	0.194174148	13.16948397	
	Slope >20%	0.465	19.79893323	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.987580688		1.5929		20.26393323	0.291920397	19.79893323	69.41595536
	Area 10																		
	Slope 0-5%	0.7131	30.36262212	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.07083596				31.07572212	0.655905077	30.36262212	
	Slope 5-10%	0.0585	2.490833535	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.027598345				2.549333535	0.053807947	2.490833535	
	Slope 10-20%	0.1527	6.501714203	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.203519881				6.654414203	0.140452539	6.501714203	
	Slope >20%	0.1629	6.936013383	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.345971815		1.0872		7.098913383	0.149834437	6.936013383	47.37838324
	Area 11																		
	Slope 0-5%	0.5134	21.85972542	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.215327897				22.37312542	0.51453197	21.85972542	
	Slope 5-10%	0.0728	3.099703955	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.145010562				3.172503955	0.072960513	3.099703955	
	Slope 10-20%	0.2617	11.14275447	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	1.472694325				11.40445447	0.262277009	11.14275447	
	Slope >20%	0.1499	6.38249482	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	1.344195249		0.9978		6.53239482	0.150230507	6.38249482	43.48247866
	Area 12																		
	Slope 0-5%	0.8128	34.60768372	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.080739683				35.42048372	0.315112042	34.60768372	
	Slope 5-10%	0.346	14.73210946	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.163231236				15.07810946	0.134139722	14.73210946	
	Slope 10-20%	0.3469	14.77042997	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.462351322				15.11732997	0.134488641	14.77042997	
	Slope >20%	1.0737	45.7163755	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	2.280355667		2.5794		46.7900755	0.416259595	45.7163755	112.4059987
	Area 13																		
	Slope 0-5%	0.3989	16.98450423	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.167304827				17.38340423	0.526392188	16.98450423	
	Slope 5-10%	0.1825	7.770549064	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.363522357				7.953049064	0.240828715	7.770549064	
	Slope 10-20%	0.0805	3.427557258	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.453006852				3.508057258	0.106228556	3.427557258	
	Slope >20%	0.0959	4.083263864	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.859962137		0.7578		4.179163864	0.126550541	4.083263864	33.02367441
	Area 14																		
	Slope 0-5%	0.2864	12.19443974	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.028449613				12.48083974	0.08604735	12.19443974	
	Slope 5-10%	0.0959	4.083263864	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.045242415				4.179163864	0.028812643	4.083263864	
	Slope 10-20%	0.3364	14.32335729	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.448356831				14.65975729	0.101069583	14.32335729	
	Slope >20%	2.6097	111.1167227	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	5.542557683		3.3284		113.7264227	0.784070424	111.1167227	145.0461836
	Area 15																		
	Slope 0-5%	0.3664	15.60070782	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.153673824				15.96710782	0.807048458	15.60070782	
	Slope 5-10%	0	0	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0				0	0	0	
	Slope 10-20%	0.012	0.510940212	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.067528972				0.522940212	0.026431718	0.510940212	
	Slope >20%	0.0756	3.218923338	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.677926356	**37.14771161**	0.454	**31.6671**	3.294523338	0.166519824	3.218923338	19.78457137
3	**Area 1**																		
	Slope 0-5%	1.6884	937.5315571	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	9.23509763				939.2199571	0.455204767	937.5315571	
	Slope 5-10%	0.3154	175.1347152	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	8.193164217				175.4501152	0.085034105	175.1347152	
	Slope 10-20%	0.5939	329.7796682	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	43.58569036				330.3735682	0.160119706	329.7796682	
	Slope >20%	1.1114	617.1360889	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	129.9729059		3.7091		618.2474889	0.299641422	617.1360889	2063.291129
	Area 2																		
	Slope 0-5%	0.2064	114.6094014	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.267383592				114.8158014	0.223739837	114.6094014	
	Slope 5-10%	0.0606	33.64985333	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.372839149				33.71045333	0.065691057	33.64985333	
	Slope 10-20%	0.1931	107.2242026	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	3.356385147				107.4173026	0.209322493	107.2242026	
	Slope >20%	0.4624	256.760597	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	12.80734695		0.9225		257.222997	0.501246612	256.760597	513.1665544
	Area 3																		
	Slope 0-5%	0.1254	69.63187471	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.162451078				69.75727471	0.198104265	69.63187471	
	Slope 5-10%	0.03	16.65834323	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.184573836				16.68834323	0.047393365	16.65834323	
	Slope 10-20%	0.1213	67.35523447	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	2.108386941				67.47653447	0.191627172	67.35523447	
	Slope >20%	0.3563	197.8455898	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	9.868636934		0.633		198.2018898	0.562875197	197.8455898	352.1240422
	Area 4																		
	Slope 0-5%	0.0226	12.54928523	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.029277467				12.57188523	0.150466045	12.54928523	
	Slope 5-10%	0	0	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0				0	0	0	
	Slope 10-20%	0.0194	10.77239529	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.337202858				10.79179529	0.129161119	10.77239529	
	Slope >20%	0.1082	60.08109125	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	2.99687487		0.1502		60.18929125	0.720372836	60.08109125	83.55297178
	Area 5																		
	Slope 0-5%	0.3833	212.8380987	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.496551021				213.2213987	0.401109251	212.8380987	
	Slope 5-10%	0.1459	81.01507592	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.897644089				81.16097592	0.152678945	81.01507592	
	Slope 10-20%	0.188	104.3922843	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	3.267739035				104.5802843	0.196735036	104.3922843	
	Slope >20%	0.2384	132.3783009	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	6.603095833		0.9556		132.6167009	0.249476769	132.3783009	531.5793597
	Area 6																		
	Slope 0-5%	0.1175	65.24517766	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.152216919				65.36267766	0.142182962	65.24517766	
	Slope 5-10%	0.0185	10.27264499	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.113820532				10.29114499	0.022386254	10.27264499	
	Slope 10-20%	0.2	111.0556215	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	3.476318122				111.2556215	0.242013553	111.0556215	

Slope >20%	0.4904	272.308384	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	13.58287834	0.8264	272.798784	0.593417231	272.308384	459.7082282
Area 7																
Slope 0-5%	0.1358	75.40676703	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.175923894		75.54256703	0.422001243	75.40676703	
Slope 5-10%	0.0038	2.110056809	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.023379353		2.113856809	0.011808577	2.110056809	
Slope 10-20%	0.0372	20.65634561	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.646595171		20.69354561	0.115599751	20.65634561	
Slope >20%	0.145	80.51532562	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	4.016144697	0.3218	80.66032562	0.450590429	80.51532562	179.0102951
Area 8																
Slope 0-5%	1.5033	834.7495793	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	1.947469738		836.2528793	0.507169124	834.7495793	
Slope 5-10%	0.3173	176.1897436	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	1.952175938		176.5070436	0.10704767	176.1897436	
Slope 10-20%	0.5455	302.9042078	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	9.481657679		303.4497078	0.184035626	302.9042078	
Slope >20%	0.598	332.0563084	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	16.56313468	2.9641	332.6543084	0.201747579	332.0563084	1648.863939
Area 9																
Slope 0-5%	0.0392	21.76690182	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.050782155		21.80610182	0.098989899	21.76690182	
Slope 5-10%	0.0001	0.055527811	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.000615246		0.055627811	0.000252525	0.055527811	
Slope 10-20%	0.0968	53.75092083	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	1.682537971		53.84772083	0.244444444	53.75092083	
Slope >20%	0.2599	144.3167802	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	7.19859315	0.396	144.5766802	0.656313131	144.3167802	220.2861307
Area 10																
Slope 0-5%	0.7927	440.168956	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	1.026913631		440.961656	0.503877447	440.168956	
Slope 5-10%	0.0943	52.36272556	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.580177091		52.45702556	0.05994152	52.36272556	
Slope 10-20%	0.2878	159.8090394	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	5.002421778		160.0968394	0.182939232	159.8090394	
Slope >20%	0.3984	221.2227981	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	11.03470377	1.5732	221.6211981	0.2532418	221.2227981	875.1367191
Area 11																
Slope 0-5%	0.1365	75.7954617	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.746618589		75.9319617	0.441747573	75.7954617	
Slope 5-10%	0.0069	3.831418943	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.179241703		3.838318943	0.022330097	3.831418943	
Slope 10-20%	0.062	34.42724268	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	4.550114165		34.48924268	0.200647249	34.42724268	
Slope >20%	0.1036	57.52681196	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	12.11552371	0.309	57.63041196	0.335275081	57.52681196	171.8899353
Area 12																
Slope 0-5%	0.3648	202.5654537	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.472584953		202.9302537	0.192374624	202.5654537	
Slope 5-10%	0.1759	97.67341915	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	1.082217925		97.84931915	0.092759584	97.67341915	
Slope 10-20%	0.517	287.0787817	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	8.986282346		287.5957817	0.272636186	287.0787817	
Slope >20%	0.8386	465.6562211	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	23.22716512	1.8963	466.4948211	0.442229605	465.6562211	1054.870176
Area 13																
Slope 0-5%	0.0408	22.65534679	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.223165117		22.69614679	0.10151779	22.65534679	
Slope 5-10%	0.0348	19.32367815	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.904001632		19.35847815	0.086588704	19.32367815	
Slope 10-20%	0.1562	86.73444042	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	11.46335214		86.89064042	0.388653894	86.73444042	
Slope >20%	0.1701	94.45280612	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	19.89238015	0.4019	94.62290612	0.423239612	94.45280612	223.5681715
Area 14																
Slope 0-5%	0.8678	481.8703419	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	4.74663452		482.7381419	0.513916854	481.8703419	
Slope 5-10%	0.1449	80.45979781	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	3.764075761		80.60469781	0.085810731	80.45979781	
Slope 10-20%	0.1855	103.004089	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	13.61364802		103.189589	0.109854317	103.004089	
Slope >20%	0.4904	272.308384	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	57.34993077	1.6886	272.798784	0.290418098	272.308384	939.3312127
Area 15																
Slope 0-5%	0.9862	547.6152698	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	1.277585748		548.6014698	0.258716126	547.6152698	
Slope 5-10%	0.0835	46.36572199	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.51373051		46.44922199	0.021905087	46.36572199	
Slope 10-20%	0.3967	220.2788253	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	6.895276996		220.6755253	0.104068837	220.2788253	
Slope >20%	2.3455	1302.404802	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	64.96460267	3.8119	1304.750302	0.61530995	1302.404802	2120.476519
Area 16																
Slope 0-5%	0.5971	331.5565581	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	3.265977727		332.1536581	0.58821791	331.5565581	
Slope 5-10%	0.1606	89.1776641	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	4.171915578		89.3382641	0.158211014	89.1776641	
Slope 10-20%	0.1583	87.90052445	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	11.61746891		88.05882445	0.155945227	87.90052445	
Slope >20%	0.0991	55.02806047	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	11.58927027	1.0151	55.12716047	0.09762585	55.02806047	564.6779071
Area 17																
Slope 0-5%	0.6855	380.6431428	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.888039982		381.3286428	0.519436236	380.6431428	
Slope 5-10%	0.0629	34.92699298	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.386989809		34.98989298	0.047662348	34.92699298	
Slope 10-20%	0.1984	110.1671766	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	3.448507577		110.3655766	0.150337198	110.1671766	
Slope >20%	0.3729	207.0632064	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	10.32841626	1.3197	207.4361064	0.282564219	207.0632064	734.1202188
Area 18																
Slope 0-5%	0.4202	233.3278609	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.544353611		233.7480609	0.48337743	233.3278609	
Slope 5-10%	0.2141	118.8850429	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	1.317241943		119.0991429	0.246290118	118.8850429	
Slope 10-20%	0.182	101.0606156	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	3.163449491		101.2426156	0.209363856	101.0606156	
Slope >20%	0.053	29.42973971	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	1.467970131	0.8693	29.48273971	0.060968595	29.42973971	483.572559
Area 19																
Slope 0-5%	0.9161	508.6902745	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	5.010822636		509.6063745	0.748325437	508.6902745	
Slope 5-10%	0.0531	29.48526752	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	1.379381801		29.53836752	0.043375265	29.48526752	
Slope 10-20%	0.1488	82.62538243	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	10.920274		82.77418243	0.121548767	82.62538243	
Slope >20%	0.1062	58.97053504	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	12.41958126	1.2242	59.07673504	0.086750531	58.97053504	680.9956595
Area 20																
Slope 0-5%	0.1055	58.58184036	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.136671361		58.68734036	0.761732852	58.58184036	
Slope 5-10%	0.0207	11.49425683	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.127355947		11.51495683	0.149458484	11.49425683	
Slope 10-20%	0.0083	4.608808294	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.144267202		4.617108294	0.059927798	4.608808294	
Slope >20%	0.004	2.221112431	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.110790199	0.1385	2.225112431	0.028880866	2.221112431	77.04451792
Area 21																
Slope 0-5%	0.2541	141.0961672	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	1.38985922		141.3502672	0.634615385	141.0961672	
Slope 5-10%	0.0598	33.20563084	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	1.553428092		33.26543084	0.149350649	33.20563084	

	Slope 10-20%	0.054	29.98501782	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	3.96300266					30.03901782	0.134865135	29.98501782	
	Slope >20%	0.0325	18.0465385	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	3.800719311	**643.5655943**	0.4004	**25.5268**		18.0790385	0.081168831	18.0465385	222.7337543
4	**Area 1**																			
	Slope 0-5%	1.188	15.87851343	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.037044552					17.06651343	0.403450384	15.87851343	
	Slope 5-10%	0.1683	2.24945607	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.024923891					2.41775607	0.057155471	2.24945607	
	Slope 10-20%	0.3024	4.041803419	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.126518534					4.344203419	0.102696461	4.041803419	
	Slope >20%	1.2859	17.18702056	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.857297178		2.9446			18.47292056	0.436697684	17.18702056	42.30139348
	Area 2																			
	Slope 0-5%	2.5951	34.68546314	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.341667047					37.28056314	0.949473145	34.68546314	
	Slope 5-10%	0.1266	1.692104209	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.079160135					1.818704209	0.046319333	1.692104209	
	Slope 10-20%	0.0087	0.116282043	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.015368543					0.124982043	0.003183082	0.116282043	
	Slope >20%	0.0028	0.037424106	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.007881762		2.7332			0.040224106	0.00102444	0.037424106	39.2644735
	Area 3																			
	Slope 0-5%	1.3112	17.52517408	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.040886209					18.83637408	0.490094939	17.52517408	
	Slope 5-10%	0.2511	3.356140339	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.037185913					3.607240339	0.093855124	3.356140339	
	Slope 10-20%	0.4336	5.795390088	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.181410174					6.228990088	0.162069223	5.795390088	
	Slope >20%	0.6795	9.082028516	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.453016123	**2.202360062**	2.6754	**8.3532**		9.761528516	0.253980713	9.082028516	38.43413303
5	**Area 4**																			
	Slope 0-5%	1.2918	33.0776722	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.3258296					34.3694722	0.893360996	33.0776722	
	Slope 5-10%	0.1114	2.852494723	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.133445603					2.963894723	0.077040111	2.852494723	
	Slope 10-20%	0.0235	0.601738115	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.079529376					0.625238115	0.016251729	0.601738115	
	Slope >20%	0.0193	0.49419343	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.104080376		1.446			0.51349343	0.013347165	0.49419343	38.47209846
	Area 5																			
	Slope 0-5%	2.2292	57.0806215	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.133169019					59.3098215	0.256716762	57.0806215	
	Slope 5-10%	0.1105	2.829449433	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.031350197					2.939949433	0.012725284	2.829449433	
	Slope 10-20%	1.1824	30.27638923	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.947726545					31.45878923	0.136166292	30.27638923	
	Slope >20%	5.1614	132.1621747	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	6.592315351		8.6835			137.3235747	0.594391662	132.1621747	231.0321349
	Area 6																			
	Slope 0-5%	0.0314	0.804024545	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.007919995					0.835424545	0.09570253	0.804024545	
	Slope 5-10%	0.0319	0.816827483	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.038212879					0.848727483	0.097226455	0.816827483	
	Slope 10-20%	0.1634	4.184000338	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.552982979					4.347400338	0.498018897	4.184000338	
	Slope >20%	0.1014	2.59643595	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.546826432		0.3281			2.69783595	0.309052118	2.59643595	8.729388317
	Area 7																			
	Slope 0-5%	0.1224	3.134159372	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.030872846					3.256559372	0.250562948	3.134159372	
	Slope 5-10%	0.019	0.486511667	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.022760022					0.505511667	0.038894575	0.486511667	
	Slope 10-20%	0.0647	1.656700256	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.2189596					1.721400256	0.132446264	1.656700256	
	Slope >20%	0.2824	7.231099728	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	1.522917006		0.4885			7.513499728	0.578096213	7.231099728	12.99697102
	Area 8																			
	Slope 0-5%	0.3886	9.950443889	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.098016243					10.33904389	0.331485115	9.950443889	
	Slope 5-10%	0.0211	0.540284009	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.025275603					0.561384009	0.017998806	0.540284009	
	Slope 10-20%	0.1842	4.716602584	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.623374937					4.900802584	0.157127015	4.716602584	
	Slope >20%	0.5784	14.81043939	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	3.119175623		1.1723			15.38883939	0.493389064	14.81043939	31.19006987
	Area 9																			
	Slope 0-5%	2.7681	70.87962874	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.165362086					73.64772874	0.234945128	70.87962874	
	Slope 5-10%	0.8022	20.54103471	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.227593916					21.34323471	0.06808749	20.54103471	
	Slope 10-20%	2.5318	64.82895995	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	2.029308244					67.36075995	0.21488894	64.82895995	
	Slope >20%	5.6798	145.4362614	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	7.254433434		11.7819			151.1160614	0.482078442	145.4362614	313.4677848
	Area 10																			
	Slope 0-5%	1.1832	30.29687393	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.298437516					31.48007393	0.65136251	30.29687393	
	Slope 5-10%	0.3828	9.801929801	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.45855455					10.1847298	0.21073493	9.801929801	
	Slope 10-20%	0.1868	4.783177865	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.632173932					4.969977865	0.102835122	4.783177865	
	Slope >20%	0.0637	1.631094379	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.343519169		1.8165			1.694794379	0.035067437	1.631094379	48.32957597
	Area 11																			
	Slope 0-5%	0.3045	7.796989614	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.018190367					8.101489614	0.39048474	7.796989614	
	Slope 5-10%	0.1425	3.648837504	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.040428987					3.791337504	0.182739164	3.648837504	
	Slope 10-20%	0.2114	5.413082445	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.16944299					5.624482445	0.271095153	5.413082445	
	Slope >20%	0.1214	3.108553495	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.155056202		0.7798			3.229953495	0.155680944	3.108553495	20.74726306
	Area 12																			
	Slope 0-5%	0.4734	12.12182228	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.119405274					12.59522228	0.634669527	12.12182228	
	Slope 5-10%	0.0994	2.545224196	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.119070852					2.644624196	0.133261831	2.545224196	
	Slope 10-20%	0.0965	2.470967152	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.326578075					2.567467152	0.129373911	2.470967152	
	Slope >20%	0.0766	1.961410195	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.413085845		0.7459			2.038010195	0.102694731	1.961410195	19.84532382
	Area 13																			
	Slope 0-5%	0.6494	16.62845667	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.038794169					17.27785667	0.453396635	16.62845667	
	Slope 5-10%	0.1365	3.495202241	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.038726713					3.631702241	0.095301264	3.495202241	
	Slope 10-20%	0.4554	11.66091649	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.365015789					12.11631649	0.31795015	11.66091649	
	Slope >20%	0.191	4.89072255	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.243951686		1.4323			5.08172255	0.133351951	4.89072255	38.10759795
	Area 14																			
	Slope 0-5%	0.0219	0.560768711	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.005523818					0.582668711	0.184343434	0.560768711	
	Slope 5-10%	0.0733	1.8769108	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.087805769					1.9502108	0.617003367	1.8769108	
	Slope 10-20%	0.0173	0.442981676	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.058547157					0.460281676	0.145622896	0.442981676	
	Slope >20%	0.0063	0.161317027	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.033974423		0.1188			0.167617027	0.053030303	0.161317027	3.160778214
	Area 15																			
	Slope 0-5%	0.8079	20.68698821	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.20377592					21.49488821	0.659941186	20.68698821	

Slope 5-10%	0.112	2.867858249	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.134164341				2.979858249	0.091488319	2.867858249	
Slope 10-20%	0.1693	4.335075014	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.572949928				4.504375014	0.138294396	4.335075014	
Slope >20%	0.135	3.456793425	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.728023356		1.2242		3.591793425	0.110276099	3.456793425	32.5709149
Area 16																		
Slope 0-5%	0.6664	17.06375658	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.039809723				17.73015658	0.597079115	17.06375658	
Slope 5-10%	0.1529	3.915138627	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.043379593				4.068038627	0.136994893	3.915138627	
Slope 10-20%	0.2198	5.628171814	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.176175824				5.847971814	0.196935758	5.628171814	
Slope >20%	0.077	1.971652546	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.098347015		1.1161		2.048652546	0.068990234	1.971652546	29.69481957
Area 17																		
Slope 0-5%	11.1025	284.2892519	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.663246474				295.3917519	0.784523633	284.2892519	
Slope 5-10%	1.2694	32.50410055	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.36014425				33.77350055	0.089698203	32.50410055	
Slope 10-20%	1.1628	29.77451403	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.932016599				30.93731403	0.082165646	29.77451403	
Slope >20%	0.6172	15.80394742	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.788308799		14.1519		16.42114742	0.043612518	15.80394742	376.5237139
Area 18																		
Slope 0-5%	5.4906	140.5916295	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	1.384889302				146.0822295	0.788550748	140.5916295	
Slope 5-10%	0.4638	11.87600586	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.555584118				12.33980586	0.066610177	11.87600586	
Slope 10-20%	0.4787	12.25753343	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	1.620030305				12.73623343	0.06875009	12.25753343	
Slope >20%	0.5298	13.56599375	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	2.857087215		6.9629		14.09579375	0.076088986	13.56599375	185.2540625
Area 19																		
Slope 0-5%	6.3419	162.3899128	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	1.599611967				168.7318128	0.903005795	162.3899128	
Slope 5-10%	0.3299	8.447378896	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.395185857				8.777278896	0.046973559	8.447378896	
Slope 10-20%	0.2865	7.336083824	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	0.969581538				7.622583824	0.040793951	7.336083824	
Slope >20%	0.0648	1.659260844	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	0.349451211		7.0231		1.724060844	0.009226695	1.659260844	186.8557363
Area 20																		
Slope 0-5%	0.6919	17.71670645	71	0.1188	0.3457401	0.02	1	0.16	0.25	0	0.041333054				18.40860645	0.664840972	17.71670645	
Slope 5-10%	0.235	6.017381147	71	0.1188	1.6420015	0.02	1	0.16	0.25	0	0.066672364				6.252381147	0.225809551	6.017381147	
Slope 10-20%	0.0904	2.314771301	71	0.1188	4.6388912	0.02	1	0.16	0.25	0	0.072458119				2.405171301	0.08686461	2.314771301	
Slope >20%	0.0234	0.599177527	71	0.1188	7.3920692	0.02	1	0.16	0.25	0	0.029887275		1.0407		0.622577527	0.022484866	0.599177527	27.68873643
Area 21																		
Slope 0-5%	1.6663	42.66707322	71	0.5016	0.3457401	0.02	1	0.16	0.25	0	0.420289412				44.33337322	0.519533564	42.66707322	
Slope 5-10%	0.5562	14.24198891	71	0.5016	1.6420015	0.02	1	0.16	0.25	0	0.666269699				14.79818891	0.173416893	14.24198891	
Slope 10-20%	0.6075	15.55557041	71	0.5016	4.6388912	0.02	1	0.16	0.25	0	2.055918969				16.16307041	0.189411655	15.55557041	
Slope >20%	0.3773	9.661097476	71	0.5016	7.3920692	0.02	1	0.16	0.25	0	2.034690461	**48.65700388**	3.2073	**63.5198**	10.03839748	0.117637889	9.661097476	85.33303002

TOTAL 749.634 tonnes

138.7981 Total Area (ha)