281650 Redacted

ENGEN371-19C Engineering Work Placement 2

2019

Project Management Technical Report

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Workplace Supervisor: s 7(2)(a) - Privacy [redacted]

Tauranga City Council

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KO TE TANGATA

THE UNIVERSITY OF

WAIKATO

Te Whare Wānanga o Waikato

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1 Executive Summary

The Student Project Managers role in the Tauranga City Council was to assist in projects for the company, and to learn the role of local government in the projects and work in the city. To this degree, that was achieved, even in the first few weeks a great deal was learnt as the roles in the council far differ to the work done within the university.

The Mauao Slip Remediation succeeded in being usable over the Christmas break, and is on track to be completed at the required time. This job involved a great deal of communication with the relative parties and was successfully done in a very short amount of time. The Student Project Manager was responsible for daily reports, reviewing payment claims, and other factors in the project.

Pond G, a massive earthworks job in Papamoa, is going well and is on track for the bulk earthworks portion of the project. Daily reports again were done by the Student Project Manager, and meetings were attended to better learn the on goings of the project and the role of the project manager.

The Meander Drive DxV was managed by the Student Project Manager, with their Team Leader being the principle. This job ended up finding delays due to full design times, and though physical works has not yet begun, it still looks to be a fine project. Overall there was much to learn from this project, as all the pre-planning and forms could be looked at and used in practice by the Student Project Manager. The channel is showing to still have a flow of over 4 cubic meters per second, but the property will show a different number, where it is important that this DxV be at an acceptable number.

Health and Safety observational reporting was done during the Student Project Manager's time at the Tauranga City Council. This involved meeting with contractors, with the Health & Safety Advisor of TCC, to receive the information TCC usually does not to do a trial of looking at these observations. While overall reports were somewhat low, and therefore hard to say for certain if there is enough to base trends on, it still gives a good insight into possible reasons and effects the observations could have on more significant health and safety issues.

2 Acknowledgements

[redacted] assisted me greatly through my time at the Tauranga City Council, giving me various projects to work with, and helping with them when needed.

[redacted] Greatly assisted in my role in collecting and organising health and safety data, and offered assistance when needed in health and safety requirements in projects.

The PMO team: Everyone in the team helped me when I was stuck and needed their assistance, mostly with the various processes in the council.

[redacted] – Placement Coordinat[redacted] presented the vacancy for the summer to me and assisted me in finding work throughout the process.

[redacted] – University Supervisor: [redacted] assisted me with the university work side of the placement when it was needed, and better helped me to understand what was required when it came to the project submission that we may use in 2020.

3 Table of Contents

4 List of Figures

5 List of Tables

6 Introduction

During the summer work placement that ran from the start of November 2019 to the end of February 2020, I worked at the Tauranga City Council, near the city centre of Tauranga. The Tauranga City Council is responsible for many projects in, and upkeep of, the city of Tauranga. The team I was in, known as the project management office, was responsible for the management of projects within the city, seeing them through from pre-design, to post-construction. My work was in infrastructure delivery, assisting where possible to deliver planned projects and manage them throughout. The team manages these projects by communicating with consultants, contractors, iwi, archaeologists, members of the public, other council departments, and more groups in order to deliver a project at the best possible outcome, and cost to the ratepayer. Communication is achieved through a few different methods, such as various kinds of meetings, emails, phone contact, and personal contact where required. The aim was to deliver my projects, or assist in project managers projects, to deliver a high quality and low-cost outcome in all possible areas.

7 Background

Work was done on several projects during the summer placement, including assisting in managing excel spreadsheets of cost reports, assisting in health and safety reporting, and completing update reports on site.

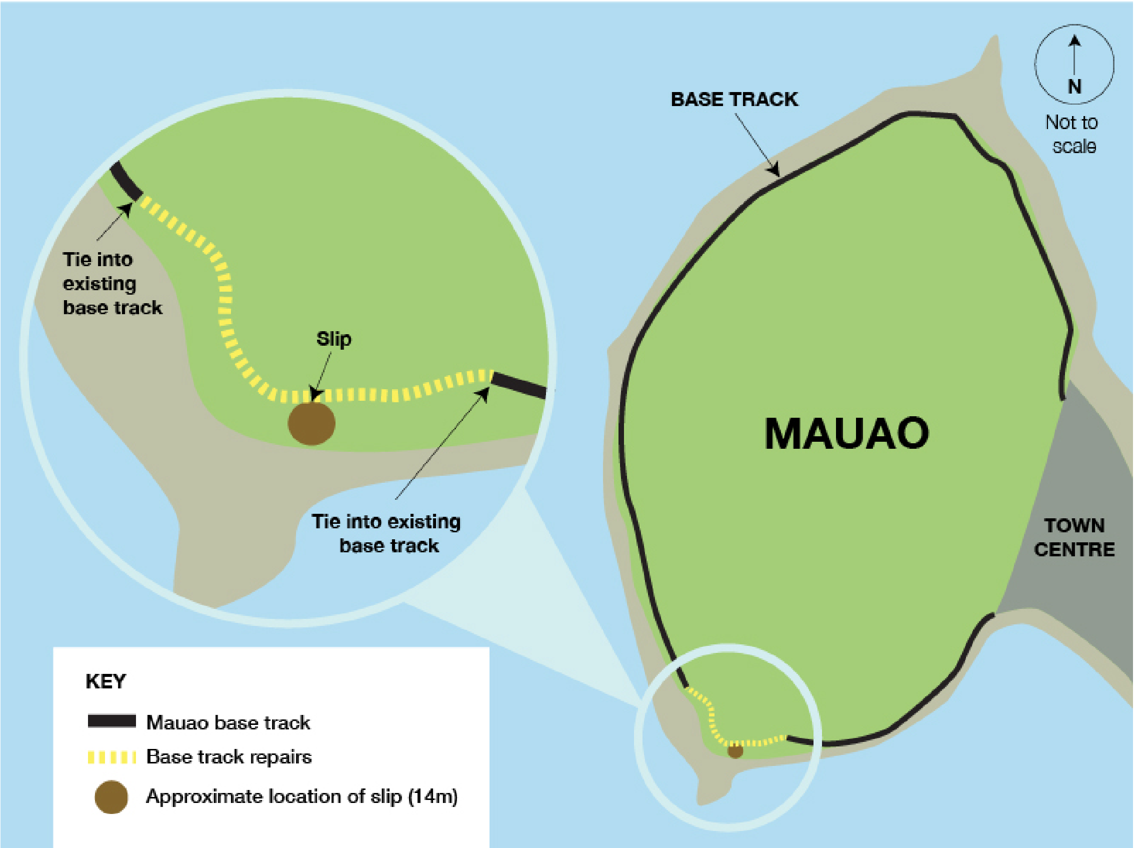

Figure 7:1: Mauao Slip Location

One sensitive project was the Mauao slip remediation, located on the base track of Mount Maunganui. In April of 2017, during Cyclone Debbie, a section of the base track of Mauao was destroyed (Tauranga City Council, 2019). Temporary access was restored to the base track, but this was by steps, making the access for wheelchairs and prams limited. Long term solutions were looked at and discussed for years until physical works began late in 2019.

Another project was for a very large pond located in East Papamoa Te Tumu area, the proposed works included large stormwater conveyance swales, pond construction, outlet and inlet structures, and landscaping. The earthworks quantities in the contract have a strip topsoil volume of 46,000m^3 and 200,000m^3 cut to stockpile quantity (Tauranga City Council, 2019).

A personal project, a recontouring of an overflow path to address a DxV issue, was also taken, with plans to go from design to construction during the summer. It was far smaller in scale, now estimating around 30m^3 of soil cut, and the principle was the supervisor, rather than the student. Still, the project was managed mainly by the student, and is expected to begin physical works in the last week of February.

The health and safety reporting focused on the data that Tauranga City Council did not already receive from its contractors. While Tauranga City Council receives all reports of near misses, incidents, and accidents, it does not receive all reports of health and safety observations from their contractors. This work involved meeting with contractors in order to explain, and find ways to better receive this information, and to trial what patterns could be seen from these observations in the workplace.

8 Processes

8.1 Mauao Slip Remediation

Figure 8:1: Mauao Slip, Prior to Physical Works (Tauranga City Council)

The first steps in the Mauao Slip Remediation, at least from when the student started at the Tauranga City Council, was the planning of how to address the issue. There were many issues with fixing the track, and they were all quite sensitive. There is an archaeological site close to the slip's upper slope, meaning that any plans for heavy excavation there could have been denied by Heritage New Zealand. There are also a few pohutukawa trees at, and even on the slip, which could cause further issue if not removed due to possible voids in their roots, but which the iwi that managed Mauao wished to keep due to their significance.

Figure 8:2: Pohutukawa Tree

The trees needed to be examined by an arborist, after which, it was determined that they could remain, though trimming of their branches at certain locations would be required to ensure their stability. The site was previously fenced off and remained fenced during the arboreal works.

A site meeting was held with HNZ, TCC, Mauao Trust and others. In this the design proposals were not rejected, and the parties wished to be involved in design development and risk workshops regarding the options. Geotechnical analysis was taken to analyse slope stability and determine critical sections to develop an understanding on the rates of regression.

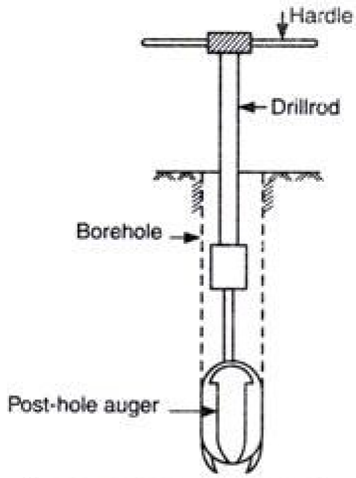

FIG. E1.1 Auger boring

(Khan)

Figure 8:3: Hand Auger

Track alignment models were finalised, and physical drawings developed to discuss with the contractor. Five hand test augers, like that seen in Fig. 8:3. were performed at the Mauao slip, the bores were 50mm in diameter and up to 5 meters in depth. They were done at different locations of the slip, including the top of the upper slope, track, and lower slope. These augers were accepted by InSitu Heritage and so could be done to test the soil, with a cultural monitor and archaeologist present. Establishing clear sampling objectives is the first stage in soil investigations. It must be clearly defined why and how the samples are being collected, and lead to the formulation of a strategy for sampling. The necessary permits are first required, as well as permission for access to the site. The advantage of hand augers are that they are low cost, quick, have no access restrictions, and most importantly to this project they cause minimal soil disturbance (mfe, 2011).

The process of a hand auger is as follows:

- Grasses from the ground where the boring is to be made must be removed and cleaned.
- Place the tip of the post hold auger to the ground.
- Using the handle, rotate the auger ensuring it is kept in a vertical position.
- When the bucket is full of soil, take the auger from the ground.
- Using a trowel, remove the soil from the auger.
- Collect the soil in a bag depending on the soil type.
- Continue for greater depths, use extension rods for greater depths.

- Measure the groundwater level. (Khan)

After investigations, designs took place by a consultant, who delivered four options in an options assessment.

Option 1: Was to undertake minor earthworks and slope stabilisation with soil nails and erosion protection matting. This option involved cutting a steep batter into the slope of approximately 76 degrees batter angle. In order to achieve the required width of the track, the excavation would be cut into the existing slop above the track over an approximately 15m horizontal distance. Approximately $40m^3$ would be excavated. It was found by preliminary slope stability analyses, the slope above the track would likely be negatively affected by this due to toe support loss with a cut slope height up up to 3.8m below large Pohutakawas. The cut slope would therefore require stabilisation such as soil nails in order to maintain long term stability of the cut batter. These nails would be required also on the slip face due to observations that under adverse weather conditions the risk of further under slips remains high, in order to maintain long-term stability of the slope under these weather conditions or changes in groundwater conditions which could cause increased pore pressures.

Option 2: Was to construct a footbridge to span the failed area in order to reinstate the track. The option would have involved creating a footbridge spanning the slipped area. Based on concept design, a retaining wall or piles would support the bridge. Due to the marginal stability of the slip face the piles would need to be designed to resist the lateral movements of future slips and be long. Conversely, stabilising the existing slop prior to installing the foot bridge through installation of soil nails or ground anchors could have been advantageous. This option kept the risk of overslips coming from the slope above the track that could potentially damage such a structure and require clearing slip debris from the track. It would have a design life of 2 to 5 years for this option, which could be extended with the use of soil nails into the upslope. Costal erosion would also be a risk from the same mechanism. Due to these possible causes of damage, it was anticipated that this option would not have provided a long-term solution.

Option 3: Was to realign the existing track at the existing level by excavating into the slope above the track. This would have involved earthworks in order to retreat the current track away from the slip face. The track's new edge would be situated approximately two meters from the edge of the slip face and would have a 45-degree batter cut into the slope above the track. The earthworks would involve approximately

400 cubic meters based on that design. The initial slope analyses indicated that the removal of the soil would result in an overall improvement to slope stability conditions and provide greater regression resilience of the slip face due to landslips or erosion. The benefit of this option is that the construction of the track could have been undertaken with conventional plant such as a hydraulic excavator that could very quickly be carried out. This option, however, would require the removal of the two large Pohutukawa trees on the slope above the track, which the trustees strongly opposed. This option would have given an estimated 5-10-year life, though that could have been extended with erosion matting to protect the slip face and protecting the toe from coastal erosion. Horizontally bored drains could have been installed within seepage zones to enhance stability, or soil nails could have been incorporated within the face of the existing slip. This option would have required regular inspections in order to check for erosion or small slips after heavy rainfall events. Clearing of slip material from above may also be required on the track.

Option 4: Was to create a higher-level track above the existing Pohutukawa trees. This would have required cutting a new track into the slope, totalling 600 cubic meters of earthworks cut volume. This would mean the trees could potentially be left in place with the track passing above and around. This also would mean the track would have been positioned a greater distance from the face of the slip resulting in greater resilience against coastal erosion and small landslips. This would have had an estimated design life of 10 to 15 years. The option would also require regular inspection to check for erosions or small slips following heavy rainfall events. Slip material clearing may also have been required on the track. (WSP, 2019)

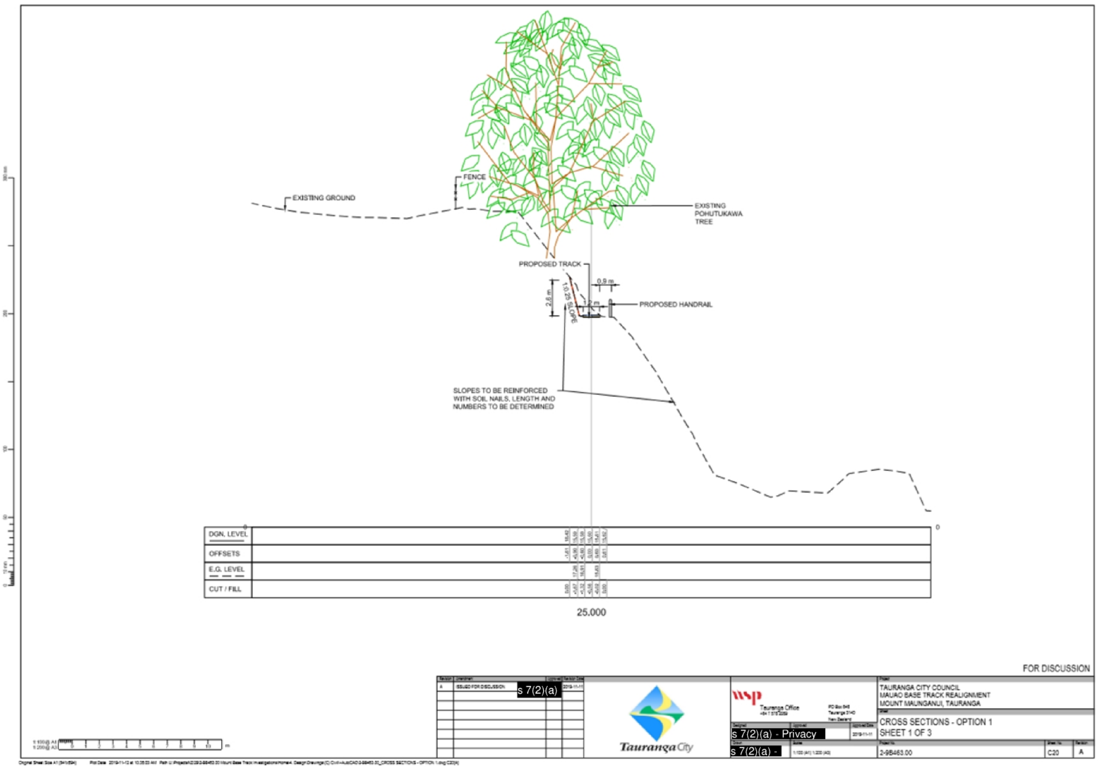

Figure 8:4: Cross Section Diagram Option 1

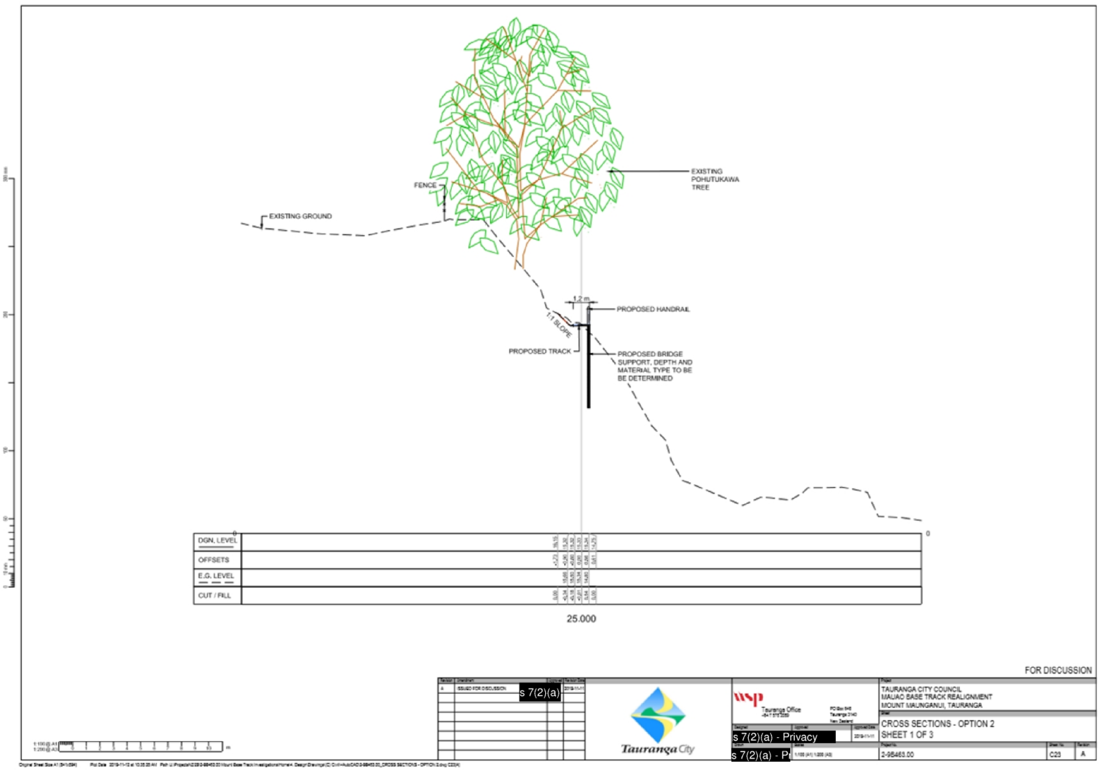

Figure 8:5: Cross Section Diagram Option 2

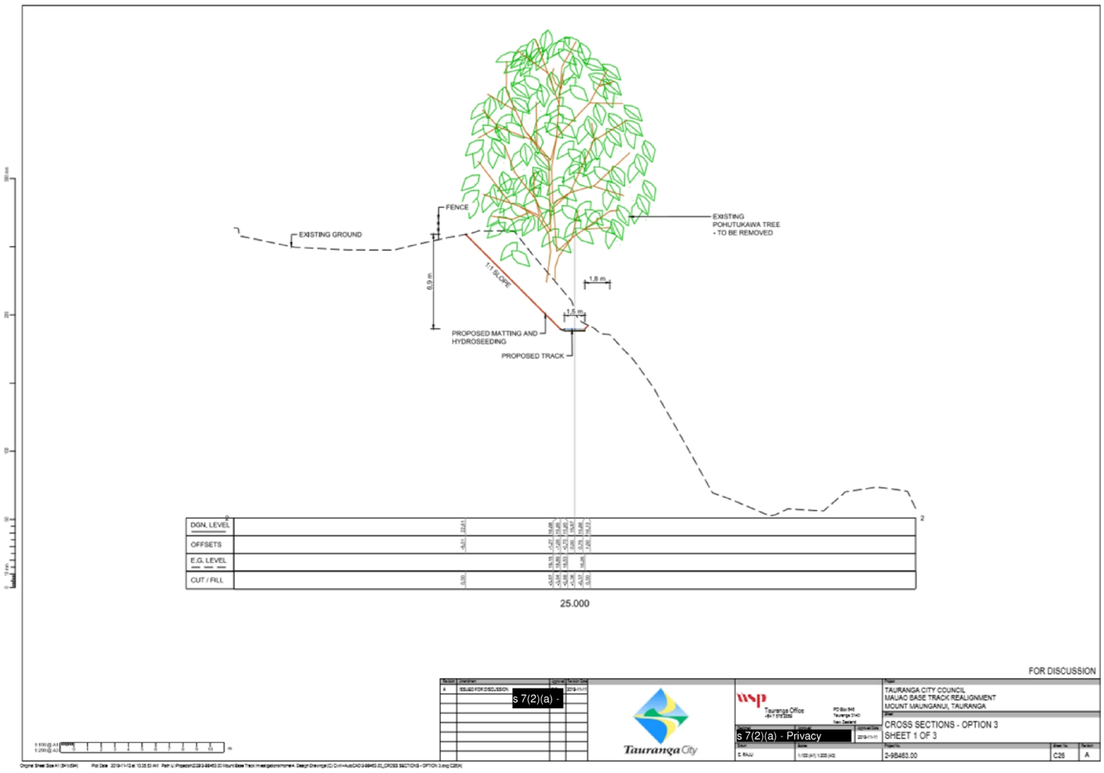

Figure 8:6: Cross Section Diagram Option 3

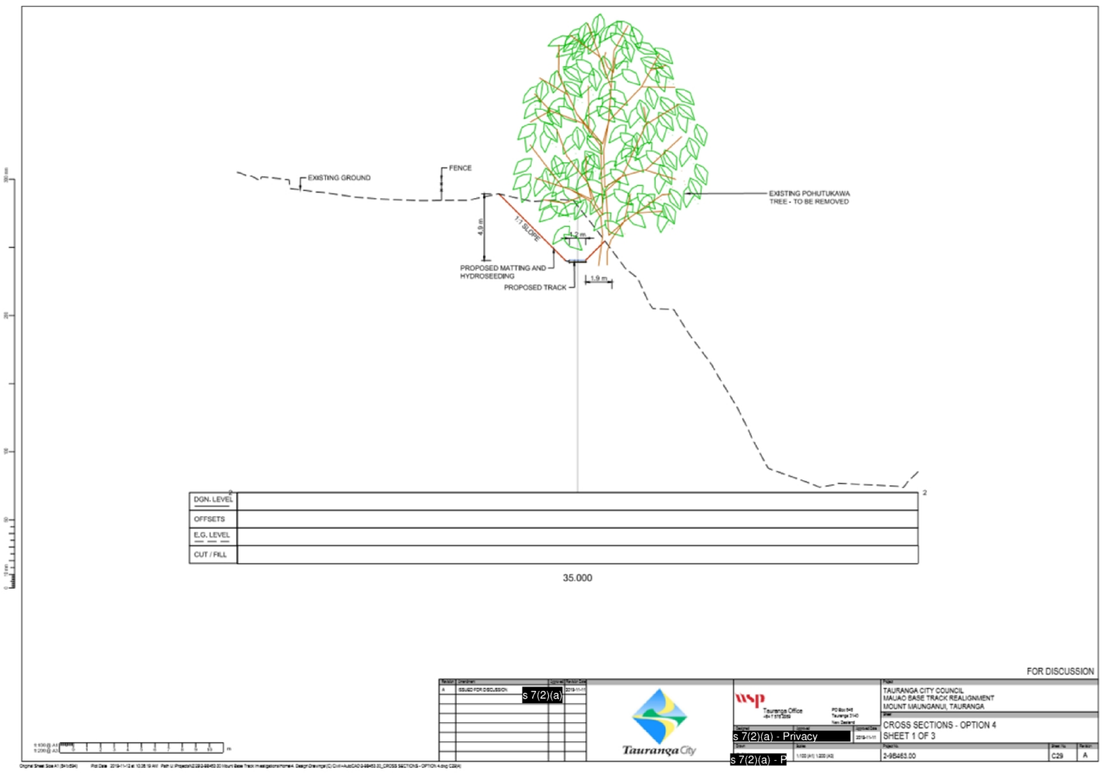

Figure 8:7: Cross Section Diagram Option 4

(WSP, 2019)

Table 8:1: Options Assessment

Option	Advantages	Disadvantages
Option 1 - Minor earthworks and slope stabilisation with erosion protection matting and soil nails.	Finished slip face aand cut slope above track will blend into surrounding environment	May cost more than 3/4
	Does not require resource consent from TCC or BOPRC	Procurement of materials may take time, such as anchor rods and erosion mat
	Less cut material to dispose of onsite than 3/4	Requires specialist machinery to achieve
	Can use existing archeological authority	
	Less chance of disruption to archeologically significant areas	
	Stability of slip face is enhanced	
	Pohutukawas do not need to be removed	
	Small earthworks volume	
Option 2 - Reinstate the track in the existing location through construction of a footbridge to span the failed area	Would result in least disturbance to archeologically significant areas	Bridge would be sensitive to damage from any future slips from above, this would include damage from fallen trees if they were invorporated into landslide debris
	Doesn't require resource consents from TCC or BOPRC	High risk of damage from future landslips
		Abutments for bridge require piled foundations and would need large piles in order to resist lateral forces of landslips
Option 3 - Reinstate track at current existing level through excavating into slope above the track	Physical works can be undertaken by conventional earthworks equipment	Will require Pohutukawas removal to facilitate the excavation
	Once established on site with plant work will be quick to undertake	Will accumulate up to 400 cubic meters of soil that will need to be disposed of on site
	Does not require BOPRC resource consent	Requires TCC resource consent for tree removal and earthworks

	Likely cost effective	
Option 4 - Create a higher-level track above the existing Pohutukawas	Physical works can be undertaken by conventional earthworks equipment	Will generate up to 600 cubic meters of soil that will need to be disposed of on site
	Pohutukawa trees won't need to be removed	Requires excavation in archaeologically dignificant areas
	Track is less susceptible to erosions from coast and landslips	Has largerst earthworks volume and footprint and potential to disturb culturally significant areas
	Does not require BOPRC resource consent	Requires TCC resource consent for earthworks
	Resilient long-term option	

Table 8:2: Options Assessment - Maintenance

Option	Maintenance Requirements	Suggested Frequency
1 and 2	Inspect base of slip face for coastal erosion signs Inspect track integrity as well as width or signs of instability or erosion below and above track	0 to 2 months following construction, weekly monitoring suggested 2 to 4 months following construction, inspect fortnightly 4 to 12 months, inspect monthly After 12 months consider reducing to regular two monthly inspections Requires inspection after major seismic or rain events
3 and 4	Inspect base of slip face for coastal erosion signs Inspect track integrity as well as width or signs of instability or erosion below and above track	0 to 2 months following construction, weekly monitoring suggested 2 to 4 months following construction, monitor fortnightly After 4 months consider reducing to regular two monthly inspections Requires inspection after major seismic or rain events

(WSP, 2019)

Tables 8:1, and 8:2 show the positives and negatives of each of the options, while Fig. 8:4. to 8:7. show the cross-sectional drawings. These options were analysed and discussed over in order to choose the best one for the project. Though the budget was not unlimited, option 1 was decided upon, as the Mauao trust did not wish to remove the Puhutukawas, and the sensitive archaeological areas could not be excavated.

After the respective parties gave their approval to the option, physical works could begin, and a contractor set out their methodology to complete the project, and a price to be agreed upon. Due to Christmas coming up, the plan was to complete the works to a sufficient extent to have the track open for Christmas, and then at the end of January to close it once more to complete the lower slope. For this the works were split into phases. Phase 1 consisted of the works on the track, and the upper slope, while phase 2 consisted of the lower slope works.

Figure 8:8: Container Set-up

For the methodology, firstly there was the establishment/mobilisation/dis-establishment by way of hiab and transporter. As can be seen by Fig. 8:8. the containment consisted of two containers to be located at the existing parking area seaward side in order to provide housing of materials and tools for the projects duration. A geo-cloth or similar was to bund socks around the outer of the containers.

For the plant, like those seen in Fig. 8:8. there was to be a 5 tonne excavator, 3 tonne skid steer, pedestrian roller 1.5 tonne, 5 tonne exc/drilling rig. The plant was to carry out the works, while also being able to move to and from the worksite through the track. A small ATV/Quad and Pump plant was also needed for grouting and hydroseeding native growth material.

Figure 8:9: Front Fecing and Hazard Board

Figure 8:10: Back Fencing

As seen in Fig. 8:9. and Fig. 8:10. the installation of safety fencing was also required, the minimum of which was 1.2m high. The installation of construction boards and signs in facility were also required.

For the plant movement, each individual plant was required to be accompanied by two spotters, one at the front and rear of the machine for safety and to warn the members of the public using the track. Where there was no possible safe passing opportunities for track users, the spotters would have to hold back the track users until it was safe to pass the machine only once the machine was fully shut down and inoperable for that duration.

Figure 8:11: Track Works

Figure 8:11. shows the work to the track, where a skidsteer was to remove the top ~30mm and stockpile on the track to be relayed/compacted back on the track. The cut from the bank trim was to be placed on the track at a maximum height of 400mm or to an acceptable grade determined by the engineer. At the completion of works the CAP would then be relayed over the top and compacted to walking track standards.

Working from the eastern part of the slip, a five-meter longitudinal section was to be excavated and passed back cut as the contractors progressed to skid steer. Skid steer was then to be relayed over the existing track in order to meet grade requirements.

Figure 8:12: Drilling and Inserting Soil Nails

Drilling was to then be completed by use of a five tonne excavator with mast attachment in order to meet required specifications as designed by the engineer, as shown in Fig. 8:12. The mark-out of the soil nails was to be completed by the consultants, at the completion of the five meter longitudinal section, the rig would standby while grouting was completed.

Figure 8:13: Mesh, Backing Plates

Mesh was to be placed over the extent of the upper slope face once the soil nails were installed, this can be seen by Fig. 8:13. GV Backing Plates were also to be installed to completion.

Figure 8:14: Permanent Handrail

A permanent handrail was to be completed as programmed to the design set out by the engineer, this was created based on keeping the design natural to the area. Hence, it was designed as a wooden handrail.

At the completion of the construction works, native seeds would be hydroseeded using a quad vehicle, final reinstatement and inspections of track conditions would also be completed.

A health and safety management plan was to be developed specifically for the contract through consultation with TCC, the contractor and subcontractors, and consultants in order to achieve a collaborative health and safety plan with all necessary policies and procedures currently adopted, and statutory provisions. There was to be daily tool boxes and updates to the hazard boards, which was upheld. (WAIOTAHI CONTRACTORS LTD , 2019)

Figure 8:15: Open for Christmas Pilot Bay Sign

Figure 8:16: Open for Christmas Opposite end Sign

During the down periods of construction for Christmas, signs were required to be put on each side of the slip in order to tell the public that the track was open during the Christmas break as seen in Figs. 8:15 and 8:16. The Student Project Manager was responsible for bringing these signs to the track, and indicating where they were to be located, as well as ensuring they had been set up, were easily visible, and did not obstruct the track. The signs read: “Open This section of track is open for the holiday season. Works are not complete. We will close this portion of track in late January to complete the works. Thank you for your patience.”

Figure 8:17: Temporarily Closed Sign

Figure 8:18: Base Track Open Sign

After the works began again, a good amount of public became confused concerning the works, thinking that they had already been completed despite the previous signs. As such, signs were then set up in the previous positions each side of the slip as seen in Fig. 8:17. These signs stated: “Temporarily closed This section of the Base Track is temporarily closed while we finish the remainder of the required works. Please use the stairs. The track will be open again by early Match. We apologise for any inconvenience.” Signs were also set up at the starting ends of the track as seen in Fig. 8:18., as to inform people before they potentially walk to the area to need to turn back. These signs stated: “The base track is open However, stairs must be used at one location while repairs are taking place. We apologise for an inconvenience.” Again, the Student Project Manager was required to ensure they were up and in a good position. These signs helped to inform the public who were unaware or unsure of what was occurring.

Tauranga City

Daily Report

Date:		Start Time:		Finish Time:	
Site Name:				Contractor:	

WEATHER CONDITIONS (√)

FINE ☐	OVERCAST ☐	SHOWERS ☐	RAIN ☐	HEAVY RAIN/THUNDER ☐

ENVIRONMENTAL CONTROLS (√ or X)

EROSION & SEDIMENT CONTROLS COMPLYING ☐	DUST & NOISE AT ACCEPTABLE LEVELS ☐	WATER COURSES PROTECTED ☐	SITE ENTRANCE FULLY STABILISED ☐	WORKSITE CLEAN AND TIDY ☐

TRAFFIC CONTROL IN PLACE (√ or X)

Public Managed Safely ☐	Sufficient Entry/Exit for Site ☐	Vehicle Areas Designated ☐	Induction Completed ☐	Protection of New Seal ☐	Site Attended ☐	TSL in Place and Working __km/h ☐

H&S OBSERVATIONS: (e.g PPE, Exclusion Zones, Site) + or -

PLANT/RESOURCES NOTES:

WORK PLANNED/COMPLETED TODAY:

WORK PLANNED FOR FUTURE:

WEATHER FORECAST FOR WEEK REMAINING:

NOTES, NOTIFICATIONS & IWI MONITORING DETAILS:

COMPLETED BY (NAME): ______________________________ SIGNED: ___________

Figure 8:19: Tauranga City Council Daily Report

Part of the Student Project Manager's role with all projects was to complete a daily report upon site visits. However, a proper template did not exist for this, so another responsibility was to create a daily report that could be used by project managers during site visits. To do this, other contractor's daily reports were used as a guide, and over various iterations made using a pdf editor, including testing on site to better fit the details a project manager would need to use, and response from other project managers, the report seen in Fig. 8:19. was made. An online version was also created for those preferring to use their phones or tablets on site visits, making a more interactive form for that use. These reports were done on each visit, which was near daily, and photos were taken to observe the work done on the site and any details that need to be looked at (these pictures were used in this report).

Figure 8:20: Soil Nail Drilling and Abseiling

Soil nails were a large part of the work on the slopes of Mauao at the slip site. In order to work on the lower slope, specialised abseiling sub-contractors were required, and special safety plans were also necessary. Temporary anchors points were installed to allow safe access for drill rig and crew. The proposed anchors consisted of slinging the mature Pohutukawas within the centre of the site, which had been reviewed and deemed suitable by the project's supervising arborist. After mobilisation and equipment setup was complete the drilling locations were marked out, then the drilling and installation of soil nails could commence. The drilling took place by rope access trained drillers and technicians utilising a specialist lightweight Marini drill rig designed for steep gradients, as seen in Fig. 8:20. Grouting was completed with a small Whyte hall grout plant, that could be easily operated by a small team. This grout plant was pneumatically driven. A batcher, a spotter, and a man on the nozzle was required to operate the grouter. Radios were required as they needed visual and audio communication at all times. The soil nails were tested once the grout had cured to ensure they met specifications (Earth Stability, 2019).

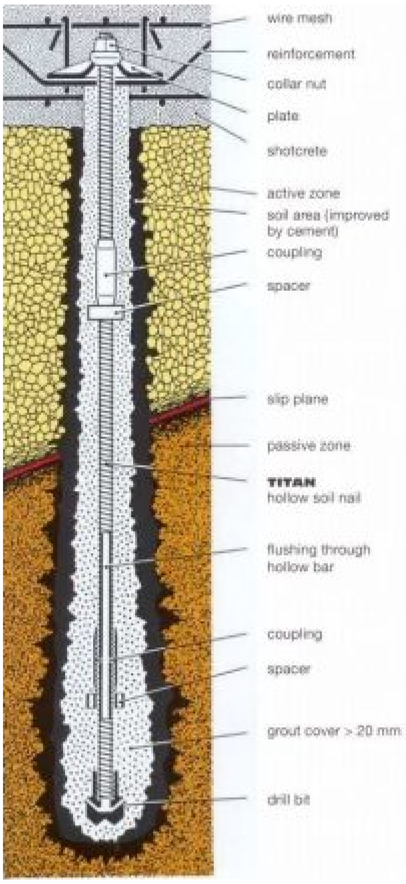

Figure 8:21: Soil Nail Sections

Figure 8:22: Soil Nailing Process

In the soil nail technique, soil is reinforced using slender elements such as reinforcing bars, also known as nails as seen in Fig. 8:21. These nails are installed into pre-drilled holes, then they are grouted. These nails are installed at an inclination of 10 to 20 degrees with the vertical of the slope as can be seen in Fig.8:22. As excavation proceeds, the shotcrete, concrete, or other grouting materials are applied on the face of the excavation in order to grout the reinforcing steel or nails.

8.2 Pond G

Pond G is a large earthworks project at the eastern end of Papamoa. For this, the student project manager’s role was similar to that in Mauao, but less involved. Daily reports were done usually twice per week, updating the project file with pictures and in the previously mentioned form to note the changes in the large section of earthworks over time.

Figure 8:23: Archaeological Digging

The first thing that was required to occur before any digging commenced, was to have an archaeologist check the topsoil. This was required before any bulk earthworks could begin in the area, however, due to the size of the area being excavated the contractors were able to start once the archaeologist moved to another part of the site. That meant the contractors could work at the same time as the archaeologist so long as that area had been examined first.

Due to health and safety reasons, a one-way haul road design was used. This allowed for one-way circulation of traffic. Trucks would pass safely as even at a low speed impacts of these plant could cause great damage and risks to health. The bunds on ramp and stockpile tipping areas were required to be 50% of the largest tyre diameter. Regular maintenance was also required.

For this job, due to the size of it, large plant was used to more efficiently move the soil. For topsoil stripping, a 35 tonne Hitachi Excavators (gps) was used with 2 number 30t Moxt ADTs. For the bulk cut, 50 tonne Hyundai Excavators were used with 3 number 30t Moxy ADTs. For the swales and final pond cut 35 tonne Hitachi Excavators (gps) were used with 2 number 30t Moxy ADTs. For the trim and topsoil spread batters 20 tonne Hitachi Excavators (gps) were used with load out by the swales and final pond cut crew. For the structures a 20 tonne Hitachi and 14 tonne Hyundai were used and loaded out by the same crew. For dust reduction, haul road and site maintenance, two 10,000 watercarts and an 18 tonne XCMG grader were used. Watercarts were full time for one and about half for the second, while the grader was for about 2 to 3 hours.

Daily and weekly tasks had allowed resources for: dust control and suppression, daily environmental check on I auditor and PDF's direct to client, measurement and recording of water take, and production graphs for weekly reports (MAP Projects, 2019).

Figure 8:24: Topsoil Stripping

The topsoil strip required iwi monitoring as the works proceeded. Once a section of site was cleared, the topsoil from a section of the swale and a section of the pond was removed. Excavation sites were progressively cleared as to control dust since there would be larger unworked areas where grass would remain until work began there. Initial topsoil strips were carted to the nominated stockpile area and tipped. Topsoil was required to be stacked loosely over 4m high, so it was logical to move the topsoil to the end of the stockpile.

Topsoil placement occurred as follows:

- Excavate to final grade and use gps dozer to trim

- Hand over the survey package for the quality lot, then confirm acceptance for northern and eastern batters of the swale
- Place the topsoil on the northern or eastern batter of the swale with a gps dozer
- Using the "drag box" method, place the soil rip rap as follows:
- Place Boulders
- Hand over the survey package for the quality lot, then confirm acceptance for northern and eastern batters of the swale
- Place the topsoil to the centre, southern and/or western batter of the swale with gps dozer
- Create a final survey package finished topsoil to handover
- Once the topsoil is finished hydroseed and make the area ready for planting
- Maintain as required to the specifications (MAP Projects, 2019)

8.3 Meander Drive DxV

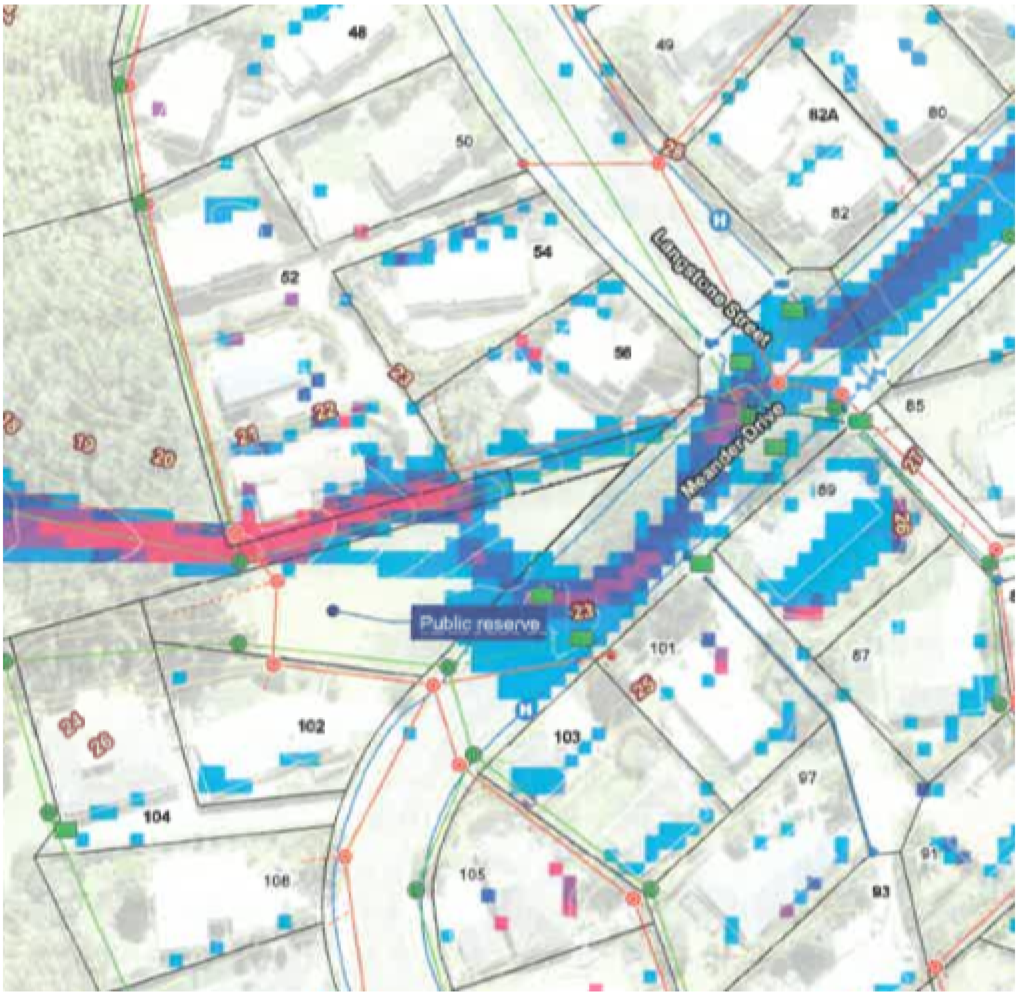

Figure 8:25: Meander Drive DxV Analysis

(GHD, 2019)

The Meander Drive project was based on an investigation of the track leading toward Johnson Reserve as can be seen in Fig. 8:25. In the figure, the pink shows a DxV of over 0.8, the purple between 0.6-0.8, the dark blue being 0.4-0.6, while the lighter blues are under 0.4. The required DxV on a property is below 0.4, so the issue here was that on the nearby property there was a high DxV as can be seen on Fig. 8:25. The aim of the project was to reduce the DxV on the house to below 4 cubic meters per second.

Table 8:3: Meander Drive Flood Records

Reference	Comment	Customer/Location
646442 27 Mar 2017 10:31am	Stormwater/sand bags 30 x sand bags required for stopping flooding from a neighbouring property on the retaining wall	Not confidential Anne O'sullivan 69 Meander Drive
135687 19 Apr 2007 09:35am	Stormwater/instruction to city SW kerb connection pipe is broken as a result of vehicle movements over pipe in berm. Requires repair and berm filled in	Not confidential Kathryn Michel 53a Meander Drive
95136 27 Mar 2006 10:44pm	Stormwater/flooding - sump/cess 20:50 - Margaret phoned to say the bank behind her house at 48B Meander Drive, W/Bay had given way. Their concrete patio had now	Not confidential no name unknown Meander Drive

(GHD, 2019)

This project was run mostly by the Student Project Manager, though the principle was the Team Leader of Infrastructure Delivery, and hence they were required to review all documents.

The first tasks of the project were the pre-planning, and the options. The first option was to do nothing, as after a site inspection the property was found to be on piles, and hence had some resistance to a heavy rainfall event and flooding. The second was to look at methods to improve the DxV in the area. The second option was chosen as it was found that the best option was to improve the overflow path that ran by the property.

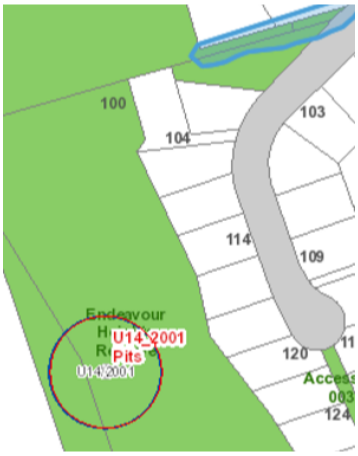

Figure 8:26: Archaeology in Meander Drive Area

The archaeology of the area was examined to determined what plan would be required for excavation. Using the Tauranga City Council maps, the significant sites could be brought up and their proximity to the planned works area examined, as can be seen in Fig. 8:26. This map was sent to Heritage NZ, in order to determine if a plan was required for excavation, however, it was determined that work could go on without one, and anything significant during digging would require work to stop so archaeologists could examine the area further.

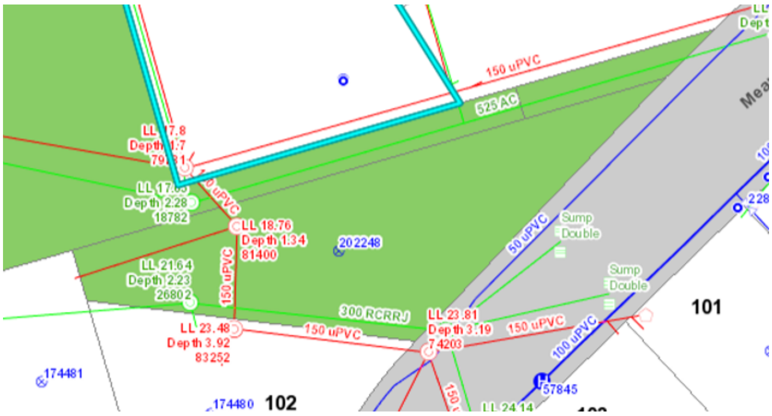

Figure 8:27: Services in Meander Drive Area

A dial before you dig was also undertaken to see if any services were within the proposed work area. The only services found within the proposed work area were stormwater and wastewater drains, though they could be found on the Tauranga City Maps, as seen in Fig. 8:27. These drains were deep enough to not effect works, however, the connections to the households would be unknown, and by checking the as-builts the general locations of these could be deduced.

After meeting with a consultant and contractor, it was found that the best options to improve the overflow path was to form a bund near the fence line to move the water away, or to build a retaining wall.

Initially, the plan was to do a simple design, which would have been cost effective and quick, however, the consultants investigated doing a full design. After consulting with the waters team within the council, who had the budget for the improvements, a full design was decided for the project, including an options assessment, and project management.

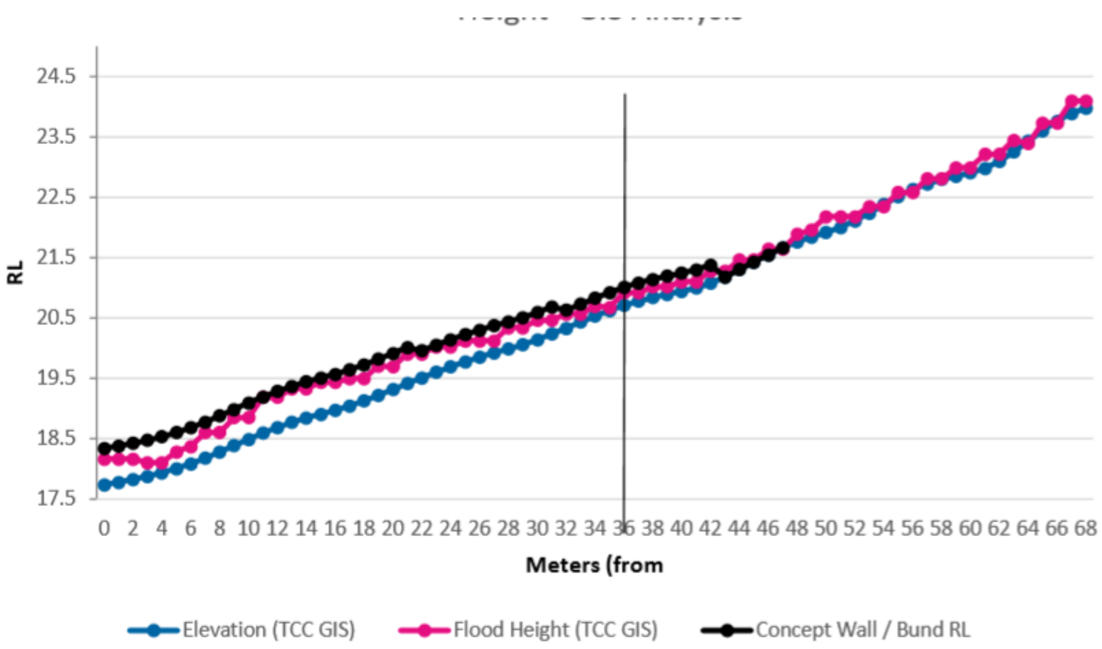

Figure 8:28: Height Analysis

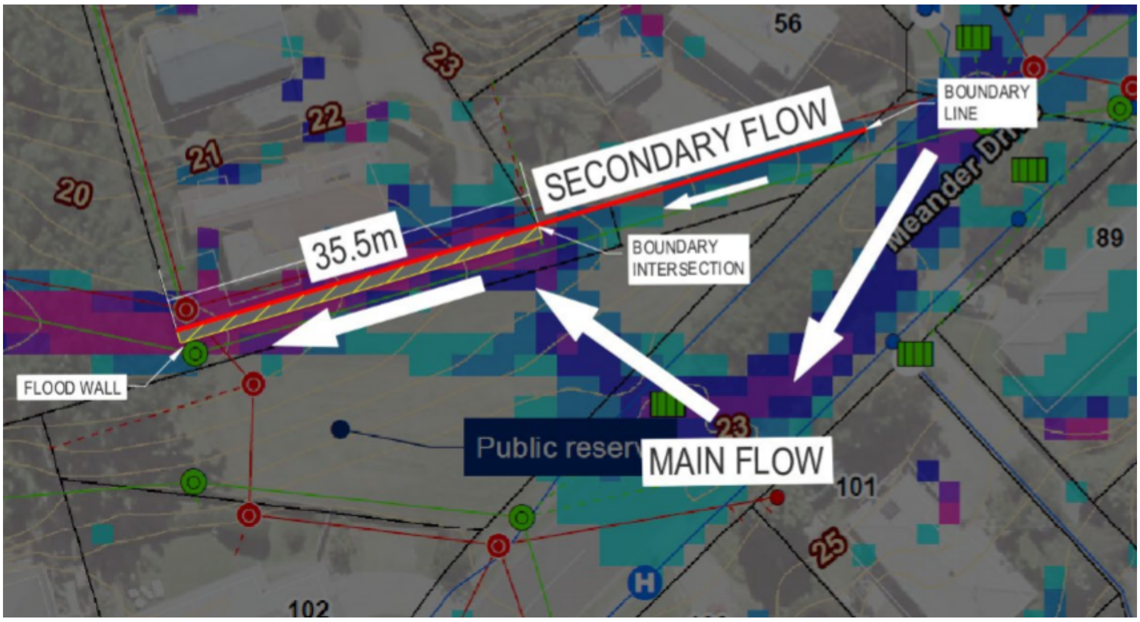

Figure 8:29: Length of Flood Wall/Bund

Using the height analysis in Fig. 8:28. it was found that a height of 0.6m was required to divert flow away from the property. This, in turn, would reduce the DxV issue. Figure 8:28. shows the required length of the wall/bund in order to divert the flow. The length would be required to be 35.5 meters, this is only required due to the majority of flow coming from Meander Drive, down the footpath and into the current fence-line below the boundaries intersection. (GHD, 2019)

Table 8:4: Options Assessment

Categories	Flood Wall	Bund
Building Consent	Unlikely to require building consent in accordance to Building Act 2004 as the proposed wall is less than 2.5 m. Would require confirmation at design stage.	Does not require building consent as landscaping works not affecting a building or structure.
Resource Consent	Flood wall near private property boundary is unlikely to require resource consent	May require consent for works within an overland flow path. Planning assessment required to confirm.
Design Complexity	Retaining wall would likely require a specific design due to the risks associated with retaining high velocity flood water.	Likely to require some specific design, however not as complex as a flood wall.
Construction Complexity	Construction of retaining walls is a specialist activity	Reasonably straight forward to construct so long as material available on site is suitable.
Cost	The cost of a retaining structure is expected to be higher than that of a bund.	The cost of the bund is expected to be lower than that of a wall if site won material can be used.
Footprint	Floodwall has a very small footprint.	The bund will have a larger footprint (approximately 1.1m wide).
Maintenance	Programmed structural inspection and maintenance of the wall would be required.	Periodic maintenance of the bund would be required.
Programme	Due to design and construction complexity.	Due to design and construction complexity.

Table 8:4. was the options assessment given by GHD in their options assessment document. Green colouring indicated beneficial attributes, yellow for less desirable, and red for undesirable. Based on the given options, and the recommendation from the consultants, the option of the bund was chosen.

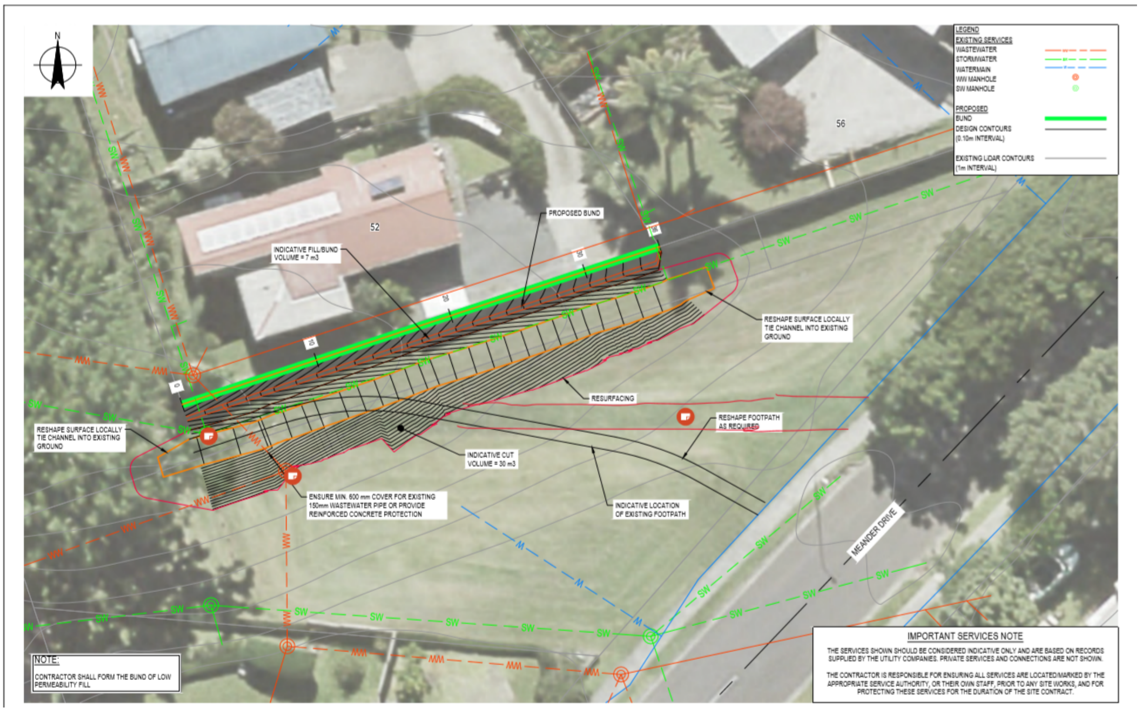

Figure 8:30: Design of Bund and Channel

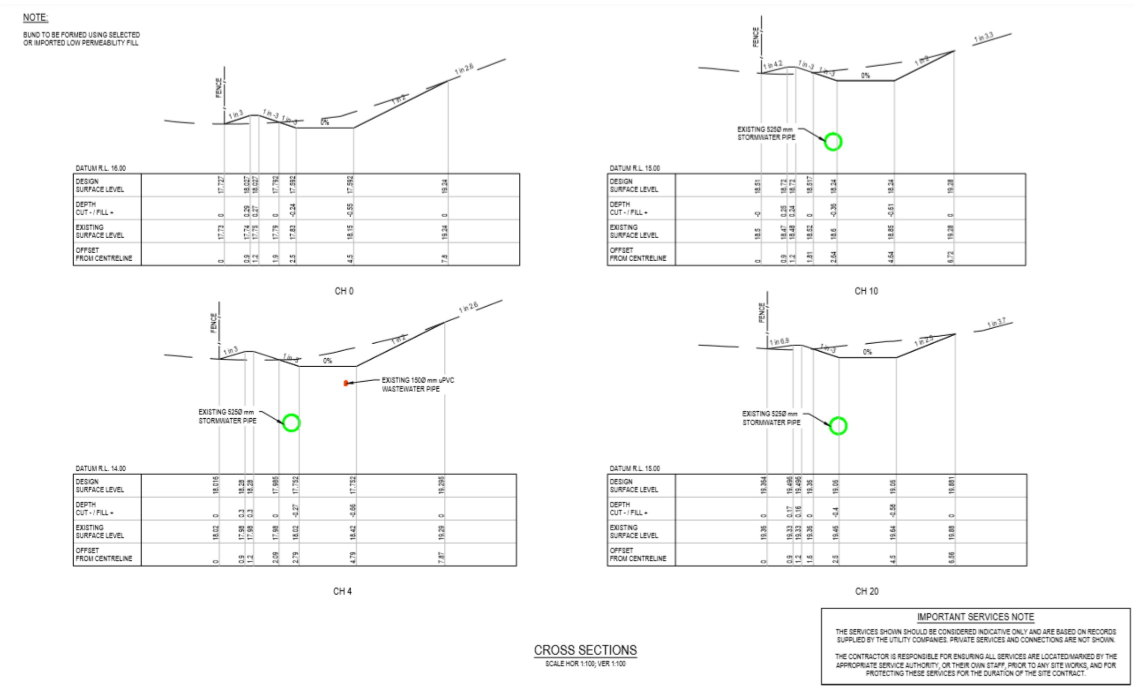

Figure 8:31: Proposed Cross Sections 1

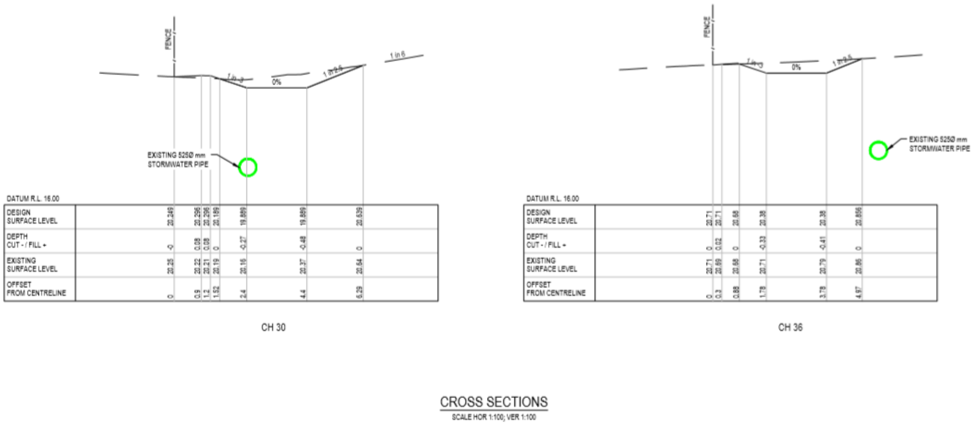

Figure 8:32: Proposed Cross Sections 2

Table 8:5: Flow Capacities Post-Design

Chainage	Flow Capacity (m3/s)
CH 0	4.63
CH 10	5.59
CH 20	4.78
CH 30	4.12
CH 36	4.63

Table 8:6: Flow Capacity Calculations

CH 36			CH 30			CH 20			CH 10			CH 0		
A	m^2	1.32	A	m^2	1.24	A	m^2	1.38	A	m^2	1.52	A	m^2	1.33
P	m	4.46	P	m	4.34	P	m	4.54	P	m	4.58	P	m	4.34
S	m/m	0.0765	S	m/m	0.072	S	m/m	0.072	S	m/m	0.072	S	m/m	0.072
n		0.035	n		0.035	n		0.035	n		0.035	n		0.035
Q	**m^3/s**	**4.63**	**Q**	**m^3/s**	**4.12**	**Q**	**m^3/s**	**4.78**	**Q**	**m^3/s**	**5.59**	**Q**	**m^3/s**	**4.63**

(GHD, 2019)

After the option was chosen, a design was made for the DxV of Meander Drive. It was found that the best way to deal with the issue was to construct both a bund and build a channel to divert the flow of water away from the property fence-line. This is seen in Fig. 8:30. while the cross sections are displayed in Fig. 8:31 and 8:32. One issue in the design, seen in CH 4, shows a high service, which would need to either have enough ground above it, or to be reinforced by concrete. As can be seen by the data in Tab. 8:5. calculated by the manning equation using the data from Tab. 8:6. there is still a flow capacity above 4 cubic meters per second, however, this is on the channel, not at the property.

Contractors were then, and previously, organised to begin physical works on the proposed work, including site specific safety plans and methodology.

8.4 Health and Safety Observation Reporting

Table 8:7: Event Type Explanations

Event Type	Explanation
Works	Observations based on work going on, or operation by workers. For example, inspections of the work being done, observations on worker actions.
Environment	Observations that pose risk or are good for environmental controls, such as possible areas where runoff could get to waterways, or good controls set up to prevent this
Equipment	Observations based on equipment, such as noticing that a piece of equipment is due for inspection, or that it has been well maintained and well used
MoP	Anything to do with members of the public, such as those not following the set path created by an stms, or assisting members of the public to get around the site.
PPE	Anything based on PPE, it could be that all workers are in good ppe for a positive observation, or that an employee was found to have insufficient ppe
Site	Observations based on the site, such as an area that could pose risk like a hole not being coned off, or on the contrary if the hazards are all clearly shown
Services	Any observation around already existing services, this could be that all services were detected prior to work, or that a service was suddenly found during the work
Plant	Observations around the use and maintenance of driven machinary, such as if they are being operated/used inproperly, or if all are in good condition and being used well
Meeting	Meeting is simply to identify the observations recorded that discuss that a toolbox took place, or other sort of meeting, in general these will be positive observations
Weather	Observations of the current weather and the danger it poses. It could be a negative observation based on there being extreme heat and little water for the workers, or rain that can cause issue to the works. It could also be positive in the way that they are actively working to mitigate the weather's effect

Tauranga City Council receives all reports of near misses and higher from contractors regarding health and safety. During the summer, a trial was run of collecting observational data from contractors to compile and observe possible trends and their relation to near miss and higher reports. The Student Project Manager and Health and Safety Rep from Tauranga City Council met with various contractors in order to discuss this reporting, and what they required. These reports were only for the jobs the contractors had with Tauranga City Council and was stored within TCC's vault system. This data was used on an excel spreadsheet and analysed to observe any possible trends. At the start of each month, the contractors would give the previous month's reports, and the Student Project Manager would compile them, and organise them by categories depending on their description, these are explained in Tab. 8:7.

9 Outcomes and Discussion

Figure 9:1: Soil Nails in Lower Bank

Figure 9:2: Track and Upper Slope

As can be seen in Fig. 9:1. and 9:2. the work for Mauao is going well. The permanent safety handrails were taken down temporarily in order for the absailers to get down to the lower slope, but it is not difficult to put back. The top slope has been fully drilled, grouted, and matted, and has a very good look ready to be hydroseeded. The bottom slope has nearly 110 nails in it, providing a great amount of structural support to the slope to protect it from a significant event. The track is fully cleaned up and compacted, more than fit for use. It is expected that the track will be finished by the end of February, either the same week, or week after the Student Project Manager finishes.

Figure 9:3: Pond G at Start of Works

Figure 9:4: Pond G Currently

Figure 9:5: Pond G Stockpile

The work on Pond G has been going smoothly since physical works started. As far as earthworks are concerned over one third has been completed, and considering the finish date being around August, and starting late January of the same year, the project is more than on track. The differences between Fig. 9:3. and Fig. 9:4. are clear, the previously hilly or flat terrain has transformed into a large excavation where shaping has already begun. Figure 9:5. shows the large stockpile that has been formed so far during the works. It is expected that this stockpile at its largest will be one kilometre long, and six meters high.

Meander Drive has yet to begin physical works. It was planned to start in January, however, due to delays by doing a full design, that was pushed back into mid-February. Due to this, the contractors had already booked themselves out with work, causing further delays in the start time of the physical works. As well as this, by requiring site specific safety plans, environmental plans, and other documents from the contractor, it is possible further delays may occur. The work is still going well however, there is a set and good costing for the project works, all designs are set out and ready to go, and other factors such as iwi monitoring have been planned and consulted.

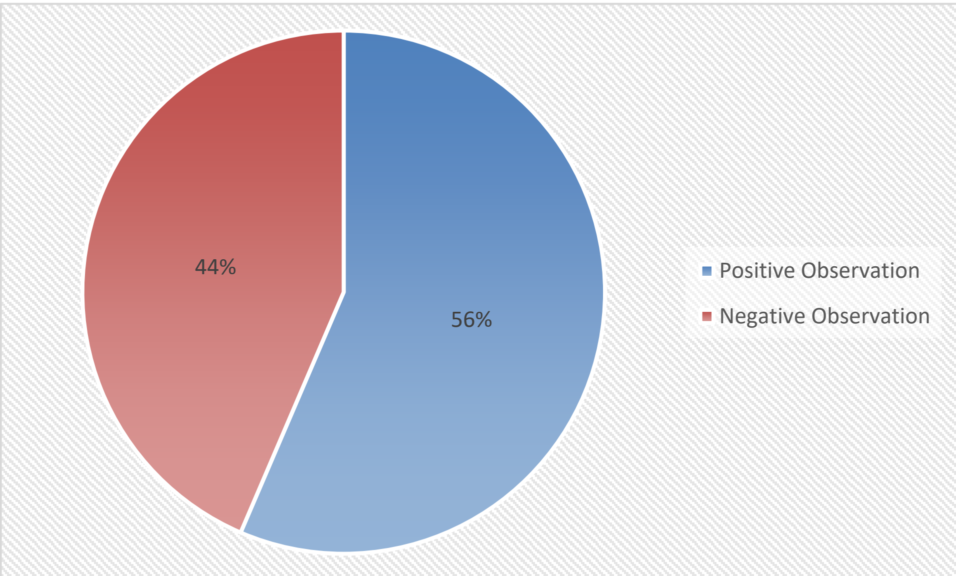

Figure 9:6: Total Positive and Negative Observations

Figure 9:6. shows the percentage of positive to negative observations for the observational health and safety reporting. The data for which can be found in Tab. 12:1. in the appendices. As can be seen, over these four months there was a greater number of positive observations than negative, which is good to see as there is a lack of positive reporting in health and safety, and shows these observations give good opportunity to receive them.

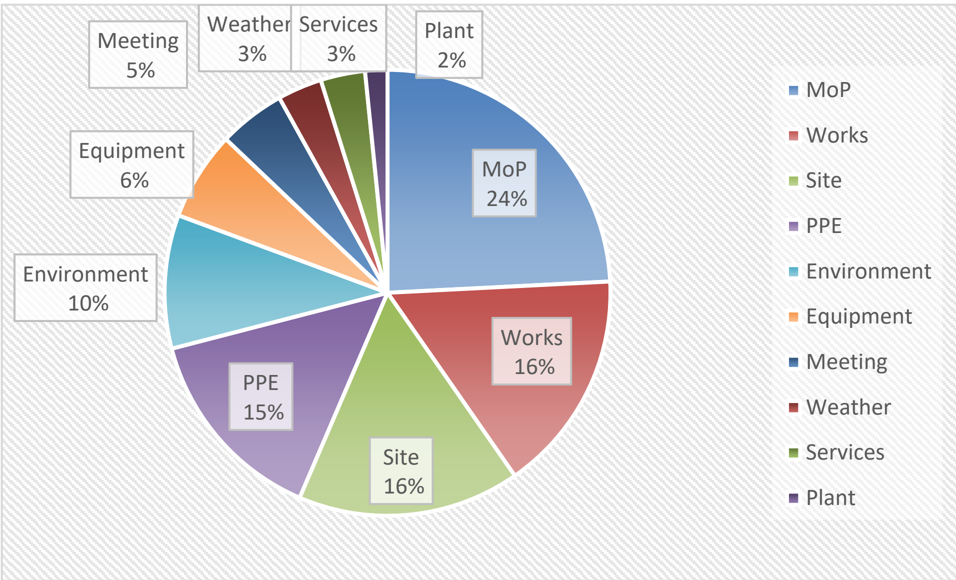

Figure 9:7: Observational Category Numbers

Figure 9:7. shows the respective amount of reports depending on the event. It can be seen from this pie chart that almost a quarter of the reports were on the members of public, with works, site, and ppe making up around 15-16% each, while equipment, meeting, weather, services, and plant are rather low. This can be explained by a lot of these lesser categories often being more likely to be involved in near misses and up, such as services and plant, or simply that they are not reported a great deal, such as meetings and weather. This pie chart gives a good deal of information about how much each event occurs on an observational basis on a job site.

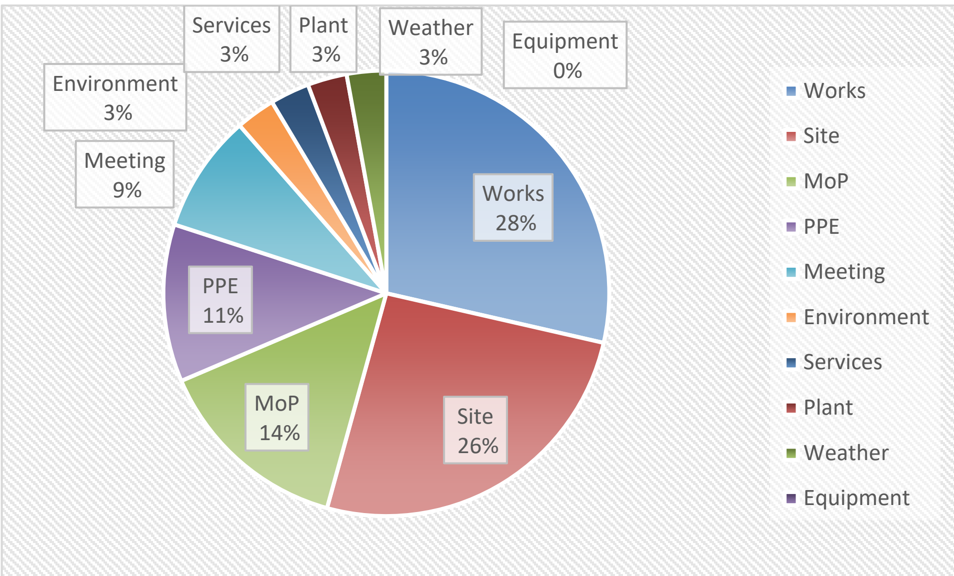

Figure 9:8: Positive Observation Events

By looking only at the positive events, like in Fig. 9:8. it can be seen that most positive reports are from the site, and works. This is often due to site inspections and walk throughs, where a representative would see people working well, that the site has well cordoned off hazards, and people are following correct health and safety procedures.

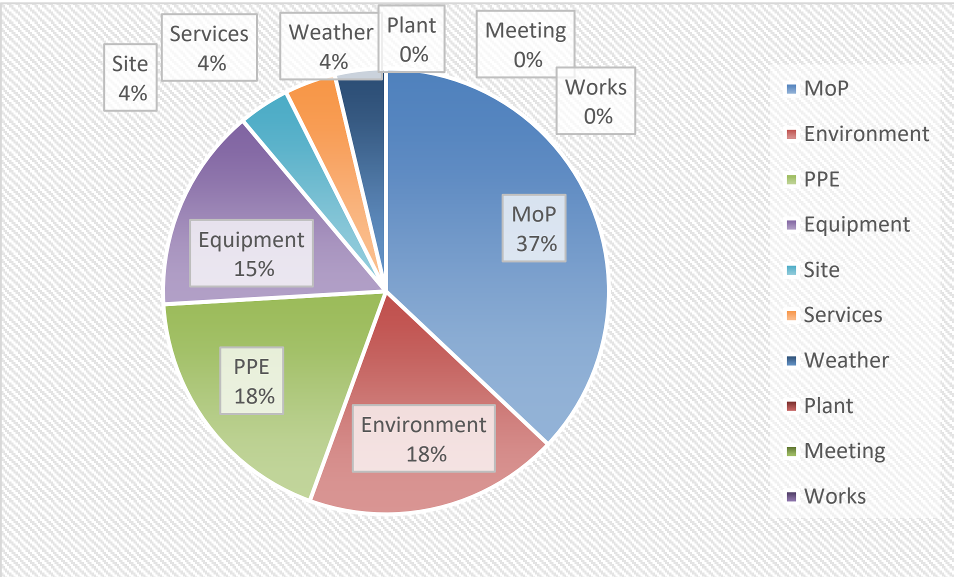

Figure 9:9: Negative Observation Events

Figure 9:9. is a very interesting pie chart, especially when compared to the previous section. Over one third of all negative observations are reported to be due to members of the public. Members of the public acting up near, or even on worksites can be a large issue, and can cause more serious health and safety concerns. When compared to the positive observations, where only 14% are from the members of the public, and where a lot of those reports are from workers helping members of the public, a clearer view of how the public, or a small number of them, react to worksites. An interesting statistic here also is the PPE, or personal protective equipment, being 18% of the negative observations, and only 11% of the positive. This is likely because a representative is more likely to report on negative or insufficient PPE on site, but it does also show a need for improved use of PPE in the workplace. PPE is vital for health and safety, it is not difficult to use, and a lack of it can have severe consequences. Factors such as plant, meetings, and works had no negative observations. Overall it seems that negative observations stem from four main areas: MoP, environment, PPE, and equipment. The negative environment observations would be from possible areas where work could later breach controls, and as such it is far easier to detect negative observations of it. For the equipment, it seems quite common to observe equipment being used incorrectly, or to be used when it is not fit for use, both of which can lead to incidents and accidents.

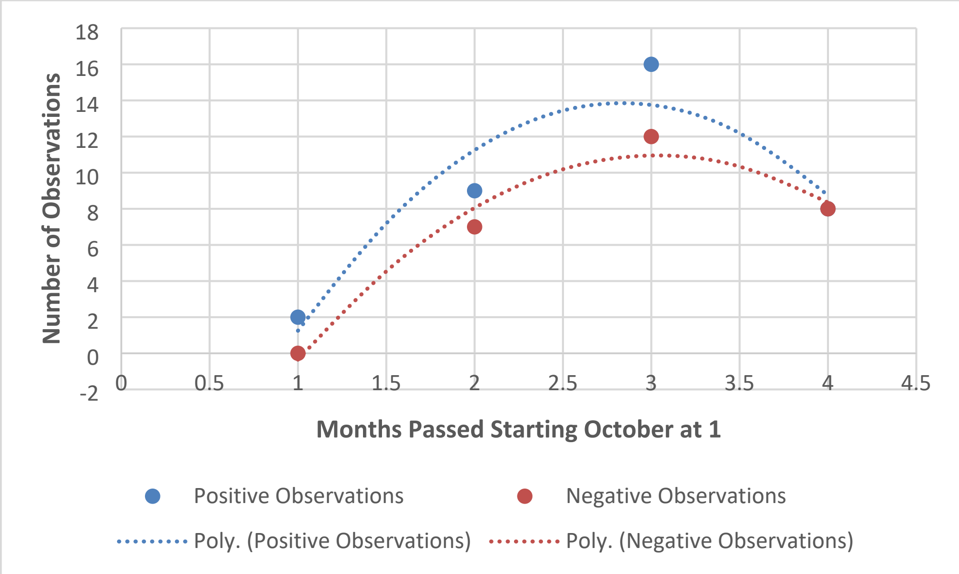

Figure 9:10: Observations over time Scatterplot

Figure 9:10. shows the scatterplot of observations over time during the months of October to January, the data of which can be found on Tab. 12:2. in the appendices. It is hard to say exactly what the reason is for the changes in observations over time, though for the first month it could simply be due to that month being before observations were even requested, hence only a small amount could be supplied. In general, a longer timespan would be required to extrapolate the data and see a true tend in observations. Nevertheless, it is still interesting to see the amount of positive an negative observations seems to stay concurrent, with each month except January having more positive than negative observations.

10 Conclusions/Recommendations

The key outcome in the Mauao job was to complete the work to an acceptable degree to allow people to use it over the Christmas break, and then continue work afterward and finish it all in early March. It can be said that this job was very successful in doing this, the track was open for Christmas, and when work began again, it remained on track and will be completed at the required date.

The main requirement of Pond G currently is to move the earth in good time and begin to form the pond. As can be seen in the discussion this has been achieve to a good amount and is looking to continue in this way for the future.

Meander Drive DxV was expected to be completed before February, however, due to delays it has not begun physical works yet. Though it is not completed, it could be argued that by having full designs, which caused a great deal of delay, the work will be more successful. The channel is showing to still have a flow of over 4 cubic meters per second, but the property will show a different number, where it is important that this DxV be at an acceptable number.

The point of the health and safety observational reporting was to find trends in observations that could explain higher severity issues in H&S. While the time and number of observations is relatively low, it still gives good discussion into the issues and positives in the workplace and could be used to find solutions that could prevent incidents and accidents before they occur.

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12 Appendices

Table 12:1: Health and Safety Observation Data

	Observation Number
Positive Observation	35
Negative Observation	27
Total	62
	Event Category Number
MoP	15
Works	10
Site	10
PPE	9
Environment	6
Equipment	4
Meeting	3
Weather	2
Services	2
Plant	1
Total	62

	Positive Event
Works	10
Site	9
MoP	5
PPE	4
Meeting	3
Environment	1
Services	1
Plant	1
Weather	1
Equipment	0
Total	35

	Negative Event
MoP	10
Environment	5
PPE	5
Equipment	4
Site	1
Services	1
Weather	1
Plant	0
Meeting	0
Works	0
Total	0

Table 12:2: Health and Safety Data to Dates

	Positive Observation	Negative Observation	Total Observations
October	2	0	2
November	9	7	16
December	16	12	28
January	8	8	16
Total			62