



SMEC INTERNAL REF. C1945

Method Statement

Rehabilitation of Upstream embankment of Garden Route Botanical Gardens Dam Wall

Reference No. C1945

Prepared for Cape EAPrac Environmental Consultants

1 March 2023

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1 Introduction

SMEC South Africa was appointed for a Multi-Year Professional Services Contract (Tender No. T/ING/010/2020), under Project 12: Work Package 11 for the Rehabilitation/Upgrading of Water Network and Associated Bulk Facilities: Rehabilitation of Dam Wall in the Garden Route Botanical Gardens, herein after referred to as the Botanical Gardens Dam.

Based on the dam’s small size it is not deemed a dam with a safety risk in terms of the National Water Act (1998). The Dam Safety Regulations (Government Notice R. 139 of 24 February 2012) published in terms of the Act does not apply to the dam. The purpose of this project is to mitigate the risk of a total collapse of the dam wall. This could potentially lead to extensive damage to the lower parts of the Camphersdrift suburb along Caledon Street. This damage could then further lead to extensive claims against the George Municipality and the Trust.

1.1 Problem Identification

At the time of writing of this report, the eastern, southern and western embankments of the existing dam wall show signs of moderate to severe erosion on the upstream slope of the dam wall. The erosion was mainly due to wave action of the water over the life span of the dam and with a lack of maintenance increased the severity of the erosion over time. Further to this the extensive growth of trees and vegetation on the dam wall contributed to undermining the stability of the wall. A portion of the crest walkway is unsafe due to erosion encroachments undermining the stability of the walkway. In addition to the erosion damage, there is a problem with the old overflow and outlet pipe system.

1.2 Locality

The dam is situated north-east of the suburb Camphersdrift in George, Western Cape and it borders the Outeniqua Nature Reserve to its northern side. The property on which the Botanical Gardens dam is located, is managed by the Garden Route Botanical Garden Private Trust (GRBG Trust) as part of a MoU with the George Local Municipality’s Parks and Recreation Department. The GRBG Trust is a registered environmental non-governmental organisation (NGO) with Public Benefiting Organisation (PBO) status.

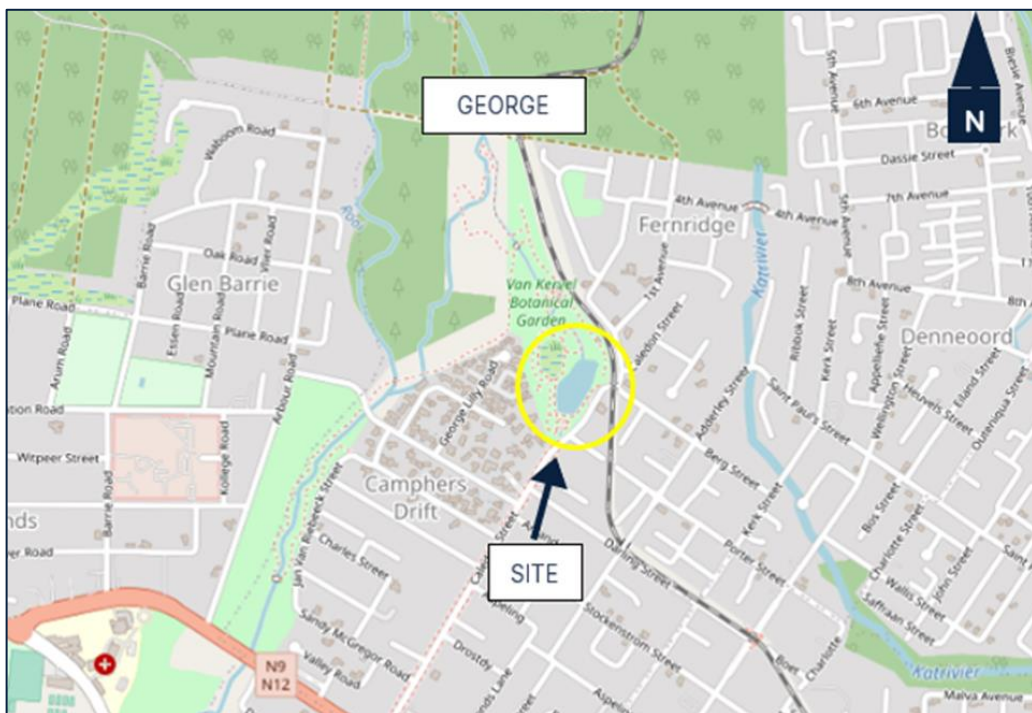


Figure 1-1: Project Location

1.3 Description of the Work

The scope of works agreed to at the Concept and Viability Report meeting is the following:

1. Establishment of Contractor on-site.
2. Dewatering of entire dam to obtain access and workspace inside dam wall for slope rehabilitation may be considered. A portion of this water will be stored in a temporary coffer dam (pond).
3. Clear and grub remainder of trees and vegetation inside the work area.
4. Construct temporary coffer dam inside the existing dam basin to protect the fauna during the construction phase.
5. Remove silt (unsuitable) material and spoil material at site provided by GRBG Trust. A portion of material to be stockpiled inside the dam to create an artificial island.
6. Import suitable fill material and construct new dam wall embankment on upstream slope.
7. Construct new erosion protection at upstream slope.
8. Construct new spillway (overflow) at suitable location.
9. Assess existing bottom pipe outlet and make recommendations on suitable rehabilitation options to permanently decommission the bottom outlets.
10. Rehabilitate the existing crest walkway where necessary.

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2 Standards and Specifications

The following specifications and legislative documentation shall apply to the scope of works to ensure that the works are executed in accordance with the design drawings, at acceptable quality and to the relevant safety standards:

- Occupational Health & Safety Specification
- Occupational Health and Safety Act 85 of 1993
- Construction Regulations 2014
- SANS 1200 Standard Specifications
- Project Specifications
- Construction Drawings
- Environmental Management Programme
- Maintenance Management Plan

2.1 Occupational Health and Safety

The Municipality appointed Xaks Consulting to perform the OH&S duties on the project. The scope of works of the Client's Agent will in general cover the requirements of Section 4 (Duties of the Client) of Construction Regulations 2014. Xaks Consulting compiled a Baseline Risk Assessment and OHS Specifications for the scope of works.

Responsibilities, authority and accountability of Xaks Consulting will include, but are not limited to, the management and review of the following:

- The principal contractor shall appoint a full-time competent person as the construction manager with the duty of managing all the construction work on the Site.
- A competent safety officer to perform OHS duties on site.
- OHS file on site with all the necessary documents.
- A site-specific baseline risk assessment and hazard identification will be performed
- Toolbox talks will be carried out at the beginning of each workday with all employees prior to work commencing.
- Ensure all confined space entry works are performed safely and a Confine Space Entry permit system is implemented before entering or works start within a confined space.
- No employee will be allowed access within the excavation area while the TLB or Excavators are busy working.
- Dust masks are compulsory during dusty conditions.
- Protection around the excavations will be installed. A construction barrier nett of at least 1m high and as close to the excavations as possible will be installed. Warning signs are to be posted on these barriers.
- All employees and contractors involved in this activity are competent to do so.
- All operators must be licenced and certified. Copies of such documents will be kept on file at the Site Office.
- Ensure that environmental issues receive adequate attention in the site induction training.
- Prepare and conduct awareness training (posters and signage) for contractor's personnel on site.
- Take required corrective actions within specified time frame.
- Compilation of project environmental management file.
- Make the workers aware of the unbalanced slope and impacts of dams on the upstream side (however the slope is considerably flat, 1:3.5)
- Be considerate for dam collapses during the excavation of the existing dam embankment.
- Be aware of the risks and effects of heavy rain or floods and have flood control methods in place.

2.2 Construction Works Specifications

The standard specifications for the completion of the construction works will be the SABS1200, Standardized Specification for Civil Engineering Construction, that includes a section on small earth dams which will form the basis of the standard specifications.

Any variation to the standard specifications named above will be documented and described inside the Project Specifications which will be included in Part C3 of the Contract Document.

Further to the above the construction drawings will comply with the relevant design principles and all works shall be completed as per the dimensions, specifications and requirements set out on the construction drawings.

2.3 Environmental Management

The environmental management on this project is taking high priority due to the location of the site inside a botanical garden that is also frequently used by the public. Cape EAPrac Environmental Consultants was appointed as the Environmental Practitioner for this project and will conduct regular site visits to ensure the Contractor comply with the relevant environmental specifications and requirements as, but not limited to, the following:

- Monitor compliance with the EMP and environmental method statements.
- Maintain site documentation related to environmental management (permits, EMP, Method statements, audit reports, monitoring results, receipts of waste removal, etc.) These documents need to be stored in the relevant site Documents Control System.
- Inspect and report on environmental incidents and check corrective actions.
- Keep photographic records of all environmental incidents.
- Keep records of environmental incidents, hazardous substance register, complaints register and environmental non-compliance register.

Under the environmental management there will be demarcated NO-GO areas which will be cordoned off and protected during the construction works activities. These areas will be the entire area from the outside of the walkway edge all the way to the toe-line of the downstream embankment of the dam wall.

The construction work activities shall be performed within the dam basin and up to the walkway. This will ensure the works area are contained within the a fixed perimeter. The construction work activities involve the rehabilitation of the upstream slope, the walkway and the construction of the new spillway. Any work/rehabilitation to be done on the downstream slope does not fall within this contract. Therefore the contractor will not work beyond the edge of the walkway on the crest of the dam wall.

Access to the dam basin will be through a temporary access road located in the north-eastern corner of the dam. The temporary access road shall be constructed using 200mm thick gravel material to ensure stability during the material hauling (transport) activity. All major plant must enter the dam through the temporary access road. In the dam itself, the only disturbance of soil will be along the length of the embankment to be rehabilitated as indicated on the construction drawings. The spillway will be constructed on the western side of the dam and will comprise earthworks and small concrete works on the crest of the dam wall.

Access to the site will be gained through the gate at the parking area to the left in Caledon Street just before the railway and intersection with Berg Street. Further, the contractor will transport the excavated material from the dam to a location where it will be stockpiled via the existing gravel road inside the gardens. **Figure 2-1** below shows the various areas in which work will take place. **Figure 2-2** shows the area where material will be stockpiles as indicated by an employee of the Gardens.



Figure 2-1: Work Area Layout

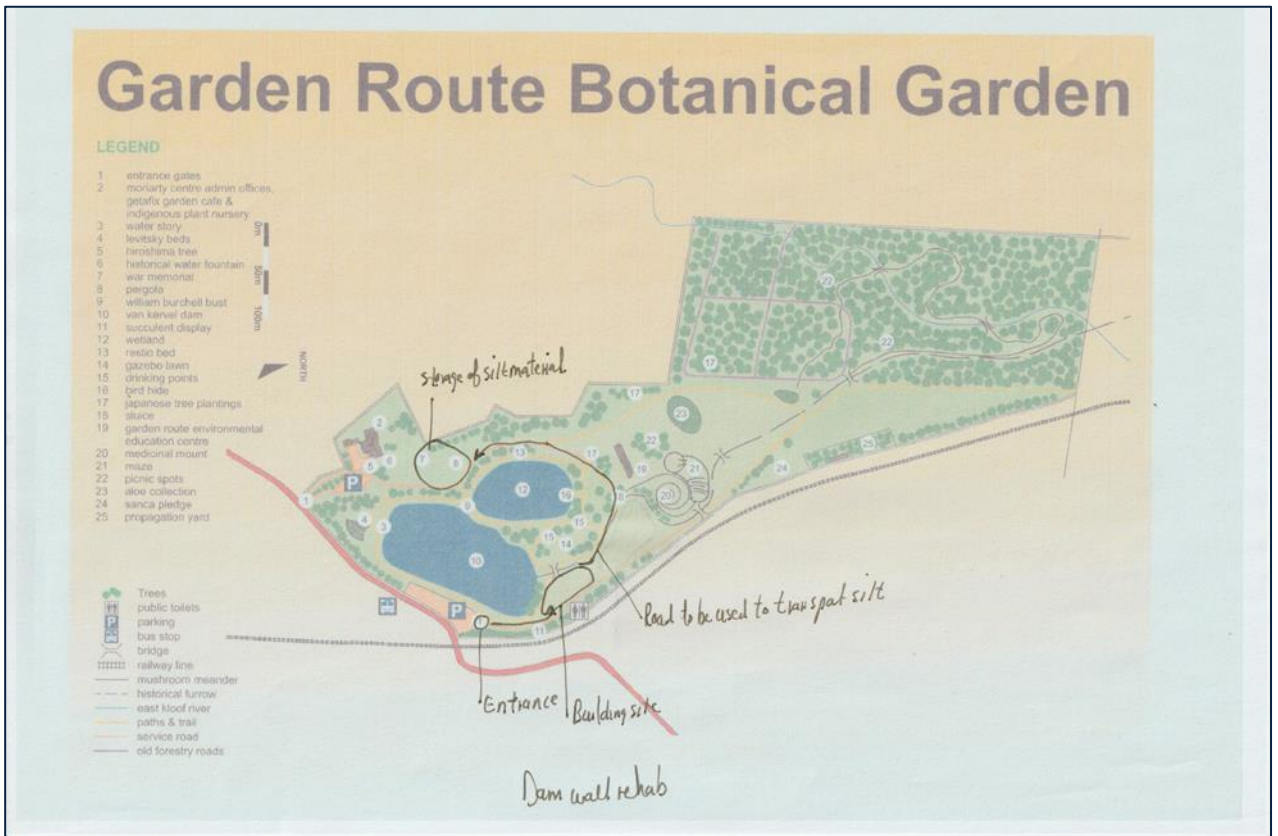


Figure 2-2: Stockpile Location

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3 Plant & Equipment

For the effective execution of each construction work activity a dedicated team of personnel, plant and equipment must be used. Below is the list of personnel, plant and equipment envisaged to be used during the construction works activities. Note that the below list could be updated without any delay when the conditions on-site change, and it is required for more specialised plant to be utilised.

3.1 Personnel List

- Employer (Client – George Municipality)
- Employers Agent (Professional Engineering Consultant - SMEC)
- Assistant Employer’s Agent (Professional Engineering Consultant - SMEC)
- ECO (Environmental Control Officer – Cape EAPrac)
- Contracts Manager (Appointed Contractor)
- Construction Manager (Appointed Contractor)
- Work Activity Foreman/Supervisor (Appointed Contractor)
- Drivers and Plant Operators (Appointed Contractor)

3.2 Plant List

- 30ton track excavator
- 20ton Articulated Dump Trucks (the number will depend on the loading cycles and haul times)
- 5ton track bulldozer
- Front-wheel Loader
- 10 000 litres water truck
- 10m³ Tipper Trucks
- 12ton Padfoot Earthworks Roller
- 4x4 Tractor Loader Backhoe (TLB)

3.3 Equipment List

- Medium size 4” water pump with a pump capacity of $\pm 27l/s$
- Small size 2” water pump with a pump capacity of $\pm 12l/s$
- Padfoot Rammer
- 250kg Walk-behind Roller
- Concrete vibratory poker machine
- Troxler nuclear density gauge
- Safety Fencing and Netting
- Temporary construction Road signs

4 Methodology of Works Construction

The method statement below will provide a chronological methodology for the construction work activities associated with the rehabilitation of the upstream embankment of the Garden Route Botanical Gardens dam wall. The construction activities include, but not limited to, site clearance, dewatering of dam basin, mass earthworks excavations, loading and transportation of materials, offloading and compacting of materials, temporary stockpiles, temporary works, waste management and prescribes the plant, equipment and PPE to be used on site when carrying out the construction activities.

4.1 Step 1 – Site Clearance

4.1.1 Dewatering of Dam

The entire dam basin will be dewatered to obtain access and ensure a dry workspace inside the dam during the upstream embankment construction activity.

It will be the responsibility of the Botanical Gardens Management, Environmental Practitioner and Freshwater Specialist to arrange that the aquatic life is rescued and relocated before construction activities commence. It is anticipated that the water turtles and all other fauna will be relocated to the constructed coffer dam.

The water will be drained through the existing siphon system until the siphon can't operate anymore. The definition of a siphon is a tube used to convey liquid upwards from out a reservoir and then downwards to the lower level where it discharges. There is no mechanical energy used to convey the water and the water moves on the principle of kinetic energy where the discharge force is higher than the suction force and thereby pulling the water through the tube.

Once the siphon stops the remaining water will be pumped out by using 4-inch water pumps with a pumping capacity of ± 27 l/s. All water pumps shall be placed on suitable drip trays to prevent any pollution of the soil and or water. Two (2) silt traps shall be installed inside the channel downstream of the discharge point and all silt shall be removed once the pumping operation is complete. It is noted that larger pumps will not be able to operate in these conditions due to the channel where the water is discharged only has a certain capacity before flooding and erosion takes place. Refer to **Figure 4-1** below indicating the extent of the water to be pumped out.

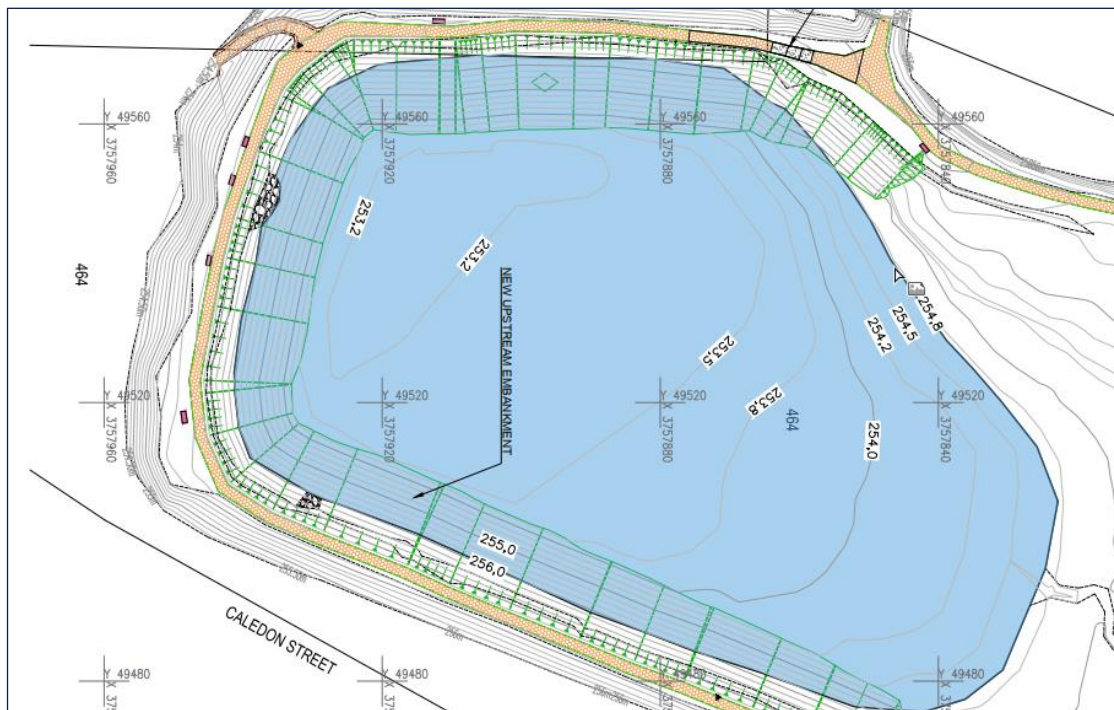


Figure 4-1: Existing Water Level inside Dam

Part of the dewatering of the dam is the construction of a small temporary coffer dam inside the dam basin which could form part of the rescue of certain fauna species present in the dam. The small temporary coffer dam will be excavated using a TLB, and the material will be placed and compacted to form the temporary coffer wall.

4.1.2 Clear and Grub

Once the dewatering operation is complete the dam basin will be cleared and grub in terms of the SABS1200C specification. The clear and grub includes removal of existing plants and trees and other vegetation on the eroded upstream embankment of the dam. The inputs from the GRBG Trust on any existing flora that need to be protected or relocated in the work area will be obtained.

All vegetation and trees, not relocated during the search and rescue operation, will be removed by means of a 30ton track excavator and selected material shall be loaded on 10m³ tipper trucks and spoiled off-site at a site established by the Contractor. All other material and trees will be hauled to the designated stockpile on the premises for later use by the Botanical Gardens. All tree and plant roots will be removed as far as reasonable possible. Refer to **Figure 4-2** below showing the type of vegetation and trees that need to be removed.

There is one Yellow Wood tree in the north-western section of the dam which will require a permit for removal. This tree will be protected during the construction activities.



Figure 4-2: Existing eroded embankment

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4.1.3 Removal of Topsoil

Once the clear and grub of the entire dam basin is complete the topsoil shall be stripped to a minimum depth of 150mm. the exact depth of the topsoil stripping shall be confirmed by the Employers Agent in consultation with the Employer, ECO and the Botanist on-site.

The topsoil shall be removed with a 30ton track excavator by scraping the required topsoil on a stockpile and loading the topsoil material onto 20ton articulated dump trucks. The topsoil material shall then be hauled to the designated stockpile areas on the GRBG premises for re-use as top dressing during the erosion protection works and in the Gardens area.

4.2 Step 2 – Removal of unsuitable material and Roadbed Preparation

Once step 1 is complete the unsuitable material in the dam basin will be removed to a depth where suitable material is found on which the new embankment will be constructed. The construction activity will be a cut to be stockpile operation. Once the unsuitable material is removed the roadbed preparation can commence.

4.2.1 Excavation of Unsuitable material

- All excavations shall be carried out under supervision and the operator shall be trained with the required certifications, assessed, and deemed competent to operate the respective plant.
- The excavation shall be done with a 30ton track excavator and loaded on 20ton articulated dump trucks.
- The loaded material shall be hauled to the designated stockpile area and off-loaded on specifically controlled heaps (stockpiles). The stockpiles shall not be higher than 3m to ensure visibility and safety measures are adhered to.
- The upstream embankment slopes shall be excavated up to the founding layer prior to the preparation of the roadbed layer.
- Refer to **Figure 4-3** below for area of unsuitable material that need to be removed.

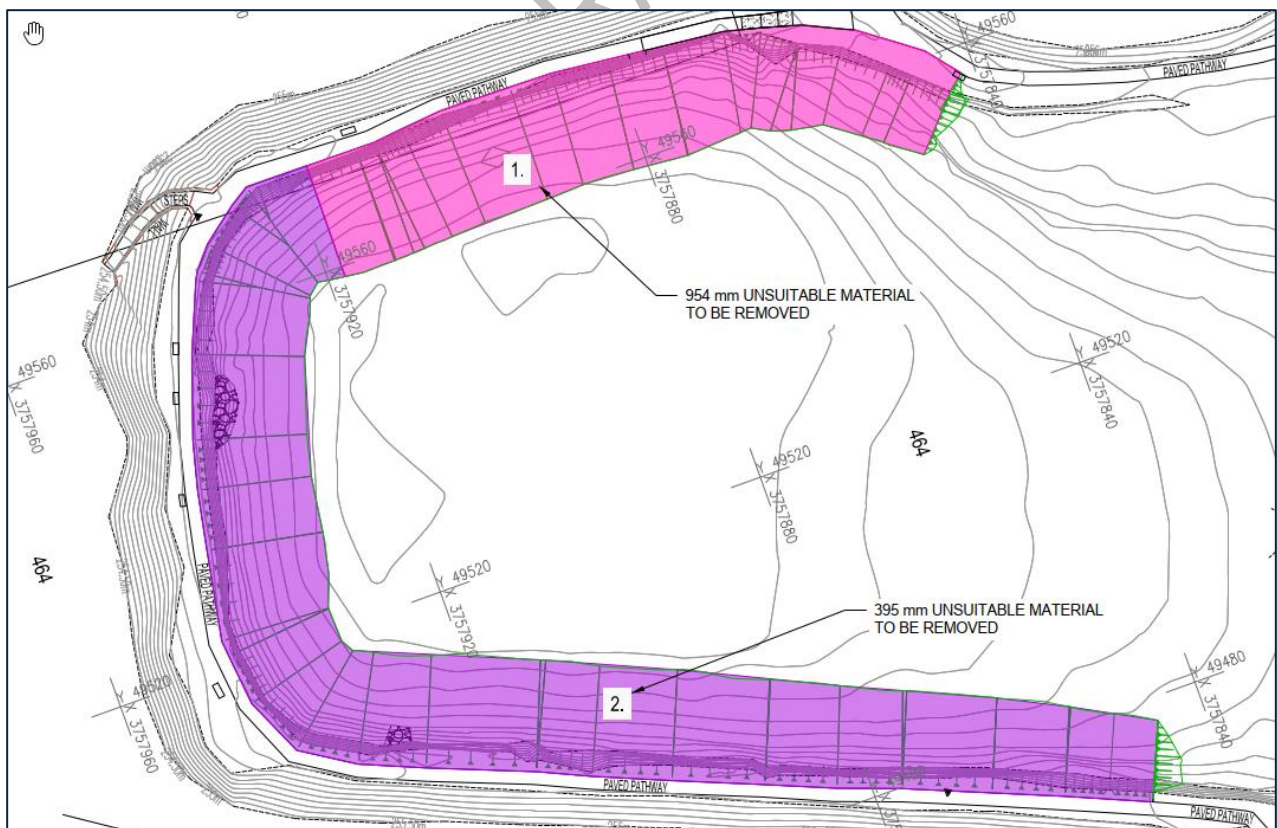


Figure 4-3: Extent of unsuitable Material

4.2.2 Roadbed Preparation

- The preparation of the roadbed shall commence on a level portion inside the dam basin and at a suitable width to accommodate a 12ton padfoot roller during compaction. The minimum width of the roadbed preparation shall be 3m.
- Wooden droppers and profiles will be used for level control.
- The roadbed layer shall be levelled using the 30ton track excavator and the TLB.
- Once the roadbed layer is levelled the 12ton padfoot roller shall compact the layer to a minimum 98% Proctor density at optimum moisture content (OMC). The number of passes by the roller shall depend on when the desired compaction density is achieved.
- The roadbed layer shall be tested using a nuclear density gauge to confirm if the desired compaction density was achieved.
- Large boulders or rocks that exist within the area of excavation will be removed and replaced with suitable material and compacted.
- Only after Quality Control has been signed off by the Employers Agent can the next layer of fill material be placed to start construction of the new upstream fill embankment.

4.3 Step 3 – Upstream Embankment Construction

4.3.1 Imported Fill Material

- The upstream embankment will consist of imported fill material provided by the Employer and obtained from an off-site stockpile at the new George WTW site.

4.3.2 Fill Construction

- Suitable fill material will be selected from the main stockpile using a front-wheel loader and loaded onto the 10m³ tipper trucks. It is noted that the loading weight of the tipper trucks shall be monitored, and any over loaded trucks shall be stopped, put off-site and a fine will be issued.
- The tipper trucks shall off-load the fill material at the designated fill area and shall be spaced equally to ensure a levelled layer thickness prior to compaction of 300mm. Offloading will take place under supervision and the required plant will be used to ensure safe and effective offloading.
- For each fill layer an 300mm key (bench) shall be cut into the existing embankment to ensure suitable stability of the new upstream embankment.
- The filling of the embankment will take place over the entire length as indicated on the construction drawings.
- Once the fill layer is levelled the 12ton padfoot roller shall compacted the layer to 98% Proctor density. Each layer shall be tested using a nuclear density gauge to confirm if the desired compaction density was achieved. Only after Quality Control has been signed off by the Employers Agent can the next layer of fill material be placed.
- The filling material will be placed in approved layers until the desired design levels has been reached.
- Once the design levels are reached, batters will be installed at a 1:3.5 slope and the embankment shall be trimmed neatly to the desired slope using the 30ton excavator.
- This process will be done continuously for each layer of the embankment before the next layer of fill material is placed. Water will be utilised where necessary to ensure fill material are at optimum moisture content during the placement and compaction.
- Refer to **Figure 4-4** for visual presentation of the extent of the fill material required.

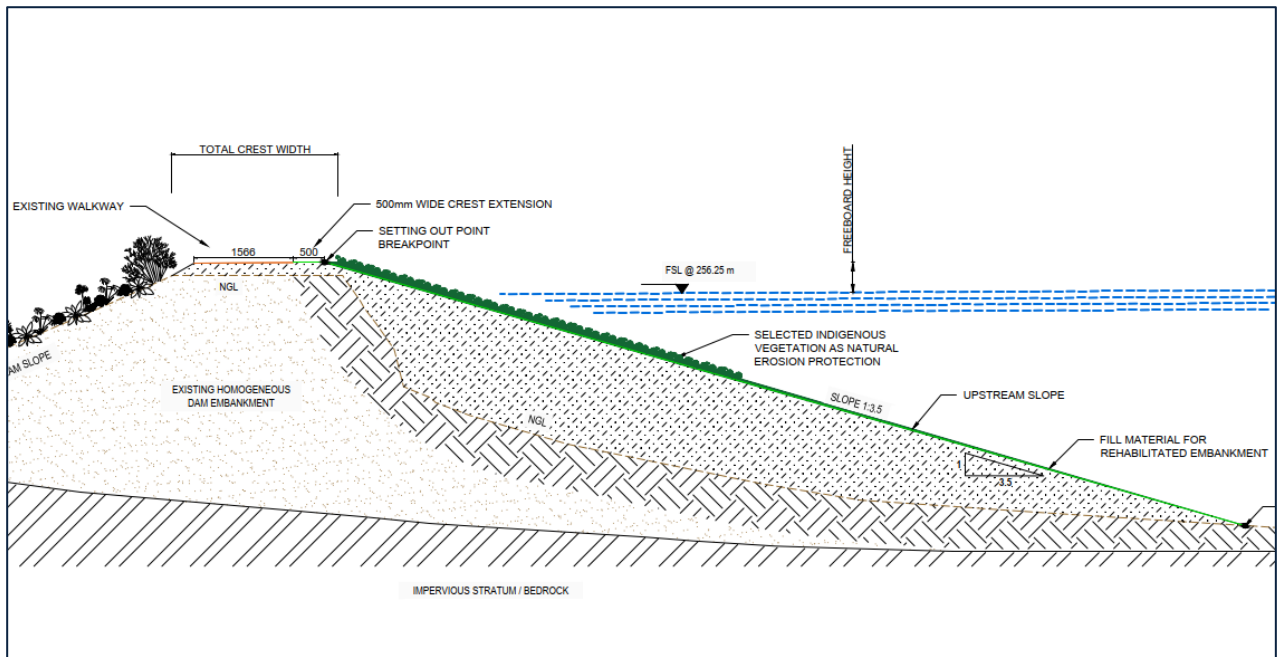


Figure 4-4: Upstream Embankment Cross-section

4.4 Step 4 – Spillway

4.4.1 Excavations

- The spillway will be excavated as per the dimensions indicated on the construction drawings.
- All excavations shall be done with a TLB.
- Once the excavations are completed the spillway foundation shall be compacted to 95% MOD AASHTO using a 250kg walk-behind roller and padfoot rammers.
- The spillway foundation layer shall be tested using a nuclear density gauge to confirm if the desired compaction density was achieved. Only after Quality Control has been signed off by the Employers Agent can the spillway construction commence.
- Refer to **Figure 4-5** for indication of depth of excavation at the spillway. Each horizontal lines indicate a 1m vertical height.

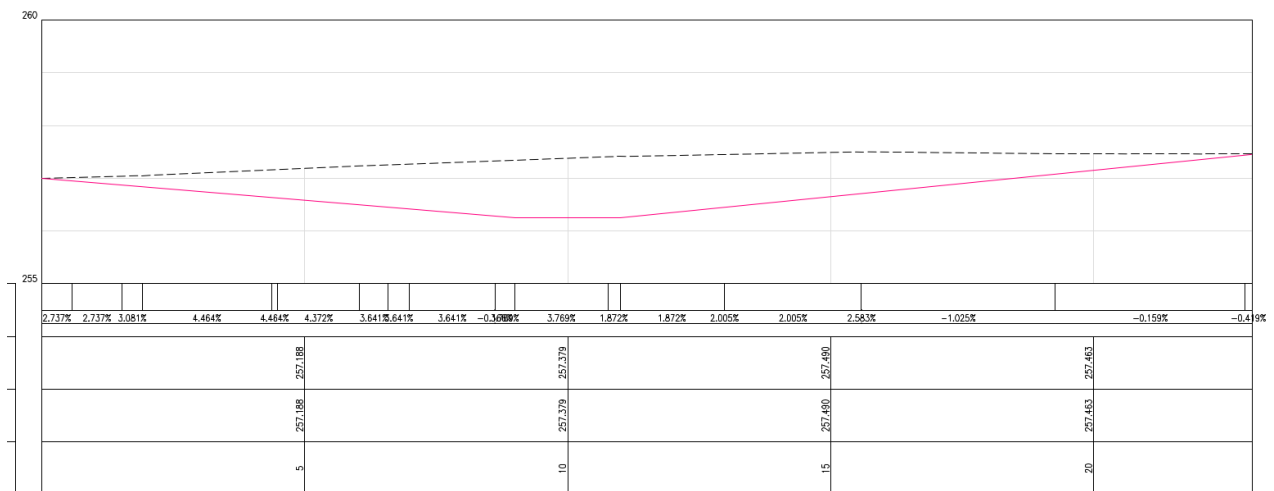


Figure 4-5: Spillway Longsection

4.4.2 Spillway Construction

- The spillway will comprise of a reinforced concrete slab spanning the invert of the spillway with a nominal overhang on the upstream and downstream slopes of the embankment.
- The spillway shall be constructed in accordance with the dimensions on the construction drawings.
- Once the foundation has been compacted and approved the formwork will be installed and secured.
- Thereafter the reinforcement will be placed by hand and installed on 50mm spacer blocks as per the specifications.
- The concrete will be mixed off-site, transported to the site using concrete trucks and discharged within the formwork using a chute to create the new spillway. A vibratory poker will be used to extract any trapped air within the placed concrete. The vibratory poker shall be placed on a suitable drip tray to prevent any soil pollution.
- Once the concrete has set, wood floats and brooms will be used to create the specified surface finish on the concrete.
- HDPE sheeting will be installed around the spillway area and a small bund wall will be formed to catch any concrete run-off water.
- Refer to **Figure 4-6** and **Figure 4-7** for layout and detail of spillway.

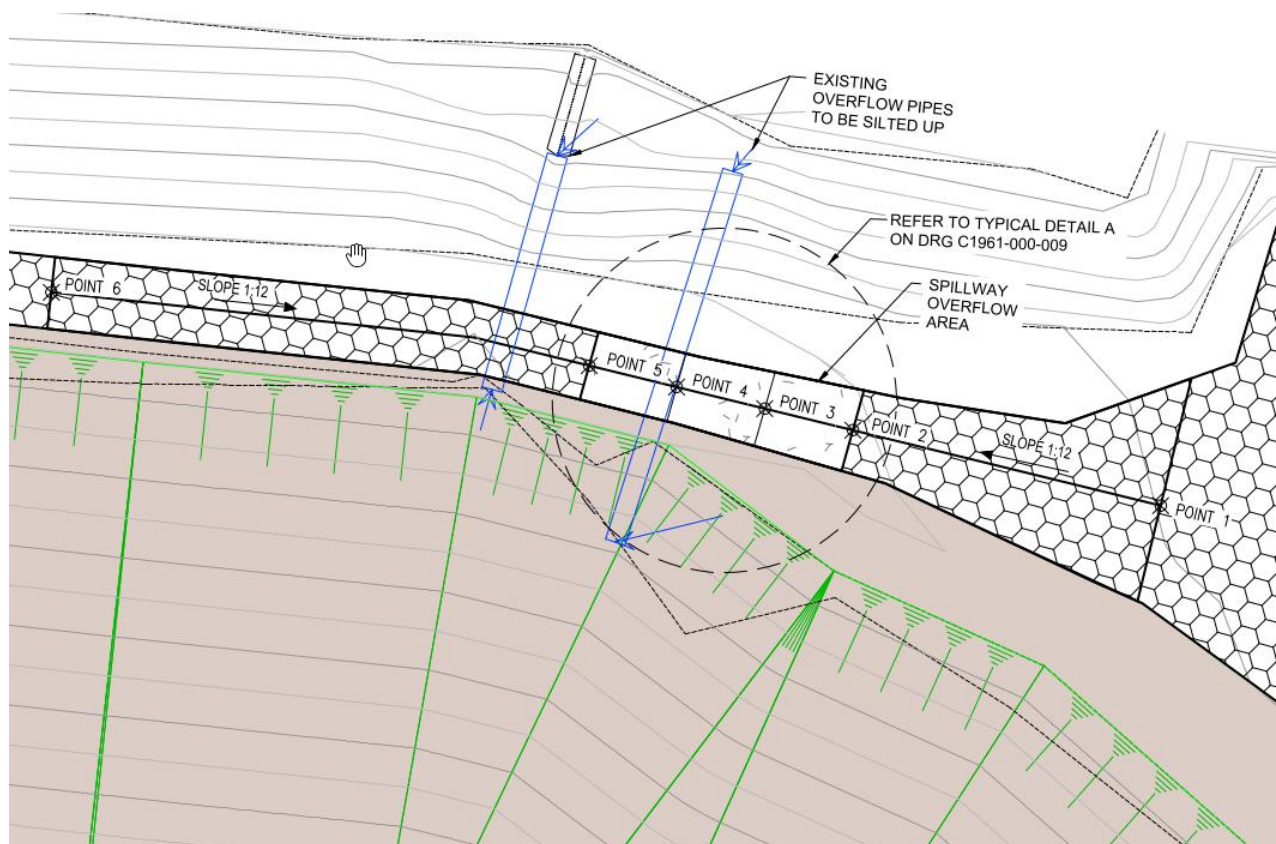


Figure 4-6: Spillway Layout

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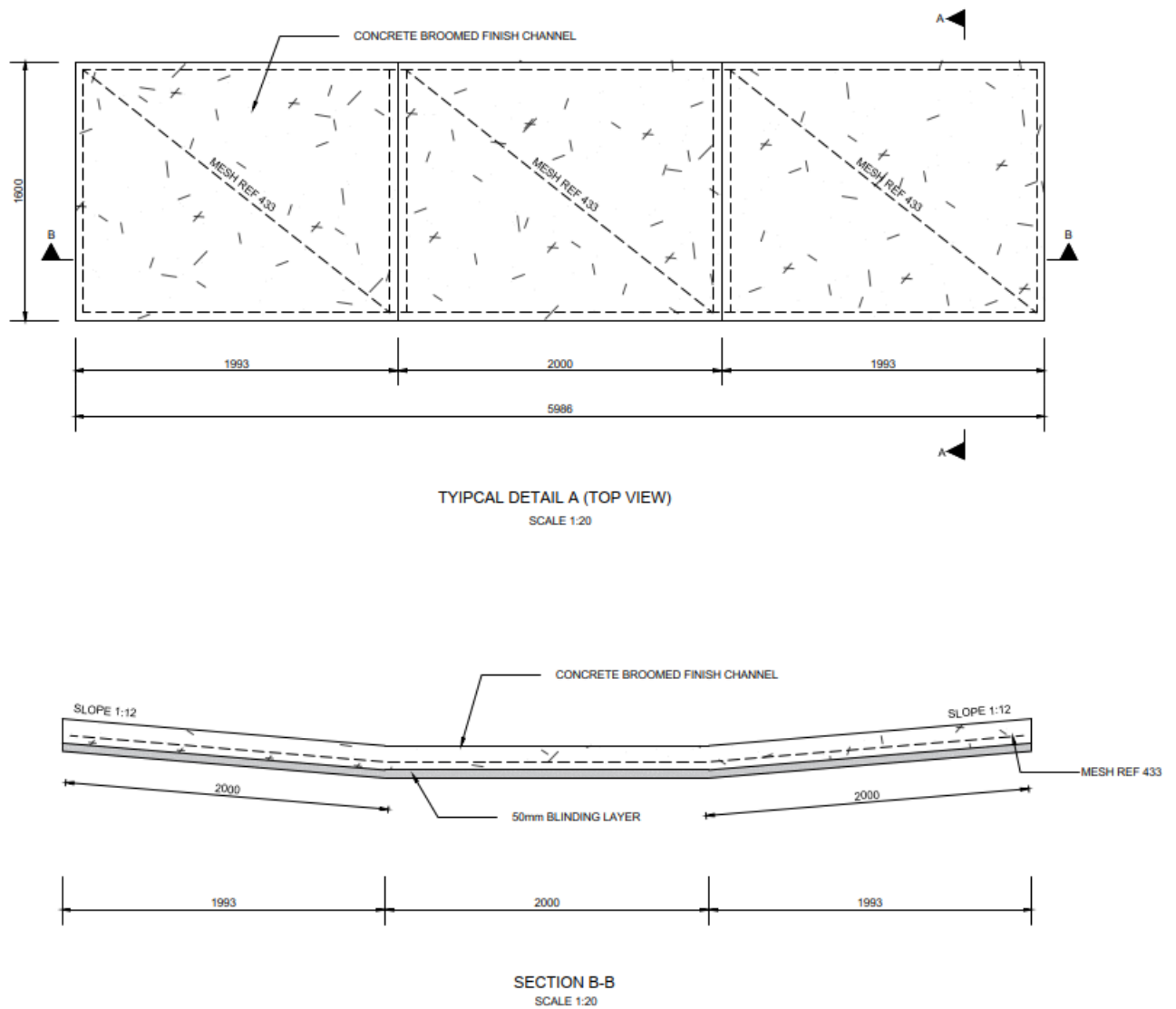


Figure 4-7: Spillway Reinforcing Layout and Typical Section

4.5 Step 5 – Walkway Repairs

4.5.1 Clear and Grub

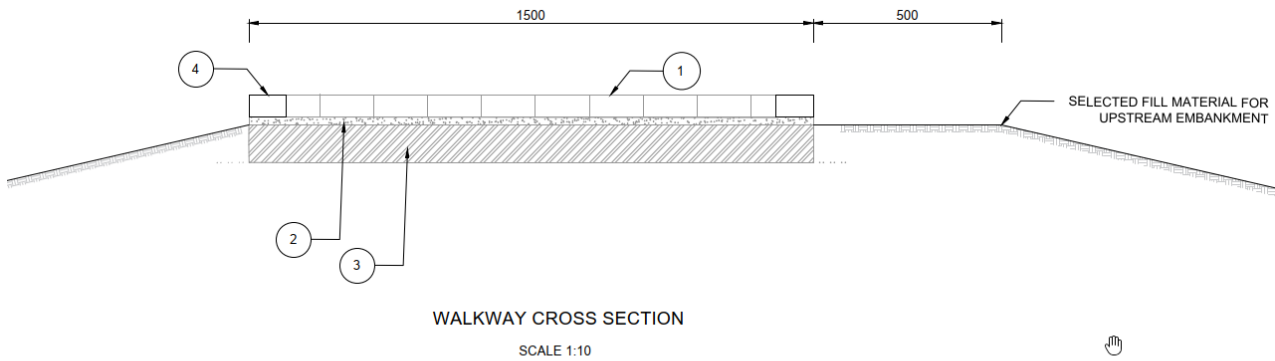
- The sections where the walkway is undermined as indicated by the Engineer will be repaired, mostly on the western side of the crest walkway.
- All the existing brick paving will be removed and stockpiled at the specific sections for re-use when the layer works are reinstated.

4.5.2 Walkway Construction

- Material of minimum G7 quality shall be imported and filled using a TLB at all sections of the walkway foundation which was undermined by erosion.
- The fill material will be levelled and compacted to 93% MOD AASHTO density up to 180mm from final walkway level. The compaction on the fill material shall be completed using a padfoot rammer. Each layer shall be tested using a nuclear density gauge to confirm if the desired compaction density was achieved. Only after Quality Control has been signed off by the Employers Agent can the next layer of fill material be placed.
- For the C4 cement stabilised layer a material of G5 quality shall be imported from a commercial source and stockpiled at a suitable area for mixing. Cement will then be added to the material at the agreed

percentage and thoroughly mixed using a TLB. Water shall be added using a water truck to ensure the material is mixed at optimum moisture content.

- Once the fill material is completed and the C4 material is mixed a 100mm thick layer of C4 material shall be imported from the mixing stockpile using the TLB, levelled and compacted to 95% MOD AASHTO density using a padfoot rammer.
- Once the C4 layer was cured over a 4-day period the existing 60mm hexagonal brick paving on the temporary stockpile will be installed as per the specifications and dimensions indicated on the construction drawings and relevant specifications.
- A 100mm brick paving edge restraint (header course) will be installed on a 50mm concrete bedding and backing.
- The walkway repairs will be completed using labour-intensive construction as far as reasonable possible.
- Refer to **Figure 4-8** for typical section through the walkway.



PAVEMENT LAYER TABLE				
LAYER	MATERIAL CLASSIFICATION	DEPTH	DENSITY	MIN. C.B.R
1	210x140 HEXAGONAL PAVERS	60mm	N/A	N/A
2	SAND	20mm	100% MOD AASHTO	
3	G5	125mm	93% MOD AASHTO	15%
4	230x110x60 BLOCK PAVERS	60mm	N/A	

Figure 4-8: Typical Walkway Section

4.6 Step 6 – Erosion Protection

4.6.1 Topsoil Spreading

- Once the upstream embankment construction is complete the erosion protection will follow.
- Topsoil will be obtained from the designated stockpile area, loaded onto 20ton articulated dumper trucks using a front-wheel loader or excavator, hauled, and off-loaded at the upstream embankment and spread using a TLB to the desired thickness.
- A minimum thickness of 150 mm layer topsoil will be placed unless otherwise agreed on site during further investigation or requirements by the Botanist.
- The topsoil shall be lightly rolled using a 250kg walk-behind roller.

4.6.2 Establishment of Erosion Protection

- The establishment of the erosion protection in the form of various plant species and in accordance with the relevant vegetation zones will be performed by the GRBG Trust in conjunction with an nominated sub-contractor.
- Vegetation shall be established in five different zones along the new upstream embankment and in each area bring in 5-6 different plant species.

- The GRBG and SMEC consulted Corné Brink (Kaëlvoet Consulting Requirements) to obtain a list of indigenous plant species to be planted in these 5 zones.
- The proposed plant list for each zone will be in accordance with the requirements of the Dam Engineer and shall be species that are effective in the stabilisation of topsoil, while remaining low growing, easy to maintain and easy to replicate on other earth dams.
- The plant species will also have to meet the aesthetic, educational and practical requirements of the Garden Route Botanical Gardens.
- The five erosion protection zones will be implemented by means of labour-intensive methods.
- The GRBG will maintain these zones until fully established as per the specification in the approved Maintenance Management plan.
- Refer to **Figure 4-9** for schematic layout of the various plant zones.

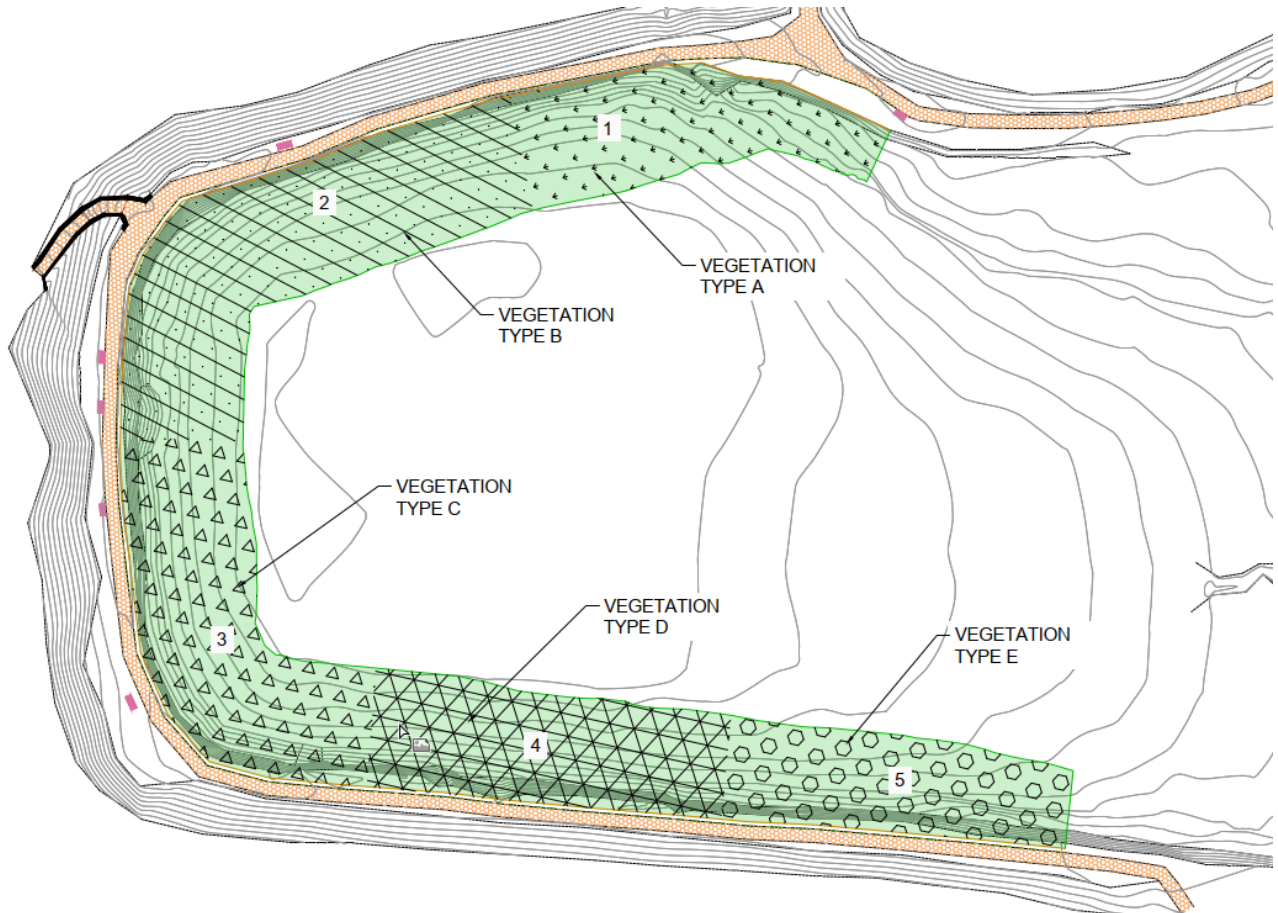


Figure 4-9: Various Plant Zones

5 Programme

The anticipated programme for the rehabilitation of the Botanical Garden Dam Wall is listed below in **Table 4-1**.

Table 5-1: Project Programme

No.	Stages	Anticipated Completion Date
1	Commencement Date	08 September 2022
2	Submission of Inception Report	25 October 2022
3	Topographical and land surveys	4 November 2022
4	Geotechnical Investigation	4 November 2022
5	Submission of Concept Design Report	13 December 2022
6	Submission of Detailed Design Report	02 March 2023
7	Submission Draft Tender Document	16 March 2023
8	Tender Advert	23 March 2023
9	Tender Closing	13 April 2023
10	Tender Evaluation Report	27 April 2023
11	Bid Evaluation Committee (BEC)	11 May 2023
12	Bid Adjudication Committee (BAC)	18 May 2023
13	Construction Commencement (Include 14-day appeal period)	01 June 2023
14	Construction Practical Completion	01 December 2023
15	Construction Completion	15 December 2023
16	Close-Out	12 January 2024
17	Construction Final Approval & Retention Release	13 December 2024

6 Summary

The George Municipality is responsible for service delivery in the George Municipal area and appointed SMEC South Africa (Pty) Ltd for providing professional engineering services for the rehabilitation of the Garden Route Botanical Garden dam in the van Kervel Local Nature reserve, George.

The embankment along the dam wall has eroded over the years and with the heavy rains in January 2020 a few slips formed which increased the risk of a possible dam failure. The slips also undermined the stability of the crest walkway, and a portion of the walkway was closed for public access for safety reasons. The objective of the George Municipality is to mitigate any risks, prevent any loss of life due to a dam failure and to ensure the safe movement of the public in the Botanical Gardens.

Specifications that include the OHS Act 85 of 1993, SANS 1200 Standard Specifications, construction drawings, project Specifications and Environment Specifications shall apply to this contract to ensure that the works are performed within the relevant safety and environmental parameters and in compliance with the design while still ensuring good quality work.

The methodology of works to be carried out involved 5 main steps:

1. Site Clearance
2. Removal of unsuitable material
3. Embankment Construction
4. Spillway Construction
5. Walkway Repairs
6. Erosion Protection

The anticipated starting date for construction is 01 June 2023.

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