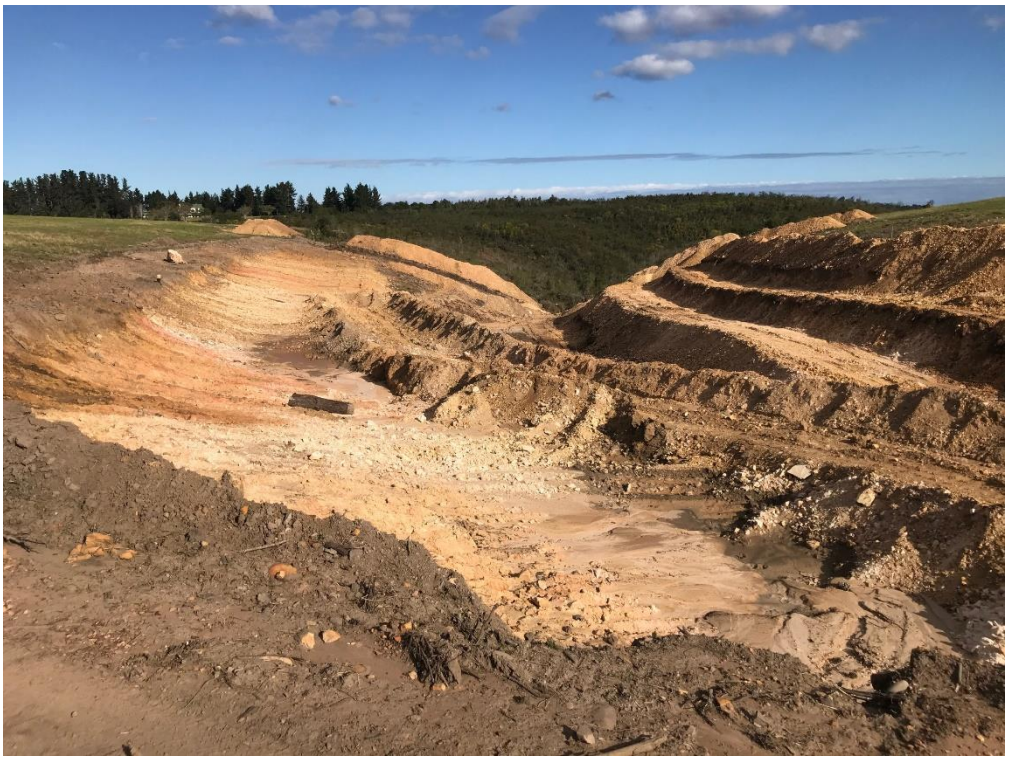
Aquatic Specialist Assessment for a Section 24G and Water Use License Application at 17 / 232 Redford Farm, Knysna.



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For

Ecoroute / Ecosense

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DECLARATION OF CONSULTANTS INDEPENDANCE

I consider myself bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP);

• At the time of conducting the study and compiling this report I did not have any interest, hidden or otherwise, in the proposed development that this study has reference to, except for financial compensation for work done in a professional capacity;

• Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part, other than being members of the general public;

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• I do not have any influence over decisions made by the governing authorities;

• I undertake to disclose all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by a competent authority to such a relevant authority and the applicant;

• I have the necessary qualifications and guidance from professional experts in conducting specialist reports relevant to this application, including knowledge of the relevant Act, regulations and any guidelines that have relevance to the proposed activity;

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• All the particulars furnished by me in this document are true and correct.

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Expertise: > 10 years' experience working on aquatic ecosystems across South Africa, with a focus on the Southern Cape in the last 3 years. Includes research and consulting expertise, having published > 10 water-related research articles and compiled > 80 aquatic specialist reports. Research and consulting have been in a range of sectors including agriculture, urban developments, linear structures, renewable energy, conservation, and mining.

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1. INTRODUCTION

The land-owners of 17/232 Redford Farm commenced with the construction of an instream dam without prior environmental authorisations. As a result, a rectification process has been initiated by the Department of Environmental Affairs & Development Planning (DEA&DP) under Section 24G of the National Environmental Management Act (NEMA; Act No. 107 of 1998). The activities also triggered Sections 21 c) and i) water uses of the National Water Act (NWA; Act No. 36 of 1998). These water uses are defined as follows:

Section 21c): Impeding or diverting the flow of water in a watercourse, and

Section 21 i): Altering the bed, banks course or characteristics of a watercourse

Confluent Environmental (Pty) Ltd. were appointed by the landowner to conduct the Aquatic Specialist Assessment required for the Section 24G and Water Use License Application (WULA) process.

1.1 Proposed Water Use

The landowner would like to irrigate 3 farm portions to be planted with macadamia nuts under drip irrigation. The farm portions are 17, 15 and 12 / 232 and the total area to be irrigated is 28 ha. The maximum irrigation requirement for the macadamia nut orchards is approximately 116 000 m^3 per annum.

Water storage of 70 000 m^3 in an instream dam is proposed to provide sufficient water security for the irrigated area (See proposed dam in Appendix 1). This was determined through the hydrology report (Confluent Environmental) and dam engineer report (Jan Brink) that were commissioned for the Water Use License Application. This would constitute a Section 21 b) water use.

Water sources for storage and irrigation are from the 3 furrow allocations (Existing Lawful Use), surface runoff from the proposed dam's catchment, and a borehole. The estimated 3 furrow allocations are estimated to yield between 25 000 m^3 and 50 000 m^3 per annum and surface runoff from the catchment is 12 200 m^3 per annum (Confluent Environmental Hydrology Report). The volume required from the borehole is the maximum sustainable yield of 69 000 m^3 per annum (Confluent Environmental Hydrological Assessment & DHS Groundwater report). The Section 21 a) water use would exclude the Existing Lawful Use provided by the 3 furrow allocations, with the difference applied for in the WULA for the surface runoff and borehole volumes.

In addition to the above water uses, a WULA would need to include Section 21 c) and i) water uses given the existing and proposed future clearing of soil and vegetation within the dam basin, as well as construction of the dam wall across the watercourse.

Should the proposed water uses not be approved through a WULA it may be necessary to rehabilitate the entire area of disturbance.

1.2 Scope of Work

The Scope of Work for the aquatic assessment is informed by the pre-compliance notice and requirements for the Section 24G and WULA process. This includes the following key aspects:

- Provide a map delineating the watercourse and area affected by the unlawful activity.
- Determine the Present Ecological State and Ecological Importance and Sensitivity (PESEIS) of the watercourse in its current and historical condition.
- Compile an impact assessment of the current dam excavation area as well as continuing with construction of the dam;
- Consider the impacts associated with decommissioning and rehabilitating the excavated area;
- For each of these scenarios recommend rehabilitation measures where excavations have removed indigenous vegetation and left soil vulnerable to erosion.

1.3 Description of Unauthorised Activities

At the beginning of 2021 the owners of portion 17 / 232 Redford Farm commenced with construction of an instream dam (Figure 1). The dam is located at the upper extent of a non-perennial watercourse. The intended dam capacity *was* 300 000 m^3 with a dam wall height of 17 m. This required volume was calculated based on purchasing 5 farm portions and planting them with Macadamia nuts which require drip irrigation. Subsequently, the applicant secured 3 of the 5 properties (Figure 1), with purchase of the remaining 2 properties uncertain. It has since been shown in the engineering report (J. Brink, November 2021) that even if the full extent of the excavated site is utilised, a maximum storage capacity of 73 000 m^3 is attainable with a dam wall height of 17 m.

The appointed earthworks contractor commenced with scraping out the basin area which comprised of steep vegetated valley sides and a watercourse at the bottom of the valley. Alien vegetation was present on the slopes as can be seen in photos of the site provided by the landowner (Figure 6). Topsoil, subsoil, and underlying rock in some places was excavated and stockpiled (Figure 2). The total area excavated and disturbed covers approximately 1.2 ha. Construction of the dam was stopped by receipt of the pre-directive from DEA&DP prior to the dam wall being built. Therefore, no water storage is currently taking place. The water source for the dam was intended to include surface water runoff from the catchment, borehole water, and 3 furrow allocations (1 per portion) through the Rondebosch River Water User Association (RRWUA).

The landowner has undertaken extensive clearing of alien vegetation downstream of the excavated area of the dam on their property, where indigenous vegetation is recovering well. The intention is to maintain this area in as natural a state as possible if the dam is approved. This management action meets the landowner's responsibility in terms of the National Environmental Management: Biodiversity Act 2004 (Act No. 10 of 2004) and in the Alien and Invasive Species Regulations of 2014.

Figure 1. Map of the excavated dam area showing the three farm portions owned by the applicant (Google Earth imagery, March 2021).

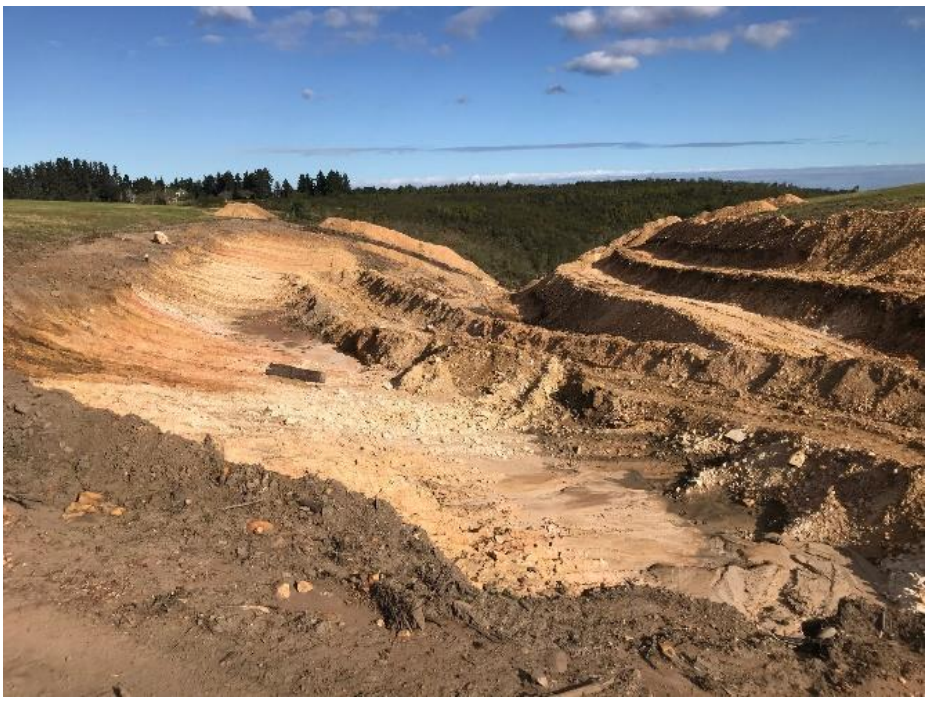


Figure 2. Photo taken of the excavated dam basin showing disturbance of topsoil, subsoil and rock, and the removal of vegetation (17 June 2021).

2. CHARACTERISTICS OF THE SITE

Portion 17/232 is in quaternary catchment **K60E** in the Gouritz Water Management Area (Table 1). The dam is excavated into a headwater non-perennial tributary of the Whiskey Creek, which is a tributary of the Keurbooms River. The property is bordered by the Whiskey Creek Nature Reserve to the south, which is an extensive protected area. Historical land use in the catchment was dryland grazing and subsistence crops. Minimal irrigation and storage of water occurred using furrow allocations, of which there are 31 in total on the RRWUA.

Table 1. Summary of relevant catchment features for 17/232, Redford Farm.

Feature	Description
Water Management Area	Gouritz
Quaternary catchment	K60E
Mean Annual Runoff	101 mm
Mean Annual Precipitation	774 mm
Ecoregion Level II	20.02, South Eastern Coastal Belt
Geomorphological Zone	Upper foothills
NFEPA area	9097, FEPA (Freshwater Ecosystem Priority Area)
Vegetation Type	Tsitsikamma Sandstone Fynbos (Least Concern)

The catchment has a relatively high mean annual precipitation (by South African standards) of 774 mm which has distinct bimodal peaks in March (Autumn) and September (Spring; Figure 4).

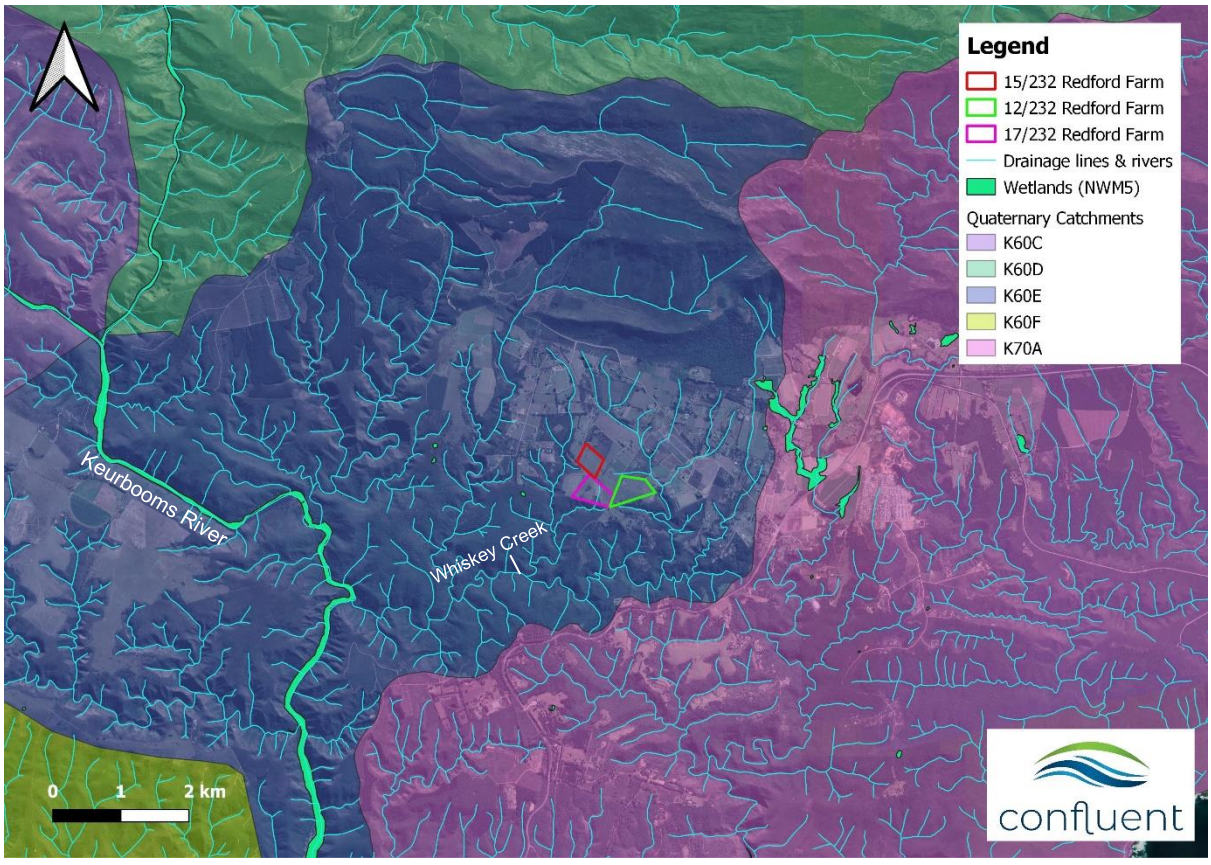


Figure 3. Location of Portion 17/232 in quaternary catchment K60E.

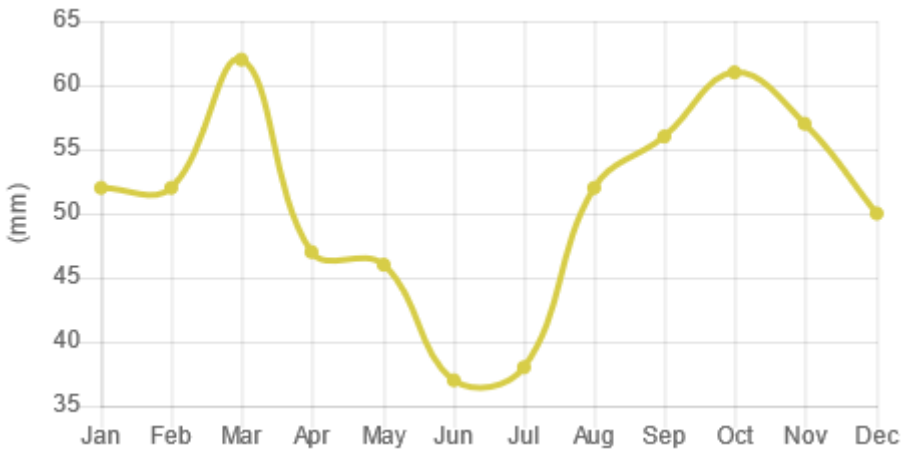


Figure 4. Mean monthly rainfall for the catchment (from Freshwater Biodiversity Information System).

The Redford Farm area in general has small to medium scale agricultural development on mostly lifestyle farms. Most tributaries of the Whiskey Creek have multiple instream farm dams, and approximately 52 were counted in this area (Figure 5). The stream reach upon which the proposed dam is located on Portion 17/232 currently has no other dams.

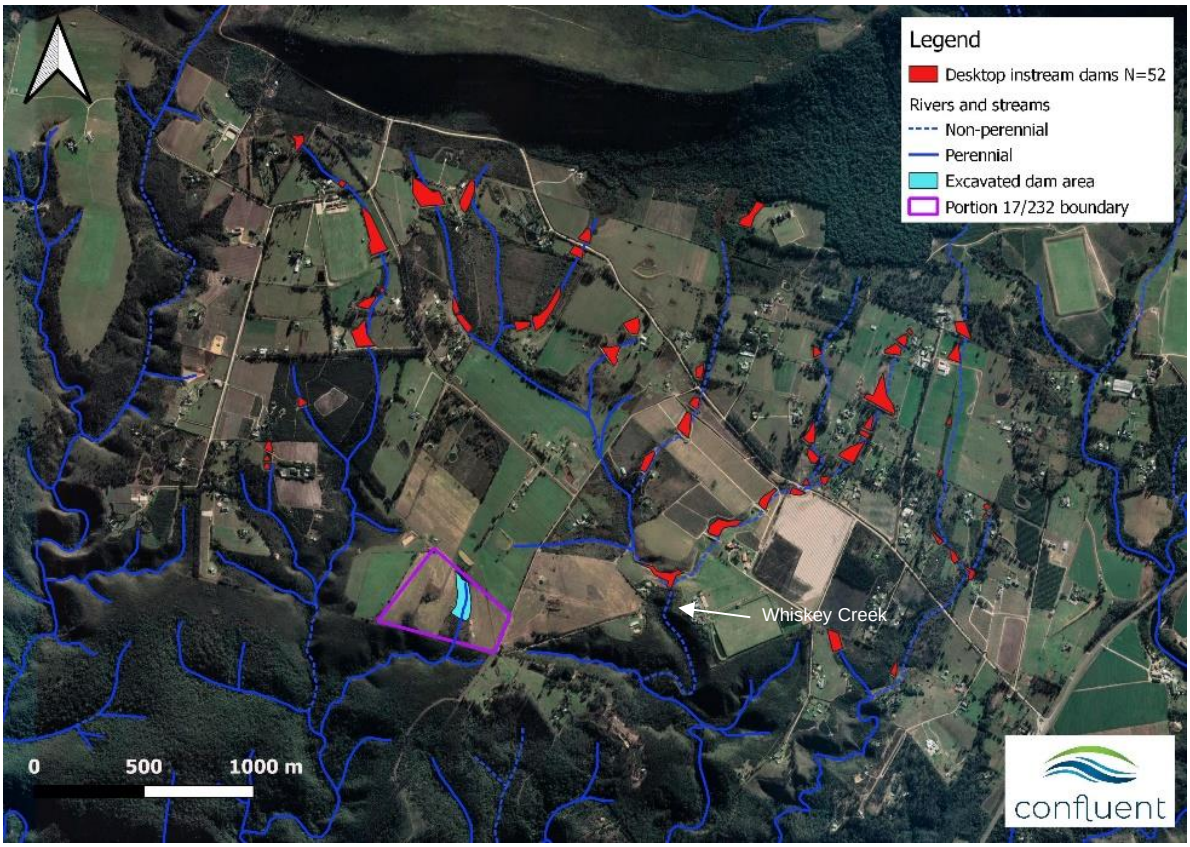


Figure 5. Dams identified in the Redford district using satellite imagery.

2.1 Vegetation

The mapped vegetation type is Tsitsikamma Sandstone Fynbos. The area where vegetation was cleared for excavation of the dam was invaded by alien vegetation including mature black wattle (*Acacia mearnsii*) and *Pinus* sp. trees which are evident in photos of the site prior to

excavation (Figure 6). During the site visit conducted on 17 June 2021, vegetation above and below the excavated area was in relatively good condition consisting largely of indigenous plants typically associated with the area. The state of this vegetation has been assisted by alien clearing conducted by the landowner. It is likely that some indigenous plants typically associated with riparian and possibly wetland areas were in the footprint of the dam and were subsequently cleared during excavation. However, it is not possible to accurately determine the relative proportion of indigenous to alien vegetation.

Figure 6. Photos of vegetation in the dam area pre- and post-slashing of alien invaded scrub and pre-earthworks supplied by the landowner (D. Bernard, 25/11/2020).

Some isolated specimens of indigenous wetland vegetation were observed to be regenerating in the disturbed channel (Figure 7) indicating that at least remnant indigenous vegetation occurred along the channel.

Figure 7. Isolated specimens of *Juncus lomatophyllus* and *Isolepis* sp. in the disturbed watercourse bed.

2.2 Historical Assessment

Vegetation along the watercourse that was excavated appears to be fairly uniform and similar to that downstream in the Whiskey Creek Nature Reserve according to the historical photo from 1990. This suggests that the watercourse was not heavily invaded by alien vegetation at this time, although it is impossible to be certain of this.

Figure 8. Historical photo of the drainage line that was cleared from 1990 showing the approximate farm boundary for 17/232.

Almost two decades later the extent of vegetation along the drainage line was similar to that in 1990. While the composition of vegetation could not be confirmed, it does appear that more woody, denser vegetation has colonised the drainage line in the 2004 photo. Again, it is not possible to confirm this, and may be due to better resolution in the more recent photo.

Figure 9. Historical photo of the drainage line that was cleared from 2004 showing the approximate farm boundary for 17/232.

2.3 Conservation Status

2.3.1 Western Cape Biodiversity Spatial Plan

The area excavated for the dam was classified in the Western Cape Biodiversity Spatial Plan (WCBSP; 2017) mostly as Ecological Support Area 1 (Aquatic). This is defined as:

"Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of Protected Areas or Critical Biodiversity Areas, and are often vital for delivering ecosystem services."

According to the WCBSP the management objective for these areas is:

"Maintain in a functional near-natural state. Some habitat loss is acceptable, provided the underlying biodiversity objectives and ecological functioning are not compromised."

The location of the watercourse immediately upstream of the Whiskey Creek Nature Reserve (the Protected Area) is consistent with the definition. Excavation of the valley for construction of the dam is not consistent with the management objective because entire habitat loss has occurred resulting in complete loss of ecological functioning at this location.

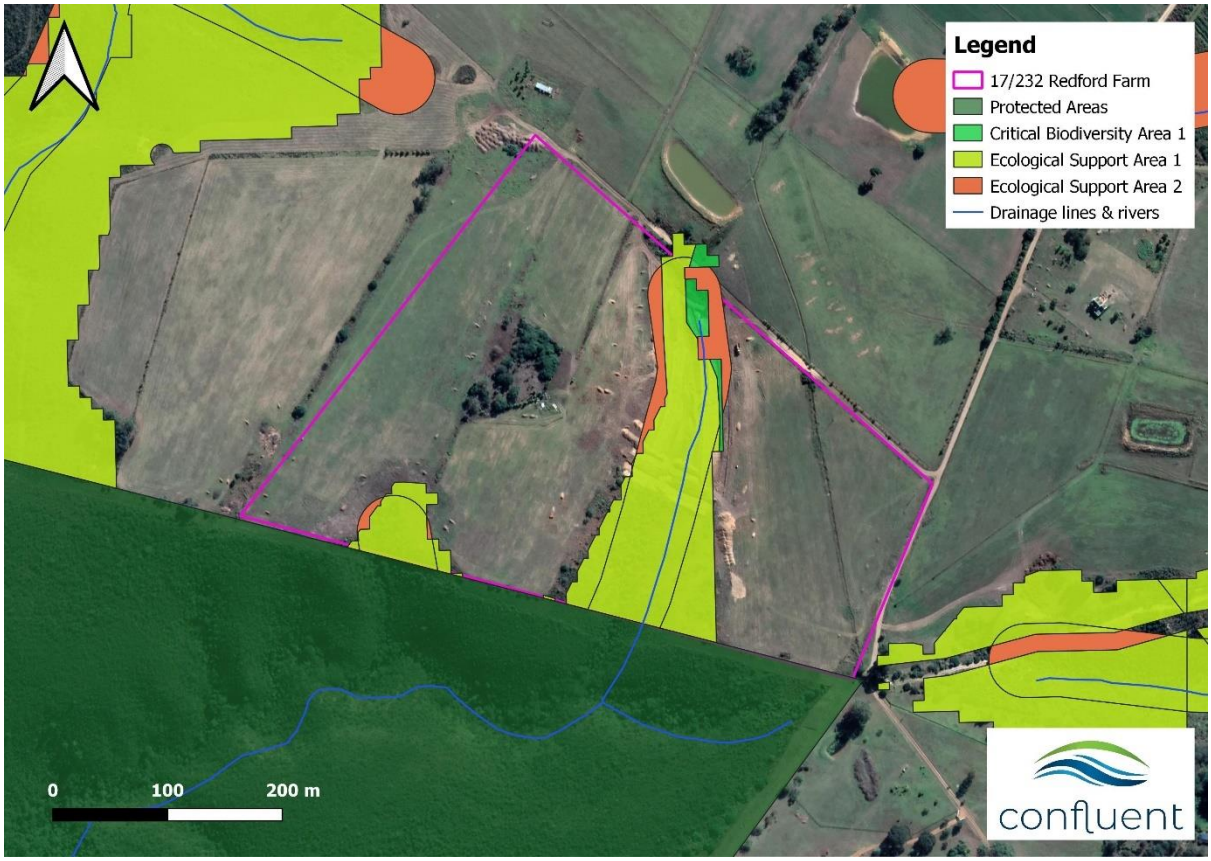


Figure 10. Areas classified in the Western Cape Biodiversity Spatial Plan.

2.3.2 National Freshwater Ecosystem Priority Atlas

The watercourse is within NFEPA area (sub-quaternary reach) 9097, which is categorised as a FEPA (Freshwater Ecosystem Priority Area). A FEPA is an area prioritised for conserving freshwater ecosystems and associated biodiversity. The selection of FEPAs is determined through a process of systematic biodiversity planning using data on freshwater ecosystem types, species and ecological processes. FEPAs should be maintained in a good condition to manage and conserve freshwater ecosystems and to protect water resources for human users. This does not mean that FEPAs should be fenced off from humans, but they should be supported by good planning, decision-making and management. The recommended condition for all river FEPAs is an A or B ecological category (Nel *et al*., 2011).

2.3.3 Resource Quality Objectives (RQOs)

Resource Quality Objectives (RQOs) are defined as clear goals (numerical or descriptive statements) relating to the quality of a water resource and are set in accordance to the management class for the resource to ensure the water resource is protected. The purpose of RQOs is to set clear objectives for the resource against which water use licenses and the related impacts can be evaluated and managed to achieve a balance between the need to protect and utilise the resource. The Breede-Gouritz Catchment Management Agency (BGCMA) recently concluded an assessment of major rivers in the Water Management Area (DWS, 2018).

The scale of assessment meant that smaller rivers and streams like Whiskey Creek were excluded, and the nearest relevant river system for Redhaus Farm would be Keurbooms River.

The Keurbooms River has 3 endemic fish species, *Pseudobarbus afer*, *Anguilla mossambica*, and *Sandelia capensis*. No exotic fish species have been recorded in the river, and no exotic fish species should be introduced anywhere in the catchment. The largest threats to endemic fish species is predation and habitat modification by exotic fish. High and low flows must be maintained according to levels prescribed in the RQOs. Water quality parameters such as nutrients, salts, and dissolved oxygen must be maintained at present levels (stipulated values in the RQOs). The cumulative impact of a catchment being transformed to more intensive agriculture (ie. Redford Farm area) can result in reduced water quality if the transformation is not well managed both during construction and operational phases.

3. SITE VISIT

The site visit was conducted on 17 June 2021 which is mid-winter. During the site visit it was noted that extensive excavation for the dam had been conducted on steep slopes and valley bottom which included topsoil, subsoil, and underlying rock (Figure 2).The watercourse downstream of the excavation had no flowing water toward the upper extent, very minor flow was present further downstream indicating that it is a gaining stream (gaining water from the ground and slopes through interflow).

3.1 Sedimentation Downstream

A silt fence had been installed at the lower end of the excavated area which was completely filled with silt (Figure 11), and minor sedimentation had already occurred in the stream bed downstream. An Erosion Control Plan (Confluent Environmental) was prepared and submitted to both DEA&DP and the BGCMA for their approval on 26 August 2021. The focus of the plan was the installation of multiple hay bale check dams to reduce eroded soil from reaching downstream. At the time of the first site visit (17 June 2021) the extent of sedimentation was recorded by GPS and had reached 26 m into the watercourse below the excavated area (-33.950721, 23.445723).

Figure 11. Overwhelmed silt curtain at the outflow of the dam excavation.

3.2 Watercourse Classification

The watercourse was classified using methods described by Ollis *et al.* (2016). An entirely accurate classification was constrained by the lack of any vegetation indicators remaining in the valley and the wide-scale disturbance of soil. Therefore, physical and biological indicators in relatively undisturbed habitat upstream and downstream of the excavated area were used for classification. While the upper-most section has a small area of wetland vegetation this is partially due to seepage from a small dam on the adjacent property. Downstream of the excavated area, there is a distinct channel and riparian vegetation with no distinct wetland features.

The watercourse is therefore classified as a **non-perennial drainage line**.

4. PES & EIS

This section refers to the Present Ecological State and Ecological Importance and Sensitivity of the affected watercourse.

4.1 Present Ecological State

4.1.1 PES Methods

Drainage lines are natural channels in which water flows intermittently following rainfall. These are assessed using the Index of Habitat Integrity (IHI; Kleynhans, 1996) which measures the impact of human disturbance on riparian and instream habitats. The IHI is a rapid assessment of the severity of impacts affecting habitat integrity within a defined segment of a watercourse. The method can be applied to both perennial and non-perennial watercourses. The instream impacts considered both before and after the excavation were: water abstraction; flow modification; bed modification; channel modification; physico-chemical modification; inundation; alien macrophytes; and rubbish dumping. The riparian impacts assessed were: vegetation removal; exotic vegetation; bank erosion; channel modification; water abstraction; inundation; flow modification; physico-chemistry. Each of the impacts were given a score based on their degree of modification (1-25; Table 2), along with a confidence rating based on the level of confidence in the score.

Table 2. Descriptive classes for assessment of habitat modifications (Kleynhans, 1996)

Impact Class	Description	Score
None	No discernible impact or the modification is located in a way that has no impact on habitat quality, diversity, size and variability.	0
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.	1-5
Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability is limited.	6-10
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.	11-15
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not affected.	16-20
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.	21-25

An IHI class is then determined based on the resulting score which is shown in Table 3. These results provide an indication of the site-specific PES which can be compared to that determined in the desktop PES&EIS (DWS, 2014).

Table 3. Index of habitat integrity (IHI) classes and descriptions

Integrity Class	Description	IHI Score (%)
A	Natural	> 90
B	Largely Natural	80 – 90
C	Moderately Modified	60 – 79
D	Largely Modified	40 – 59
E	Seriously Modified	20 – 39
F	Critically Modified	0 – 19

4.1.2 PES Results

The PES was determined as far as possible without the present excavations for the proposed dam (Pre-excavation) as well as in its present state (Post-excavation). The assessment is applicable for the river reach within the excavated area only and is intended to indicate the degree to which the aquatic ecosystem has been affected by the excavation. The conventional approach to the PES assessment is to assess a longer river reach. However, the excavated area is located at the very upper extent of the watercourse. The pre-excavation PES relied on examination of photographic and video evidence provided by the landowner (D. Bernard), historical aerial and satellite imagery, and the condition of habitat downstream of the excavated area. The stream bed below the excavated site and beyond the extent of sedimentation was narrow (approximately 50 cm wide) with a mixed sand and rock substrate covered by a dense film of diatoms indicating continuous trickle flows (Figure 12). By comparison the stream bed was at least 2 metres wide in the excavated area indicating that sediment had filled in the narrow channel smothering the instream habitat.

Figure 12. Stream bed in the excavated area, and downstream with / without sedimentation as labelled.

The results of the IHI indicate that the PES of the watercourse **declined from a Class A/B (Largely Natural) to a Class E (Seriously Modified**). Both instream and riparian habitat were seriously impacted, but riparian habitat was most severely modified by the excavation (Table 4).

Table 4. Scores determined for the Index of Habitat Integrity pre- and post-excavation.

Habitat Modification	Pre-excavation score	Post-excavation score	Notes
INSTREAM HABITAT			
Water abstraction	0	0	None at present
Flow	5	10	Flow obstructed by earthworks
Bed	0	25	Bed characteristics destroyed
Channel	5	25	Channel characteristics destroyed
Physico-chemistry	0	15	Increased turbidity following earthworks
Inundation	0	0	None at present
Alien macrophytes	0	0	None observed
Introduced aquatic fauna	0	0	None observed
Rubbish dumping	0	0	None present
A, Natural		**E, Seriously Modified**	
RIPARIAN HABITAT			
Vegetation removal	5	25	Complete removal of all vegetation
Exotic vegetation	15	0	Currently no vegetation, but disturbance will increase aliens
Bank erosion	0	15	Wide-scale erosion beginning
Channel modification	0	25	Completely removed channel and vegetation
Water abstraction	0	0	None at present
Inundation	0	0	None at present
Flow modification	0	0	Not affecting riparian zone
Physico-chemistry	0	0	Not affecting riparian zone
B, Largely Natural		**E, Seriously Modified**	

Excavation for the dam effectively removed all vegetation from the bed, channel and riparian areas. While it is impossible to know what bed and channel characteristics were present prior to the excavation, any features that may have been present were eliminated by the earthworks. Strip excavations were very deep in sections, measuring up to 130 cm in depth (Figure 13). See detailed survey of the present site in Appendix 7.2.

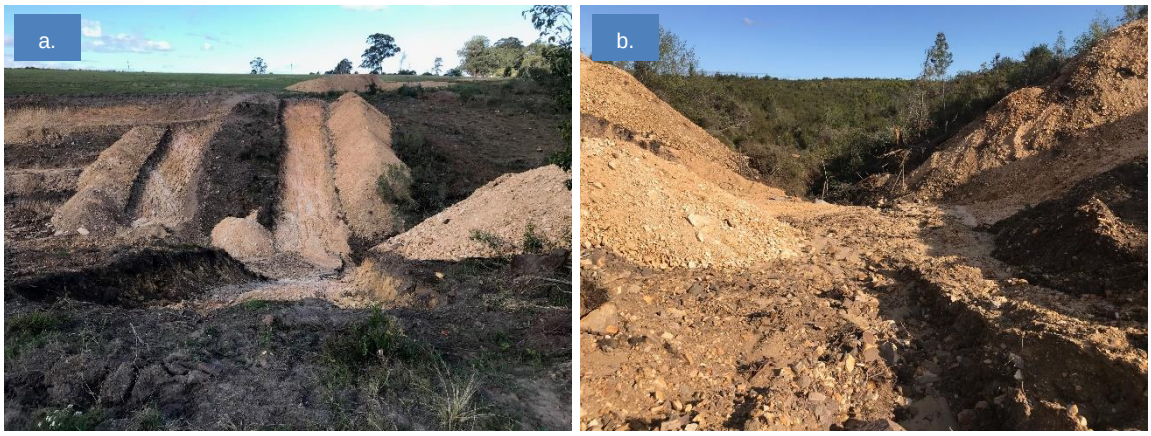


Figure 13. Photos of the site indicating a: the extent of earthworks across the valley effectively eliminating the watercourse channel and bed; b: the lower portion of the excavated area showing the natural vegetation beyond; c: the depth of strip excavations in relation to a soil auger (130 cm), and d: a small area of remnant vegetation on topsoil with some dead pine trees interspersed with indigenous trees and grasses.

4.2 Ecological Importance and Sensitivity

4.2.1 EIS Methods

The Ecological Importance and Sensitivity (EIS) for drainage lines was derived using the methods developed by Department of Water Affairs and Forestry (DWAF; 1999). Ecological Importance of a system is defined as the expression of its importance to the maintenance of ecological diversity and functioning on local as well as broader scales. Ecological sensitivity relates to the system's resilience to disturbance, or its ability to recover from disturbance that has occurred. The EIS rating does not incorporate the PES and therefore indicates the potential importance or sensitivity of a system as could be expected under unimpaired conditions (ie. Pre-excavation). For the assessment both biotic and abiotic factors are considered as follows:

- The presence of rare, endangered or unique aquatic species. This includes species of conservation concern, endemic or isolated species populations, intolerant species and overall species richness;
- Diversity and refuge value of habitat types;
- Sensitivity of the system to changes in flow and related water quality changes;
- Importance of providing functional connectivity between related systems;
- Biological connectivity in the form of migration routes / corridors instream and along riparian zones;
- Protection level of the area where the system is located (e.g. National Park).

These parameters are scored individually and the median score of all variables is calculated to derive an EI and ES category as defined in (Table 5).

Table 5. Ecological Importance and Sensitivity Categories

Ecological Importance and Sensitivity Categories	General Description
Very High	Quaternaries/delineations that are considered to be unique on a national or even international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use
High	Quaternaries/delineations that are considered to be unique on a national scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases, may have a substantial capacity for use.
Moderate	Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually not very sensitive to flow modifications and often have a substantial capacity for use.
Low/Marginal	Quaternaries/delineations that are not unique at any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have a substantial capacity for use.

4.2.2 EIS Results

The EIS was determined to be Moderate (Table 6). The most important aspect of the watercourse is preservation of ecological structure and function of habitat adjoining a Protected Area of conservation significance (Whiskey Creek Nature Reserve). The importance of the watercourse in terms of connectivity is not very high because it is at the headwater of the watercourse and surrounded by modified agricultural lands. In this sense it represents a dead end for migrating wildlife. As a non-perennial system, any biota associated with the watercourse would be well adapted to periodic no flows, and therefore less sensitive to this aspect. The EIS does not however, account for sensitivity to earthworks and clearing, which would negatively affect most biota.

It is not possible to determine whether any rare or endangered species were affected by the clearing and excavation works. Rare and endangered species are also not frequently identified in once-off site visits. The level of confidence in rating the presence of rare, unique, or endangered species at the site is relatively low.

Table 6. Ecological Importance and Sensitivity of the drainage line on portion 17/232, Redford Farm.

Determinant	Drainage lines assessed collectively
Presence of Rare & Endangered Species	**0** – No species/taxon judged as rare or endangered at a local scale.
Populations of Unique Species	**2 -** Taxa judged to be unique at a local scale as they are associated with the riparian habitat and exhibit a different growth form and density.
Intolerant Biota	**1** - A very low proportion of the biota is expected to be only temporarily dependent on flowing water for the completion of their life cycle. Sporadic and seasonal flow events expected to be sufficient.
Species/Taxon Richness	2 – Rated on a local scale
Diversity of Habitat Types or Features	**1 -** Not significant at any scale
Refuge value of habitat types	**2** – Rated on a local scale as it provides a corridor of more dense vegetation allowing movement for wildlife through an increasingly fragmented agricultural landscape.
Sensitivity of habitat to flow changes	**2** – Historically (pre-furrow diversion) the flow would have been more persistent. The lack of aquatic species is not indicative of the expected reference condition, although presently there are unlikely to be species sensitive to reduced flows.
Sensitivity to flow related water quality changes	**1** – Streams of a particular size (often "larger") and with habitat types rarely sensitive to water quality change related to flow decreases or increases.
Migration route for instream and riparian biota	**2** – The stream delineation is a moderately important link in terms of connectivity for the survival of biota upstream and downstream and is moderately sensitive to modification.
Protection Status	**3** – The stream delineation is downstream from a protected area which is important for the conservation of ecological diversity on a regional scale.
EIS Score	**1 - MODERATE**

5. IMPACT ASSESSMENT

Methods used for the impact assessment are described in Appendix 1. Three broadly grouped impacts were assessed which account for various scenarios which are described as follows:

1. ***Impact of current excavation***
- Construction phase
2. ***Impact of continuing with dam construction***
   - Construction phase
   - Operational phase
3. ***Impact of decommissioning and rehabilitating the dam***
   - Construction phase
   - Operational phase

5.1 Impact of Current Excavation

This section assesses the impacts of the degree to which the excavation at its current state has impacted on the watercourse. This assessment simply considers the impact to the watercourse of excavating the dam basin. To an extent this has been described qualitatively through the comparison of the PES pre- and post-excavation (Section 4.1.2). However, this section will consider specific impacts and how they would have been mitigated through planning retrospectively.

To an extent the impacts of the current excavation could have been mitigated by a more thorough approach to the planning phase in terms of dam sizing, water availability and water sources. Excavations for a dam inherently cause environmental degradation which is difficult to mitigate, which is why minimising the damage through careful siting of the dam with due consideration for environmental sensitivities is important.

Had the current site been selected through an impact assessment of proposed alternatives, the construction phase impact of sedimentation downstream would have been prevented through recommended mitigation measures which are fairly standard (e.g. silt fencing, hay bale check dams).

The impacts of the current excavation are considered in their unmitigated state as minimal mitigation measures were implemented for the current excavation. Typical measures to mitigate the impacts are listed as an indication of how these could have been reduced.

The impact of vegetation removal and excavation of the dam area was considered to be a Moderate Negative impact (Table 7 and Table 8). With limited certainty about the pre-condition of the site and the presence / absence of any sensitive fauna or flora at the site the level of confidence in the assessment of these impacts is moderate.

The specific impact associated with erosion risk and resulting sedimentation of the watercourse downstream in the short-term has been addressed through compilation of the proposed Erosion Control Plan (Confluent Environmental). However, to date (January 2022) this has not been implemented due to lack of approval by the Department of Environmental Affairs and Development Planning (DEA&DP) despite the willingness of landowners and approval by the BGCMA of the plan.

Table 7. Impact of Current Excavation: Vegetation Removal

Project phase	**Construction**			
Impact	**Vegetation removal with chainsaws, stump removal and chipping using heavy machinery.**			
Description of impact	**Death or injury to ground and tree dwelling biota, destruction of indigenous plants, compaction of soil and soil erosion.**			
Mitigatability	Medium	Mitigation exists and will notably reduce significance of impacts		
Potential mitigation	**• Had the dam been proposed through an environmental authorisation process considering viable alternatives, the minimum footprint of disturbance would have been proposed. • Only vegetation within the main basin of the dam would have been recommended for removal. All other remaining indigenous vegetation would have been excluded from removal. • Control of alien trees would not have included stump removal outside of the dam basin as this causes too much soil disturbance on steep slopes of a watercourse. • Direct chipping of vegetation in riparian zones would not have been recommended due to the possible presence of slow-moving biota that couldn't escape from branches or could be crushed by heavy machinery on the ground. • Vegetation clearing is usually specified out of major breeding seasons in Spring and Summer to minimise disturbance and injury to biota.**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Negative	
Duration	On-going	Impact will last between 15 and 20 years	On-going	Impact will last between 15 and 20 years
Extent	Limited	Limited to the site and its immediate surroundings	Limited	Limited to the site and its immediate surroundings
Intensity	Very high	Natural and/ or social functions and/ or processes are majorly altered	Very high	Natural and/ or social functions and/ or processes are majorly altered
Probability	Almost certain / Highly probable	It is most likely that the impact will occur	Almost certain / Highly probable	It is most likely that the impact will occur
Confidence	Medium	Determination is based on common sense and general knowledge	High	Substantive supportive data exists to verify the assessment
Reversibility	Medium	The affected environment will only recover from the impact with significant intervention	Medium	The affected environment will only recover from the impact with significant intervention
Resource irreplaceability	Medium	The resource is damaged irreparably but is represented elsewhere	Medium	The resource is damaged irreparably but is represented elsewhere
Significance	**Moderate - negative**		**Moderate - negative**	
Comment on significance	The significance is a "moderate negative" in both cases because the impact cannot be mitigated in retrospect.			
Cumulative impacts	Not applicable.			

Table 8. Impact of Current Excavation: Excavation of the dam

Project phase	Construction			
Impact	Extensive excavation work using heavy machinery			
Description of impact	Removal of topsoil, subsoil and rock from a large area killing ground-dwelling biota, creating an erosion risk and habitat loss.			
Mitigatability	Low	Mitigation does not exist; or mitigation will slightly reduce the significance of impacts		
Potential mitigation	• Had the dam been proposed through an environmental authorisation process, alternative sites would have been considered and the site sensitivity taken into account. • The erosion risk due to excavation of the dam basin would have been managed through the installation of silt fences, sand-bag barriers and hay-bale check dams.			
Assessment	Without mitigation		With mitigation	
Nature	Negative		Negative	
Duration	On-going	Impact will last between 15 and 20 years	On-going	Impact will last between 15 and 20 years
Extent	Local	Extending across the site and to nearby settlements	Local	Extending across the site and to nearby settlements
Intensity	Extremely high	Natural and/ or social functions and/ or processes are severely altered	Extremely high	Natural and/ or social functions and/ or processes are severely altered
Probability	Almost certain / Highly probable	It is most likely that the impact will occur	Almost certain / Highly probable	It is most likely that the impact will occur
Confidence	High	Substantive supportive data exists to verify the assessment	High	Substantive supportive data exists to verify the assessment
Reversibility	Low	The affected environment will not be able to recover from the impact - permanently modified	Low	The affected environment will not be able to recover from the impact - permanently modified
Resource irreplaceability	Medium	The resource is damaged irreparably but is represented elsewhere	Medium	The resource is damaged irreparably but is represented elsewhere
Significance	Moderate - negative		Moderate - negative	
Comment on significance	The significance is a "moderate negative" in both cases because the impact cannot be mitigated in retrospect.			
Cumulative impacts	Not applicable			

5.2 Impact of Continuing with Dam Construction

Should the proposed dam at the current location be approved to some extent through the WULA and S24G process, then construction of the dam would need to continue. Rehabilitation of disturbed areas outside of the dam basin (e.g. spillway, dam wall, shoreline) would also be required.

Findings of the engineer's report (J. Brink) and hydrology study (J.M. Dabrowski) report that the proposed dam's capacity would be 70 000 m^3 which would be sufficient for irrigation of macadamia nuts on the three properties. According to J. Brink's report, the proposed dam would be accommodated by the existing footprint of disturbance with little additional disturbance required.

This section considers the impacts and mitigation measures if the dam is approved and construction goes ahead.

5.2.1 Construction Phase

If construction continues, contractors will commence with earthworks. These impacts can be mitigated to an extent, especially as the work could largely be maintained within the existing footprint of disturbance, which is one of the recommended mitigation measures (Table 9). It is

likely that an additional degree of disturbance will be required to construct the spillway for instance, but this are of disturbance must be kept to a minimum.

Table 9. Impact of Continuing with Dam Construction: Renewed Earthworks

Project phase	**Construction**			
Impact	**Renewed earthworks to finish constructing the dam**			
Description of impact	**Soil erosion, downstream sedimentation, further vegetation loss, extension of disturbance footprint.**			
Mitigatability	Medium	Mitigation exists and will notably reduce significance of impacts		
Potential mitigation	**• The revised dam (including dam wall) must be within the existing area of disturbance ensuring no further vegetation is removed or disturbed. • The footprint of the dam includes the spillway which should also be included in the existing area of disturbance. • Demarcate the disturbed area with temporary fencing (not danger tape) and ensure all workers know this is the limit of disturbance. • Construction vehicle parking and equipment stores must be located at least 100 m from the demarcated area to prevent fuel and material spills from entering the watercourse. • Access by vehicles must be in and out on one road only to reduce the area of disturbance. Vehicles must not leave this road. • Fence off the watercourse downstream and the wetland area upstream of the excavated area for the duration of construction. These must be demarcated 'No-go Areas'. • Remove loose soil material from within the dam basin and stockpile it in distinct piles of rocky material, subsoil and topsoil. These must not be mixed as they can be re-used for rehabilitation. • Until the dam wall has been constructed, a large silt fence must be actively maintained across the outflow of the excavated area to prevent sedimentation downstream. Refer to methods in the soil erosion control plan (Confluent Environmental)**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Negative	
Duration	Medium term	Impact will last between 5 and 10 years	Medium term	Impact will last between 5 and 10 years
Extent	Local	Extending across the site and to nearby settlements	Local	Extending across the site and to nearby settlements
Intensity	High	Natural and/ or social functions and/ or processes are notably altered	Moderate	Natural and/ or social functions and/ or processes are moderately altered
Probability	Certain / definite	There are sound scientific reasons to expect that the impact will definitely occur	Probable	The impact has occurred here or elsewhere and could therefore occur
Confidence	High	Substantive supportive data exists to verify the assessment	High	Substantive supportive data exists to verify the assessment
Reversibility	Low	The affected environment will not be able to recover from the impact - permanently modified	Medium	The affected environment will only recover from the impact with significant intervention
Resource irreplaceability	Medium	The resource is damaged irreparably but is represented elsewhere	Medium	The resource is damaged irreparably but is represented elsewhere
Significance	**Moderate - negative**		**Minor - negative**	
Comment on significance				
Cumulative impacts	Not applicable			

Note that the impacts and recommended mitigation measures for 'soil erosion above the high-water mark' (should there be an exposed area above the high-water mark) are identified for the construction phase of renewed dam construction (Table 10 and Figure 14). This indicates that the recommended work must take place prior to operation of the dam. The methods for revegetating and stabilising slopes above the high-water mark area also applicable to vegetating the dam embankment (wall) which will also require stabilisation at this phase of the development.

The extent (if any) of disturbed areas that would be exposed above the high-water mark were unknown at the time of writing, because the dam has not been authorised. However, if the proposed dam as outlined in J. Brink's report is approved, then the disturbed area above the high-water mark is likely to be fairly limited.

Table 10. Impact of Continuing with Dam Construction: Soil erosion above high-water mark

Project phase	**Construction**			
Impact	**Soil erosion above the high water mark**			
Description of impact	**Loosely piled soils and rock will erode over time and areas will be colonised by alien vegetation.**			
Mitigatability	Medium	Mitigation exists and will notably reduce significance of impacts		
Potential mitigation	**• Once the dam basin and wall have been prepared, any disturbed areas above the high water mark needs to be rehabilitated. • In excavated areas replace and compact first the rocky layer then subsoils in all areas above the high water mark, sloping the material to a 1:3 slope that ties in with the dam basin. • Cover the above compacted layer with loose topsoil from the site to a depth of at least 50 cm. • Seed the slopes with a grass mixture (Teff, Cynodon dactylon (kweek), Digitaria eriantha (Smuts finger grass), cover with a light mulch, and then nail in overlapping soil saver matting to protect the soil (Methods in Appendix 2). • On both sides of the dam two silt fences must be installed along the full length of the 'edge' approximately 8 - 10 m apart (Methods in Appendix 3).**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Positive	
Duration	Permanent	Impact may be permanent, or in excess of 20 years	Short term	Impact will last between 1 and 5 years
Extent	Local	Extending across the site and to nearby settlements	Limited	Limited to the site and its immediate surroundings
Intensity	High	Natural and/ or social functions and/ or processes are notably altered	Negligible	Natural and/ or social functions and/ or processes are negligibly altered
Probability	Certain / definite	There are sound scientific reasons to expect that the impact will definitely occur	Probable	The impact has occurred here or elsewhere and could therefore occur
Confidence	High	Substantive supportive data exists to verify the assessment	Medium	Determination is based on common sense and general knowledge
Reversibility	Low	The affected environment will not be able to recover from the impact - permanently modified	Medium	The affected environment will only recover from the impact with significant intervention
Resource irreplaceability	Medium	The resource is damaged irreparably but is represented elsewhere	Medium	The resource is damaged irreparably but is represented elsewhere
Significance	**Moderate - negative**		**Negligible - positive**	
Comment on significance	Mitigation measures will result in a negligible improvement compared to the current state of the disturbed area.			
Cumulative impacts	No applicable			

Figure 14. Annotated photo of the impacted area indicating mitigation measures should construction with the dam continue as described in Table 9 and Table 10.

5.2.2 Operational Phase

One of the greater risks likely during the operational phase is that the sloping areas above the high-water mark are at risk of eroding despite the grassy vegetation cover applied during the construction phase (previous section). This impact can be reduced, and the biodiversity value of the dam enhanced, through the establishment of a **10 m buffer of indigenous vegetation** measured from the edge of the previously excavated area (shown in Figure 15). This will intercept and reduce overland flow from surrounding slopes reducing its impact on previously disturbed slopes.

The plant species that must be actively planted in the buffer zone (not previously disturbed slopes) can be sourced from most indigenous nurseries and are listed in Table 11. The aim is to create a complex and diverse vegetated buffer that provides (a) habitat, (b) improves connectivity and (c) protects the banks from surface runoff that will cause erosion.

Table 11. Recommended indigenous plant species for active replanting in 10 m buffer zone.

Species Name	Common Name
Trees	
Ekebergia capensis	Cape Ash
Halleria lucida	Tree fuchsia
Osteospermum moniliferum	Bitou
Searsia undulata	Kuni-bush
Searsia glauca	Blue kuni-bush
Buddleja salviifolia	Sagewood
Buddleja Saligna	False olive
Tarchonanthus littoralis	Coastal camphorbush
Virgilia oroboides	Keurboom
Podocarpus latifolius	Yellowwood
Shrubs	

Agathosma recurvifolia	Boegoe
Helichrysum petiolare	Licorice plant
Psoralea axillaris	Violet-flash fountainbush
Watsonia knysnana	Narrow watsonia
Selago corymbosa	Stiff bitterbush
Pelargonium cordifolium	Heartleaf storksbill
Pelargnoium citronellum	Lemon-scented pelargonium
Grasses	
Themeda triandra	Red grass
Cynodon dactylon	Kweek / Bermuda (use with caution as can be invasive)
Groundcover	
Plectranthus fruticosus	Pink fly bush (shade-loving, plant under trees)
Carprobrotus sp.	Creeping sour fig

Table 12. Impact of continuing with dam construction: Erosion of previously excavated slopes

Project phase	**Operation**			
Impact	**Erosion of previously excavated slopes**			
Description of impact	**Historically disturbed soil may be difficult to stabilise and protect from erosion**			
Mitigatability	Medium	Mitigation exists and will notably reduce significance of impacts		
Potential mitigation	**• Revegetated slopes above the high-water mark must be actively monitored to ensure a dense cover of > 80% of grass. Gaps should be actively reseeded. • A 10 m buffer zone surrounding the area of disturbance must be established and demarcated with basic fencing. • A combination of active and passive revegetation must take place in the 10 m buffer zone: Active = planting recommended indigenous speces, and Passive = not disturbing plants that naturally germinate. • Alien vegetation must be actively removed before it becomes established when it can either be hand-pulled or removed with a tree popper. NO heavy machinery can be used within the bufffer or previously disturbed area for the purpose of alien removal. • Revegetation of the buffer area must be monitored 6-monthly for 3 years by an Environmental Control Officer / Aquatic Ecologist.**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Negative	
Duration	Long term	Impact will last between 10 and 15 years	Short term	Impact will last between 1 and 5 years
Extent	Limited	Limited to the site and its immediate surroundings	Limited	Limited to the site and its immediate surroundings
Intensity	Moderate	Natural and/ or social functions and/ or processes are moderately altered	Low	Natural and/ or social functions and/ or processes are somewhat altered
Probability	Likely	The impact may occur	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur
Confidence	Low	Judgement is based on intuition	High	Substantive supportive data exists to verify the assessment
Reversibility	Medium	The affected environment will only recover from the impact with	High	The affected environment will be able to recover from the impact
Resource irreplaceability	Low	The resource is not damaged irreparably or is not scarce	Low	The resource is not damaged irreparably or is not scarce
Significance	**Minor - negative**		**Negligible - negative**	
Comment on significance				
Cumulative impacts	Not applicable			

Figure 15. Photo showing the area of disturbance (blue line) and the 10 m buffer of indigenous vegetation that must be actively replanted (red dotted line).

As an instream dam, and with the likelihood of erosion of surrounding areas fairly high, it is possible that the dam may require dredging to remove accumulated silt in the years following construction. While every effort must be made to manage the water quality and surrounding land to reduce this requirement, it could still be necessary. The impacts of dredging dams located close to natural areas (e.g. Whiskey Creek Nature Reserve) can be significant as they become extended habitat for a range of wildlife and plants. This can be mitigated to a Negligible level by implementing the mitigation measures stipulated in Table 13. These guidelines should also be applied when maintaining other dams on the property.

Table 13. Impact of continuing with dam construction: Maintenance involving dredging of silt

Project phase	Operation			
Impact	Maintenance of the dam involving dredging to remove silt			
Description of impact	Disturbance of rehabilitated slopes, disturbance to instream habitat and biota, increasing the dam capacity			
Mitigatability	Medium	Mitigation exists and will notably reduce significance of impacts		
Potential mitigation	• Heavy machinery for dredging the dam may only gain access to the basin from the dam wall or from the road indicated in Figure 9. Machines may not drive over previously disturbed and rehabilitated slopes. • To minimise the impact of dredging on instream biota (plants and animals) dredging must be conducted in mid-winter to avoid the breeding season. • Only 60% of vegetation that has established (reeds etc.) can be removed, working from the central basin outwards. • Make an effort to rescue any obvious wildlife from disturbance such as frogs. • Work should be conducted when the water level is as drawn down as low as possible to minimise increasing suspended sediments in the dam. • The dam's original capacity must not be increased in volume, and records of the cubic metres of sediment removed must be maintained. • No trees or large shrubs must be allowed to grow on the dam embankment (wall) as these can lead to piping erosion and dam wall failure.			
Assessment	Without mitigation		With mitigation	
Nature	Negative		Negative	
Duration	Long term	Impact will last between 10 and 15 years	Short term	Impact will last between 1 and 5 years
Extent	Limited	Limited to the site and its immediate surroundings	Limited	Limited to the site and its immediate surroundings
Intensity	High	Natural and/ or social functions and/ or processes are notably altered	Low	Natural and/ or social functions and/ or processes are somewhat altered
Probability	Almost certain / Highly probable	It is most likely that the impact will occur	Probable	The impact has occurred here or elsewhere and could therefore occur
Confidence	High	Substantive supportive data exists to verify the assessment	High	Substantive supportive data exists to verify the assessment
Reversibility	Medium	The affected environment will only recover from the impact with significant intervention	Medium	The affected environment will only recover from the impact with significant intervention
Resource irreplaceability	Medium	The resource is damaged irreparably but is represented elsewhere	Medium	The resource is damaged irreparably but is represented elsewhere
Significance	Minor - negative		Negligible - negative	
Comment on significance				
Cumulative impacts	Not applicable			

5.2.2.1 Ecological Reserve

The proposed dam site is in the upper reaches of the catchment for Whiskey Creek. The catchment is small, measuring a total area of 0.14 km^2 (Confluent Environmental Hydrological Study) Mean Annual Runoff for the catchment is approximately 12 200 m^3 per annum which would be stored in the Bernardskloof Dam (if approved) instead of flowing through the system. The classification of the system as a non-perennial, intermittent drainage line means that the associated habitat and biota are less susceptible to increased periods of no flow. The sensitivity of the watercourse downstream of the dam is considered to be low, and able to withstand reduced periods of flow. It is therefore not considered essential to release water to meet the Ecological Reserve.

5.3 Impact of Decommissioning and Rehabilitating the Dam

This section considers the possibility of rehabilitating the excavated area with no dam placed on the site.

The three main activities that would be required would be:

1. The replacement and stabilisation of soil (rock, subsoil and topsoil);
2. Restoration of the stream bed; and,
3. Revegetation of the disturbed area.

The unmitigated impact considers the excavation in its current state, and the mitigated state considers the impacts with recommended rehabilitation measures.

The mitigation measures associated with earthworks required to replace the soil are extensive and will need to be carefully implemented under the supervision of an Environmental Control Officer / Aquatic Ecologist (Table 14). Excavated slopes are very steep, apart from terraced areas making stabilisation of the soil and rock a challenge in this situation. Refer to Appendix 7.2 for a detailed survey of the current area.

Table 14. Impact of decommissioning and rehabilitating the dam: Earthworks to replace soil

Project phase	**Decommissioning**			
Impact	**Earthworks to replace soil**			
Description of impact	**Erosion leading to soil loss and sedimentation of the watercourse downstream**			
Mitigatability	Medium	Mitigation exists and will notably reduce significance of impacts		
Potential mitigation	**• Demarcate the disturbed area with temporary fencing (not danger tape) and ensure all workers know this is the limit of disturbance. • Construction vehicle parking and equipment stores must be located at least 100 m from the demarcated area to prevent fuel and material spills from entering the watercourse. • Access by vehicles must be in and out on one road only to reduce the area of disturbance (indicated in Figure 9). • Fence off the watercourse downstream and the wetland area upstream of the excavated area for the duration of construction. These must be demarcated 'No-go Areas' for people and vehicles. • Replace and compact soils in the order in which they were removed. ie. rock layer followed by subsoils (usually yellowish colour). Topsoil must be placed over the subsoil, but the latter must not be compacted. • Topsoil must be at a depth greater than or equal to 50 cm. • It is extremely important to not mix soil profiles (e.g. subsoil with topsoil). • There may not be sufficient topsoil from the site, in which case this will need to be purchased and brought in to achieve the required depth. • Attempt to reshape and slope the valley to the natural site contours, avoiding the creation of ditches and cuts which channel water flow and cause erosion. • Work must not be conducted during periods of rainfall to avoid further disturbance. • A large silt fence must be established and maintained free of silt for the duration of the rehabilitation work. • The depth of topsoil and final landform must be independently assessed by an Environmental Control Officer / Aquatic Ecologist using an auger prior to revegetation to ensure a uniform distribution of topsoil has been achieved.**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Negative	
Duration	On-going	Impact will last between 15 and 20 years	Medium term	Impact will last between 5 and 10 years
Extent	Local	Extending across the site and to nearby settlements	Limited	Limited to the site and its immediate surroundings
Intensity	Very high	Natural and/ or social functions and/ or processes are majorly altered	High	Natural and/ or social functions and/ or processes are notably altered
Probability	Almost certain / Highly probable	It is most likely that the impact will occur	Probable	The impact has occurred here or elsewhere and could therefore occur
Confidence	High	Substantive supportive data exists to verify the assessment	Medium	Determination is based on common sense and general knowledge
Reversibility	Low	The affected environment will not be able to recover from the impact - permanently modified	Medium	The affected environment will only recover from the impact with significant intervention
Resource irreplaceability	Medium	The resource is damaged irreparably but is represented elsewhere	Medium	The resource is damaged irreparably but is represented elsewhere
Significance	**Moderate - negative**		**Minor - negative**	
Comment on significance				
Cumulative impacts	Not applicable			

Once the soil has been replaced, the stream bed must be restored to enable the conveyance of flowing water without causing severe erosion and downstream sedimentation. This is unavoidable and expected to some degree but can be mitigated by installing a series of check dams aimed at slowing flows and retaining water for longer periods within the stream. These modifications represent a permanent alteration to the stream bed and channel but will be required if erosion and sedimentation are to be controlled.

Table 15. Impact of decommissioning and rehabilitating the dam: Restoration of the stream bed.

Project phase	**Decommissioning**			
Impact	**Restoration of the stream bed**			
Description of impact	**Erosion, habitat loss, and sedimentation downstream**			
Mitigatability	Medium	Mitigation exists and will notably reduce significance of impacts		
Potential mitigation	**• install 4 - 5 gabion check dams equally spaced at intervals along the stream bed (Figure 11). The purpose is to slow and filter flows, and encourage settling of sediment upstream of each check dam. • Gabions must be correctly installed on a geotextile such as bidim to prevent erosion from occurring beneath and around them. They should be 'anchored in' to the bottom of the valley sides. • The final gabion must be located at lower extent of the disturbed area. • Cover approximately 40% of the stream bed with cobbles and small rocks (Approx. 30 cm width) placed randomly along the length of the stream bed.**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Negative	
Duration	Medium term	Impact will last between 5 and 10 years	Short term	Impact will last between 1 and 5 years
Extent	Local	Extending across the site and to nearby settlements	Limited	Limited to the site and its immediate surroundings
Intensity	Very high	Natural and/ or social functions and/ or processes are majorly altered	Moderate	Natural and/ or social functions and/ or processes are moderately altered
Probability	Certain / definite	There are sound scientific reasons to expect that the impact will definitely occur	Probable	The impact has occurred here or elsewhere and could therefore occur
Confidence	High	Substantive supportive data exists to verify the assessment	High	Substantive supportive data exists to verify the assessment
Reversibility	Medium	The affected environment will only recover from the impact with significant intervention	Medium	The affected environment will only recover from the impact with significant intervention
Resource irreplaceability	Medium	The resource is damaged irreparably but is represented elsewhere	Medium	The resource is damaged irreparably but is represented elsewhere
Significance	**Moderate - negative**		**Minor - negative**	
Comment on significance				
Cumulative impacts	No applicable.			

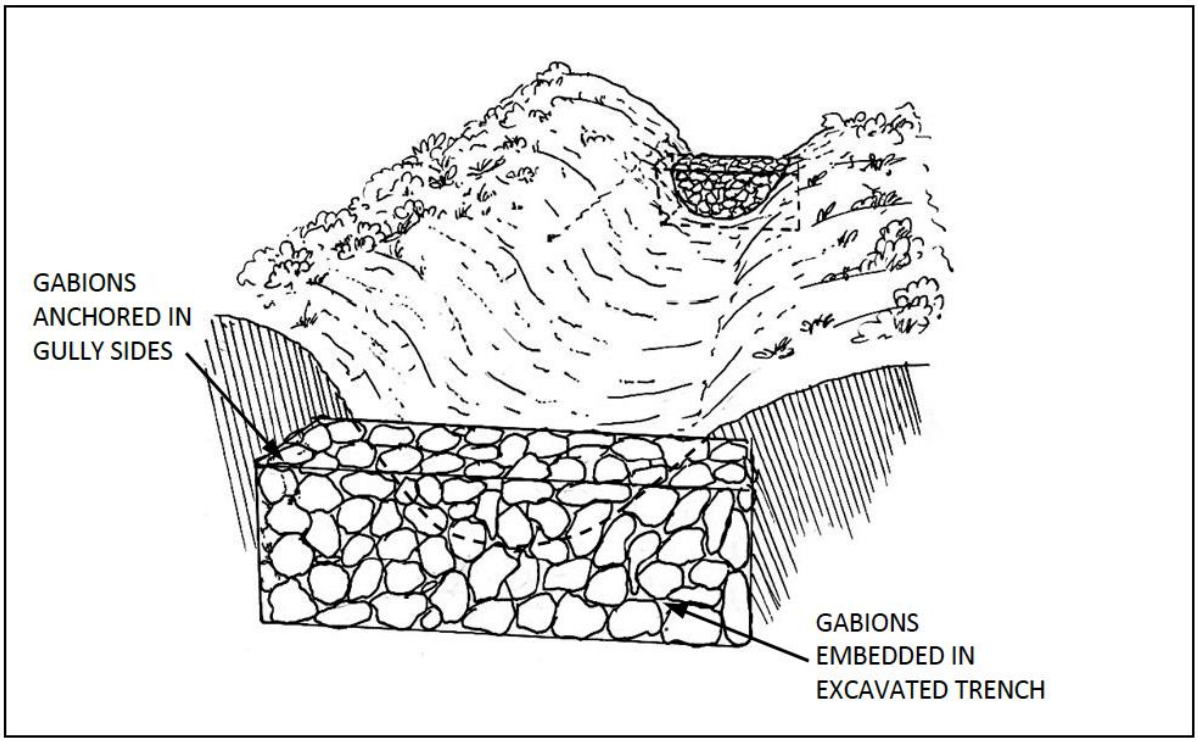


Figure 16. Cross section of recommended gabion check dam excavated into the stream bed to control erosion and slow flow (from Ministry of Environment, Water and Natural Resources, Kenya).

Revegetation of the slopes and stream bed will be required to provide stability to the soil and prevent erosion. This is the primary aim in the short-term, while improving biodiversity of the site would be a longer-term aim. Monitoring of the site is recommended (Table 16) to ensure that rehabilitation efforts are successful and that problematic areas are attended to effectively and proactively. Without successful revegetation, the slopes will undoubtedly erode in areas, causing ongoing degradation of the watercourse. It is therefore crucial that if the decision is made for the excavated area to be rehabilitated that a detailed rehabilitation plan be followed using the mitigation measures in Table 16.

Table 16. Impact of decommissioning and rehabilitating the dam: Erosion of recently replaced soil

Project phase	**Decommissioning**			
Impact	**Erosion of recently replaced soil**			
Description of impact	**Without revegetation, replaced soil will erode causing habitat loss and sedimentation downstream**			
Mitigatability	Medium	Mitigation exists and will notably reduce significance of impacts		
Potential mitigation	**• Seed the slopes and stream bed with a grass mixture (Italian Ryegrass, Cynodon dactylon (kweek), Digitaria eriantha (Smuts finger grass) and cover with a light mulch. • On the slopes, nail in overlapping soil saver matting to protect the soil (Methods in Appendix 2). • On both sides of the dam four silt fences must be installed parallel to each other along the full length of the disturbed slopes approximately 8 - 10 m apart (Methods in Appendix 3). • Revegetated slopes must be actively monitored to ensure a dense cover of > 80% of grass. Gaps should be actively reseeded. • A 10 m buffer zone surrounding the area of disturbance must be established and demarcated with basic fencing. • A combination of active and passive revegetation must take place in the 10 m buffer zone: Active = planting recommended indigenous speces, and Passive = not disturbing indigenous plants that naturally germinate (See Table 11 for suitable plant species). • Alien vegetation must be actively removed before it becomes established when it can either be hand-pulled or removed with a tree popper. NO heavy machinery can be used within the bufffer or previously disturbed area for the purpose of alien removal. • Revegetation of the buffer and previously excavated area must be monitored 6-monthly for 3 years by an Environmental Control Officer / Aquatic Ecologist. • Monitoring should also take place by the land-owner following heavy rainfall to identify and proactively address erosion before it can progress too severely. • Eroded areas of the steep banks must be refilled with topsoil, reseeded with grass mix, covered with a light mulch and protected with soil saver mats. The use of silt fencing can be extended to problem areas to provide further protection.**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Negative	
Duration	On-going	Impact will last between 15 and 20 years	Medium term	Impact will last between 5 and 10 years
Extent	Local	Extending across the site and to nearby settlements	Limited	Limited to the site and its immediate surroundings
Intensity	Very high	Natural and/ or social functions and/ or processes are majorly altered	High	Natural and/ or social functions and/ or processes are notably altered
Probability	Certain / definite	There are sound scientific reasons to expect that the impact will definitely occur	Probable	The impact has occurred here or elsewhere and could therefore occur
Confidence	High	Substantive supportive data exists to verify the assessment	Medium	Determination is based on common sense and general knowledge
Reversibility	Medium	The affected environment will only recover from the impact with significant intervention	Medium	The affected environment will only recover from the impact with significant intervention
Resource irreplaceability	Medium	The resource is damaged irreparably but is represented elsewhere	Medium	The resource is damaged irreparably but is represented elsewhere
Significance	**Moderate - negative**		**Minor - negative**	
Comment on significance				
Cumulative impacts	Not applicable			

6. CONCLUSIONS

Excavations for the dam that was proposed at 17/232 Redford Farm cover an area of about 1.2 ha and have had a significant negative impact on the affected watercourse which is classified as a non-perennial drainage line. This has resulted in a decline in the localised Present Ecological State from a **Class A/B (Largely Natural) to a Class E (Seriously Modified**).

The dam originally proposed for the site was sized to store water to irrigate macadamia nuts on 5 properties. The landowners have only purchased 3 properties with an area of proposed orchards covering 28 ha. Conclusions from engineering and hydrological studies suggest that 70 000 m^3 storage capacity is needed. The proposed water for storage will come from 3 furrow allocations (25 000m^3/a), runoff from the catchment (12 200m^3/a) and the borehole (69 000 m3/a) which will form part of the Water Use License Application.

Had the correct process for environmental authorisations been followed from the start, an alternative site for an offstream dam would have to have been considered in the process. Offstream dams are preferred storage reservoirs when surface water is not the main source of water as they cause less environmental damage than an instream excavation. However, now that the site has been excavated to such a large extent, it is considered preferable to construct the dam (with revised proportions) in the existing footprint of disturbance. This will ensure that large volumes of disturbed sediment on steep banks which will be difficult to stabilise will be contained within the dam, ensuring they do not move downstream.

Furthermore, it could be possible to divert the surface runoff from the small catchment through the dam from the bottom release pipe as indicated in the dam engineer study. Essentially creating an offstream dam from a surface runoff perspective. However, this option would result in a slight deficit in the maximum irrigation requirements. If this option is considered, then a surface release of water is preferable to a bottom release given that water quality in the hypolimnion (deep layer of dam water) is frequently oxygen-depleted with elevated iron and manganese. This can be achieved with installation of a floating intake with a flexible pipe connected to the bottom outlet.

Impacts in terms of the Ecological Reserve are not considered major because: 1) the dam is located at the very top of the stream system, and 2) the watercourse downstream is non-perennial and aquatic life are therefore accustomed to periods of low / no flow. The primary ecological function of the watercourse is therefore to deliver flows to downstream catchments which are more perennial in nature. In terms of volumes however, these are considered to be low in terms of the overall contribution of the local catchment at only 25% loss due to the dam (Confluent Environmental Hydrology Report).

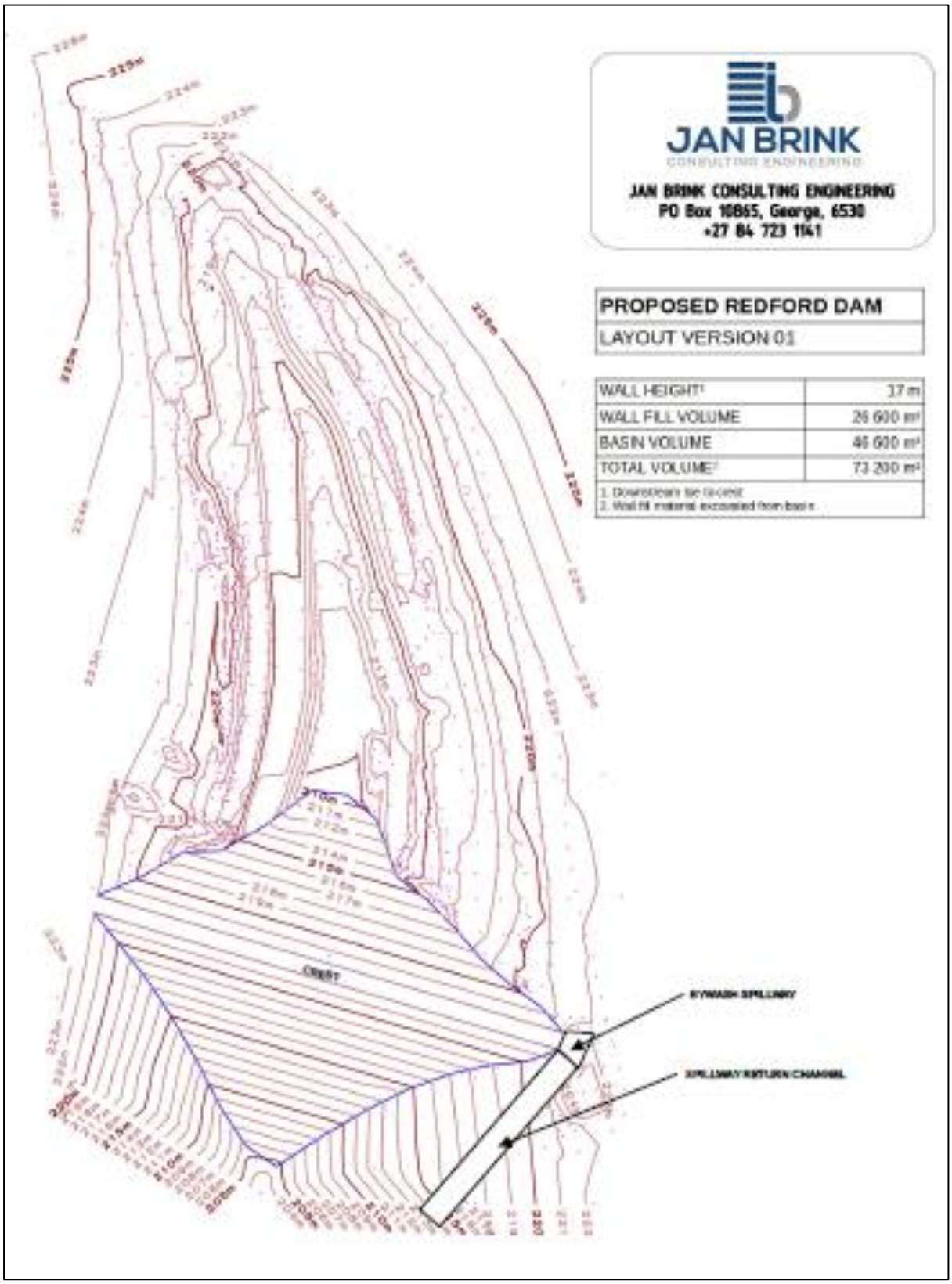
Rehabilitation of the excavated area (decommissioning the dam) will not be an easy task, and even with the rigorous implementation of mitigation measures recommended in this report is likely to have failures which would require ongoing monitoring and maintenance. This is because the surrounding slopes are steep (See Appendix 7.2) and a lot of material (soil and rock) has been destabilised and moved. A concerted and sustained effort is necessary to reduce downstream impacts however, as the site is located within a FEPA and Ecological Support Area and is located upstream of a Protected Area.

If part or all of the excavated area is used for the dam, this leaves less area that requires rehabilitation (above the high-water mark), and reduces the risk of sedimentation downstream, as eroded sediment will largely be retained within the dam basin.

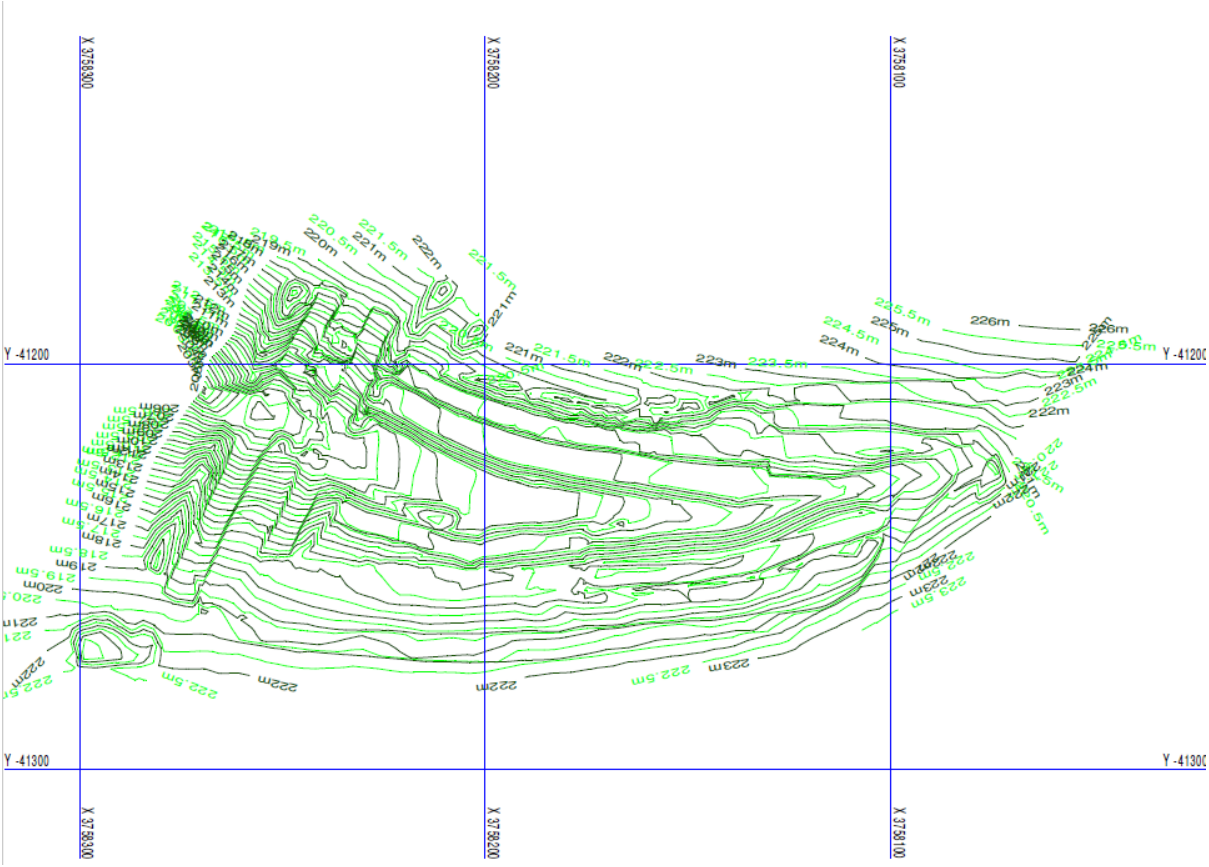
Given these considerations it is concluded that a dam with proportions informed by the hydrological and engineering study be considered for approval within the footprint of disturbance. In this instance, all mitigation measures explained for this scenario must be fully implemented to rehabilitate degraded areas and prevent further habitat loss and degradation.

7. APPENDICES

7.1 Proposed dam design (Jan Brink)



7.2 Survey of the current dam site



7.3 Impact assessment methods

Criteria are ascribed for each predicted impact. These include the intensity (size or degree scale), which also includes the type of impact, being either a positive or negative impact; the duration (temporal scale); and the extent (spatial scale), as well as the probability (likelihood). The methodology is quantitative, whereby professional judgement is used to identify a rating for each criterion based on a seven-point scale (Table 17) and the significance is auto-generated using a spreadsheet through application of the calculations.

For each predicted impact, certain criteria are applied to establish the likely **significance** of the impact, firstly in the case of no mitigation being applied and then with the most effective mitigation measure(s) in place.

These criteria include the **intensity** *(*size or degree scale), which also includes the **nature** of impact, being either a positive or negative impact; the **duration** (temporal scale); and the **extent** (spatial scale). These numerical ratings are used in an equation whereby the **consequence** of the impact can be calculated. Consequence is calculated as follows:

Consequence = type x (intensity + duration + extent)

To calculate the significance of an impact, the **probability** (or likelihood) of that impact occurring is applied to the consequence.

Significance = consequence x probability

Depending on the numerical result, the impact would fall into a significance category as negligible, minor, moderate or major, and the type would be either positive or negative.

Table 17. Assessment criteria for the evaluation of impacts

Criteria	Numeric Rating	Category	Description
Duration	**1**	**Immediate**	Impact will self-remedy immediately
	2	**Brief**	Impact will not last longer than 1 year
	3	**Short term**	Impact will last between 1 and 5 years
	4	**Medium term**	Impact will last between 5 and 10 years
	5	**Long term**	Impact will last between 10 and 15 years
	6	**On-going**	Impact will last between 15 and 20 years
	7	**Permanent**	Impact may be permanent, or in excess of 20 years
Extent	**1**	**Very limited**	Limited to specific isolated parts of the site
	2	**Limited**	Limited to the site and its immediate surroundings
	3	**Local**	Extending across the site and to nearby settlements
	4	**Municipal area**	Impacts felt at a municipal level
	5	**Regional**	Impacts felt at a regional level
	6	**National**	Impacts felt at a national level
	7	**International**	Impacts felt at an international level
Intensity	**1**	**Negligible**	Natural and/ or social functions and/ or processes are negligibly altered
	2	**Very low**	Natural and/ or social functions and/ or processes are slightly altered
	3	**Low**	Natural and/ or social functions and/ or processes are somewhat altered
	4	**Moderate**	Natural and/ or social functions and/ or processes are moderately altered
	5	**High**	Natural and/ or social functions and/ or processes are notably altered
	6	**Very high**	Natural and/ or social functions and/ or processes are majorly altered
	7	**Extremely high**	Natural and/ or social functions and/ or processes are severely altered
Probability	**1**	**Highly unlikely / None**	Expected never to happen
	2	**Rare / improbable**	Conceivable, but only in extreme circumstances, and/or might occur for this project although this has rarely been known to result elsewhere
	3	**Unlikely**	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur
	4	**Probable**	Has occurred here or elsewhere and could therefore occur
	5	**Likely**	The impact may occur
	6	**Almost certain / Highly probable**	It is most likely that the impact will occur
	7	**Certain / Definite**	There are sound scientific reasons to expect that the impact will definitely occur

When assessing impacts, broader considerations are also considered. These include the level of confidence in the assessment rating; the reversibility of the impact; and the irreplaceability of the resource as set out in (Table 18, Table 19, Table 20), respectively.

Table 18. Definition of confidence ratings.

Category	Description
Low	Judgement is based on intuition
Medium	Determination is based on common sense and general knowledge
High	Substantive supportive data exists to verify the assessment

Table 19. Definition of reversibility ratings.

Category	Description
Low	The affected environment will not be able to recover from the impact - permanently modified
Medium	The affected environment will only recover from the impact with significant intervention
High	The affected environmental will be able to recover from the impact

Table 20. Definition of irreplaceability ratings.

Category	Description
Low	The resource is not damaged irreparably or is not scarce
Medium	The resource is damaged irreparably but is represented elsewhere

7.4 Soil saver matting and revegetation

Between the silt fences described in the section below, soil will be vulnerable to erosion and must be stabilised. A combination of temporary vegetation cover and soil matting will be used (Figure 17). The following steps must be taken.

- Lightly rake over the soil to create a uniform surface.
- Seed the areas between silt fences with a cover of weed-free grass mix consisting of rye grass, *Cynodon dactylon* and *Digitaria eriantha* purchased from a registered supplier (e.g. Agricol). These grasses will rapidly provide cover and stabilise the soil. The seeding rate should be 20 -30 kg / ha. Seed should be scattered as uniformly as possible to prevent clumping, and the silt fences should be avoided as seed will probably collect along these lines anyway.
- The seeded area must be covered in a **light mulch (1-2cm deep**). This can consist of shredded woody material but must not be wood chips. Chipped alien vegetation is not suitable as it will contain seeds of alien vegetation.
- Cover the seeded and mulched slops with a rolled erosion control product (such as jute, coir or straw matting). Preferably a natural (vs. man-made), bio-degradable product should be used. The use of a jute geotextile called *Soilsaver* is recommended. It is available from Kaytech in Port Elizabeth and in Cape Town.

Figure 17. Images of installed soil saver matting and silt fences several weeks after installation.

The role of the erosion control matting is not to provide long-term protection for slopes from erosion, but to protect the soil surface until vegetation can establish and become the permanent stabilising feature. The slope should be seeded and mulched, and then covered with erosion control matting which will remain in place until the vegetation has established.

Matting should be overlapped by about 10cm and secured using wooden stakes along the edges. Terminal ends of the matting can also be staked or buried in an anchor trench.

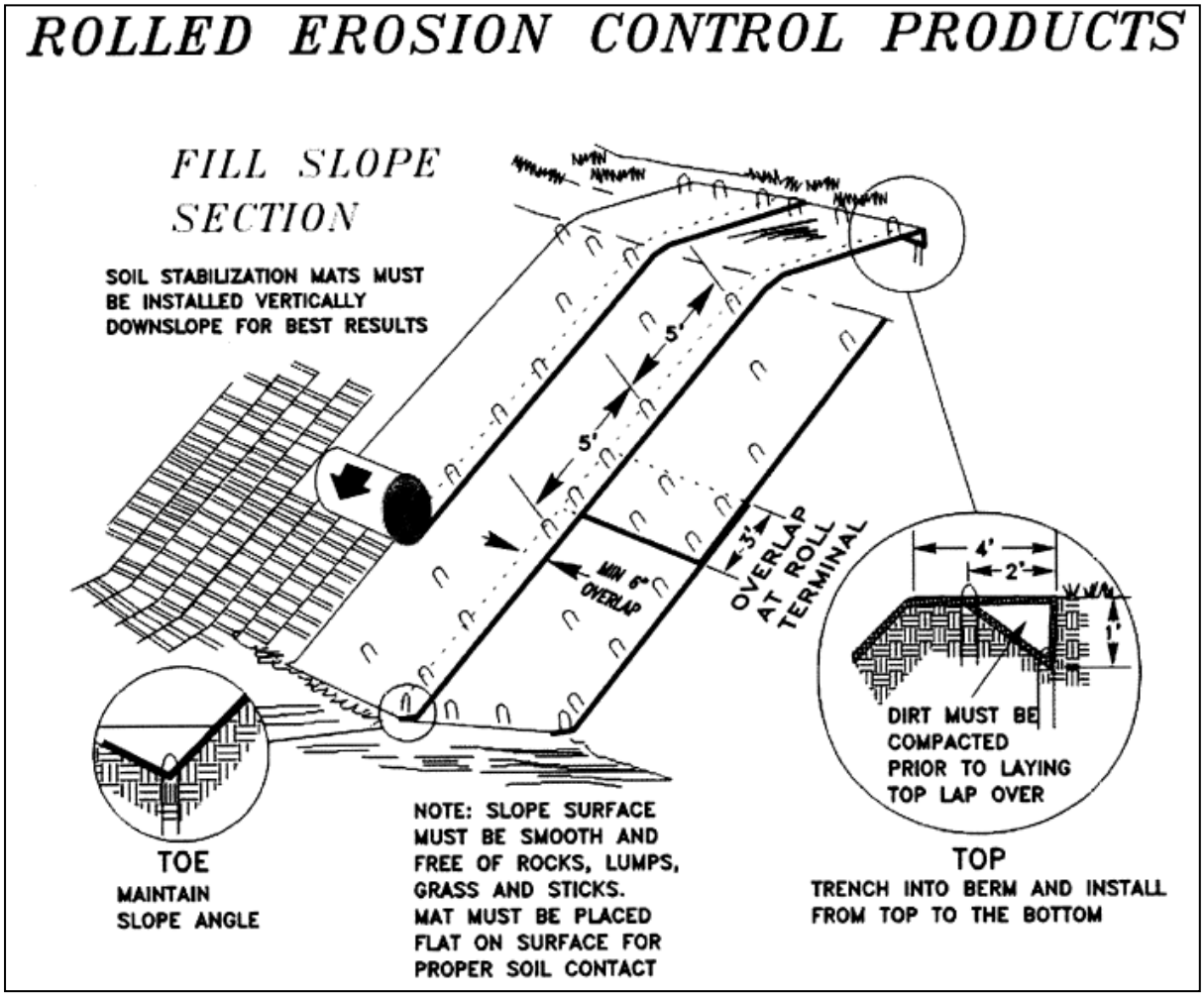


Figure 18. Example of methods recommended to install erosion control matting on sloping areas that require revegetation (Source: Department of Environmental Protection, West Virginia)

7.5 Silt fencing

Proper installation of soil erosion control fences is necessary for them to be effective. At least 2 silt fences approximately 8 – 10 m apart must be installed above the high-water mark of the proposed dam as per Figure 14. These guidelines must be followed:

- Geotextile fences must be installed perpendicular to the direction of water flow and along a line of uniform elevation or contour. In other words they should not waiver up and down the slope, but should be in a straight line across the slope. If this guideline is not followed, water will flow along the fence to the lowest point creating stress and potential collapse at this point;
- Use synthetic UV resistant geotextile fabric able to withstand at least 6 months of sun exposure. The product *Grassfence* (available from Kaytech) is specifically made for this application and is available in rolls 500mm and 700mm wide. The material must be able to allow water to move through it, so materials like bidim are not suitable, but 70-80% shadecloth can be used if necessary;

- Silt fences can be staked using wooden stakes. Metal droppers are preferable but will be stolen. The stakes should be arranged in straight lines across the area to be rehabilitated, at most 3m apart and firmly driven into the ground. A steel wire along the top of the stakes and also along the ground must then be secured and to which the geotextile is fastened, top and bottom;
- A 250 to 350 cm wide and 10 cm deep trench must be dug upslope of the location of the fence and the bottom half of the geotextile then laid into the trench;
- The trench must be backfilled and the soil compacted over the geotextile;
- The height of the silt fence should be between 20 and 30 cm;
- The distance between silt fences should be 8-10m. This results in 4 silt fences at the site, with the lowest one following the line of the lowest uncleared vegetation;
- Geotextile should be in a continuous roll to avoid joins which weaken the structure. Where joins are unavoidable both fabric ends should be wound around stakes to prevent it from unravelling (See Figure 20);
- Terminal ends of the silt fence should run slightly uphill to prevent runoff from going around the ends of the fences.
- Silt fences will be removed once vegetation has established on exposed areas.

Figure 19. Installation of the soil erosion control fence. A: Installing the standards and wires and preparing the trench. B: Fitting the geotextile, tying it on with wire. C: Filling in the trench over the geotextile. D: Applying a mulch against the completed fence (Photos courtesy Ken Coetzee).

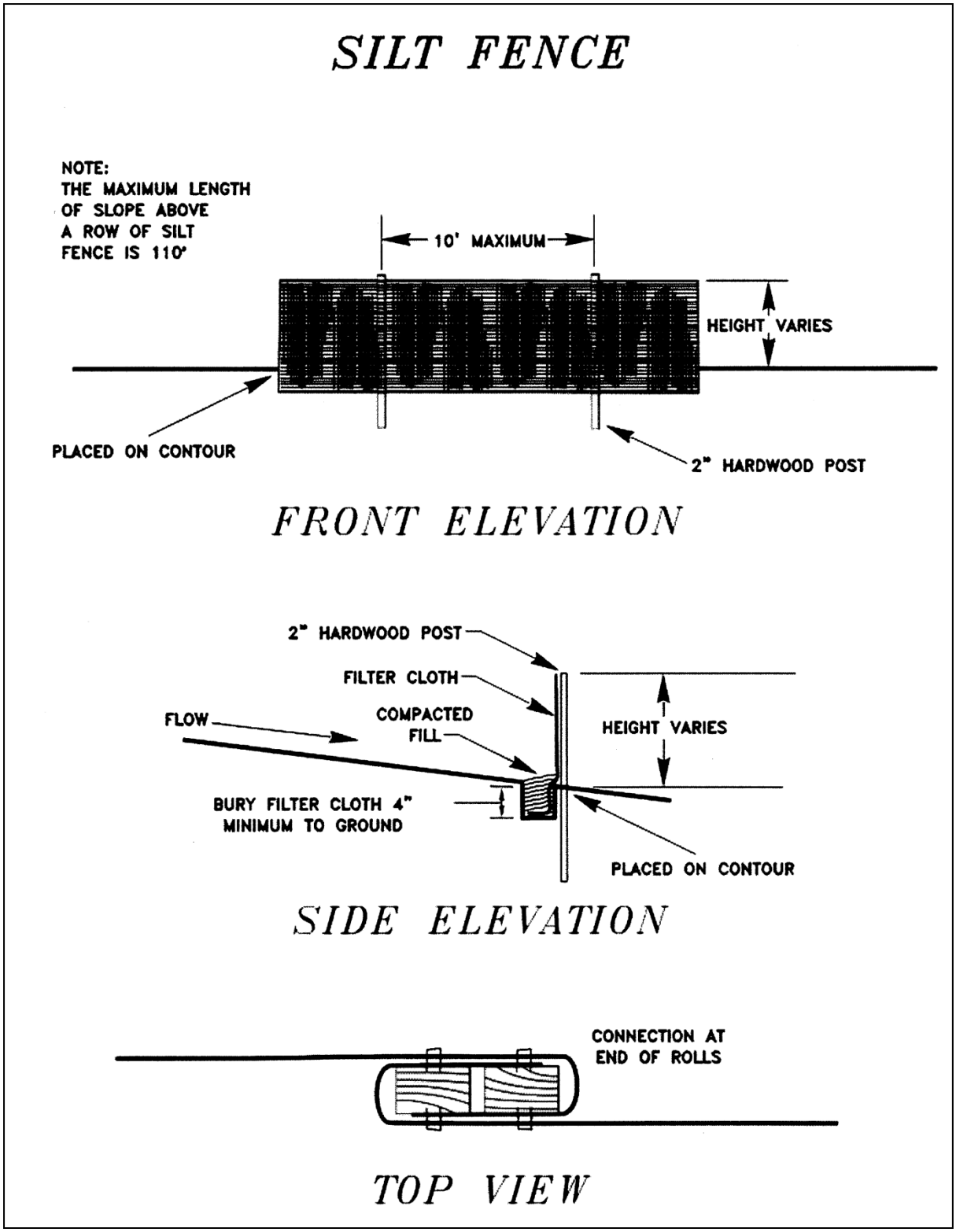


Figure 20. Example of methods recommended to install silt fencing (Measurements in inches; Source: Department of Environmental Protection, West Virginia)

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