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PG CONSULTING ENGINEERS
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28 March 2024

The Technical Manager

Limpopo: Department of Agriculture and Rural Development (LDARD)

Private Bag X9487

Polokwane

0700

Attention: Mr. Douw Wessels

E-mail: wessels.douwg@limpopo.gov.co.za

Tel: 015 294 3348

PROJECT: WILLIE VAN WYK DAM PROPOSED UPGRADING AND BETTERMENT WORKS, DISTRICT OF VHEMBE, LIMPOPO PROVINCE

1. Introduction

The Willie van Wyk dam is situated on an unnamed tributary of the Mambedi River, on the farm Welgevonden 36 LT, approximately 30km south-east of Louis Trichardt, district of Vhembe, in the Limpopo Province. The larger Tom Mitchell Dam is situated on the same watercourse some 2.3km downstream of Willie van Wyk Dam. The dam is a homogeneous earthfill structure with an auxiliary spillway on the right bank. The embankment is approximately 18 meters high by 241 meters long, with an average crest width of 3.6 meters. The outlet system comprises of a 13m high wet / dry combination intake tower, divided by a 100mm concrete wall. A 750mm dia and 250mm dia outlet pipes are linked to the intake tower.

The dam presently belongs to a Local Tribal Authority of which the legal ownership still has to be confirmed. The Limpopo Department of Agriculture and Rural Development (LDARD) currently acts as the custodian of the dam.

The dam was completed in March 1980 and was built by Delta Construction. The design Engineer was Mr. T.C. Mitchell (Pr Eng).

The center co-ordinates (WGS84 – Lo 31°) of the dam wall are Latitude **23° 09' 25.4"** and Longitude **30° 09' 48.2"**.

The dam had been classified as a Medium size, Category 2-dam, with a Significant hazard potential rating by DWS on 17 June 1994.

The existing dam embankment, after initial construction (in the 1980), is presently in a much-neglected condition and in need of betterment and upgrading work.

This report is about the following details and measures that need to be implemented which also covers most of the recommendations from previous and present dam safety inspection reports namely:

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- Settlement beacons on the crest must be installed at 40m intervals. After installation, the beacons must be surveyed and noted in an Operation and Maintenance Manual for future reference.
- Install new toe drains with v-notch measuring structure. To replace existing.
- Reinstate and refurbish the dam's outlet works / system.
- Enlarge and reform the auxiliary spillway to assist in accommodating the recommended SEF.
- Reinstate the western access road to the dam.
- Provide the spring discharge water with a formal channel to protect the embankment.

NOTE: All these implementation measures will be discussed in detail herewith.

It is anticipated that the upgrading works will commence after a contractor has been appointed by LDARD. If appointed, PG Consulting Engineers will assist with construction supervision while Mr. P.J. Gouws will act as APP. PG Consulting Engineers will also assist with the compilation of all the required documentation as well as an application for a License to Construct.

2. Proposed betterment and upgrading works

2.1. Instal settlement beacons on the dam wall crest

There are currently no settlement beacons on the dam wall crest. With reference to this it is recommended that settlement beacons shall be reinstated / installed on the crest section at 40m intervals for future dam safety reference.

The settlement beacons are part of dam monitoring systems and vital to compare past and future surveys for signs of embankment settlement.

A number of seven (7) settlement beacons need to be reinstalled and numbered following the specifications and details provided in **Figure 1** below.

Figure 2 below shows a typical installed settlement beacon.

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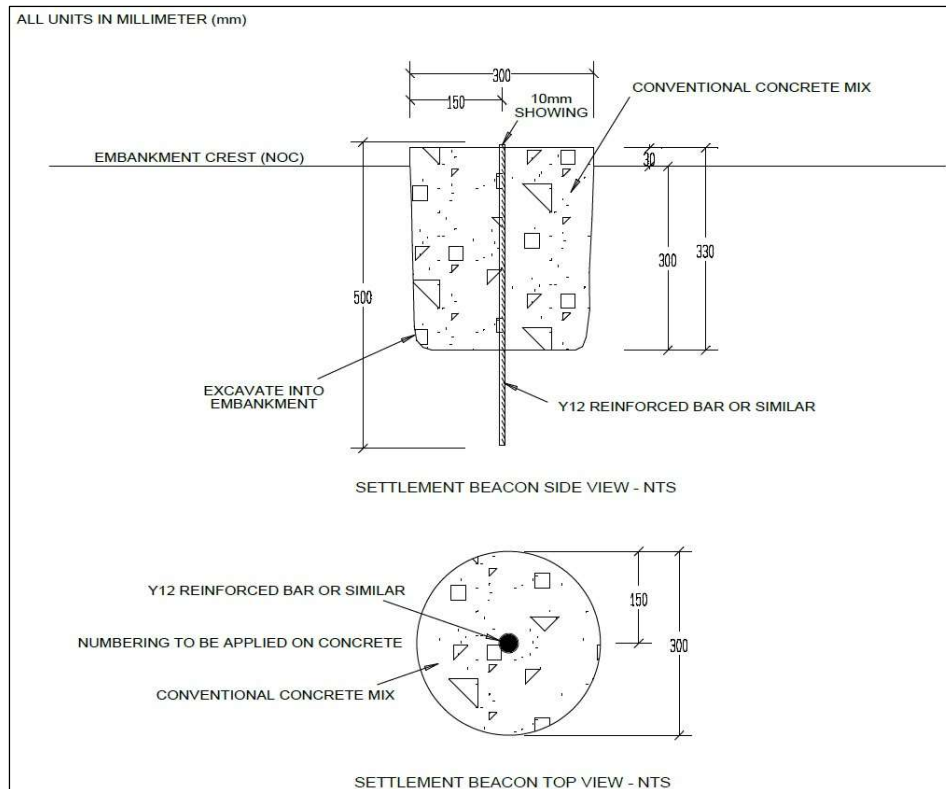


Figure 1: Schematic of a settlement beacon



Figure 2: Settlement beacon typical example

Company Registration Number: 2012/039090/07

Directors:

P.J. Gouws (Snr.) Pr Eng, APP; M.F. Joubert Pr Tech Eng, APP; P.J. Gouws (Jnr.) B Tech.



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2.2. Install toe drains and V-notch measuring structure

The installed toe drain system appears to be non-functional and blocked and needs to be replaced. Standing water was visible within the manhole. It is therefore recommended to install new toe drains with v-notch measuring structure in order to manage, control, and record future seepage. (Refer to Betterment Works & Upgrading Document attached for detail).

The manhole at the existing toe drain exit is totally blacked and filled with soil. Subsequently the effectiveness of the existing drains could not be evaluated and should be reevaluated during upgrading construction.

The anticipated new toe drains length is measured as 140m (i.e., 80m on the western side and 60m on the eastern side). The toe drains will comprise of 110mm dia slotted Drainex drainpipes surrounded with 9mm stone and wrapped in AG200 bidim or similar approved. The drains will be installed within excavated trenches which is filled with approved graded filter sand. Refer to **Figure 3** below for detail.

The two toe drains will join at the deepest end at a V-notch measuring structure where seepage can be monitored and controlled. The details of the V-notch structure are presented in **Figure 4** below.

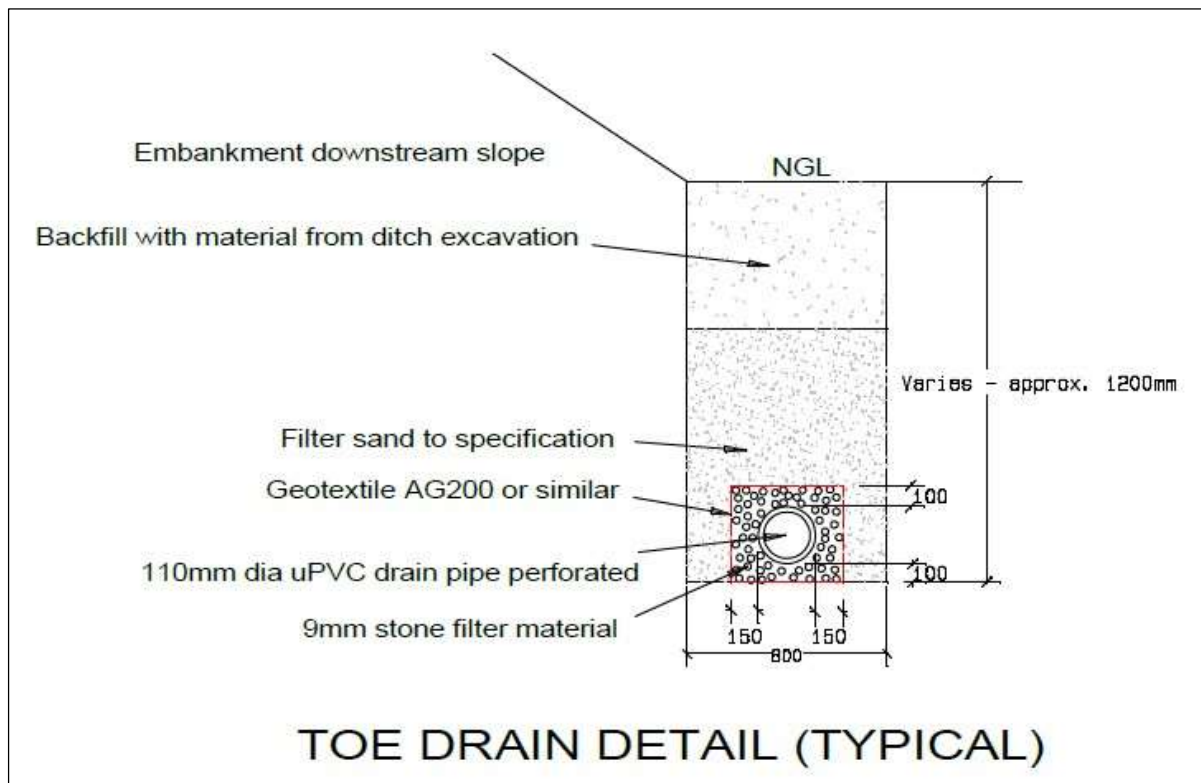


Figure 3: Schematic of a toe drain cross section

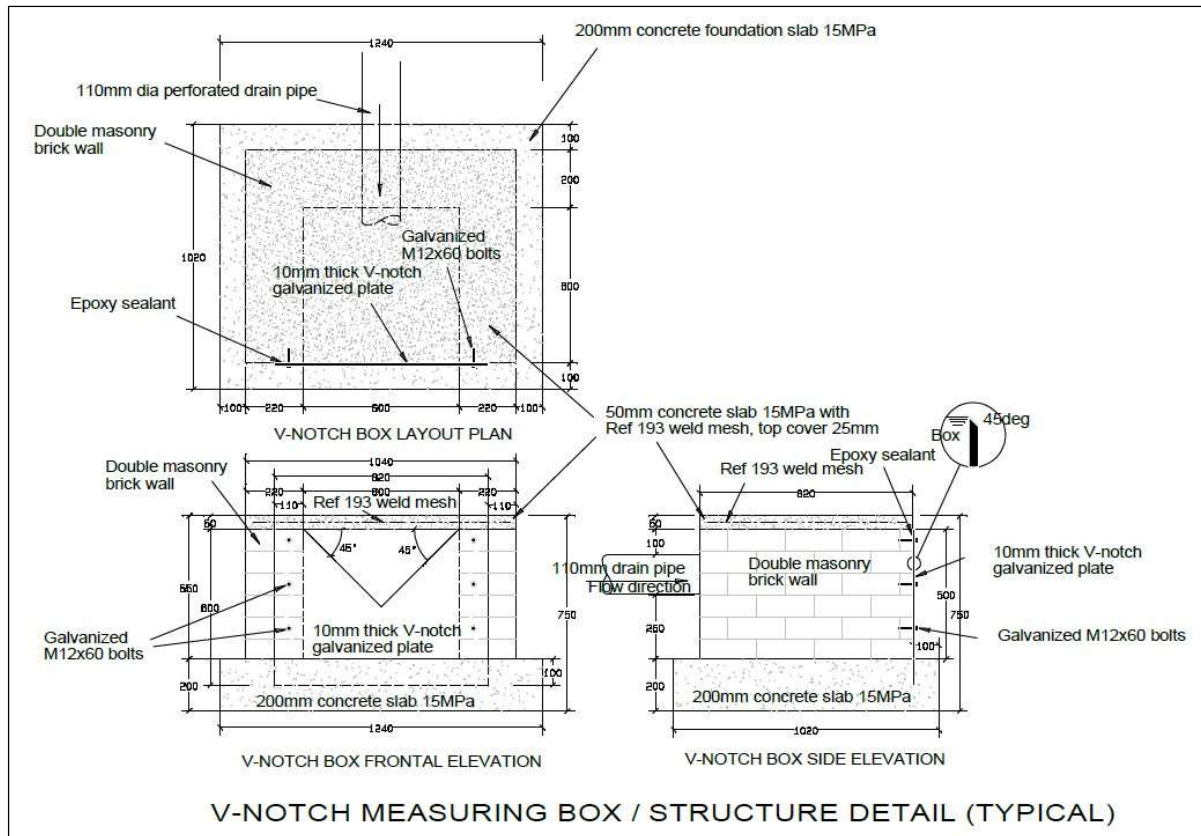


Figure 4: Schematic of a V-notch measuring structure

2.3. Reinstate / refurbish the outlet works system

With reference to previous inspection reports, the outlet system comprises of a 13m high wet / dry combination intake tower (dual purpose intake structure), divided by a 100mm concrete wall. There are 4 x 200mm-dia inlet valves on the inside at different levels which were operated from the tower top. All the valves are connected to a 250mm-dia steel pipe which joins a 250mm-dia outlet pipe installed through the embankment. The tower is furthermore equipped with two 1050 x 260mm openings on the same level (i.e. FSL – 871.25) which serves as drop inlets. The flood water from the wet well passes through the embankment by means of a 750mm-dia concrete pipe.

No access to the tower was possible and assumptions based on previous reports were adopted. Since the second inspection, the bridge from the crest to the tower had been totally removed. As a result of this the current state of the outlet works and tower structure could not be inspected / evaluated. However, it is assumed that the pipe works and valves are in urgent need of refurbishment.

The access bridge to the intake tower is not going to be reinstated as part of the betterment works due to the risk of being vandalized again. New access will be provided by means of step irons which will be fixed to the inlet tower. Access in the future will be by means of a boat

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only for emergency purposes to close the valves or for repairs as the valves will be in an open position.

Note: It is of great importance that the outlet works be reinstated. The tower structure should be refurbished and handrailing reinstalled on the tower. All the valves, pipes etc within the dry well should be refurbished. This is to comply to current dam safety standards to allow for emergency drawdown during extreme flood conditions to safeguard the dam. It is furthermore of crucial importance that the outlet works shall be made operational again to allow for instream flow release in terms of DWS's legislation, as and when required.

With regard to access to the intake tower, the walkway / access bridge from the crest is not going to be reinstated as part of the betterment works due to the risk of being vandalized again and security reasons. New access will be provided by means of step irons which will be fixed to the inlet tower. Access in the future will be by means of a boat. All valves will be in a closed position.

The old outlet works appear to be damaged and out of commission. The intake gate valves in the tower appear to be in a closed position to avoid discharge from the dam. There is currently no downstream closing mechanism on the 125mm dia outlet pipe.

As described, proper inspection of the outlet works was not possible during the inspection; however, the following works is anticipated:

- a) Reinstall a new handrailing on top of the intake tower.
- b) Install step irons to the outer side of the intake tower to access the tower from a boat.
- c) Refurbish the four 200mm gate valves within the tower.
- d) Refurbish and paint the pipework with an anti-rust medium.
- e) Refurbish the cad ladder in the tower.
- f) Replace the tower access cover plate on top of the tower. Cover plate to be galvanized.
- g) Construction of two brick masonry headwalls. One at the 250mm dia outlet pipe for water releases, and one at the 750mm dia pipe for flood discharge. Refer to **Figure 4** below for headwall details.
- h) Installation of a 250mm dia gate valve on the downstream side at the new headwall.

Note: APP is to be consulted with regard to the reinstatement of the outlet works. An amount of R750k has been allowed as a provisional sum due to various uncertainties at this time.

Please refer to the attached Appendix showing the outlet works inside the tower which was taken during the January 2008 inspection when access was possible.



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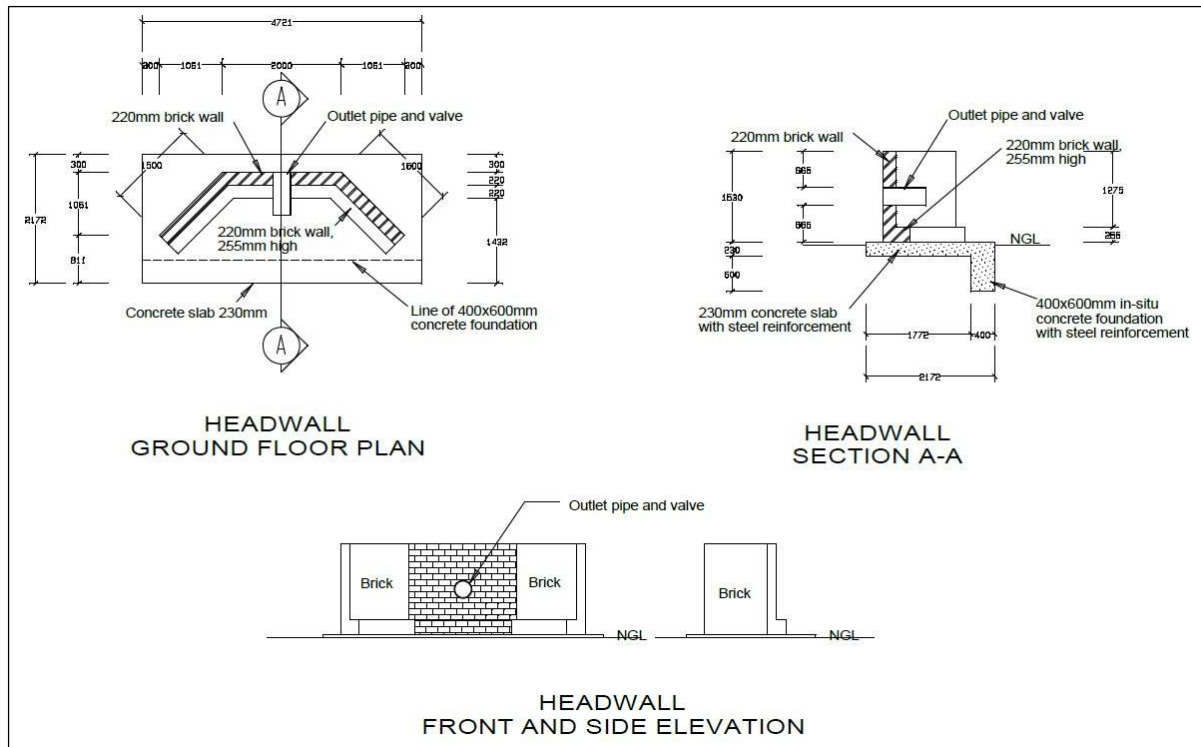


Figure 4: Schematic of an outlet pipe headwall structure

2.4. Enlarge and reform auxiliary spillway

The combined current discharge capacity of the tower intake and auxiliary spillway on the right bank is inadequate to accommodate the recommended routed SEF peak of 71m³/s as described in the Dam safety Evaluation Report (2024). It is therefore recommended to increase the combined discharge capacity by enlarging and reforming / reshaping the auxiliary spillway.

In view of the above and based on recommended design dimensions for the enlarged auxiliary spillway, a new reservoir routing analysis was conducted and an attenuation effect of approximately 43% was found. It was found that the incoming RMF-Δ peak will be reduced to a discharge of 71 m³/s through the spillway (subsequently the SEF adopted value).

The recommended dimensions for the auxiliary spillway enlargement are as follows:

- Freeboard = 2.20m, and
- Base width = 15m (at overflow level 871.96m) which is still 710mm higher than the FSL.
- Side slopes geometry 1(V):3(H).

The existing embankment shall be cleared of all vegetation and shall be excavated and formed to the recommended design specifications. The area to be cleared is estimated as 1 800m².

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The volume of earth excavation within the spillway channel is estimated as 2 300m³. The length of the new formed channel shall be 80m from where it can safely be discharged away from the dam's toe line. The entrance shall be properly shaped to allow for unobstructed hydraulic flow conditions. The excavated material from the spillway channel shall be spoiled and landscaped at the dam's toe area.

Refer to drawings 254/D/WVW002 & 004 attached herewith for construction details.

2.5. Reinststate western access road to the dam

The access roads to the dam are in a much-neglected state. Only the access road from the eastern side, via the village, was barely accessible. The contractor appointed for the clearing of the dam wall had cut some of the vegetation along the route just to make access possible. This route is also very rocky. It is therefore recommended rather to reinstate the shorter access road (old existing) from the western side. The length of the road to be reinstated is measured as approximately 3km.

The road section (route) should be cleared of all vegetation first by applying bush cutters. Once cleared, the road should be ripped and recompactd with a roller to smooth the surface. All rock and boulders in the path should be removed. The aim is to reinstate the road to such a condition that access to the dam will be possible by a 2x4 vehicle.

Note: APP to be consulted with regard to the reinstatement of the access road. An amount of R750k has been allowed as a provisional sum due to various uncertainties at this time.

2.6. Provide a formal channel to accommodate the spring water

A spring near the left abutment is present. According to locals the spring was there since even before the dam was built. It is recommended that the water flowing from the spring shall be formally channelled and released at a safe place and distance downstream of the dam to avoid wet ponding and saturated areas.

A properly excavated and formed earth channel will suffice. Refer to **Figure 5** below showing the eye of the spring.

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Figure 5: Eye of the spring

Yours faithfully

A handwritten signature in black ink, appearing to read 'Pieter Gouws'.

Pieter Gouws, Pr Eng, APP

Managing Director: PG Consulting Engineers (Pty) Ltd

Attached: (i) Photos of outlet works inside the tower (Inspection of January 2008)

Photo 10
Inlet tower with flood
inlet and FSL clearly
visible



Photo 11
Top of inlet tower

Note the missing hand-
rail and manhole covers

Photo 12
One of the valve intakes
visible above the water
level





Photo 13
Flood inlet opening seen
from inside the tower



Photo 14
View of access bridge



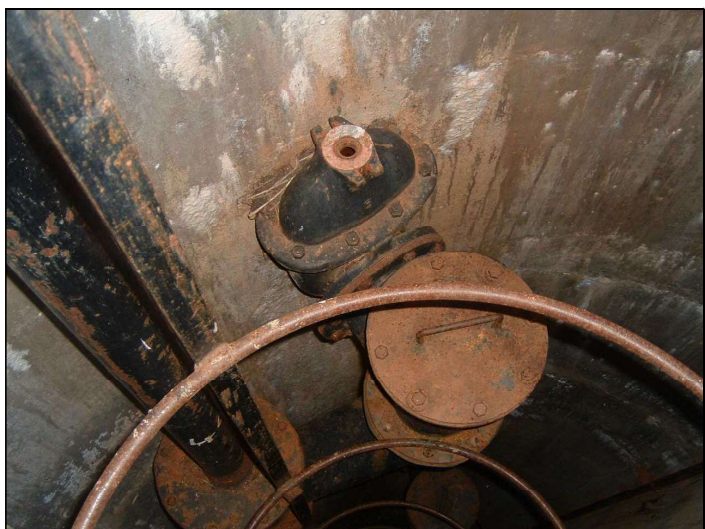
Photo 15
Access ladder inside
inlet tower seen from the
bottom

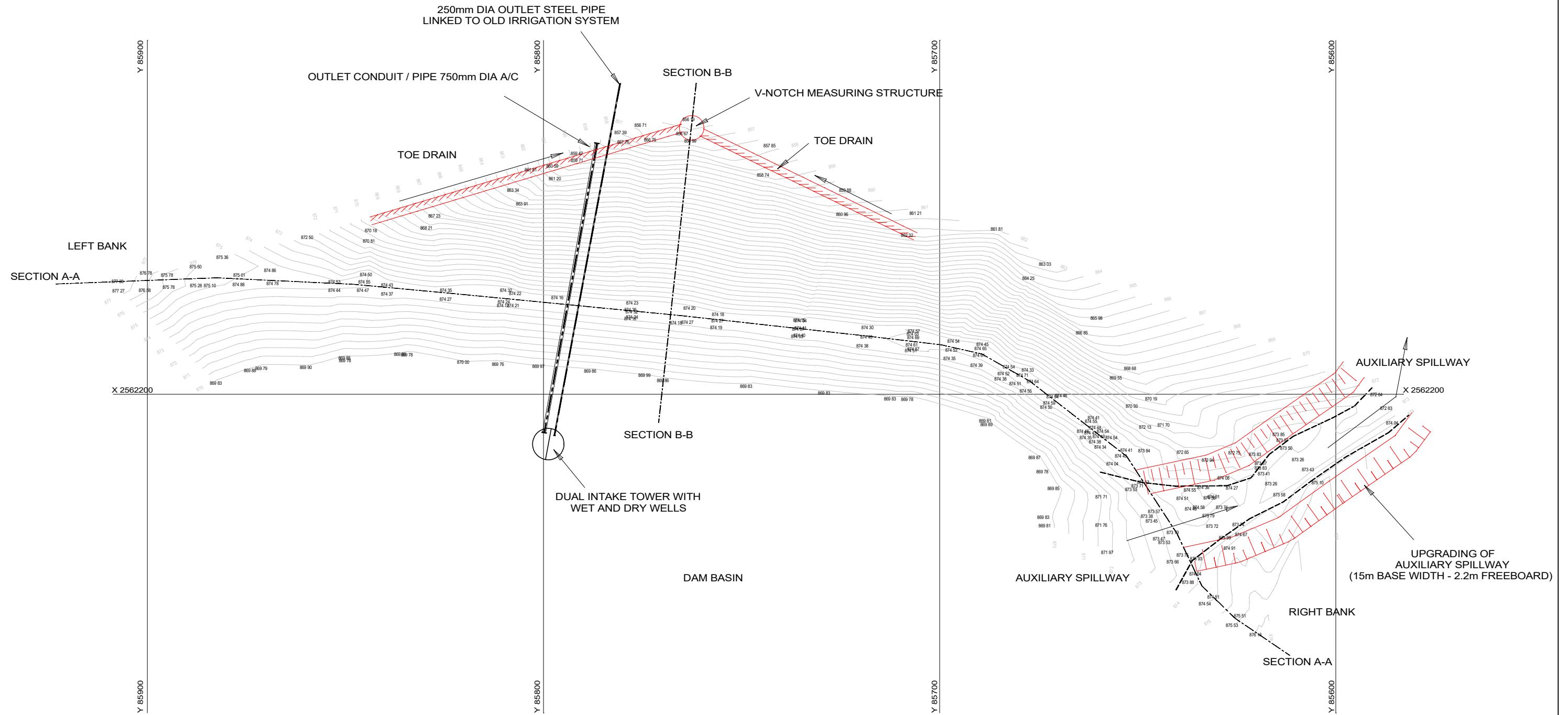
Photo 16
Accumulated debris at
the bottom of the tower



Photo 17
Rusted valves inside
the tower

Photo 18
Same as above
See missing spindles



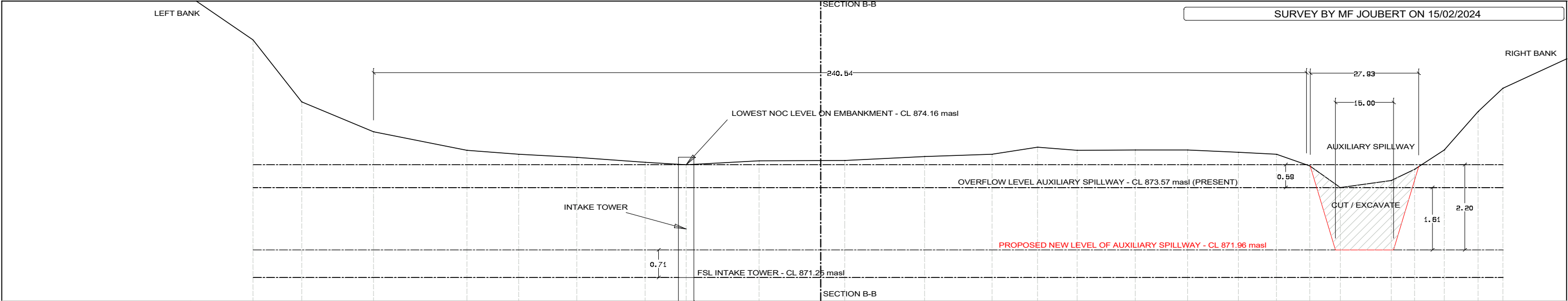


DAM WALL SURVEYED PLAN LAYOUT - SCALE 1:1000 (A3)

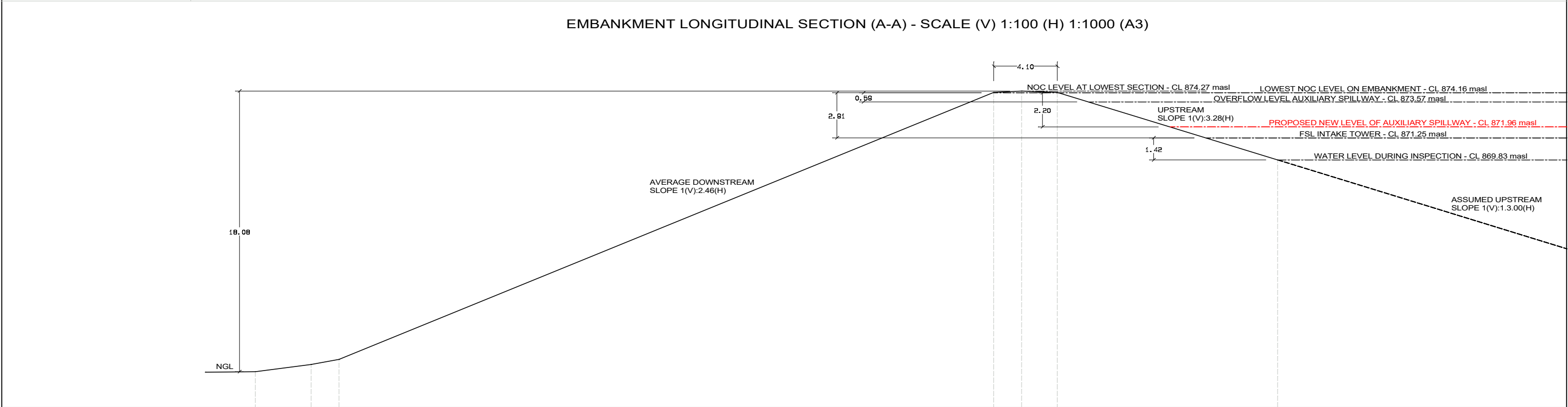
INSPECTION SURVEY

ORIGINAL SIZE A3

AMENDMENTS				NOTES:	<div><div>LIMPOPO PROVINCIAL GOVERNMENT REPUBLIC OF SOUTH AFRICA</div><div></div></div>	CONSULTANTS			SURVEYED	MF JOUBERT	Project			
NO.	DATE	APPROVED	DESCRIPTION			Address: WHITE RIVER					WILLIE VAN WYK DAM			
						9 Alma Street, White River, 1140	323 Alpine Way, Lyndenwood, Pretoria, 0081	120 Marshall Street, Pretoria, 0009			Plan Description	DATE	SCALE	
						Telephone: (Pretoria) 012 800 1346 (White River) 015 291 1577			Mobile: (Pretoria) 082 237 6905 (Pretoria) 076 876 4185 (Jansco) 080 723 8831			2024-03-01	AS SHOWN	
						E-mail: info@pgconsulting.co.za / enquiries@pgconsulting.co.za / james@pgconsulting.co.za						DRAWING NUMBER		
						Website: www.pgconsulting.co.za			PG CONSULTING ENGINEERS PASSIONATE ABOUT DAMS			232/D/WWV003		
						DRAWN			MF JOUBERT Pr Tech Eng			REVISION NUMBER	0	
						REVIEWED						PROJECT NUMBER	254	
						APPROVED PR. NO.			PJ GOUWS Pr Eng 880061 (APP)			Copyright is vested in PG Consulting Engineers (Pty) Ltd in terms of the Copyright Act (98 of 1978)		
						SIGNATURE								



Pen Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Prog. Distance (m)	0.00	12.64	31.12	55.16	68.52	83.46	101.05	111.70	130.54	152.63	173.23	190.58	202.28	212.45	227.53	241.02	254.12	263.93	272.50	280.44	293.52	299.48	307.45	315.90	322.34
Contour Height (masl)	877.38	875.78	875.01	874.53	874.43	874.35	874.22	874.16	874.26	874.27	874.37	874.43	874.61	874.53	874.54	874.54	874.48	874.43	874.13	873.57	873.75	874.04	874.54	875.53	876.13



Pen Number	1	2	3	4	5	6	7
Prog. Distance (m)	0.00	3.64	5.35	47.60	49.43	51.69	65.91
Contour Height (masl)	856.19	856.66	856.99	874.18	874.27	874.19	869.83

INSPECTION SURVEY

ORIGINAL SIZE A3

EMBANKMENT CROSS SECTION (B-B) - SCALE 1:250 (A3)

AMENDMENTS				NOTES:	<div><div>LIMPOPO PROVINCIAL GOVERNMENT REPUBLIC OF SOUTH AFRICA</div><div>DEPARTMENT OF AGRICULTURE AND RURAL DEVELOPMENT</div></div>	CONSULTANTS		SURVEYED	MF JOUBERT	Project										
NO.	DATE	APPROVED	DESCRIPTION			Address: WHITE RIVER			PRETORIA	POLKOWANE	DRAWN	MF JOUBERT Pr Tech Eng	Plan Description		DATE	SCALE				
						9 Alma Street, White River, 1240			521 Alpine Way, Lynwood, Pretoria, 0001	120 Marshall Street, Polkowane, 0699		REVIEWED	PJ GOUWS Pr Eng 880061 (APP)	ENLARGEMENT DETAILS FOR AUXILIARY SPILLWAY	2024-03-01	AS SHOWN				
						Telephone: (Pretoria) 012 800 1346 (Polkowane) 015 291 1577			Mobiles: (Pretoria) 082 237 6903 (Francis) 016 876 4240 (James) 060 723 8831								APPROVED PR. NO.	SIGNATURE	DRAWING NUMBER	232/D/WWV004
						E-mail: info@pgconsulting.co.za / francis@pgconsulting.co.za / james@pgconsulting.co.za			www.pgconsulting.co.za											
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