Global Contracting Solutions Limited

Te Awamutu Waste to Energy Plant Groundwater Assessment

GROUNDWATER ASSESSMENT

WGA222576

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August 2023

Revision History

REV	DATE	ISSUE	ORIGINATOR	CHECKER	APPROVER
A	1/08/2023	Client	CHO	BAS	CHO

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1 INTRODUCTION

1.1 Background

Global Contracting Solutions Limited (GCS) is seeking resource consents to construct a waste to energy processing plant in Te Awamutu. As part of the resource consent process, the Waikato Regional Council (WRC) has requested more detailed analysis of the effects on groundwater during construction and through the life of the plant. In the original investigations to support the resource consent application only limited onsite groundwater level testing had been undertaken as part of the initial geotechnical assessment. WRC indicated that further assessment of groundwater levels needed to be undertaken with respect to stormwater and flood mitigation design.

Wallbridge Gilbert Aztec (WGANZ Pty Ltd; WGA) has provided GSC with technical hydrogeological support in response to the Section 92 request from WRC. This has included a site visit, review of existing information, support for installation of additional monitoring bores and analysis of the water level monitoring results. This report outlines the findings from our review and analysis.

1.2 Site Description

The proposed waste to energy plant is located between the Mangapiko Stream and the racecourse in Te Awamutu. The site has an upper terrace at the same level as the racecourse and lower terrace at the stream level.

The land surrounding the proposed site consists of residential properties to the east and south. To the west of the property land use consists of industrial activities such as a Fonterra dairy factory. Land to the north of the property consists mostly of rural land.

The Mangapiko Stream, which flows along the southern border of the property, coalesces with the Mangahoi Stream upstream, approximately 550 m to the south-east of the property. The catchment areas of the Mangapiko and Mangahoi streams are 174 km^2 and 94 km^2 respectively. The 100-year storm stream flow past the site, at the confluence, is reported to be 236 m^3/s (Joynes 2021).

1.3 Groundwater Effect Areas

In terms of the effects on groundwater from the proposed activities, the focus is on the planned excavation of a series of shallow basins on the lower terrace at the site. Maps of the site showing the planned excavation area and cross-sections, as provided in the resource consent application, are presented in Appendix A.

Although there was limited groundwater information available at the time of the original application, WGA understands that preliminary groundwater level contouring was carried out. More detailed shallow groundwater site investigations have since been carried out as detailed in this report and documented in Appendix B.

1.4 Regional Council Review

The application was reviewed by Mr Greg Sheppard, the WRC consultant Hydrogeologist. The WRC report on the application contains the following summary from Mr Sheppard:

"The dipped levels should be considered to be more representative of water level than the CPT derived levels, particularly if the CPT levels are from maximum pore pressure rather than dissipation tests. The assertation of a perched water table needs to be backed up by nested piezometers."

"Notwithstanding – interpretation of the presented water level contours and cross sections indicate the following:

a. *Section B acknowledges the shallow water table at around 0.5 m bgl in this area showing the water table above the invert 1 level. Planting in this area is also planned as a wetland.*
b. *Extrapolation of the 40 m water level contour at Section C indicates that the water table is likely around 1 m below the flood plain which would put the water table above the invert level of the flood mitigation basin.*
c. *Extrapolation of the 41 m water level contour indicates that the water table would be approximately 1 m or less below the flood plain in the vicinity of Section D and above the invert level of the flood mitigation basin.*
d. *Extrapolation of the 42 m and 43 m water level contours indicate that the contours are likely to "daylight" along the terrace scarp resulting in a seepage face, particularly at times of high water levels. The presence of a drainage ditch at the base of the scarp in the vicinity of Section G suggests that this seepage is occurring.*
e. *At Section E the water table contours are likely to be at approximately 42 m which is above the base of the invert.*
f. *At Section G, where the ditch is currently controlling seepage at the base of the scarp, the ditch would be replaced by the flood mitigation basin which would then receive the seepage."*

> *"…. Mr Sheppard considers that this may have a limiting effect on the mitigating effect of the basins. No allowance for groundwater take has been included nor has an assessment of effects on groundwater from the potential groundwater take been undertaken. Seasonal groundwater highs have potential to exacerbate any effects. In this scenario the planned planting vegetation would need to be replaced by wetlands."*

Concerns regarding the potential effects of groundwater inflow to the basins were also raised in the flooding risk assessment review. The flood modelling WRC reviewer, Ms Stokes, has identified that:

> *"In DWG No RC-012, 013 and 14 (Rev C) indicative groundwater levels are shown in some of the cross sections. In Sections C and D, the invert level of the flood displacement mitigation is at a similar level to the indicative groundwater level. The groundwater level is likely to fluctuate seasonally, therefore there is a likelihood that the flood displacement mitigation areas could experience ponding and the flood displacement mitigation will not be fully effective. Sections F and G do not show indicative groundwater levels as the groundwater contours in plan DWG RC-045 do not cover this area, however the invert of the flood displacement mitigation is at similar levels to the stream invert so there is also a risk that groundwater levels will cause ponding that will reduce the amount of flood displacement mitigation available in a flood."*

2 HYDROGEOLOGY

2.1 Regional Geology and Hydrogeology

The proposed site is located within the Hamilton Basin, which is a 2,000 km^2 tectonic basin centred on Hamilton City and traversed by the Waikato River. The basin is surrounded by ranges of Mesozoic (Manaia Hill Group) and Tertiary age (Te Kuiti and Waitemata Groups) rocks. The basin is infilled with Tauranga Group alluvial sediments dating from the Pliocene to the middle Holocene, overlain by late Holocene unconsolidated alluvial and colluvial sediments. The Tauranga Group sediments are up to 300 m thick and include gravels, sands, silt, muds and peats of fluvial, lacustrine and distal ignimbrite origin. Basement greywacke underlies the sedimentary deposits at depth, with occasional topographic basement highs occurring within the Hamilton basin (GNS 2005).

The Tauranga Group, which underlies much of the Hamilton Basin, was deposited by braided river systems of the Waikato River initiated by volcanism in the Taupo Volcanic zone (Petch 1987). These deposits contain the aquifers used most extensively for water supplies across the Hamilton Basin. Within these sediments, the most productive aquifers consist of well sorted coarse sands and gravels. These discontinuous sequences of rhyolitic and pumiceous gravelly sands and gravels are interspersed with pumiceous silt, clay and peat (Figure 1). Lithological variability generally results in several zones of higher permeability within each of the formations rather than a single, continuous aquifer (Schofield 1972).

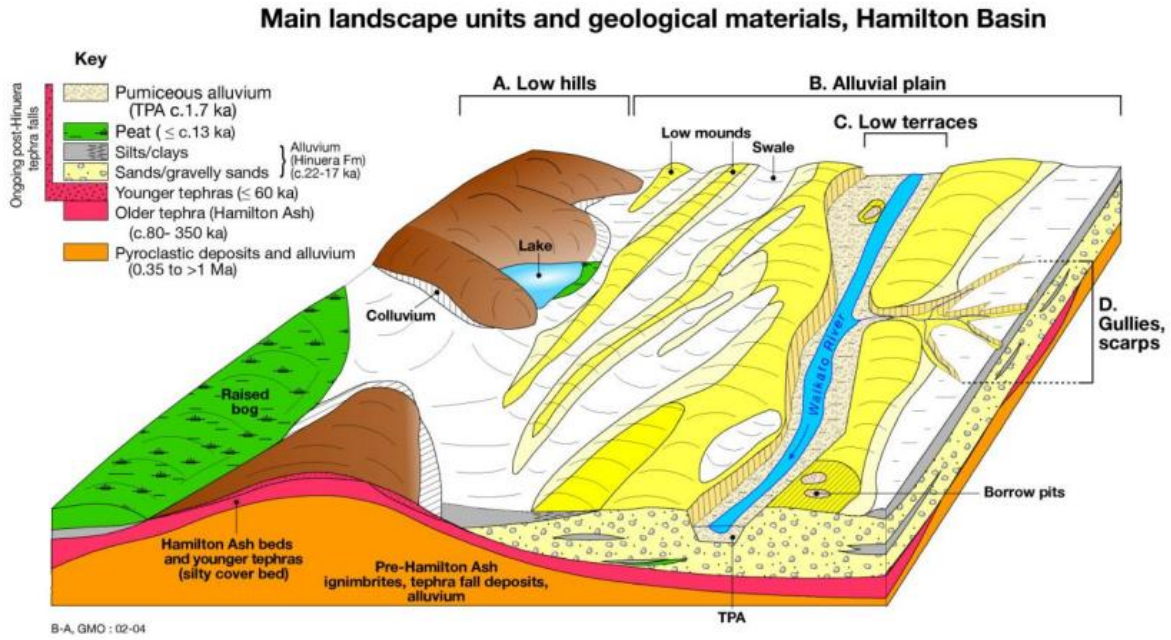

Figure 1: Main Landscape Units of the Hamilton Basin (Lowe, 2010).

Reported hydraulic conductivity in the Hamilton Basin sediments ranges from 0.5 m/day in the silts and peat layers to 13.5 m/day in the coarse gravelly sands. Aquifer transmissivity values derived from pumping tests range from 10 m^2/day to 1,000 m^2/day but are usually less than 100 m^2/day. Storativity values vary from 0.001 for deep, confined or semi-confined aquifers to 0.1 for shallow, unconfined aquifers in the Hamilton Basin (Petch and Marshall 1988). In some areas these discontinuous aquifers may yield flows of up to 30 L/s (Petch 1987).

The piezometric surface in the Hamilton Basin is closely related to surface topography. Piezometric gradients beneath un-dissected areas of the Hamilton Basin surface have gentle slopes that steepen near incised stream channels. Groundwater is recharged from rainfall, predominantly during the winter when soil moisture deficits are satisfied. The shallow groundwater subsequently discharges to the incised streams and the Waikato River. Isotropic analyses suggest that the groundwater flux is mainly through shallow aquifers. Groundwater in deeper aquifers within the basin is significantly older, having been dated at up to 6,500 years old (Marshall and Petch 1985).

The WRC's Waikato Regional Plan (WRC 2012) defines the aquifer in the area of the proposed groundwater abstraction to be the Waipa Aquifer, which is not currently fully allocated.

2.2 Local Aquifer Definition

2.2.1 Local Hydrogeology

This section summarises the local hydrogeology of the GCS site. Data discussed in this section has been sourced from GNS (2005), HD Geo (2021) and the WRC.

The GNS geological map provided indicates that the eastern, higher side of the GCS site is located upon the Hinuera Formation, consisting of cross-bedded pumice sand, silt and gravel with interbedded peat. The western, lower lying side of the property is located within a former stream channel of the Mangahoi Stream, consisting of Holocene alluvial and colluvial sand, silt, mud and clay with local gravel and peat beds.

Initial geotechnical investigations were conducted by HDGeo at the site in August 2021. The investigations included 12 hand augers with lithological strength testing alongside six 20 m deep cone penetration tests (CPT) across the site. A map of the test locations is provided in Appendix A. HDGeo's assessment separated the property into two areas, Area 1 (upper) and Area 2 (lower). Area 1 consisting of exploratory sites in the Hinuera Formation and Area 2 consisting of exploratory sites in the Piako Subgroup.

HDGeo exploratory auger holes HA01 and HA02 in the upper part of the site intersected 0.1 – 0.2 m of topsoil (HDGeo, 2021). The topsoil is underlain by medium dense to dense gravelly sand to at least 3 m below ground level (bgl) (HDGeo, 2021). Thin layers of loose sand were also logged in the upper 1 m. Groundwater was not identified in the 3 m deep holes on the upper terrace (HDGeo, 2021).

HDGeo exploratory holes in the lower lying areas of the site, HA03 to HA12, intersected approximately 0.2 m of topsoil. The topsoil was underlain by sandy silt, silt or clayey silt of the Piako Subgroup to between 0.3 – 1.9 m. Deeper soils consisted of sands and occasional thin silt layers of the Hinuera Formation (HDGeo 2021). HDGeo found uncontrolled fill at HA03, HA05, HA06, HA09, and HA12 to depths of between 0.3 – 1.1 m bgl. Groundwater was intersected at between 0.4 and 1.8 m bgl. Groundwater was not identified in HA05, HA08 or HA10 (HDGeo, 2021).

HDGeo's review of historical aerial imagery shows paleo channels on the lower terrace, including one partially infilled channel that is currently draining the eastern side of the lower terrace.

Additional investigations were conducted by HDGeo and WGA in 2023 in response to the Section 92 request for further information. Four piezometers were drilled and installed on the lower terrace (Appendix B). Maps of piezometer locations, photographs and monitored groundwater levels in terms of depth below ground level are provided in Appendix A. A similar sequence of sand with occasional silt layers was intersected by the recent drilling at the site to install the four piezometers (Appendix B).

2.2.2 Groundwater Levels

The initial investigation assessment by HDGeo concluded that that the shallow groundwater level is controlled by the stage of the Mangapiko Stream, tracking higher as distance from the stream increases. Groundwater levels from the initial investigation are summarised in Table 1.

Groundwater levels measured during drilling for installation of the new piezometers was similar to the subsequent groundwater levels monitored over a period of 43 days (Appendix B). The shallowest groundwater level (approximately 0.5 m bgl) has been observed in Piezometer P02, which is located in a relatively low-lying topographical position on the terrace.

Terra Consultants prepared a groundwater contour map during the consent application process, but this contour map did not take the hydrogeological setting into account. WGA considers that groundwater is moving from the higher terrace (higher groundwater levels) towards the Mangapiko Stream (lower groundwater levels). Groundwater will be discharging to the stream adjacent to the site. The groundwater levels in the recently installed shallow piezometers are consistent with this conceptulisation.

Table 1: Groundwater Levels Recorded by HDGeo at the GCS Site.

Test ID [1]	Test RL (m)	Groundwater (m bgl) [2]	Approx Groundwater Elevation (m RL) [2]
HA01	48.5	n/a	n/a
HA02	49	n/a	n/a
HA03	43	1.8	41.2
HA04	43.5	0.9	42.6
HA05	45	n/a	n/a
HA06	43.5	1	42.5
HA07	42.5	1.2	41.3
HA08	43.5	n/a	n/a
HA09	43	0.5	42.5
HA10	43	n/a	n/a
HA11	41	0.5	40.5
HA12	40	0.4	39.6
CPT01	48.5	7.6	40.9
CPT02	43.5	2.79	40.7
CPT03	43.5	1.57	41.9
CPT04	43	2.20	40.8
CPT05	43	2.75	40.25
CPT06	43.5	2.63	40.9

Notes: 1) Data from HDGeo (2021). Map of piezometer locations is provided in Appendix A.
2) Below Ground Level (bgl). RL refers to elevation relative to local datum.

3 RESPONSE TO INFORMATION REQUEST

3.1 Response to Hydrogeological Review

In response to the following statements from Mr Sheppard:

> *"drainage ditch at the base of the scarp in the vicinity of Section G"*
>
> *"At Section G, where the ditch is currently controlling seepage at the base of the scarp, the ditch would be replaced by the flood mitigation basin which would then receive the seepage."*
>
> *"…. Mr Sheppard considers that this may have a limiting effect on the mitigating effect of the basins. No allowance for groundwater take has been included nor has an assessment of effects on groundwater from the potential groundwater take been undertaken. Seasonal groundwater highs have potential to exacerbate any effects. In this scenario the planned planting vegetation would need to be replaced by wetlands."*

WGA notes that this 'drainage ditch' is a paleochannel as identified in HDGeo 2021 (Figure 2). The lower terrace ditch receives both groundwater and runoff water. Therefore, WGA considers that there are currently groundwater discharges at the site.

Groundwater levels are not expected to be lowered to any significant amount due to the planned excavations (Appendix A). WGA understands that at least two or three outlets will be installed to discharge water from the basins to the stream. Groundwater seepage into the flood basins is expected but no long-term drawdown effect will be generated as the overflow levels will be similar to the current outflow level for the 'drainage ditch'. The groundwater will be discharged to the local stream, effectively at the location where it would naturally discharge. Therefore, WGA does not consider that the proposed earthworks will generate an effect sufficient to require a "Groundwater Take" consent. Therefore, the water level in the basins will be maintained at the basin invert level, or below during naturally occurring dry conditions. By maintaining water levels at the basin invert the basins will maintain their active storage volume for mitigation of flood volumes.

In addition, WGA understands from the project's landscape architect that wetland plantings will be used within the basins to enhance the natural stream environment and cope with any seepage.

In terms of seasonal "highs", the recent groundwater level monitoring indicated groundwater levels during a particularly high rainfall period were still 0.5 m to 2.0 m below ground level on the lower terrace (Appendix B). Small fluctuations were observed in response to rainfall events over 43 days of monitoring. However, since the site is located near the stream discharge location this will maintain relatively stable groundwater levels. Therefore, WGA disagrees that seasonal groundwater highs have potential to exacerbate any effects.

In summary, the planned basins are considered to have a de-minimis effect on groundwater flows and levels.

3.2 Response to Flood Effects Review

In terms of flood risk, Ms Stokes raises the following:

"…there is a likelihood that the flood displacement mitigation areas could experience ponding and the flood displacement mitigation will not be fully effective"

WGA understands that outlets to the flood mitigation basins will be installed to maintain groundwater level at or below the basin invert levels. With these additions to the basin design the basins should retain their active flood storage volume.

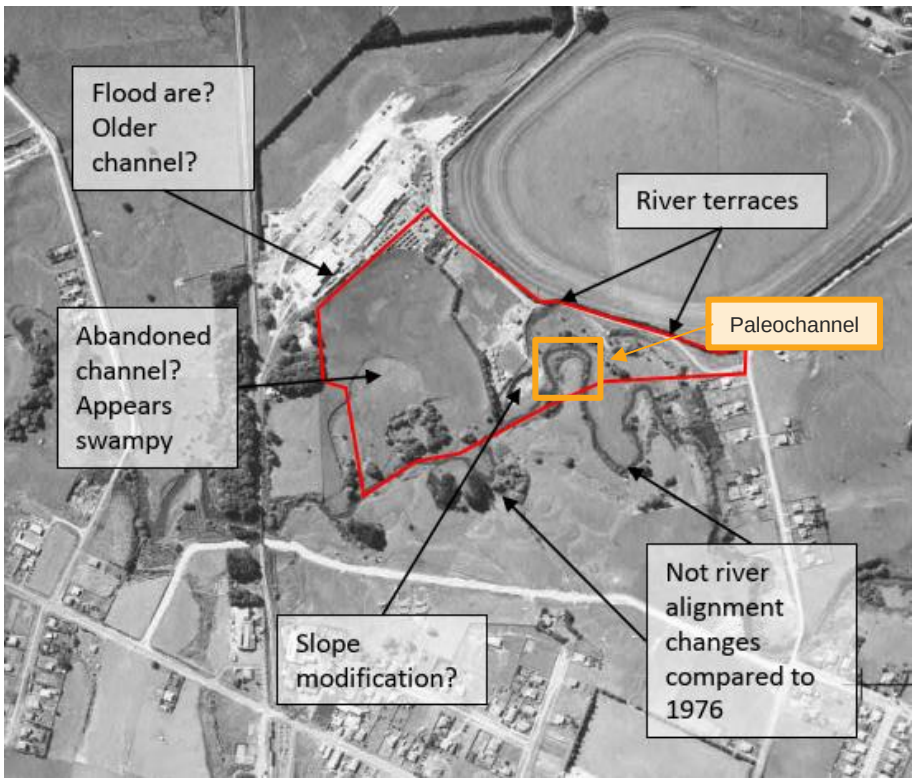

Figure 2: Historical Aerial imagery from 1944 Adapted from HGGeo 2021.

Figure 3: Present Day Paleochannel in Eastern Area of Lower Terrace 18 May 2023.

4 CONCLUSIONS

WGA and HDGeo have carried out further site investigations on the lower terrace and four new piezometers have been installed, in response to the questions raised in the Section 92 request. The additional information is consistent with the original conceptualisation that local shallow groundwater is moving toward the local stream adjoining the site.

The floors of the planned basins will be at a similar level to the observed local groundwater levels and will be planted as wetlands. WGA understands that outlets to the basins will be installed to maintain water levels at the basin invert level, or below during dry conditions. These outlets will maintain the active storage within the basins for potential flood mitigation.

In response to the concerns raised in the Section 92 review, WGA has considered if a consent is required for a “Groundwater Take”. The planned basins are expected to have a de-minimis effect on groundwater flows and levels. Any groundwater seepage will continue to discharge to the stream at the same location as the current seepage into the paleochannel and to the stream bed.

5 REFERENCES

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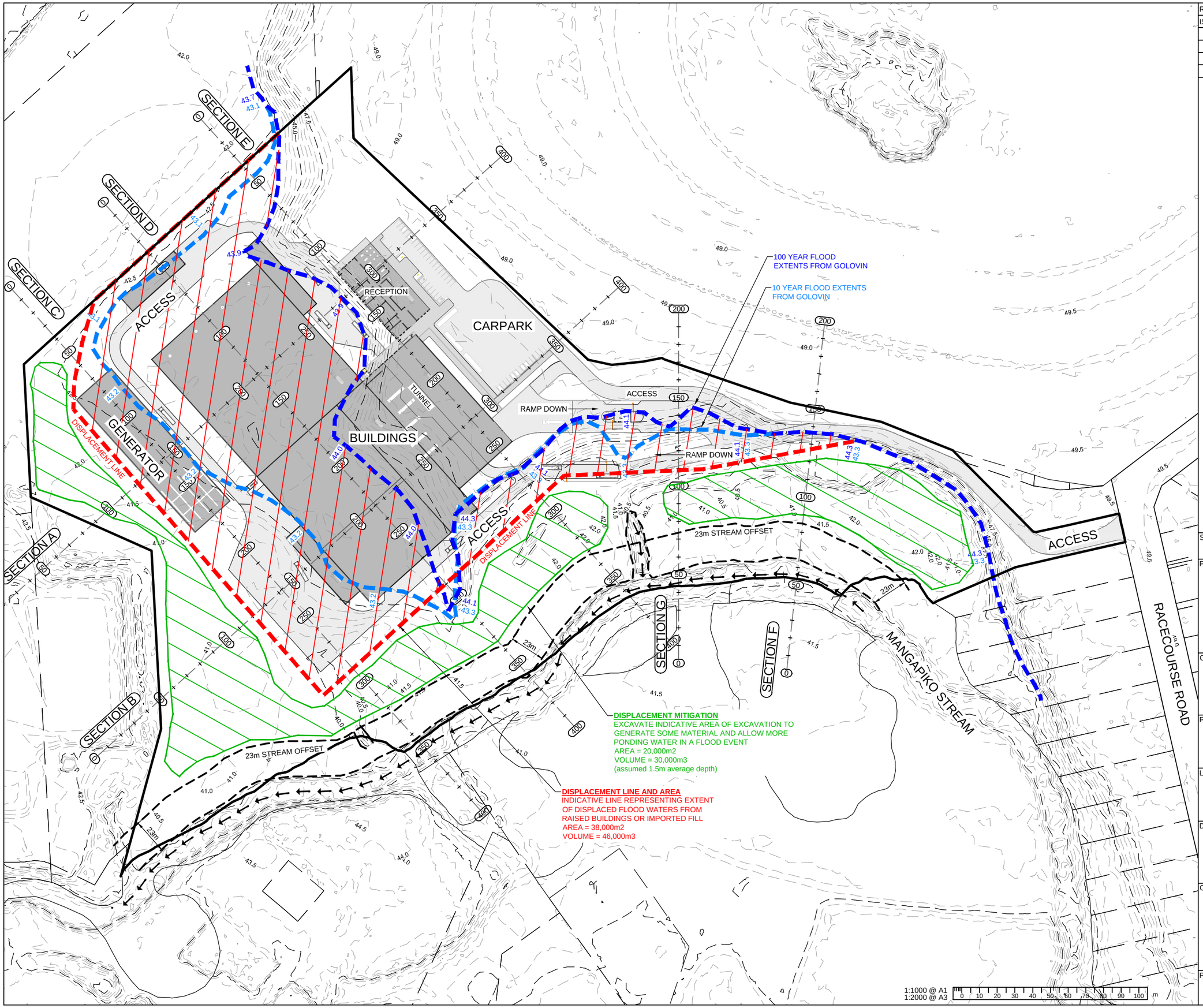
APPENDIX A
SITE MAPS AND CROSS-SECTIONS



REVISION

ISSUE	DATE	DETAIL	CHKD	DRWN
A	01/12/21	FOR RESOURCE CONSENT	GC	AC

STAGE

RESOURCE CONSENT

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CLIENT

GLOBAL METAL SOLUTIONS

PROJECT

PAEWIRA RECYCLE PLANT

LOCATION

401 RACECOURSE PARADE, TE AWAMUTU

DRAWING TITLE

LOCATION OF TYPICAL CROSS SECTIONS

ORIENTATION

N

SCALE	A1	1:1,000
	A3	1:2,000
DATE		01/12/2021
SURVEYED		TERRA
DESIGNED		VARIOUS
DRAWN		A.COOK
CHECKED		G.CLARKE

PROJECT NUMBER	DWG NUMBER	REVISION
200065	RC-010	A

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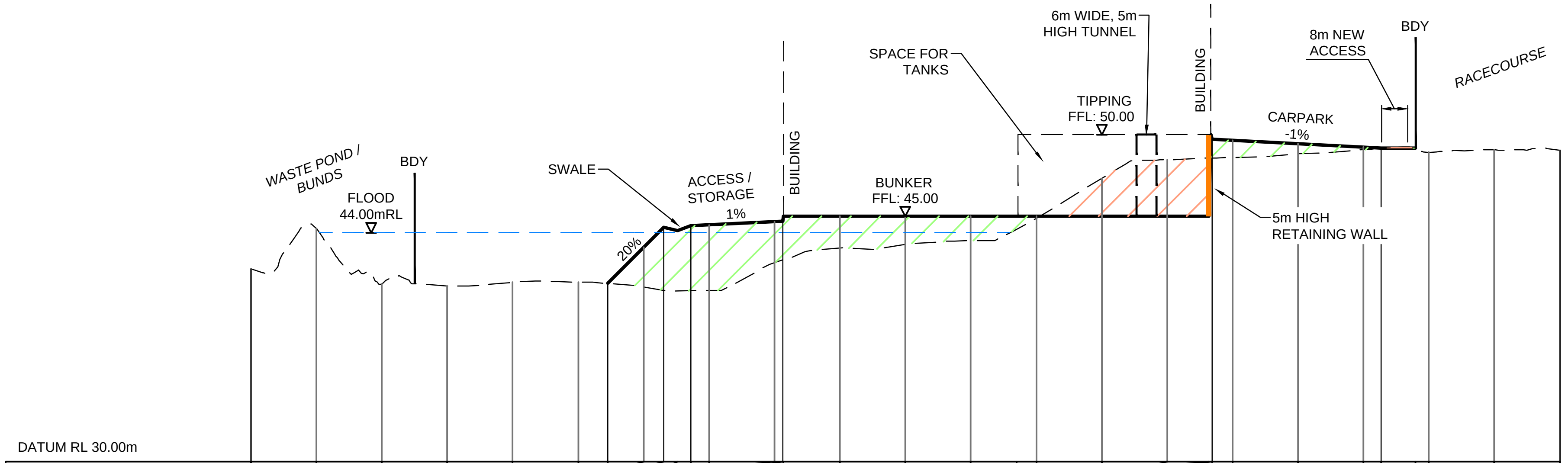
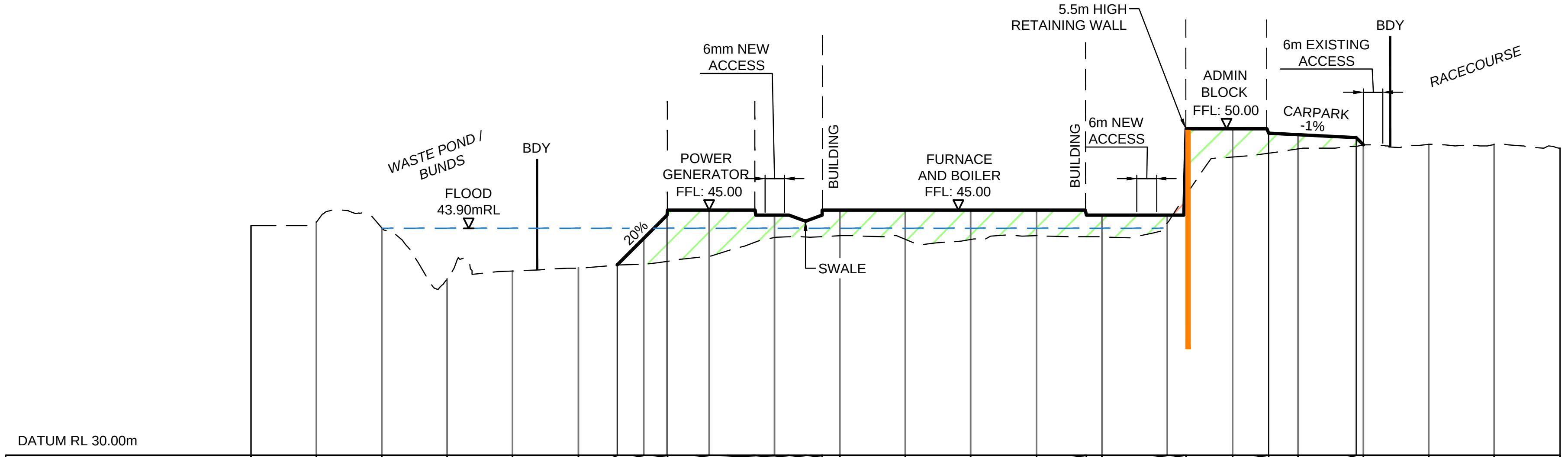


PROPOSED LEVEL							40.90	43.10	44.34	44.13	44.42	44.47	44.67	44.70	45.00
EXISTING LEVEL	41.79	44.24	40.88	40.76	40.97	40.98	40.90	40.69	40.48	40.44	40.45	40.47	42.16	42.33	42.35
CUT (-) / FILL (+)							0.00	2.41	3.85	3.68	3.96	4.01	2.51	2.37	2.65
CHAINAGE	0.00	20.00	40.00	60.00	80.00	100.00	109.00	120.00	126.17	130.42	134.35	140.00	160.00	162.51	162.78

PROPOSED LEVEL	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	50.00	49.70	49.64	49.44	49.24	49.18	49.17			
EXISTING LEVEL	43.06	43.29	43.51	44.22	44.87	47.32	48.47	48.56	48.57	48.57	48.60	48.83	49.08	49.16	49.17	48.92	49.06	49.04
CUT (-) / FILL (+)	1.94	1.71	1.49	0.78	0.13	-2.32	-3.47	-3.56	1.43	1.13	1.04	0.61	0.16	0.02	0.00			
CHAINAGE	180.00	200.00	220.00	234.06	240.00	260.00	280.00	292.75	293.33	293.82	300.00	320.00	340.00	345.35	355.91	360.00	380.00	400.00

SECTION B (5x VERTICAL EXAGGERATION)
1:1000H 1:200V @ A1 (DOUBLE FOR A3)



PROPOSED LEVEL							41.64	43.26	44.70	45.00	45.00	45.00	44.70	44.70	44.70	44.33	44.70	45.00	45.00
EXISTING LEVEL	44.06	44.29	43.90	40.80	41.27	41.47	41.64	41.71	41.86	41.86	42.19	43.05	43.06	43.34	43.36	43.36	43.39	43.39	43.45
CUT (-) / FILL (+)							0.00	1.55	2.84	3.14	2.81	1.95	1.64	1.36	1.34	0.97	1.31	1.61	1.55
CHAINAGE	0.00	20.00	40.00	60.00	80.00	100.00	111.89	120.00	127.19	127.29	140.00	153.99	154.16	160.00	164.37	169.46	174.58	174.63	180.00

PROPOSED LEVEL	45.00	45.00	45.00	45.00	44.70	44.70	44.70	44.70	50.00	50.00	50.00	49.70	49.61	49.43	48.99			
EXISTING LEVEL	43.22	43.21	43.43	43.38	43.38	43.36	44.23	45.72	45.92	48.26	48.47	48.49	48.76	48.90	48.99	49.03	49.03	48.81
CUT (-) / FILL (+)	1.78	1.79	1.57	1.62	1.32	1.34	0.47	-1.02	4.08	1.74	1.53	1.21	0.85	0.53	0.00			
CHAINAGE	200.00	220.00	240.00	255.05	255.38	260.00	280.00	285.06	285.73	300.00	310.45	310.97	320.00	337.69	340.00	360.00	380.00	400.00

SECTION A (5x VERTICAL EXAGGERATION)
1:1000H 1:200V @ A1 (DOUBLE FOR A3)

1:1000 @ A1
1:2000 @ A3
0 10 20 30 40 50 60 70 80 90 100 m

REVISION

ISSUE	DATE	DETAIL	CHKD	DRWN
A	01/12/21	FOR RESOURCE CONSENT	GC	AC

STAGE
RESOURCE CONSENT

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CLIENT
GLOBAL METAL
SOLUTIONS

PROJECT
PAEWIRA RECYCLE PLANT

LOCATION
401 RACECOURSE PARADE,
TE AWAMUTU

DRAWING TITLE
TYPICAL SECTION
A AND B

ORIENTATION

SCALE	A1	1:1,000
	A3	1:2,000
DATE		01/12/2021
SURVEYED		TERRA
DESIGNED		VARIOUS
DRAWN		A.COOK
CHECKED		G.CLARKE

PROJECT NUMBER	DWG NUMBER	REVISION
200065	RC-011	A

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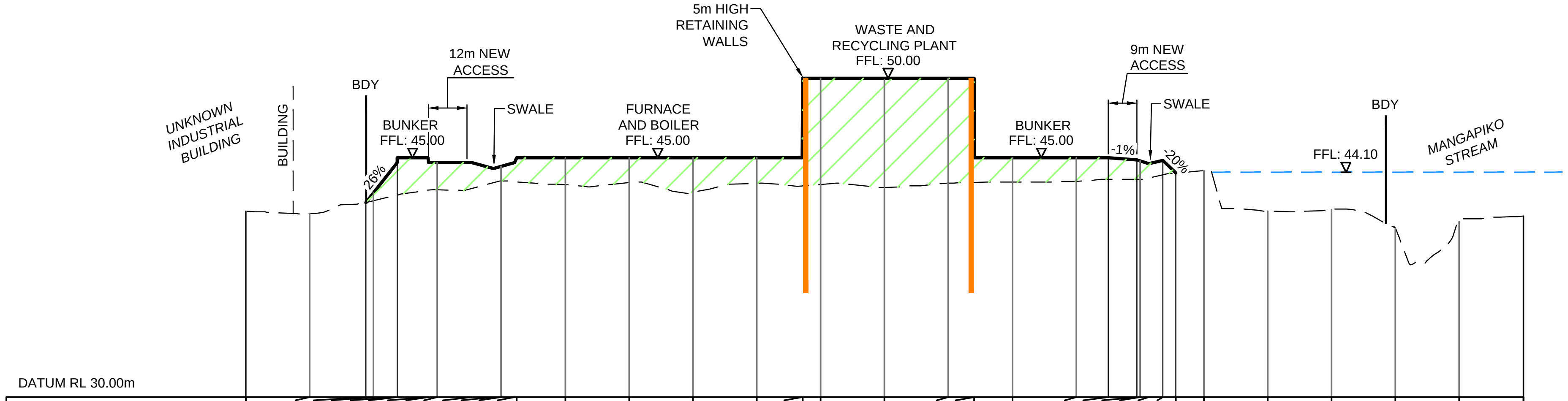
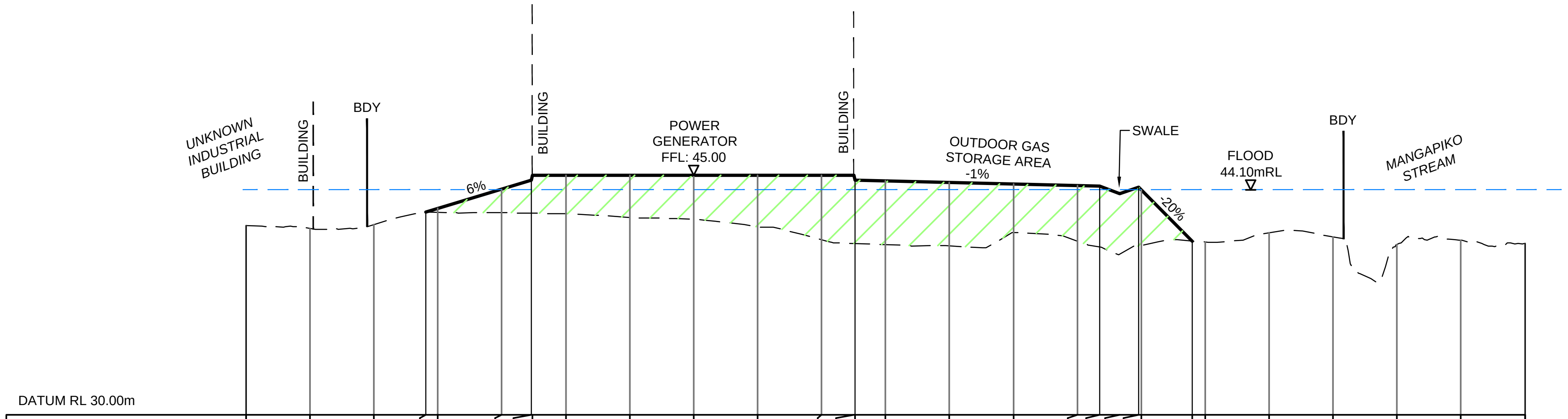


CHAINAGE	PROPOSED LEVEL	EXISTING LEVEL	CUT (-) / FILL (+)
0.00		41.66	
20.00		41.52	
37.63	42.21	42.21	0.00
40.00	42.82	42.32	0.50
47.33	44.70	42.67	2.03
47.37	45.00	42.68	2.32
57.10	45.00	42.97	2.03
57.17	44.70	42.97	1.73
60.00	44.70	43.01	1.69
70.70	44.70	43.07	1.63
77.59	44.34	43.45	0.89
80.00	44.47	43.56	0.91
84.22	44.70	43.50	1.20
84.77	45.00	43.49	1.51
100.00	45.00	43.32	1.68
120.00	45.00	43.46	1.54
140.00	45.00	42.85	2.15
160.00	45.00	43.40	1.60
174.28	45.00	43.26	1.74
174.38	50.00	43.26	6.74
180.00	50.00	43.34	6.66
200.00	50.00	43.14	6.86
220.00	50.00	43.43	6.57
228.00	50.00	43.47	6.53
228.06	45.00	43.47	1.53
240.00	45.00	43.49	1.51
260.00	45.00	43.52	1.48
270.00	45.00	43.67	1.33
279.02	44.88	43.67	1.21
280.00	44.81	43.67	1.15
282.76	44.63	43.73	0.90
287.22	44.85	43.94	0.91
291.24	44.05	44.05	0.00
300.00		44.21	
320.00		41.65	
340.00		41.76	
360.00		40.58	
380.00		41.02	
400.00		41.34	

SECTION D (5x VERTICAL EXAGGERATION)
1:1000H 1:200V @ A1 (DOUBLE FOR A3)



CHAINAGE	PROPOSED LEVEL	EXISTING LEVEL	CUT (-) / FILL (+)
0.00		41.85	
20.00		41.67	
40.00		41.92	
56.27	42.71	42.71	0.00
60.00	42.93	42.69	0.24
80.00	44.14	42.67	1.47
89.27	44.70	42.64	2.06
89.55	45.00	42.64	2.36
100.00	45.00	42.59	2.41
120.00	45.00	42.36	2.64
140.00	45.00	42.24	2.76
160.00	45.00	41.77	3.23
180.00	45.00	40.97	4.03
190.06	45.00	40.74	4.26
190.39	44.70	40.74	3.96
200.00	44.65	40.66	4.00
220.00	44.55	40.59	3.96
240.00	44.45	41.41	3.04
260.00	44.35	40.88	3.47
267.03	44.32	40.50	3.81
273.27	43.86	40.08	3.78
279.26	44.26	40.56	3.69
280.00	44.11	40.60	3.51
296.00	40.89	40.89	0.00
300.00		40.82	
320.00		41.41	
340.00		41.16	
360.00		40.69	
380.00		40.95	
400.00		40.74	

SECTION C (5x VERTICAL EXAGGERATION)
1:1000H 1:200V @ A1 (DOUBLE FOR A3)

1:1000 @ A1
1:2000 @ A3
0 10 20 30 40 50 60 70 80 90 100 m

REVISION

ISSUE	DATE	DETAIL	CHKD	DRWN
A	01/12/21	FOR RESOURCE CONSENT	GC	AC

STAGE
RESOURCE CONSENT

PROJECT CONSULTANTS
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CLIENT
GLOBAL METAL
SOLUTIONS

PROJECT
PAEWIRA RECYCLE PLANT

LOCATION
401 RACECOURSE PARADE,
TE AWAMUTU

DRAWING TITLE
TYPICAL SECTION
C AND D

ORIENTATION

SCALE	A1	1:1,000
	A3	1:2,000
DATE		01/12/2021
SURVEYED		TERRA
DESIGNED		VARIOUS
DRAWN		A.COOK
CHECKED		G.CLARKE

PROJECT NUMBER	DWG NUMBER	REVISION
200065	RC-012	A

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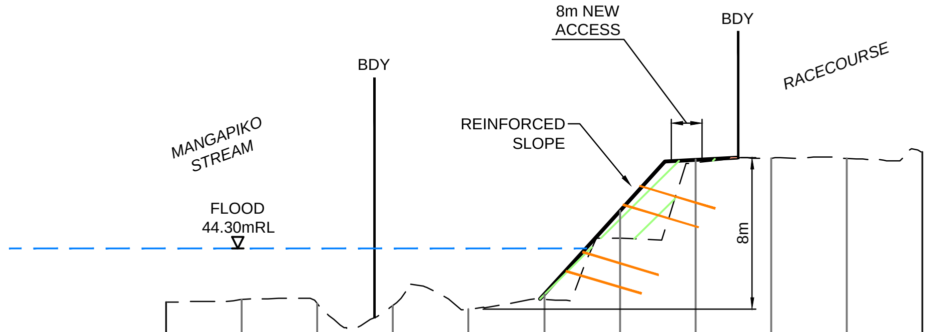
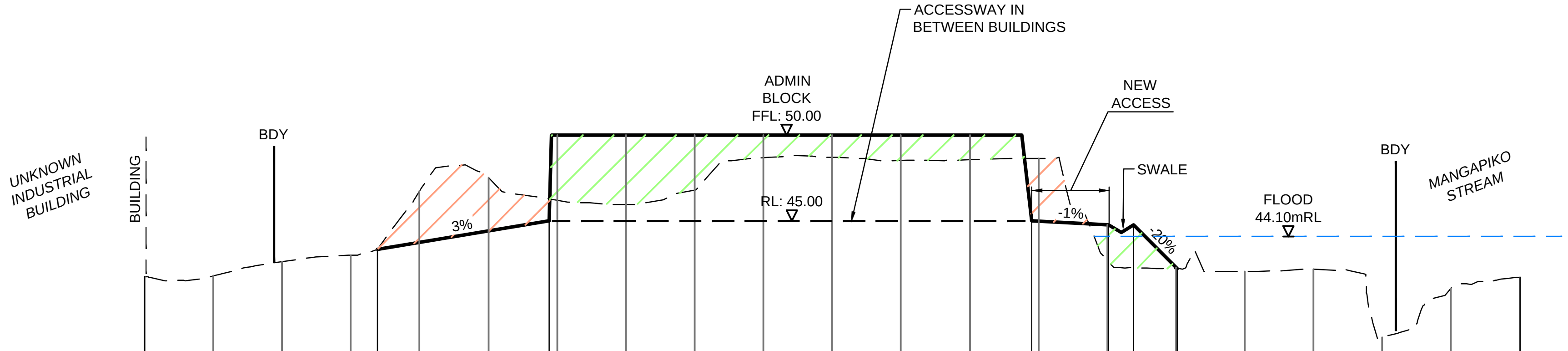


DATUM RL 30.00m

PROPOSED LEVEL						41.62	41.86	46.29	48.91	48.99	49.10			
EXISTING LEVEL	41.44	41.60	41.37	41.26	41.09	41.62	41.60	44.85	45.25	48.83	49.10	49.09	49.07	49.41
CUT (-) / FILL (+)						0.00	0.26	1.44	3.66	0.17	0.00			
CHAINAGE	0.00	20.00	40.00	60.00	80.00	98.92	100.00	120.00	131.81	140.00	151.02	160.00	180.00	200.00

SECTION F (5x VERTICAL EXAGGERATION)
1:1000H 1:200V @ A1 (DOUBLE FOR A3)



DATUM RL 30.00m

PROPOSED LEVEL					43.34	43.75	44.41	45.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
EXISTING LEVEL	41.77	41.81	42.64	43.00	43.34	46.72	47.52	46.27	46.25	46.20	45.95	46.78	48.68	48.69	48.51
CUT (-) / FILL (+)					0.00	-2.98	-3.11	-1.27	3.75	3.80	4.05	3.22	1.32	1.31	1.49
CHAINAGE	0.00	20.00	40.00	60.00	67.69	80.00	100.00	117.69	118.38	120.00	140.00	160.00	180.00	200.00	220.00

PROPOSED LEVEL	50.00	50.00	45.00	44.98	44.78	44.78	44.32	44.77	42.30	42.22					
EXISTING LEVEL	48.56	48.62	48.62	48.62	42.72	42.62	42.28	42.29	42.22	42.22	42.05	42.21	38.22	41.08	41.72
CUT (-) / FILL (+)	1.44	1.38	-3.62	-3.64	2.06	2.15	2.04	2.49	0.08	0.00					
CHAINAGE	240.00	255.13	258.02	260.00	280.00	280.44	284.03	287.62	300.00	300.39	320.00	340.00	360.00	380.00	400.00

SECTION E (5x VERTICAL EXAGGERATION)
1:1000H 1:200V @ A1 (DOUBLE FOR A3)

1:1000 @ A1
1:2000 @ A3
0 10 20 30 40 50 60 70 80 90 100 m

REVISION

ISSUE	DATE	DETAIL	CHKD	DRWN
A	01/12/21	FOR RESOURCE CONSENT	GC	AC

STAGE
RESOURCE CONSENT

PROJECT CONSULTANTS

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CLIENT
GLOBAL METAL SOLUTIONS

PROJECT
PAEWIRA RECYCLE PLANT

LOCATION
401 RACECOURSE PARADE,
TE AWAMUTU

DRAWING TITLE
TYPICAL SECTION
E AND F

ORIENTATION

SCALE	A1	1:1,000
	A3	1:2,000
DATE		01/12/2021
SURVEYED		TERRA
DESIGNED		VARIOUS
DRAWN		A.COOK
CHECKED		G.CLARKE

PROJECT NUMBER	DWG NUMBER	REVISION
200065	RC-013	A

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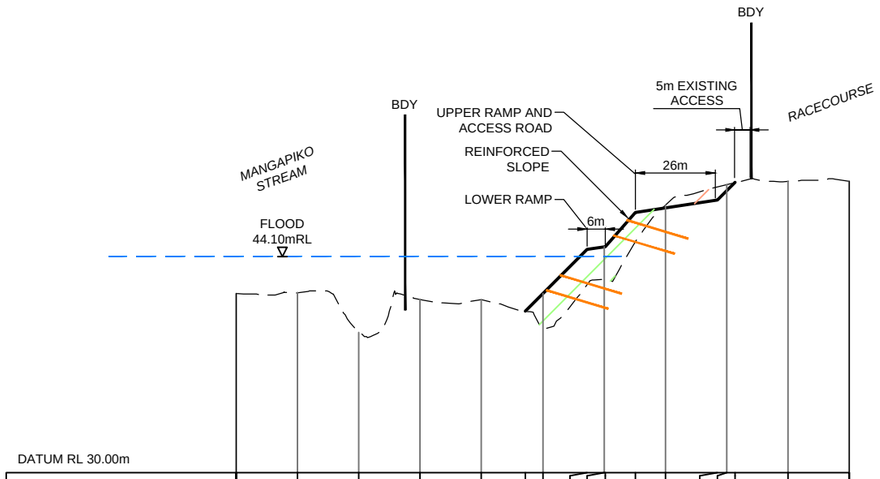

DATUM RL 30.00m

PROPOSED LEVEL						40.54	41.68	44.56	44.72	44.73	46.97	47.27	47.78	48.38	48.92		
EXISTING LEVEL	41.67	41.74	39.15	41.30	41.28	40.54	39.38	42.24	42.61	42.60	45.06	47.44	48.64	48.79	48.92	49.00	49.00
CUT (-) / FILL (+)						0.00	2.30	2.32	2.11	2.13	1.91	-0.17	-0.86	-0.41	0.00		
CHAINAGE	0.00	20.00	40.00	60.00	80.00	94.29	100.00	114.37	120.00	120.33	130.22	140.00	156.98	160.00	162.72	180.00	200.00

SECTION G (5x VERTICAL EXAGGERATION)
1:1000H 1:200V @ A1 (DOUBLE FOR A3)

1:1000 @ A1
1:2000 @ A3
0 10 20 30 40 50 60 70 80 90 100 m

REVISION

ISSUE	DATE	DETAIL	CHKD	DRWN
A	01/12/21	FOR RESOURCE CONSENT	GC	AC

STAGE
RESOURCE CONSENT

PROJECT CONSULTANTS

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CLIENT
GLOBAL METAL SOLUTIONS

PROJECT
PAEWIRA RECYCLE PLANT

LOCATION
401 RACECOURSE PARADE, TE AWAMUTU

DRAWING TITLE
TYPICAL SECTION G

ORIENTATION

SCALE	A1	1:1,000
	A3	1:2,000
DATE		01/12/2021
SURVEYED		TERRA
DESIGNED		VARIOUS
DRAWN		A.COOK
CHECKED		G.CLARKE

PROJECT NUMBER	DWG NUMBER	REVISION
200065	RC-014	A

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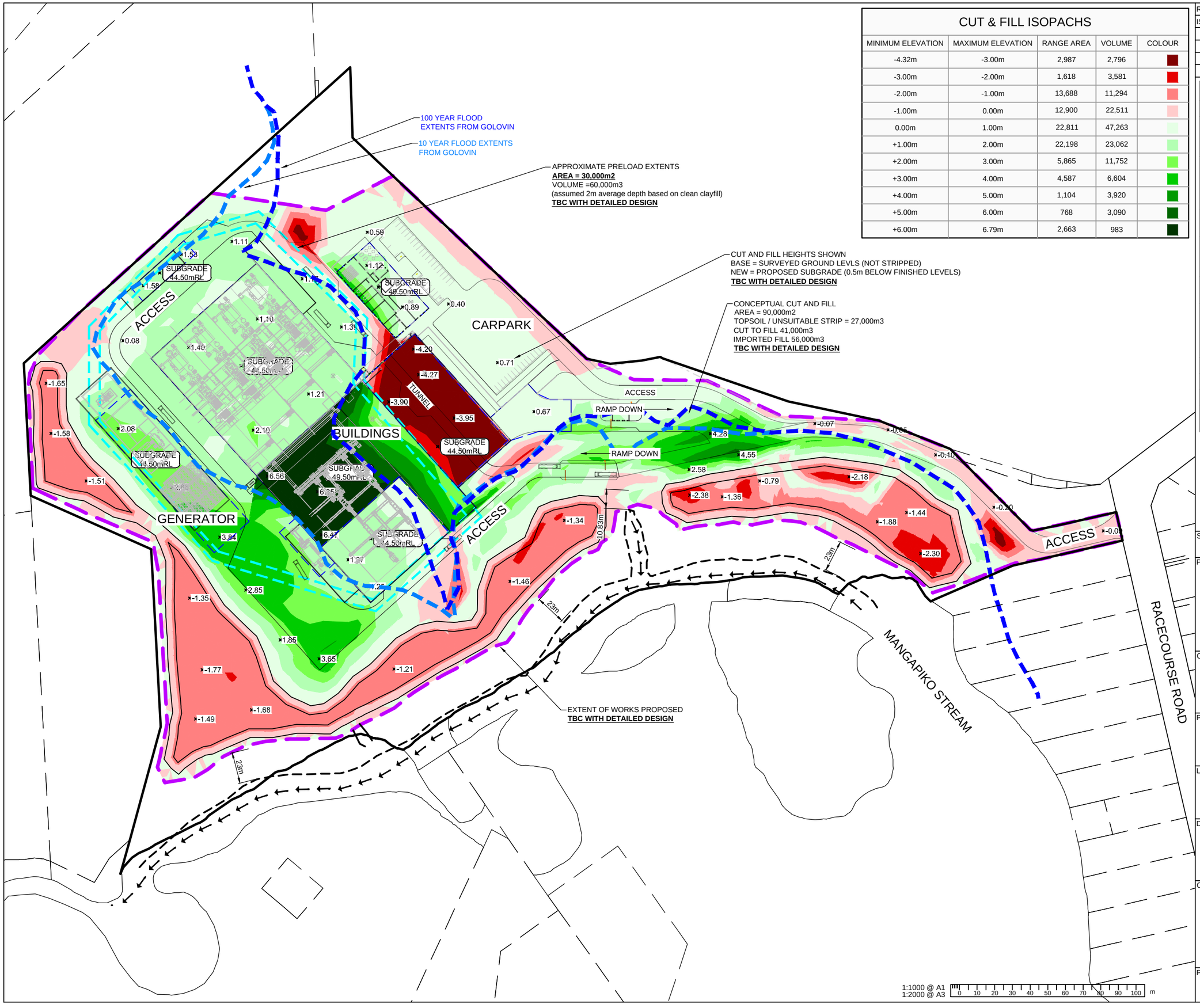

CUT & FILL ISOPACHS

MINIMUM ELEVATION	MAXIMUM ELEVATION	RANGE AREA	VOLUME	COLOUR
-4.32m	-3.00m	2,987	2,796	
-3.00m	-2.00m	1,618	3,581	
-2.00m	-1.00m	13,688	11,294	
-1.00m	0.00m	12,900	22,511	
0.00m	1.00m	22,811	47,263	
+1.00m	2.00m	22,198	23,062	
+2.00m	3.00m	5,865	11,752	
+3.00m	4.00m	4,587	6,604	
+4.00m	5.00m	1,104	3,920	
+5.00m	6.00m	768	3,090	
+6.00m	6.79m	2,663	983	

REVISION

ISSUE	DATE	DETAIL	CHKD	DRWN
A	01/12/21	FOR RESOURCE CONSENT	GC	AC

VOLUME SUMMARY

ITEM	VOLUME
TOPSOIL STRIP AND STOCKPILE OR REMOVE	20,000
UNSUITABLE AND CONTAMINATED STRIP AND REMOVE FROM SITE	7,000
CUT TO FILL OPERATION	41,000
IMPORTED FILL FOR SUBGRADE PREPARATION	56,000
IMPORTED FILL FOR PRELOAD	60,000
ALLOWANCE TO REMOVE PRELOAD OFFSITE	60,000
TOPSOIL SPREAD	18,000
CONTINGENCY	30,000
TOTAL	292,000m3

STAGE
RESOURCE CONSENT

PROJECT CONSULTANTS

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CLIENT
GLOBAL METAL SOLUTIONS

PROJECT
PAEWIRA RECYCLE PLANT

LOCATION
401 RACECOURSE PARADE, TE AWAMUTU

DRAWING TITLE
EARTHWORKS PLAN OVERALL

ORIENTATION

SCALE	A1	1:1,000
	A3	1:2,000
DATE		01/12/2021
SURVEYED		TERRA
DESIGNED		VARIOUS
DRAWN		A.COOK
CHECKED		G.CLARKE

PROJECT NUMBER	DWG NUMBER	REVISION
200065	RC-020	A

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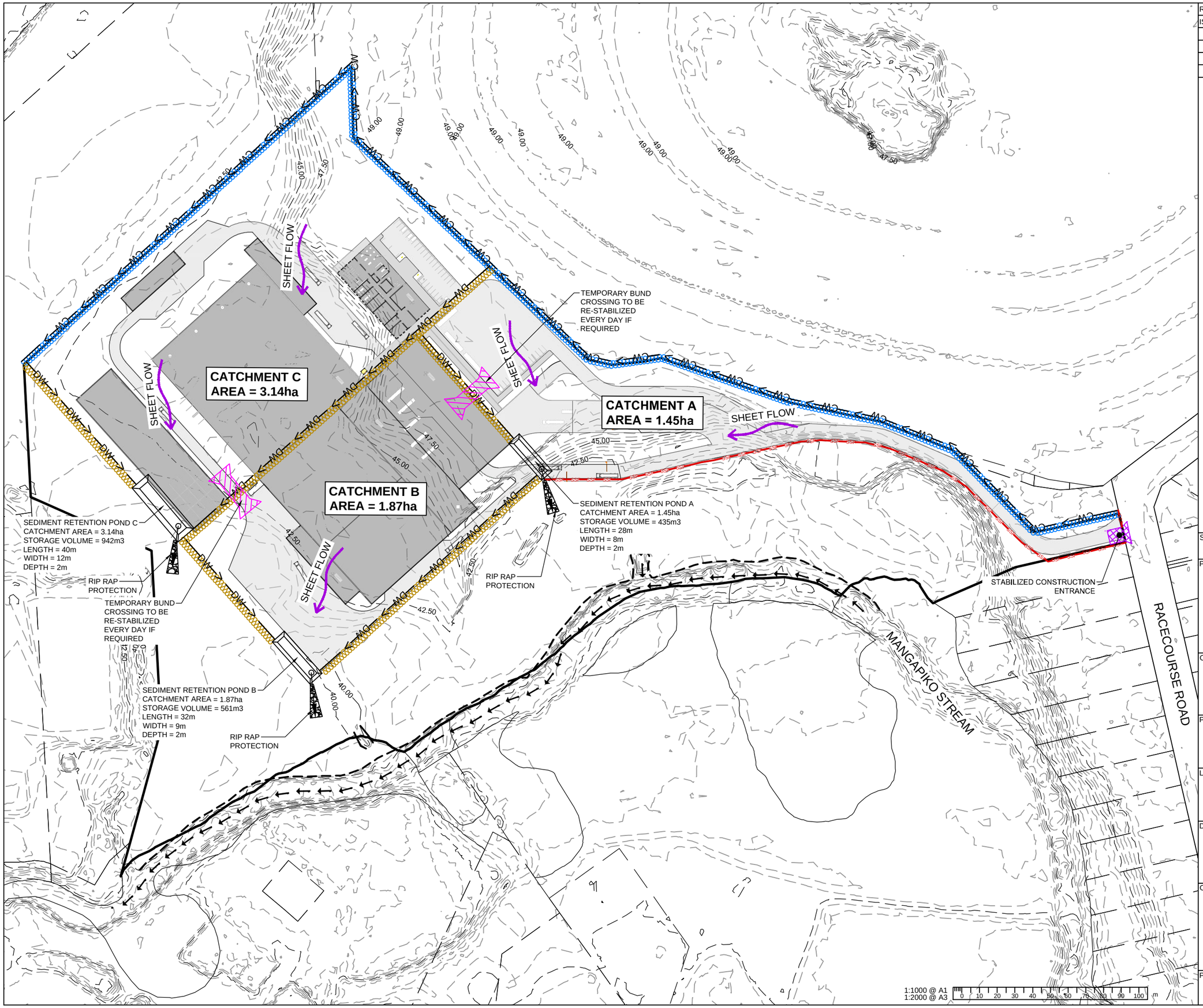

1:1000 @ A1
1:2000 @ A3
0 10 20 30 40 50 60 70 80 90 100 m

REVISION

ISSUE	DATE	DETAIL	CHKD	DRWN
A	01/12/21	FOR RESOURCE CONSENT	GC	GCAI

LEGEND:

- SUPER SILT FENCE
- CLEAN WATER DIVERSION BUND
- DIRTY WATER DIVERSION BUND
- STABILIZED CONSTRUCTION ENTRANCE
- POND

STAGE

RESOURCE CONSENT

PROJECT CONSULTANTS

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CLIENT

GLOBAL METAL SOLUTIONS

PROJECT

PAEWIRA RECYCLE PLANT

LOCATION

401 RACECOURSE PARADE,
TE AWAMUTU

DRAWING TITLE

EROSION AND SEDIMENT CONTROL PLAN

ORIENTATION

N

SCALE	A1	1:1,000
	A3	1:2,000
DATE		01/12/2021
SURVEYED		TERRA
DESIGNED		VARIOUS
DRAWN		G.CAI
CHECKED		G.CLARKE

PROJECT NUMBER	DWG NUMBER	REVISION
200065	RC-027	A

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APPENDIX B
PIEZOMETER INFORMATION

Piezometer Locations and Water Level Data

Figure B1: Location of Piezometer P1

Figure B2: Location of Piezometer P2

Figure B3: Location of Piezometer P3

Figure B4: Location of Piezometer P4

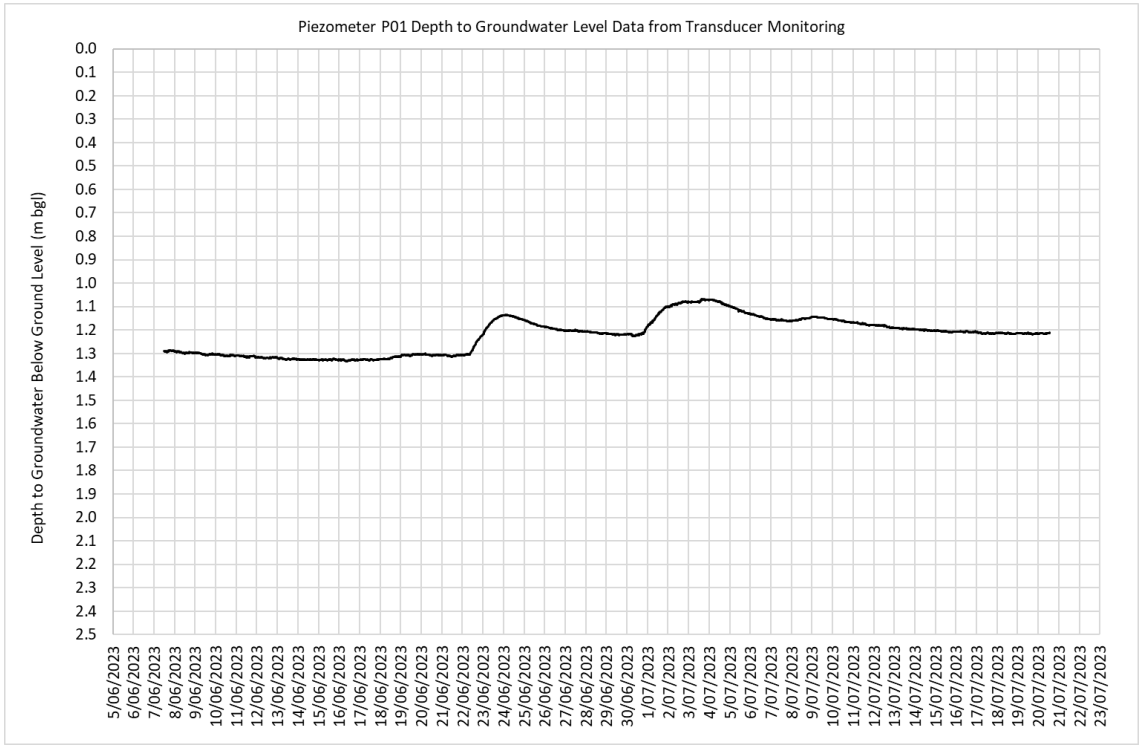


Figure B5: Groundwater Level Monitored Levels Piezometer P1

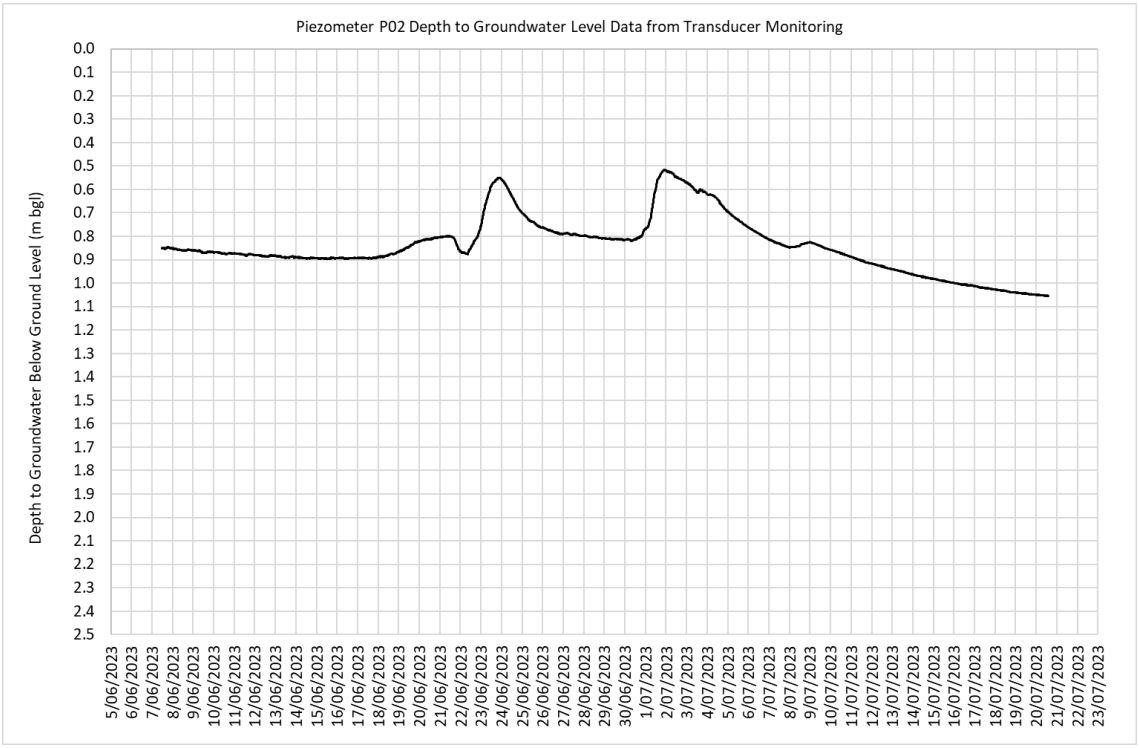


Figure B6: Groundwater Level Monitored Levels Piezometer P2

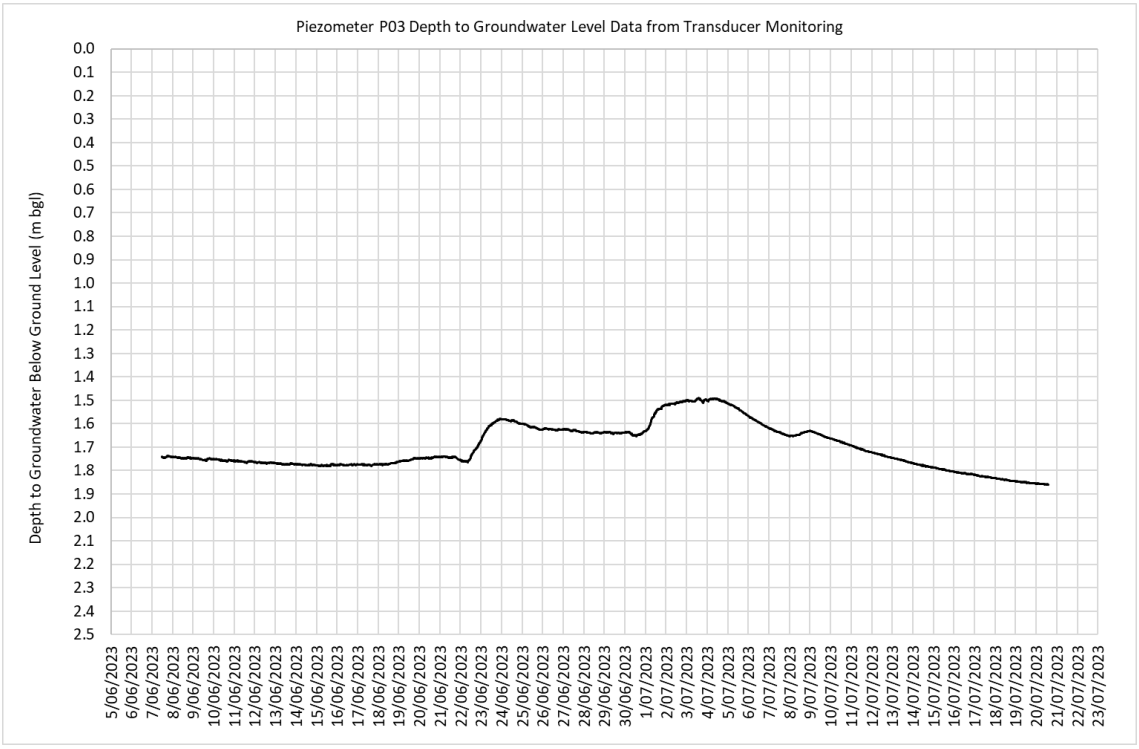


Figure B7: Groundwater Level Monitored Levels Piezometer P3

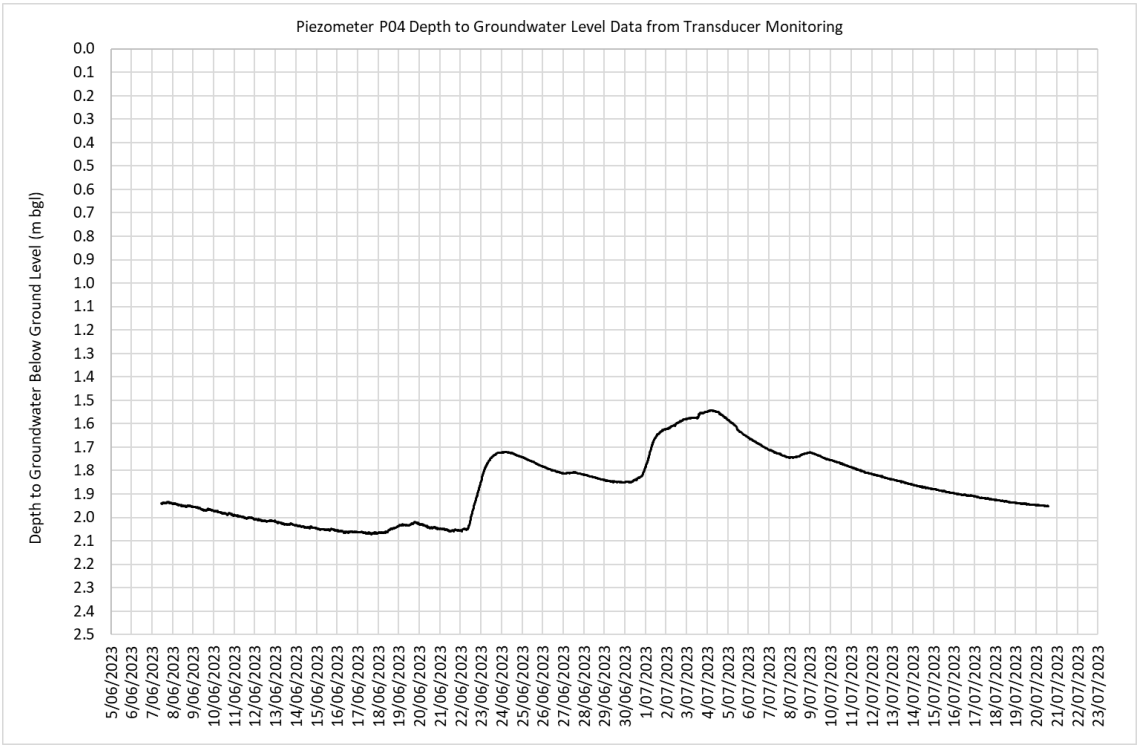
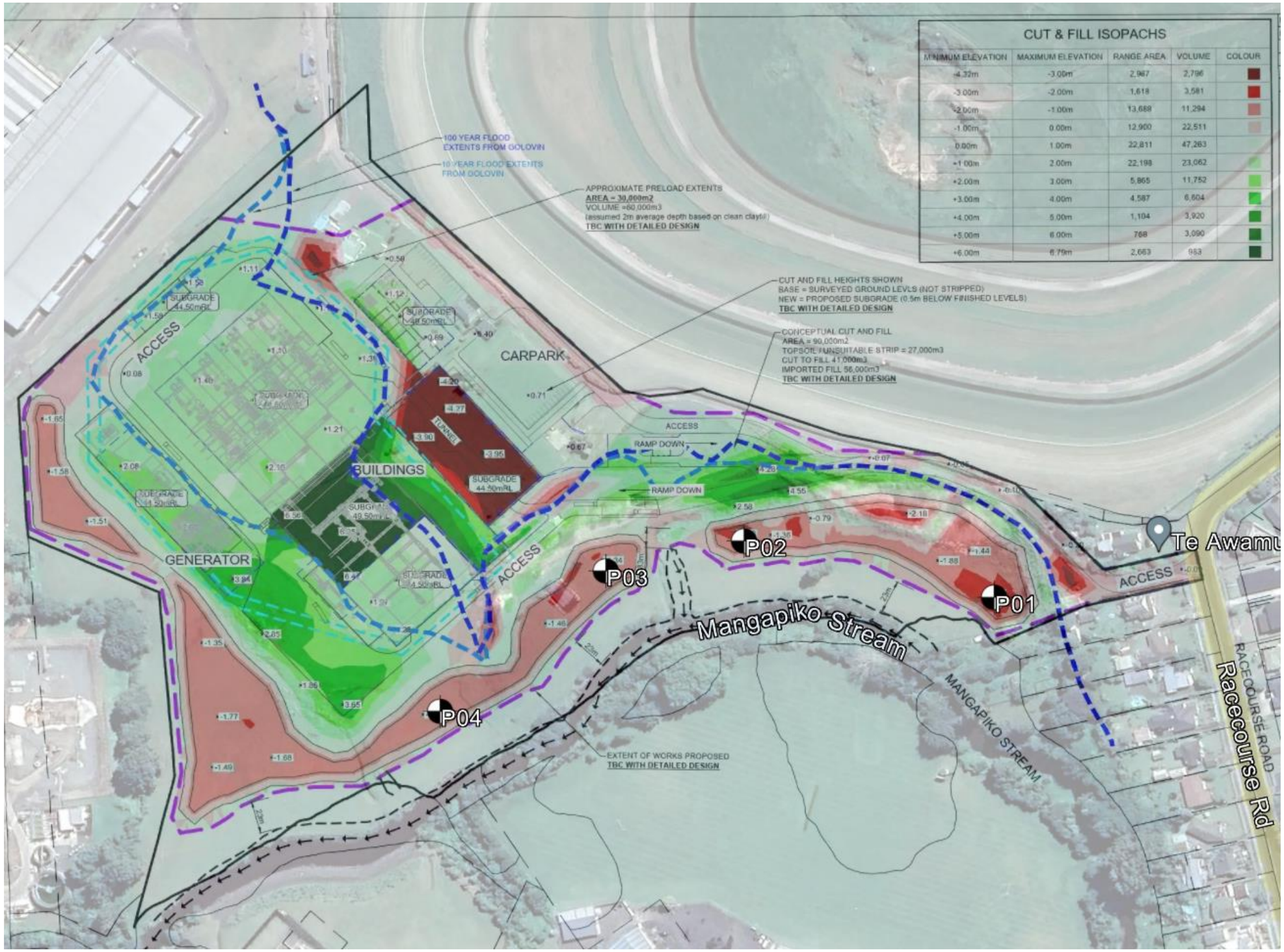


Figure B8: Groundwater Level Monitored Levels Piezometer P4



Notes: Overlay supplied by Terra Consultants: Paewira Recycle Plant. Earthworks Plan Overall. DWG: RC-020. Rev: A. Dated 01/12/2021.

LEGEND

Piezometer (P)

PROJECT: Project Paiwera

PROJECT No: HD2090-2

TITLE: Piezometer location plan

SCALE: N/A

Drawing No: 01

Drawing By: LM

Rev	Initials	Date
I	LM	28/06/2023

INVESTIGATION LOG

Job No.:	HD2090-2		
Client:	Global Contracting Solutions	**No.:**	P1
Project:	401 Racecourse Road, Te Awamutu		
Location:	Adjacent to the Mangakino stream, east of the site.	**Date:**	06.06.23
Co-ordinates:	-	**Logged By:**	LM
Contractor:	Brown Bros	**Checked By:**	HJ
Elevation:	Ground	**Sampling Method:**	Direct push

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Legend	Testing	Method	Coring TCR (%)	Coring RQD (%)	Defect Log	Additional Comments	Fluid Loss (%)	Water	Installation
Topsoil	TOPSOIL; dark brown. Moist.											
Fill	SAND, with some silt; brown. Moist; sand, fine to coarse. 0.8 m: -0.85 m: heavy Fe+ staining.					83						
	Silty SAND; light brown. Moist; sand, fine to coarse; moderate Fe+ staining.	1									1.35 m	
Holocene River Deposits	Sandy SILT; bluish grey. Medium dense; moist; moderate dilatency; sand, fine to coarse.											
	SAND; grey. Moist; sand, fine to coarse.	2				83						
	Organic SILT, with minor sand; brown. Moist; low dilatency; sand, fine to coarse.											
	Wood. Intact.											
	SAND, with some peat (fibrous); greyish brown. Moist; sand, fine to coarse. 2.4 m: -3.6 m: assumed zone of core loss.	3										
	Gravelly SAND; yellow brown. Moist; sand, fine to coarse; gravel, fine to coarse. 3.6 m: -4.9 m: assumed zone of core loss.	4				67						
	Clayey SILT; dark brown. Moist; low to moderate plasticity.	5				100						
	EOH: 5.00 m											

Remarks

Target depth achieved @ 5 m.

Legend

Key		Water	Discontinuities
TCR	Total core recovery	Standing Water Level	
RQD	Rock quality designation	Out flow	
		In flow	

CORE PHOTOS

HOLE No.: P1 Photo
JOB No.: HD2090-2

0.00m - 5.00m

INVESTIGATION LOG

Job No.:	HD2090-2		
Client:	Global Contracting Solutions	**No.:**	P2
Project:	401 Racecourse Road, Te Awamutu		
Location:	Adjacent to the Mangakino stream. Central.	**Date:**	06.06.23
Co-ordinates:	-	**Logged By:**	LM
Contractor:	Brown Bros	**Checked By:**	HJ
Elevation:	Ground	**Sampling Method:**	Direct push

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Legend	Testing	Method	Coring TCR (%)	Coring RQD (%)	Defect Log	Additional Comments	Fluid Loss (%)	Water	Installation
Topsoil	TOPSOIL; dark brown. Moist.		TS									
Fill	SILT, with some sand; brown. Moist; sand, fine.											
Fill	Clayey SILT, with some rootlets; brown. Moist; low plasticity.											
Holocene River Deposits	SAND, with some rootlets, with trace gravel; grey. Moist; sand, fine to coarse; gravel, fine to medium, subround to rounded.	1				47					0.85 m	
Holocene River Deposits	Sandy GRAVEL; greyish brown. Moist; gravel, fine to coarse, subround to rounded; sand, fine to coarse. 2.6 m: -2.75 m: strong Fe+ staining.	2				90						
Holocene River Deposits	SAND; greyish brown. Moist; sand, fine to coarse.	3				100						
Holocene River Deposits	Clayey SILT; dark brown. Moist; low to moderate dilatency.	4										
Holocene River Deposits	PEAT (AMORPHOUS); black. Moist.											
Holocene River Deposits	SILT, with minor sand; brown. Moist; low dilatency; sand, fine.											
	EOH: 4.50 m	5										

Remarks

Target depth achieved @ 4.5 m.

Legend

Key		Water	Discontinuities
TCR	Total core recovery	Standing Water Level	
RQD	Rock quality designation	Out flow	
		In flow	

CORE PHOTOS

HOLE No.: **P2 Photo**

JOB No.: HD2090-2

0.00m - 4.50m

INVESTIGATION LOG

Job No.:	HD2090-2		
Client:	Global Contracting Solutions	**No.:**	P3
Project:	401 Racecourse Road, Te Awamutu		
Location:	Adjacent to the Mangakino stream. West of site.	**Date:**	06.06.23
Co-ordinates:	-	**Logged By:**	LM
Contractor:	Brown Bros	**Checked By:**	HJ
Elevation:	Ground	**Sampling Method:**	Direct push

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Legend	Testing	Method	Coring TCR (%)	Coring RQD (%)	Defect Log	Additional Comments	Fluid Loss (%)	Water	Installation
Topsoil	TOPSOIL; dark brown. Moist.											
Holocene River Deposits	SAND; brown. Moist; sand, fine to coarse; Strong Fe+ staining.											
	Gravelly SAND; yellowish brown. Moist; sand, fine to coarse; gravel, fine to medium, subround to rounded.	1				67						
	2.4 m: -2.7 m: Strong Fe+ staining.	2				63					1.8 m	
		3				90						
	EOH: 4.50 m	4										
		5										

Remarks

Target depth achieved @ 4.5 m.

Legend

Key		Water	Discontinuities
TCR	Total core recovery	Standing Water Level	
RQD	Rock quality designation	Out flow	
		In flow	

CORE PHOTOS

HOLE No.: P3 Photo
JOB No.: HD2090-2

0.00m - 4.50m

INVESTIGATION LOG

Job No.:	HD2090-2		
Client:	Global Contracting Solutions	**No.:**	P4
Project:	401 Racecourse Road, Te Awamutu		
Location:	Adjacent to the Mangakino stream. West of site.	**Date:**	06.06.23
Co-ordinates:	-	**Logged By:**	LM
Contractor:	Brown Bros	**Checked By:**	HJ
Elevation:	Ground	**Sampling Method:**	Direct push

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)	Legend	Testing	Method	Coring TCR (%)	Coring RQD (%)	Defect Log	Additional Comments	Fluid Loss (%)	Water	Installation
Topsoil	TOPSOIL; dark brown. Moist.											
Fill	Clayey SILT, with some rootlets; brown. Moist; moderate plasticity.											
Holocene River Deposits	Silty SAND; yellowish brown. Moist; sand, fine to coarse; moderate Fe+ staining and manganese nodules.					73						
	Gravelly SAND; brown. Moist; sand, fine to coarse; gravel, fine to medium, rounded.	1										
		2				73					1.85 m	
		3										
	SAND, with minor gravel; greyish brown. Moist; sand, fine to coarse; gravel, fine, rounded.	4				80						
	EOH: 4.50 m											
		5										

Remarks

Target depth achieved @ 4.5 m.

Legend

Key		Water	Discontinuities
TCR	Total core recovery	Standing Water Level	
RQD	Rock quality designation	Out flow	
		In flow	

CORE PHOTOS

HOLE No.: P4 Photo

JOB No.: HD2090-2

0.00m - 4.50m

WGA

AUSTRALIA

60 Wyatt Street
Adelaide SA 5000

Level 6, 312 St Kilda Road
Southbank VIC 3006

Level 1, 66 Kings Park Road
West Perth WA 6005

7/9 Keith Lane
Fannie Bay NT 0820

Ground Floor, 154 Melbourne Street
South Brisbane QLD 4101

Level 1, 15 Darling Terrace
Whyalla SA 5600

559 Hunter Street
Newcastle West NSW 2302

WGA.COM.AU

NEW ZEALAND

4 Ash Street
Christchurch Central
Christchurch NZ 8011

10 Bisley Road
Room 38 'The Homestead'
Hamilton NZ 3214

The Hangar, 2/2 Boundary Road
Catalina Bay, Hobsonville Point
Auckland NZ 0618

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