REPORT

TAURANGA CITY COUNCIL

Soak-hole Decommissioning Extension Study for the Matua and Avenues Areas

Revision 1

Report prepared for:

TAURANGA CITY COUNCIL

Report prepared by:

TONKIN & TAYLOR LTD

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July 2008

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Executive summary

Tonkin & Taylor Ltd was commissioned by the Tauranga City Council (TCC) to extend a study into the effect of soak-holes on the stability of slopes in the Otumoetai area of Tauranga into Matua and the Avenues. The intent of this work is to define and prioritise areas in which soak-holes should be decommissioned to enhance the stability of adjacent slopes.

The stability of the slopes in the field areas are mostly controlled by their height and gradient. The shallow geology in Matua and the Avenues are similar to Otumoetai and tends to follow the topography. This geology comprises Younger Ash (including the Rotoehu Ash) overlying dark brown Hamilton Ash. Any water supplied to the shallow strata is likely to flow sub parallel to surface water. Slopes that are greater than 5 m high with gradients greater than 25 degrees are classified as vulnerable to landslipping. The vulnerable slopes have been further subdivided into major (greater than or equal to 15 m) and minor (less than 15 m) slopes.

Zones where decommissioning of soak-holes are recommended include any areas that direct water toward vulnerable slopes. For major slopes these zones extend to the catchment boundaries behind the slope crests, and for minor slopes they extend behind the crest for three times the slope height. These zones have been categorised into two levels of priority to aid Tauranga City Council (TCC) in resourcing the decommissioning process. Soak-holes should be set back from slope crests in any case, including areas where soak-hole decommissioning has not been specifically recommended. We suggest that soak-holes should not be drilled closer than 15 m to the crest of any slope, embankment or cutting that is greater than 5 m high or steeper than 20 degrees.

No new soak-holes should be drilled in areas where their decommissioning is recommended. In other areas specific designs for individual soak-holes should be submitted to TCC for their approval prior to excavation. These designs must show that the soak-hole is able to cope with water supplied to it during a 1 in 10 year storm in accordance with the Building Code. These designs should also take into account the outlet points of any seepage and show that the soak-hole will not have a detrimental effect on neighbouring properties or slopes.

1 Introduction

Tonkin & Taylor Ltd (T&T) was commissioned by the Tauranga City Council (TCC), in July of 2006, to carry out a study into the effect of soak-holes on the stability of slopes in the Bellevue, Brookfield, Judea and Otumoetai areas of Tauranga following the 18 May 2005 rainstorm event[1]. The event led to widespread landslippage throughout Tauranga City, but particularly in the areas mentioned and also Maungatapu and Welcome Bay[2]. On completion of this study TCC further commissioned Tonkin & Taylor in December of 2006 to extend this study to the Matua and Avenues Areas. The final report for the study was submitted in December 2007[3].

T&T was asked by TCC to revisit the decommissioning zones upon their review of our December 2007 based upon field checks of slopes in the study areas. These field checks identified some areas where the assessment based on a desk study of ground topograghy had not fully characterised the conditions on the ground. Some changes were made to the decommissioning zones based on the council review and field work. This report contains figures with updated soak-hole decommissioning zones. It supersedes our December 2007 report *"Soak-hole Decommissioning Extension Study for the Matua and Avenues Areas"*.

A previous study into soak-holes in Tauranga was carried out in 1992[4]. This subdivided Tauranga into areas where soak-holes were generally suitable or unsuitable and areas where specific investigations should be carried out prior to their excavation. The 1992 study classified most of the central elevated area in Matua as being generally suitable for soak-holes, while areas in close proximity to the cliff edges were generally unsuitable. The Avenues area was classified as generally suitable through portions of the central elevated area, while all other areas were classified as generally unsuitable.

The field areas for the current study are shown in Figure 1. The Matua area covers the Matua Peninsula bound by the railway track running along side Ngatai Road. The Avenues area stretches from Chapel Street in the CBD to Twenty Third Avenue.

Previous studies into slope stability in the Otumoetai area indicate that major landslippage was generally isolated to steep slopes and that it occurred during intense rainfall events that were preceded by periods of high rainfall or relatively recent storm events[2]. The primary cause of the landslips in Otumoetai was determined as substantial infiltration of water into the ground caused by rainfall[2] and concentration of overland flow towards vulnerable slopes. It was also noted that soak-holes were detrimental to slope stability, albeit to a lesser extent, because they can concentrate water and create local areas of high pore water pressure. They may also have supplied water to the fissured surface of the Hamilton Ash allowing deeper permeation of the water than would naturally occur which would have adverse effects, particularly when the soak-holes are present close to the crests of steep slopes[2]. The aim of this project is, therefore, to produce maps of the Matua and Avenues Areas, with lines around vulnerable slopes to demarcate areas where soak-holes should be decommissioned and prohibited to minimise their effect on slope stability.

2 Methodology

Our methodology has been to:

i. Check existing borehole data, soil descriptions and geomorphic data for the Matua and Avenues areas for comparison with Otumoetai;

ii. Analyse the TCC database for relic slips and landslides caused by the rainstorm event of 18 May 2005;

iii. Determine slopes that are vulnerable to landslipping and define catchment divides;

iv. If the geology and geomorphology is found to be sufficiently similar to the Otumoetai area, define areas for soak-hole decommissioning and prioritise the slopes according to the criteria outlined in the Otumoetai soak-hole study[1];

v. If the geology and geomorphology is significantly different to that of Otumoetai, develop new criteria for the decommissioning of soak-holes;

vi. Field check the decommissioning areas with a member of Tauranga City Council.

It is our understanding that contractors excavating soak-holes usually drill until they reach the Hamilton Ash, i.e. through the Rotoehu Ash[5]. The Rotoehu Ash is generally a silty fine to medium sand that is porous and permeable. Water supplied to the soak-holes drain away through the Rotoehu Ash. Although we believe this to be the most common practice, it does not always occur. In areas where the Rotoehu Ash is not present contractors are likely to keep excavating the holes until they reach a porous and permeable layer. Such layers are also present at various levels in the Matua Subgroup but at depths where they are less likely to affect the stability of the slopes. This being the case we have concentrated our investigations on the Rotoehu Ash and have checked its distribution, thickness and depth at various locations around Matua and the Avenues. Our approach has been to examine previous studies carried out by Tonkin & Taylor and TCC for any information pertaining to the geology and geomorphology of the areas of interest. Borehole, hand auger and test pit logs along with head scarp descriptions were used to draft cross sections of the general geology. This approach has allowed us to determine whether the geology and geomorphology of Matua and the Avenues is sufficiently similar to that of Otumoetai to allow the use of the same criteria to define areas for soak-hole decommissioning.

We have further refined these areas assigning levels of priority as we did for the Otumoetai study[1]. These priority levels are to assist the TCC in the allocation of resources to the decommissioning process only. Two levels of priority were deemed appropriate for Matua and the Avenues. Areas in which we believe soak-hole decommissioning should take place first are assigned priority level 1.

3 Geology and Geomorphology

3.1 Introduction

The geological map of Tauranga Area, (1:50,000 scale)[6] shows Matua to be completely underlain by fluviatile terrace sequences of the Matua Subgroup. The same map shows the Avenues are underlain by Matua Subgroup deposits between Chapel Street and 11th Avenue.

Volcanic ash deposits overlie the Matua Subgroup and are subdivided into the Younger Ashes (including Rotoehu Ash) and Hamilton Ash.

3.2 Matua Peninsula

3.2.1 Geomorphology

The Matua Peninsula comprises an upstanding area of land that reaches a maximum of 27 metres above sea level. It is a raised area of gently sloping hills bound by steep sea cliffs up to 20 metres high. This raised area is cut by broad low-lying valleys that have eroded inland. Relic slips can be identified along cliff lines and on the flanks and heads of valleys.

The slopes have been classified according to their gradients using ArcInfo GIS software and topographic information provided by the TCC. The results of this slope classification are shown in Figure 2. The results of this show that the steepest slopes mainly occur at the sea cliff and that a significant portion of this cliff is steeper than 35 degrees.

3.2.2 Geology

Nineteen boreholes or soil descriptions of the Matua area were found in previous studies that ranged in depth between 2 to 25 metres below ground level (mbgl). The locations of these can be seen on Figure 3. These descriptions confirm the general geological sequence described in 3.1. The general shallow geological variation can be seen in the cross section of the peninsula (Figure 4), with the range and average depths and thicknesses shown in Table 1.

	Depth (mbgl)		Thickness (m)	
	Range	Average	Range	Average
Fill	0	0	0 – 2.0	0.6
Younger Ash (excluding Rotoehu Ash)	0 – 2.0	0.6	0.7 – 3.0	1.8
Rotoehu Ash	0.5 – 4.0	1.8	0.2 – 2.5	1.1
Hamilton Ash	0.7 – 6.0	2.8	0.8 – 4.5	2.8
Matua Subgroup	2.7 – 9.5	5.1	-	-

Table 1- Shallow Geology Variation for the Matua Peninsula

3.3 Avenues

3.3.1 Geomorphology

The Avenues area is part of a long narrow peninsula extending into Tauranga Harbour. The upstanding area reaches up to 32 metres above sea level. As with the Matua Peninsula the Avenues area is bound by sea cliffs and broken by eroded gullies. Low-lying flat areas and estuaries extend beyond the cliffs and gullies. Relic slips have been identified along eroding cliff lines, gully flanks and gully heads.

As for Matua the slopes in the Avenues have been classified according to their gradients using ArcInfo GIS software and topographic information provided by the TCC. The results of this slope classification are shown in Figures 5 and 6. The results again show that the steepest slopes are largely confined to the eroded sea cliff where many portions are greater than 35 degrees. They also show that the steeper slopes predominantly occur on the western side of the peninsula.

3.3.2 Geology

Thirty two borehole logs or soil descriptions ranging in depths from 2 to 30 mbgl were found in previous studies, the locations of these can be seen in Figures 7 and 8. These descriptions confirmed the general geological sequence described in 3.1. The variation in the shallow geology can be seen in cross sections drawn through Elizabeth Street, 11th Ave and from Humber Crescent to 16th Ave (Figures 9, 10 and 11). The range and average depths and thicknesses of the shallow strata are shown in Table 2.

	Depth (mbgl)		Thickness (m)	
	Range	**Average**	**Range**	**Average**
Fill	0	0	0 – 1.5	0.4
Younger Ash (excluding Rotoehu Ash)	0 - 1.5	0.4	0.5 – 3.6	2.4
Rotoehu Ash	1.0 – 3.8	2.7	0.3 - 1.6	0.9
Hamilton Ash	2.3 - 4.9	3.8	1.0 – 3.9	2.4
Matua Subgroup	4.5 – 7.8	6.4	-	-

Table 2- Shallow Geology Variation for the Avenues Area

3.4 Discussion

Although the Matua and Avenues areas did not experience the extent of land slipping that occurred in the Otumoetai area during the storm event of 18 May 2005 many relic slips have been identified in the two areas. These relic slips are present along eroded cliff lines, gully flanks and gully heads in similar locations to those in Otumoetai[1]. Both Matua and the Avenues are lower elevation than Otumoetai and as a result gullies and valleys are not so deeply incised. Even so the mechanisms of slope failure are essentially the same.

The geology of Matua and the Avenues, in its elevated areas, was found to be predominately the same as that found in the Otumoetai area. It is also apparent that shallow geology tends to follow topography and any water supplied to these strata is likely to flow sub-parallel to overland flow as postulated for Otumoetai[1]. Younger Ash

and Hamilton Ash was sometimes absent in low-lying valleys and along cliff lines which is probably due to recent marine erosion and land slipping.

In the Otumoetai study[1] the capacity of the Rotoehu Ash (the aquifer) to cope with the discharge from soak-holes was estimated by examining both the storage capacity of the layer, and the rate at which water can flow into and out of the layer. These two factors govern the influence that the water entering the soak-holes has on groundwater regime. The study[1] showed that the rate of water flow into the aquifer is unlikely to exceed about 2.5 m^3/hr and that when "dry" the aquifer was able to accept between 80 to 160 m^3 from a single house. A long period of dry weather would be required for the aquifer to fully drain and so the storage capacity of the aquifer at any given time is largely dependent on the weather events leading up to a particular storm event. The flow rate and capacity was calculated to be insufficient to accept the storm discharge from an event like that experienced in Otumoetai during 18 May 2005[1]. During such events soak-holes are likely to fill up creating a pressure head that will force water into deeper layers more quickly than would naturally occur. The soak-holes are also likely to overflow and discharge directly onto the ground. These results assisted in determining areas around Otumoetai where the decommissioning of soak-holes was recommended.

Both the geomorphology and shallow geology for the Matua and the Avenues have been found to be broadly similar to that found in Otumoetai. The ground response to the influx of water is also likely to be similar. This allows the use of the same criteria for decommissioning of soak-holes. The "decommissioning" criteria are discussed in section 3.5.

Cross sections show that the Avenues area from Marsh Street to Hamilton Street may be missing the shallow stratigraphy that is typical of Tauranga. For any new soak-holes in this area further site specific investigations should be carried out.

3.5 Criteria for Removal of Soak-holes

As in Tonkin & Taylor (2006)[1] *"Study into the Decommissioning of Soak-holes in the Otumoetai Area"* the first step is to identify slopes vulnerable to landslippage. Slopes most vulnerable to instability have been identified primarily on the basis of their surface shape, in particular their inclination and height. The Otumoetai classification criteria recognised slopes steeper than 2H:1V (approximately 25 degrees) and over 5 metres in height as vulnerable to landsliding. The Otumoetai Study subdivided these slopes into major slopes, those greater or equal to 15 metres in height and minor slopes, those less than 15 metres high.

All of the slopes in the Matua and Avenues areas have been classified according to their gradients using ArchInfo GIS software based on topographic information provided by the TCC. The distribution of these slope gradients are shown on Figures 2, 5 and 6. These show that slope gradients vary with many slopes steeper than 35 degrees.

Having established vulnerable slopes the extent of soak-hole removal has to be defined. The Rotoehu Ash layer that the soak-holes are designed to discharge into generally follows ground surface at a depth of 2 m to 3 m so that any water discharging into this layer at sites uphill of vulnerable slopes flows towards those slopes. Establishing "uphill" areas involves determining the flow direction of the surface water, i.e. the "catchment". With this in mind, Tonkin & Taylor (2006)[1] *"Study into the Decommissioning of Soak-holes in the Otumoetai Area"* recommends for major slopes the decommissioning of the soak-holes

back to the nearest catchment divide. For minor slopes soak-holes should be removed from a horizontal distance of three times the height of the slope behind its crest.

A further criterion of prioritisation has been used to aid TCC in allocating resources for the decommissioning process. These priorities follow the Otumoetai study and are as follows:

- Priority 1 – All major slopes and minor slopes that have experienced stability problems historically, especially during the 18 May 2005 storm event.
- Priority 2 – All other minor slopes.

Unlike Otumoetai[1], only two orders of priority have been used in this study. This is due to the lesser extent of landslippage that occurred in Matua and the Avenues during the rainstorm event of 18 May 2005 compared to Otumoetai[1]. All of the slopes in the Matua and Avenues areas fall into the two priorities described above.

In areas where vulnerable slopes were closely spaced, the decommissioning zones were connected for practicality.

No new soak-holes should be permitted in the shaded areas of Figures 3, 7 and 8 regardless of their priority.

In areas that have not been classified as priority 1 or 2, caution should be exercised during soak-hole design. No soak-holes should be drilled within 15 m of the crest of a slope, embankment or cutting that is greater than 5 m high and steeper than 20 degrees. Where they are permitted the design of individual soak-holes should be submitted to TCC for approval. These designs must show that the soak-hole is able to cope with water supplied to it during a 1 in 10 year storm in accordance with the Building Code. These designs should also take into account the outlet points of any seepage and show that the soak-hole will not have a detrimental effect on neighbouring properties or slopes.

4 Conclusions

The soak-holes in some of the Otumoetai area were identified as having a potentially detrimental effect on slope stability. With that in mind a study was completed determining where the decommissioning of soak-holes would most enhance the stability of slopes in the area[1]. That study[1] has been extended to the Matua and Avenues areas. The following conclusions for the Avenues and Matua areas have been reached:

- Geology and geomorphology of Matua and the Avenues are similar to Otumoetai[1], indicating that sub surface water movement and soak-hole effects are also similar. The same criteria for soak-hole removal as in Tonkin & Taylor (2006)[1] may therefore be used for Matua and the Avenues.
- Areas where it is recommended that soak-holes be decommissioned are shown on Figures 3, 7 and 8. The areas of soak-hole decommissioning are based on the criteria of removing the soak-holes completely in areas where the water will flow towards the major slopes (i.e. to the nearest catchment boundary behind the slope crest), and within three times the slope height for minor slopes;
- In areas where decommissioning has not been prioritised they should not be drilled closer than 15 m to the crest of a slope, embankment or cutting;
- Where soak-holes are permitted their designs must be in accordance with the Building Code and should take into account the exit points for any seepage. They should be designed according to specific site conditions and should not have a detrimental effect on neighbouring properties or slopes.
- The Avenues area from Marsh Street to Hamilton Street may be missing the shallow stratigraphy that is typical of Tauranga. For any new soak-holes in this area further site specific investigations should be carried out.

5 Applicability

This report has been prepared for the benefit of Tauranga City Council with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

TONKIN & TAYLOR LTD
Environmental and Engineering Consultants

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Geotechnical Engineer

Authorised for Tonkin & Taylor by:

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for Chris Bauld
Senior Geotechnical Engineer
Project Co-ordinator

sjk_ dmmm

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6 References

Tonkin & Taylor Ltd (2006) Report on the Study into the Decommissioning of Soak-holes in the Otumoetai Area. Job Number 23064.

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Tonkin & Taylor Ltd (2006) Soak-hole Decommissioning Extension Study for the Matua and Avenues Areas. Job Number 850913.

Shrimpton and Lipinski Ltd (1992) Report on the Investigation into Residential Stormwater Disposal to Soakpits. Report prepared for Tauranga District Council. Reference 10633.

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Briggs, R.M., et al., 1996: Geology of the Tauranga Area. Department of Earth Sciences Occasional Report No. 22. University of Waikato. Hamilton.

Appendix A: Figures

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Sourced from Terraview

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TAURANGA CITY COUNCIL
AVENUES/MATUA SOAK-HOLE STUDY

Field Areas

FIG. No. Figure 1

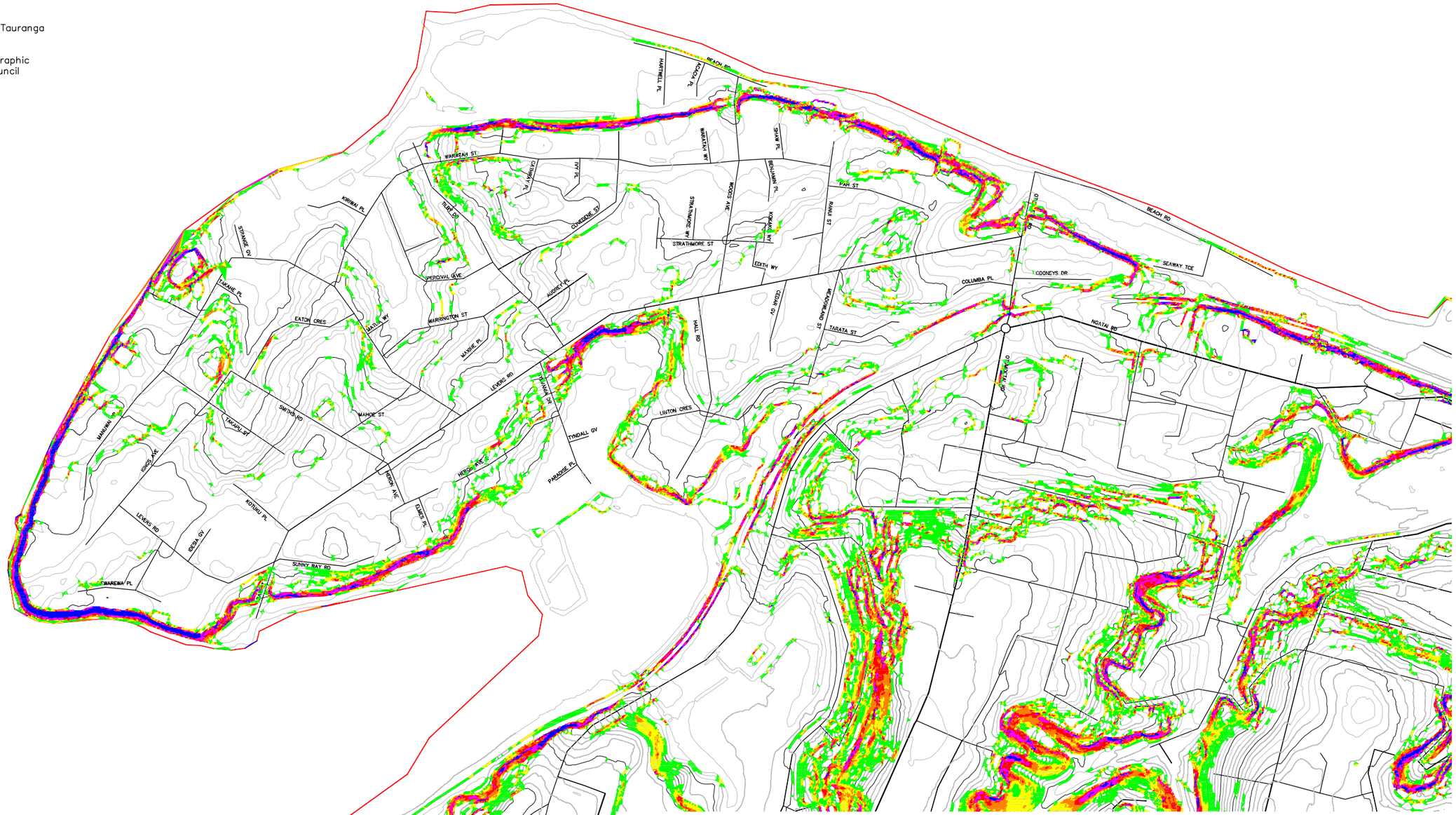
REV. 0

LEGEND

- 10°– 15° SLOPE
- 15°–20° SLOPE
- 20°–25° SLOPE
- 25°–30° SLOPE
- 30°–35° SLOPE
- +35° SLOPE

Base map information provided by Tauranga City Council

Slope angles calculated from topographic data provided by Tauranga City Council



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A3 SCALE 1: 10,000
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FIG. No. Figure 2
REV. 0

TAURANGA CITY COUNCIL
AVENUES/MATUA SOAK–HOLE STUDY
MATUA
Slope Angle Plan

LEGEND

- Catchment boundary
- Existing borehole location and address
- Priority 1 soak-hole decommission area
- Priority 2 soak-hole decommission area

A 1 SCALE 1: 5,000
A3 SCALE 1: 10,000
0 100 200 300 400 500 (m)

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TAURANGA CITY COUNCIL
AVENUES/MATUA SOAK-HOLE STUDY
MATUA
Areas Recommended for Soak-hole Decommissioning

FIG. No. Figure 3 REV. 0

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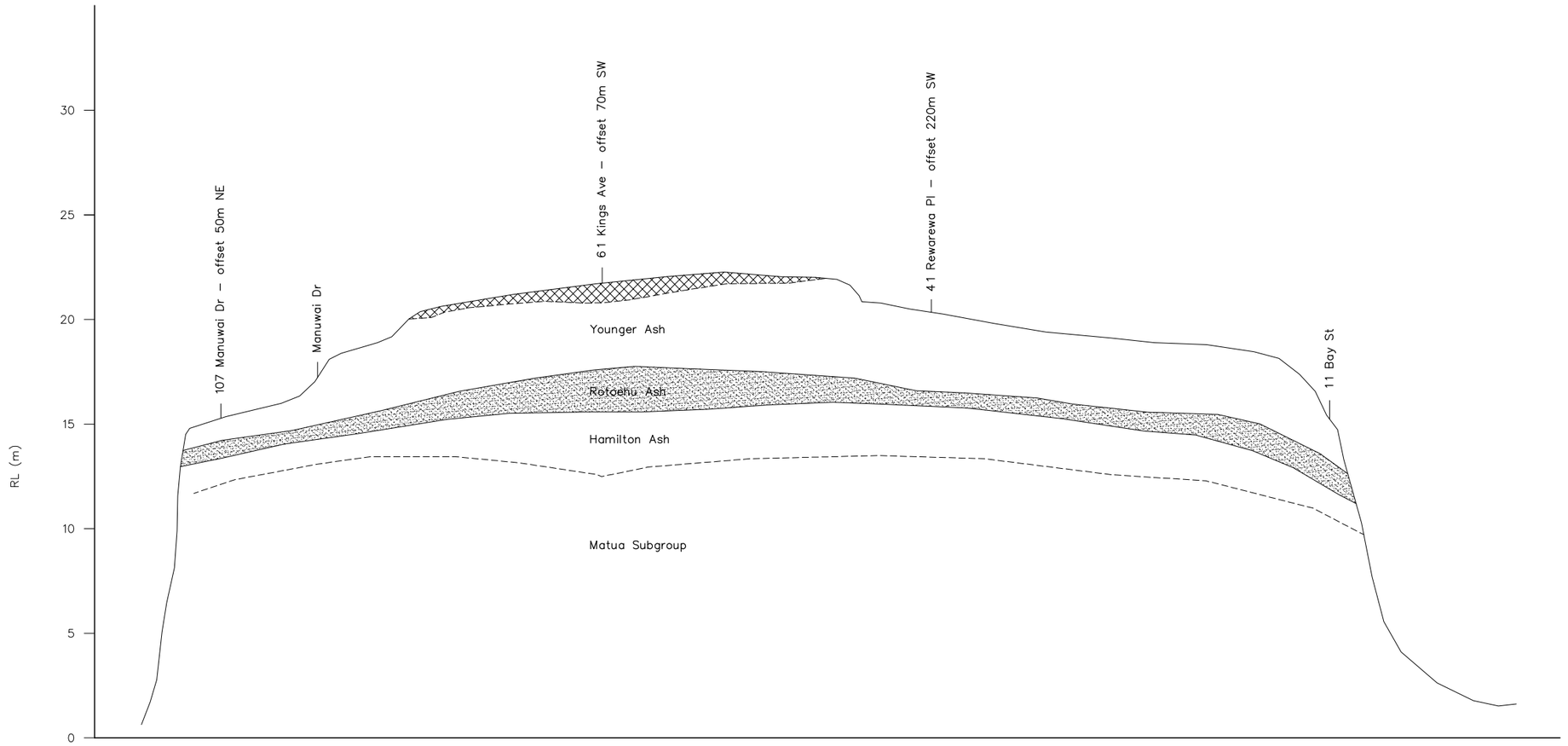

SECTION A GEOLOGICAL CROSS SECTION
Fig3

VERTICAL SCALE 1: 250
0 5 10 15 (m)

HORIZONTAL SCALE 1: 2,500
0 50 100 150 (m)

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TAURANGA CITY COUNCIL
AVENUES/MATUA SOAK–HOLE STUDY
MATUA PENINSULA
Geological Cross Section A

FIG. No. Figure 4 REV. 0

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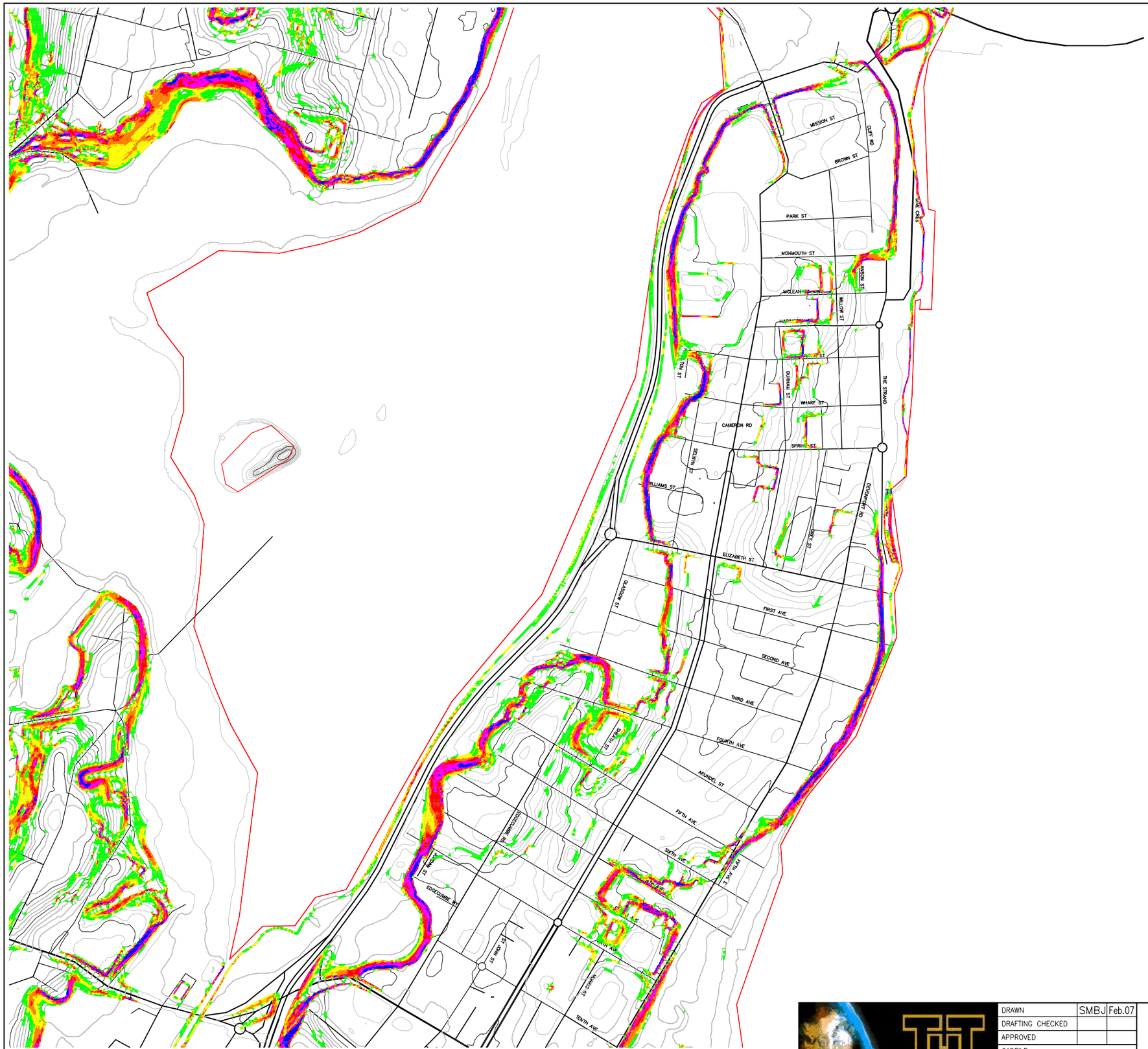

Base map information provided by Tauranga City Council

Slope angles calculated from topographic data provided by Tauranga City Council

LEGEND

- 10°– 15° SLOPE
- 15°–20° SLOPE
- 20°–25° SLOPE
- 25°–30° SLOPE
- 30°–35° SLOPE
- +35° SLOPE

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AVENUES/MATUA SOAK–HOLE STUDY EARLY AVENUES

Slope Angle Plan

FIG. No. Figure 5

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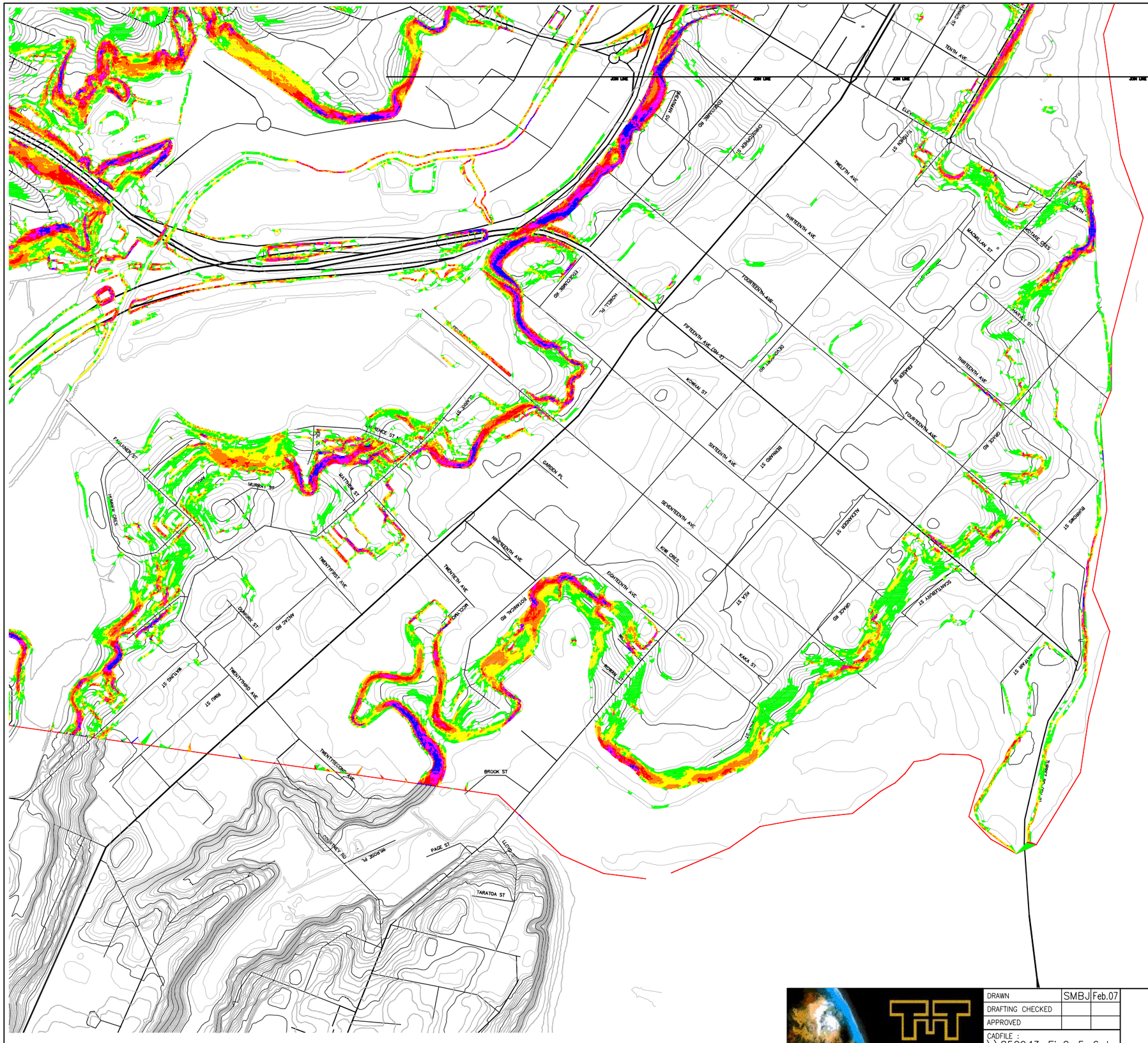

Base map information provided by Tauranga City Council

Slope angles calculated from topographic data provided by Tauranga City Council

LEGEND

- 10°– 15° SLOPE
- 15°–20° SLOPE
- 20°–25° SLOPE
- 25°–30° SLOPE
- 30°–35° SLOPE
- +35° SLOPE

A 1 SCALE 1: 5,000
A3 SCALE 1: 10,000
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TAURANGA CITY COUNCIL
AVENUES/MATUA SOAK–HOLE STUDY
LATE AVENUES
Slope Angle Plan

FIG. No. Figure 6
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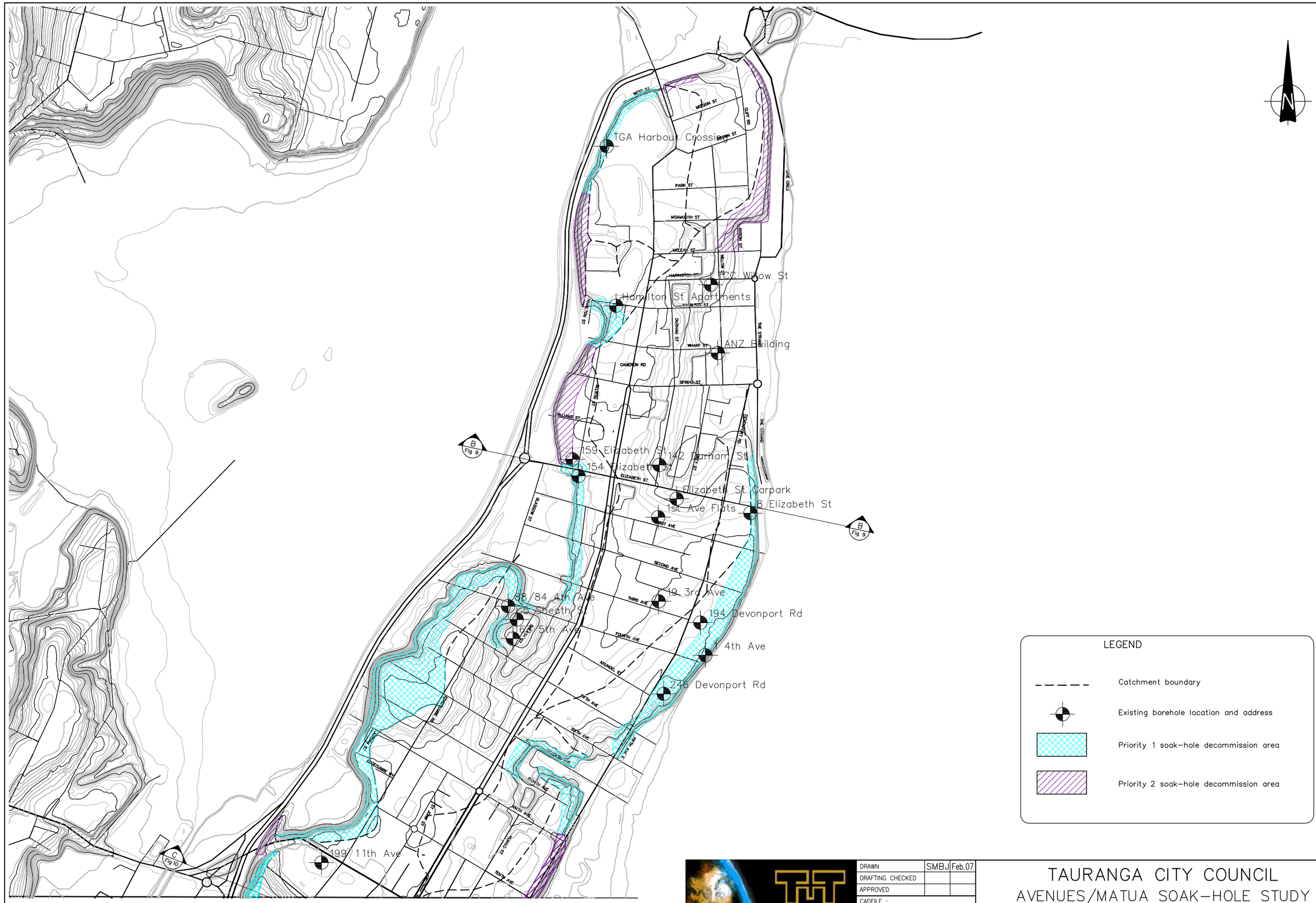

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TAURANGA CITY COUNCIL
AVENUES/MATUA SOAK-HOLE STUDY
EARLY AVENUES
Areas Recommended for Soak-hole Decommissioning

FIG. No. Figure 7
REV. 0

199 11th Ave

167 Edgecumbe Rd

43 Brierley St

St Johns Ambulance

141 17th Ave

Tauranga Hospital

45 Clark St

114,116,118 Humber Cres

180 18th Ave

166 / 168 Fraser St

17 Canterbury St

24 Canterbury St

16th Ave

229 Fraser St

257 Fraser St

124/26 Tanner St

Boundary of study area

C Fig10

D Fig11

N

LEGEND

- Catchment boundary
- Existing borehole location and address
- Priority 1 soak-hole decommission area
- Priority 2 soak-hole decommission area

A1 SCALE 1:5,000
A3 SCALE 1:10,000
0 100 200 300 400 500 (m)

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DRAFTING CHECKED		
APPROVED		
CADFILE : \\8509 13-Fig3-7-8.dwg		
SCALES: AT A3 SIZE 1: 10000	AT A1 SIZE 1: 5000	
PROJECT No. 8509 13		

TAURANGA CITY COUNCIL

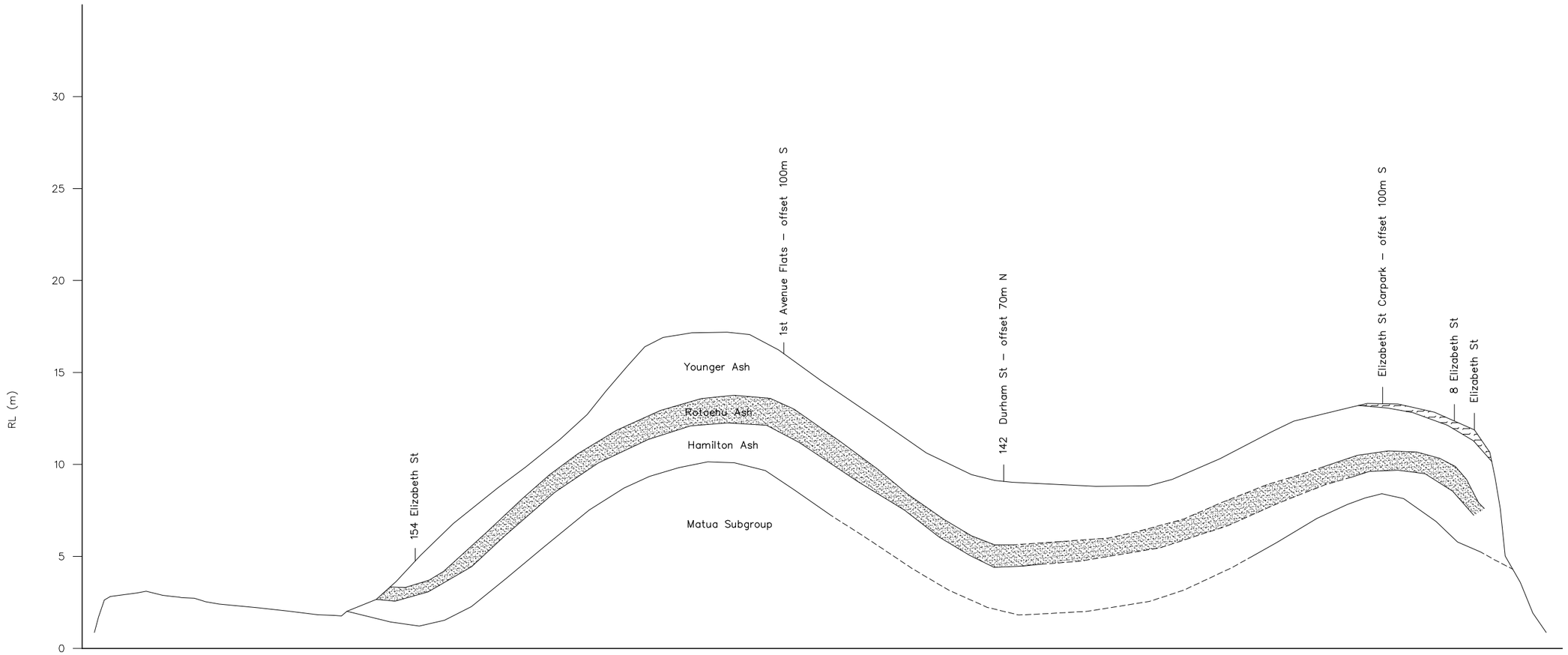
AVENUES/MATUA SOAK-HOLE STUDY

LATE AVENUES

Areas Recommended for Soak-hole Decommissioning

FIG. No. Figure 8

REV. 0



SECTION B Fig7 GEOLOGICAL CROSS SECTION

VERTICAL SCALE 1:250
0 5 10 15 (m)

HORIZONTAL SCALE 1:2,500
0 50 100 150 (m)

P:\850913\WorkingMaterial\CAD\850913-SectA-D.dwg, Fig 9, 10/10/2007 10:47:08 a.m., smbj, 1:1

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APPROVED		
CADFILE : \\8509 13–SectA–D.dwg		
SCALES (AT A3 SIZE)	AS SHOWN	
PROJECT No.	8509 13	

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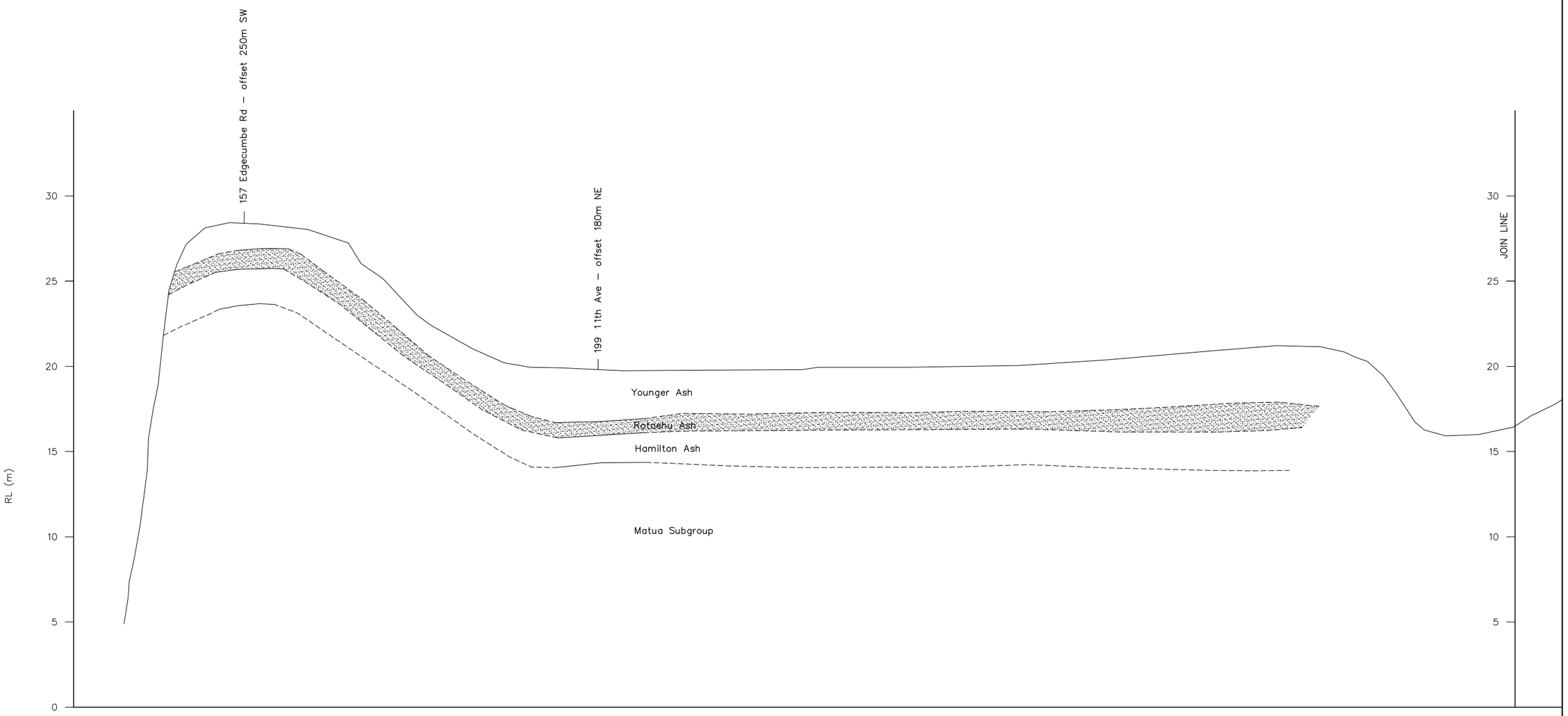
AVENUES/MATUA SOAK–HOLE STUDY
EARLY AVENUES
Geological Cross Section B

FIG. No. Figure 9 REV. 0



SECTION C Fig8 GEOLOGICAL CROSS SECTION

CONTINUED ON SHEET 2

VERTICAL SCALE 1: 250

0 5 10 15 (m)

HORIZONTAL SCALE 1: 2,500

0 50 100 150 (m)

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SCALES (AT A3 SIZE)	AS SHOWN	
PROJECT No.	8509 13	

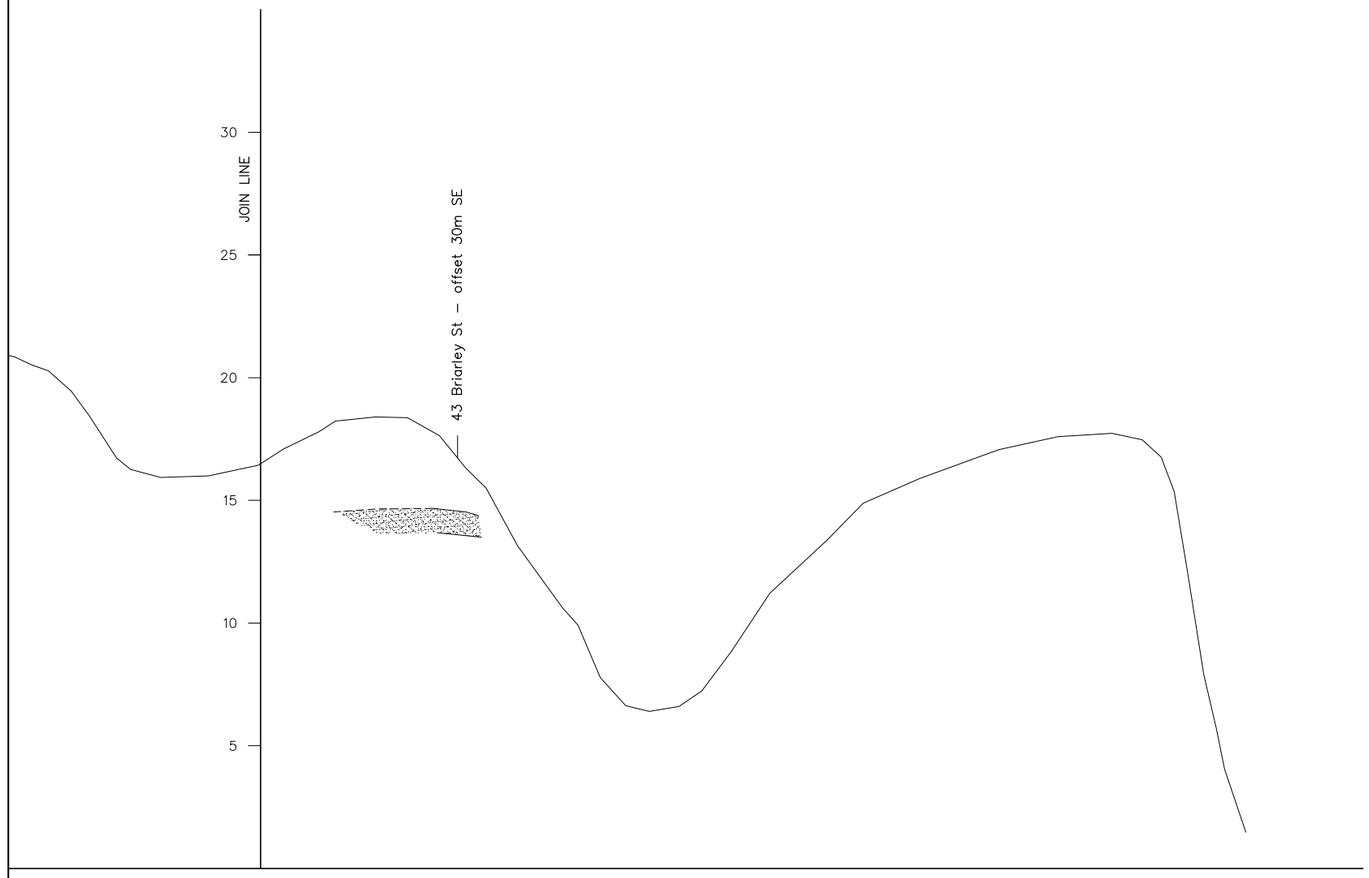
TAURANGA CITY COUNCIL

AVENUES/MATUA SOAK–HOLE STUDY
MID AVENUES

Geological Cross Section C – Sheet 1 of 2

FIG. No. Figure 10

REV. 0



SECTION C Fig8 GEOLOGICAL CROSS SECTION

CONTINUED FROM SHEET 1

VERTICAL SCALE 1:250

0 5 10 15 (m)

HORIZONTAL SCALE 1:2,500

0 50 100 150 (m)

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APPROVED		
CADFILE : \\8509 13–SectA–D.dwg		
SCALES (AT A3 SIZE)	AS SHOWN	
PROJECT No.	8509 13	

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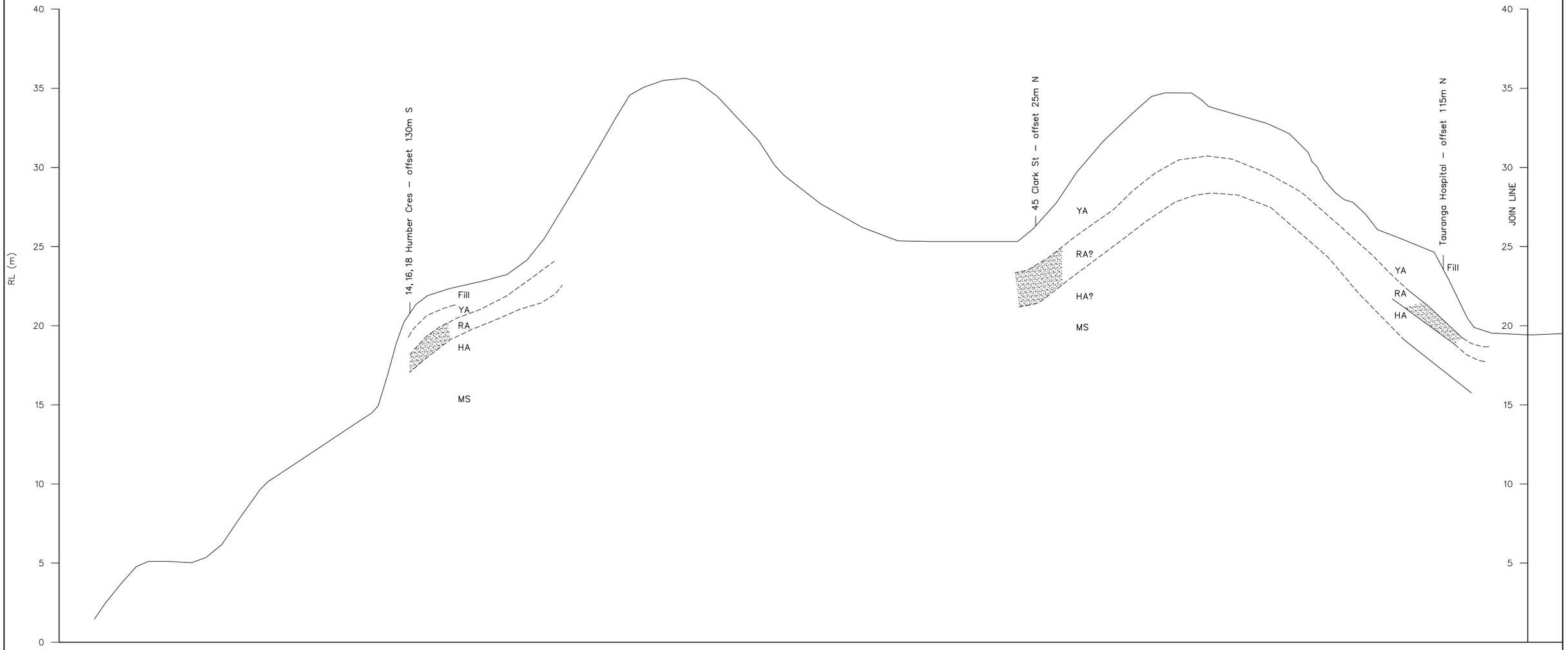
AVENUES/MATUA SOAK–HOLE STUDY
MID AVENUES

Geological Cross Section C – Sheet 2 of 2

FIG. No. Figure 10

REV. 0



SECTION D (Fig8) GEOLOGICAL CROSS SECTION

CONTINUED ON SHEET 2

VERTICAL SCALE 1: 250

0 5 10 15 (m)

HORIZONTAL SCALE 1: 2,500

0 50 100 150 (m)

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SCALES (AT A3 SIZE)	AS SHOWN	
PROJECT No.	8509 13	

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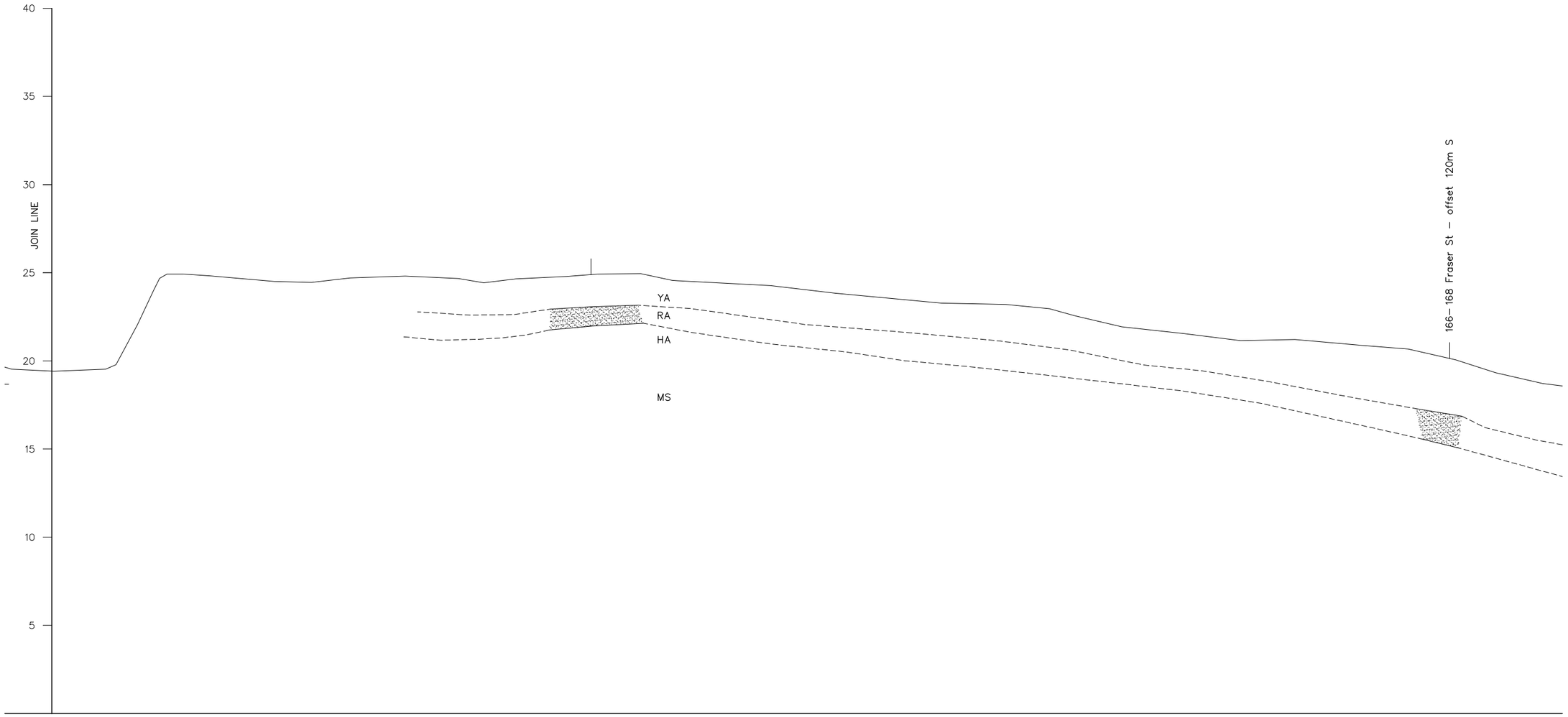
AVENUES/MATUA SOAK–HOLE STUDY
LATE AVENUES

Geological Cross Section D – Sheet 1 of 2

FIG. No. Figure 11

REV. 0



SECTION D (Fig8) GEOLOGICAL CROSS SECTION
CONTINUED FROM SHEET 1

VERTICAL SCALE 1: 250
0 5 10 15 (m)

HORIZONTAL SCALE 1: 2,500
0 50 100 150 (m)

P:\850913\WorkingMaterial\CAD\850913-SectA-D.dwg, Fig 11 (2), 10/10/2007 10:48:11 a.m., smbj, 1:1

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CADFILE : \\8509 13–SectA–D.dwg		
SCALES (AT A3 SIZE)	AS SHOWN	
PROJECT No.	8509 13	

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AVENUES/MATUA SOAK–HOLE STUDY
LATE AVENUES
Geological Cross Section D – Sheet 2 of 2

FIG. No. Figure 11
REV. 0