Appendix C: Ngaruawahia CMP Assessment

REPORT

Waikato District Council

Appendix C

Catchment Management Plan

Ngaruawahia Structure Plan Area

Tonkin & Taylor

ENVIRONMENTAL AND ENGINEERING CONSULTANTS

REPORT

Waikato District Council

Appendix C
Catchment Management Plan
Ngaruawahia Structure Plan Area

Report prepared for:

Waikato District Council

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1 Catchment description

1.1 Location

The Ngaruawahia Structure Plan Area (SPA) surrounds the central Waikato township of Ngaruawahia, located approximately 17 km northwest of Hamilton City. Ngaruawahia is located at the confluence of the Waipa and Waikato Rivers. The location of the Ngaruawahia SPA is presented in Figure 1. The SPA (red outline) covers approximately 780 ha. The structure plan area is bounded by the Hakarimata Ranges to the west, and by rural land to the north, east and south. The North Island Main Truck railway line runs through the centre of the structure plan area, following Great South Road through the centre of Ngaruawahia Township.

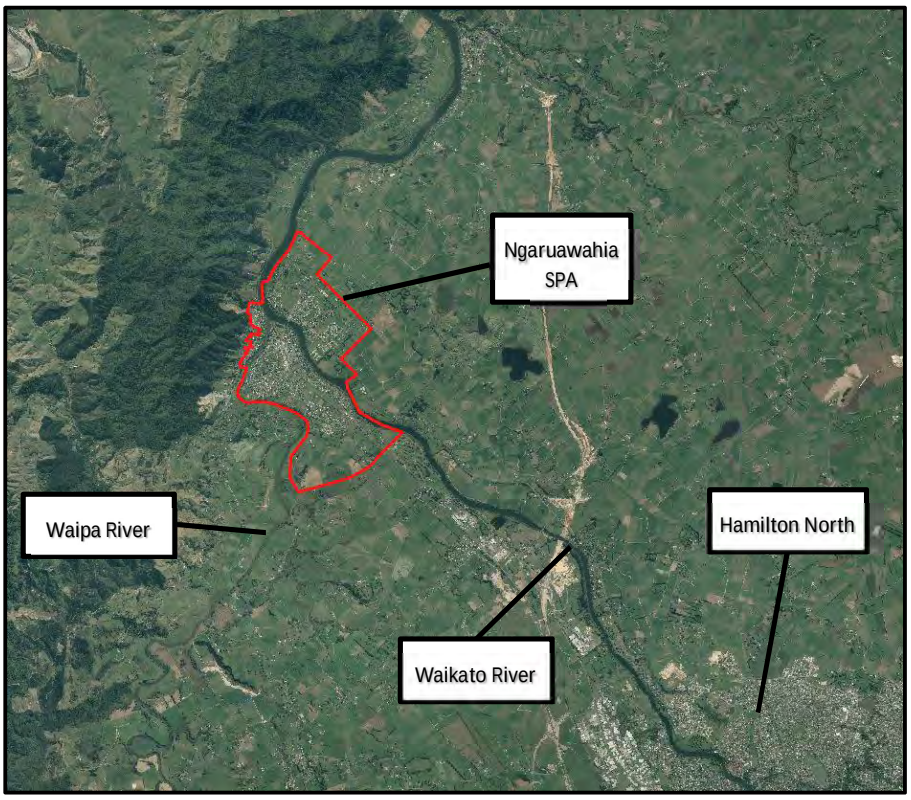

Figure 1. Ngaruawahia SPA (Image sourced from WDC)

1.2 Topography

The topography of the SPA is mainly flat and the area is dominated by the incised channels of the Waikato and Waipa Rivers. Near these features, the land generally slopes down gently to meet river levels. The southern part of the structure plan area is more undulating. Immediately beyond the western boundary lies the Hakarimata Ranges which rise steeply above the surrounding river terraces.

1.3 Geology and hydrogeology

The published geology of the area shows that the majority of the Ngaruawahia structure plan area is underlain alluvial and colluvial deposits of the Piako Subgroup (Edbrooke S. , 2005) as shown in the geological map below. The Ngaruawahia Township is underlain by the Hinuera Formation which comprises cross-bedded pumice sand, silt and gravel with interbedded peat. Along the river

channels, Taupo Formation pumice alluvium is present which comprises pumice sands and gravels. In the eastern part of the structure plan area, north of the Waikato River, swamp deposits consisting of soft, dark brown to black, organic-rich mud, muddy peat and woody peat are present.

The low hills in the southern part of the structure plan area are underlain by older Walton Subgroup deposits comprising pumiceous alluvium and colluvium dominated by primary and reworked, non-welded ignimbrite.

The SPA abuts the Hakarimata Range which comprise older greywacke rocks of the Newcastle Group.

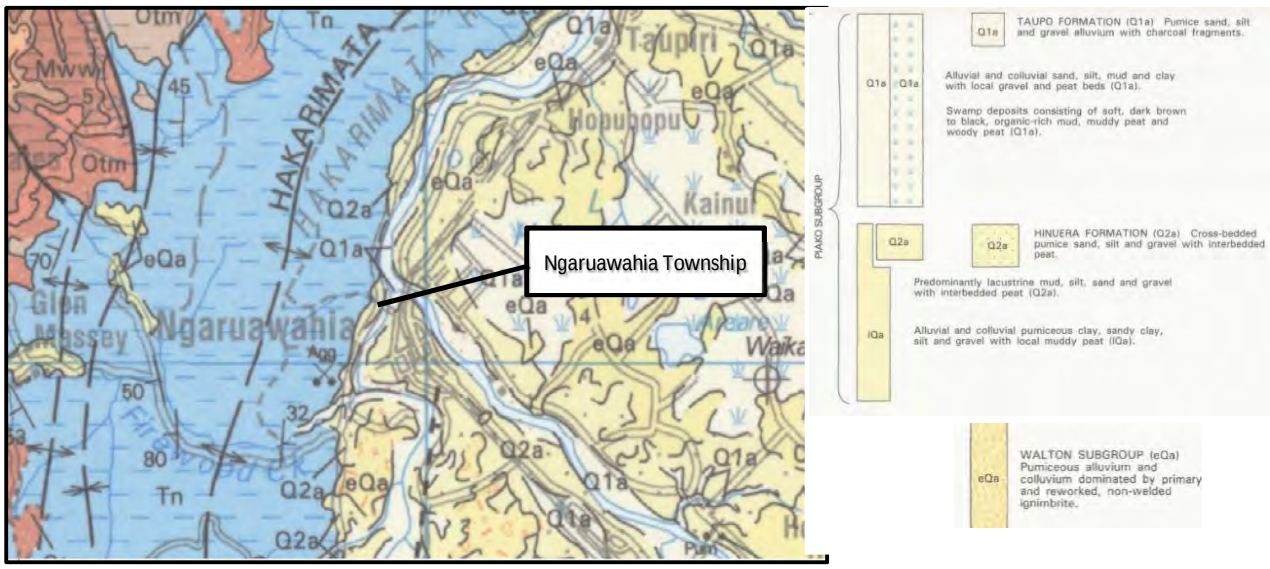

Figure 2. Geological map of Ngaruawahia structure plan area.

The hydrogeology of the Tauranga Group is characterised by a series of shallow unconfined and deeper semi-confined aquifers, which are variable in their horizontal and vertical distributions, and show varying degrees of connectivity with one another.

Groundwater is recharged from rainfall infiltration (and on the western side of the SPA some recharge from the Hakarimata Range) and a significant proportion of groundwater discharges to streams through the incised gullies. Marshall and Petch (1985) estimated that up to 85% of mean annual stream flow is sustained by groundwater discharges.

1.4 Watercourses

Two main watercourses dominate the existing Ngaruawahia Township and the SPA; the Waikato River and the Waipa River. The Mangaheka Stream is also a significant tributary stream within the southern SPA. The Mangarata Stream receives runoff from the Hakarimata Range to the west of the township but only 150m of the stream is actually within the SPA before is discharges into the Waipa River just upstream of the confluence with the Waikato. There are also multiple overland flow paths running through the Ngaruawahia SPA which feed into these water courses.

The rivers and streams are described in more detail and shown in Figure 3 below.

The Waipa River is the largest tributary of the Waikato River (Waikato Regional Council, 2014). The river generally follows the western side of the SPA. At approximately 71B Waingaro Road, the SPA extends west and encompasses the Waipa River until the river discharges to the Waikato

River. The catchment of the Waikato and Waipa Rivers is dominated by agricultural land uses, but also comprises multiple towns, villages and all manner of other land uses.

The Mangaheka Stream, located to the south of the SPA, drains mainly agricultural land and discharges into the Waipa River.

The Mangarata Stream, located to the west of the SPA, drain the Hakarimata ranges and discharges into the Waipa River, just upstream of the confluence of the Waipa and Waikato Rivers.

There are a number of tributaries within the Ngaruawahia SPA that feed into the above water courses. The unnamed tributaries generally drain residential and farmland, and can be seen in Figure 3.

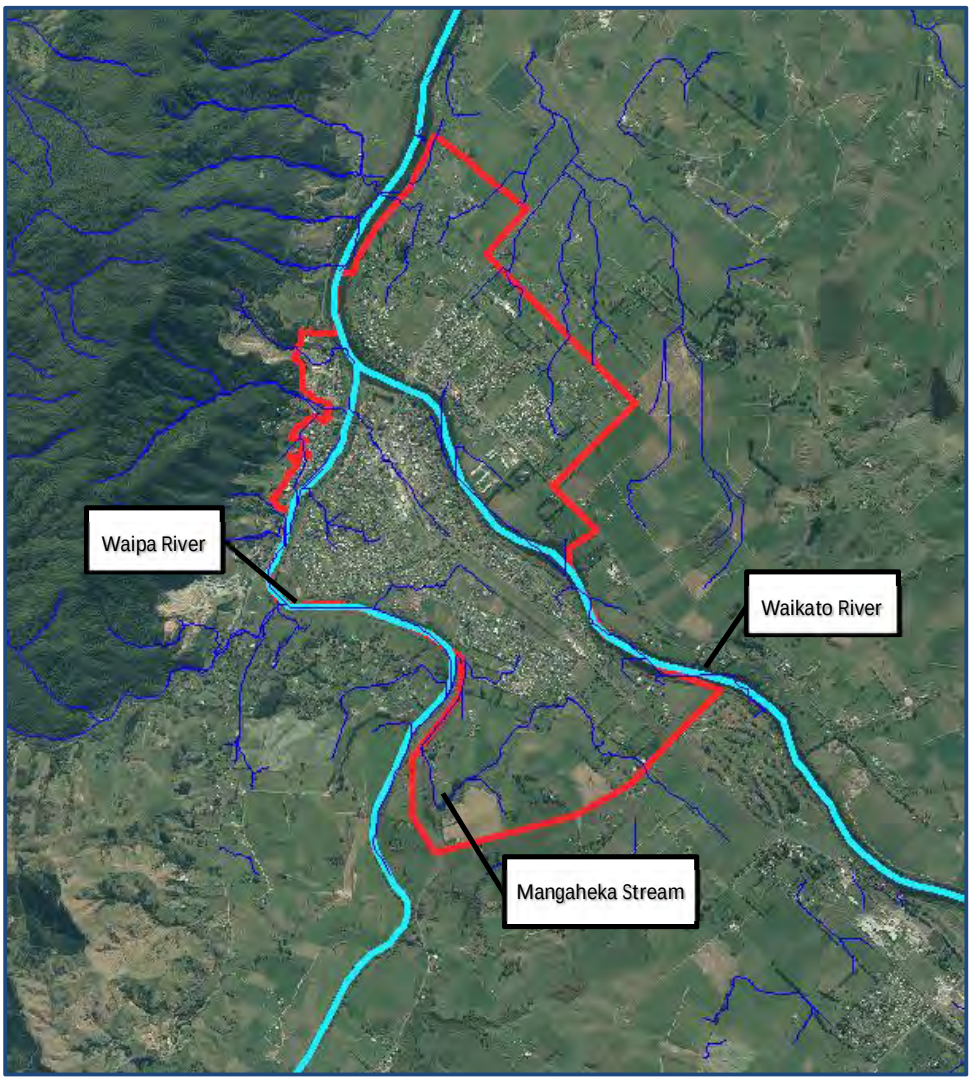

Figure 3. Main water courses (light blue) and tributaries (dark blue) surrounding the SPA.

1.5 Receiving environments

The identified surface water receiving environments within or adjacent to the Ngaruawahia SPA include:

- Waikato River.
- Waipa River.

- Mangaheka Stream.
- Mangarata Stream
- Unnamed tributaries of all of the above.

1.6 Existing WRC resource consents

1.6.1 General

WRC's online database has been used to broadly identify the types of resource consents held within the SPA and these are summarised in Table 1 below.

Table 1. WRC Resource Consents

Resource Consent Type	Number	Growth Sector
Discharge - Air	0	-
Discharge - Land	1	-
Discharge - Water	1	-
Land Use – Bore/Well	2	-
Land Use – Other	3	-
Water Take - Ground	1	F
Water Take - Surface	1	-
Water Take - Other	1	D

1.6.2 Comprehensive stormwater discharge consent

Waikato District Council holds Resource Consent No. 105645, being a Comprehensive Stormwater Discharge Consent (CSDC) associated with urban Ngaruawahia.

Relevant extracts from the resource consent are reproduced below:

Consent Type:	Discharge permit
Consent Subtype:	Discharge to land and water
Activity authorised:	Divert & discharge urban stormwater & associated contaminants at multiple locations to the Waikato River, Waipa River & land, & use discharge structures, within the vicinity of Ngaruawahia urban area
Consent Duration:	Granted for a period expiring on 22 September 2028

It is noted that the extent of the above consent (reticulated urban area of Ngaruawahia) is somewhat smaller than the extent of the SPA, with the SPA extending further north and south.

2 Land use in Ngaruawahia

2.1 Current land use

The land within the SPA is dominated by Ngaruawahia which includes residential, commercial and industrial land used. Agricultural land dominates the remainder of the SPA, beyond the current urban boundary. Other land uses currently occurring within the SPA include rural residential and limited horticultural land use. The North Island Main Trunk railway line runs through the centre of the SPA, following State Highway 1 through the centre of Ngaruawahia Township.

The main commercial/retail area of Ngaruawahia is located in the centre of the SPA, between State Highway 1 and the Waikato River. Established industrial areas are located to the west of the town centre, and further south, adjacent to the rail corridor. Residential areas make up the bulk of the Ngaruawahia urban area which surrounds the town centre, and extend to the western boundary of the SPA.

Outside of the township, the SPA is dominated by pastoral land with some rural residential development. Individual blocks of horticultural and industrial land use are present within the rural parts of the SPA.

Immediately west of the SPA, on the slopes of the Hakirimata Range, there is also hard rock (aggregate) quarry activities.

2.2 Future land use

Future growth within the SPA has been provided by WDC and is shown in Figure 4 below. The figure shows that the future land use is anticipated to be only residential zones.

For reporting purposes, the growth areas defined by WDC have been categorised into “Growth Sectors” D, E and F. These are also presented in Figure 4.

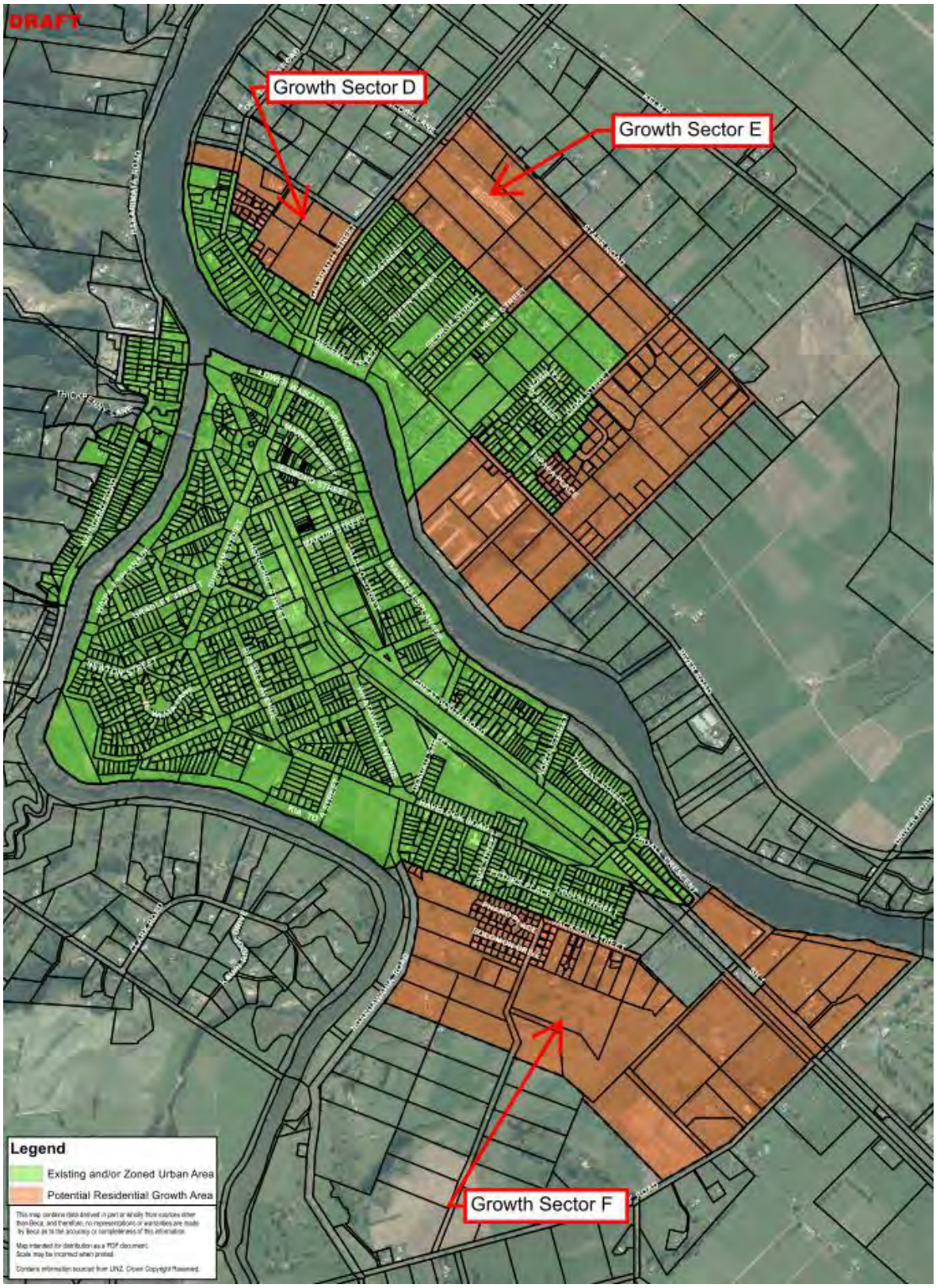

Figure 4. Ngaruawahia growth plan provided by WDC and Growth Sectors used for reporting.

3 Ecological review

This section presents the results of our review and assessment of the ecological status of stream resources in the Ngaruawahia SPA. The assessment is based on a review of existing ecological information with a brief site visit to publicly accessible parts of the SPA.

3.1 SPA overview

3.2 Assessment methods

There has been no ecological assessments of Ngaruawahia and its surrounds provided by Waikato District Council. Our assessment has reviewed the information available within national and regional ecological databases.

In addition, a site walk over of streams at publicly accessible locations was conducted by a T&T ecologist on 9 April 2014 to confirm levels of development, observe in stream structures, assess fish passage conditions and visually assess habitat condition. The sites assessed during the field assessment are shown on Figure 212 in Appendix CA.

3.3 Summary of existing ecological information

3.3.1 Waikato District Council Stormwater Management Plan (Tonkin & Taylor, 2009)

The 2009 SMP summarised the results of thirteen random samples of Ngaruawahia stormwater collected and analysed from several outlet points and several different storm events between 2000 and 2004. The report concluded that the stormwater quality was generally similar to average concentrations of contaminants in urban stormwater contained in published literature.

3.3.2 Operative District Plan

The Operative Waikato District Plan and associated maps were reviewed for any ecological features of note. The Ngaruawahia SPA is included on Planning Map 20 and 26. There was no ecological features of note within the Ngaruawahia SPA.

3.3.3 Waikato Regional Plan maps

Waikato Regional Plan (WRP) water management and stock exclusion maps were reviewed to check for any specific values that apply to SPA streams.

The Waikato and Waipa Rivers and unnamed streams draining the Hakarimata Range on the western side of the SPA are classified as Indigenous Fish Habitat Areas (Map S14). This classification is applied to significant habitats or areas that are characterised by high water quality.

The Waikato and Waipa Rivers are also designated as Trout Habitat and Contact Recreation.

Some reaches of the unnamed streams that are within the Hakarimata Range have also been classified as Natural State and Priority 1 Stock Exclusion areas (Stock Exclusion Map 4)

All permanent watercourses within the area are classified as Waikato Surface Water (Map S14) and will be subject to the relevant standards in Section 3.2 of the WRP in regard to discharges of contaminants.

3.4 T&T's 2014 field assessment

A site inspection of publicly accessible locations on the unnamed tributaries within the SPA was conducted on 9 April, 2014. Locations inspected are shown on Figure 212 in Appendix CA.

Observations from site inspections concluded that streams were in range of conditions based on catchment size and land use.

The unnamed streams that drain the Hakarimata Range were typically of high quality due to the high percentage of native vegetation cover. The lower reaches of theses streams had been negatively affected by development due to a reduction in riparian cover allowing excessive macrophyte growth. Instream habitat was generally run type habitat with small sections of shallow pools or riffles. Barriers to upstream fish passage were identified under the Waingaro Rd and Hakarimata Rd. These consisted of perched culverts, it is likely that the migration of fish species will be impeded by these culverts under normal flow conditions. At times where water level within the Waikato River are high these culverts may become passable.

Streams draining the central urban area were intermittent and had no flow on the day of the site visit. Streams within the area were highly modified with large sections culverted or have undergone channel straightening. Perched culverts or flood protection devices restricted upstream fish passage.

The watercourses to the east of Waikato River, including growth areas D and E, have been modified into farm and roadside drains that have little ecological value. These watercourses are intermittent/ephemeral and were dry at the time of site inspection.

The Mangaheka Stream to the south of the Ngaruawahia SPA, within growth area F, is a permanent stream that has undergone significant modification. Large sections of the stream channel have been straightened (presumably to increase drainage capacity) reducing the availability of some habitat types. There was excessive macrophyte and periphyton growth within the lower stream reaches. The likely factors contributing to excessive macrophyte growth are the lack of significant areas of riparian vegetation providing shade to the stream channel and the presence of nutrients in the stream due to the agricultural land use in the upper catchment. In-stream habitat at the sites inspected was generally limited to slow moving runs and pools with undercut banks, root mats and overhanging vegetation present at limited locations. There was also lack of large woody debris providing hard substrate habitat for macroinvertebrate species. Upstream from Ngaruawahia Rd there is a large area of wetland that is possible habitat for the At Risk black mudfish (*Neochanna apoda*) (Goodman et al, 2014). Perched culverts under Ngaruawahia Rd and Saulbery Rd were identified as barriers to upstream fish passage. It is likely that migration of non-climbing fish species such as inanga, would be impeded by these barriers. It is noted that lampery (*Geotria australis*) are present with in SPA and are classified as nationally vulnerable (Goodman et al, 2014).

4 Ecological assessment

4.1 Introduction

This section provides an assessment of the potential effects of development of the Ngaruawahia SPA on surface water resources. The assessment has considered the general issues outlined within Section 2 of the main report. This section provides an assessment of the significance of these issues for each of the growth areas identified by WDC.

4.2 Assessment of effects

The main ecological issues associated with future urban development in the SPA are described in Section 2 of the main report. The significance of proposed development to a range of issues for each growth area is presented in Table 2.

For the Ngaruawahia SPA, zero and first order streams are located within growth areas and therefore are considered to be more vulnerable to effects of development on hydrological issues.

Table 2. Significance of potential adverse effects from proposed development

Growth Sector / Issue	D - Low density residential	E - Low density residential	F - Low density residential
Stormwater			
Contaminants[1]	Low	Low	Low
Increase in peak flows leading to stream bed/bank erosion	Low	Low	Low
Hydrological			
Reductions in base flow[2]	Low	Low	Low
Reduction in flow variability leading to reduced habitat quality	Low	Low	Low to Medium
Habitat			
Culverting or infilling of perennial streams reducing habitat	Low	Low	Low to medium
Protection of riparian margins[3]	Low	Low	Low to medium
Barriers to fish movement	Low	Low	Low
Overall potential adverse effect on surface water	Low	Low	Low to Medium

5 Flooding assessment

5.1 Introduction

A ponding map of the Ngaruawahia SPA has been produced. The purpose of the ponding map is to determine the areas which may be inundated if no pipe network is available. The ponding map is a valuable tool to provide an indication of where potential flooding hazards may occur and where future modelling efforts should be concentrated. This approach assumes that the reticulated network (pipes, culverts and catchpits) are blocked but does include rainfall-runoff analysis.

5.2 Methodology

To create the ponding maps, a GIS tool has been used to infill and map all topographic depressions based on the LiDAR survey provided. We note that LiDAR provided was collected in 2007 and 2008 so is considered somewhat out of date. The mapped depressions represent all areas where stormwater could *potentially* pond.

A key issue is that the mapping does not allow for culverts or other sub-surface drainage features which could convey stormwater and reduce or eliminate ponding. Overall the largest ponding areas are generally caused by road embankments, bridges or culverts.

From the ponding maps, critical areas have been identified and a field assessment has been undertaken to identify sub-surface drainage features that could significantly affect the ponding areas shown.

The key culverts that may influence the ponding areas have been identified on Figures 202-204 in Appendix CA and also in Table 3.

5.3 Information provided by WDC

5.3.1 Waterway and reticulated assets

WDC did not provide any information on any bridges or significant culverts within the catchment.

Some stormwater reticulation data was provided but in general layout information only was provided and infrastructure elements such as pipe sizes, lengths, and invert levels were generally not provided. It is also noted that road culverts were generally not shown on the stormwater asset layer provided and we understand that culvert information may be available on WDC's RAMM database but these were not available at the time of this assessment.

The stormwater network in Ngaruawahia consists of a network of pipes and open drains which discharge stormwater into either the Waipa or Waikato Rivers. There are an estimated 33 stormwater outlets from Ngaruawahia Township.

A visual inspection of several outlet structures was undertaken in 2009 by T&T and showed that many of the 33 stormwater outlets are small pipe outlets (<300mm diameter) discharging above the river level. Discharges from larger outlets commonly flow over riprap or concrete erosion protection structures before entering the river. Some steeper sections of the reticulated network are fitted with energy dissipaters to reduce the risk of scour at the outlet. Some flap gates have been installed in flood prone areas to prevent upstream flooding in the catchments. Most entry points to the stormwater network are fitted with catchpits for the removal of litter and sediments.

5.3.2 Buildings

WDC provided building footprints within the Waikato but no information on any floor levels.

5.3.3 Drainage operational issues

No drainage issues or flood reports were noted or provided by WDC.

The town is located within the Lower Waikato Waipa Control Scheme, Section B (Waikato River Channel) and Section C (Waipa River Channel) administered by Waikato Regional Council.

5.3.4 Waikato and Waipa River flooding, 2009.

T&T has liaised with WRC to obtain flood model data for the Waikato and Waipa Rivers.

Waikato River 1D flood model (MIKE 11) cross sections including 1% AEP (with no climate change) flood levels from the Karapiro Dam to Port Waikato were available as well as an interpolated 2D flood extent.

Only 2D interpolated flood levels for the Waipa River (1% AEP with no climate change) were available.

The interpolated 2D extent of 1% AEP flooding for both rivers was undertaken by WRC by interpolating the 2009 MIKE 11 1D models on to a LiDAR derived topography using WaterRide Software.

The WRC cross sections indicate that the Waikato River 1% AEP (with no climate change) flood level ranges from approximately 14.0 m RL to 14.6 m RL within the Ngaruawahia SPA.

The WRC flood extents indicate that the Waipa River 1% AEP (with no climate change) flood level ranges from approximately 15.0 m RL to 14.3 m RL within the Ngaruawahia SPA.

The interpolated 1% AEP river flood extents (with no allowance for climate change) are presented in Figures 202 to 204 in Appendix CA.

5.4 Reporting

For reporting purposes, each area of potential growth has been broken up into “Growth Sectors”. Within the Ngaruawahia SPA, there are three Growth Sectors – D, E and F. The locations of the Growth Sectors are shown in Figure 4 above and Figures 202 to 204 in Appendix CA. All three Growth Sectors contain only proposed residential land.

Growth Sector D is the smallest of the three, with an approximate area of 14.3 ha. It is bound by the Waikato River to the west and SH1 to the east. The current land use in Growth Sector D appears to be primarily farmland.

Growth Sector E has an approximate area of 91 ha. The general land use of Growth Sector E appears to be industrial, rural residential and farmland. Growth sector E is located northeast of the Waikato River and has what appear to be overland flow paths/minor tributaries feeding the river.

Growth Sector F is the southernmost sector within the SPA, and has an approximate area of 98 ha. It is bound by the Waipa River to the west, the Waikato River to the east, existing residential land to the north and farmland to the south. Growth Sector F appears to consist of mainly farmland, with a small area of existing residential.

5.5 Results

The results from the ponding assessment are presented in Figures 202 to 204 in Appendix CA. The ponding assessment entails a high level overview of the model provided in these figures and reviews the feasibility of the proposed residential area.

Flooding of each Growth Sector has been reviewed separately in the following sections. The areas within the SPA but outside of the proposed growth areas have not been considered as they are existing and not anticipated to change.

5.5.1.1 Growth Sector D

Generally, Growth Sector D appears to have relatively low extent of significant ponding. Figure 202 in Appendix CA shows localised areas of ponding only, scattered throughout the Growth Sector.

The 1% AEP flood extent of the Waikato River slightly encroaches on the western edge of the growth sector. The edge of the Growth Sector may need to be slightly adjusted to account for this.

There appears to be an overland flow path through the middle of the Growth Sector which runs north and is conveyed under Old Taupiri Road through a culvert (cNGA100). A site visit was undertaken in Ngaruawahia which found this culvert to be a 750 mm diameter culvert.

To the south of Growth Sector D there is known to be a 300 mm diameter culvert (cNGA101) which discharges to the Waikato River.

It is also important to note that if Growth Sector D is developed, the area will become more impermeable and result in greater runoff flows to both cNGA100 and cNGA101.

No assessment has been undertaken on whether or not these culverts have sufficient capacity as there was no available information about the upstream or downstream invert levels of the pipes.

5.5.1.2 Growth Sector E

There are three unnamed tributaries running through Growth Sector E, which result in significant extensive ponding as shown in Figure 202-204 in Appendix CA. Approximately 20% of the area is covered by ponding greater than 0.1 m deep. Development within this areas may be significantly constrained.

The overland flow path (ofpNGA01), presented in Figure 202 in Appendix CA runs parallel with Great South Road to the north. There is extensive ponding (greater than 0.3 m deep) at the property on the corner of Starr Road and Great South Road. This appears to be mainly confined to farmland.

There is a culvert (cNGA 102) conveying the tributary under Starr Road which was seen at the site inspection. The size of the culvert was not able to be measured. The culvert was seen to be half filled with debris.

An overland flow path (ofpNGA02) presented in Figure 202 runs parallel with ofpNGA01. There is extensive flooding around the flow path on the southern side of Starr Road. The flood map shows that three existing buildings are affected by the flooding of this flow path, with flood depths between 0.1 m and 0.3 m.

There is also a culvert (cNGA103) conveying this tributary under Starr Road. Similar to cNGA102, the size was unable to be determined and the culvert was half filled with debris.

At the Starr Road/Duke Street intersection, there are two culverts (cNGA104 & cNGA105) which have been estimated to have a 300 mm diameter. The culverts convey an overland flow path under Duke Street and then Starr Road. The flooding map shows that two existing buildings are at risk of flooding if either culvert is under capacity to take the 1% AEP rainfall event.

There is potential flooding (see Figure 203 in Appendix CA) to the southeast of Herangi Crescent, which appears to affect one existing building. The majority of the flooding currently appears to be contained within farmland.

Culvert cNGA106 was identified during the site visit to the south of Growth Sector E. The flooding map shows flooding greater than 0.3 m around the culvert. It appears to be in poor condition, with branches covering the entrance and one end of the culvert broken.

No assessment has been undertaken on whether or not these culverts or the stormwater network at Herangi Crescent have sufficient capacity as there was insufficient asset information available.

The south of Growth Sector E is bounded by the Waikato River. The 1% AEP flood extent of the Waikato River encroaches into growth sector E covering approximately 14 ha and would constrain growth in the area. We note that this flooding affects approximately six existing buildings. The edge of the Growth Sector may need to be adjusted to account for this flooding.

5.5.1.3 Growth Sector F

Overland flowpath (ofpNGA03) flows through the middle of Growth Sector F and feeds into the Mangaheke Stream. In a 1% AEP storm, the Waipa River flood extent backs up this flow path into Growth Sector F. The flood extent appears not to affect any existing buildings.

The west of Growth Sector F is bordered by the Waipa River. Some of the northern border of Growth Sector follows the Waikato River. The interpolated 1% AEP flood extents show that that the rivers encroach into Growth Sector F at both of these locations and may constrain development of these areas.

Throughout Growth Sector F, there are areas of flooding greater than 0.3 m depth. Some of these areas appear to be caused by road embankments, and some appear to be natural low points. The flooding is mainly contained within farmland, except for one existing building. If Growth Sector F is to be developed into residential area, the natural low points and the overland flow path running through it will need to be considered.

5.5.1.4 Infrastructure

Table 3 below summarises the existing critical infrastructure within the Ngaruawahia SPA which is considered a potential restriction on the flow of major overland flow paths, watercourses or streams. Refer to Figure 202 to 204 in Appendix CA which shows the locations of these restrictions. The ponding map was used to determine which infrastructure assets were considered ‘restrictions’. WDC have provided stormwater asset details but unfortunately this did not include the majority of culverts identified as constrictions.

Table 3. Summary of critical infrastructure

Infrastructure ID	Length (m)	Diameter (mm)	IL's – US/DS	Capacity check required?	Other notes
cNGA100	No data	750	No data	Yes	
cNGA101	No data	300	No data	Yes	
cNGA102	No data	No data	No data	Yes	Half filled with debris
cNGA103	No data	No data	No data	Yes	Half filled with debris
cNGA104	No data	300	No data	Yes	
cNGA105	No data	300	No data	Yes	
cNGA106	No data	No data	No data	Yes	Culvert covered in branches and broken at one end

5.6 Summary of flooding issues

This section provides an assessment of the potential effects of flooding on the Ngaruawahia SPA. The assessment includes an evaluation of potential ponding areas on future residential development, and on the capacity of infrastructure critical to managing flood hazard within the SPA.

A summary evaluation of the issues is presented in Table 4.

In this table we have made the following assumptions on the constraint that potential ponding might pose to development in each growth sector:

- Low constraint to development have been categorised as Growth Sectors with large areas not affected by flooding, and overall no significant flood mitigation required.
- Medium and high constraints to development would probably need to be managed through land use policies, and/or rules in the District Plan, or modifications to the Development Manual.
- For critical infrastructure, those structures that are unable to pass the 1% AEP (peak flow) without heading up to above road crown level would likely pose a significant constraint to development.

Table 4. Summary of flooding issues

Flooding Assessment	Growth Sector D - Residential	Growth Sector E - Residential	Growth Sector F - Residential
Existing buildings affected by ponding?	Yes	Yes	Yes
Existing potentially critical infrastructure	cNGA100 cNGA101	cNGA102 cNGA103 cNGA104 cNGA105 cNGA106	-
Overall constraint[1]	Low	Medium	Low

1. Based on area affected by ponding and ability of the land use type to avoid or mitigate the adverse effects of flood hazards on the built environment.

5.7 Information gaps

Through our review of available information and our assessment of issues and constraints we have identified the following information gaps:

- Information about existing culvert levels, diameters, lengths and materials. This information would be useful in verifying the capacity of existing culverts that are of concern and is essential for more detailed modelling efforts.
- Existing building floor levels to clarify potential flood vulnerability.
- More detailed information on future growth areas including road layout and waterway crossings.

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7 Applicability

This report has been prepared for the benefit of Waikato District 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

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
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BMQ

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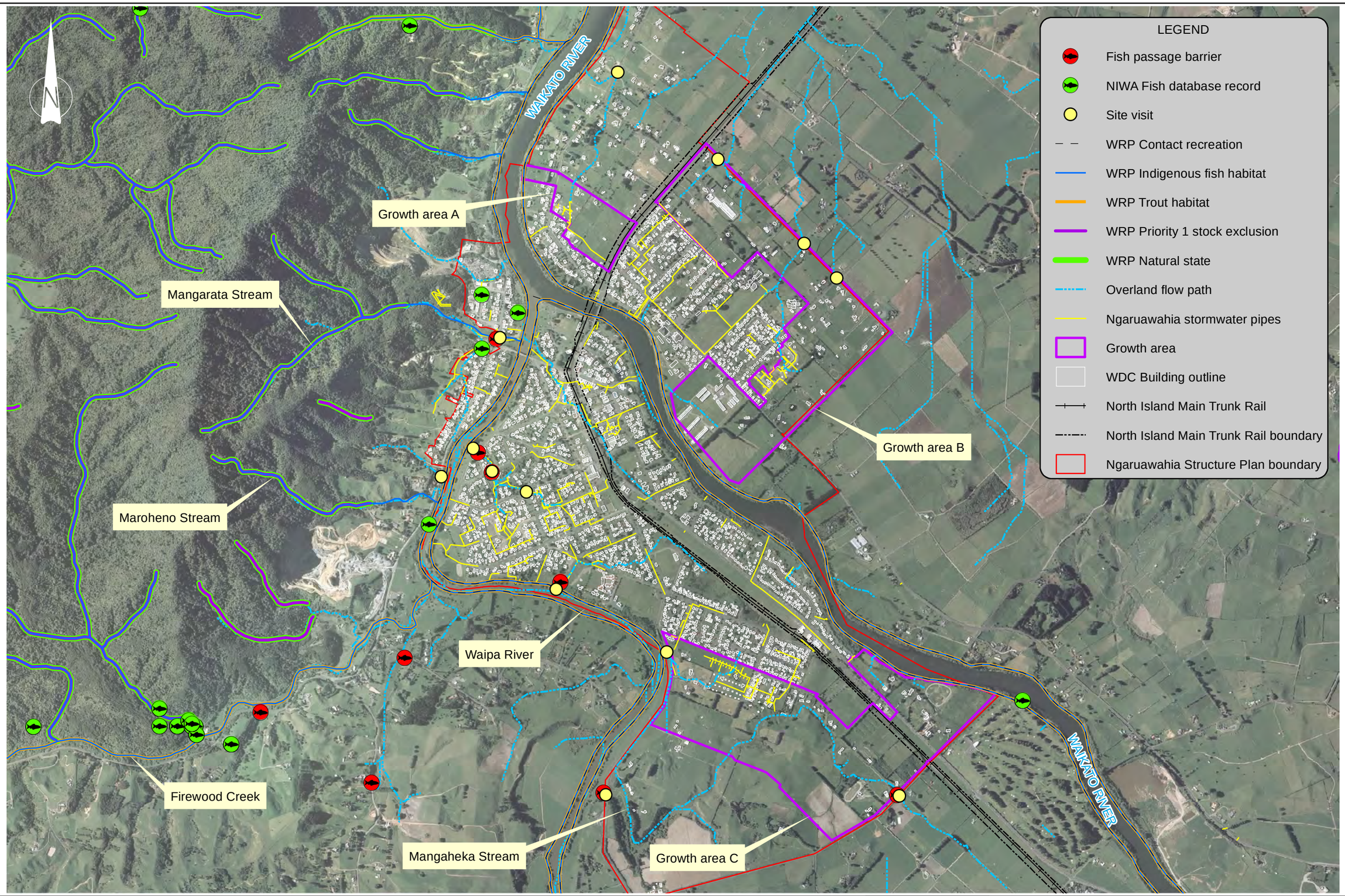
Appendix CA: Figures

- **Figure 212 Ecological Map**
- **Figures 202 to 204 Flooding Maps Sheets 1 to 3**



Notes: Aerial photograph Supplied by Waikato District Council.

A3 SCALE 1:20,000

0 200 400 600 800 1,000 Meters

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DRAWN	DWM	Aug.14
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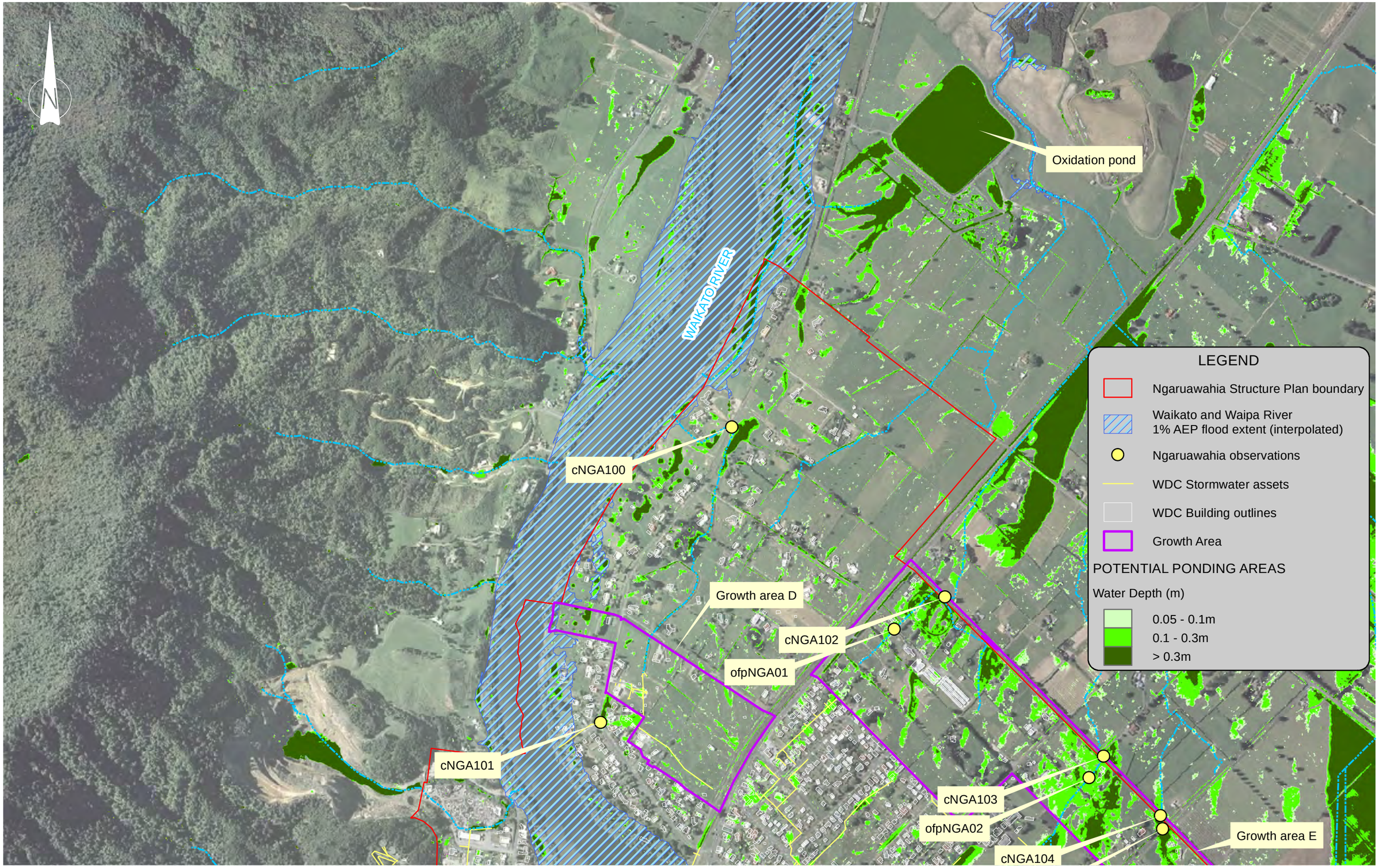
ARCFILE 61814.200-F212.mxd		
SCALE (AT A3 SIZE) 1:20,000		
PROJECT No. 61814.200		

WAIKATO DISTRICT COUNCIL
CATCHMENT MANAGEMENT PLAN
NGARUAWAHIA STRUCTURE PLAN AREA
Ecological Map

FIGURE No. Figure 212

Rev. 0

Path: P:\61814\61814.2000\WorkingMaterial\GIS\61814.200-F212.mxd Date: 11/08/2014 Time: 12:39:17 p.m.



Notes: Aerial photograph supplire by Waikato Regional Council.

A3 SCALE 1:10,000

0 100 200 300 400 500 Meters

Location Plan

1 2 3

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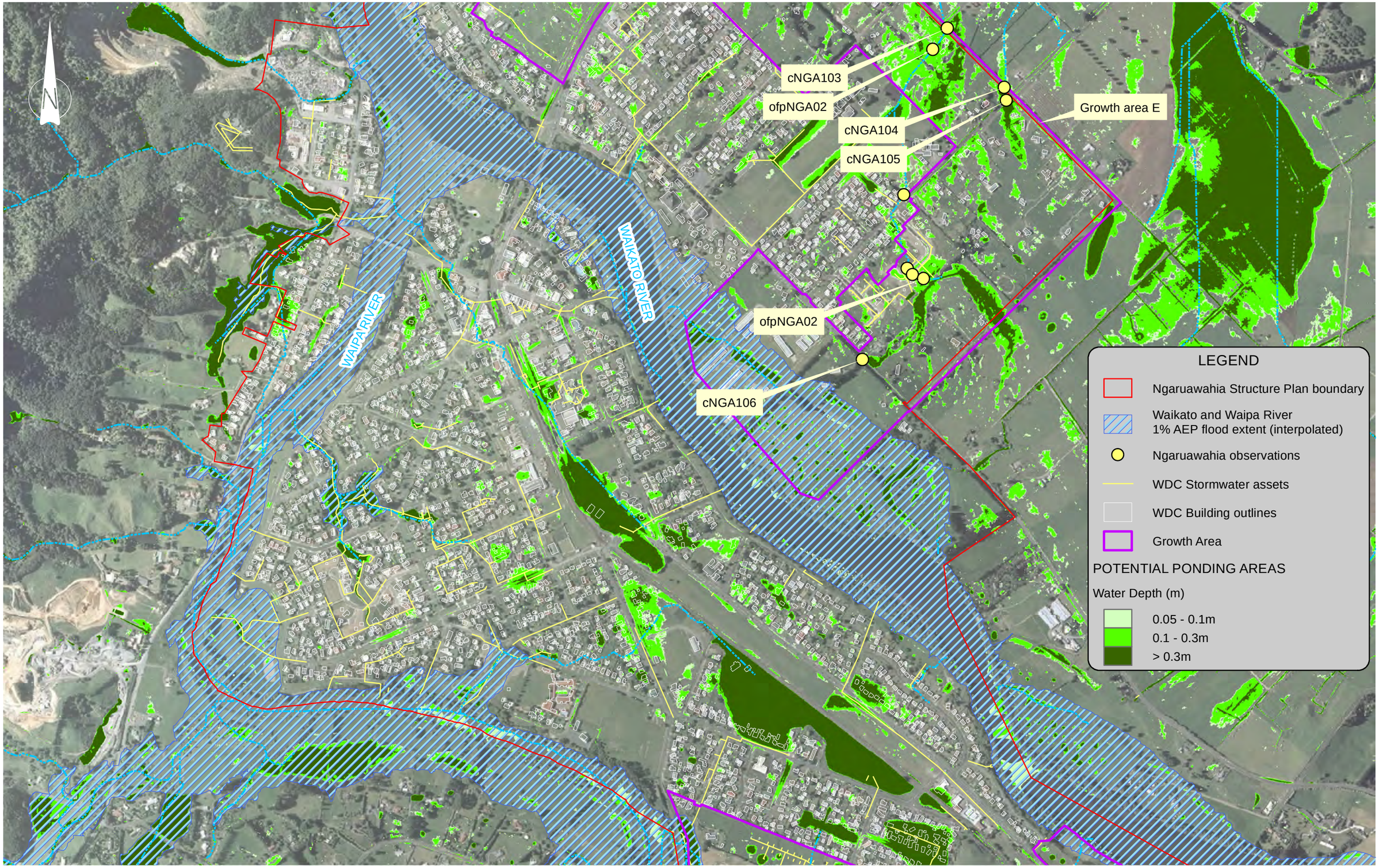
ARCFILE 61814.200-F202_204.mxd		
SCALE (AT A3 SIZE) 1:10,000		
PROJECT No. 61814.200		

WAIKATO DISTRICT COUNCIL
CATCHMENT MANAGEMENT PLAN
NGARUAWAHIA STRUCTURE PLAN AREA
Flooding Map - Sheet 1 of 3

FIGURE No. Figure 202

Rev. 0

Path: P:\61814\61814.2000\WorkingMaterial\GIS\61814.200-F202_204.mxd Date: 11/08/2014 Time: 12:03:34 p.m.

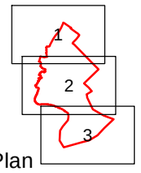


Notes: Aerial photograph supplire by Waikato Regional Council.

A3 SCALE 1:10,000

0 100 200 300 400 500 Meters

Location Plan



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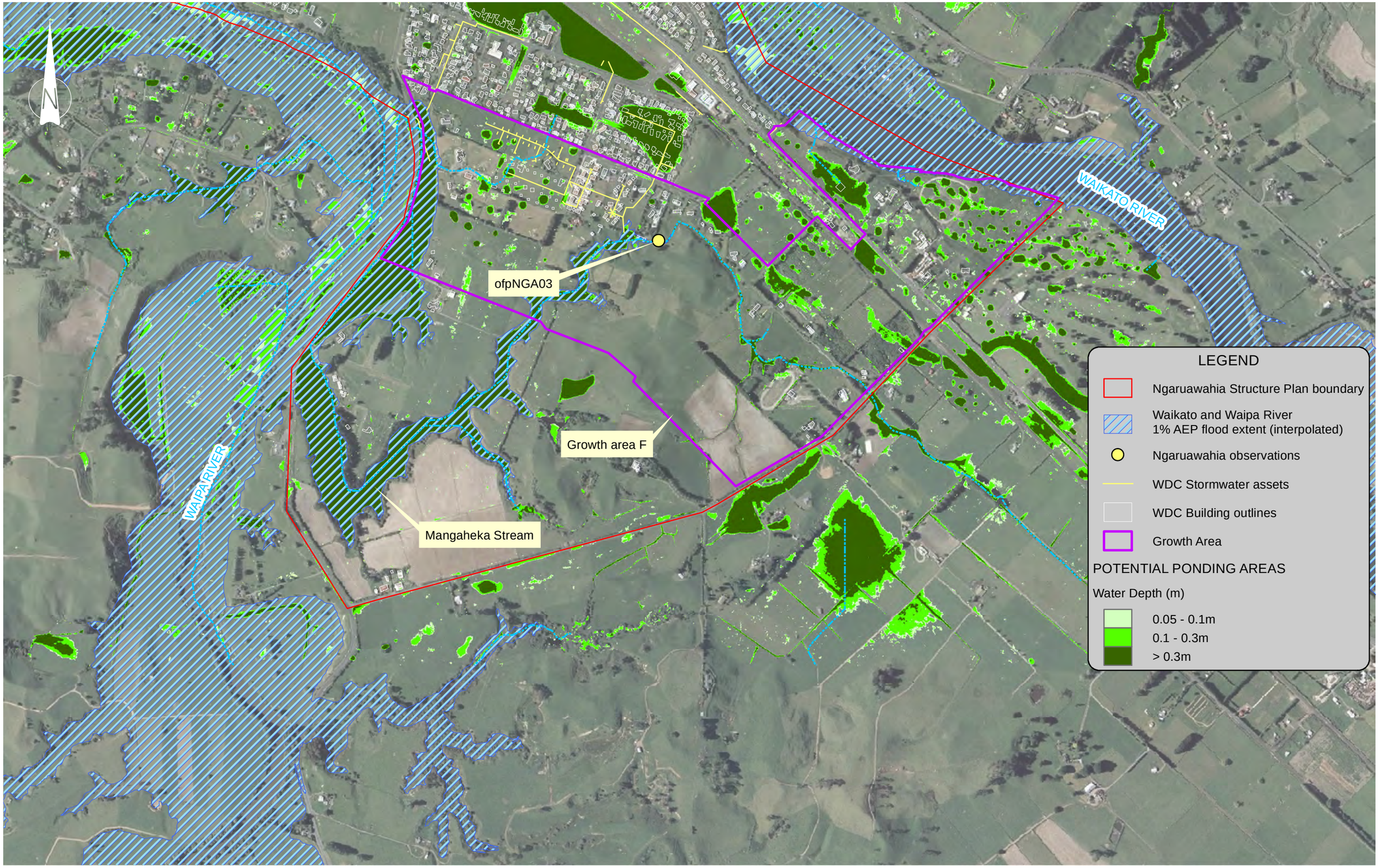
DRAWN	DWM	Aug.14
CHECKED	PRC	8/14
APPROVED	BMQ	8/14
ARCFILE 61814.200-F202_204.mxd		
SCALE (AT A3 SIZE) 1:10,000		
PROJECT No. 61814.200		

WAIKATO DISTRICT COUNCIL
CATCHMENT MANAGEMENT PLAN
NGARUAWAHIA STRUCTURE PLAN AREA
Flooding Map - Sheet 2 of 3

FIGURE No. Figure 203

Rev. 0

Path: P:\61814\61814.2000\WorkingMaterial\GIS\61814.200-F202_204.mxd Date: 11/08/2014 Time: 12:03:37 p.m.

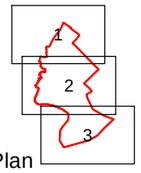


Notes: Aerial photograph supplire by Waikato Regional Council.

A3 SCALE 1:10,000

0 100 200 300 400 500 Meters

Location Plan



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DRAWN	DWM	Aug.14
CHECKED	PMC	8/14
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ARCFILE 61814.200-F202_204.mxd		
SCALE (AT A3 SIZE) 1:10,000		
PROJECT No. 61814.200		

WAIKATO DISTRICT COUNCIL
CATCHMENT MANAGEMENT PLAN
NGARUAWAHIA STRUCTURE PLAN AREA
Flooding Map - Sheet 3 of 3

FIGURE No. Figure 204

Rev. 0

Path: P:\61814\61814.2000\WorkingMaterial\GIS\61814.200-F202_204.mxd Date: 11/08/2014 Time: 12:03:40 p.m.