Appendix 3: Stakeholder Standards

Includes:

1. Summary of KiwiRail stormwater standards from the WRRP project
2. Memo re: *Interpretation of stakeholders' stormwater standards*

TRACK AND CIVIL DESIGN PARAMETERS SUMMARY				
Parameter	Desirable	Absolute	Source	Comment
Drainage Design life	50 years		ONTRACK DRAFT Drainage Design Guidelines January 2008	
Lateral Drainage	3% cross fall		ONTRACK DRAFT Drainage Design Guidelines January 2008	Cross stormwater only required to percolate through ballast of one set of tracks.
Stormwater outside of Rail Corridor				
Primary Systems	20% AEP or 1 in 5 year return with no surcharging		ONTRACK DRAFT Drainage Design Guidelines January 2008	Unless KCDC require higher levels of service.
Secondary Systems	1% AEP or 1:100 year return		ONTRACK DRAFT Drainage Design Guidelines January 2008	If flow is piped, KCDC approval is required **
Building	No inundation for 1% AEP		ONTRACK DRAFT Drainage Design Guidelines January 2008	
Stormwater inside of Rail Corridor				
Primary Systems	10% AEP or 1:10 year return with no surcharging		ONTRACK DRAFT Drainage Design Guidelines January 2008	Unless KCDC require higher levels of service.
Secondary Systems	1% AEP or 1:100 year return		ONTRACK DRAFT Drainage Design Guidelines January 2008	Piped flow only if no viable alternative.**
Longitudinal (outside underground)	1% AEP or 1:100 year return with minimum 300mm freeboard from rail track Match existing if already present.		ONTRACK DRAFT Drainage Design Guidelines January 2008	To be swale drains with catchpits or turnouts as appropriate. Swales to have side slopes < 1.5h:1.0v and may be flatter where insitu soil dictates**
Longitudinal (underground)	1% AEP or 1:100 year return with minimum 600mm freeboard from rail track - Match existing if already present.		ONTRACK DRAFT Drainage Design Guidelines January 2008	Unless KCDC requirements are more onerous.**
Manholes	60m centres		ONTRACK DRAFT Drainage Design Guidelines January 2008	At all changes in grade, horizontal alignment or max crs 60m
Cross Stormwater	10% AEP or 1:10 year return with no surcharging and 1% AEP with min 600mm freeboard to rail tracks		ONTRACK DRAFT Drainage Design Guidelines January 2008	Match existing waterways if in close proximity

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TO	Warren Bird
COPY	
FROM	Richard Coles
DATE	22 July 2011
FILE	5-C1814.00 – PP2O - Stormwater
SUBJECT	Interpretation of stakeholders' stormwater standards

1 Stakeholders stormwater standards

There is no definitive and universally accepted document that encompasses the design standards for all aspects of stormwater design. As such we have collated the various stakeholders' requirements from a range of documents and then carried out interpretation as required. This process is captured below.

2 Conclusion

2.1 Peak flow attenuation

We conclude that the NZTA SWTS document, does not require peak flow attenuation in this situation. However KCDC does require attenuation upto and including the 1% AEP rainfall event.

2.2 Channel erosion control

We conclude that NZTA requires channel erosion control for project sections discharging in to the Major Waitohu and Awatea catchments (the Waitohu catchment includes the Te Manuao and the Mangapouri catchments). KCDC does not have this requirement.

3 High level summary of stakeholders stormwater standards

We have collated the main stormwater standards from NZTA, the Councils (GWRC and KCDC) and KiwiRail. These standards are summarised in Table 1 below.

Table 1 – Stakeholder's Stormwater Standards

	KCDC (from documents)	KCDC (from consultation)	NZTA	GWRC	KiwiRail
Primary drainage	10% AEP[1]	No further comment	20% AEP to edge of trafficked lane[2] 10% AEP catchpit and pipe capacity	Not specified	10% AEP with no surcharging[3]
Secondary drainage	1% AEP[1]	No further comment	2% AEP, with no more than 100mm depth on road [2]	Not specified	1% AEP with minimum 300mm freeboard from rail track[3]
Attenuation - (Storm peak discharge control)	10% AEP: no increase in flows or less than minor adverse efects[1]	either provide attenuation to pre-development level or establish a case that effects are no more than minor	1%AEP limited to 80% of predevelopment flow (where existing downstream problems exist)[4] 50% and 10% AEP flows to match pre development flows[4]	Not specified	Not specified
Stream channel erosion control	Not specified	No further comment	Three different approaches considering 50% AEP flows[4]: • Check the 50% AEP stream velocities to ensure that velocities are non-erosive • Implement extended detention or volume control • Conduct a shear stress analysis for a specific site NB: only applies where catchment imperviousness is expected to exceed 3% (including future foreseeable development) [4]	Not specified	Not specified
Treatment of road runoff	Best Practicable Option (BPO) approach [1 & 5]	KCDC are reviewing NZTA Stormwater Standard	Best Practicable Option (BPO) aproach[4]. Treat all new impermeable surfaces (or equivalent area).	Not specified	Not specified
Waterway crossings (at culverts)	10% AEP typically but 1% if appropriate (to be assessed on case by case basis) [1]	Existing level of service not to be reduced.	1% AEP, with 500mm freeboard[6]	Not specified	10% AEP or 1:10 year return with no surcharging and 1% AEP with min 600mm freeboard to rail tracks[3]
Climate change	Best practice (as MfE guidance)[7]	Use of MfE guidelines (or use of SKM rainfall charts also accepted)	Apply to assets lasting longer that 25 years [4], or Apply to assets lasting longer that 50 years for pipe and culverts[8]	Best practice (as MfE guidance)	Not specified

[1] Subdivision and Development Principles and Requirements, KCDC, 2005
[2] Highway surface Drainage, NZTA, 1977
[3] Draft Drainage Design Guidelines, Ontrack, January 2008
[4] Stormwater Treatment Standard for State Highway Infrastructure, NZTA, May 2010
[5] TP10, Stormwater Management Devices: Design Guideline Manual, Auckland Regional Council (ARC), 2003
[6] Bridge Manual Second Edition NZTA, 2003
[7] Stormwater Management Strategy, KCDC, 2009
[8] Climate Change Position Statement, NZTA, 2004

	KCDC (from documents)	KCDC (from consultation)	NZTA	GWRC	KiwiRail
Loss of floodplain storage	Not specified	establish effects are no more than minor by modelling or provide compensatory storage	Not specified	Not specified	Not specified
Sediment and Erosion control (during construction)	Not specified	No further comment	As per NZTA draft Standard [9]	As GWRC guidelines[10]	Not specified
Fish passage requirements	Not specified	No further comment	Not specified	As GWRC guidelines[11]	Not specified

[9] Draft Erosion and Sediment Control Standard for State Highway Infrastructure, NZTA August 2010.
[10] Erosion and Sediment Control Guidelines for the Wellington Region, GWRC, September 2002
[11] Fish-friendly culverts and rock ramps in small streams, GWRC, 2003

4 Interpretation of NZTA stormwater attenuation requirements

We have followed the rationale and process described in the NZTA SWTS for assessing stormwater attenuation requirements in different sections of the proposed road. The potential quantitative adverse effects and associated mitigation are split into 2 components. These are:

- Existing flooding problems in the catchment (addressed by peak flow attenuation)
- Stream erosion potential (addressed by extended detention)

Figure 1 below shows a flow chart extracted from the NZTA SWTS (page 84), which gives the process to follow for assessing what stormwater mitigation is appropriate in a given catchment.

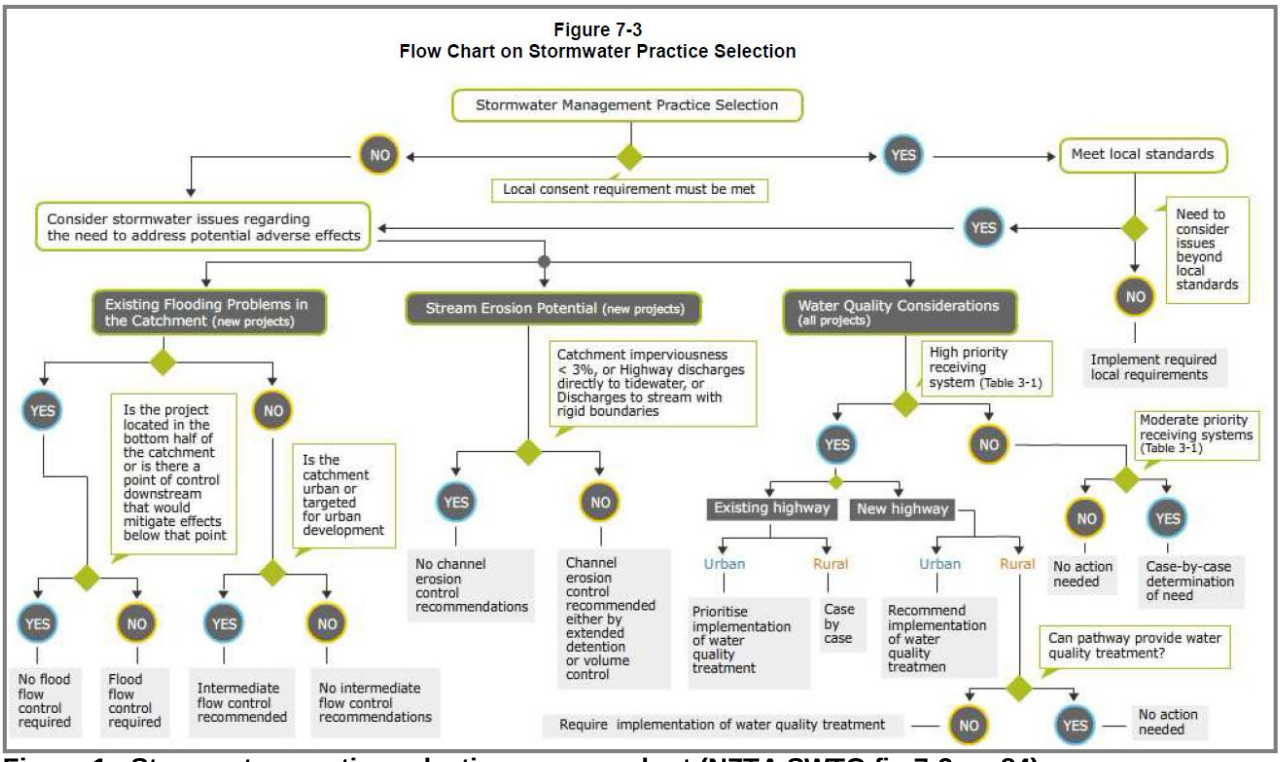


Figure 1 - Stormwater practice selection process chart (NZTA SWTG fig 7-3 pg 84)

The two quantity related components (Peak flow attenuation and Channel erosion control) are discussed in the following sections of this report.

4.1 Peak flow attenuation

The rationale and process described in the NZTA SWTS for used to assess the need for, and extent of peak flow attenuation. As shown in Figure 1 above, the NZTA selection process chart refers to the catchment, flood control and intermediate flow control. Clarification of these is given below:

- Intermediate flow control is defined as limiting the flows after road construction to the flows before the road was constructed, for the 50% and 10% AEP storm flows.

- Flood flow control is defined as limiting the post development flows to the 80% of the predevelopment flows for the 1% AEP storm flows.
- The catchment is referring to the whole or major catchment for a stream network (defined from the coastal outfall), not the catchments defined for waterway road crossings.

There are four major catchments that encompass the proposed road. We are referring to these four major catchments as:

- The major Waitohu catchment;
- The major Otaki catchment;
- The major Mangaone catchment; and
- The major Awatea catchment.

Figure 2 shows a plan of these four major catchments and the location of the proposed road within them.

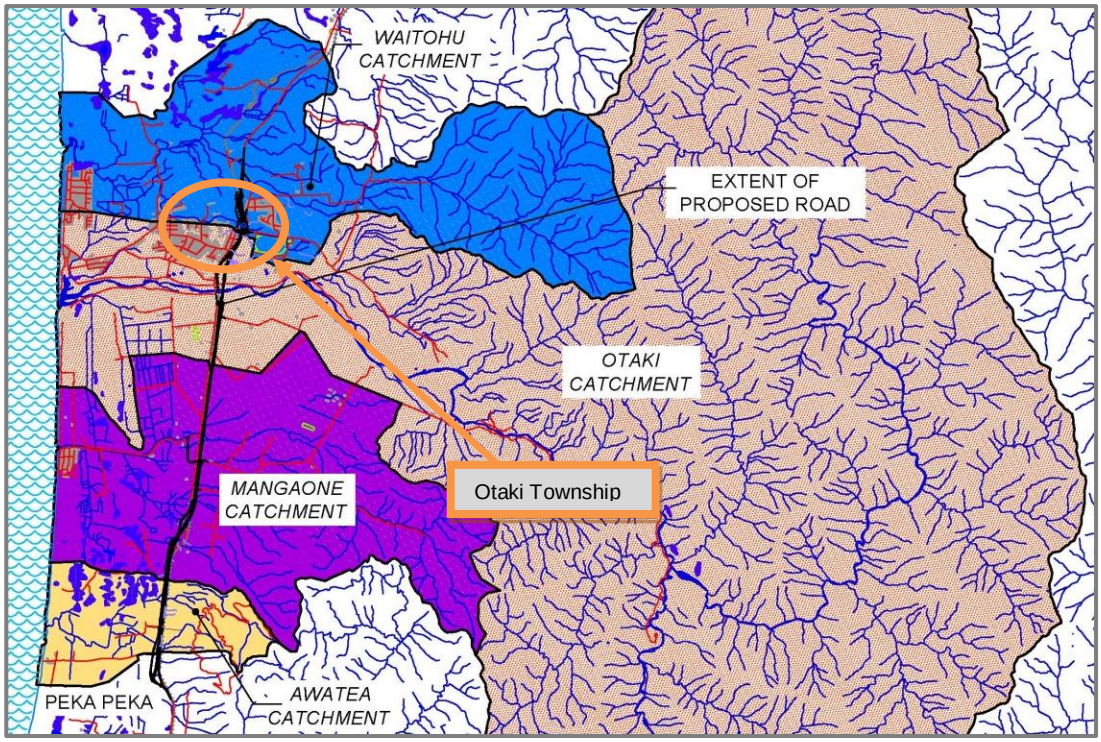


Figure 2 - The four major catchments that the proposed road lies within

4.1.1 Peak flow question 1 – Are there flooding problems in the catchment?

Following the attenuation selection process chart (shown in Figure 1 above), the first question is: are there flooding problems in the catchment?

To assess the extent of flooding problems, we have used the information shown on the KCDC GIS system. These 1% AEP flood extent maps are included in Attachment 1, and give a very good indication of the flooding problems the area. A summary is given in Table 2 below.

Table 2 – Major catchment flooding issues

Catchment name	Are there flooding problems downstream from proposed road?
The major Waitohu catchment	Yes
The major Otaki catchment	Yes
The major Mangaone catchment	Yes
The major Awatea catchment	No

The 1% AEP flood extent (as shown on the KCDC GIS system) spans across the Waitohu Otaki and Mangaone catchments; the flood extent does not extend into the Awatea catchment.

4.1.2 Peak flow question 2 – Is the road located in the bottom half of the catchment?

Following the attenuation selection process chart (shown in Figure 1 above on page 4), where there are flooding problems in the catchment, the next question is: is the road located in the bottom half of the catchment?

From Figure 2 above, we can see where the proposed road is within each of the catchments. The NZTA SWTS is not explicit as to how the midpoint of the catchment is defined (by length, by area, or by time of concentration) so we have considered all three ways. By visual inspection we can see that the road is in the lower half of all the catchments (in all but the Awatea catchment) considering area and length. Considering time of concentration: by visual inspection we can conclude that the road is in the top half of the Awatea catchment and the bottom half of the Otaki catchment, but the Waitohu and Mangaone catchments require more analysis. See Attachment 2 for our time of concentration (Toc) analysis. The result of our ToC analysis is that the road is in the bottom half of both the Waitohu and Mangaone catchments (assuming that the Bransby-Williams method is used, as preferred by KCDC). Our assessment is summarised in Table 3 below.

Table 3 – Location of road within major catchment

Catchment name	Location of proposed road
The major Waitohu catchment	Bottom half
The major Otaki catchment	Bottom half
The major Mangaone catchment	Bottom half
The major Awatea catchment	Top half

4.1.3 Peak flow question 3 – Is the catchment urban or targeted for urban development?

Following the attenuation selection process chart (shown in Figure 1 above on page 4), - where there are no flooding problems in the catchment- the next question is: is the catchment urban or targeted for urban development?

We have assessed the maximum possible extent of urbanisation by referring to the KCDC district plan (Urban plan zone features maps are located in

Attachment 3). The result of this assessment is shown in Table 4 and Table 5 below.

Table 4 – Amount to urban zone in catchment

Catchment name	Catchment area (ha)	Urban Zone area (ha)	Urban Zone as percentage of Catchment area
The major Waitohu catchment	4852	235	4.8%
The major Otaki catchment	35700	311	0.9%
The major Mangaone catchment	5053	84	1.7%
The major Awatea catchment	1192	44	3.7%

The percentages shown are the percent of land in the catchment zoned as ether residential, commercial (retail) or industrial (services). This is not an assessment of catchment permeability (catchment permeability would be expected to be around half these figures shown).

From the percentage of land that has been zoned as urban, we have made a judgement as to whether the catchment is targeted for urban development. See Table 5 below.

Table 5 – Is the catchment urban or targeted for urban development?

Catchment name	Is the catchment urban or targeted for urban development?
The major Waitohu catchment	No
The major Otaki catchment	No
The major Mangaone catchment	No
The major Awatea catchment	No

4.1.4 Putting the Peak flow questions together

Table 6 below gives a summary of peak flow attenuation selection process chart (as shown in Figure 1 above on page 4).

Table 6 – What level of attenuation is required?

Catchment name	Are there flooding problems in the catchment?	Is the road located in the bottom half of the catchment?	Is the catchment urban or targeted for urban development?	What level of attenuation is required /recommended?
Waitohu	Yes	Yes	N/A	No flood flow control required
Otaki	Yes	Yes	N/A	No flood flow control required
Mangaone	Yes	Yes	N/A	No flood flow control required
Awatea	No	N/A	No	No intermediate flow control recommendations

So, having worked through the process attenuation decision chart in the NZTA SWTS document, we conclude that no peak flow attenuation is required for this project.

4.2 Channel erosion control

The rationale and process described in the NZTA SWTS was used to assess the need for erosion control of the receiving water body. Figure 3 below shows this

process as an extract from the NZTA Stormwater practice selection process chart (this is shown in its entirety on page 4, Figure 1).

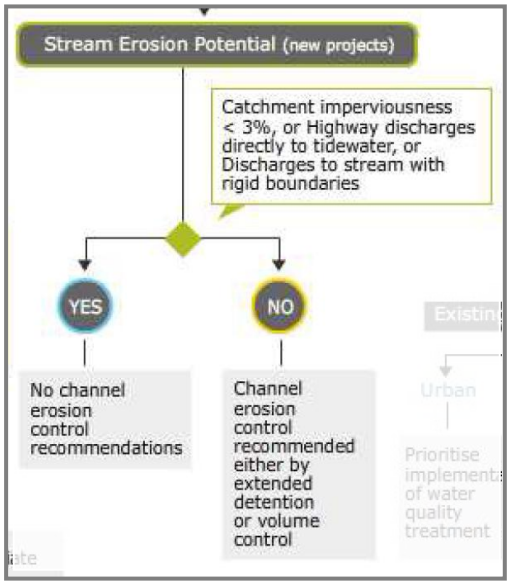


Figure 3 – Channel erosion control requirement selection process chart

The NZTA SWTS requires channel erosion control to protect the receiving environment (typically streams on this project) from increased flows (and associated increased erosion) from small and frequent storm events.

Although the above extract only refers to providing erosion control by either extended detention or volume control, section 6.2 of the NZTA SWTS covers this in more detail. If channel erosion control is recommended, then the NZTA SWTS describes three options. These are (see NZTA SWTS section 6.2.4.1):

- Check the 2-year stream velocities against Table 6-2 to ensure that post development velocities are non-erosive (assuming ultimate development of the catchment under the district plan land use). If this can be shown, no channel erosion control is needed;
- Implement extended detention/volume control. Capture and release over 24 hours of a volume equivalent to the water quality storm (volume multiplied by 1.2 for unstable stream receiving environments);
- Conduct a shear stress analysis for a specific site (requires specific catchment analysis and is not proposed for this project).

Unlike assessing the requirement for peak flow control (where we consider only the major catchment down to the coast), the channel erosion control assessment needs to consider both local and major catchments.

Our starting assumption is that we need channel erosion control everywhere. The following sections are a process to identify which receiving environments do not require channel erosion control.

4.2.1 Where can we eliminate the need for channel erosion control due to environment type?

The NZTA SWTS considers six types of receiving environment. These are shown in Figure 4 below.

Table 3-1 Receiving Environments and Stormwater Issues			
Receiving system	Flooding issues	Stream erosion issues	Water Quality
Streams	May be a priority depending on location within a catchment	High priority if the receiving stream is a natural, earth channel	High priority
Ground	Not an issue depending on overflow	Not an issue	High priority
Estuaries	Not an issue	Not an issue	High priority
Harbours	Not an issue	Not an issue	Moderate priority
Open Coast	Not an issue	Not an issue	Lower priority
Lakes	Not an issue	Not an issue	High priority

Figure 4 - Table of basic receiving environments (extract from (NZTA SWTS page 21)

All receiving environments in this project will be classified by the NZTA's SWTS as streams (even the Otaki River). So no receiving environments can be eliminated at this stage.

4.2.2 Where can we eliminate the need for channel erosion control due to catchment imperviousness?

To answer this question we need to consider four things:

- What are the local and major catchments?
- What are the district plan zone areas in each catchment?
- What is the maximum allowable impermeability allowed in each District Plan zone?
- Is the maximum potential catchment imperviousness less than 3%?

We have considered both the major and the local catchment imperviousness. Assessing the major catchment allows for cumulative effects in the catchment and assessing the local catchment allows for any hot spots of development.

4.2.3 What are the local and major catchments?

The major catchments that the road is within are shown in Figure 2 above (on page 5), and a map showing the local catchments is included in as a separate appendix.

4.2.4 What are the District Plan zone areas in each catchment?

As can be seen from the KCDC District Plan maps (included in Attachment 3), the vast majority of this part of the Kapiti Coast has rural zonings, with

urban zonings principally confined to a relatively small area around the Otaki township

The areas zoned as Conservation, Residential, Industrial and commercial (see maps in Attachment 3) have been measured and shown on Table 7. The five rural zonings (refer rural maps Attachment 4) have also been measures in each catchment and are shown in Table 7 also.

Table 7 – Zone areas within catchments*

Catchment name / Zone	Local Te Manuao	Local Mangapouri	Local all others	Major Waitohu	Major Otaki	Major Mangaone	Major Awatea
Residential (Ha)	37	31	0	253	261	35	84
Industrial (Ha)	0	0	0	0	50	5	0
Commercial (Ha)	0	0	0	3	13	0	0
Rural (Ha)	0	218	(100%)[12]	4639	35560	5373	1333
Total (Ha)	**37**	**249**	**(100%)**	**4895**	**35884**	**5413**	**1417**
Rural zone is further split as follows:							
Rural residential (Ha)	0	0	-	84	0	0	150
Alluvial planes (Ha)	0	218	-	835	2392	1960	133
Hill country (Ha)	0	0	-	723	4866	2351	358
Costal/Dunes (Ha)	0	0	-	1341	827	1062	692
Conservation (Ha)	0	0	-	1656	27475	0	0

*Zone and catchment areas are approximate as zoning information was only available in PDF format

[12] The other catchments have not been measures as by inspection it can be seen that they have no urban zoning. From this we can conclude that the impervious percentage will be less than 3%.

4.2.5 What is the maximum impermeability allowed in each District Plan zone?

The KCDC District Plan does not define maximum imperviousness values for any zoning; only lot sizes, number of buildings per lot and maximum site coverage. These rules have been used in conjunction with an assessment of existing development examples, to estimate the expected imperviousness in each zone at full development. The key information is shown in Table 8 below.

Table 8 – Zone district plan rules and Zone importability

Zone	District Plan rules	Maximum Zone importability
Residential	The maximum area of any site covered by all buildings shall be 40% except that this standard shall not apply to network utilities on sites less than 200m^2.	Allow an additional 20% hard standing (driveways and roads), so zone impermeability 60%
Industrial		Assume 100% impermeable surfaces, so zone impermeability 100%
Commercial		
Rural (general)	One dwelling and one family flat per lot except on Kapiti Island	Allowing 500m^2 of impermeable surface per lot[13]
Rural zone is further split as follows:		
Rural residential (Ha)	Some areas: The minimum area for any lot shall be 1ha Other areas: average area of 1ha	Average lot area 1ha, lot impermeable surface 500m^2, so zone impermeability 5%
Alluvial plains	Lots must have: a minimum area of 4ha and an average size of 6ha	Average lot area 6ha, lot impermeable surface 500m^2, so zone impermeability 0.8%
Hill country[14]	Lots must have a: minimum area of 20ha.	Average lot area 20ha, lot impermeable surface 500m^2, so zone impermeability 0.25%
Coastal/Dunes	The average area of land for all lots within the subdivision shall be not less than 4ha.	Average lot area 4ha, lot impermeable surface 500m^2, so zone impermeability 1.25%
Conservation	The maximum floor area for any one building shall be 30m^2.	Average lot area 20ha (assumed as hill country), lot impermeable surface 30m^2, so zone impermeability 0.015%

4.2.6 What is the maximum potential catchment imperviousness?

Using our assessments of zone areas, District Plan rules and impermeable surface per lot; we have produced an estimate of the maximum potential catchment imperviousness at full development. A summary of the maximum potential catchment imperviousness is shown in Table 9 below.

[13] We have assessed the foot print of the houses and associated hard standing areas of the new sub-developments off Ludlan Way and Speranza Road (to the east of Otaki). We estimate that these typically have 350m^2 to 400m^2 of impermeable surface (drive and roof). We have also allowed 100m^2 local road surface, so in total we have allowed 500m^2 of impermeable surface for each lot in our assessment.
[14] Including water collection areas.

Table 9 – Impervious areas and Maximum Probable Development (MDP)

Catchment name / Zone	Local Te Manuao	Local Mangapouri	Local all others	Major Waitohu	Major Otaki	Major Mangaone	Major Awatea
Residential (Ha)	22.2	18.6	0.0	151.8	156.6	21.0	50.4
Industrial (Ha)	0.0	0.0	0.0	0.0	50.0	5.0	0.0
Commercial (Ha)	0.0	0.0	0.0	3.0	13.0	0.0	0.0
Rural residential (Ha)	0.0	0.0	0.0	4.2	0.0	0.0	7.5
Alluvial planes (Ha)	0.0	1.7	-	6.7	19.1	15.7	1.1
Hill country (Ha)	0.0	0.0	-	1.8	12.2	5.9	0.9
Costal/Dunes (Ha)	0.0	0.0	-	16.8	10.3	13.3	8.7
Conservation (Ha)	0.0	0.0	-	0.2	4.1	0.0	0.0
Total Impervious area (Ha)	**22**	**20**	**-**	**184**	**265**	**61**	**69**
Total area (Ha)	37	249	-	4895	35884	5413	1417
Total potential impervious (MDP) %	**60%**	**8%**	**Less than 1%**[15]	**4%**	**1%**	**1%**	**5%**

4.2.7 Where can we eliminate the need for channel erosion control due to catchment impermeability?

From the NZTA SWTS, any catchment with less than 3% potential imperviousness (under the local District Plan rules) does not require channel erosion control (or extended detention).

From our assessment above, a large portion of the road is in a rural setting, and shown to have a Maximum Probable Development (MPD) of less than 3% (from the NZTA's SWTS, extended detention is not required for catchments with a MPD of less than 3%).

Of the four major catchments, the sections of road within the Mangaone and the Otaki do not require channel erosion control (or extended detention).

4.2.8 Putting the channel erosion control questions together

Due to the receiving environment and the catchments' potential imperviousness; channel erosion control is required for sections of road discharging in to the Major Waitohu and Awatea catchments (the Waitohu catchment includes the Te Manuao and the Mangapouri catchments).

[15] All other minor catchments are zoned ether Alluvial or Hill country. From Table 8, we can see that the MDP will be between 0.25 and 0.8%.

5 Interpretation of KCDC stormwater standards and aspirations

Through consultation with KCDC, we have developed a better understanding of KCDC's expectations that build on the written standards given in their subdivision guidelines, 2005. The cornerstone of KCDC's stormwater philosophy is to "not make the existing situation worse"; how this is demonstrated is left up to an applicant.

5.1 Peak flow attenuation

5.1.1 KCDC's Subdivision Guidelines (2005) and Stormwater Management Strategy (2009)

The stormwater section of KCDC's subdivision guidelines require the post road construction flows to be attenuated to the equivalent pre construction level, for the 10% AEP storm event (page 44).

KCDC's Stormwater Management Strategy does not comment specifically on attenuation of stormwater flows but does detail that the stormwater network will continue to be updated so that primary systems can accommodate the 10% AEP storm event (page 36).

5.1.2 Through consultation

KCDC have indicated that peak flow attenuation requirement includes the 1% AEP storm event (that is post construction 1% AEP flow attenuated to the equivalent pre construction flows). Additionally, KCDC would also expect pre and post road construction peak rates to be matched for the 20% AEP storm event.

If less than 1% AEP peak flow attenuation is proposed for a project, then KCDC would like to see evidence (such as use of a model) that the existing situation is "not being made any worse" (or has a "less than minor effect" if using RMA terminology). In areas with habitable buildings, a water level change of less than 10mm has previously been used by KCDC to define a less than minor effect.

5.2 Channel erosion control (Extended detention)

5.2.1 KCDC's Subdivision Guidelines (2005) and Stormwater Management Strategy (2009)

The KCDC's documents do not comment on stream channel erosion control.

5.2.2 Through consultation

KCDC indicated that they have no requirements around controlling increased stream or channel erosion due to increases in flows of minor events (less than the 50% AEP storm event) due to urbanisation and increases in hard surface areas.

5.3 Stormwater Treatment

5.3.1 KCDC's Subdivision Guidelines (2005) and Stormwater Management Strategy (2009)

The stormwater section of KCDC's subdivision guidelines direct the applicant to using Auckland Regional Council documents TP124 (Low Impact Design Manual) and TP10 (Stormwater Management Devices). These are both BPO documents and the applicant is "deemed to comply" with best practice if followed. Since 2005 KCDC have been accepting stormwater treatment devices designed according to TP10.

KCDC's Stormwater Strategy does not comment on stormwater quality or treatment.

5.3.2 Through consultation

KCDC have indicated that designing treatment devices to TP10 or the NZTA SWTS will be generally sufficient for this project however they have indicated a desire for higher standard to be applied in catchments with high receiving environment values. To date the only specific location indicated as having 'high value" is the reaming old bush and associated wetland at Marycrest.

KCDC have indicated that, for this project, base line assessments of stream quality are desired.

BPO solutions based on TP1016 have been historically used and accepted by KCDC.

[16] TP10, Stormwater Management Devices: Design Guideline Manual, Auckland Regional Council (ARC), 2003

6 Interpretation of GWRC stormwater requirements

GWRC's requirements (over and above those of KCDC and NZTA) revolve around sediment laden discharge during construction and maintaining ecological passage. Sediment laden discharge will be addressed by erosion and sediment controls on site during construction and fish passage will be provided at locations identified as requiring it. Generally GWRC consider all stormwater discharges as permitted activities[17], and have no requirement for stormwater treatment.

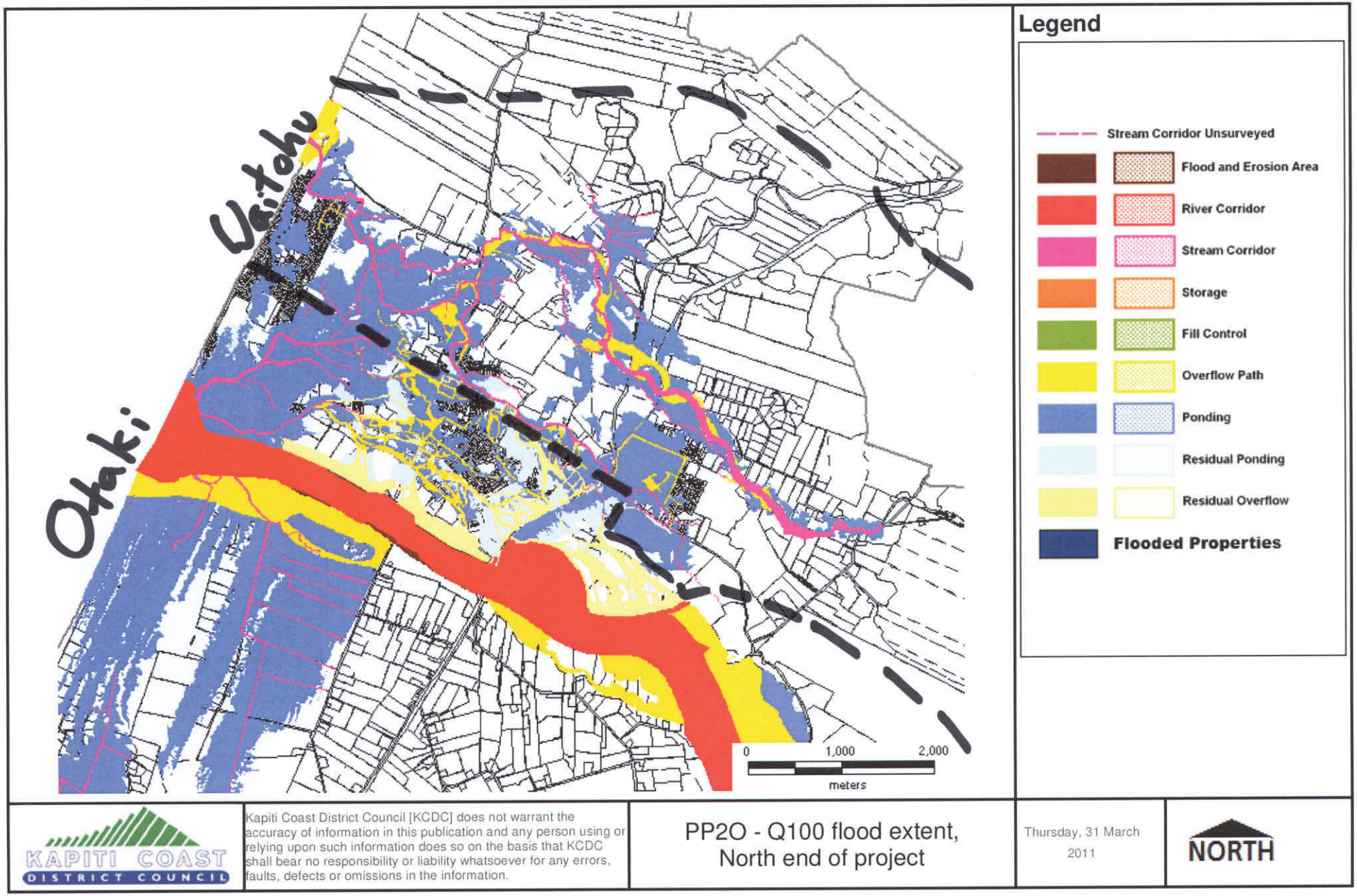
[17] Except discharges during construction which are not considered here

7 Interpretation of KiwiRail stormwater standards

KiwiRail stormwater standards are straight-forward and do not require discussion. Consultation with KiwiRail indicated no further expectations or requirements above those identified during the Wellington Region Rail Programme (WRRP) MacKay's to Waikanae Double Tracking project. A summary of these standards are included in Attachment 5.

Attachments

Attachment 1 - KCDC flood extent maps


Otaki
Ngatokahu
Legend
Stream Corridor Unsurveyed
Flood and Erosion Area
River Corridor
Stream Corridor
Storage
Fill Control
Overflow Path
Ponding
Residual Ponding
Residual Overflow
Flooded Properties
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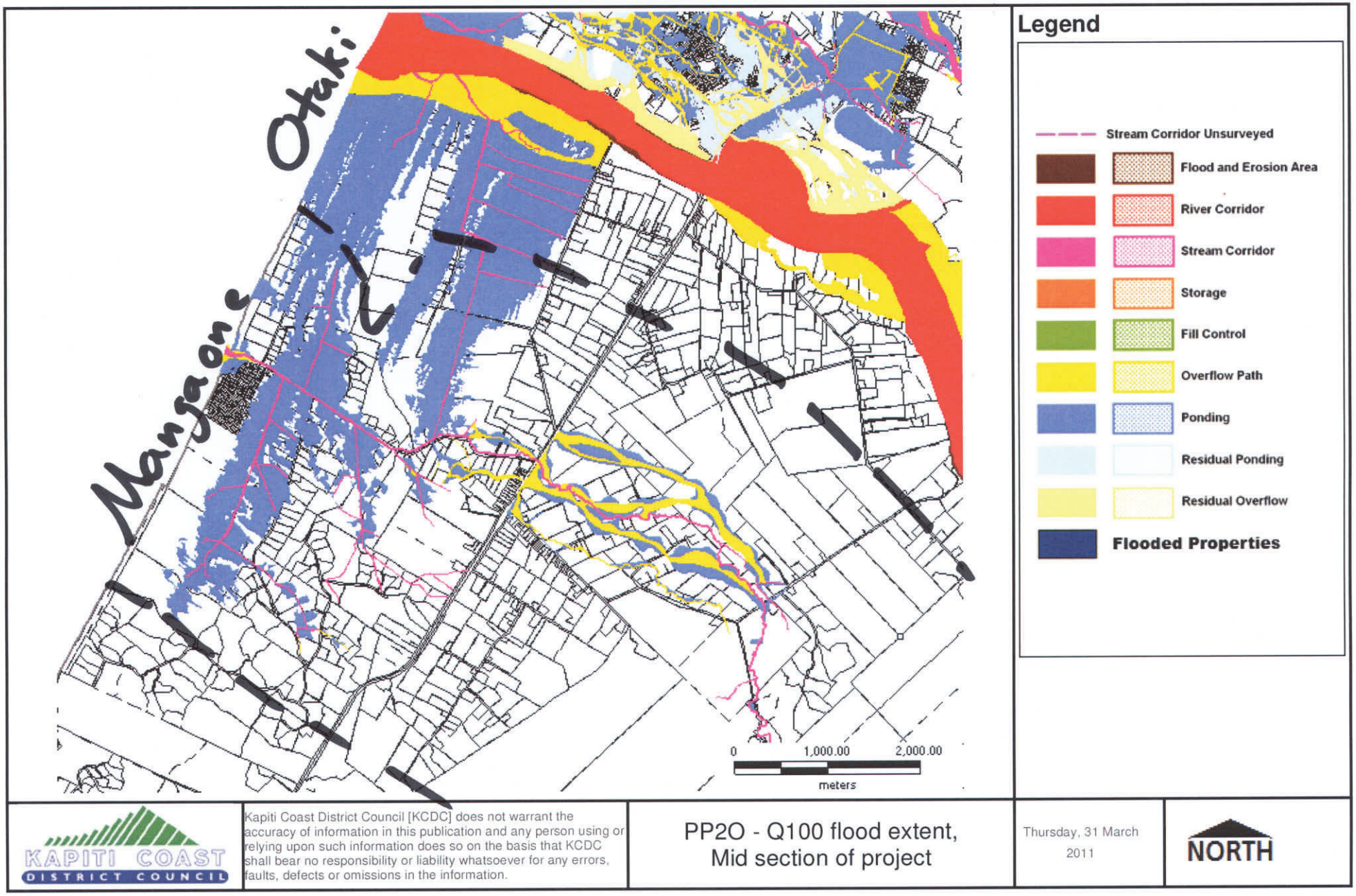
PP2O - Q100 flood extent, North end of project
Thursday, 31 March 2011
NORTH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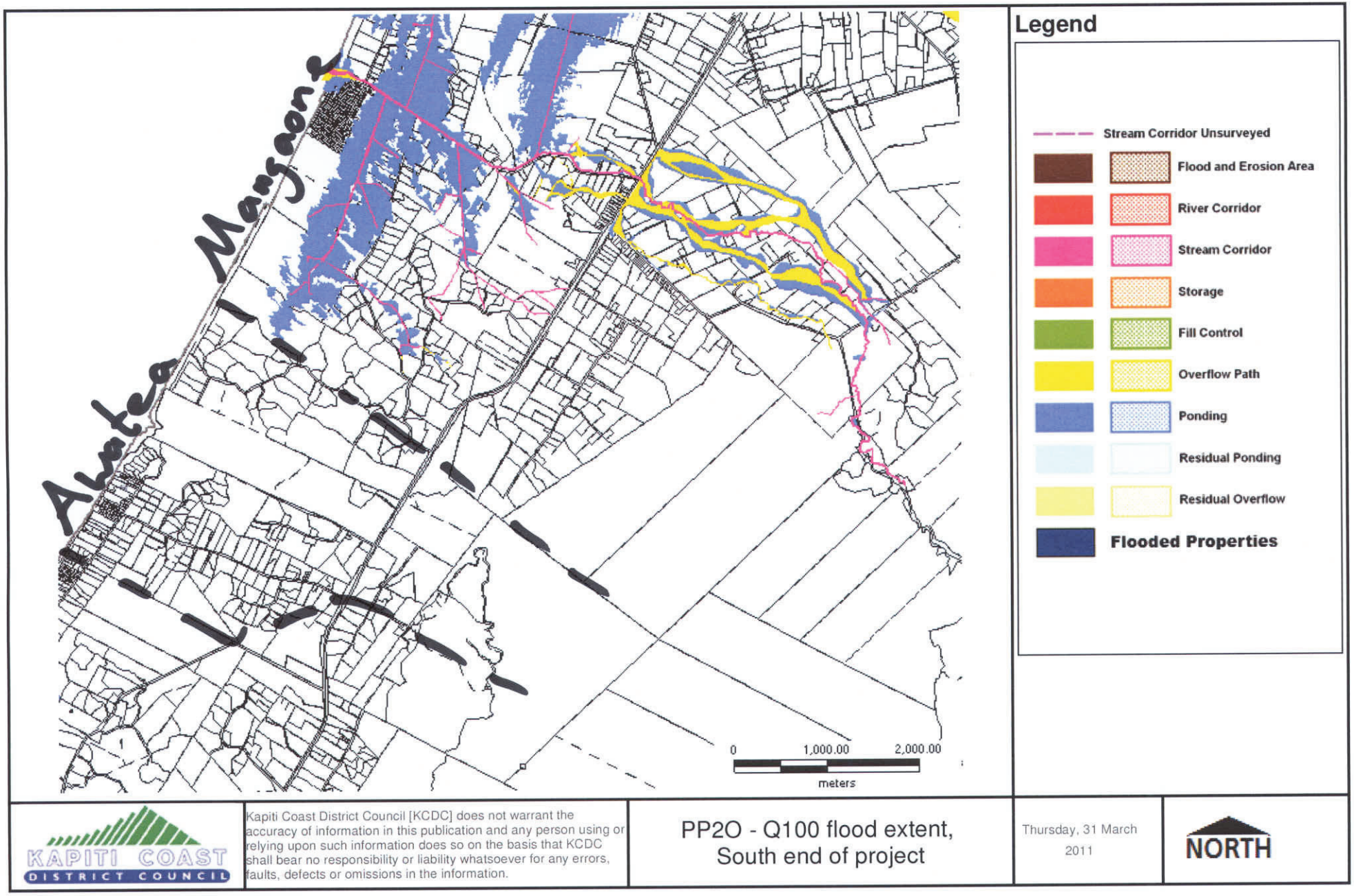
Manjaone
Legend
Stream Corridor Unsurveyed
Flood and Erosion Area
River Corridor
Stream Corridor
Storage
Fill Control
Overflow Path
Ponding
Residual Ponding
Residual Overflow
Flooded Properties
0
1,000.00
2,000.00
meters
KAPITI COAST DISTRICT COUNCIL
Kapiti Coast District Council [KCDC] does not warrant the accuracy of information in this publication and any person using or relying upon such information does so on the basis that KCDC shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.
PP2O - Q100 flood extent, Mid section of project
Thursday, 31 March 2011
NORTH


Awatea
Mangaone
Legend
Stream Corridor Unsurveyed
Flood and Erosion Area
River Corridor
Stream Corridor
Storage
Fill Control
Overflow Path
Ponding
Residual Ponding
Residual Overflow
Flooded Properties
0
1,000.00
2,000.00
meters
KAPITI COAST
DISTRICT COUNCIL
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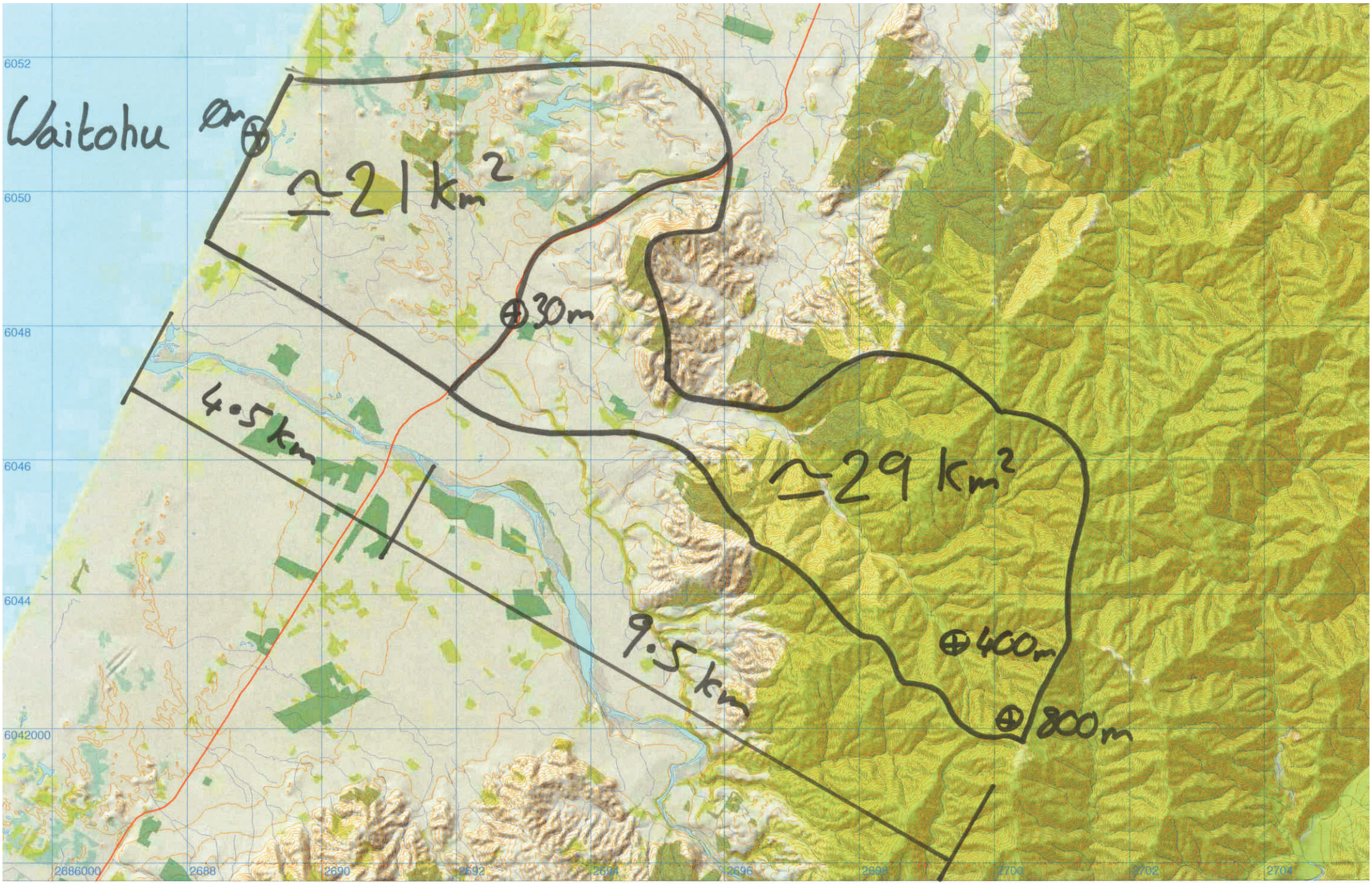
PP2O - Q100 flood extent, South end of project
Thursday, 31 March 2011
NORTH

Attachment 2 - Time of concentration above and below the road for Waitohu and Mangaone Catchments

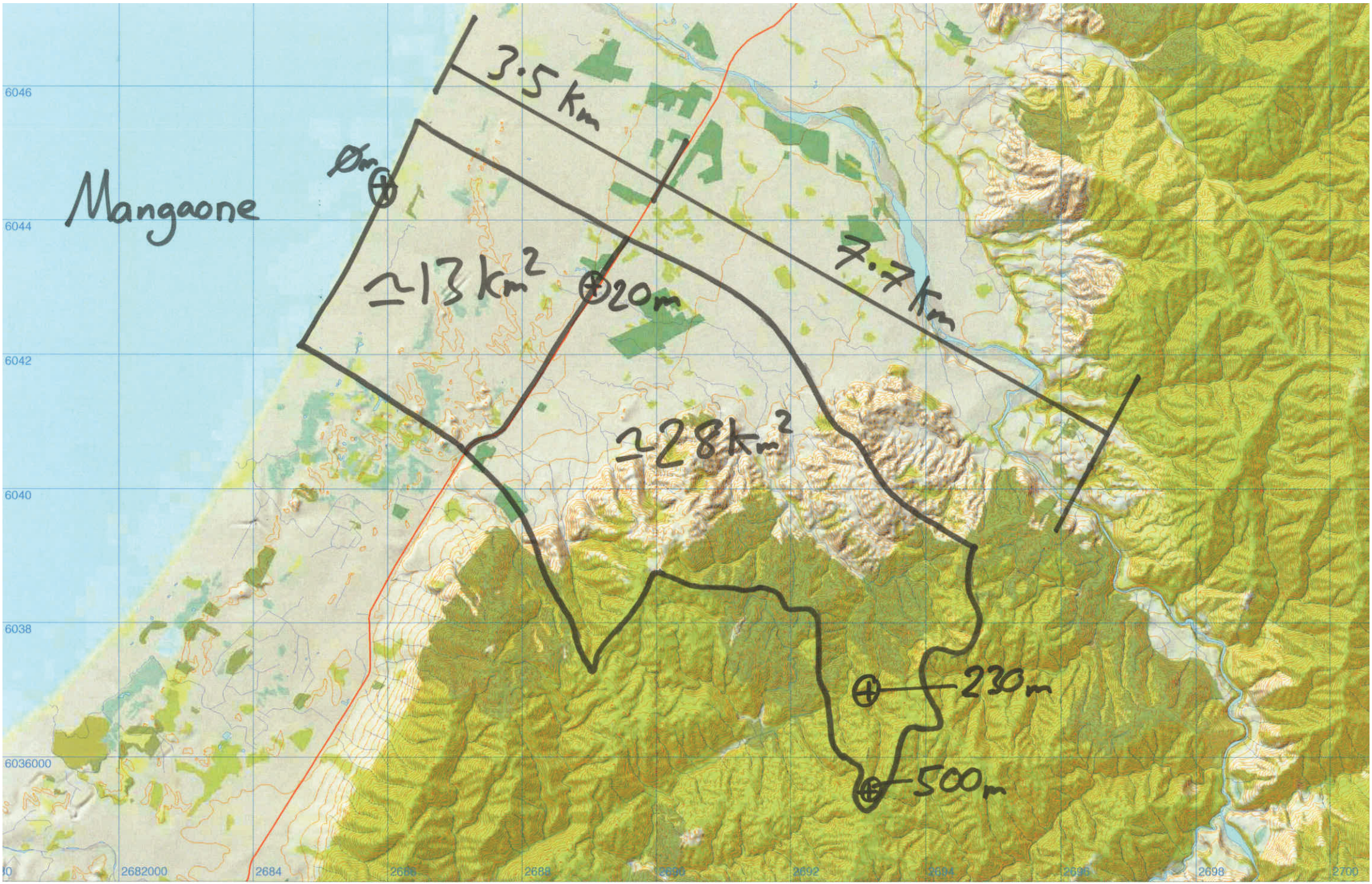


0 1000 2000 3000 4000 5000 6000 7000 8000 9000m

QuickMap
Custom Software Ltd

Any person wishing to rely on the information shown on this map must independently verify the information

Scale 1:70000 Topographical and Cadastral map derived from LINZ data. Printed: 9/06/2011 16:55.



0 1000 2000 3000 4000 5000 6000 7000 8000 9000m

QuickMap
Custom Software Ltd

Scale 1:70000 Topographical and Cadastral map derived from LINZ data. Printed: 9/06/2011 17:00

This calculation is a further way to identify if the project is in the top or botton half of the catchment it is in.
In this case the project is in four catchments.

See attached for catchment maps of the Waitohu and the Mangaone.

Catchment perameters table (for ToC)

Catchemnt name		Length (Km)	Area ($km^{2)}$	Slope (m/km)	Top Lvl (m)	Bottom Lvl (m)
Waitohu (top)	Hill crest to road	9.50	29	38.9	400	30
Waitohu (botton)	Road to coast	4.50	21	6.7	30	0
Mangaone (top)	Hill crest to road	7.70	28	27.3	230	20
Mangaone (botton)	Road to coast	3.50	13	5.7	20	0

NB: Top Level is taken from 90% of the main channel length

Time of concentratoin Table (verious methods)

	Standard Method for	Ramser-Kirpich Method	Bransby-Williams Method	US Soil Conservation Service
Catchemnt name	$58\ L / (A^{0.1}\ Se^{0.2})$	$3.98\ L^{0.77}\ (Se^{-0.385})$	$57.18\ L^{1.2} / (A^{0.1}\ H^{0.2})$	$56.868\ (L^3 / H)^{0.385}$
Waitohu (top)	189	79	186	79
Waitohu (botton)	132	87	130	87
Mangaone (top)	165	77	163	77
Mangaone (botton)	111	76	109	76

Attachment 3 - KCDC District wide and Urban Plan Zone Features Maps (Measurements of urban zones)

Click on grid number to view 2 page .pdf showing Zones Map and Features Map

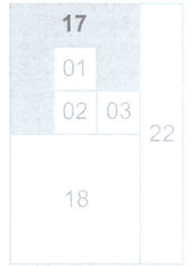
Kapiti Coast District Council Planning Maps

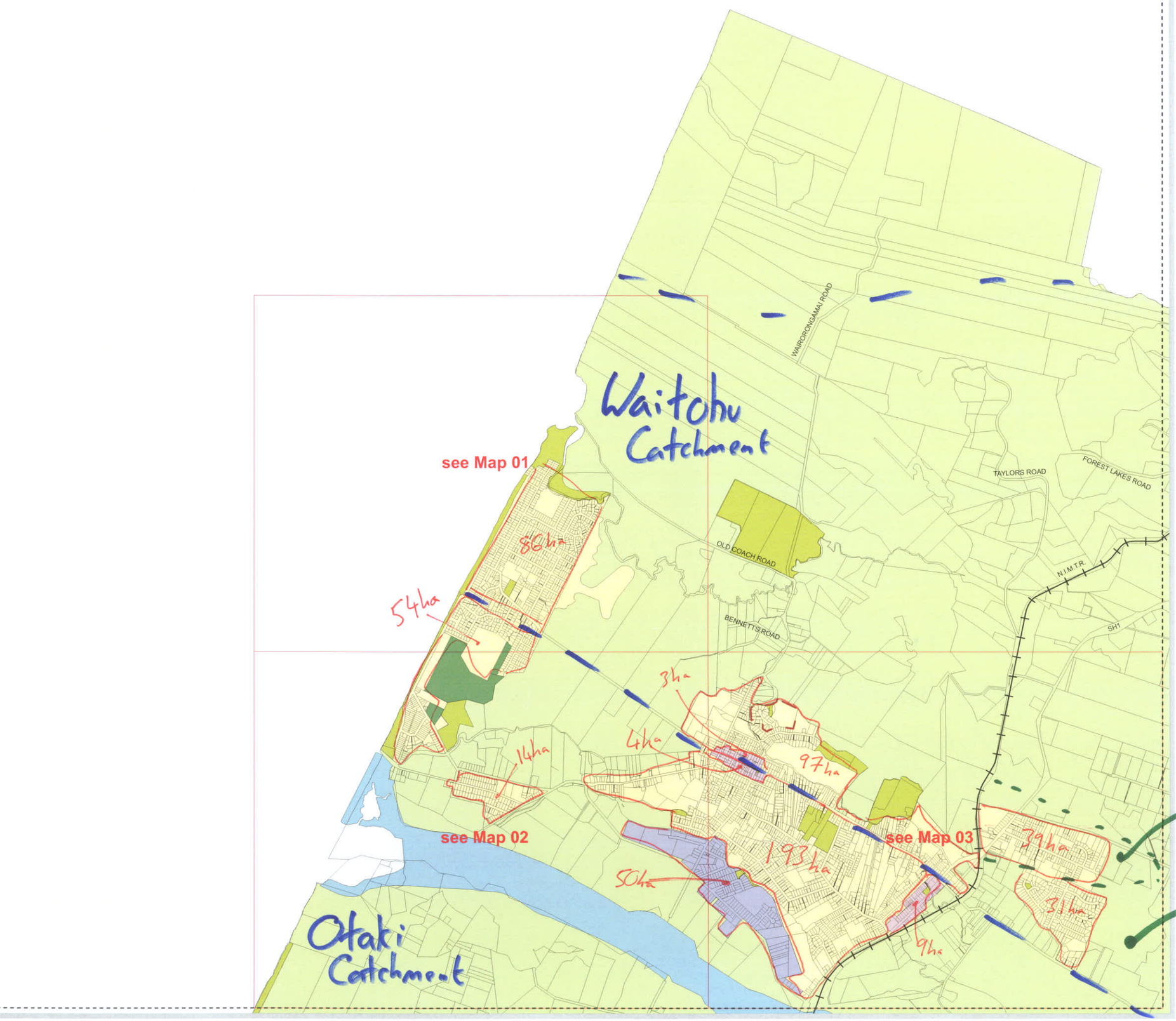
Districtwide and Urban Plan Zones and Features

Paired maps need to be read in conjunction with each other.

Kapiti Coast District Council Planning Maps

Map 17 Districtwide and Urban Plan Zones





LEGEND

ZONES

- Residential
- Rural
- Commercial / Retail
- Town Centre
- Industrial / Service
- Open Space
- River Corridor
- Conservation

AREAS

- I.R. Infil Residential
- M.D.H. Medium Density Housing
- L.D.H. Low Density Housing
- TAP... **Tourist Activity Precincts:** A,B,C and D. See District Plan for details
- GP....1 **General Precincts:** 1. Peka Peka North Rural Residential Redevelopment Area; 2. Pekawy; 3. Waikanae Garden Area Developments Area; 4. Waikanae Golf Residential Area; 5. Ferndale Area. See District Plan for details

MISCELLANEOUS

- North Island Main Trunk Railway

Scale 1:30,000 / A3

0m 300m 600m

NORTH

Otaki Catchment

Mangaone Catchment

Awatea Catchment

35 ha

see Map 04

5ha

39ha

see Map 05

45 ha

LETHBRIDGE

ADDINGTON RD

TE WAKA RD

SIMS ROAD

SWAMP RD

SH1

OTAKI GORGE RD

HARPER RD

OLD HAUTERE ROAD

TOTARANUI RD

TE HORO BEACH RD

ARCUS RD

CATLEY RD

SCHOOL ROAD

GEAR ROAD

HAUTERE CROSS ROAD

MICKELL ROAD

MANGAONE NORTH ROAD

PUKENAMU

WAITAHEKE

MORRISON

DERHAM ROAD

TE HAPUA ROAD

SUTTON RD

BEST RD

SETTLEMENT RD

TE KOWHAI ROAD

GARY ROAD

PEKA PEKA ROAD

HADFIELD ROAD

OCTAVIUS

Kapiti Coast District Council Planning Maps

Map 18 Districtwide and Urban Plan Zones

17
02 03
22
04
18
05
07
20
23

LEGEND

ZONES

- Residential
- Rural
- Commercial / Retail
- Town Centre
- Industrial / Service
- Open Space
- River Corridor
- Conservation

AREAS

- I.R. Infil Residential
- M.D.H. Medium Density Housing
- L.D.H. Low Density Housing
- TAP.... Tourist Activity Precincts: A,B,C and D. See District Plan for details
- GP....1 General Precincts: 1. Peka Peka North Rural Residential Redevelopment Area 2. Pekawy 3. Waikanae Garden Area Developments Area 4. Waikanae Golf Residential Area 5. Ferndale Area See District Plan for details

MISCELLANEOUS

- North Island Main Trunk Railway

Scale 1:30,000 / A3

0m 300m 600m

NORTH

Awatea Catchment

Mangaone Catchment

Mangaone Catchment

HUIA STREET

MANGAONE ROAD SOUTH

NGATIAWA ROAD

TERRACE ROAD

KENTS ROAD

RANGIORA ROAD

AKATARAWA ROAD

Included on Map 23

Waikanae Catchment

Otaki Catchment

Kapiti Coast District Council Planning Maps

Map 20 Districtwide and Urban Plan Zones

18
07
10
13
20
21
23

LEGEND

ZONES

- Residential
- Rural
- Commercial / Retail
- Town Centre
- Industrial / Service
- Open Space
- River Corridor
- Conservation

AREAS

- I.R. Infil Residential
- M.D.H. Medium Density Housing
- L.D.H. Low Density Housing
- TAP... Tourist Activity Precincts: A,B,C and D. See District Plan for details
- GP...1 General Precincts: 1. Peka Peka North Rural Residential Redevelopment Area 2. Pekawy 3. Waikanae Garden Area Developments Area 4. Waikanae Golf Residential Area 5. Ferndale Area See District Plan for details

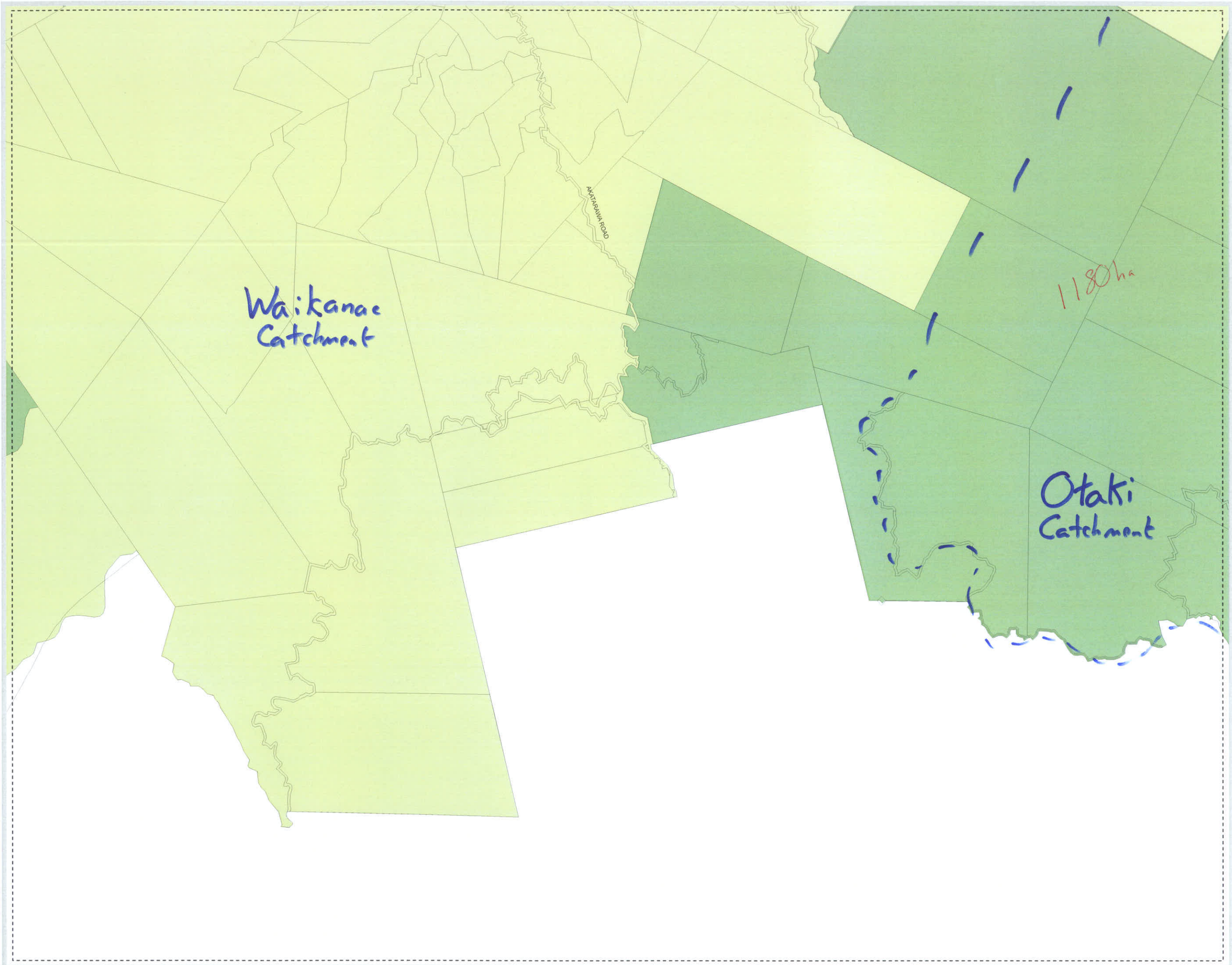
MISCELLANEOUS

- North Island Main Trunk Railway

Scale 1:30,000 / A3

0m 300m 600m

NORTH



Kapiti Coast District Council Planning Maps

Map 21 Districtwide and Urban Plan Zones

LEGEND

ZONES

- Residential
- Rural
- Commercial / Retail
- Town Centre
- Industrial / Service
- Open Space
- River Corridor
- Conservation

AREAS

- I.R. Infil Residential
- M.D.H. Medium Density Housing
- L.D.H. Low Density Housing
- TAP.... **Tourist Activity Precincts:** A,B,C and D. See District Plan for details
- GP....1 **General Precincts:** 1. Peka Peka North Rural Residential Redevelopment Area 2. Pekawy 3. Waikanae Garden Area Developments Area 4. Waikanae Golf Residential Area 5. Ferndale Area See District Plan for details

MISCELLANEOUS

- North Island Main Trunk Railway

Scale 1:30,000 / A3

0m 300m 600m

NORTH

Kapiti Coast District Council Planning Maps

Map 22 Districtwide and Urban Plan Zones

08	22	
14		
11		
20		23

LEGEND

ZONES

- Residential
- Rural
- Commercial / Retail
- Town Centre
- Industrial / Service
- Open Space
- River Corridor
- Conservation

AREAS

- I.R. Infil Residential
- M.D.H. Medium Density Housing
- L.D.H. Low Density Housing
- TAP... **Tourist Activity Precincts:** A,B,C and D. See District Plan for details
- GP....1 **General Precincts:**
  1. Peka Peka North Rural Residential Redevelopment Area
  2. Pekawy
  3. Waikanae Garden Area Developments Area
  4. Waikanae Golf Residential Area
  5. Ferndale Area

  See District Plan for details

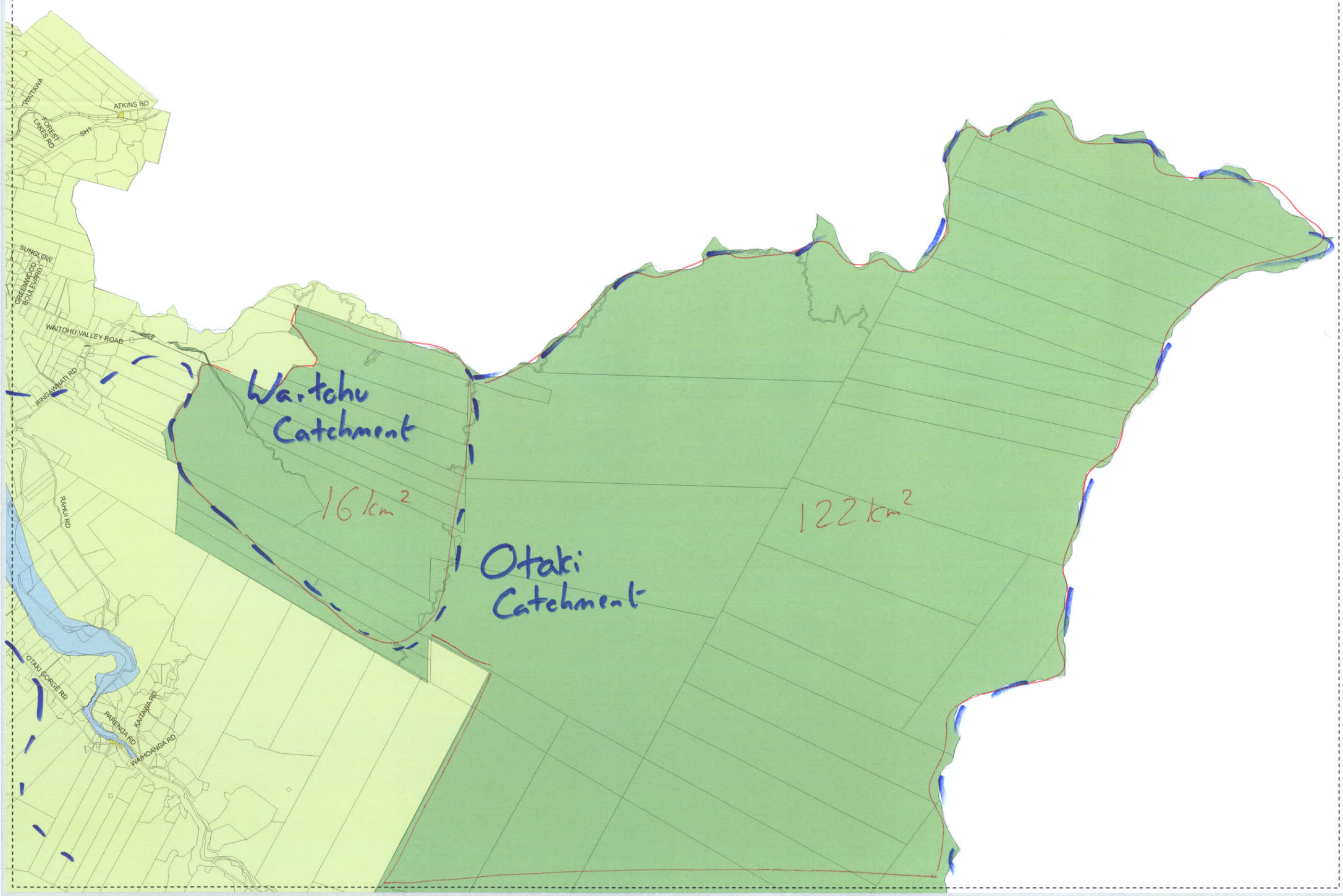
MISCELLANEOUS

- North Island Main Trunk Railway

Scale 1:60,000 / A3

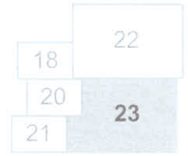
0m 600m 1200m

NORTH



Kapiti Coast District Council Planning Maps

Map 23 Districtwide and Urban Plan Zones



LEGEND

ZONES

- Residential
- Rural
- Commercial / Retail
- Town Centre
- Industrial / Service
- Open Space
- River Corridor
- Conservation

AREAS

- I.R. Infil Residential
- M.D.H. Medium Density Housing
- L.D.H. Low Density Housing
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- GP....1 **General Precincts:**
  1. Peka Peka North Rural Residential Redevelopment Area
  2. Pekawy
  3. Waikanae Garden Area Developments Area
  4. Waikanae Golf Residential Area
  5. Ferndale Area

  See District Plan for details

MISCELLANEOUS

- North Island Main Trunk Railway

Scale 1:60,000 / A3

0m 600m 1200m

NORTH

Kapiti Coast District Council Planning Maps

Map 01 Districtwide and Urban Plan Zones

17
01
02 03

LEGEND

ZONES

- Residential
- Rural
- Commercial / Retail
- Town Centre
- Industrial / Service
- Open Space
- River Corridor
- Conservation

AREAS

- I.R. Infil Residential
- M.D.H. Medium Density Housing
- L.D.H. Low Density Housing
- TAP.... **Tourist Activity Precincts:** A,B,C and D. See District Plan for details
- GP....1 **General Precincts:** 1. Peka Peka North Rural Residential Redevelopment Area 2. Pekawy 3. Waikanae Garden Area Developments Area 4. Waikanae Golf Residential Area 5. Ferndale Area See District Plan for details

MISCELLANEOUS

- North Island Main Trunk Railway

Scale 1:10,000 / A3

0m 100m 200m

NORTH

Kapiti Coast District Council Planning Maps

Map 02 Districtwide and Urban Plan Zones

17
01
02 03
18

LEGEND

ZONES

- Residential
- Rural
- Commercial / Retail
- Town Centre
- Industrial / Service
- Open Space
- River Corridor
- Conservation

AREAS

- I.R. Infil Residential
- M.D.H. Medium Density Housing
- L.D.H. Low Density Housing
- TAP... Tourist Activity Precincts: A,B,C and D. See District Plan for details
- GP...1 General Precincts: 1. Peka Peka North Rural Residential Redevelopment Area 2. Pekawy 3. Waikanae Garden Area Developments Area 4. Waikanae Golf Residential Area 5. Ferndale Area See District Plan for details

MISCELLANEOUS

- North Island Main Trunk Railway

Scale 1:10,000 / A3

0m 100m 200m

NORTH

Kapiti Coast District Council Planning Maps

Map 03 Districtwide and Urban Plan Zones

17
01
02 **03** 22
18

L.D.H. Lupin Road

1370m
380m
345m
44ha
80m
450m
80m
1100m
1380m
500m
62-3=59ha
68-4=64ha
310m
920m
630m
29ha
760m
740m
17ha
880m
240m
89ha-9=80ha
550m
9ha
790m
330m
370m
1100m
1370m
176m
430m
8. 910m
39ha
230m
700m
31ha
640m

LEGEND

ZONES
- Residential
- Rural
- Commercial / Retail
- Town Centre
- Industrial / Service
- Open Space
- River Corridor
- Conservation

AREAS
- I.R. Infil Residential
- M.D.H. Medium Density Housing
- L.D.H. Low Density Housing
- TAP... **Tourist Activity Precincts:** A,B,C and D. See District Plan for details
- GP...1 **General Precincts:** 1. Peka Peka North Rural Residential Redevelopment Area 2. Pekawy 3. Waikanae Garden Area Developments Area 4. Waikanae Golf Residential Area 5. Ferndale Area See District Plan for details

MISCELLANEOUS
- North Island Main Trunk Railway

Scale 1:10,000 / A3
0m 100m 200m

NORTH

Kapiti Coast District Council Planning Maps

Map 04 Districtwide and Urban Plan Zones

04 18

SIMS ROAD
SANDOWN ROAD
SEA ROAD
GRANVILLE STREET
BONNET AVENUE
DUKE STREET
GAWLER STREET
NICHOLAS ST
BRENDAN DR
SYLVIA WAY
KITCHENER STREET
TE HORO BEACH ROAD
HARAKEKE ROAD
PUKEMAKU ROAD
PURUAHA ROAD
430m
800m
35ha
400m
5ha
240m

LEGEND

ZONES

- Residential
- Rural
- Commercial / Retail
- Town Centre
- Industrial / Service
- Open Space
- River Corridor
- Conservation

AREAS

- I.R. Infil Residential
- M.D.H. Medium Density Housing
- L.D.H. Low Density Housing
- TAP.... Tourist Activity Precincts: A,B,C and D See District Plan for details
- GP....1 General Precincts:
  1. Peka Peka North Rural Residential Redevelopment Area
  2. Pekawy
  3. Waikanae Garden Area Developments Area
  4. Waikanae Golf Residential Area
  5. Ferndale Area

  See District Plan for details

MISCELLANEOUS

- North Island Main Trunk Railway

Scale 1:10,000 / A3

0m 100m 200m

NORTH

Kapiti Coast District Council Planning Maps

Map 05 Districtwide and Urban Plan Zones

04 18
05
06 07

780m
39ha
GP.1
300m
PAETAWA ROAD
GP.2
1500m
45ha
500m
RUAKAWA ROAD
GARY ROAD
PEKA PEKA ROAD
MARRAM WAY
PAETAWA ROAD
KENSINGTON DRIVE

LEGEND

ZONES
- Residential
- Rural
- Commercial / Retail
- Town Centre
- Industrial / Service
- Open Space
- River Corridor
- Conservation

AREAS
- I.R. Infil Residential
- M.D.H. Medium Density Housing
- L.D.H. Low Density Housing
- TAP... **Tourist Activity Precincts:** A,B,C and D. See District Plan for details
- GP... **General Precincts:**
  1. Peka Peka North Rural Residential Redevelopment Area
  2. Pekawy
  3. Waikanae Garden Area Developments Area
  4. Waikanae Golf Residential Area
  5. Ferndale Area

  See District Plan for details

MISCELLANEOUS
- North Island Main Trunk Railway

Scale 1:10,000 / A3
0m 100m 200m

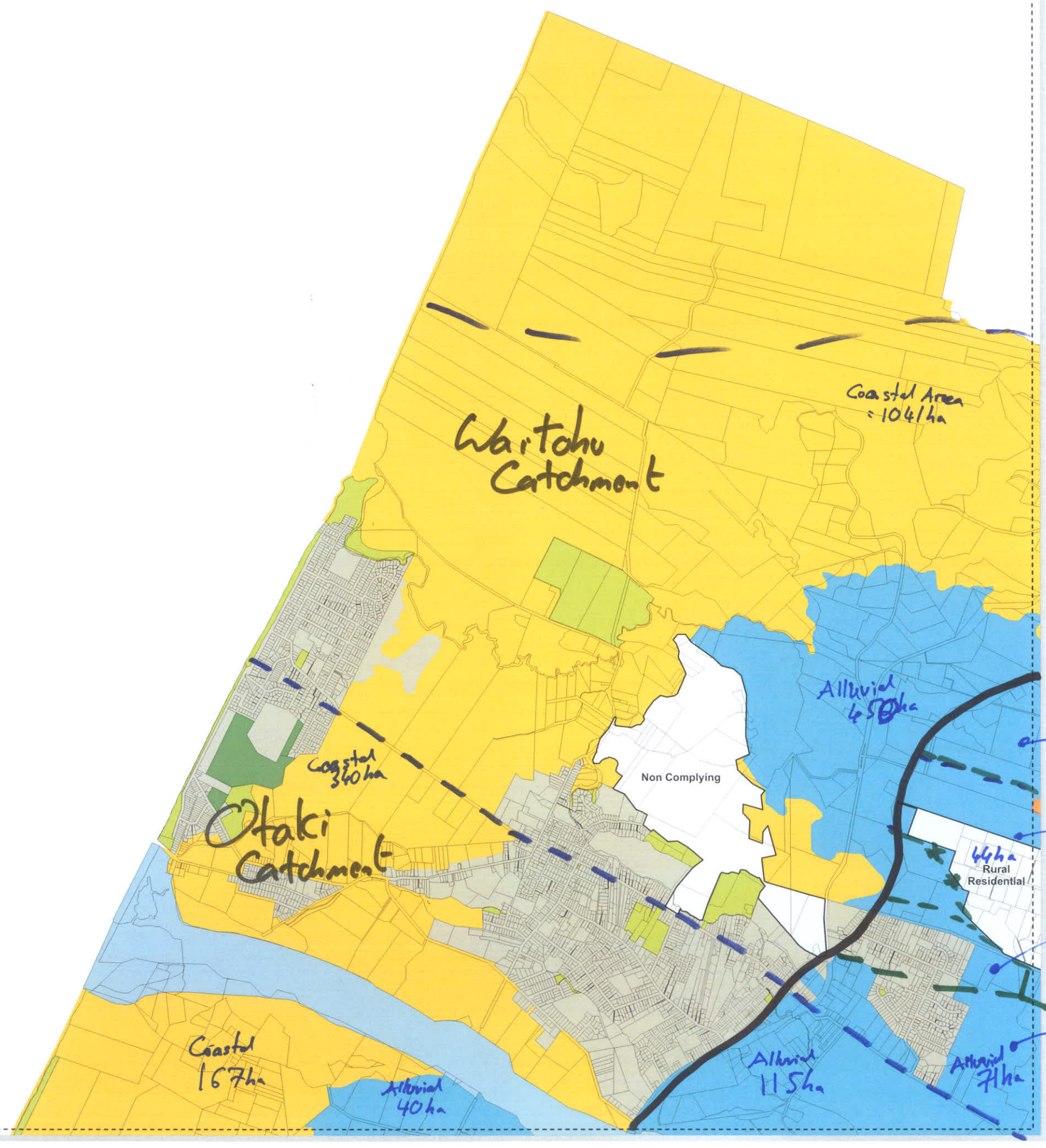
NORTH

Attachment 4 - KCDC Rural Sub-division Maps (Measurements of different rural areas)

Kapiti Coast District Council Planning Maps

Map 01 Rural Subdivision

01 | 02 | 05



LEGEND

- Rural Subdivision
- Urban Area
- Alluvial
- Hillcountry
- Coastal
- Water Supply Area
- Conservation
- River Corridor
- Open Space

Scale 1:30,000 / A3

0m 300m 600m

NORTH

Kapiti Coast District Council Planning Maps

Map 02
Rural Subdivision

01 02 03 05 08 09

Otaki Catchment
Coastal 320ha
Coastal 1062 ha
Alluvial 319ha
SH1
Alluvial 1327 ha
Alluvial 1960 ha
Mangaone Catchment
Awatea Catchment
Coastal 692ha
Rural Residential 150ha RR
Non Complying
Kumototo Catchment
alluvial 133ha
Gear Catchment
Settlement Heights Catchment
Jewell Catchment
Hill country 245 ha
Awatea Catchment
Mangaone Catchment
Hillcountry 1373ha
Waikanae Water Collection Area

LEGEND

- Rural Subdivision
- Urban Area
- Alluvial
- Hillcountry
- Coastal
- Water Supply Area
- Conservation
- River Corridor
- Open Space

Scale 1:30,000 / A3
0m 300m 600m

NORTH

Kapiti Coast District Council Planning Maps

Map 06
Rural Subdivision

02
05
06
04
09
07

Non Complying
Non Complying
Non Complying
Rural Residential
Jewell Catchment also Mangaone 49ha
Awatea Catchment 113ha
Otaki Hill country
40ha
Waikanae Water Collection Area
SH1

LEGEND

- Rural Subdivision
- Urban Area
- Alluvial
- Hillcountry
- Coastal
- Water Supply Area
- Conservation
- River Corridor
- Open Space
- Waikanae Urban Edge

Scale 1:30,000 / A3

0m 300m 600m

NORTH

Last Revision:
P.C.79 26/03/10
P.C.80 22/03/10

Kapiti Coast District Council Planning Maps

Map 07
Rural Subdivision

	06	
04	07	09
05		

Waikanae Water Collection Area

24ha

95ha

180ha

Otaki Catchment

LEGEND

- Rural Subdivision
- Urban Area
- Alluvial
- Hillcountry
- Coastal
- Water Supply Area
- Conservation
- River Corridor
- Open Space

Scale 1:30,000 / A3

0m 300m 600m

NORTH

Kapiti Coast District Council Planning Maps

Map 08
Rural Subdivision

01 | 08 | 02 | 09

Coastal 300ha

SH1

Hillcountry 723ha

Greenwood Catchment.

40ha

Alluvial 320ha Waitohu

Alluvial Mangapuri 44.7ha

Waitohu Catchment (29km²)

Waitohu Water Collection Area

Conservation 1656ha

Mangapuri Catchment.

Alluvial 910ha

Hillcountry 2837ha

Mangaone Catchment

324ha

Conservation area 10500ha

Otaki Catchment

LEGEND

- Rural Subdivision
- Urban Area
- Alluvial
- Hillcountry
- Coastal
- Water Supply Area
- Conservation
- River Corridor
- Open Space

Scale 1:60,000 / A3

0m 300m 600m

NORTH

Mangaone Catchment 605ha

Hill country 1360ha

Conservation area 16700ha

Otaki Catchment

Kapiti Coast District Council Planning Maps

Map 09
Rural Subdivision

02 08
06 09
07

LEGEND

- Rural Subdivision
- Urban Area
- Alluvial
- Hillcountry
- Coastal
- Water Supply Area
- Conservation
- River Corridor
- Open Space

Scale 1:60,000 / A3

0m 300m 600m

NORTH

Attachment 5 - Summary of 2008 KiwiRail WRRP stormwater standards

TRACK AND CIVIL DESIGN PARAMETERS SUMMARY				
Parameter	Desirable	Absolute	Source	Comment
Drainage Design life	50 years		ONTRACK DRAFT Drainage Design Guidelines January 2008	
Lateral Drainage	3% cross fall		ONTRACK DRAFT Drainage Design Guidelines January 2008	Cross stormwater only required to percolate through ballast of one set of tracks.
Stormwater outside of Rail Corridor				
Primary Systems	20% AEP or 1 in 5 year return with no surcharging		ONTRACK DRAFT Drainage Design Guidelines January 2008	Unless KCDC require higher levels of service.
Secondary Systems	1% AEP or 1:100 year return		ONTRACK DRAFT Drainage Design Guidelines January 2008	If flow is piped, KCDC approval is required **
Building	No inundation for 1% AEP		ONTRACK DRAFT Drainage Design Guidelines January 2008	
Stormwater inside of Rail Corridor				
Primary Systems	10% AEP or 1:10 year return with no surcharging		ONTRACK DRAFT Drainage Design Guidelines January 2008	Unless KCDC require higher levels of service.
Secondary Systems	1% AEP or 1:100 year return		ONTRACK DRAFT Drainage Design Guidelines January 2008	Piped flow only if no viable alternative.**
Longitudinal (outside underground)	1% AEP or 1:100 year return with minimum 300mm freeboard from rail track Match existing if already present.		ONTRACK DRAFT Drainage Design Guidelines January 2008	To be swale drains with catchpits or turnouts as appropriate. Swales to have side slopes < 1.5h:1.0v and may be flatter where insitu soil dictates**
Longitudinal (underground)	1% AEP or 1:100 year return with minimum 600mm freeboard from rail track - Match existing if already present.		ONTRACK DRAFT Drainage Design Guidelines January 2008	Unless KCDC requirements are more onerous.**
Manholes	60m centres		ONTRACK DRAFT Drainage Design Guidelines January 2008	At all changes in grade, horizontal alignment or max crs 60m
Cross Stormwater	10% AEP or 1:10 year return with no surcharging and 1% AEP with min 600mm freeboard to rail tracks		ONTRACK DRAFT Drainage Design Guidelines January 2008	Match existing waterways if in close proximity