

# **Appendix C**

**Technical Assessment - Stormwater**



# Stormwater and Flooding Assessment



## Te Utanganui Master Plan

Palmerston North City Council

2 May 2022

→ **The Power of Commitment**



<b>Project name</b>		Te Utanganui Stormwater TA					
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S4	Draft	D. Arseneau	R. Baugham		R. Baugham		2/5/2022

**GHD Limited**

52 The Square, Level 2

Palmerston North, Manawatu 4410, New Zealand

T 64-6-353 1800 | F 353 1801 | E palmmail@ghd.com | [ghd.com](http://ghd.com)

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# 1. Introduction

## 1.1 Background

Te Utanganui is Palmerston North City Council's (PNCC) vision for a nationally significant distribution hub in the northeast portion of the city, and has evolved out of a convergence of logistics-dependent land zoning (i.e., North East Industrial Zone - NEIZ) and both existing and planned multi-modal transportation infrastructure, including the Palmerston North airport, Regional Freight Ring Road, and KiwiRail Regional Freight Hub. To respond to this convergence, PNCC and the Central Economic Development Agency (CEDA) joined together to produce the Central New Zealand Distribution Hub (CNZDH) Strategy to promote the development of this freight and distribution hub with integrated infrastructure across the range of transportation modes and end-users in Palmerston North and beyond.

The CNZDH Strategy identified four discrete workstreams related to the realisation of the Strategy's goals, one of which is the master planning of the hub itself. The master planning process will involve a range of technical disciplines to address potential constraints to future development in the hub area and infrastructure requirements to support the hub. GHD is providing stormwater technical services for the Master Plan in collaboration with the core master planning team and other technical advisors (transportation, noise impacts, economics, etc.), including considerations for stormwater management infrastructure that may be required for future/existing development (i.e., best practice approaches, centralised vs distributed measures, etc.), flood protection, surface water-related catchment issues, and potential effects on floodplain and catchment management.

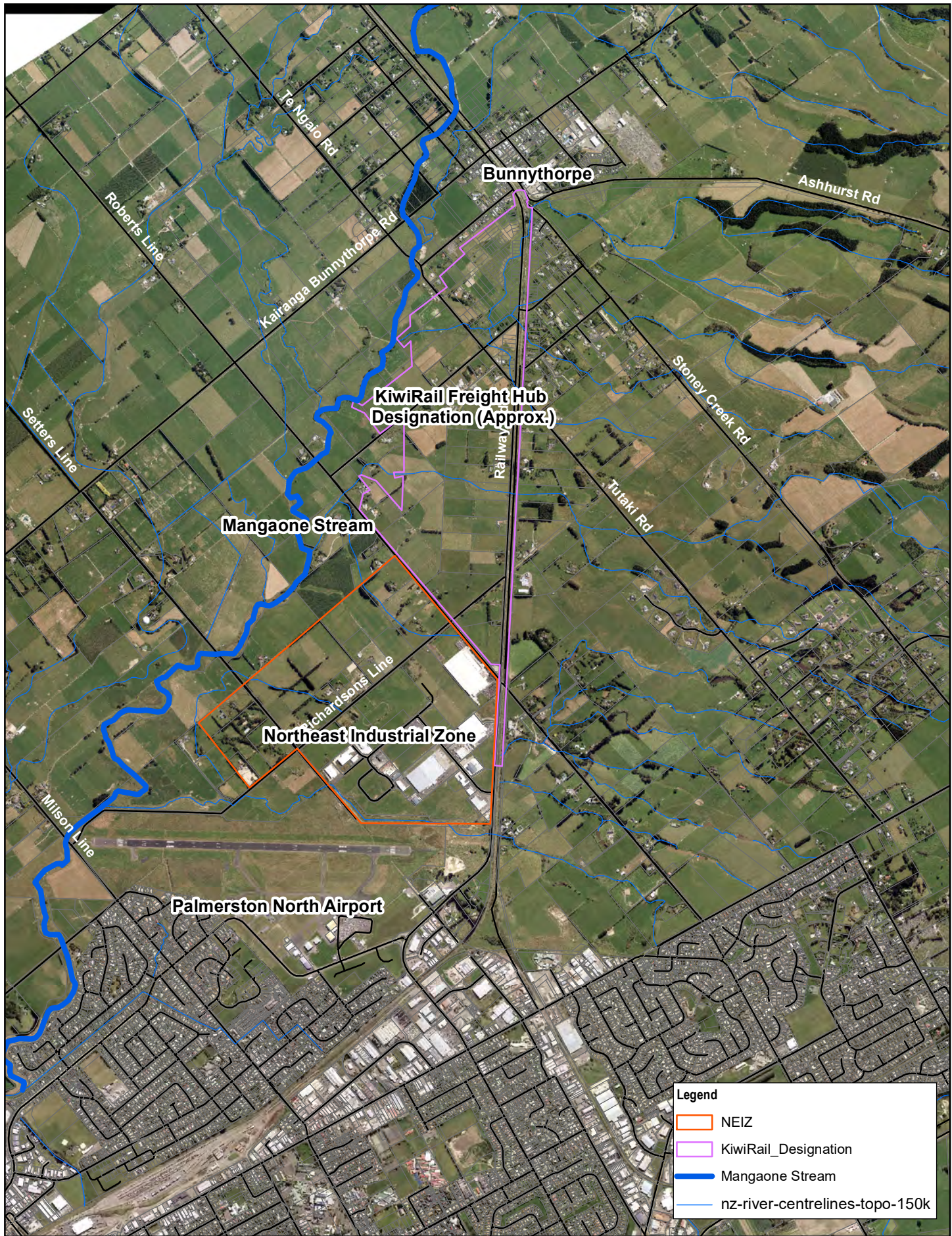
## 1.2 Master Plan Area

The study area for the Te Utanganui Master Plan is not yet defined by a clear boundary line; for the purpose of this stormwater and flooding assessment, a broad area focused on the northeast portion of Palmerston North and surrounding land will be considered the "study area". This includes the Palmerston North Airport, the Northeast Industrial Zone, the KiwiRail Freight Hub designation area, the settlement of Bunnythorpe, the Mangaone Stream upstream of Flyers Line, the Railway Road corridor, and the rural areas adjacent to these features. Beyond this general area, relevant factors will be considered only as needed, such as the general characteristics of the Mangaone Stream catchment that extends north of Bunnythorpe, or as relevant to the assessments of other technical advisors for the Master Plan.

The general study area for the stormwater and flooding assessment is shown on Figure 1.1, identifying key features/areas to provide geographic context.

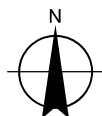
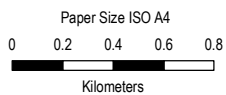
## 1.3 Purpose of This Report

The purpose of this report is to document the stormwater and flooding assessment undertaken in support of the Te Utanganui Master Plan. The intended use of this report is to help inform the development of Master Plan options by the broader master planning team, including PNCC officers, other GHD staff, and the other technical advisors contributing to the Master Plan.



**Legend**

- NEIZ
- KiwiRail\_Designation
- Mangaone Stream
- nz-river-centrelines-topo-150k



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**STUDY AREA**

**FIGURE 1.1**

## 1.4 Scope and Limitations

GHD's scope of work for the stormwater and flooding assessment includes the following:

- Establish and characterise the stormwater objectives, obstacles, and success factors for inclusion in the Te Utanganui Master Plan, in collaboration with stakeholders and in the context of wider planning and statutory requirements.
- Undertake a conceptual stormwater and flooding assessment for the potential land use and transportation facilities proposed by the respective Technical Advisors (economics and transportation).
- Summarise the above work in a technical report (i.e., the current document) to inform development of Master Plan options.
- Evaluate strengths and weaknesses of Master Plan options from a stormwater perspective and contribute to documentation of the evaluation as needed to support the master planning team (to be documented in the Master Plan MCA – not addressed in this report).

This report has been prepared by GHD for Palmerston North City Council and may only be used and relied on by Palmerston North City Council for the purpose agreed between GHD and Palmerston North City Council as set out in section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than Palmerston North City Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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## 2. Relevant Statutory Context

There are several local, regional and national-level statutory documents that govern the management of flood risk and the planning and design of stormwater management measures. A high-level overview of the most pertinent documents is provided below. The overviews are not exhaustive and do not include a comprehensive inventory of relevant policies, objectives, rules or standards; rather, they are intended to provide context for the consideration of stormwater and flooding issues in the Te Utanganui Master Plan.

### 2.1 PNCC District Plan

The PNCC operative District Plan includes several sections relevant to the Te Utanganui Master Plan and the way in which stormwater and flooding issues are managed. Of key interest to the Master Plan are Section 7 (Subdivision) and Section 12A (North East Industrial Zone), which require avoidance of flood and other natural hazards as well as stormwater management planning and design to mitigate risks to the public and environment. Achieving “hydraulic neutrality”, defined as control of post-development peak flows to pre-development levels, is the baseline performance standard for runoff quantity control, with erosion and water quality issues managed through an effects-driven assessment. In addition, the North East Industrial Zone provisions require retention of the first 5 mm of rainfall for a 24-hour rain event, and the setting aside of 10% of each site for on-site stormwater retention purposes. Beyond the requirements for runoff quantity and quality management, the District Plan generally requires that stormwater facilities be designed in such a way as to integrate into the surrounding community and provide some level of amenity.

### 2.2 Horizons Regional Council One Plan

The HRC Regional Plan, known as the “One Plan”, governs a wide range of issues related to the management of natural resources and hazards, including the management of flood risk and stormwater runoff. Of particular relevance to the Te Utanganui Master Plan are controls around development and infrastructure in areas prone to flooding, consideration of climate change effects, controls around activities in watercourses, and rules around the discharge of stormwater to the environment (either to land or to surface water bodies). Generally, flood risk to people and infrastructure must be avoided, impacts to drinking water sources must be avoided, and effects to watercourses and other natural areas (i.e., wetlands) must be avoided or mitigated, including a range of potential effects that may originate from stormwater runoff: water quality impairment, watercourse erosion, exacerbated flooding, etc.

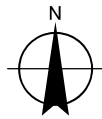
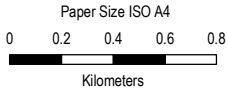
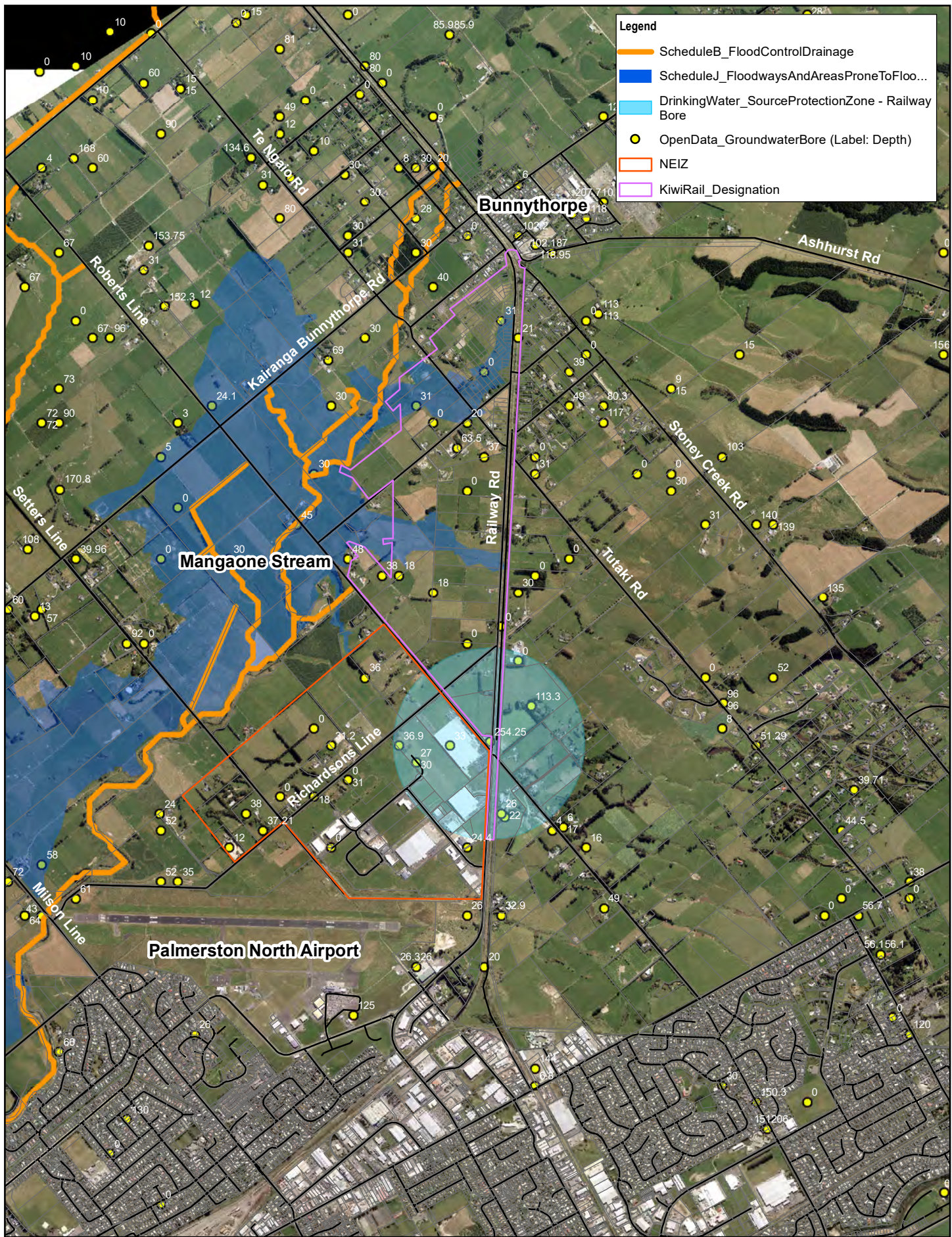
The One Plan also includes an inventory of water management zones and their resource management values (Schedule B), with varying rules and requirements for activities that affect these waterways. Of relevance to the Te Utanganui Master Plan is the Upper Mangaone Stream which has a prominent “Flood Control and Drainage” value that is protected under the One Plan.

Figure 2.1 on the following page displays a selection of One Plan data relevant to the Master Plan.

### 2.3 National Policy Statement for Freshwater Management (2020)

The National Policy Statement for Freshwater Management (NPS-FM), revised in 2020, provides direction for the management of natural and physical resources according to the fundamental concept of Te Mana o te Wai, which encompasses the management of all freshwater resources in Aotearoa. More explicitly, the NPS-FM requires management of freshwater resources according to a hierarchy of priorities, namely (in order):

1. The health and well-being of water bodies and freshwater ecosystems.
2. The health needs of people (such as drinking water).
3. The ability of people and communities to provide for their social, economic, and cultural well-being, now and in the future.



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HORIZONS REGIONAL COUNCIL  
ONE PLAN DATA

FIGURE 2.1

Based on these explicit priorities, the NPS-FM requires that development and infrastructure be carried out with consideration of the natural environment in the first instance, which is particularly relevant to the planning and design of flood risk and stormwater management measures. Key aspects of the NPS-FM that may impact the Master Plan and future development include protection of natural waterbodies from degradation, enhancement of natural waterbodies where possible, provision of fish passage along watercourses and other broad mandates that will govern how the development interfaces with the natural environment.

## **2.4 National Environmental Standards for Freshwater**

The National Environmental Standards for Freshwater (NES-F) are a set of regulations under the Resource Management Act (1991) that provide direction for a range of activities that take place in and around natural waterbodies. Of most relevance to the Te Utanganui Master Plan are the activity status rules related to natural wetlands and the provision of fish passage along watercourses. In particular, the rules around any activities that occur within or adjacent to natural wetlands are stringent and prohibitive, and have the potential to significantly affect the layout and location of any planned development. The identification of any potential natural wetlands in the Te Utanganui Master Plan area should be prioritised to inform master plan options for future development.

# 3. Existing Stormwater and Flooding Conditions

## 3.1 Catchment Context

The Te Utanganui Master Plan area is located in the north-eastern part of Palmerston North which in turn is contained within the Upper Mangaone Stream catchment (i.e., upstream of Milson Line), an expansive watershed that extends over 20 kilometres north of the City and covers approximately 157 square kilometres of rural land. The Mangaone Stream exhibits a “flashy” hydrologic response to rainfall despite its largely rural land use, and conveys a significant amount of flow through the downstream urban area of Palmerston North. A sample of flow data for the Mangaone Stream at Milson Line is shown below (Figure 3.1), as collected by the Horizons Regional Council river gauge at that location (with rainfall from the Palmerston North AWS meteorological station), showing the extreme and rapid increases in flow that frequently occur in the stream.

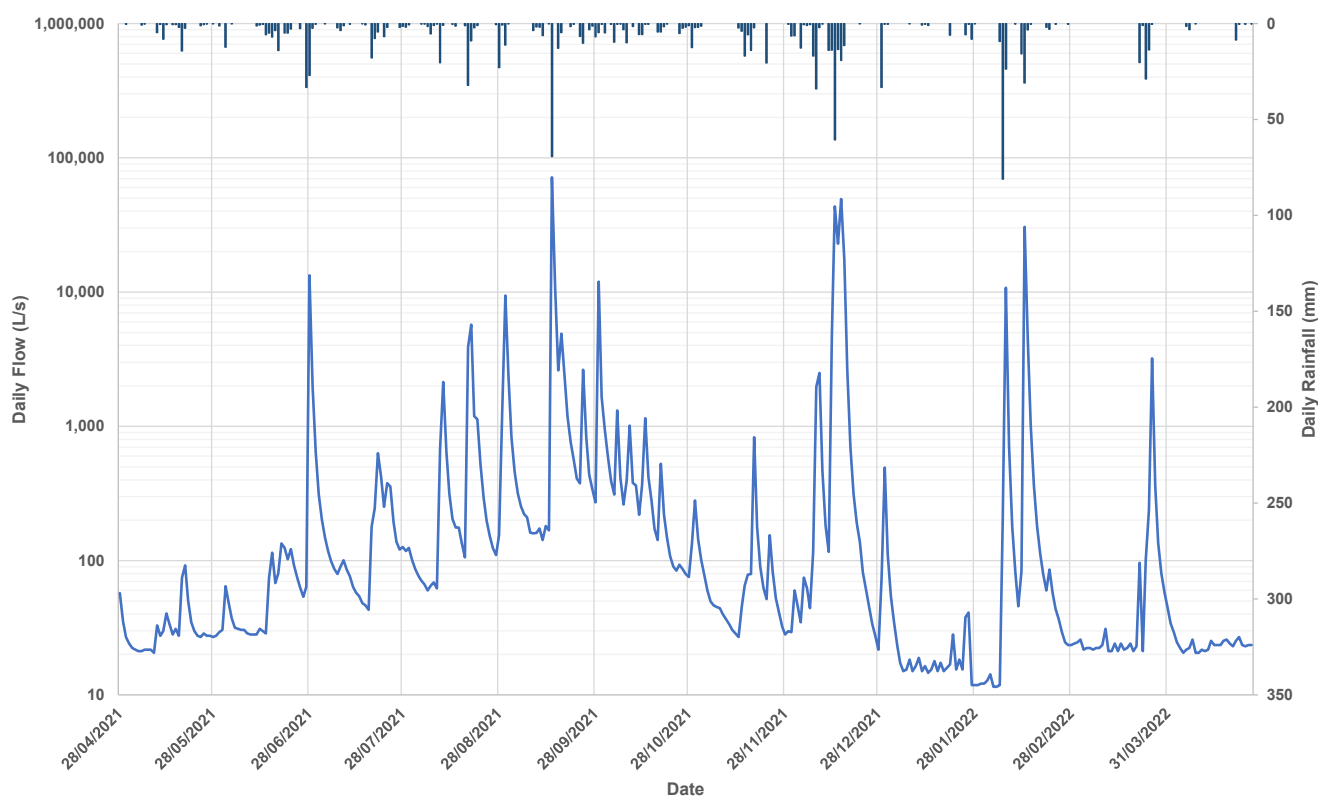
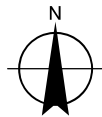
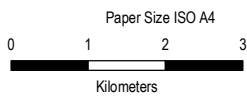
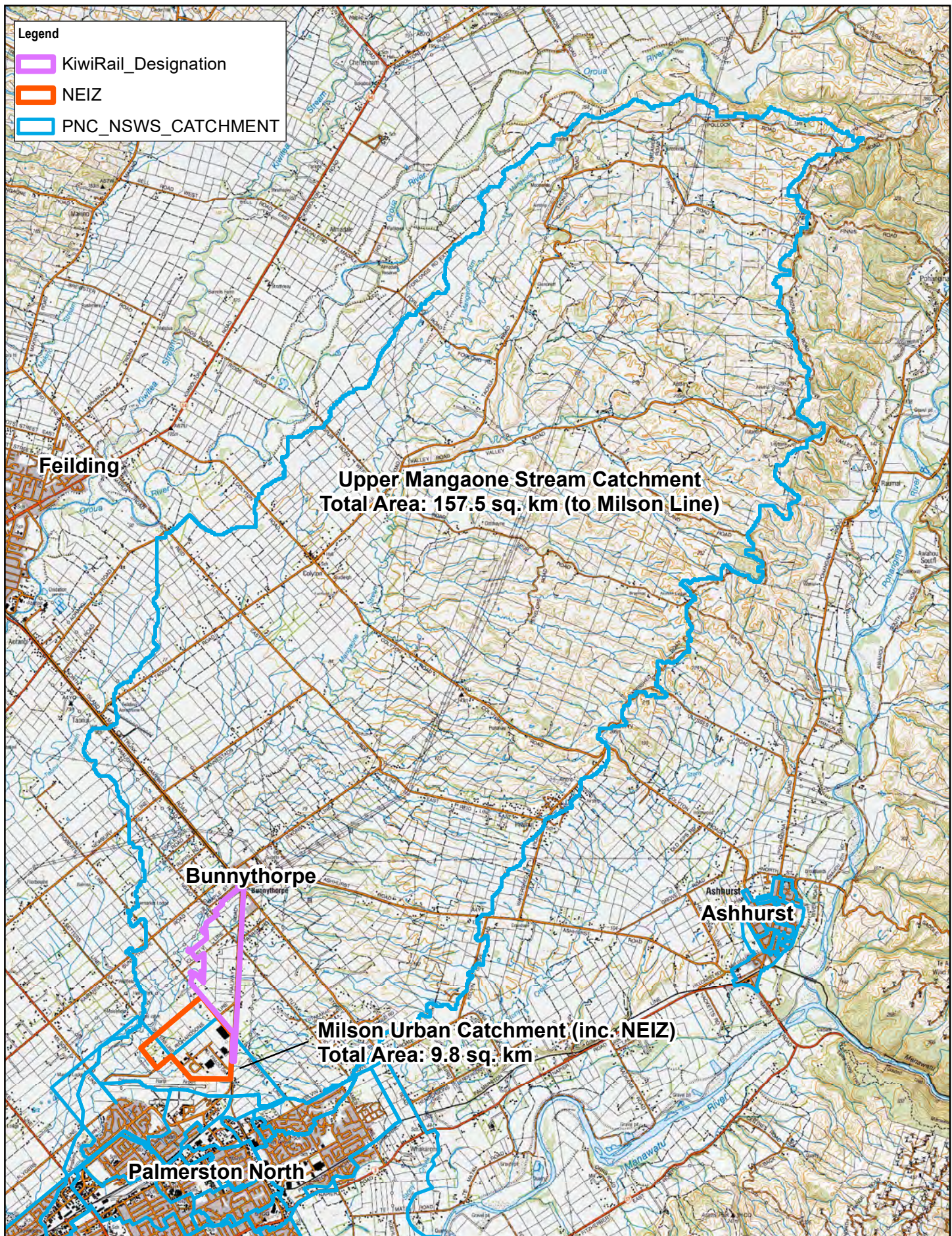


Figure 3.1 Daily Flows in Mangaone Stream at Milson Line, 28-Apr-2021 to 27-Apr-2022

Considering the high flows and sensitive downstream land use, the stream is a focus for flood risk mitigation works by Horizons Regional Council (as discussed in Section 2.2) including stopbanks and formal floodways to bypass the urban area, and there is a significant “floodable area” zone around the stream in the Te Utanganui Master Plan area and in areas north of the City (i.e., between Flygers Line and Kairanga Bunnythorpe Road as a result of the Horizons-managed floodway). These areas will likely not be suitable for future development.

Portions of the study area, particularly around the airport and NEIZ, are within the “Milson Urban Catchment” of the City; these areas ultimately contribute to the Upper Mangaone Catchment flows after flowing through various reticulation systems, channels and stormwater management facilities.

The major catchments located around the Master Plan study area are shown on Figure 3.2 on the following page.



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**SURFACE WATER CATCHMENTS  
 IN NORTH EAST PNCC**

**FIGURE 3.2**

## 3.2 Study Area Soils, Land Use and Topography

The study area is dominated by soils that exhibit poor drainage characteristics (see Figure 3.3 for general soil drainage properties from Landcare Research S-Map Online), consisting of pallic silts and clays east of the Mangaone Stream and silty-loamy gley soils to the west (see Figure 3.4 for more detailed soil distribution from LRIS soil particle size data). These soils will typically be saturated over the winter months, indicating that stormwater management measures that are dependent on soakage/infiltration will not be effective.

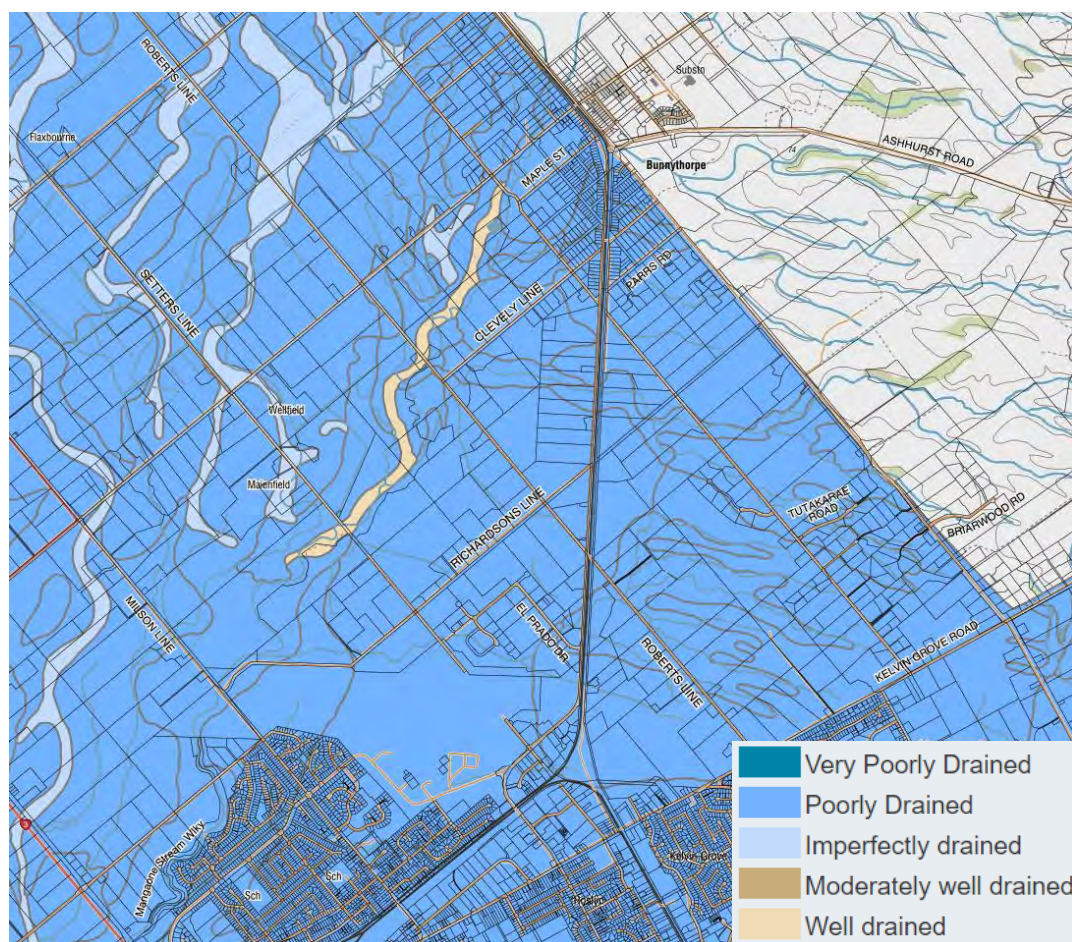
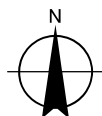
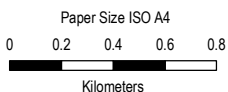
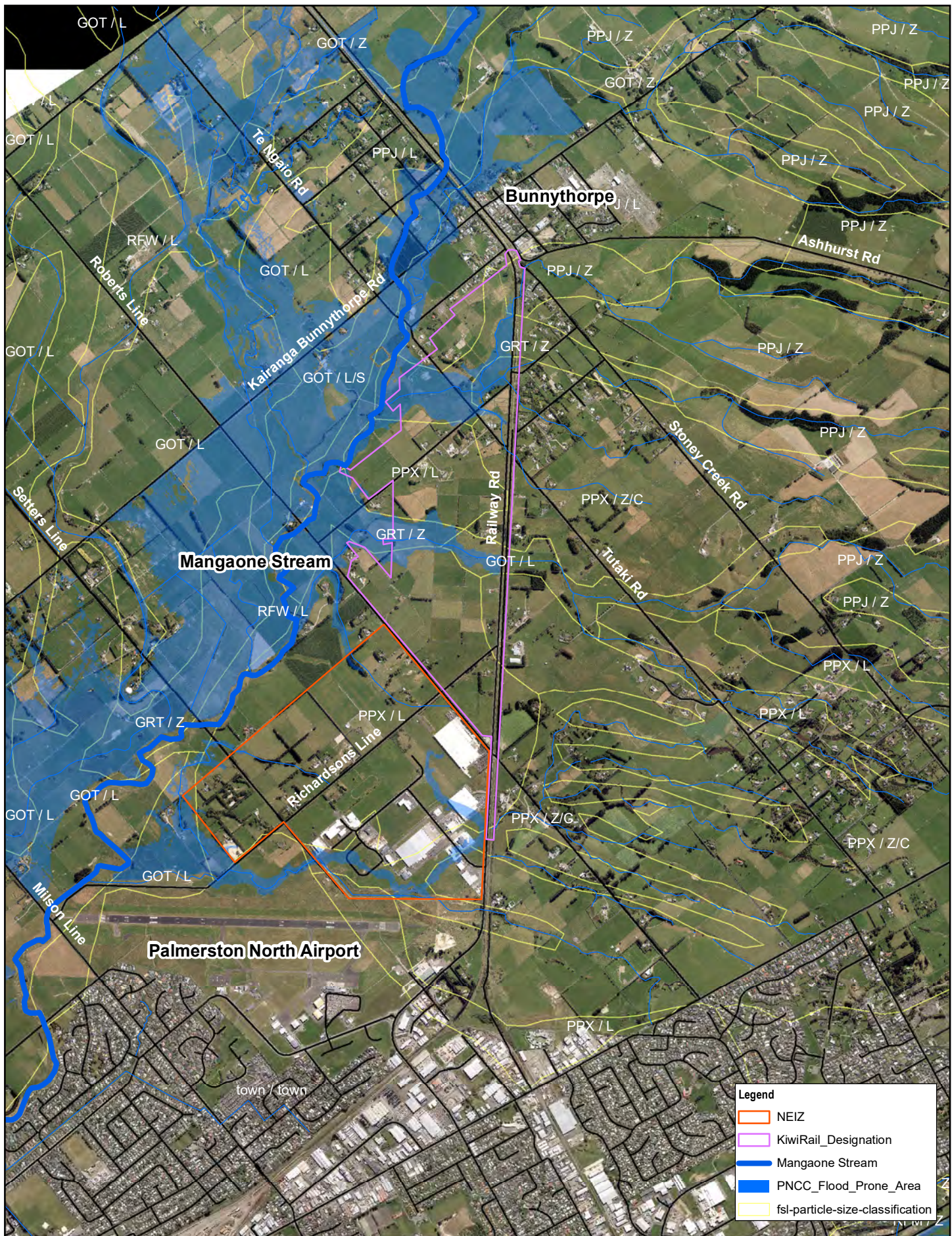


Figure 3.3 Soil Drainage Characteristics (S-Map Online, Landcare Research)

The current land use of the Master Plan area is almost entirely “high producing exotic grassland” (see Figure 3.5 based on Land Cover Database v50 data from LINZ), used as a mixture of pasture and lifestyle/rural residential. Small, isolated fragments of exotic and native forest remain along the edges of pastures and within some gullies to the east of Railway Road. The NEIZ is partially built-out, as is Palmerston North to the south and Bunynthorpe to the north. Aside from the existing built-out areas and the airport (including flight paths, noise levels, etc.), there are no significant land use restrictions within the Te Utanganui area.

The topography of the Master Plan area is dominated by the Mangaone Stream and its tributary waterways, creating a series of east-west gullies perpendicular to Railway Road (see Figure 3.6, including a sample elevation transect cut parallel to Railway Road). Close to the Mangaone Stream these gullies are vulnerable to flooding effects, particularly in the KiwiRail designation area, but this is expected to diminish to the east of Railway Road. The gullies provide numerous pathways for stormwater drainage and provide relief to mitigate flood risk to development, but also fragment and isolate relatively flat areas suitable for large-scale development. Identification of future development areas will need to preserve existing drainage pathways and topography while navigating the gullies to create cohesive, integrated built-up areas.



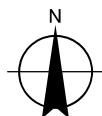
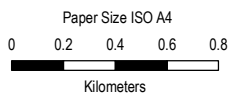
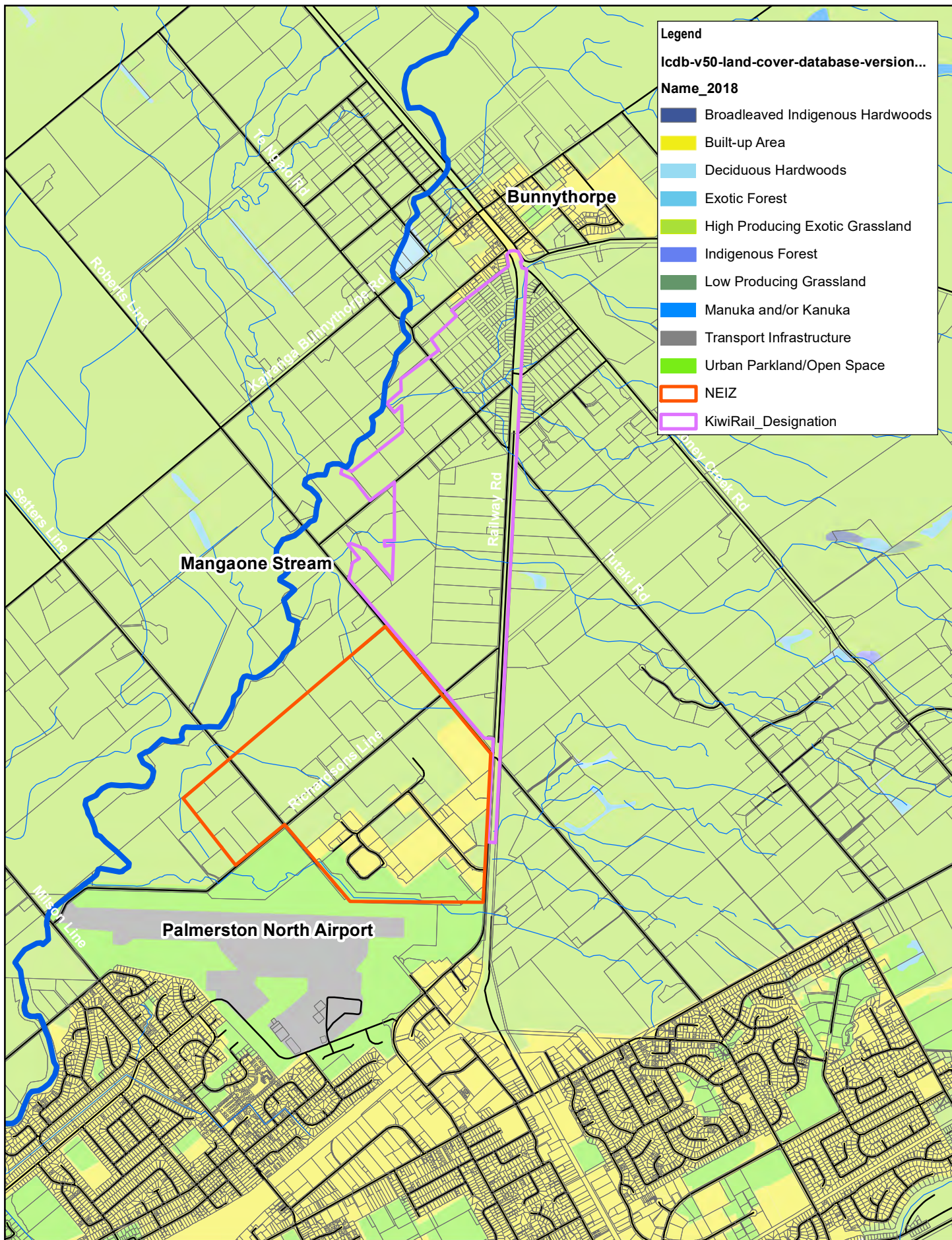
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STUDY AREA SOILS

FIGURE 3.4



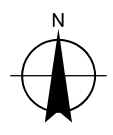
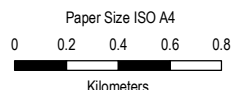
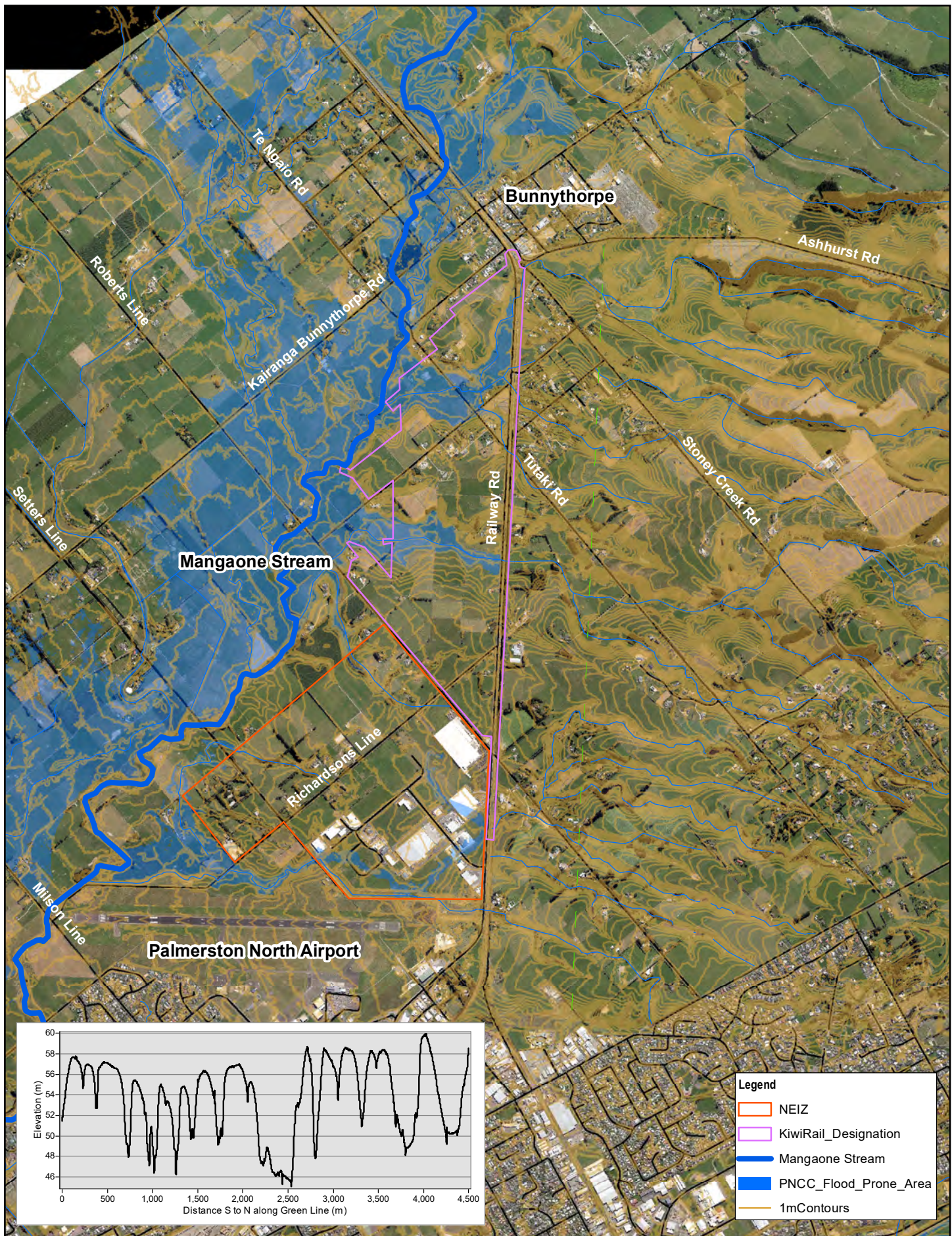
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**STUDY AREA  
 LAND COVER/LAND USE**

**FIGURE 3.5**





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STUDY AREA TOPOGRAPHY

FIGURE 3.6

### 3.3 Current Stormwater Management Infrastructure

Existing stormwater infrastructure in the Master Plan area is concentrated in the NEIZ, and consists of piped reticulation, a stormwater attenuation facility, and conveyance channels to mitigate runoff peak flows from the current industrial development. The current stormwater infrastructure in the area is shown on Figure 3.7.

The design of the stormwater attenuation facility that services the core NEIZ area (i.e., east of Richardsons Line) is documented in a 2007 report by Riley Consultants (“Proposed Detention Dam – North East Industrial Development”). The facility consists of a dam outlet structure placed across an existing channelised drain with an integrated 1500 mm diameter culvert and an earth and gabion-lined overflow spillway. The structure was designed to attenuate the 100-year 24-hour storm to the 2-year “winter storm” peak flow, which was estimated to be 8 m<sup>3</sup>/s, and provides capacity for approximately 165,000 m<sup>3</sup> of storage with some freeboard. However, the pond design likely results in increased peak flows for smaller, more frequent events which could be creating an adverse erosion effect in the downstream channels. The hydrologic assumptions that informed the pond design are documented in an earlier letter (John Philpott, “Stormwater Analysis North-East Industrial Area”, 11 March 2003); the analysis was based on an assumed 24-hour 100-year ARI rainfall depth of 127 mm, which aligns well with modern climate change adjusted depths, and resulted in a reasonable pond volume requirement. The capacity of this facility to attenuate additional industrial land outside of the core NEIZ area would require assessment.

The current stormwater facility provides little water quality treatment/benefit to runoff from the NEIZ but there is significant opportunity to retrofit such features into the facility, such as with a treatment wetland constructed within or just offline of the existing drain alignment.

Another aspect of the stormwater attenuation facility that was evaluated in the Riley Consultants report is the potential impact rating of the outlet dam itself. The report concluded that the dam would have a “low” impact rating based on the dam height, storage volume, and relatively sparse downstream development. In terms of more modern guidelines (NZSOLD, 2015), this structure would be considered a “classifiable dam” due to its potential storage volume exceeding 20,000 m<sup>3</sup> and dam height of approximately 4 m. PNCC should be aware that dam safety regulations in New Zealand are evolving and there may be future management obligations for this structure (i.e., emergency preparedness plans, operations and maintenance plans, recurring dam safety inspections, etc.).

### 3.4 Current Flooding Conditions

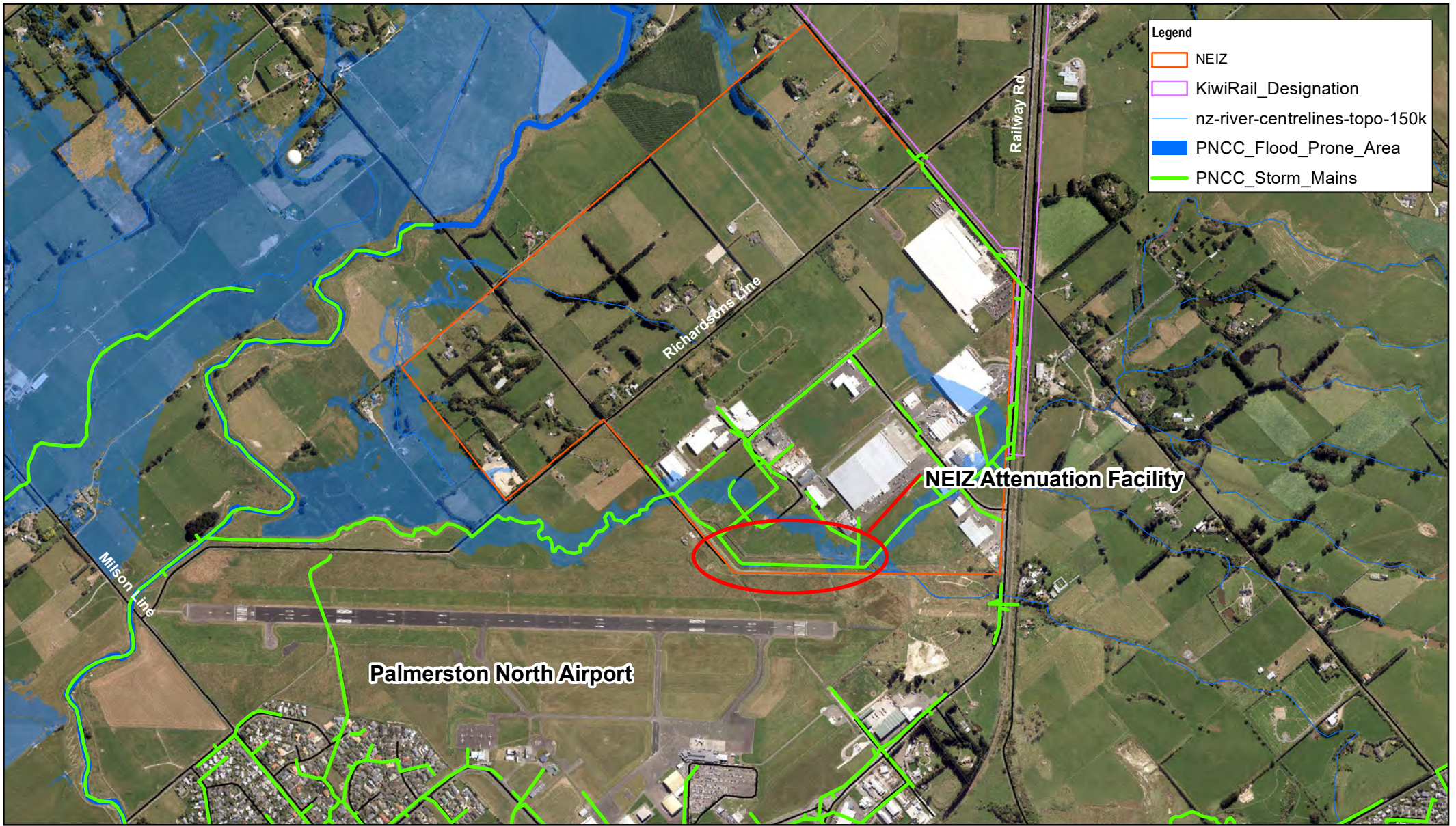
The Te Utanganui Master Plan area is located along the Mangaone Stream which has a history of flooding issues and is managed as such by Horizons Regional Council. There are two formal spillways for Mangaone Stream overflows north of the City, one at Roberts Line and one downstream at Rangitikei Line (near Flyers Line), to relieve the main Mangaone channel running through the Palmerston North urban area. Significant areas of rural land north of the City are inundated during high flow events as a result of these overflow spillways (see Figure 3.8 for an illustration of flood prone areas in the wider area north of the City).

Development within these flood prone areas is strictly controlled under both the District Plan and One Plan, requiring measures to avoid potential risks to people, property and infrastructure, and although development is not impossible in these areas it is discouraged and considered inefficient. However, if suitable land is not available in other nearby locations, development of these areas could be explored.

### 3.5 Potential Ecological Considerations

Although the purpose of this report is to address stormwater and flooding aspects of the Te Utanganui Master Plan area, these are intimately connected to the ecological conditions and characteristics of the site. In particular, the ecological values of any watercourses and wetlands within the study area are critical to understand when determining stormwater attenuation and treatment controls required for future development, and indeed for determining feasible locations for future development as a whole. The NPS-FM and NES-F provide a suite of policies and rules that control a range of activities around natural waterbodies, including earthworks, stormwater discharges, and channel crossings (i.e., to ensure fish passage is provided).

It is recommended that PNCC obtain a high-level ecological screening report of the study area to identify these potential constraints prior to developing Master Plan options and to inform the future MCA.

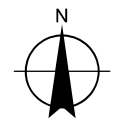


**Legend**

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- KiwiRail\_Designation
- nz-river-centrelines-topo-150k
- PNCC\_Flood\_Prone\_Area
- PNCC\_Storm\_Mains

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 Kilometers

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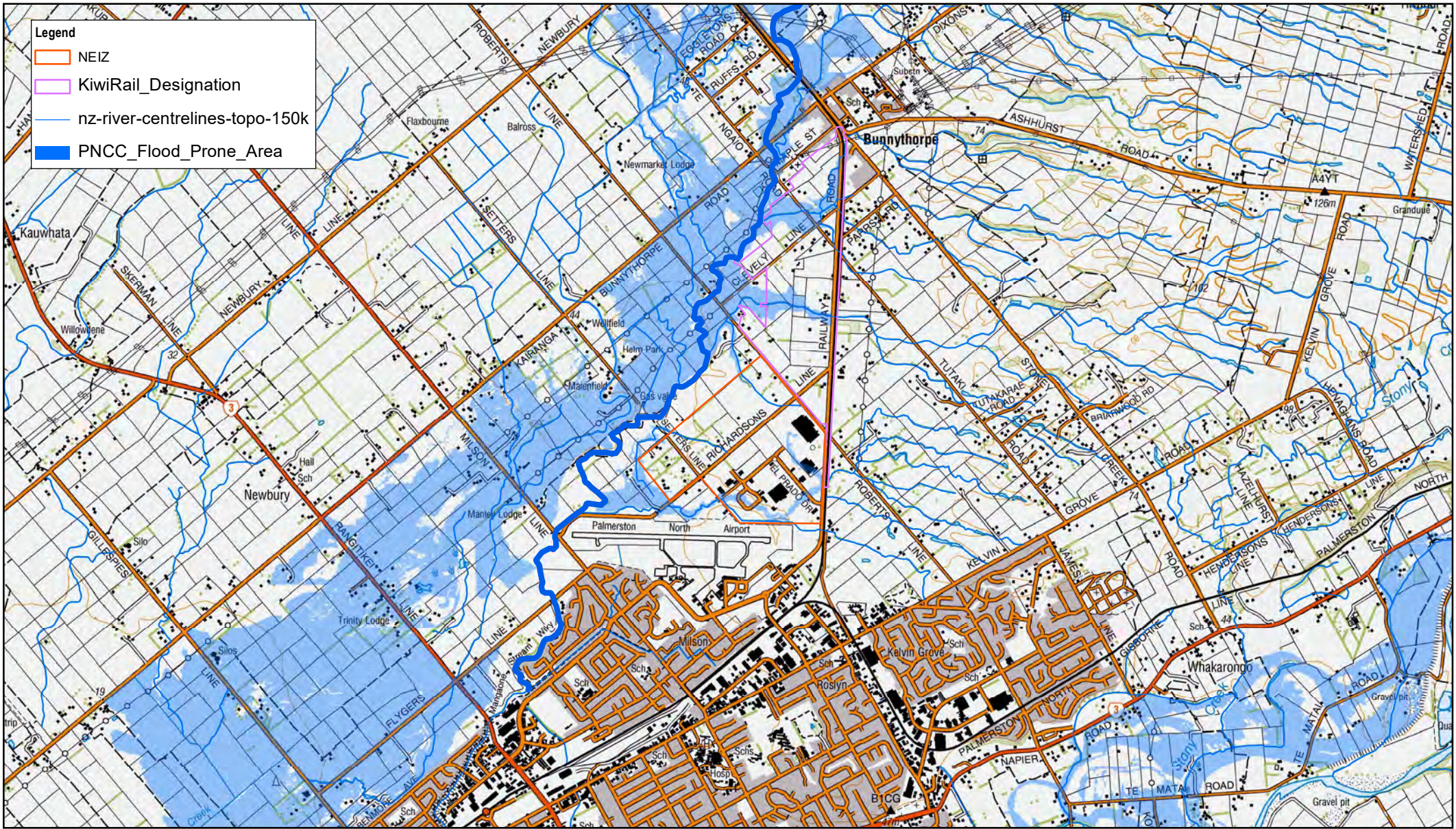


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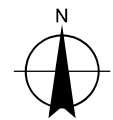
**EXISTING STORMWATER  
 INFRASTRUCTURE**

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**FIGURE 3.7**



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 Kilometers  
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**FLOOD PRONE AREAS**

**FIGURE 3.8**

# 4. Future Development Considerations

## 4.1 Summary of Development Projections

As part of the Te Utanganui Master Plan, PNCC retained a team of economists and market researchers from Fresh Info to forecast a range of potential scenarios for industrial land demand in northeast Palmerston North. These scenarios included low, medium and high demand projections assuming two broad conditions where the KiwiRail Freight Hub (KR) is or is not constructed. A summary of the projected demand for industrial land is shown in Figure 4.1 (Fresh Info, 2022) for the high-yield scenarios. Linked to the demand for industrial land is the total population in Palmerston North and the demand for new housing to support this population; the projected demand for new households is shown in Figure 4.2 (Fresh Info, 2022) for the high-yield demand scenario, along with the current or already-planned housing capacity in the City. These two projections – the demand for industrial land and new households – are the critical factors for the stormwater and flooding assessment, as they determine the potential magnitude of new development, exposure to potential flood risk, and required stormwater infrastructure.

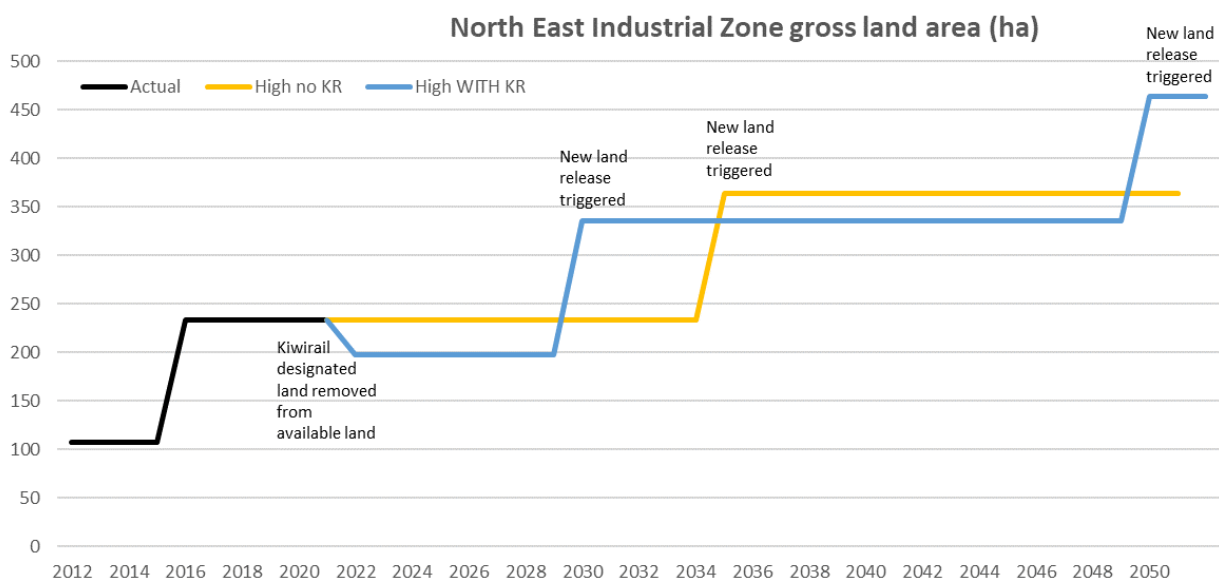


Figure 4.1 Projected demand for industrial land in northeast Palmerston North (Fresh Info, 2022)

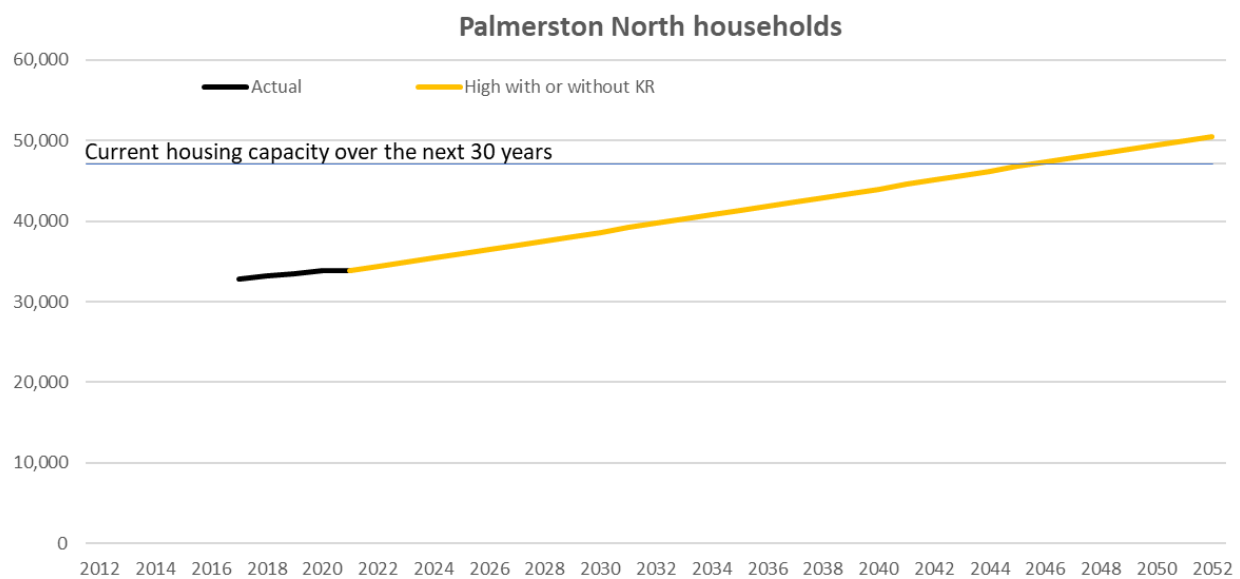


Figure 4.2 Projected households in Palmerston North under high-yield industrial land demand scenario (Fresh Info, 2022)

In summary, under the high-yield demand scenario, there is an expectation for an additional demand for industrial land of approximately 130-140 ha between 2028 and 2034, with an additional 130-140 ha of demand around 2050. The type of industrial use projected for this area is expected to be primarily related to wholesale trade and construction (Fresh Info, 2022), generally in line with the distribution and logistics purpose of the Te Utanganui area, with no major manufacturing, chemical, or wet industries anticipated. Although this industrial demand is associated with a general City-wide demand for housing, there appears to be sufficient capacity planned over the next 30 years to accommodate this demand; additional long-term residential zoning should be considered across the City, though this is likely not critical to include in Te Utanganui itself.

For the purpose of this Master Plan, it is assumed that two separate blocks of approximately 130-140 ha of industrial land will be identified, along with the required transportation and infrastructure links to the City, NEIZ, airport and future KiwiRail Freight Hub (at minimum).

## 4.2 Stormwater and Flooding Considerations

A range of considerations for stormwater and flooding concerns have been developed to inform the development of Master Plan options for Te Utanganui. These considerations are based on the projected future development needs summarised in Section 4.1, the assessment of current stormwater and flooding conditions described in Section 3, and the statutory context summarised in Section 2, and are intended to provide initial guidance at this early-planning stage of work to ensure stormwater and flooding concerns can be adequately addressed in the future, as well as to help direct future development to suitable areas.

Table 4.1 Stormwater and Flooding Considerations for Future Development

Criteria	Future Considerations
Flood Prone Areas	<ul style="list-style-type: none"> <li>– Future development should be located outside of identified flood prone areas, unless no other suitable land is available. This indicates that new zoning for industrial land would be best located east of Railway Road, away from the floodable areas of the Mangaone Stream.</li> <li>– Development located within flood prone areas will require potentially significant works to redirect/replace flood storage volume, provide sufficient minimum floor levels, provide safe access/egress routes, etc.</li> <li>– Future transportation linkages through flood prone areas should follow existing road alignments wherever possible to minimise effects, and should consider overall resiliency and consequence of failure in flooding scenarios. Upgraded roads will also require upgraded culverts for flood flows and potential raising of the road bed for safe access during flooding events.</li> </ul>
Flood Risk	<ul style="list-style-type: none"> <li>– Future development must be designed in such a way as to avoid increased flood risk to upstream or downstream properties, including sufficient stormwater attenuation/storage, conveyance corridors, etc.</li> <li>– Flooding assessments for future development must consider impacts related to both runoff peak flows and volumes, extend far enough upstream and downstream to confirm effects to adjacent properties are “less than minor” (i.e., through numerical modelling), and consider insofar as possible future development in other areas.</li> </ul>
Natural Watercourses and Wetlands	<ul style="list-style-type: none"> <li>– The locations and ecological values of all watercourses and wetlands must be identified and incorporated into development planning and design, following requirements under NPS-FM/NES-F.</li> <li>– Existing natural wetlands are unsuitable areas for development, and a minimum 100 m buffer should be granted around them to meet the NES-F requirements.</li> <li>– There may be potential to integrate stormwater features into or adjacent to natural wetlands into development planning through focused restoration work, as permitted under the NES-F; the extent to which stormwater works can be built in proximity to natural wetlands has not yet had widespread testing against the relatively new NES-F.</li> <li>– There may be opportunities to use the undulating study area topography effectively for stormwater management, using non-sensitive gully areas for treatment wetlands and attenuation that would otherwise be unsuitable or difficult for industrial development.</li> </ul>

Criteria	Future Considerations
<p>Stormwater Management Approach for Development Areas (Distributed vs. Centralised)</p>	<ul style="list-style-type: none"> <li>– Community-scale centralised stormwater treatment and attenuation facilities (i.e., wetlands) are the preferred approach to service new greenfield development in the Master Plan area, due to efficiencies for future operations/maintenance and overall long-term effectiveness. <ul style="list-style-type: none"> <li>• Sufficient area should be accommodated for community-scale facilities when allocating land for re-zoning and when developing structure plans for future development.</li> <li>• An estimate of 4-6% of total development area allocated for centralised stormwater facilities (including both treatment and attenuation) can be used at initial planning stages, not including any buffers or land required for natural streams/wetlands, conveyance of upstream flows or other drainage-related needs.</li> <li>• Centralisation of stormwater management needs to be flexible and responsive to local topographic conditions and landowner distribution in order to remain cost-effective and practical.</li> </ul> </li> <li>– Smaller distributed facilities (i.e., rain gardens, bioretention) are acceptable in intensification or redevelopment areas where sufficient space for centralised community-scale facilities is not available.</li> <li>– Where specific industrial uses have an elevated risk of runoff contamination, on-site measures will be required to address those targeted risks prior to discharge to any community-scale centralised facilities.</li> </ul>
<p>Stormwater Management Performance and Design Criteria</p>	<ul style="list-style-type: none"> <li>– Generally as per PNCC Engineering Standards for Land Development: <ul style="list-style-type: none"> <li>• Control of post-development peak flows to pre-development levels for ARI design rainfall events of 2-year through 100-year, incorporating climate change (RCP 6.0 2081-2100 scenario).</li> <li>• Water quality treatment to avoid effects to downstream natural environments and other at-risk areas. Considering the generally low-risk nature of industrial uses planned for Te Utanganui, typical industry best practice design is acceptable.</li> <li>• Over-control of peak flows in areas where downstream erosion is identified as a potential effect to natural habitat or built infrastructure, accompanied by an erosion threshold analysis where applicable.</li> </ul> </li> <li>– Soakage and infiltration for stormwater disposal is likely to be not appropriate for the Master Plan area, due to soil characteristics.</li> <li>– Higher-risk industrial users may require additional on-site treatment measures that cannot be accommodated in standard stormwater devices; to be determined on a case-by-case basis.</li> <li>– Design of specific stormwater treatment measures to follow accepted industry guidelines, such as Auckland Council GD2017/001.</li> </ul>

# 5. Objectives, Obstacles and Success Factors

The high-level stormwater and flooding characterisation for the Te Utanganui Master Plan area, as documented in previous sections of this report, is intended to be used by the master planning team in the generation and analysis of potential options for future development, in conjunction with input from a range of other technical fields. To assist in this process, the characterisation has been refined and consolidated into a series of objectives, obstacles and success factors for consideration by the master planning team. As well, a stormwater stakeholders workshop was facilitated by the master planning team on 23 Feb 2022 to collaboratively discuss potential objectives, obstacles and success factors, and included representatives from PNCC, Horizons Regional Council, and local landowners in NEIZ. These are summarised in the following sections.

## 5.1 Objectives

The objectives developed for the master planning team provide high-level targets for stormwater and flooding aspects of Te Utanganui to be considered in the generation and analysis of master plan options. A preliminary list of stormwater and flooding objectives include the following:

1. A forward-facing approach to stormwater and flood risk management that incorporates existing regulations and remains flexible to incorporate emerging practices and statutory changes.
2. A stormwater system that improves environmental outcomes in its hydrologic sphere of influence.
3. A stormwater system that manifests Te Mana o te Wai principles, enhances the mauri of water flowing through the system, and provides opportunities for cultural enhancement and amenity through reconnection of natural spaces.
4. A self-sufficient stormwater and flood risk management system that does not depend on or trigger any further upstream or downstream infrastructure.
5. A comprehensive, integrated stormwater system that is centrally planned and accommodating of staged future development.
6. A cost-effective and land-efficient stormwater system that is enabling of growth and development.
7. A stormwater management approach that rewards innovation and initiative from landowners to go above and beyond in managing their environmental impact.
8. Related transportation and infrastructure linkages designed in a way that contributes to beneficial stormwater and flood risk management outcomes.

## 5.2 Obstacles

Obstacles are factors that provide a barrier to achieving the Master Plan objectives, including factors such as cost, regulatory hurdles, technical/engineering challenges, and others. Some obstacles that have been identified through this assessment include the following:

1. The suitability and environmental sensitivity of receiving environments for stormwater runoff, including the currently unknown potential presence of natural wetlands which are protected under the NES-F.
2. The extent and severity of flood prone areas around the Te Utanganui Master Plan area will limit suitable areas for future industrial development as well as potential corridors for transportation and infrastructure connections/upgrades.
3. The availability and timing of funding to establish a stormwater system that achieves the Master Plan objectives.
4. The natural topography of the study area, crossed by numerous gullies and streams, in supporting centralised stormwater management solutions.
5. Potential flood risk effects associated with the extensive earthworks and fill proposed for the KiwiRail Freight Hub.



6. District Plan and Engineering Standards that may not be sufficiently robust to ensure the desired stormwater outcomes are achieved.

## 5.3 Success Factors

Considering the objectives and obstacles described above, the success factors then are those quantitative and qualitative metrics that determine whether Te Utanganui has successfully achieved its objectives. An initial suite of success factors/metrics is proposed below:

1. Stormwater features are well-managed by PNCC with sufficient operational and capital budgets in the Long Term Plan to manage the system effectively and efficiently.
2. Stormwater features provide significant amenity and desirability to industrial growth areas, helping to support the prosperity of a thriving industrial community.
3. A mana- and mauri-enhancing stormwater system that revitalises connections to the natural environment and enhances cultural awareness and vitality.
4. Stormwater features enable industrial land demand to be realised in an efficient manner by leveraging land for stormwater purposes that would otherwise be unsuitable for development.
5. Stormwater features that result in a net benefit to their internal and external natural environments.
6. A community where landowners are engaged and encouraged to actively contribute to the stormwater solution through sustainable site design and stormwater management.

# 6. Conclusions and Recommendations

## 6.1 Summary and Conclusions

A high-level characterisation of stormwater and flooding conditions in the Te Utanganui Master Plan area has been completed to inform the development and assessment of future growth options. The core of the study area, located to the west of Railway Road, is occupied by existing and planned industrial and transportation uses, including the Palmerston North airport, the North East Industrial Zone, and the proposed KiwiRail Freight Hub. To the west of this area is the Mangaone Stream and expansive floodable areas that are likely unsuitable for development. To the east of Railway Road is rural land located amongst rolling hills crossed by a network of gullies and streams that drain west to the Mangaone Stream, and it is this area that is considered most favourable for expanded industrial land zoning with respect to stormwater and flooding considerations.

Centralised, community-scale stormwater infrastructure, such as stormwater wetlands, is considered most efficient and effective to service an expanded greenfield industrial zone, depending on number of landowners and topography, with smaller distributed controls, such as raingardens and bioretention, considered appropriate in the retrofit/redevelopment of existing built-up areas. This is in line with the general approach taken with the core NEIZ area which is serviced by a large attenuation facility (though Council should be aware that changing dam safety regulations may increase management needs for this facility).

Based on the site characterisation, a suite of preliminary objectives, obstacles and success factors have been defined for consideration by the master planning team.

## 6.2 Recommendations and Next Steps

The stormwater and flooding assessment has identified gaps and opportunities that should be investigated as part of the master planning process, as well as some recommendations for next steps, including the following:

### Recommendations for Master Plan stage:

1. Undertake ecological screening to identify wetlands and other potential high-value communities/areas within the Master Plan area.
2. Avoid future industrial development in the flood prone areas around the Mangaone Stream, focusing instead on existing rural land east of Railway Road if adequate transportation links can be developed to this area.
3. Incorporate a minimum of 4-6% additional total land area for stormwater management purposes in the identification of future industrial zoning.
4. Consider and incorporate the proposed objectives, obstacles and success factors into the development and analysis of Master Plan options.
5. Review preliminary Master Plan options for stormwater and flood management suitability prior to formalising the options for MCA.

### Recommendations for next steps:

6. Investigate the opportunity to upgrade the existing NEIZ stormwater attenuation facility to both provide water quality treatment of runoff and accommodate additional future industrial development located east of Railway Road, including consideration of changing dam safety requirements.
7. Investigate the suitability and level of detail of the existing Mangaone Stream flood modelling, and engage with Horizons Regional Council to improve flooding extent confidence/certainty.
8. Consider the development of Te Utanganui planning and design standards for stormwater management (along with other relevant criteria).
9. Undertake a comprehensive stormwater management plan for the proposed Master Plan development option, once confirmed, to proactively identify infrastructure needs and secure LTP funds for implementation.



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