RDC 3 Waters Growth Strategy

Growth Assessment

Rangitikei District Council

17 February 2026

→ **The Power of Commitment**

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The Power of Commitment

Executive summary

New Zealand is experiencing a period of accelerated and continuous population growth, with much of the growth expected to occur in the regions outside of the major urban centres. Townships within the Rangitikei District are no exception to this. To accommodate the expected growth, Rangitikei District Council (RDC) have been required to identify potential growth areas and develop spatial strategies that outline long-term issues, opportunities and challenges for development. RDC have developed spatial strategies for five of their townships (Bulls, Marton, Mangaweka, Taihape and Hunterville Urban) and now require a three waters infrastructure assessment to understand what areas are 'infrastructure-ready' and what areas require infrastructure upgrades to accommodate additional growth.

The infrastructure assessment spans both water and wastewater treatment as well as potable water, wastewater and stormwater infrastructure. The assessment has been completed using a two-stage approach – an existing infrastructure assessment followed by a growth infrastructure assessment. The Stage 1 existing infrastructure assessment was completed to inform the considered growth areas in Stage 2.

Hydraulic models have been previously developed and were used to inform the Stage 2 growth infrastructure assessment. The completion of Stage 2 has identified potential options that RDC could consider to accommodate Council's growth projections at the targeted growth areas. The requirement of network augmentations is summarised in Table 1[1]. It should be noted that this does not incorporate the water and wastewater treatment plant assessments done separately[2].

Table 1 Requirement of network augmentations to service growth areas

Growth Area	Water Supply Upgrades (Yes/No)	Wastewater Upgrades (Yes/No)	Flood Hazard Management* (Yes/No)
BUL01	Yes	No	Yes
BUL02	Yes	Yes	Yes
BUL03	Yes	No	No
Bulls Infill	Yes	No	No**
MAN01	No	No	Yes
MAN02	Yes	No	Yes
MAR01	Yes	Yes	Yes
MAR02	Yes	Yes	Yes
MAR07	Yes	No	Yes
Combined (MAR01, MAR02, MAR03 – partial, MAR04 – partial, and MAR07)	Yes	Yes	Yes
Marton Infill	Yes	No	No**
Taihape Infill	No	No	No**

* Flood hazard management refers to the need to address existing significant flooding only; it does not negate the need for stormwater management to manage the effects of the development itself.

** The high-level modelling indicates minimum floor levels may be required for some areas.

[1] Refer to Section 4 of this report for more details on the upgrade requirements for each growth area.
[2] Refer to *Stage 2 – Bulls Water Treatment Plant Capacity Assessment* (GHD, October 2024) report, *Stage 1 Workshop and Presentation* (GHD, 10 May 2024), and *Marton, Bulls and Taihape Wastewater Treatment Plant Assessment* (GHD, 17 February 2026) for growth implications.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.2 and the assumptions and qualifications contained throughout the Report.

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1. Introduction

Townships within the Rangitikei District are projected to undergo a period of rapid and sustained growth. To accommodate the expected growth, Central Government has requested territorial authorities to develop long-term strategies that identify issues, opportunities and challenges associated with supporting the additional growth. Rangitikei District Council (RDC) have developed spatial strategies for five of their townships (Bulls, Marton, Mangaweka, Taihape and Hunterville Urban) and now require a three waters infrastructure assessment to understand what areas are 'infrastructure-ready' and what areas require infrastructure upgrades.

RDC have commissioned GHD Limited (GHD) to complete a three waters infrastructure assessment while considering various planned growth areas. The assessment aimed to identify infrastructure upgrades required to service additional growth.

The infrastructure assessment has been completed in a two-stage approach, separated into Stage 1, an existing infrastructure assessment and Stage 2, a growth infrastructure assessment. GHD completed Stage 1 for the townships on 22 May 2024, highlighting suitability and deficiencies of existing infrastructure to accommodate future growth. The stormwater assessment identified flood prone areas within the townships which informed the growth areas considered in Stage 2.

The purpose of this work is to inform RDC's proposed plan change for urban growth and identify capacity issues requiring RDC's investment to support the plan change. Upon a successful plan change, additional work will be required to translate the identified issues into executable projects by RDC.

1.1 Purpose of this report

The purpose of this report is to:

- Provide a high-level summary of the Stage 1 existing infrastructure assessment.
- Document the assumptions used and the methodology taken in the Stage 2 growth assessment.
- Present model results for both stages of the three waters infrastructure assessment.
- Summarise identified areas where infrastructure is adequate or insufficient to support additional growth.
- Recommend upgrades required to accommodate the additional planned growth.

1.2 Scope and limitations

This report: has been prepared by GHD for Rangitikei District Council and may only be used and relied on by Rangitikei District Council for the purpose agreed between GHD and Rangitikei District Council as set out in section 1 of this report.

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

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

Accessibility of documents

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.

GHD has prepared the Water, Wastewater, Stormwater models ("Models") for, and for the benefit and sole use of, Rangitikei District Council to support the purpose as discussed in 1.1 to notify the plan change in early 2026 and must not be used for any other purpose or by any other person.

The Model is a representation only and does not reflect reality in every aspect. The Model contains simplified assumptions to derive a modelled outcome. The actual variables will inevitably be different to those used to prepare the Model. Accordingly, the outputs of the Model cannot be relied upon to represent actual conditions without due consideration of the inherent and expected inaccuracies. Such considerations are beyond GHD's scope.

The modelling was carried out in mid-2025. The information, data and assumptions ("Inputs") used as inputs into the Model are from publicly available sources or provided by or on behalf of the Rangitikei District Council, (including possibly through stakeholder engagements). GHD has not independently verified or checked Inputs beyond its agreed scope of work. GHD's scope of work does not include review or update of the Model as further Inputs becomes available.

The Model is limited by the mathematical rules and assumptions that are set out in the Report or included in the Model and by the software environment in which the Model is developed.

The Model is a customised model and not intended to be amended in any form or extracted to other software for amending. Any change made to the Model, other than by GHD, is undertaken on the express understanding that GHD is not responsible, and has no liability, for the changed Model including any outputs.

GHD has prepared this report on the basis of information provided by Rangitikei District Council and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.3 Assumptions

1.3.1 General assumptions

The following assumptions have been made in carrying out this assessment:

- All assets are presented in New Zealand Transverse Mercator 2000 (NZTM 2000) horizontal datum and NZVD2016 vertical datum. Lid and invert levels in RDCs asset data for assets constructed prior to 2020 were assumed to be in Moturiki 1953 and converted to NZVD2016.
- Ground models built from LiDAR data have been previously sourced from Horizons Regional Council and used in the model builds. Where required, supplementary ground models have been sourced from LINZ. Assumptions surrounding these ground models and LiDAR data can be found in their respective model build reports.
- The population is based on 2018 census data from Statistics NZ.
- The existing models are assumed to be representative of the existing RDC infrastructure and townships at the time of this study.
- The existing models have not been validated or calibrated against any field data or otherwise.
- A population density of 2.7 people per dwelling has been assumed for all population growth calculations.
- The infill growth polygons (and their calculated areas) provided by RDC have been assumed to be correct. The current study assumes one additional dwelling for each lot between 800 and 1000 square metres and two additional dwellings for each lot between 1000 and 1200 square metres. Details of the infill growth yields are provided in Table 4 of this report.
- The greenfield lot (dwelling) yields provided by RDC have been assumed to be correct. The current study assumes "Yield Scenario 2" only. This assumes 30% of greenfield areas will be allocated for roading and greenspace, leaving 70% developable area. Details of the greenfield yields and greenfield growth population are provided in Table 5 of this report.
- For the purposes of the current study, it is assumed that infill and greenfield growth will not be occurring at the same time and will therefore be assessed separately.
- Wastewater Treatment Plant assessment is outside of the Stage 2 scope of work and is therefore not included in this report.

1.3.2 Water Supply Assumptions

The following assumptions have been made in the current study:

- A daily consumption of 250 litres/person/day.

- Demand peaking factors (based on population) for infill scenarios have been based on a total population of the town (existing population growth + infill growth population).
- Demand peaking factors (based on population) for greenfield scenarios have been based on the total projected population growth only.
- Additional non-revenue water (NRW) has been assumed in greenfield scenarios only and are based on a calculation of each township's total non-revenue water per connection. Details are provided in Table 8.
- The Bulls water supply network has been assumed to be fed from the new Taumaihi Street booster pump station i.e. the Trickers Hill Reservoirs have been decommissioned and are not in use. The new Bulls booster pump station is assumed to be downstream of the new Taumaihi Street concrete reservoir and is represented by a fixed head of 83 m as per the basis of design in the *Bulls Reservoir Booster Pump Station Detailed Design (GHD, December 2020)* report.
- For the purposes of optioneering, GHD assumes that an additional reservoir feed is available in Marton at 5 Calico Line. It has been assumed that this feed can supply up to 30 l/s.
- The Marton PRV has been set at 52 m as per communications with RDC. The Taihape PRV settings have been left as is at 85 m.
- Upgrades have been proposed with the intent of achieving existing levels of service.
- Proposed upgrades are assumed to be PE PN12.5 SDR13.6 pipes with a Colebrook-White roughness value of 0.06 mm.
- System augmentations were developed keeping in mind constructability, ease of maintenance, implementation and pipe criticality. Proposed upgrades have attempted to avoid roads such as the State Highway.
- System Performance Criteria as set out in NZS4404
    - Minimum pressure of 25 m
    - Maximum pressure of 80 m
    - Headlosses less than 5 m/km for pipes smaller than or equal to DN150
    - Headlosses less than 5 m/km for pipes smaller than or equal to DN200
    - Velocities between 0.5 m/s and 2 m/s
- The current study focusses on achieving a level of system performance that meets existing levels of service. Reservoir performance has not been assessed in this study.
- The completed fire flow assessment has only assessed FW2 (applicable to residential domestic buildings only) in place of insufficient building classification information. The assessment has assumed 2/3 of the PDD flow + 25 l/s at 10 m of residual pressure at the hydrant as per the firefighting code of practice (SNZ PAS 4509_2008).
- With regards to fire flow, the current study has not modelled or considered the fire tank at 4 Criterion Street near the visitor centre in Bulls as it is assumed to only service non-residential firefighting demands within close proximity of the tank.

1.3.3 Wastewater Assumptions

The following assumptions have been made in the current study:

- The wastewater models used in this assessment are not calibrated.
- The following flow assumptions have been used in this assessment:
    - Design flows as per NZS 4404
    - Residential – 250 L/person/day
    - Commercial – 0.4 L/s/ha
    - Industrial (medium) – 0.7 L/s/ha
    - Industrial (heavy) – 1.3 L/s/ha
    - Synthetic diurnal residential pattern with dry weather peaking factor of 2.5
    - Non-residential profile for commercial (8-hr shift) and industrial (11-hr shift) catchments

- Wastewater profile for schools (9am – 3pm) with peak design flow of 40L/person/day for dry weather, and a wet weather peaking factor of 5.
- Wet weather peaking factor of 5 for greenfield and infill growth areas.
- Wet weather peaking factors based on 2019/2020 flow monitoring data for existing catchments as follows:
  - Bulls – 0.6-year ARI (1 hr storm duration) average wet weather peaking factor of 9.5
  - Hunterville – 1-year ARI (12 hr storm duration) average wet weather peaking factor of 13
  - Marton – 1-year ARI (12 hrs storm duration) average wet weather peaking factor of 14
  - Mangaweka – 0.7-year ARI (6 hrs storm duration) average wet weather peaking factor of 12.5
  - Taihape – 1-year ARI (6 hrs storm duration) average wet weather peaking factor of 10
- Fixed discharge pump assumed based on incoming flows.
- All of the greenfield and infill growth areas are residential.
- Where the model indicates the network had limited capacity and exhibited predicted spills under the status quo scenario (i.e., no growth), necessary upgrades to mitigate these spills were identified before incorporating growth into the model to resolve those constraints in the network. The proposed upgrades in this study were attributed exclusively to growth.
- The sizing of the proposed pipe upgrades assumes pipe surcharge below pipe sofit after the upgrades.

1.3.4 Stormwater Assumptions

The following assumptions have been made in the current study:

- For this growth study, 2D surface flow models were considered sufficient to obtain an understanding of drainage patterns and to identify flood prone areas where development should be avoided.
- The urban drainage network is not included in the models except where they intersect overland flow paths.
- For Mangaweka, the model is developed from a Digital Surface model (DSM). Therefore, the Mangaweka model results show that the open drains in some areas may not convey the runoff as expected due to irregularities in the ground surface restricting flow into the drains.
- The stormwater assessment for greenfield development quantified the existing flooding hazard that must be addressed by the developer, separate from any stormwater mitigation measures they implement, to inform the feasibility of rezoning.
- This assessment only provided a qualitative evaluation of the potential effects of development on the downstream catchment. This assessment did not involve any modelling of the proposed greenfield development.
- For infill scenarios for stormwater assessment, an additional impervious area of 40% is assumed per infill lot.

In addition to the above, assumptions associated with specific parts of the current study have been discussed throughout the remainder of this report.

2. Methodology

The following section details the approach taken in both stage 1 and stage 2 of this assessment.

2.1 Water treatment plant assessment

An assessment was carried out on the Water Treatment Plants in five Rangitikei District townships – Bulls, Marton, Mangaweka, Taihape, and Hunterville. The study evaluated future demand and service gaps based on existing capacity, performance, and consents, alongside expected growth trends. The findings offered a high-level overview of future plant requirements and concerns, emphasizing the challenges of necessary upgrades.

The assessment also highlighted the need for additional data and site visits to all treatment plants to verify capacity, assess proposed upgrades, refine cost estimates, and consider consent implications. And that moving forward, determining the population that the water treatment plant can accommodate would be valuable.

After the stage 1 assessment, Rangitikei Council confirmed that Bulls and Marton are the most likely areas to be considered for future growth. Marton is set to receive a new water treatment plant and source, with some allowance for future expansion incorporated into the design. The council plans to include design allowances to support the strategic plan for potable water infrastructure growth in the community. As such, no further work was carried out for the Marton WTP. Upon speaking with RDC staff to finalise this report, it is understood that council is still in the planning stages for this upgrade, with detailed design set to begin in late-2026 / early-2027.

As part of stage 2, further assessment of the Bulls Water Treatment Plant (WTP) Capacity was carried out to evaluate the current treatment capacity of the plant and its main components - such as filters, dosing systems, and pumps – based on site inspections and interviews with RDC staff conducted in July 2024. The assessment aimed to estimate the number of people the WTP can currently serve and identify any constraints or upgrade needs to support future growth.

The WTP currently serves approximately 1,850 people, with an average daily demand of around 1,904 m^3/day. The plant operates near its capacity, constrained primarily by the chlorination system and limited raw water supply from underperforming bores.

The outcomes of the assessments were:

- Bulls WTP is likely able to supply the average demand of the approved 111 new connections at 2.4 persons per connection not larger than 360 L/person/day.
- Water treatment capacity upgrades will be required for further future growth either as upgrades of the existing WTP, or as a new WTP at a different location.
- There is limited space for new or additional equipment on the existing WTP site.
- Coagulant dosing and filtration have potential for higher production. However, there are limiting factors for increased production at the existing WTP:
    - Raw water supply. The existing bores do not recharge fast enough to support continuous high production. A new water source will need to be developed, or existing bores redeveloped to achieve a greater sustainable yield.
    - Chlorination system. Provided that the existing chlorination system is in good condition, chlorination capacity would require a relatively minor intervention, likely involving replacement of the chlorine gas flow unit and possibly replacement of the gas injector. It would be good practice to install a dedicated chlorine to ensure chlorine carry water flow to the injector at a constant flow rate and thus ensure consistent vacuum within the system.
- The UV reactors are likely capable of treating the full flow from the filters operating at higher filtration rates.
- Some upgrades will likely be required to ensure a continuous safe operation of the existing WTP:
    - Backwash system, including a backwash tank and backwash pumps
    - Control software upgrade to accommodate new equipment
    - Electrical upgrades to accommodate new equipment
    - Comms between bores and WTP.

Refer to the *Stage 2 – Bulls Water Treatment Plant Capacity Assessment (GHD, October 2024)* report for further details.

2.2 Water supply network model build

Development of the water supply network model builds for the five Rangitikei District townships were previously completed as part of RDC's water masterplan and used in the Stage 1 existing infrastructure assessment. The water supply network was built based on RDC's online GIS data, downloaded on 31/10/2023. Customer consumptions and non-revenue water were based on a high-level analysis of Council's provided data at the time.

Refer to the *Rangitikei Water Supply Model Build (GHD, November 2024)* report for further details.

The water supply models for Marton and Taihape are currently being calibrated against field test data and as such, were not calibrated for this study. Although field data has been collected for Bulls, the impending commissioning of the Taumaihi Street booster pump station and reservoir has delayed calibration of this model as new field data will need to be collected. GHD are currently not aware of any plans to calibrate the Mangaweka or Hunterville Urban water supply models.

2.2.1 Water supply growth modelling

Modelling scenarios were developed based on the provided growth locations. Infill and greenfield growth locations have been provided by RDC as GIS polygon shapefiles. As the exact location of development is unknown (particularly greenfield), it is assumed that centroids of these polygons are representative of the growth development demand. All calculated consumptions have been assigned to these centroid points and connected to a nearby part of the water supply network. Table 2 provides the pipe asset ID and location that the growth consumption is connected to.

Table 2 Greenfield growth connections to the water supply network

Greenfield Growth Area	Elevation of Customer Connection (m)	Average Elevation of Growth Area (m)	Pipe Asset ID	Location
BUL01	63.37	61.97	2002327370	20 Wilson Street
BUL02	60.63	61.03	2002327361	19 Watson Street
BUL03	56.63	56.46	20120720090644ds	Flower Street
MAR01	166.99	167.92	20023271174	50 Tutaenui Road
MAR02	162.64	162.03	200232736	40 Milne Street
MAR03	162.10	161.13	20100421135740us	Calico Line
MAN04	155.91	155.01	20100421135740us	103 Calico Line
MAR07	170.01	177.99	200232736	40 Milne Street
MAN01	321.73	322.44	20030403152332	Kakariki Street
MAN02	318.40	318.01	20180702105256	22 Raumaewa Road

2.3 Wastewater network model build

2.3.1 Background

Five wastewater models were developed for the townships of Marton, Bulls, Taihape, Hunterville and Mangaweka for RDC's wastewater masterplan project. These models were built in Infoworks ICM modelling software using data provided by RDC. The models use NZTM 2000 coordinate projection and elevations are in NZVD2016 datum.

The wastewater network models were built using reasonably good invert level data (50-65%), lid level data (60-80%), pipe diameter and material data (98-100%) for all towns. No other asset data was available for the model build, except for the pump station information for the Taihape Papakai pump station.

The catchment models were built using the wastewater network layout data, population, land use and topography data provided by RDC and HRC. Assumed values were assigned for missing data based on engineering judgement, and basic quality and sense checking of the data was carried out. These models were not calibrated at the time of this growth study.

Refer to *Wastewater Model Build Report – Marton, Bulls, Taihape, Hunterville, and Mangaweka* (GHD 2024) for more detailed methodology.

At the time of this report GHD was undertaking calibration of the five townships. Although this study could not utilise the calibrated models, real flow data was utilised for the townships to help inform the wet weather response.

2.3.2 Wastewater growth modelling

The uncalibrated wastewater models for each town were used for the growth assessment. Different scenarios were created for each town for the different proposed greenfield growth areas and infill scenarios. Each scenario was run to identify network constraints due to growth (i.e. where spilling is predicted due to the addition of growth).

The growth areas provided by RDC have the number of lots, and population were calculated based on 2.7 people per lot. It is assumed that all of the growth areas are residential, hence a synthetic diurnal residential wastewater profile was applied for these subcatchments. Dry weather and wet weather peaking factors of 2.5 and 5 were used, respectively. For existing subcatchments, inflows were added to simulate wet weather flows based on 2019/2020 flow monitoring data. Wet weather peaking factors mentioned in section 1.3.3 were applied in the model for each respective town. These peaking factors were calculated from the gauge flows and wastewater treatment plant flows provided by RDC.

The wastewater flows from the greenfield areas and infill lots were connected into the most suitable nearest wastewater manhole. Table 3 shows the greenfield area connection points to the existing wastewater network.

Table 3 Greenfield growth manhole connection locations

Greenfield Growth Area	Manhole Name (Asset ID)	Location
BUL01	BU2MH01170 (20020305104517600)	14A Wilson Street
BUL02	BU2MH02150 (20050407114901)	15A Watson Street
BUL03	BU2MH01810 (20020305104517600	43 Flower Street
MAR01	ML2MH02970 (2002030510451665)	52 Tutaenui Road
MAR02	ML2MH05730 (20020305104516120)	56 Wanganui Road
MAR03	ML2MH02620 (20020305104517307)	23 Calico Line
MAR04	ML2MH02520 (20020305104516267)	60 Calico Line
MAR07	ML2MH04330 (2002030510451691)	35 Milne Street
MAN01	MA2LH00230 (20111006084601)	32 Broadway
MAN02	MN2MH00090 (20020305104517874)	State Highway 1 and Raumaewa Road intersection

System improvement scenarios were developed to assess network upgrades required to accommodate for growth areas. Upgrades were proposed to resolve any ‘spilling’ predicted by the model along the wastewater mains as a result of the added growth. Since this was a high-level assessment, upgrades were designed to lower the hydraulic grade line below the soffit of the pipe. If the network had limited capacity and showed predicted spills for the status quo scenario (i.e., no growth), upgrades to resolve these spills were determined prior to introducing growth in the model. Theoretical calculations were carried out to determine the increase in diameter that could be solely attributed to growth.

2.4 Stormwater model build

2.4.1 Background

Four stormwater models were developed for the townships of Marton, Bulls, Taihape and Hunterville. These models were built in Infoworks ICM modelling software using the data provided by RDC. The models use NZTM 2000 coordinate projection and elevations are in NZVD2016 datum.

For this growth study, 2D surface flow models were considered sufficient to obtain an understanding of drainage patterns and to identify flood prone areas where development should be avoided. The urban drainage network is not included in the models except where they intersect overland flow paths.

The catchment models were built using the available topography provided by Horizons Regional Council (HRC), and culvert data provided by Waka Kotahi, Kiwirail, RDC and HRC. Assumed values were assigned for missing data based on engineering judgement, and basic quality and sense checking of the data was carried out.

The 2D surface models have since been further developed to include the piped reticulation as part of RDC's stormwater masterplan project. However at the time of this report, the model build for Marton, Bulls, Taihape and Hunterville had not been completed.

2.4.2 Mangaweka stormwater model build

As part of this growth study, a 2D surface model for Mangaweka was developed from Digital Surface Model (DSM) data provided by HRC. This lower resolution DSM may result in overland flow conveyance issues in some areas of the catchment.

The model results show that the open drains in some areas may not convey the runoff efficiently due to irregularities in the ground surface restricting flow into the drains. Specific areas of concern will be discussed further in the existing network assessment in Section 4.3.1. Additional lidar survey would be beneficial in the future to assess the conveyance of surface flow in the growth areas and to refine the model.

2.4.3 Stormwater growth modelling

It is understood that RDC will require greenfield development to be hydraulically neutral, meaning the peak flow from the site post-development must not exceed the pre-development peak flow. The stormwater assessment includes quantifying the extent of the existing flood hazard that the developer will need to accommodate independent of their own stormwater mitigation requirements, and providing a qualitative assessment of the development's effects on the downstream catchment.

The existing flood volume within each growth area was calculated to inform the existing flood hazard assessment, and possible downstream effects from the development were qualitatively assessed. Only flood depths greater than 50 mm were included in the calculation as lower depths may not contribute to flooding.

For the assessment of infill growth, the infill lots provided by RDC were imported into the model. Each infill lot was assigned a pervious and impervious percentage calculated based on the existing perviousness and imperviousness values, plus the additional 40% impervious due to infill development.

3. Growth projections and modelling scenarios

3.1 Growth Projections

RDC provided infill and greenfield growth projections, summarised in Table 4 and Table 5 respectively. "Yield Scenario 2" is defined in the assumptions.

Table 4 Infill growth projections

Lot Area (m^2)	Township		
	Bulls	**Marton**	**Taihape**
800 – 1000	164	141	50
1000 - 1200	79	110	44
Total Lots	243	251	94
Total Dwellings*	322	361	138

*Assumes two additional dwellings per lot size of 1000 -1200 square metres

Table 5 Yield Scenario 2 greenfield growth projections

Town	Growth Area	Total Area (ha)	Developable Area (ha)	Dwelling Yield	Population
Bulls	BUL01	33.7	31.8	342	925
Bulls	BUL02 (whole area)	45.7	39.8	429	1157
Bulls	BUL03	7.1	2.0	22	58
Marton	MAR01	64.2	54.9	591	1596
Marton	MAR02	41.8	33.6	362	977
Marton	MAR03 (partial)	3.8	3.8	41	110
Marton	MAR04 (partial)	2.0	1.8	19	52
Marton	MAR07	43.7	41.6	291*	786
Mangaweka	MAN01	8.1	3.9	42	113
Mangaweka	MAN02	27.2	17.0	183	494

*Assumes 1000 square metre sections rather than 650 square metre sections as the lots are expected to be larger lifestyle blocks as provided by RDC

3.2 Modelling scenarios

Table 6 details the modelling scenarios completed under the Stage 2 growth infrastructure assessment. These were based on the growth areas identified in Figure 1 for the proposed greenfield growth areas for Bulls, Marton and Mangaweka, and Figure 2 for the proposed infill growth areas for Bulls, Marton and Taihape.

As per the scope of works, each infill and greenfield growth scenario has been assessed separately. Network upgrade requirements for each scenario have also been assessed.

Table 6 Modelling scenarios

Town	Water Supply	Wastewater	Stormwater
Bulls	Existing System Performance	Existing DWF	Existing (Pre-development)
	Existing Fire Flow (FW2) Assessment	Existing WWF	
	BUL01 System Performance	BUL01 DWF	-
	BUL01 Fire Flow (FW2) Assessment	BUL01 WWF	
	BUL02 System Performance	BUL02 DWF	-
	BUL02 Fire Flow (FW2) Assessment	BUL02 WWF	
	BUL03 System Performance	BUL03 DWF	-
	BUL03 Fire Flow (FW2) Assessment	BUL03 WWF	
	Infill System Performance	Infill DWF	Infill (post-development)
	Infill Fire Flow (FW2) Assessment	Infill WWF	
Hunterville	Existing System Performance	Existing DWF	Existing (Pre-development)
	Existing Fire Flow (FW2) Assessment	Existing WWF	
Marton	Existing System Performance	Existing DWF	Existing (Pre-development)
	Existing Fire Flow (FW2) Assessment	Existing WWF	
	MAR01 System Performance	MAR01 DWF	-
	MAR01 Fire Flow (FW2) Assessment	MAR01 WWF	
	MAR02 System Performance	MAR02 DWF	-

Town	Water Supply	Wastewater	Stormwater
	MAR02 Fire Flow (FW2) Assessment	MAR02 WWF	
	MAR07 System Performance	MAR07 DWF	-
	MAR07 Fire Flow (FW2) Assessment	MAR07 WWF	
	MAR01, MAR02, MAR03 (partial), MAR04 (partial), MAR07 System Performance	MAR01, MAR02, MAR03 (partial), MAR04 (partial), MAR07 DWF	-
	MAR01, MAR02, MAR03 (partial), MAR04 (partial), MAR07 Fire Flow (FW2) Assessment	MAR01, MAR02, MAR03 (partial), MAR04 (partial), MAR07 WWF	
	Infill System Performance	Infill DWF	Infill (post-development)
	Infill Fire Flow (FW2) Assessment	Infill WWF	
Mangaweka	Existing System Performance	Existing DWF	Existing (Pre-development)
	Existing Fire Flow (FW2) Assessment	Existing WWF	
	MAN01 System Performance	MAN01 DWF	-
	MAN01 Fire Flow (FW2) Assessment	MAN01 WWF	
	MAN02 System Performance	MAN02 DWF	-
	MAR02 Fire Flow (FW2) Assessment	MAN02 WWF	
Taihape	Existing System Performance	Existing DWF	Existing (Pre-development)
	Existing Fire Flow (FW2) Assessment	Existing WWF	
	Infill System Performance	Infill DWF	Infill (post-development)
	Infill Fire Flow (FW2) Assessment	Infill WWF	

Bulls

1. BUL01
2. BUL02
3. BUL03

Marton

4. MAR01
5. MAR02
6. MAR07
7. MAR01, MAR02, MAR03 (partial), MAR04 (partial), MAR07

Mangaweka

8. MAN01
9. MAN02

Figure 1 Proposed Greenfield growth areas and scenarios (Bulls, Marton, Mangaweka)

Figure 2 Proposed infill growth areas (Bulls, Marton, Taihape)

3.2.1 Water Supply Growth Demand

Table 7 documents the modelled consumptions as a result of the above growth projections. Peak hour factors were calculated based on population growth. As per NZS4404, a peak hour factor of 5 was applied to all greenfield growth scenarios other than the combined Marton growth scenario. The combined Marton scenario and infill scenarios used interpolated peaking factors as the populations exceeded 2,000 people.

Table 8 summarises the assumed NRW per greenfield connection. These are only presented for the relevant townships with greenfield growth and exclude Taihape as no greenfield growth was expected or has been modelled. The amount of NRW assumed per greenfield lot has been calculated based on a leakage rate per existing connection. The estimated total NRW was previously assumed in Stage 1 based on water loss data provided by RDC.

Table 7 Existing demands and additional consumption of growth areas

Zone	Estimated Existing Population	Existing Peak Day Demand (L/s)	Existing Peak Hour Demand (L/s)	Growth Area	Additional Growth Population	Additional Average Demand (L/s)	Additional Peak Demand (L/s)	Additional Demand at Peak Hour (L/s)
Bulls	2114	16.59	57.30	BUL01	925	2.68	5.35	26.75
				BUL02 (whole area)	1157	3.35	6.70	33.49
				BUL03	58	0.17	0.34	1.68
				Bulls Infill	869	2.52	4.90	22.31
Marton	5538	39.85A	95.24	MAR01	1596	4.62	9.24	46.19
				MAR02	977	2.83	5.65	28.27
				MAR03 (partial)	110	0.32	0.64	3.20
				MAR04 (partial)	52	0.15	0.30	1.51
				MAR07	786	2.28	4.55	22.75
				Marton Infill	975	2.82	4.89	15.38
Mangaweka	238	1.78	3.30	MAN01	113	0.33	0.66	3.28
	238	1.78	3.30	MAN02	494	1.43	2.86	14.30
Taihape	1928	14.05	27.07	Taihape Infill	373	1.08	2.14	10.35

Table 8 Assumed non-revenue water per greenfield lot

Township	Total Township NRW (L/s)	Number of Customer Connections	NRW per connection (Litres/connection/day)
Bulls	2.16	920	202.49
Marton	17.14	2412	613.80
Mangaweka	2.10	264	687.27

DRAFT

3.2.2 Wastewater Growth Flows

Table 9 summarises the wastewater flows generated from each growth area. The average dry weather flows were calculated based on a wastewater loading rate of 250 L/person/day with a peaking factor of 2.5. The peak wet weather flows were calculated using the same loading rate of 250 L/person/day, but with a wet weather peaking factor of 5.

Table 9 Wastewater flows generated from growth areas

Township	Growth Area	No. of Dwellings	Population	Average Dry Weather Flow (L/s)	Peak Wet Weather Flow (L/s)
Bulls	BUL01	342	925	6.7	13.4
	BUL02	429	1157	8.4	16.7
	BUL03	22	172	0.4	0.8
	Bulls Infill	313	845	6.1	12.2
Mangaweka	MAN01	42	113	0.8	1.6
	MAN02	183	494	3.6	7.2
Marton	MAR01	591	1596	11.5	23.1
	MAR02	362	977	7.1	14.1
	MAR03 (partial)	41	110	0.8	1.6
	MAR04 (partial)	19	52	0.4	0.8
	MAR07	291	786	5.7	11.4
	Marton Infill	316	853	6.2	12.3
Taihape	Taihape Infill	134	362	2.6	5.2

DRAFT

4. Three Waters Network Performance and Upgrades

4.1 Bulls

The existing network performance in Bulls for the three waters is summarised in Table 10, and the network performance under greenfield and infill growth scenarios are summarised in Table 11 and Table 12 respectively. Network performance maps are provided in Appendix A.

4.1.1 Existing network assessment

Table 10 Bulls existing network assessment

Water Supply Network	Wastewater Network	Stormwater Flood Hazard
Refer to **Appendix A Figure 1.1.1** for the system performance results of the existing network and **Appendix A Figure 1.1.2** for the FW2 fire flow assessment results of the existing network. – The topography of Bulls is lowest in the southern end of the township where the Taumaihi Street booster pump will be. – Due to increasing topography, pressures are expectedly decreasing away from the Bulls booster pump station. – Model results of the existing network suggest pressure deficiencies (< 25 m) north of High Street and towards the east along High Street and Watson Street. – Headloss is not an issue within the existing network as high headloss is only observed in areas where pressures are sufficient (> 25 m). The network along Brandon Hall Road experiences the highest headloss, with pressures at the extremity dropping below 25 metres (22.96 m). – Hydrants within the Bulls network can generally support FW2 fire flow, particularly in the central part of the network. Hydrants at the extremity of the network along Watson Stret, George Street	Refer to **Appendix A Appendix A Figure 1.2.1** and **Figure 1.2.2** dry weather flow and wet weather flow results. – High inflow/infiltration on the western branch of the network based on 2019/2020 flow monitoring. – Wet weather network surcharge in Gorton Street/ Hammond Street network and downstream network to the WWTP. – No predicted manhole spilling in dry weather and wet weather.	Refer to **Appendix A Appendix A Figure 1.3** for Bulls Stormwater Rapid Flood Hazard map result. – There are major overland flow paths at the northern part of the town going across State Highway 3 from east to west. This leaves significant ponding predicted on either side of Bridge Street around Gorton Street and south of Wilson Street. This overland flow path continues southwest toward Johnson Street. – There are also major overland flow paths on the east side of the State Highway 1 north of Watson Street. – Significant ponding predicted around Devon Crescent and Kittyhawk Row. – Minor overland flow crossing High Street from east to west, causing some predicted ponding on Mansell Crescent with flow continuing in southwestern direction.

Water Supply Network	Wastewater Network	Stormwater Flood Hazard
and the west of High Street towards Brandon Hall Road are unable to provide sufficient flow at 10 m pressure to meet the firefighting code of practice. – It is understood that if a large central town fire occurs, the fire tank near the visitor information centre at 4 Criterion Street can assist.		

4.1.2 Greenfield growth assessment

Table 11 Bulls greenfield growth assessment

	Water Supply Network	Wastewater Network	Stormwater Flood Hazard
BUL01	Refer to **Appendix A Figure 2.1.1** for the system performance results under the BUL01 scenario. – Model results indicate a drop in pressures of up to 9 metres increasing towards the extremity of the Bulls water supply network. This affects the existing low pressures in the north part of the network – Higher headloss observed southwest of the Bulls central business district between High Street and Taumaihi Street along the aging AC pipes (where the network is already at capacity). – Higher headloss can also be observed in the northwest on High Street and Daniell Street.	Refer to **Appendix A Figure 2.2.1** for BUL01 results for dry weather flow and Appendix A **Figure 2.2.2** for BUL01 results for wet weather flow. – There is predicted pipe surcharge in both dry weather and wet weather on the eastern side of the town downstream of BUL01 connection point due to the added flow from the BUL01 growth area. In wet weather, these issues start from manhole BU2MH00900 at 4 Criterion Street up to manhole BU2MH01170 on Wilson Street. Similar extents of pipe surcharge in dry weather. – There is no predicted manhole spilling in dry weather and wet weather.	Refer to **Appendix A Figure 1.3** for a map showing Bulls pre-development peak flood depths. Based on the pre-development flood results - – There are some overland flow paths crossing from east to west of this growth area that need to be addressed when the development occurs. – BUL01 growth area contains a total flood volume of 6,300 m^3 within the growth area boundary. This flood volume and any additional runoff volume generated due to the development to be managed within the growth area utilising new attenuation pond(s) to minimise flood effects on the downstream urban area. – A substantial ponded area exists along the western boundary of BUL01, adjacent to State Highway 3. When development happens, it may be necessary to designate this area as a formal pond.
BUL02	Refer to **Appendix A Figure 3.1.1** for the system performance results with water under the BUL02 scenario.	Refer to **Appendix A Figure 3.2.1** for BUL02 results for dry weather flow and **Appendix A Figure 3.2.2** for BUL02 results for wet weather flow.	Refer to **Appendix A Figure 1.3** for a map showing Bulls Pre-development peak flood depths.

	Water Supply Network	Wastewater Network	Stormwater Flood Hazard
	– Model results indicate a drop in pressures of up to 32 metres at the end of Watson Street and 11 metres at the end of Bridge Street. The pressure drop on Watson Street (where the BUL02 greenfield growth is connected) is enough such that pressures become negative at peak time. – Pressure drops north of high street begin at around 8 metres and is sufficient to drop pressures below the 25 m NZS4404 criteria. – High headlosses can be observed in the Bulls network. The central part of the network (between High Street and Taumaihi Street) experiences up to 53 m/km of headloss due to pipe size whereas the northeast (High Street and Daniell Street experience up to 9 m/km. Headloss (up to 41 m/km) on Watson Street cause negative pressures on the downstream network, indicating upgrades are required to support the BUL02 growth.	– There are capacity issues, and manholes spilling in both dry weather and wet weather, upstream of the Domain Road pump station up to Watson Street due to the added flow from BUL02 growth area. These issues are caused by both pump capacity and pipe capacity limitations in the network. However, the Domain Road pump rate is required to be confirmed by RDC. – Manholes BU2MH02010 and BU2MH02080 are predicted to spill in both dry weather and wet weather.	Based on the pre-development flood results - – There are several overland flow paths within the growth area that flow from northeast to southwest. These flow paths need to be addressed when the development occurs. – BUL02 growth area contains a total flood volume of 29,514 m^3 within the growth area boundary. This flood volume and any additional runoff volume generated due to the development to be managed within the growth area utilising new attenuation pond(s) to minimise flood effects on the downstream urban area.
BUL03	Refer to **Appendix A Figure 4.1.1** for the system performance results under the BUL03 scenario. – Model results indicate a negligeable drop in pressures (up to 0.4 metres) at across the Bulls water supply network. – Headlosses increase up to 0.6 m/km across the network, worsening existing headloss issues. – The impact of the BUL03 growth on performance is considered negligible when compared to existing network performance.	Refer to **Appendix A Figure 4.2.1** for BUL03 results for dry weather flow and **Appendix A Figure 4.2.2** for BUL03 results for wet weather flow. – There is existing wet weather pipe surcharge in the western mains, specifically on Gorton Street/ Hammond Street area where BUL03 is proposed to be connected. Additional flow from BUL03 causes further pipe surcharge. – There is no predicted manhole spilling in dry weather and wet weather.	Refer to **Appendix A Figure 1.3** for a map showing Bulls Pre-development peak flood depths. Based on the pre-development flood results - – Overland flow paths through the growth area from northeast to southwest need to be addressed when the development occurs. – BUL03 growth area contains a total flood volume of 1,335 m^3 within the growth area boundary. This flood volume and any additional runoff volume generated due to the development to be managed within the growth area utilising new attenuation pond(s) to minimise flood effects on the downstream urban area.

4.1.3 Infill growth assessment

Table 12 Bulls infill growth assessment

Scenario	Water Supply Network	Wastewater Network	Stormwater Flood Hazard
Infill	Refer to **Appendix A Figure 5.1.1** for the system performance results under the Bulls infill scenario. – Model results indicate a general drop in pressures of up to 6 metres at the extremity of the Bulls water supply network. – The infill growth causes pressures along Johnson Street and areas north of High Street to no longer meet the NZS4404 pressure criteria of 25 m. Existing pressure issues further away from the Taumaihi pump station worsen. – Large drop in pressure (about 15 metres) observed at the end of Fagan Street. This is a pre-existing issue with the existing network, where there is high headloss along Fagan Street as a result of the small 20 mm diameter copper pipe. Upgrades should be considered if infill is to occur along this section of the network. – Higher headlosses increase between 3 m/km and 6 m/km across the network, particularly between High Street, Taumaihi Street and State Highway 3/Bridge Street. – Model results predict the DN50 rider main on the south end of Johnson Street will experience an additional 5 m/km of headloss due to the infill growth.	Refer to **Appendix A Figure 5.2.1** and **Figure 5.2.2** for infill scenario results for dry weather flow and wet weather flow, respectively. – Minor increase in pipe surcharge in both dry weather and wet weather due to the added flow from the infill lots. – There is no predicted manhole spilling in dry weather and wet weather.	Refer to **Appendix A Figure 5.3** for post infill development peak flood depths map results. – Minor increase in peak flood depths on the overland flow path south-west of Oldfield Place of approximately 50 mm due to infill development.

4.1.4 Upgrades

The proposed network upgrades to address issues in the water supply and wastewater networks are summarised in Table 13. An upgrade assessment has not been undertaken for the stormwater network. Network performance maps with the proposed upgrades in place are provided in Appendix A.

Table 13 Proposed upgrades for Bulls growth areas

Scenario	Water Supply Network**	Wastewater Network
Status Quo	– Not assessed (Not part of water supply scope).	– No upgrades required.
BUL01*	– Option 1: Upgrade Bulls booster pump station to deliver 93 m of head as per the *Bulls Reservoir Booster Pump Station Detailed Design* (GHD, December 2020) report (Appendix A Figure 2.1.2). – Refer to **Appendix A Figure 2.1.3** for the FW2 fire flow assessment results with the proposed Option 1 upgrades.	– No upgrades required.
	– Option 2: Upgrade 1,000 metres of AC and steel mains (<150 mm) from the Bulls booster pump station along Kittyhawk Row and along High Street until the intersection with State Highway 3 to DN355 (ID: 301.6 mm) (Appendix A Figure 2.1.4). – Refer to **Appendix A Figure 2.1.5** for the FW2 fire flow assessment results with the proposed Option 2 upgrades.	
BUL02*	– Option 1: Upgrade Bulls booster pump station to deliver 93 m of head as per the Bulls Reservoir Booster Pump Station Detailed Design (GHD, December 2020) report (**Appendix A Figure 3.1.2**). – Option 1: Upgrade 550 metres of AC and steel mains (<150 mm) from the Bulls booster pump station along Kittyhawk Row until High Street to DN355 (ID: 301.6 mm) (**Appendix A Figure 3.1.2**). – Option 1: Upgrade 500 metres of DN150 AC mains from 1 High Street until 19 Watson Street to DN355 (ID: 301.6 mm) (**Appendix A Figure 3.1.2**). – Refer to **Appendix A Figure 3.1.3** for the FW2 fire flow assessment results with the proposed Option 1 upgrades.	– Domain Road pump station capacity increase to 20 L/s (the existing pump rate to be confirmed by RDC). – Upgrade 650 m length of pipeline from 150 mm diameter to 225 mmm diameter from manhole BU2MH02090 to manhole BU2MH02010 (from Domain Road to Watson Street). – Refer to **Appendix A Figure 3.2.3** for wet weather flow results on BUL02 with network upgrades.
	– Option 2: Upgrade 550 metres of mains north of the Bulls booster pump station along Kittyhawk Row until High Street to DN355 (ID: 301.6 mm) (**Appendix A Figure 3.1.4**). – Option 2: Upgrade 1,150 metres along High Street from 91 High Street to the intersection of Watson Street and along Watson Street until 19 Watson Street to DN315 (ID: 267.55 mm) (**Appendix A Figure 3.1.4**). – Refer to **Appendix A Figure 3.1.5** for the FW2 fire flow assessment results with the proposed Option 2 upgrades.	
BUL03*	– Option 1: Upgrade Bulls booster pump station to deliver 93 m of head as per the Bulls Reservoir Booster Pump Station Detailed	– No upgrades required.

Scenario	Water Supply Network**	Wastewater Network
	Design (GHD, December 2020) report (**Appendix A Figure 4.1.2**). – Refer to **Appendix A Figure 4.1.3** for the FW2 fire flow assessment results with the proposed Option 1 upgrades.	
	– Option 2: Upgrade the following 15 metres of delivery main from the Bulls booster pump station to DN355 (ID: 301.6 mm) (**Appendix A Figure 4.1.4**)*. – Refer to **Appendix A Figure 4.1.5** for the FW2 fire flow assessment results with the proposed Option 2 upgrades.	
Infill*	– Option 1: Upgrade Bulls booster pump station to deliver 93 m of head as per the Bulls Reservoir Booster Pump Station Detailed Design (GHD, December 2020) report (**Appendix A Figure 5.1.2**). – Refer to **Appendix A Figure 5.1.3** for the FW2 fire flow assessment results with the proposed Option 1 upgrades.	– No upgrades required.
	– Option 2: Upgrade 550 metres of mains north of the Bulls booster pump station along Kittyhawk Row until High Street to DN355 (ID: 301.6 mm) (**Appendix A Figure 5.1.4**). – Option 2: Upgrade an additional 100 metres along High Street between 147 High Street and 139 High Street to DN355 (ID: 301.6 mm) (**Appendix A Figure 5.1.4**). – Refer to **Appendix A Figure 5.1.5** for the FW2 fire flow assessment results with the proposed Option 2 upgrades.	

* Upgrading the Bulls booster pump station to 93 metres of head increases network pressure beyond existing service levels (as per the basis of design in the *Bulls Reservoir Booster Pump Station Detailed Design (GHD, December 2020))*. Since Option 2 pipe upgrades are designed for current service levels, the upgraded pump station will always generate higher pressures. GHD appreciates constraints in upgrading the pump and recommends a combined approach – Option 1 (larger pump) and Option 2 (pipe upgrades) – to support future growth.

** The discharge main from the Bulls booster pump station is considered a constraining factor in terms of delivery head to the water supply network. It is suggested in all growth scenarios to upgrade the discharge main to a DN355 (ID: 301.6 mm) before the water enters the network at Kittyhawk Row or Taumaihi Street.

4.2 Hunterville

4.2.1 Existing network assessment

The existing network performance in Hunterville for the 3 waters is summarised in Table 14. Network performance maps are provided in Appendix B.

Table 14 Hunterville existing network assessment

Water Treatment Plant	Water Supply Network	Wastewater Network	Stormwater Rapid Flood Hazard
– Water source: Rural Hunterville supply, river water, 1 bore – Treatment: chemical dosing, chlorination (gas), UV – UV (466 m3/day) and capacity of urban connection (370 m3/day) are WTP bottlenecks – Effect of increased intake on Hunterville rural supply needs to be explored – Water sometimes carted in supply residents	Refer to **Appendix B Figure 1.1.1** for the system performance results of the existing network and **Appendix B Figure 1.1.2** for the FW2 fire flow assessment results of the existing network. – Pressures across central Hunterville are quite high (56 m to 83 m). Lower and negative pressures (<30 m) in the western branch due to elevation. – Headloss is not an issue as pressures remains high in the network. – Pressure management could be considered to lower pressures in Hunterville. – Hydrants within Hunterville can support the flows associated with FW2 fire flow with the exception of hydrant 20090710113322.	Refer to **Appendix B Figure 1.2.1** and **Figure 1.2.2** for dry and wet weather flow scenarios. – Wet weather pipe surcharge in the network between Paraekaretu Street and Main Street. – No predicted manhole spilling in dry weather and wet weather.	Refer to **Appendix B Figure 1.3** for map results. – There is a major overland flow path flowing from the northwest of the town towards Te Maire Road with significant predicted flooding downstream west side of Ong Road. – Pourewa stream is flowing from northeast of the town towards south and is predicted to spill causing significant flooding between Pourewa Road and Kotukutuku Road. Predicted ponding continues south towards Milne Street down to York Street. – There is also significant predicted flooding south of Gordon Terrace, east side of the railway track.

4.2.2 Greenfield and Infill growth assessments

There was no growth assessment completed for Hunterville.

4.3 Mangaweka

The existing network performance in Mangaweka for the three waters is summarised in Table 15, and the network performance under greenfield growth scenario is summarised in Table 16. Network performance maps are provided in Appendix C.

4.3.1 Existing network assessment

Table 15 Mangaweka existing network assessment

Water Treatment Plant	Water Supply Network	Wastewater Network	Stormwater Flood Hazard
– Source: Rangitikei River, Bore – Treatment: Filters, Chlorination (gas), UV – Planned upgrades: 3 additional filters (ideally resolves performance issues when turbidity high) – Consented take close to capacity in future – Pipe capacity from river may require upgrade – Bottlenecked by UV with good raw water quality – Water sometimes carted in to supply residents	Refer to **Appendix C Figure 1.1.1** for the system performance results of the existing network and **Appendix C Figure 1.1.2** for the FW2 fire flow assessment results of the existing network. – Pressures are acceptable (between 25 m and 60 m). Area to the east has exceptionally high pressures, reaching 120 m. – Network in the east experiences both high pressures and high headloss, inducing stress on the network. – Hydrants within the Mangaweka network can generally support FW2 fire flow, particularly in the central part of the network. Hydrants at the extremity of the network along Raumaewa Road and Manawharariki Road/State Highway 1 are unable to provide sufficient flow at 10 m pressure to meet the firefighting code of practice.	Refer to **Appendix C Figure 1.2.1** and **Figure 1.2.2** for dry weather and wet weather flow results. – Despite high wet weather peaking factor, the size of the catchment and current population means there are no apparent pipe surcharge in dry weather and wet weather. – No predicted manhole spilling in dry weather and wet weather.	Refer to **Appendix C Figure 1.3** for map results. – Significant flooding at the corner of State Highway 1 and Ruahine Road due to the topography represented in the DSM. The overland flow bypasses the Ruahine Road bridge and outfall into the Rangitikei river and continues south of Ruahine Road flooding the rural properties to the north and south of Raumaewa Road. – Significant urban area flooding in the vicinity of Broadway due to the overland flow from the rural catchments to the west. – There are limitations in the model due to the DSM used for the model development. Flow restrictions into the open drains are evident in model results that may cause elevated ponding in the above discussed areas. Therefore, these flood results should be considered as high-level findings.

4.3.2 Greenfield growth assessment

Table 16 Mangaweka greenfield growth assessment

Growth Area	Water Supply Network	Wastewater Network	Stormwater Flood Hazard
MAN01	Refer to **Appendix C Figure 2.1.1** for the system performance results under the MAN01 scenario. – Pressure and headloss change because of the MAN01 growth are negligible, indicating the growth does not have a big impact on the Mangaweka network.	Refer to **Appendix C Figure 2.2.1** and **Figure 2.2.2** for dry and wet weather flow results. – No pipe surcharge in dry weather and wet weather due to MAN01 development. – No predicted manhole spilling in dry weather and wet weather.	Refer to **Appendix C Figure 1.3** for a map showing Mangaweka pre-development peak flood depths. Based on the pre-development flood results - – Scattered ponding within MAN01 growth area, but this may be due to the rough ground model for Mangaweka. – MAN01 growth area contains a total flood volume is 7,896 m^3 within the growth area boundary. This flood volume and any additional runoff volume generated due to the development to be managed within the growth area utilising new attenuation pond(s) to minimise flood effects on the downstream urban area.
MAN02	Refer to **Appendix C Figure 3.1.1** for the system performance results under the MAN02 scenario. – The MAN02 growth causes a pressure drop and high headlosses (more than 8 m/km) in the central area of the Mangaweka township. Pressures upon entry to the local reticulation at Broadway drop by approximately 2 metres before dropping up to 8 metres in the rest of the network. Higher drops (18 m) are observed at the extremity of Raumaewa Road where the MAN02 growth is expected. – Headlosses increase particularly along Raumaewa Road and Mangawharariki Road/State Highway 1 due to the required higher flows from the MAN02 growth.	Refer to **Appendix C Figure 3.2.1** and **Figure 3.2.2** for dry and wet weather flow results. – Wet weather pipe surcharge from MAN02 development connection point at Mangawhariki Road (State Highway 1) to the WWTP. – No predicted manhole spilling in dry weather and wet weather.	Refer to **Appendix C Figure 1.3** for a map showing Mangaweka pre-development peak flood depths. Based on the pre-development flood results - – The overland flow from north of Ruahine Road causes flooding within MAN02 growth area. Also, the overland flows from east contributes to the flooding. The overland flows from Ruahine Road may be reduced by regrading the stream channel. – MAN02 growth area contains a total flood volume is 33,432 m^3 within the growth area boundary. Unless addressed through Ruahine Road upgrades, this flood volume and any additional runoff volume generated due to the development to be managed within the growth area utilising

Growth Area	Water Supply Network	Wastewater Network	Stormwater Flood Hazard
			new attenuation pond(s) to minimise flood effects on the downstream urban areas. – There are limitations in the model due to the DSM used for the model development. Flow restrictions into the open drains are evident in model results that may cause elevated ponding in MAN02 growth area. Therefore, these flood results should be considered as high-level findings.

4.3.3 Upgrades

The proposed network upgrades to address issues in the water supply and wastewater networks is summarised in Table 17. An upgrade assessment has not been undertaken for the stormwater network. Network performance maps with the proposed upgrades in place are provided in Appendix C.

Table 17 Proposed upgrades for Mangaweka growth areas

Scenario	Water Supply Network	Wastewater Network
Status Quo	– Not assessed (Not part of water supply scope).	No upgrades required.
MAN01	– No upgrades required. – Refer to **Appendix C Figure 2.1.2** for the FW2 fire flow assessment results.	No upgrades required.
MAN02*	– Option 1: Upgrade 200 metres to DN250 (ID: 212.35 mm) along Kakariki Street (**Appendix C Figure 3.1.2**). – Option 1: Upgrade 500 metres to DN180 (ID: 152.75 mm) between Mangawharariki Road/State Highway 1 and Raumaewa Road (**Appendix C Figure 3.1.2**). – Refer to Appendix C Figure 3.1.3 for the FW2 fire flow assessment results with the proposed Option 1 upgrades.	No upgrades required.
	– Option 2: Upgrade 120 metres to DN180 (ID: 152.75 mm) from 2 Kawakawa Street along Broadway (**Appendix C Figure 3.1.4**). – Option 2: Upgrade 500 metres to DN180 (ID: 152.75 mm) between Mangawharariki Road/State Highway 1 and Raumaewa Road (**Appendix C Figure 3.1.4**). – Refer to **Appendix C Figure 3.1.5** for the FW2 fire flow assessment results with the proposed Option 2 upgrades.	

*Option 2 is the preferred option as the upgrade along Broadway is expected to be easier to implement due to its location. This is because Option 1 involves upgrading the trunk main along Kakariki Street. The trunk main is the sole supply source for the Mangaweka network, making option 1 less preferred.

4.4 Marton

The existing network performance in Marton for the 3 waters is summarised in Table 18, and the network performance under greenfield and infill growth scenarios are summarised in Table 19 and Table 20 respectively. Network performance maps are provided in Appendix D.

4.4.1 Existing network assessment

Table 18 Marton's existing three waters infrastructure assessment

Water Treatment Plant	Water Supply Network	Wastewater Network	Stormwater Rapid Flood Hazard
– Source: 2 bores (one new, one old), unused bore due to hardness – Planned upgrades: new WTP built adjacent to existing plant (currently in design phase) – future 5000 m^3/day. Future decommissioning of old WTP. – Future WTP could face issues in peak demand periods. – Consented take close to limit for future demand.	Refer to **Appendix D Figure 1.1.1** for the system performance results of the existing network and **Appendix D Figure 1.1.2** for the FW2 fire flow assessment results of the existing network. – The topography of Marton decreases away from the Marton Reservoir. It is lowest at the southern end of the network which results in higher pressures. – Pressures throughout the Marton network are sufficiently high (between 25 m and 60 m) and even higher in the south. – Headloss is not an issue in the Marton network as network pressures remain sufficiently high. Highest headlosses within the network are observed along the Marton trunk main feeding the township and in local areas between Cuba Street and Beaven Street. – Hydrants within the Marton network can support FW2 fire flow except, hydrants along Calico Line which are unable to provide sufficient flow at 10 m pressure to meet the firefighting code of practice. Other hydrants not meeting the firefighting code of	Refer to **Appendix D Figure 1.2.1** and **Figure 1.2.2** for dry and wet weather flow results. – Significant wet weather pipe surcharge predicted in many parts for the network. – Wet weather manhole spilling predicted near Wellington Road and Hawkestone Road intersection, and on Hammond Street. – Constructed overflow discharging to Tutaenui stream is predicted to spill approximately 86m^3 in wet weather flow scenario.	Refer to **Appendix D Figure 1.3** for map results. – There is significant predicted flooding on the eastern side of Tutaenui Road / Wellington Road running from north to south of the entire town due to overspilling of Tutaenui stream. – There are several overland flow paths on the western side of the town flowing from northwest to southern direction causing localised flooding in the urban area. There is significant flooding predicted on Skerman Street, Grey Street (between Signal Street and Follett Street), Bowen Street down to Wellington Road. – There is significant downstream flooding on Russel Street and Henderson Line from overland flow path flowing from northwest side of the town. – There are several overland flow paths flowing from the northeast side of the town towards southern direction causing significant flooding downstream on Station Road.

Water Treatment Plant	Water Supply Network	Wastewater Network	Stormwater Rapid Flood Hazard
	practice are situated at the ends of Milne Street, Tennent Court, Melody Place, Goldings Line and Princess Street.		

4.4.2 Greenfield growth assessment

Table 19 Marton greenfield growth assessment

	Water Supply Network	Wastewater Network	Stormwater Flood Hazard
MAR01	Refer to **Appendix D Figure 2.1.1** for the system performance results under the MAR01 scenario. – Model results indicate a gradual pressure drop (between 1.5 m and 4.5 m) along the first 4 kilometres of the trunk main from the Marton Reservoir, up until the DN300 CLS main. From here, pressures drop significantly, up to 18 metres at the point where the MAR01 growth is connected to and everywhere downstream. The abundance in network pressure means that the pressures meet NZS4404 criteria (>25m) and there are no low pressure issues. – Headlosses increase between 3 m/km and 10 m/km along the Marton trunk main that feeds the Marton township, indicating that it is undersized for the additional flow caused by MAR01. This also causes the aforementioned pressure drops within the network. – Local headlosses within the Marton reticulation network remain similar when compared to the results of the existing scenario.	Refer to **Appendix D Figure 2.2.1** and **Figure 2.2.2** for dry and wet weather flow scenarios for MAR01. – There is increased pipe surcharge in dry weather and wet weather due to flows from MAR01 growth area. – The following manholes off Tutaenui Road are predicted to spill in wet weather flow scenario due to flows from MAR01 growth area: ML2MH02970, ML2MH02940, ML2MH02850, ML2MH02830, ML2MH02810	Refer to **Appendix D Figure 1.3** for pre-development peak flow depths for Marton. Based on the pre-development flood results - – There are several overland flow paths from north to south that need to be addressed during the development of this area. – MAR01 growth area contains a total flood volume of 15,120 m^3 within the growth area boundary. This flood volume and any additional runoff volume generated due to the development to be managed within the growth area utilising new attenuation pond(s) to minimise flood effects on the downstream urban area. – The large existing ponding area on the southern boundary of MAR01 may be formalised as a detention area during the development of this area.

	Water Supply Network	Wastewater Network	Stormwater Flood Hazard
MAR02	Refer to **Appendix D Figure 3.1.1** for the system performance results under the MAR02 scenario. – Model results indicate a gradual pressure drop (between 1 m and 4 m) along the first 4 kilometres of the trunk main from the Marton Reservoir, up until the DN300 CLS main. – Pressures at connection point to MAN02 growth, drop significantly (approximately 75 m) and become negative at peak time. – Pressures at the extremity of the network on Calico Line and Goldings Line drop by 13 metres and 14 metres respectively but do not cause low pressure issues. – Headlosses increase between 3 m/km and 6 m/km along the Marton trunk main that feeds the Marton township, indicating that it is undersized for the additional flow caused by MAR02. Furthermore, headlosses become high on Bond Street and extremely high along Milne Street where MAR02 is connected, suggesting that it is also undersized. – Local headlosses within the Marton reticulation network remain similar when compared to the results of the existing scenario but do increase in the network upstream around Bond Street and along Calico Line where the DN150 AC main starts at 7 Calico Line.	Refer to **Appendix D Figure 3.2.1** and **Figure 3.2.2** for dry and wet weather flow scenario results for MAR02. – There is increased pipe surcharge in dry weather and wet weather due to the flows from MAR02 growth area. – Three manholes are predicted to spill off Wanganui Road in wet weather flow scenario. These are ML2MH05700, ML2MH05630, and ML2MH05500.	Refer to **Appendix D Figure 1.3** for pre-development peak flow depths for Marton. Based on the pre-development flood results - – Several overland flow paths that flow from northwest to southeast need to be addressed during the development of this area. – MAR02 growth area contains a total flood volume of 10,871 m^3 within the growth area boundary. This flood volume and any additional runoff volume generated due to the development to be managed within the growth area utilising new attenuation pond(s) to minimise flood effects on the downstream urban area.
MAR07	Refer to **Appendix D Figure 4.1.1** for the system performance results under the MAR07 scenario. – Model results indicate a gradual pressure drop (between 0.8 m and 2.5 m) along the first 4 kilometres of the trunk main from the	Refer to **Appendix D Figure 4.2.1** and **Figure 4.2.2** for dry and wet weather flow results. – There is increased pipe surcharge in dry weather and wet weather due to additional flow from MAR07 growth area. – No predicted manhole spilling in dry weather and wet weather.	Refer to **Appendix D Figure 1.3** for pre-development peak flow depths for Marton. Based on the pre-development flood results - – There are existing overland flow paths from the northwest to southeast that need to be addressed during the development of the area.

	Water Supply Network	Wastewater Network	Stormwater Flood Hazard
	Marton Reservoir, up until the DN300 CLS main. – Pressures where the MAR07 has been connected drop significantly (approximately 50 m) and become negative at peak time. – Pressures at the extremity of the network on Calico Line and Goldings Line drop by 10 metres and 11 metres respectively. – Headlosses increase by between 2 to 3 m/km along the Marton trunk main that feeds the Marton township, indicating that it is undersized for the additional flow caused by MAR07. Also, high headlosses observed on Bond Street and extremely high along Milne Street where MAR07 is connected, suggesting that the network is also undersized. – Local headlosses within the rest of the Marton reticulation network remain similar when compared to the results of the existing scenario.		– There is a large existing ponding area located on the western boundary of the MAR07 growth area that may be formalised as a detention area prior to development. – MAR07 growth area contains a total flood volume of 18,186 m^3 within the growth area boundary. This flood volume and any additional runoff volume generated due to the development to be managed within the growth area utilising new attenuation pond(s) to minimise flood effects on the downstream urban area.
Combined (MAR01, MAR02, MAR03 – partial, MAR04 – partial, and MAR07)	Refer to **Appendix D Figure 5.1.1** for the system performance results under the Marton combined scenario. – Model results indicate a gradual pressure drop (between 3 metres and 16 metres) along the first 4 kilometres of the trunk main from the Marton Reservoir, up until the DN300 CLS main. – Pressures across the Marton network have dropped significantly with the worst drop (approximately 48 metres) on Milne Street where the MAR02 and MAR07 growth are expected to occur. – The model results suggest that the majority of the Marton network will no longer meet pressure performance criteria set out in NZS4404, with only small pockets of low	Refer to **Appendix D Figure 5.2.1** and **Figure 5.2.2** for dry and wet weather flow scenarios for the combined Marton growth areas. – There is increased pipe surcharge in dry weather and wet weather due to these growth areas. – Three (3) manhole spills predicted off Wanganui Road at ML2MH05700, ML2MH05630, and ML2MH05500 – Five (5) manholes spills predicted off Tutaenui Road at ML2MH02970, ML2MH02940, ML2MH02850, ML2MH02830, and ML2MH02810 – One (1) manhole spill predicted on Cobber Kain Avenue at ML2MH02220	Refer to **Appendix D Figure 1.3** for pre-development peak flow depths for Marton. Based on the pre-development flood results - – Overland flow paths in MAR01, MAR02 and MAR07, and minor flow paths in MAR03 (partial) and MAR04 (partial) need to be addressed during the development. – The combined growth areas contain a total flood volume of 44,772 m^3. This flood volume and any additional runoff volume generated due to the development to be managed within the growth areas utilising new attenuation ponds to minimise flood effects on the downstream urban areas.

	Water Supply Network	Wastewater Network	Stormwater Flood Hazard
	elevation in the south able to meet the 25 m criteria. – Pressures at the extremity of the network on Calico Line and Goldings Line drop by approximately 47 metres. – Headlosses increase between 3 m/km and 12 m/km along the Marton trunk main that feeds the Marton township, indicating that it is undersized for the additional flow caused by the greenfield growth. Also, high headlosses observed on Bond Street and extremely high along Milne Street where MAR07 is connected, suggesting that the network is also undersized. – Local headlosses within the rest of the Marton reticulation network remain similar when compared to the results of the existing scenario but do increase in the network upstream network around Bond Street.		

4.4.3 Infill growth development

Table 20 Marton infill growth assessment

	Water Supply Network	Wastewater Network	Stormwater
Infill	Refer to **Appendix D Figure 6.1.1** for the system performance results under the Marton infill scenario. – Model results indicate a gradual pressure drop (between 0.5 m and 2 m) along the first 4 kilometres of the trunk main from the Marton Reservoir, up until the DN300 CLS main. – Although, pressures across the Marton network are sufficient (> 25 m) to support the additional infill growth, they do not meet the NZS4404 design criteria of 25 m. The additional demand required of the infill growth causes additional headloss along the Marton trunk main which drops pressures at the PRV below it's set point. – Pressures are expectedly dropping across the network with drops ranging between 4 and 8 metres. – Headlosses increase up to 1.5 m/km along the Marton trunk main due to the additional infill growth. – Local headlosses within the Marton reticulation network remain similar when compared to the results of the existing scenario but increase in the network around Bond Street/Signal Street and between Cuba Street and Russell Street. Upgrades have not been proposed as the impact on network pressures is negligible.	Refer to **Appendix D Figure 6.2.1** and **Figure 6.2.2** for dry and wet weather flow scenario for infill growth. – Minor increase in pipe surcharges due to additional infill flows in dry weather and wet weather. – No predicted manhole spilling in dry weather and wet weather.	Refer to **Appendix D Figure 6.3** for the post infill development peak flood depths. – Minor increase in predicted peak flood depths (approx. 40 mm) at Cuba Street, Harris Street, and Beaven Street to the west side of Wellington Road.

4.4.4 Upgrades

The proposed network upgrades to address issues in the water supply and wastewater networks is summarised in Table 21. An upgrade assessment has not been undertaken for the stormwater network. Network performance maps with the proposed upgrades in place are provided in Appendix D.

Table 21 Proposed upgrades for Marton growth areas

Scenario	Water Supply Network*	Wastewater Network
Status Quo	– Not assessed (Not part of water supply scope).	– Upgrade 540 m length of pipeline from 300 mm diameter to 450 mm diameter from manhole ML2MH03125 to ML2MH00650, located on Wellington Road near Hawkstone Road. Upgrade 710 m length of pipeline from 150 mm diameter to 225 mm diameter from manhole ML2MH02370 on Hammond Street to manhole ML2MH02230 on 387 Wellington Road.
MAR01	– Duplicate approximately 3 kilometres of the Marton trunk main from 391 Tutaenui Street to 50 Tutaenui Street. The modelled upgrade is a DN450 (ID: 382.35 mm) for the first 2,700 metres until around the Marton PRV and then a DN400 (ID: 339.9 mm) for approximately 300 metres beyond the PRV. (**Appendix D Figure 2.1.2**). – Refer to **Appendix D Figure 2.1.3** for the FW2 fire flow assessment results with the proposed Option 1 upgrades.	– Upgrade 1.31 km length of pipeline from 150 mm diameter to 225 mm diameter from manhole ML2MH02970 on Tutaenui Road to manhole ML2MH02655 on Hair Street. – Upgrade 1 km length of pipeline from 175 mm and 225 mm diameter to 300 mm diameter from manhole ML2MH02655 on Hair Street to manhole ML2MH02190 on Lower Beaven Street. – Refer to **Appendix D Figure 2.2.3** for a map indicating where these proposed upgrades are and the network performance for wet weather flow.
MAR02	– Duplicate approximately 2.1 kilometres of the Marton trunk main from 391 Tutaenui Street to 12 Tutaenui Street. The modelled upgrade is a DN450 (ID: 382.35 mm) for the first 1,500 metres until around the Marton PRV and then a DN400 (ID: 339.9 mm) for approximately 600 metres beyond the Marton PRV (**Appendix D Figure 3.1.2**). – Upgrade approximately 1 kilometre of mains to a DN355 (ID: 301.6 mm) from the Bond Street/Oxford Street intersection to the end of Milne Street where MAR02 is expected to occur (Appendix D 3.1.2). – Refer to **Appendix D Figure 3.1.3** for the FW2 fire flow assessment results with the proposed Option 1 upgrades.	– Upgrade 790 m length of pipeline from 150 mm diameter to 225 mm diameter from manhole ML2MH05630 on Wanganui Road to manhole ML2MH05410 on Harris Street. – Refer to **Appendix D Figure 3.2.3** for a map indicating where these proposed upgrades are and the network performance for wet weather flow.
MAR07	– Duplicate approximately 2.1 kilometres of the Marton trunk main from 391 Tutaenui Street to 12 Tutaenui Street. The modelled upgrade is a DN450 (ID: 382.35 mm) for the first 1,500 metres until around the Marton PRV and then a DN400 (ID: 339.9 mm) for approximately 600 metres beyond the PRV. (**Appendix D Figure 4.1.2**). – Upgrade approximately 1 kilometre of mains to a DN355 (ID: 301.6 mm) from the Bond Street/Oxford Street intersection to the end of	– No upgrades required.

Scenario	Water Supply Network*	Wastewater Network
	Milne Street where MAR07 is expected to occur (**Appendix D Figure 4.1.2**). – Refer to **Appendix D Figure 4.1.3** for the FW2 fire flow assessment results with the proposed Option 1 upgrades.	
Combined (MAR01, MAR02, MAR03 – partial, MAR04 – partial, and MAR07)	– Duplicate the entire Marton trunk main (approximately 6 kilometres) from the Marton Reservoir to 129 Tutaenui Street. The modelled upgrade is a DN450 (ID: 382.35 mm). The section of main along Tutaenui Road between Fern Flats Road and Snellgrove Road has not been duplicated as it is already a dual main here (**Appendix D Figure 5.1.2**). – Upgrade approximately 1 kilometre of mains to a DN355 (ID: 301.6 mm) from the Bond Street/Oxford Street intersection to the end of Milne Street where MAR02/MAR07 is expected to occur (**Appendix D Figure 5.1.2**). – Upgrade approximately 450 metres of mains to a DN180 (ID: 152.75 mm) from 7 Calico Line to 60 Calico Line where MAR03 is expected to occur (**Appendix D Figure 5.1.2**). – Refer to **Appendix D Figure 5.1.3** for the FW2 fire flow assessment results with the proposed Option 1 upgrades.	– All upgrades mentioned for MAR01 and MAR02 above. – Refer to **Appendix D Figure 5.2.3** for a map indicating where these combined upgrades are and the network performance for wet weather flow.
Infill	– Duplicate approximately 1.1 kilometres of mains to a DN450 (ID: 382.35 mm) from 267 Tutaenui Street to 141 Tutaenui Street (**Appendix D Figure 6.1.2**). – Refer to **Appendix D Figure 6.1.3** for the FW2 fire flow assessment results with the proposed Option 1 upgrades.	– No upgrades required.

*Duplication of the Marton trunk main is considered the preferred option over an option using the additional source at 5 Calico Line. This is because even with the additional source, upgrades associated with the Marton trunk main would still be required to deliver sufficient head into the Marton township from the Marton Reservoir. The only difference would be the extent of upgrades. Furthermore, duplicating the trunk main provides RDC water supply resilience in the case of pipe failure or for maintenance. Interim use of the 5 Calico Line source to accommodate future growth can be explored while the trunk main is being upgraded.

4.5 Taihape

The existing network performance in Taihape for the 3 waters is summarised in Table 22, and the network performance under the infill growth scenario is summarised in Table 23. Network performance maps are provided in Appendix E.

4.5.1 Existing network performance

Table 22 Taihape's existing 3 waters infrastructure network assessment

Water Treatment Plant	Water Supply Network	Wastewater Network	Stormwater Rapid Flood
– Water source: Hautapu River – Treatment: clarification, filters, chemical dosing, chlorination (gas), UV – Performance upgrades required to meet current demand – Limited space availability for upgrades – Consented take close to limit for future demand – New source flagged (problems with current source) – Bore information gap in area adds complexity	Refer to **Appendix E Figure 1.1.1** for the system performance results of the existing network and **Appendix E Figure 1.1.2** for the FW2 fire flow assessment results of the existing network. – Pressures are sufficiently high in the majority of the Taihape network. Lower pressures (< 25 m) in the local network are caused by proximity to the Taihape Reservoir or high elevations. – Headloss is generally not an issue as pressures remain high in the Taihape network. High headloss in the south (Otaihape Valley Road and Dixon Way) and on Mataroa Road/State Highway 1 are a result of small pipes. – The majority of hydrants within the Taihape reticulation network can support FW2 fire flows. Hydrants along Ruru Road and at the end of Manu Road (20031117091004) are unable to support FW2.	Refer to **Appendix E Figure 1.2.1** and **Figure 1.2.2** for dry and wet weather flow results. – Wet weather pipe surcharge is predicted in scattered parts of the pipe network. – No manhole spilling predicted in dry weather and wet weather.	Refer to **Appendix E Figure 1.3** for map showing Taihape peak flood depths. – There is a major overland flow path and flooding along Mataroa Road flowing in southeastern direction crossing Toroa Street, Linnet Street, and Hautapu Street discharging to Hautapu river causing downstream ponding near Toroa Street to Hautapu Street. – Minor overland flow path and flooding near Thrush Street causing some minor property ponding along that street. – There are minor overland flow paths on the northern part of town running from northwest side of the town flowing towards Goldfinch Street with some significant flooding downstream on Linnet Street down to Hautapu Street and Moa Street intersection.

4.5.2 Infill growth development

Table 23 Taihape infill growth assessment

	Water Supply Network	Wastewater Network	Stormwater
Infill	Refer to **Appendix E Figure 2.1.1** for the system performance results under the Taihape infill scenario. – Model results indicate a general drop in pressures of up to 3.5 metres within the Taihape water supply network. – The infill growth causes existing pressure issues around the intersection of Ruru Road and Pukeko Street to worsen. – The existing areas of high headloss • along Pukeko Street, Kiwi Road and the southern end of Ruru Road are worsened between 3 m/km and 9 m/km. • Increase by up to 2.5 m/km of along the mains on Paradise Terrace. – Headlosses in the southern area along Otaihape Valley Road and Dixon Way are relatively high. Local upgrades have not been proposed as network pressures still meet NZS4404 criteria. Upgrades should be considered if growth is expected.	Refer to **Appendix E Figure 2.2.1** and **Figure 2.2.2** for dry and wet weather flow scenarios for infill growth. – No significant changes in dry weather and wet weather network performance due to added infill flows. – No predicted manhole spilling in dry weather and wet weather.	Refer to **Appendix E Figure 2.3** for post infill development peak flood depths. – No significant increase in predicted peak flood extents and depths between pre- and post-development scenarios.

4.5.3 Upgrades

The proposed network upgrades to address issues in the water supply and wastewater networks is summarised in Table 24. An upgrade assessment has not been undertaken for the stormwater network. Network performance maps with the proposed upgrades in place are provided in Appendix E.

Table 24 Proposed upgrades for Taihape growth areas

	Water Supply Network	Wastewater Network
Status Quo	– Not assessed (Not part of water supply scope).	No upgrades required.
Infill	– No upgrades required. – Refer to **Appendix E Figure 2.1.2** for the FW2 fire flow assessment results.	No upgrades required.

5. Conclusion & Recommendations

Bulls

Water Supply

- Supply of the Bulls water supply network from the Bulls booster pump station is constrained by small pipe sizes causing high headloss in the network adjacent to the booster pump. With the current 83 metres of head supplied by the booster pump station, the model indicates pressure deficiencies (< 25 m) north of High Street and towards the east along High Street and Watson Street. Headloss is generally not an issue as high headloss is only observed in areas of sufficient pressures (> 25 m). Majority of the hydrants within the Bulls network can support a FW2 fire flow requirement. Hydrants that do not meet FW2 are situated at the extremities of the Bulls network.
- Consumption from the BUL01 and BUL02 growth areas are high enough such that they induce high headlosses throughout the Bulls water supply network. This causes pressures within the network to drop due to the loss of head. Although not to the same extent as BUL01 and BUL02, a similar impact can be observed with the projected infill growth at Bulls. The projected BUL03 growth was the only growth area where the impact on system performance was negligible.
- Accommodation of future growth at Bulls is dependent on reducing the head deficiency at the Bulls booster pump station. This can be achieved by an upgrade of the Bulls booster pump station or a series of pipe upgrades or a combination of both. Recommended pipe upgrades consist of approximately one kilometre of DN355 mains along Kittyhawk Row and along High Street. An additional one kilometre of upgrades are recommended along the east side of High Street and Watson Street, particularly for BUL02.

Wastewater

- The existing wastewater network experiences high inflow and infiltration on the western branch, wet weather surcharging in the Gorton Street/Hammond Street network and its downstream sections leading to the WWTP, but no predicted manhole spills under both dry and wet weather conditions.
- For growth assessment, it was found that there are capacity constraints and manhole spills occur in both dry and wet weather upstream of the Domain Road pump station to Watson Street due to increased flow from the BUL02 growth area, driven by both pump and pipe capacity limitations. Additionally, manholes BU2MH02010 and BU2MH02080 are predicted to spill under both dry and wet weather conditions, with the Domain Road pump rate yet to be confirmed by RDC.
- It is recommended to increase the Domain Road pump station capacity to 20 L/s, pending confirmation of the existing pump rate by RDC, and to upgrade 650 meters of pipeline extending from manhole BU2MH02090 to manhole BU2MH02010 (Domain Road to Watson Street).

Stormwater

- Bulls have major overland flow paths, particularly in the northern areas, with water movement crossing State Highway 3 from east to west, resulting in significant ponding near Bridge Street, Gorton Street, and Wilson Street, extending southwest toward Johnson Street. Additional major overland flow paths exist on the east side of State Highway 1, north of Watson Street. Significant ponding is also predicted around Devon Crescent and Kittyhawk Row, while minor overland flow crosses High Street, causing localised ponding on Mansell Crescent and continuing southwest.
- As development progresses in BUL01, consideration should be given to formally designating the substantial ponded area along its western boundary, adjacent to State Highway 3, as a designated pond to effectively manage surface flow.

Hunterville

Water Supply

– The existing Hunterville network does not show network performance constraints as pressures remain sufficiently high (> 25 m). As pressures remain high, headloss is not considered an issue. With the exception of the 20090710113322 hydrant on Stewart Street, hydrants within Hunterville can support FW2 fire flows.

Wastewater

– The wastewater network between Paraekaretu Street and Main Street experiences pipe surcharge during wet weather, no manhole spills are predicted under either dry or wet conditions.

Stormwater

– Hunterville faces significant stormwater management challenges, with multiple areas predicted to experience flooding and ponding due to overland flow paths, open drains, and waterways. Major concerns include the overland flow path towards Te Maire Road, flooding along Bruce Street, and the vulnerability of the northernmost growth area along SH1, which lies in a floodplain. Additionally, Porewa Stream is expected to spill, causing extensive ponding from Pourewa Road to York Street, while areas south of Gordon Terrace and east of the railway track are also at risk. Opportunities exist for stormwater attenuation, particularly utilizing existing ponding areas like those along Potaka Road, which may help mitigate the impact of future flooding. Addressing these challenges will require careful planning and strategic interventions to improve the town's resilience to stormwater-related events.

Mangaweka

Water Supply

– Pressures within the Mangaweka network are acceptable and in some cases, exceptionally high. Mains to the east of the network experience high pressure and high headloss, inducing stress on the network. Hydrants within the central part of the Mangaweka network can support FW2 fire flow whereas hydrants towards the ends of the network are unable to provide the required flow.

– The MAN01 growth has a negligible impact on network system performance. MAN02 however causes high headlosses in the southern part of the network along Raumaewa Road and Mangawharaiki Road/State Highway 1. Although pressures still meet NZS4404 criteria, the additional MAN02 growth causes fire flow capacity of the network to worsen.

– To support growth situated at MAN02, approximately 500 metres of mains along Raumaewa Road and Mangawhararikі/State Highway 1 should be upgraded to improve headlosses and fire flow capacity of the network. Furthermore, an additional upgrade would be required either on Kakariki Street (before the local reticulation) or along Broadway (within the local reticulation) to help alleviate headloss issues.

Wastewater

– The existing network do not have pipe surcharging under dry and wet weather conditions.

– There are no predicted manhole spilling due to added flow from growth areas.

– There are no upgrades recommended to facilitate growth development.

Stormwater

– Significant flooding occurs at the corner of State Highway 1 and Ruahine Road due to bridge capacity constraints, with overland flow continuing south and affecting rural properties near Raumaewa Road. Additionally, urban flooding is observed in the Broadway area due to overland flow from western rural catchments. Model limitations related to the DSM used for development indicate flow restrictions into open drains, potentially causing elevated ponding in these areas. As a result, these flood results should be considered high-level findings.

– To mitigate flood impacts on the downstream urban area, it is recommended that the significant flood volume within the MAN01 growth area, along with any additional runoff generated by development, be managed within the growth area using new attenuation ponds.

Marton

Water Supply

– Pressures throughout the Marton network are sufficiently high (> 25 m) and is supported by the decreasing topography from the Marton Reservoir. This results in higher pressures, particularly in the south of the network where the elevation is lowest as headloss is not generally an issue where pressure is concerned. The highest headlosses are expected to be on the Marton trunk main feeding the Marton township. Majority of hydrants within Marton can support FW2 fire flow other than those at the extremity of the network such as on Calico Line, Milne Street, Tennent Court, Melody Place, Goldings Line and Princess Street.
– Under normal operation, Marton is understood to be single fed from the Marton Reservoir via a single trunk main. The key constraint of the Marton network in supporting the proposed growth is the headloss along the Marton trunk main and the associated pipework that the growth will be connected to. The additional consumption imposed by the proposed Marton growth areas causes high headloss along the Marton trunk main, reducing the delivery head and therefore network pressures prior to entering the local reticulation network.
– The key upgrade required to support the proposed growth areas is reinforcing the Marton trunk main to recover the headloss induced by the additional consumption. This could involve upgrading the trunk main or duplicating it. The preferred option is considered to be a duplication which would accommodate the additional growth but also provide resilience to the Marton network in case of failure or for maintenance. Depending on the expected growth, the extent of duplication varies from a kilometre of mains to the entirety of the trunk main. Additionally, the MAR02 and MAR07 growth areas require approximately a kilometre of local upgrades on Bond Street and Milne Street to facilitate the high consumption of these two growth areas. Approximately 450 metres of fire flow upgrades are required on Calico Line to reach existing fire flow levels of service.

Wastewater

– The existing wastewater network is predicted to experience significant wet weather pipe surcharges across multiple areas, with manhole spills anticipated near the Wellington Road and Hawkestone Road intersection, as well as on Hammond Street. Additionally, the constructed overflow discharging to the Tutaenui Stream is expected to spill approximately 86m³ under wet weather conditions.
– There are multiple manholes spilling along Tutaenui Road due to added flow from MAR01 growth area. Also, multiple manholes spilling on Wanganui Road due to added flow from MAR02 growth area.
– To improve network capacity to allow for growth, it is recommended to upgrade the wastewater main across multiple locations. This includes upgrading the mains along a 1.31 km section between manhole ML2MH02970 on Tutaenui Road and manhole ML2MH02655 on Hair Street, as well as upgrading 1 km of pipeline between manhole ML2MH02655 on Hair Street and manhole ML2MH02190 on Lower Beaven Street. Additionally, a 790 m stretch of pipeline should be upgraded between manhole ML2MH05630 on Wanganui Road and manhole ML2MH05410 on Harris Street.

Stormwater

– Overland flow paths cover the entire town coming from northwest and northeast direction flowing south causing significant ponding in the urban area.
– To reduce the risk of flooding in the downstream urban area, it is advised that the substantial flood volume from the MAR01, MAR02, and MAR07 growth areas, as well as any extra runoff caused by development, be controlled within the growth area through the implementation of new attenuation ponds.

Taihape

Water Supply

- The majority of pressures within the existing Taihape network are sufficiently high (> 25 m). Lower pressures within the network are caused by proximity to the Taihape Reservoir or high elevations as the upstream headloss is minimal and acceptable. Headloss is generally not an issue as pressures remain high. Higher headloss particularly in the north and south are caused by small pipes. Most hydrants in the network can support FW2 fire flow.
- The projected Taihape infill growth causes a minor pressure drop across the network. The impact of the infill growth on system performance is considered negligible as pressures still meet NZS4404 criteria. Existing low pressures and high headlosses are worsened but are not significant as low pressures are a result of high elevation and the headlosses do not cause low pressure issues.
- The Taihape network can support the projected infill growth. Upgrades should be considered however if the growth is focussed in areas of low pressure or high headloss.

Wastewater

- The pipe network is expected to experience scattered wet weather surcharges, but no manhole spills are predicted under either dry or wet weather conditions.
- The addition of infill flows does not significantly impact system performance, and no manhole spills are predicted under either dry or wet weather conditions.
- No upgrades required.

Stormwater

- Taihape has several open channels contributing to localised ponding. One major channel flows from the northwest towards Goldfinch Street, resulting in significant ponding downstream on Linnet Street through to Hautapu Street and the Moa Street intersection. Another open channel along Mataroa Road flows southeast, leading to downstream ponding near Toroa Street to Hautapu Street. Additionally, a minor overland flow path near Thrush Street causes localised ponding affecting some properties along the street.