Appendix J – Water and Wastewater Assessments

BTW COMPANY

To:	Te Awamutu Developments Limited		
From:	Mathew Dickey (BTW Company Limited)		
Date:	23rd November 2022	**BTW Job Number:**	211365

Subject: Water Servicing Assessment – Residential Subdivision - 2025 Ōhaupō Road

EXECUTIVE SUMMARY

BTW Company Limited (BTW) have been engaged by Te Awamutu Developments Limited to undertake a water supply servicing assessment of the property located at 2025 Ōhaupō Road, Te Awamutu, to determine the feasibility of supplying a proposed residential lifestyle village subdivision from the existing Waipā District Council (WDC) water reticulation.

The water modelling assessment was completed by WSP consultants, with development demand information and preliminary reticulation layout provided by BTW. The outcome of this modelling assessment is attached as Appendix A, with the key outcomes and upgrades recommended from the modelling assessment summarised below.

Modelling Conclusions and Recommendations (Adopted from WSP's Report - Appendix A):

WSP completed water supply modelling, concluding that two applicable upgrade options are required to service the water supply for this proposed development:

- Upgrade 1: Close the two Non-Return Valves (NRVs) on Taylors Avenue.
- Upgrade 2: Replacing the current Greenhill booster pump.

Upgrade 1 was modelled by closing the two NRVs on Taylors Avenue, near George Melrose Drive. This was completed in order to make the Greenhill boosted zone a closed zone. Although no improvements in Level of Service (LoS) or fire flow occurred after closing the NRVs, this upgrade is recommended to increase the overall operating efficiency of Upgrade 2 – replacing the Greenhill booster pumps.

Upgrade 2 replaces the current Greenhill booster pump with a new pump that caters for the additional demands created by the proposed Ōhaupō Road development, the fire flow required, and improves LoS to the wider Greenhill boosted zone area. It is recommended to replace the current pump with two separate pumps, as listed below:

- Pump 1 will be continuously operating to provide daily demands.
- Pump 2 will be a “standby” pump to supply flows in an emergency event.

The controls for both Pumps 1 and 2 are identified and listed in Section 4.2 of Appendix A. Implementing Upgrade 2 resolves LoS and fire flow issues within the Greenhill boosted zone (including supplying the Ōhaupō Road development) in both the 2022 and 2050 scenarios. A detailed design for this proposed pumpstation upgrade is recommended.

Overall, to service the water demands for this development, it is recommended to upgrade the existing booster pump (Upgrade 2), along with closing the NRVs (Upgrade 1) to improve the LoS and fire flow requirements within the Greenhill boosted zone. This provides an acceptable site water supply servicing solution. It was also concluded that based on the WSP modelling assessment (subject to assumptions), water demand from the development can be sufficiently catered for by the Water Treatment Plants servicing Te Awamutu.

SITE LOCATION AND DEVELOPMENT INFORMATION

The site is located near the northern town boundary of the Te Awamutu township, as shown in Figure 1. The property assessed is currently in two Lots (Lot 1 DPS 36696 and Part Lot 1 DP 35654). The full site area (of both Lots) is approximately 25.78 Ha total.

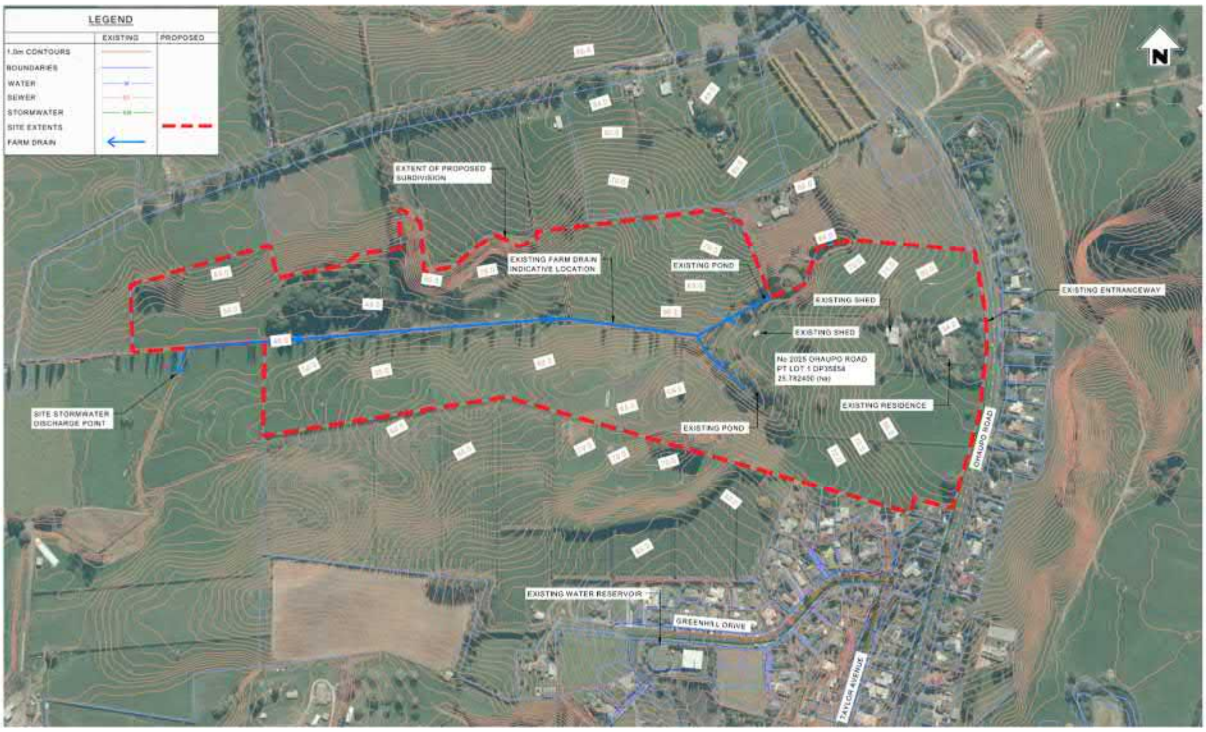


Figure 1: Site plan showing the site location and extents

The site is proposed to be developed into residential housing, with a preliminary estimate of up to 500 residential dwellings proposed by Te Awamutu Developments Limited for the purposes of this water supply servicing assessment.

EXISTING WATER SUPPLY INFRASTRUCTURE

Water supply to service the development is proposed to be provided from the Waipā District Council owned and operated Te Awamutu water supply reticulation. Figure 2 below provides an overview of the site proximity in relation to the Te Awamutu potable water reticulation. The site is in relatively close proximity to the Greenhill Drive water reservoir and existing booster pump station.

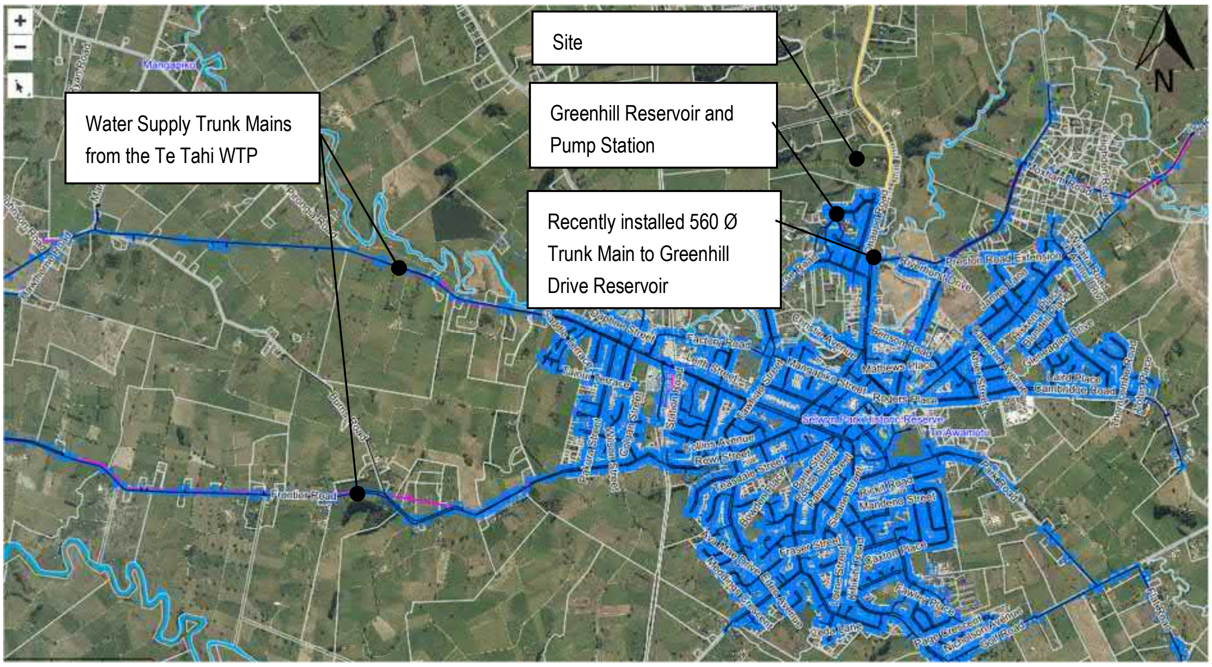


Figure 2: Existing Surrounding Water Supply Infrastructure (Source: Waipa District Council GIS maps)

WATER SUPPLY DESIGN PARAMETERS

All design parameters have generally been taken from the Waikato Local Authority Shared Services (WLASS) Regional Infrastructure Technical Specifications (RITS), Section 6 Water Supply, version May 2018. Where suitable parameters do not exist in the above documents, then parameters have been adopted with reference to NZS 4404:2010 Land development and subdivision infrastructure, the Waipa District Development and Subdivision Manual 2015, or SNZ PAS4509:2008.

Table 1 below describes some of the key parameters used in this assessment.

Table 1: Key design parameters for the Water Supply Assessment

Parameter	Value required by specification	Reference specification
Design life	100 years	RITS 6.2.1.1
Minimum residual pressure and flow at point of supply (On demand residential)	200 kPa and 25 L/min	RITS 6.1.3.1 (a)
Normal Operating Pressure	200 – 300 kPa	Waipa District Development & Subdivision Manual 2015, Section 6.4.5.2 Table 13
Maximum Pressure at point of supply	1000 kPa	RITS 6.1.3.1
Fire Supply Service Level Required	FW2 to be provided for residential areas	SNZ PAS 4509:2008, RITS 6.1.3.1 (b)
FW2 Fire Water Requirements	Fire Water Requirements for FW2 as defined in Table 2 (Page 20). Water supply system to be designed to provide 60% of annual peak demand in addition to the fire flow demand. Minimum residual reticulation pressure for fire flow events is taken as 100 kPa.	SNZ PAS 4509:2008, Table 2 SNZ PAS 4509:2008, Section 4.2
Domestic Water Demand	260 L / Person / Day	RITS 6.2.3 (a)
Persons per dwelling	2.7	RITS Table 5-3 / NZS 4404:2010 5.3.5.1

WATER SUPPLY – ESTIMATED SITE DEMANDS AND FLOWS

Water demand calculations for the proposed residential development are presented in this section (in accordance with the design parameters outlined in Table 1). At this stage, a conservative approach of assuming 500 dwellings has been adopted[1].

The residential demand calculated for the initially proposed 500 Residential Lots is calculated as follows:

$$Avg\ Residential\ Demand = 500\ Dwellings\ x\ 2.7\ People\ /\ Dwelling\ x\ \ 260\ L\ /\ person\ /\ day$$

$$Avg\ Residential\ Demand = 351{,}000\ L/day\ \ (351\ m^3/day)$$

It is estimated that the residential demand above would result in typical/average peak daily flows of approximately 6-7 L/s (pending the diurnal residential flow pattern suitable for Te Awamutu and the type of residential development).

Although typical peaking factors of 5 are recommended in RITS, due to the scale of the proposed development (approximately 500 dwellings), a reduced peaking factor of approximately 3 is proposed to be applicable.

FW2 Fire water flows (25 L/s total) coupled with 60% of annual peak flows (estimated at 10.8 - 12.6 L/s) will be required to service the development for firefighting purposes (as per the Table 1 parameters). This correlates to an estimated fire flow requirement of 38 L/s.

WATER SENSITIVE DESIGN

Water sensitive design techniques such as rainwater harvesting and re-use, and adoption of low-flow fittings and fixtures on the proposed development dwellings will be a key consideration in the master planning phase of this project and future design phases. Water sensitive design also aligns with the Te Aranga design principles adopted across this project.

Adoption of water sensitive design will likely reduce the development water demands calculated for the modelling undertaken in this investigation. Therefore, the modelling assessment completed for this project is conservative in regard to water demand / council reticulation capacity to service the development and does not include water demand reductions that may be achieved through the adoption of water sensitive design.

[1] It is likely that there will be a small portion of public facilities that are better aligned with a commercial water demand allocation. However, the residential demand allocation is more conservative, and commercial demands can be considered in future water supply assessments for this site, on completion of a development master plan.

WATER SUPPLY ASSESSMENT AND MODELLING RESULTS

Overall, the water servicing assessment and hydraulic modelling completed has confirmed that servicing water demands for the proposed residential lifestyle village development from the Te Awamutu town water reticulation (allowing for 500 residential dwellings) is feasible through the implementation of two upgrades:

- Upgrade 1: Close the two Non-return valves (NRVs) on Taylors Avenue.
- Upgrade 2: Replacing the current Greenhill booster pump

Figure 3 below is an extract from the WSP modelling report (Appendix A), which presents the LoS model outputs for the Greenhill Boosted Zone including these two upgrades, and the proposed lifestyle village residential water demands. The internal water reticulation modelled within the site is a conceptual configuration, which spatially captures the site topography where development will occur, and is representative in regard to the general water supply extents (noting that the layout/pipe alignments will naturally change in future design stages).

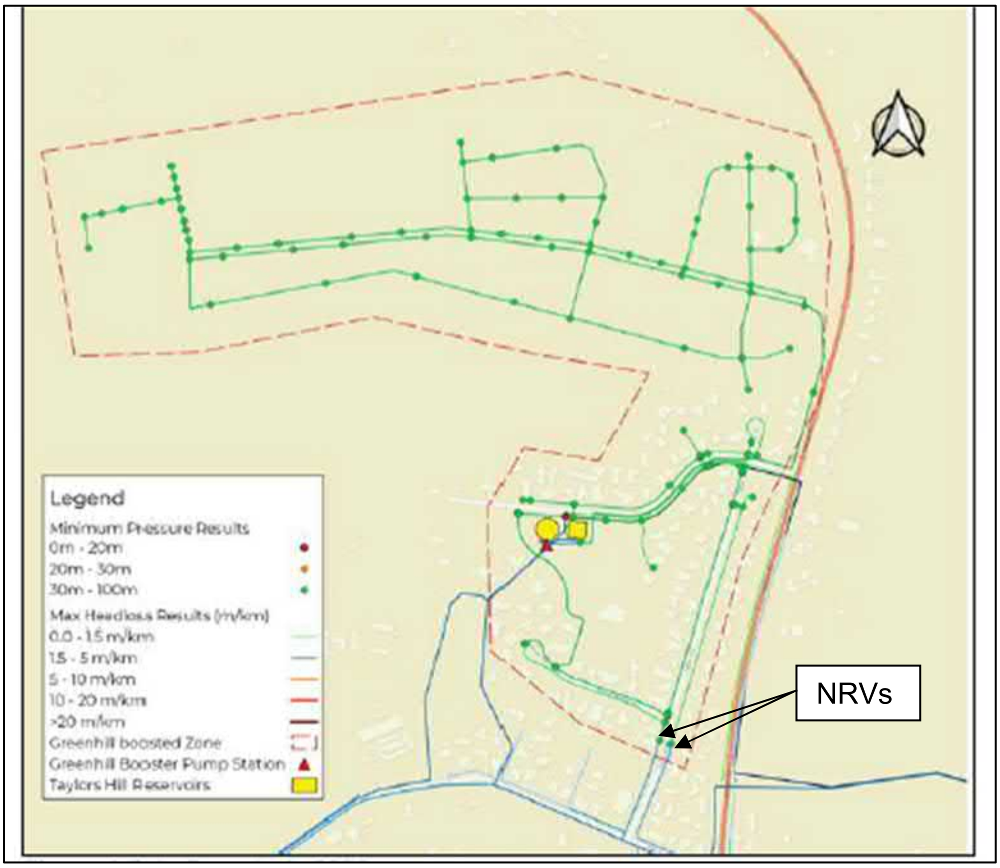


Figure 3: LoS results for both 2022 and 2050 scenarios (including Upgrades 1 & 2)

Refer to Appendix A for a detailed report of the water supply modelling results, recommendations, and conclusions.

APPENDIX A WATER MODELLING ASSESSMENT (WSP 2022)

Memorandum

To	Mathew Dickey
Copy	Melissa Allfrey, Harry Baxter, Jivir Viyakesparan
From	Pramodi Galabadage
Office	Hamilton
Date	9 November 2022
File/Ref	3-39619.00
Subject	Hydraulic Analysis for Ōhaupō Rd Development – Stage 2
Status	Final

1 Introduction

Ultimate Holdings Limited (UHL) is proposing a private plan change residential subdivision at 2025 Ōhaupō Road, Te Awamutu. Figure 1-1 shows the site location.

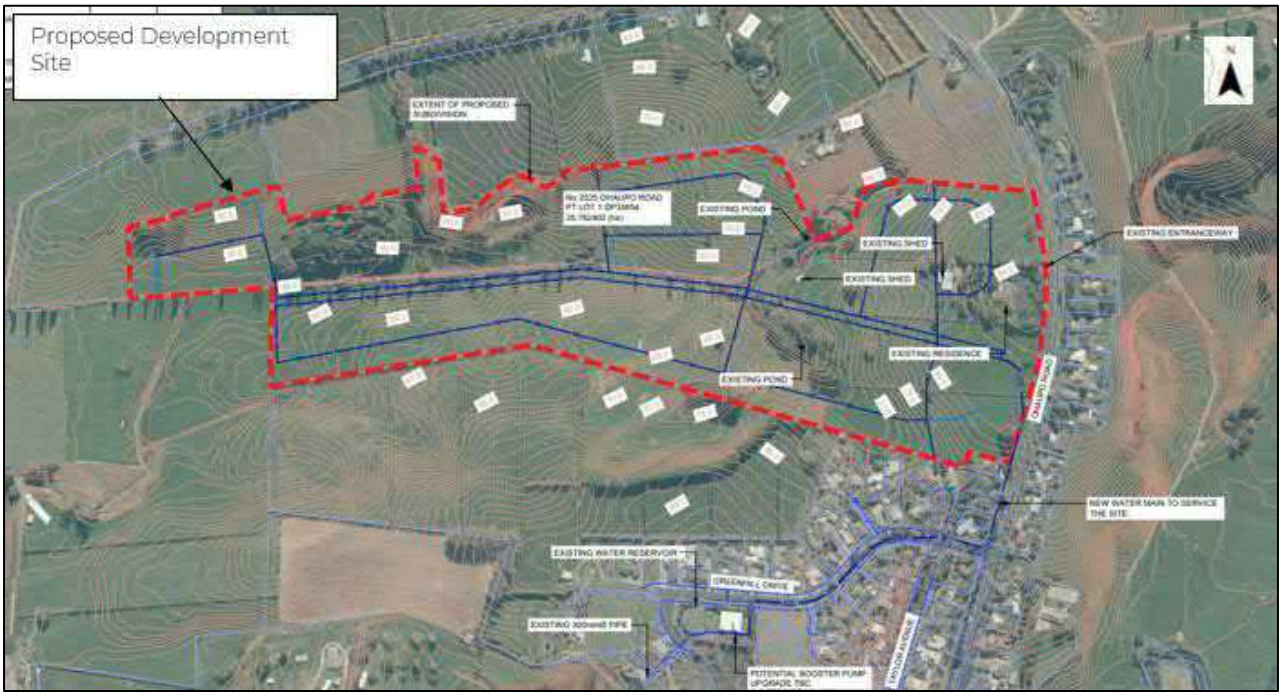


Figure 1-1 : Overview of Ōhaupō Road development

On behalf of UHL, BTW Company Ltd has approached WSP to undertake a potable water supply hydraulic assessment for the proposed land development to comply with Waipa District Council (WDC) development and subdivision requirements.

Stage 1 of this assessment was carried out to identify if the existing Greenhill booster pump can deliver to meet the additional demands created by Ōhaupō Road development. The report containing Stage 1 results can be found in Appendix A.

Stage 2 of the hydraulic assessment further analysed the options recommended in Stage 1 in order to resolve the Level of Service (LoS) and fire flow issues withing Greenhill boosted zone.

This memo includes the model results for 2022 base model and 2050 growth model after implementing the recommended options from Stage 1.

2 Recommended Options

The following lists the recommended options from Stage 1;

- Option 1: Close the Non-return valves (NRVs)
  This option proposes to close the 2 non-return valves near George Melrose Drive to make Greenhill boosted zone a closed zone.

- Option 2: Replace the current Greenhill booster pump
  This option proposes to replace the current Greenhill booster pump with a new pump that can provide sufficient flows to meet LoS and fire flow requirements.

- Option 3: Update the proposed pipe sizes
  This option proposes to use the existing booster pump, with updated pipe sizes recommended in Stage 1 if required.

These options were incorporated in the model to determine if the proposed network can meet WDC requirements for land development (The Regional Infrastructure Technical Specification (RITS)) and the New Zealand Fire Flow Standards (SNZ PAS 4509:2008, New Zealand Fire Service – Firefighting Water Supplies Code of Practice).

3 Acceptance Criteria

The following criteria was used.

a) LoS: Minimum pressure of 200 kPa (20m) pressure at every connection point.
b) Fire flow: New Zealand Fire Service Code of Practice; SNZ PAS 4509:2008 and subsequent amendments, to the satisfaction of the New Zealand Fire Service. *Table 3-1* below lists the minimum fire flow requirements (for a single hydrant).

Table 3-1. Fire Flow Requirements.

Code:	Description:	Requirements:	
		Minimum Fire Flow (L/s):	Minimum Residual Pressure at Required Fire Flow (m):
FW2	Residential	12.5	10

Limitations in the hydraulic modelling software only allows the fire flow analysis for one hydrant at a time. Therefore, WSP has adopted a methodology used for Wellington Water for a similar exercise, this is explained below.

For residential fire flows (FW2), the flow from a single hydrant is used to assess the likely flow from two hydrants. If the average flow is greater than or equal to 25 L/s, the flow from one hydrant meets the FW2 requirements.

The use of this approach also creates a buffer to cater for the uncertainty in the models.

4 Model Results

4.1 Option 1 – Closing NRVs

Currently, 2 NRVs located on Taylor Avenue near the George Melrose Drive intersection, restrict flows leaving the Greenhill boosted zone. However, flows could still enter Greenhill boosted zone through the NRVs from Te Awamutu network. Option 1 proposes to close the 2 NRVs to make Greenhill boosted zone a closed zone. This option confirms that Greenhill boosted zone is only supplied by the Greenhill booster pump and no flow is leaving the boosted zone. Option 1 was implemented in the model as a request from WDC.

Figure 4-1 shows the location of the 2 NRVs.

Figure 4-1 : Location of the NRVs proposed to close

The LoS and fire flow results from stage 1 in 2022 were unchanged after closing the NRVs (refer to Appendix A for stage 1 results). This was expected because no significant flows were simulated through the NRVs in 2022 in Stage 1.

In 2050, the model simulation shows the new Taylors Hill booster pumps back feeding into Green Hill boosted zone through the NRVs. As a result of the additional flows coming through the NRVs, both LoS and fire flow requirements were met. Closing the NRVs restricted the additional flows coming through and therefore, Greenhill boosted zone is not able to meet the minimum pressure and fire flow requirements.

In summary, no improvement in the LoS or fire flow results were observed from closing the NRVs.

4.2 Option 2 – Replacing the current pump

In Stage 1, we concluded that the current Greenhill booster pump is not capable of supplying the additional demands required for Ōhaupō Road development to meet the WDC minimum pressure requirements. Similarly, the current booster pump cannot deliver the required flows to meet FW2 fire flow requirements.

Therefore, WSP investigated replacing the current pump to one of a larger size to resolve the LoS and fire flow issues. In this case, the current Greenhill booster pump must be replaced with a pump (or pumps) that can meet future growth in Greenhill.

If we use a single pump catering for both LoS and fire flow, the controls need to be set to operate within a larger duty flow range. This means the pump could be unnecessarily oversized. Therefore, we recommend replacing the current booster pump with 2 separate pumps. Pump 1 will be operating continuously to cater for daily demands. Pump 2 will be a "stand by" pump which will be turned on in an emergency (i.e., a fire event) to provide the additional flow required.

The pump duty (flow and head) for Pump 1 was set to supply sufficient flows to Greenhill boosted zone in order to meet the minimum LoS requirements.

Pump 2 (Fire Pump) will turn on whenever the flow through Pump 1 exceeds 25 L/s. An increased flow through Pump 1 means that there is an increased demand created by an emergency event.

Pump 2 was set so that it could supply 25 L/s to any given hydrant in the zone.

4.2.1 Pump 1 controls (2022 and 2050)

The recommended duty for Pump 1 is listed in Table 4-1 below. This duty work for both 2022 and 2050 as there are no changes in the demand within the Greenhill boosted zone.

Table 4-1: Recommended controls for pump 1

Duty flow	25 L/s
Duty head	37 m

Figure 4-2 shows the resulting pump curve for Pump 1.

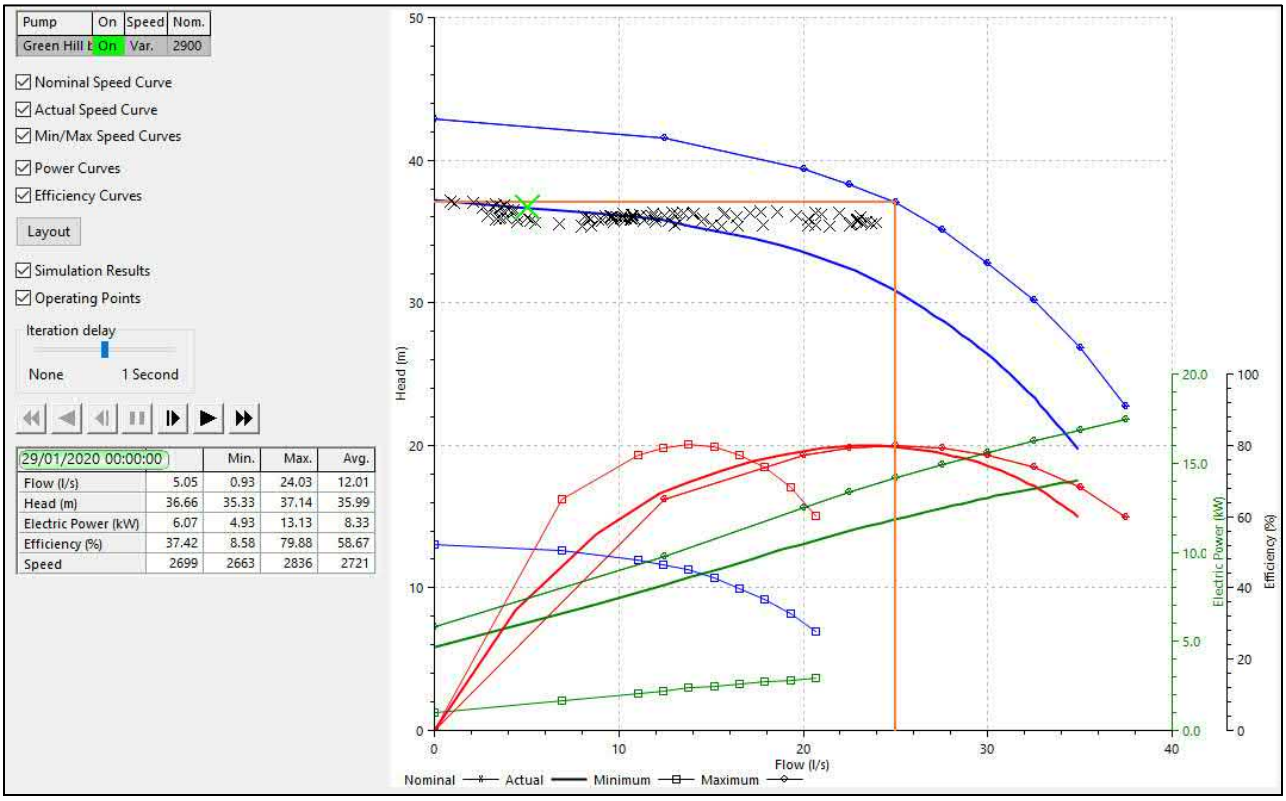


Figure 4-2 : Pump curve for pump 1

Both the 2022 base model and 2050 growth model were updated with the duty pump information above. Figure 4-3 and Figure 4-4 show the resulting LoS results in 2022 and 2050 after replacing the existing Greenhill boosted pump.

As per the figures below, the minimum pressure within the Greenhill boosted zone meets the minimum requirements, and there are no maximum headloss issues observed.

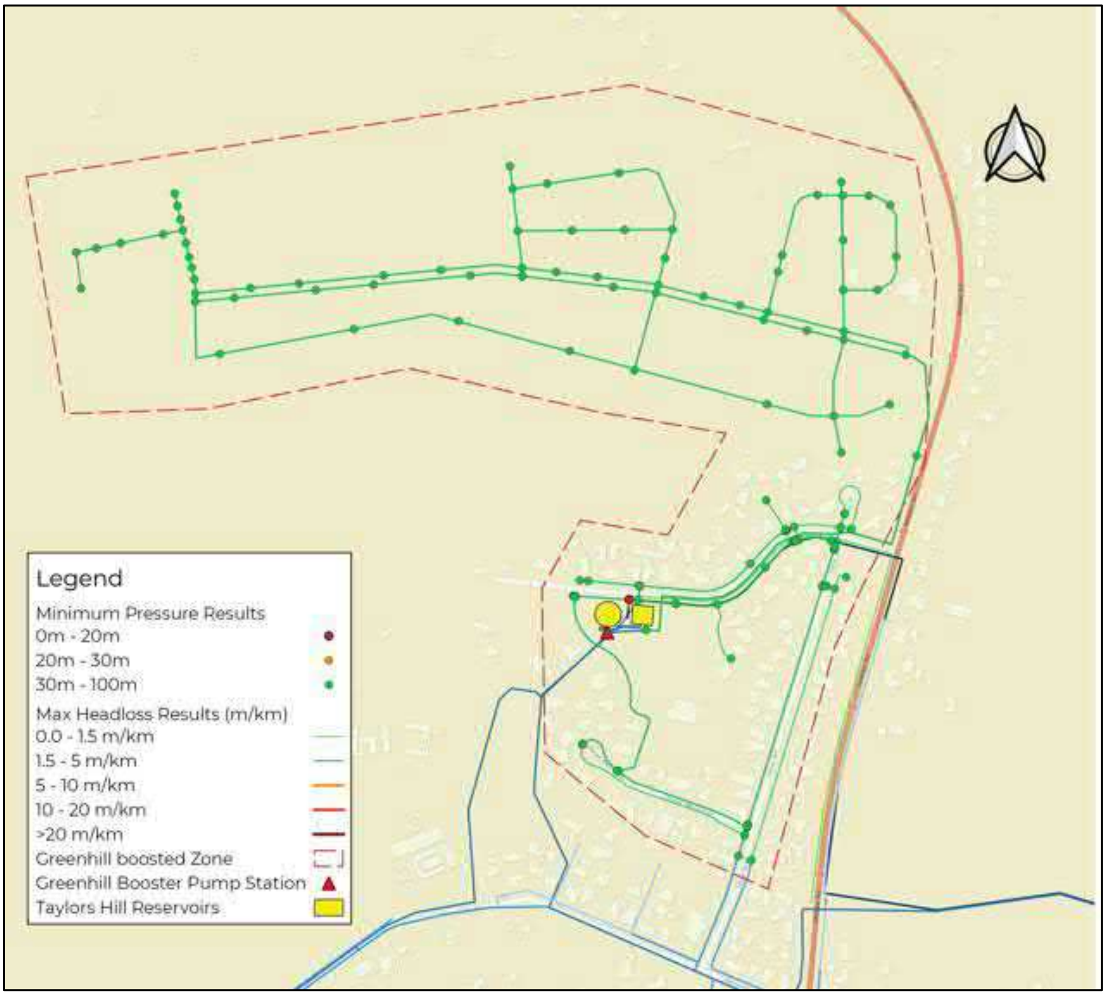


Figure 4-3 : LoS results in 2050

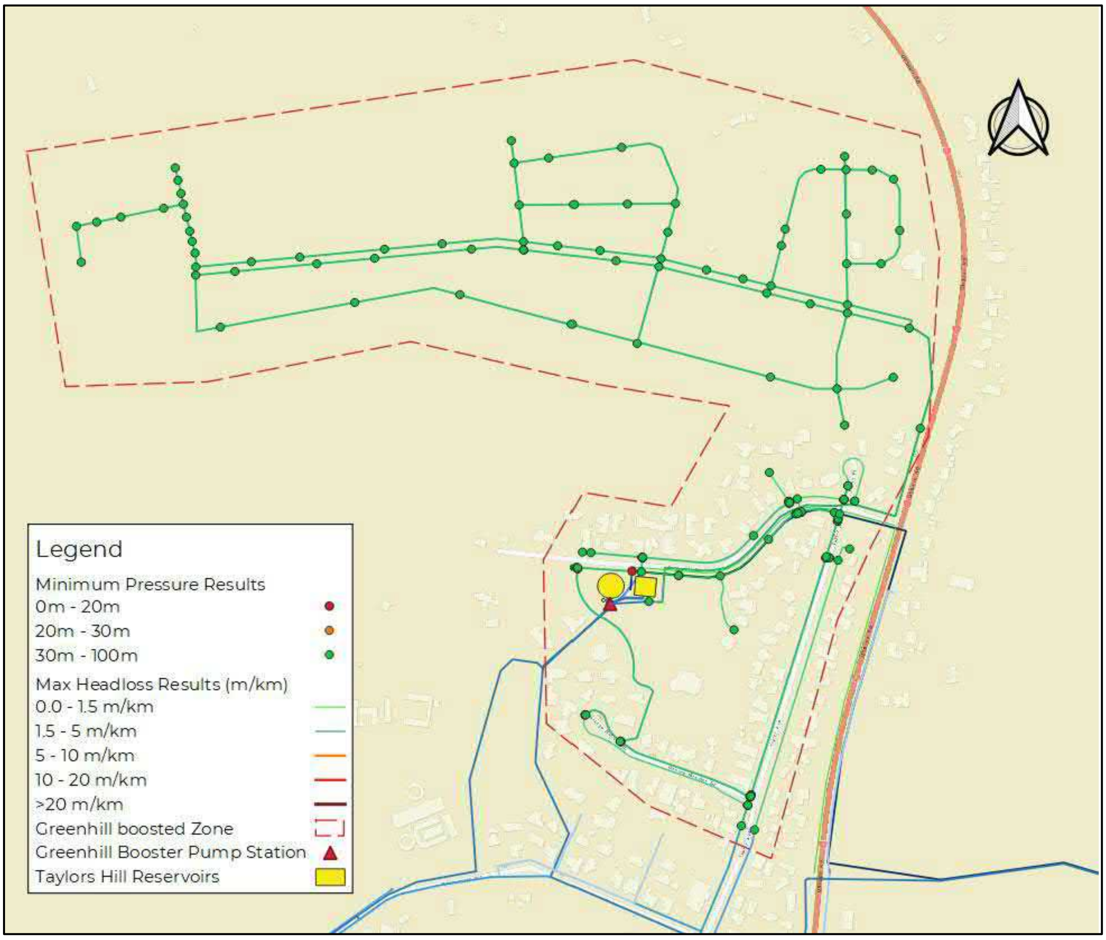


Figure 4-4 : LoS results in 2050

4.2.1 Pump 2 controls (2022 and 2050)

The recommended duty parameters for Pump 2 (Fire Pump) are listed in Table 4-2. This pump duty provides the required FW2 fire flows to any hydrant within the boosted zone. The same pump duty can be applied in both 2022 and 2050.

Table 4-2: Recommended controls for Pump 2

Duty flow	33 L/s
Duty head	37 m

This pump control must be set to turn on when the flow through Pump 1 exceeds 25 L/s which indicates a fire event or similar.

Figure 4-5 shows the fire flow results for each hydrant within the boosted zone. We have observed similar fire flow results in both2022 and 2050.

	Node	Fire Zone	Hydrant Testing Result	Minimum Fire Flow Required (l/s)	Minimum Fire Flow (l/s)	Residual Pressure at Minimum Fire Flow (m)	Minimum Residual Pressure Required (m)	Residual Pressure at Available Fire Flow (m)	Available Fire Flow (l/s)
	DEVE_H_0001		Passed	25.00	25.00	61.57	10.00	10.00	51.24
	DEVE_H_0002		Passed	25.00	25.00	62.41	10.00	10.01	51.61
	DEVE_H_0003		Passed	25.00	25.00	63.15	10.00	10.01	51.74
	DEVE_H_0004		Passed	25.00	25.00	58.95	10.00	10.01	49.82
	DEVE_H_0005		Passed	25.00	25.00	55.16	10.00	9.99	48.22
	DEVE_H_0006		Passed	25.00	25.00	53.93	10.00	10.00	47.68
	DEVE_H_0007		Passed	25.00	25.00	48.46	10.00	10.01	45.40
	DEVE_H_0008		Passed	25.00	25.00	42.28	10.00	9.99	42.11
	DEVE_H_0009		Passed	25.00	25.00	32.35	10.00	10.01	37.66
	DEVE_H_0010		Passed	25.00	25.00	54.92	10.00	10.00	47.93
	DEVE_H_0011		Passed	25.00	25.00	57.29	10.00	9.99	48.83
	DEVE_H_0012		Passed	25.00	25.00	48.21	10.00	10.00	44.43
	DEVE_H_0013		Passed	25.00	25.00	45.52	10.00	10.00	43.17
	DEVE_H_0014		Passed	25.00	25.00	42.27	10.00	9.99	41.66
	DEVE_H_0015		Passed	25.00	25.00	41.74	10.00	10.00	41.60
	DEVE_H_0016		Passed	25.00	25.00	57.86	10.00	9.99	48.39
	DEVE_H_0017		Passed	25.00	25.00	48.08	10.00	10.00	43.78
	DEVE_H_0018		Passed	25.00	25.00	43.68	10.00	10.00	42.17
	DEVE_H_0019		Passed	25.00	25.00	30.40	10.00	10.01	35.73
	TAWA_H_0428		Passed	25.00	25.00	27.44	10.00	10.00	30.97
	TAWA_H_0429		Passed	25.00	25.00	24.23	10.00	9.99	29.99
	TAWA_H_0462		Passed	25.00	25.00	41.82	10.00	10.00	34.92
	TAWA_H_0476		Passed	25.00	25.00	33.37	10.00	9.99	32.71
	TAWA_H_0478		Passed	25.00	25.00	46.58	10.00	10.00	35.65
	TAWA_H_0545		Passed	25.00	25.00	36.23	10.00	10.01	33.54
	TAWA_H_0546		Passed	25.00	25.00	20.26	10.00	9.99	28.27
	TAWA_H_0548		Passed	25.00	25.00	15.41	10.00	9.99	27.72
	TAWA_H_0579		Passed	25.00	25.00	18.65	10.00	10.00	28.91
	TAWA_H_0580		Passed	25.00	25.00	18.39	10.00	10.00	29.31
	TAWA_H_0659		Passed	25.00	25.00	18.00	10.00	9.99	27.49
	TAWA_H_0660		Passed	25.00	25.00	19.81	10.00	9.99	28.48

Figure 4-5 : Fire flow results in 2022 and 2050

4.3 Option 3 – Updating the pipe sizes

This was an optional solution we recommended in case if implementing Option 1 and Option 2 is not sufficient to improve LoS and fire flow. However, as explained in the section above, replacing the existing pump station with 2 pumps resolves the LoS and fire flow issues within the boosted zone.

Therefore, updating the proposed pipe sizes for Ōhaupō Road development in Stage 1 would not be necessary. Table 4-3 lists the pipe sizes proposed in Stage 1.

Table 4-3: Summary of pipe sizes proposed in Stage 1

Pipe Product	Nominal Size (mm)	Mean Internal Diameter (mm)	Wall Thickness (mm)
PVC-O, Series 2, PN 12.5	200	218.4	6.9
PVC-O, Series 2, PN 12.5	150	166.8	5.3
PVC-O, Series 2, PN 12.5	50	53.7	3.1 – 3.6

5 Conclusions and Recommendations

WSP carried out the stage 2 of water supply modelling for Ōhaupō Road development to evaluate the recommendations made in Stage 1. Three options have been analysed in Stage 2 as listed below.

- Option 1: Close the Non-return valves (NRVs)
- Option 2: Replacing the current Greenhill booster pump
- Option 3: Update the proposed pipe sizes

Option 1 was implemented by closing the 2 NRVs near George Melrose Drive. This was done in order to make the Greenhill boosted zone a closed zone. No improvements in LoS and fire flow were seen after closing the NRVs. While Option 1 doesn't resolve the LoS and fire flow issues, we still recommend implementing it along with Option 2 to increase the overall operating efficiency of the Option 2 pumps.

Option 2 proposes to replace the current Greenhill pump with a new pump that could cater for the additional demands created by Ōhaupō Road development as well as the fire flow. We recommend replacing the current pump with 2 separate pumps as listed below;

- Pump 1 will be continuously operating to provide daily demands.
- Pump 2 will be a "standby" pump to supply flows in an emergency event.

The controls for both pump 1 and pump 2 are identified and listed in Section 4.2. Implementing Option 2 resolves LoS and fire flow issues within Greenhill boosted zone in both 2022 and 2050. However, due to the limitations in hydraulic modelling, we recommend carrying out a detailed design for the recommended pumps.

Option 3 recommended to update the proposed pipe sizes for Ōhaupō Road development using Stage 1 solution, if required. As the LoS and fire flow issues are resolved by replacing the existing Greenhill booster pump (Option 2), evaluating this option was not necessary.

Overall, we recommend replacing the existing booster pump along with closing the NRVs to improve the LoS and fire flow requirements within the Greenhill boosted zone.

Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for BTW Company Ltd ('**Client**') in relation to assess the impact of the Ōhaupō Road development on the current and future Te Awamutu wastewater networks ('**Purpose**') and in accordance with the Water and Wastewater Modelling Assessment – 2025 Ōhaupō Road Development Offer of Service dated 21/07/2022. WSP, as per Waipa District Council's comments, acknowledge that the limitation that the modelling has not considered potential intensification due to the implementation of the new Medium Residential Density Standards permitting greater intensification by way of Plan Change 26 that WDC has given effect to. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

In preparing the models on which this report is based, WSP has relied upon data, surveys, analyses, designs, plans and other information ('**Client Data'**) provided by or on behalf of the Client. Except as otherwise stated in the Report, WSP has not verified the accuracy or completeness of the Client Data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this Report are based in whole or part on the Client Data, those conclusions are contingent upon the accuracy and completeness of the Client Data. WSP will not be liable in relation to incorrect conclusions or findings in the Report should any Client Data be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

Prepared by:	Reviewed by:	Approved for Release by:
Pramodi Galabadage	Jivir Viyakesparan	James Cassidy
Engineer – Water	Principal Engineer	Work Group Manager – Water Resources

Appendix A

Hydraulic Analysis for Ōhaupō Rd Development – Stage 1 Memo

Memorandum

To	Mathew Dickey
Copy	Melissa Allfrey, Harry Baxter, Jivir Viyakesparan
From	Sanjana Prakash/ Pramodi Galabadage
Office	Hamilton
Date	19 September 2022
File/Ref	3-39619.00
Subject	Hydraulic Analysis for Ōhaupō Rd Development – Water Supply Scheme
Status	Final (Stage 1)

1 Introduction

Ultimate Holdings Limited (UHL) is proposing a private plan change residential subdivision at 2025 Ōhaupō Road, Te Awamutu. Figure 1-1 shows the site location.

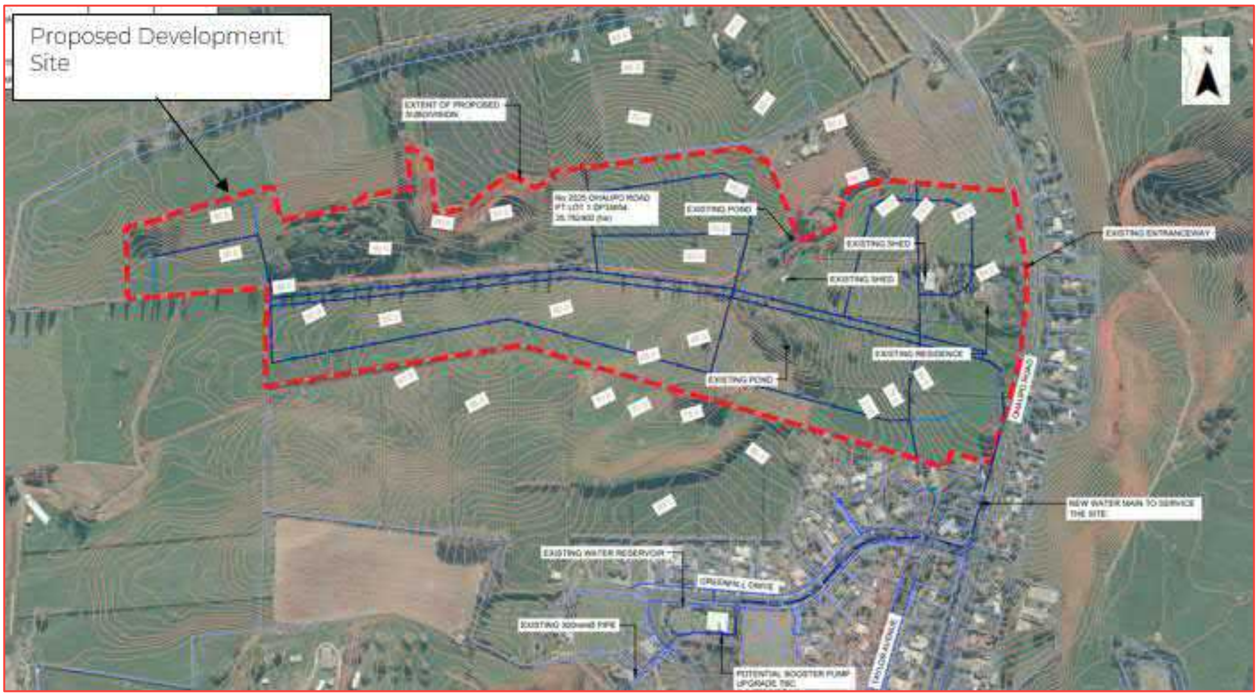


Figure 1-1 : Location of Development.

On behalf of UHL, BTW Company Ltd has approached WSP to undertake a potable water supply hydraulic assessment for the proposed land development to comply with Waipa District Council (WDC) development and subdivision requirements.

This hydraulic assessment determines if the proposed network can meet Waipa District Council's (WDC) requirements for land development (The Regional Infrastructure Technical Specification (RITS)) and the New Zealand Fire Flow Standards (SNZ PAS 4509:2008, New Zealand Fire Service – Firefighting Water Supplies Code of Practice).

The proposed water reticulation system plan is provided by BTW Company Ltd and is attached in Appendix A for reference. WSP digitised the development into the model as per this plan.

This memo includes the model results for 2022 base model and 2050 growth model with Ōhaupō Road development.

2 Key Assumptions

The following assumptions have been made in the hydraulic assessment:

- The demand used in this assessment was supplied by the client and taken from the BTW Design Preliminary Report - Three Waters and Geotechnical Assessment - 2025 Ōhaupō Road, Te Awamutu Geotechnical Assessment - 2025 Ōhaupō Road, Te Awamutu pg. 10. The information used to calculate the demand are shown in Table 2-1.

Table 2-1. Demand calculations

Number of Lots	500
Occupancy Rate (person/property)	2.7
Population Equivalent (people)	1350
Domestic demand (L/person/day)	260
Average consumption (L/day)	351,000
Peak factor	3
Average Day demand (L/s)	7
Modelling peak factor (calculated using the peak factor of 3 and peak hour factor from domestic demand profile)	1.43
Peak Day Demand (L/s)	10.02

- Peak day demand was used for pipe sizing and LoS assessment and 60% of the peak day demand was used for Fire Flow analysis.
- The 2050 growth demands and the demand from the proposed Paewira recycle plant were added to the 2022 WS base model for this assessment.
- The Frontier PRV was set to 150 kPa and the Pirongia Road PRV set to 450 kPa as currently operated.
- Parallel Road treatment plant pump controls are set up to maintain a sufficient water level in the Taylors Hill reservoirs. Taylors Hill reservoirs (through Greenhill booster pumps) will supply sufficient flows meet the additional demands created by the development. The flow rate from Parallel Road WTP pumps achieve refilling of 70% of the volume of the reservoir (i.e. between 35% and 95%) within 18 hours against a demand of (PDD) in 2021, 2025, 2035. and 2050 as stated in Harrison Grierson, Technical Memo - PARALLEL ROAD WATER TREAT PLANT, Treated Water Pump Selection, February 2020.
- The existing Greenhill booster pump will be used to supply the proposed development as part of the Greenhill boosted zone. No modifications were made to this booster pump as part of the Stage 1 works.

- As proposed in the water reticulation plan provided by the client, WSP used DN200 pipe connected to Greenhill pump station to supply the development in the model.

3 Acceptance Criteria

The following criteria was used.

a) LoS: Minimum pressure of 200 kPa (20m) pressure at ever y connection point.
b) Fire flow: New Zealand Fire Service Code of Practice; SNZ PAS 4509:2008 and subsequent amendments, to the satisfaction of the New Zealand Fire Service. *Table 3-1* below lists the minimum fire flow requirements (for a single hydrant).

Table 3-1. Fire Flow Requirements.

Code:	Description:	Requirements:	
		Minimum Fire Flow (L/s):	Minimum Residual Pressure at Required Fire Flow (m):
FW2	Residential	12.5	10

Limitations in the hydraulic modelling software only allows the fire flow analysis for one hydrant at a time. Therefore, WSP has adopted a methodology used for Wellington Water for a similar exercise, this is explained below.

For residential fire flows (FW2), the flow from a single hydrant is used to assess the likely flow from two hydrants. If the average flow is greater than or equal to 25 L/s, the flow from one hydrant meets the FW2 requirements.

The use of this approach also creates a buffer to cater for the uncertainty in the models.

4 Methodology

- Digitise the proposed development network into the current Waipa District network using Infoworks WS Pro.
- Review and assign the development demand to the proposed development network in the 2022 base model and 2050 growth model.
- Run the models and confirm if the proposed new water main sizing meets WDC's level of service (LoS) requirements and fire flow criteria.

5 Model Results

The proposed Ōhaupō Road development pipe network was digitised into the hydraulic model as shown in Figure 5-1 below. The current Greenhill boosted zone was extended to include this development. The demands of the proposed 500 residential lots were allocated to the connection nodes. Hydrants are allocated to the network as per the minimum spacing rules between two hydrants outlined in RITS.

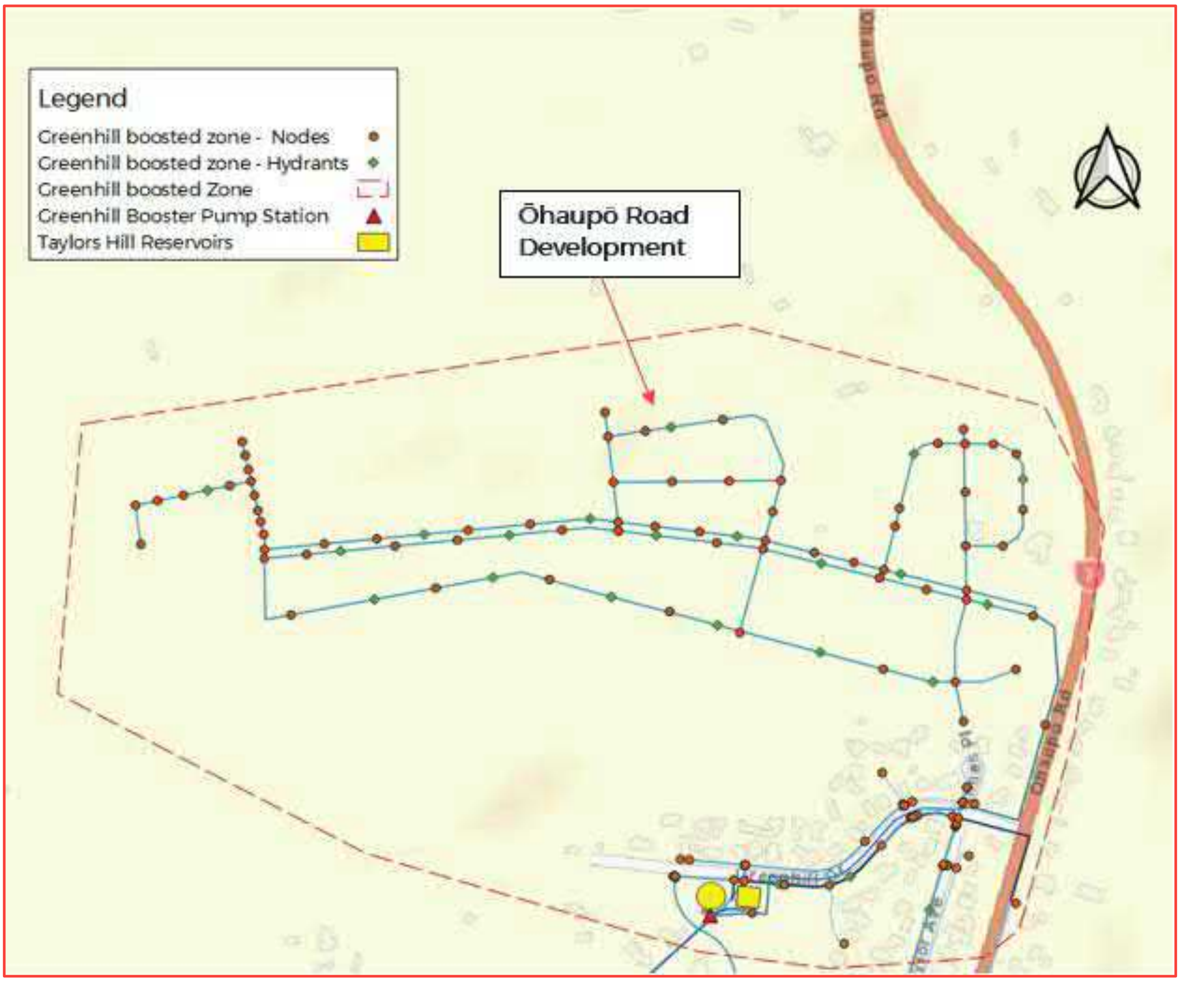


Figure 5-1 : Proposed Ōhaupō Road Development Water Supply Network

Table 5-1 below shows the pipe sizes used to build the Ōhaupō Road Development network.

Table 5-1: Pipe Parameters

Pipe Product	Nominal Size (mm)	Mean Internal Diameter (mm)	Wall Thickness (mm)
PVC-O, Series 2, PN 12.5	200	218.4	6.9
PVC-O, Series 2, PN 12.5	150	166.8	5.3
PVC-O, Series 2, PN 12.5	50	53.7	3.1 – 3.6

5.1 2022 Base Model Results

This section discusses the minimum pressure results and fire flow results of the Greenhill boosted zone including the Ōhaupō Road development in the 2022 base model.

5.1.1 LoS – Minimum Pressure

Figure 5-2 shows the minimum pressure results of the Greenhill boosted zone prior to the additional demands of Ōhaupō Road development.

Figure 5-2 : Current Greenhill boosted zone minimum pressure results in 2022

As shown in the figure above, existing Greenhill boosted zone meet the minimum pressure requirement of 20m, with the current booster pump, as shown below in Figure 5-3.

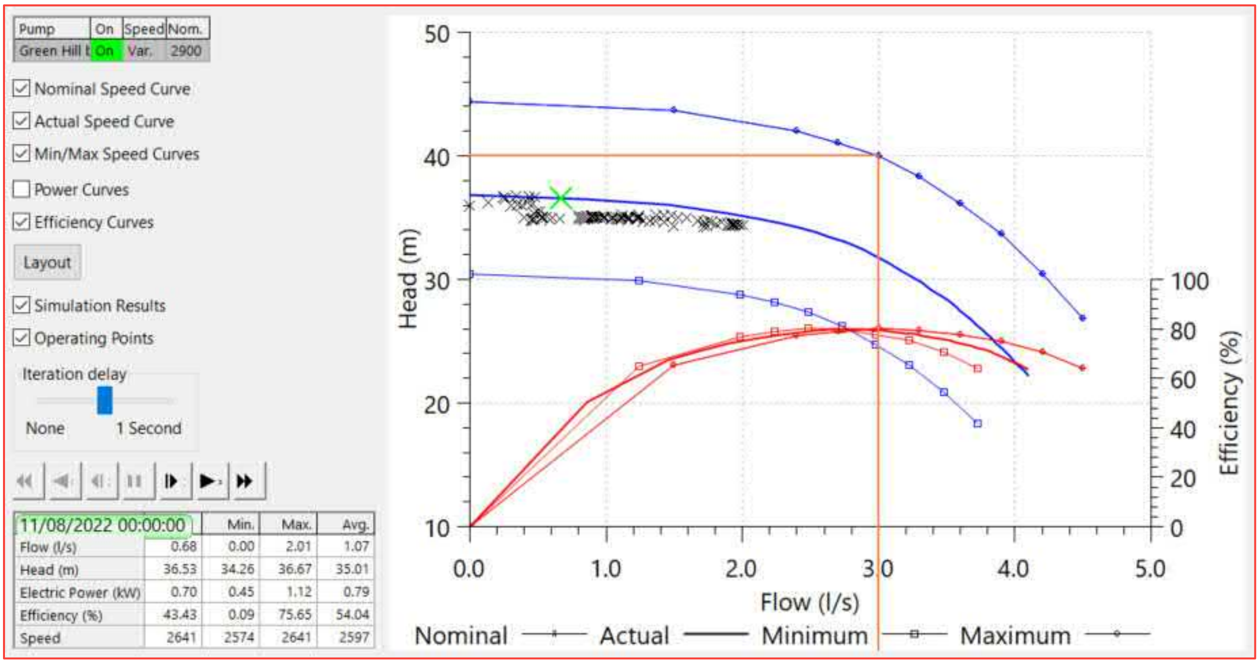


Figure 5-3 : Greenhill booster pump operation 2022

The model indicates the pumps are operating at the lower end of the pump curve with an average efficiency of 54% as shown by the operating points.

Figure 5-4 shows the minimum pressure results of the Greenhill boosted zone after adding the Ōhaupō Road development.

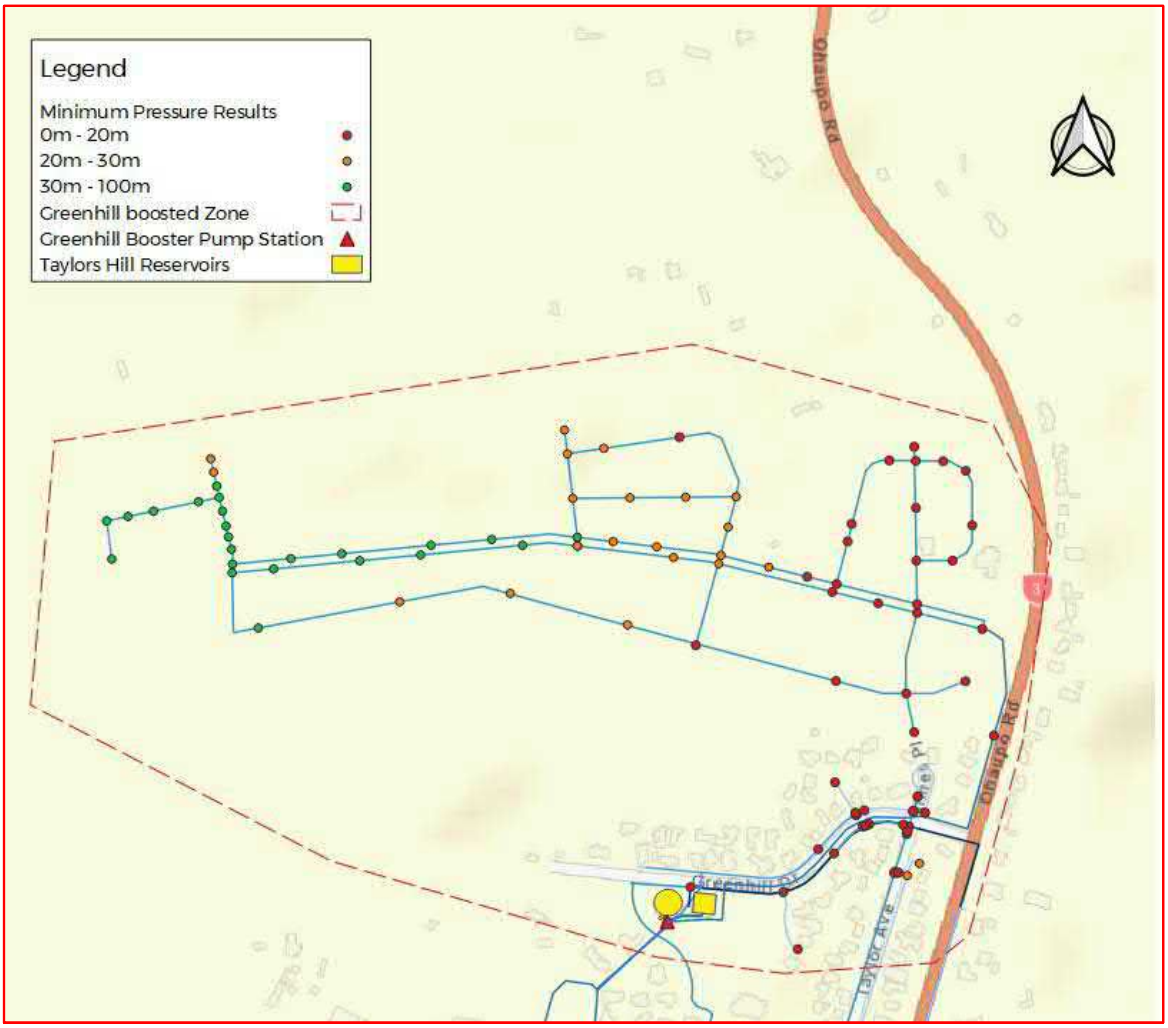


Figure 5-4 : Extended Greenhill boosted zone minimum pressure results in 2022 with the Ōhaupō Road development.

As shown in the figure above, the existing Greenhill boosted zone is failing to meet the minimum pressure requirements of 20 m after adding the Ōhaupō Road development demands. In addition, some parts of the Ōhaupō Road development also fail to meet the minimum pressure requirements.

This is possibly due to the current pump controls not being able to supply the additional demands created by the Ōhaupō Road development. Updating the Greenhill booster pump controls could be considered and modelled as an option in Stage 2.

Furthermore, there are no adverse effects on the wider Te Awamutu network because of the new Ōhaupō Road development.

5.1.2 Fire Flow Results

Fire flow testing was conducted in the model to assess if the proposed hydrants can supply sufficient fire-fighting flow when needed at the required residual pressures. As proposed development is a residential area, the fire flow was tested against FW2 criteria. The simulated fire event was created in the model for 30 minutes at the 60% of peak day demand.

Table 5-2 summarises the fire flow results of the Ōhaupō Road development.

Table 5-2: Fire Flow Results for Ōhaupō Road development

Total Hydrants	No of hydrants Passed	Percentage	No of hydrants Failed	Percentage
19	3	16%	16	84%

Figure 5-5 below shows the locations of the hydrants that passed or failed to meet FW2 criteria.

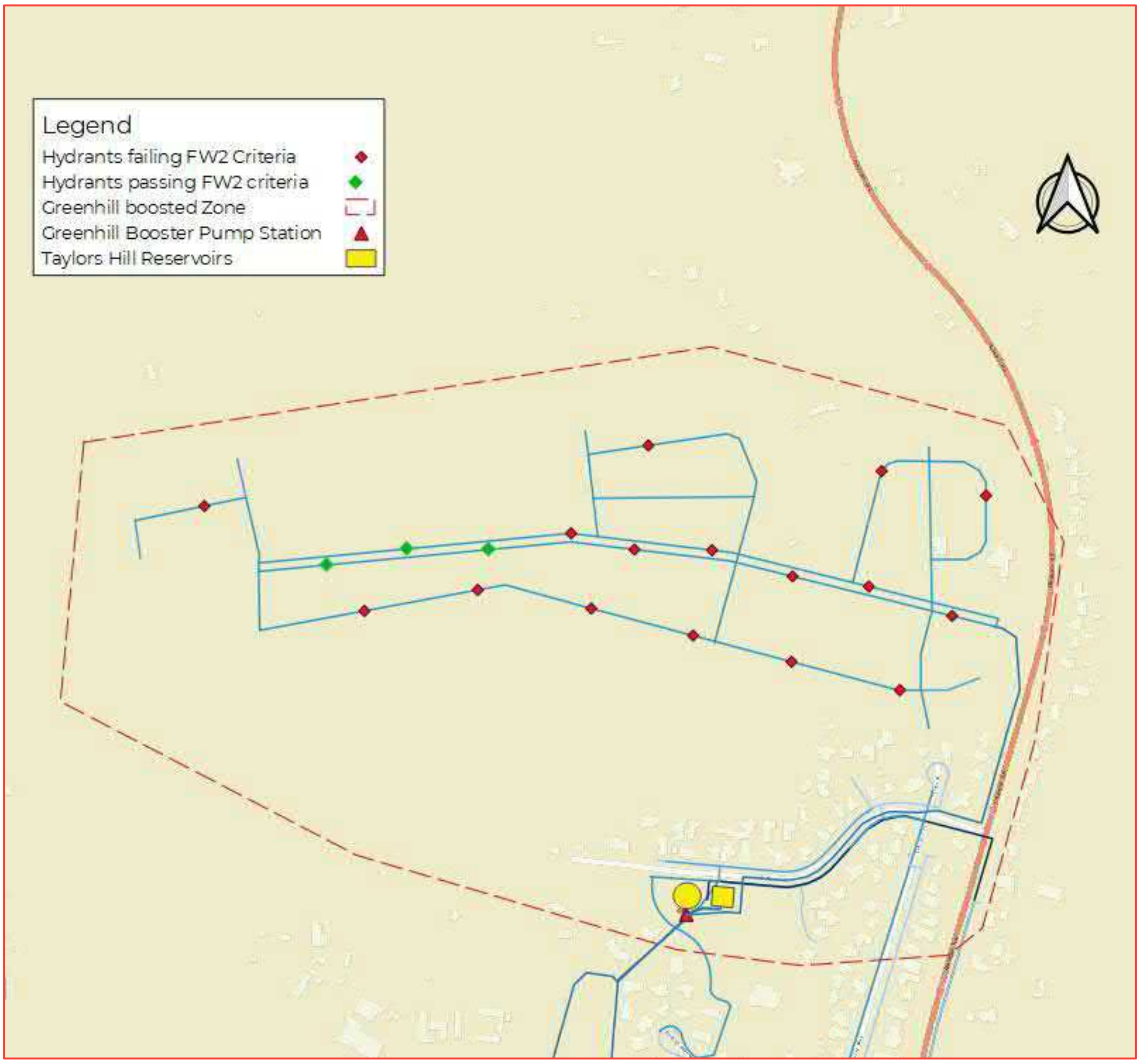


Figure 5-5 : Fire flow results of Ōhaupō Road development *in 2022*

As shown in the figure above, 85% of the hydrants failed to achieve FW2 fire flows. The 3 hydrants which passed the FW2 criteria are located in a relatively lower ground level compared to the failing hydrants. Please note that WSP has used surveyed ground level data provided by the developer for ground levels in the model, finished ground level have not been used.

Installing a dedicated fire pump at the Greenhill pump station was proposed as a solution in an earlier project to resolve the fire flow issues in the current boosted zone. This option could be further investigated to resolve Ōhaupō Road development fire flow issues in Stage 2.

5.2 2050 Growth Model Results

This section discusses the minimum pressure results and fire flow results of the Greenhill boosted zone including Ōhaupō Road development in the 2050 growth model.

5.2.1 LoS – Minimum Pressure results

Figure 5-6 below shows the minimum pressure results of the Greenhill boosted zone prior to the additional demands of Ōhaupō Road development.

Figure 5-6 : Current Greenhill boosted zone minimum pressure results in 2050

As shown in the figure above, existing Greenhill boosted zone meet the minimum pressure requirement of 20m, as the current booster pump controls can supply the demands. The pump operating range with the development is illustrated below.

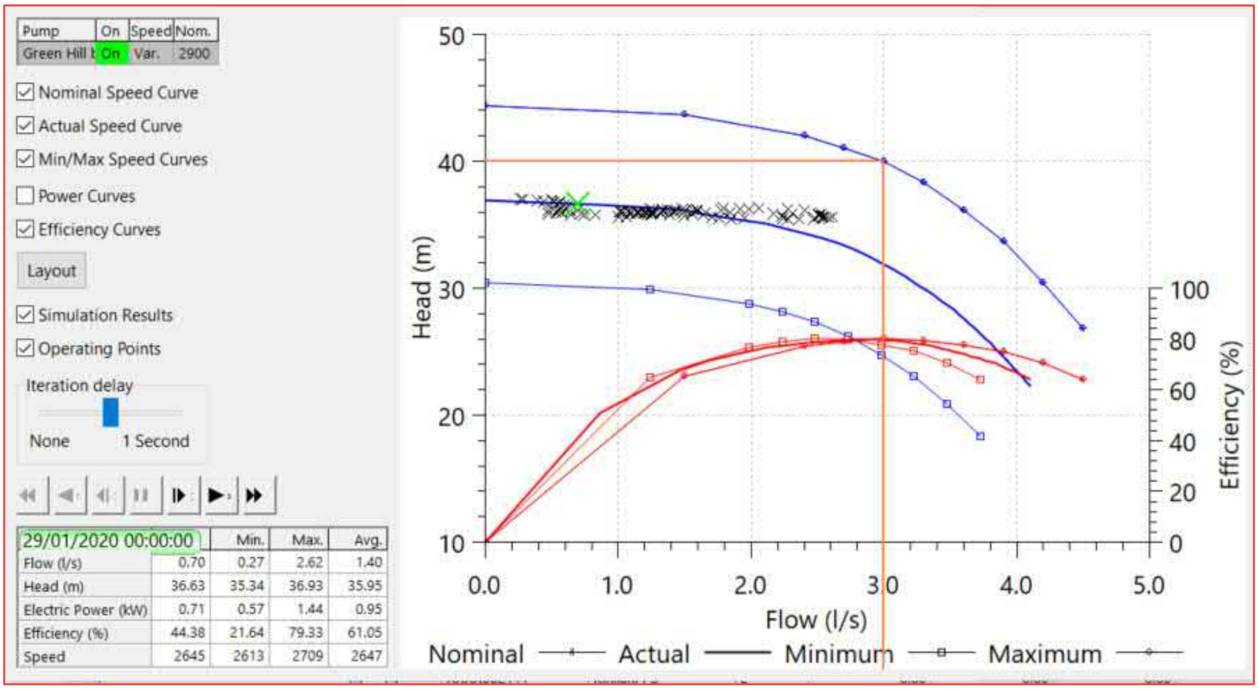


Figure 5-7 : Greenhill booster pump operation 2050

The model indicates that in the future the pumps still operate at the lower end of the pump curve, but the average efficiency has improved to 61% when compared to the 2022 base run.

Figure 5-8 below shows the minimum pressure results of Greenhill boosted zone after adding the Ōhaupō Road development.

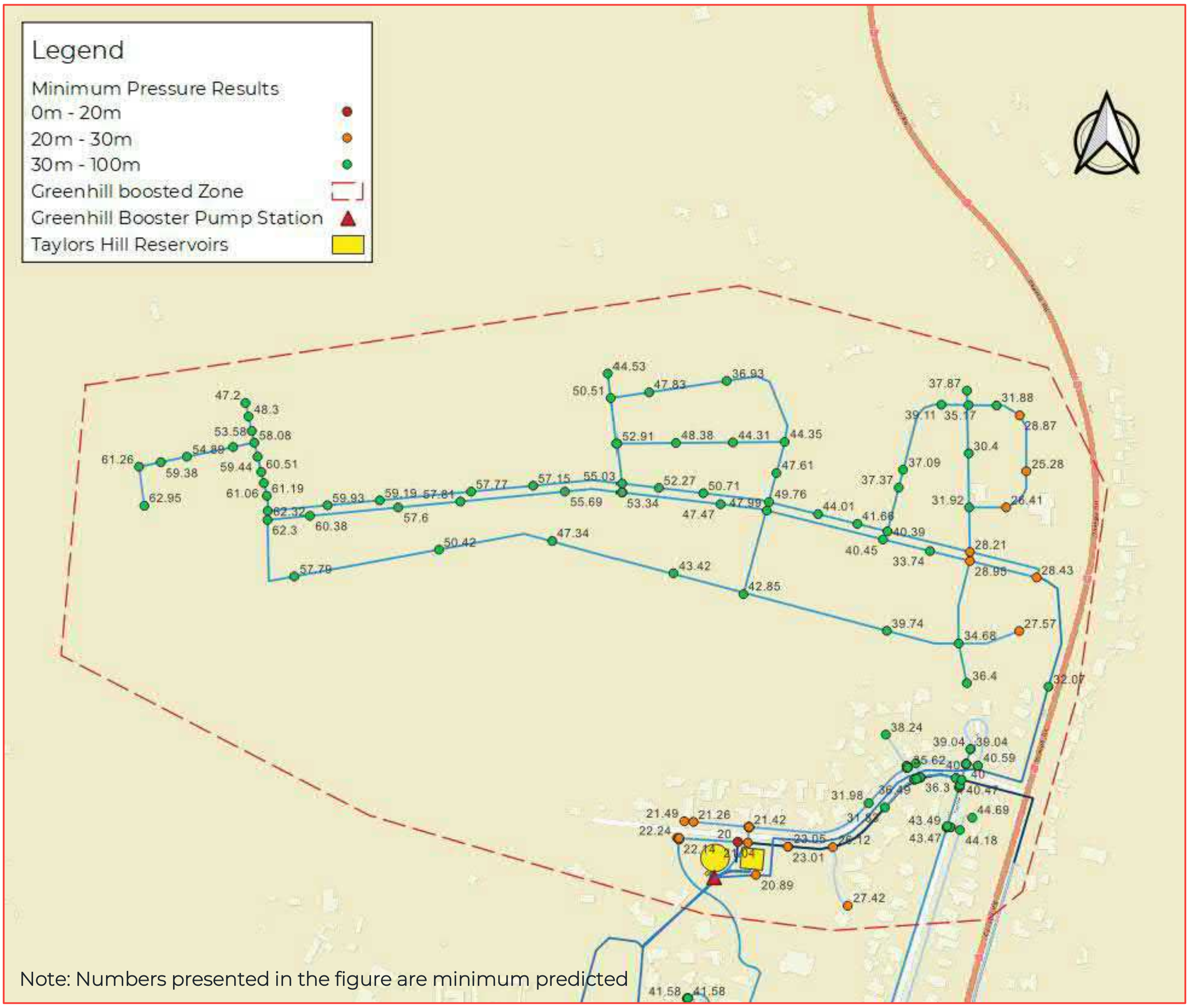


Figure 5-8 : Extended Greenhill boosted zone minimum pressure results in 2050

As shown in the figure above, the Ōhaupō Road development meets the minimum pressure requirement of 20m in 2050. In addition, there are no adverse effects on the wider Te Awamutu network outside Greenhill boosted zone.

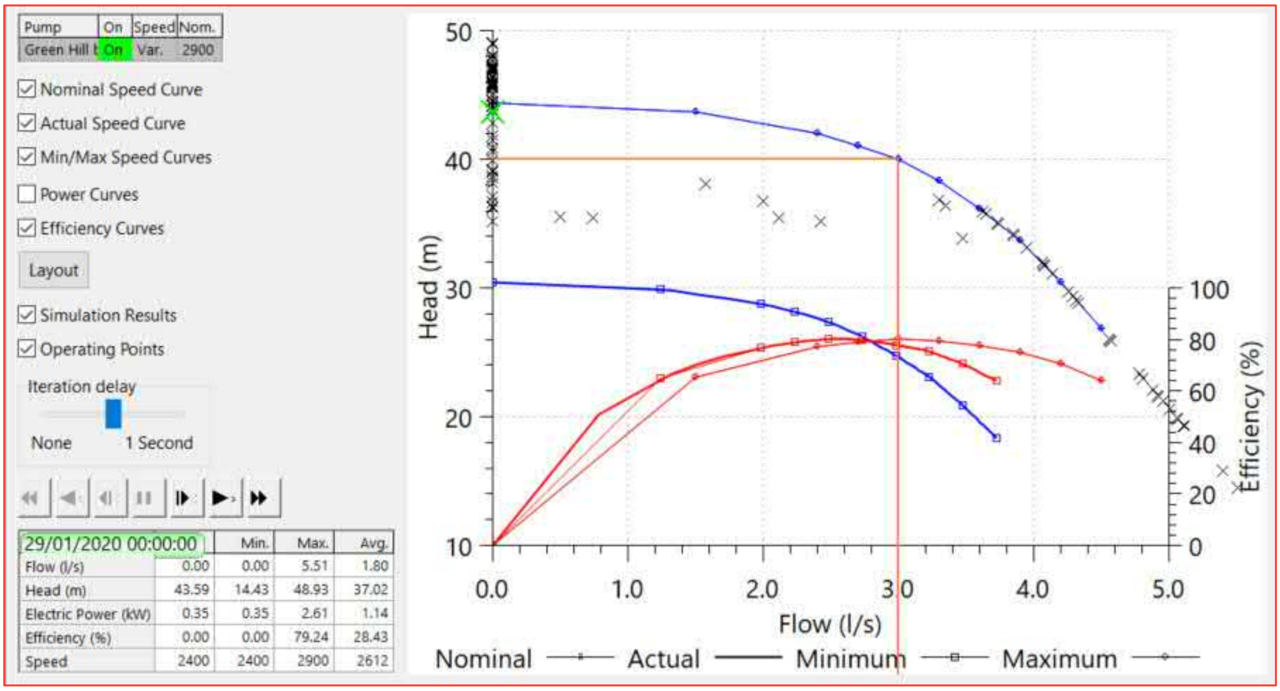


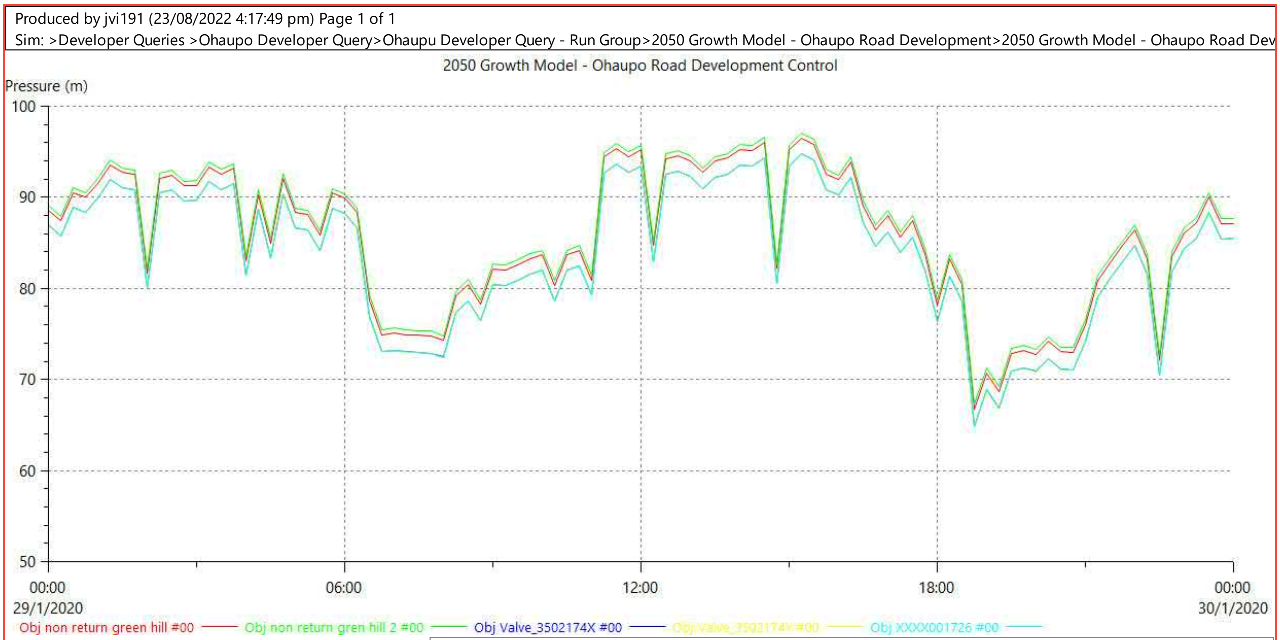
Figure 5-9 : Greenhill booster pump operation 2050 with development

The model indicates that in the future with the development the pumps will operate along the full pump curve and off the curve and is off most of the time. This is caused by the new Taylors Hill booster pumps back feeding into Green Hill boosted zone as explained below.

Greenhill boosted zone is not a closed zone. There are two non-return valves located near Taylor Avenue/ George Melrose Drive intersection, providing flow into Greenhill boosted zone.

Even though the non-return valves exist in 2022 base model allowing flow into Greenhill boosted zone, the flow from Taylors Hill reservoirs does not have sufficient head to supply Greenhill. Therefore, no inflow is seen through the non-return valves because the ground elevations of Greenhill boosted zone are higher than the operating water levels in Taylors Hill reservoirs.

In 2050, flow to TA is boosted by new Taylors Hill booster pumps. The additional head provides sufficient flow and pressures through the non-return valves for Greenhill boosted zone, and Ōhaupō Road development. However, pressures around the non-return valves (Figure 5-10) will experience pressures more than 60m and maximum pressures of around 95m.



	Pressure	
	Min (m)	Max (m)
non return green hill	66.722	96.509
non return gren hill 2	67.251	97.043
Valve_3502174X	64.853	94.818
Valve_3502174Y	64.825	94.812
XXXX001726	64.849	94.817

Figure 5-10 : Simulated pressures with new Taylors Hill Pump at Greenhill lower elevation

Figure 5-11 shows the locations of the non-return valves and the nodes graphed for minimum pressure above.

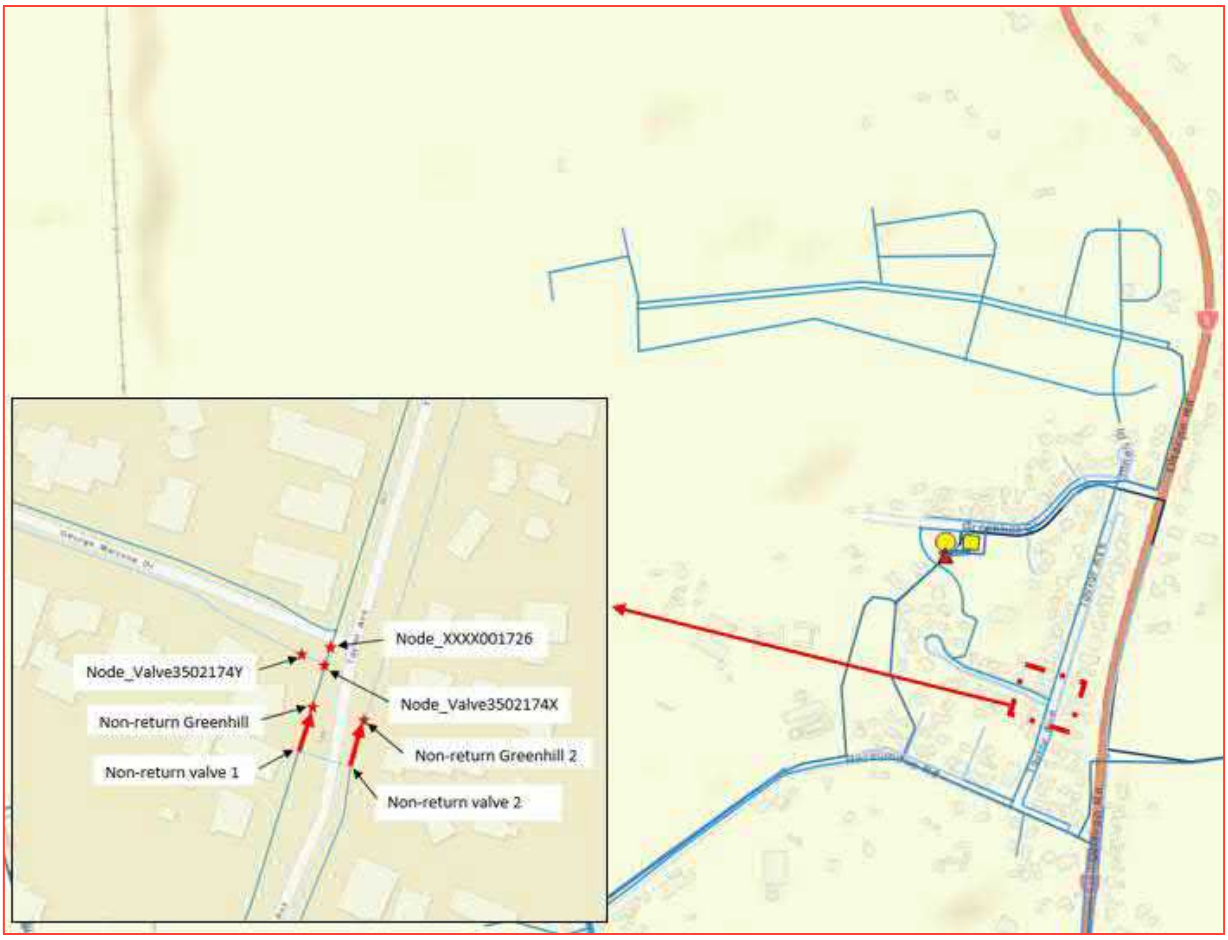


Figure 5-11 : locations of the non-return valves and the nodes graphed for minimum pressure

To better manage the operating pressures between the two zones it is recommended that the Greenhill boosted zone is isolated from the rest of TA and supplied only by Greenhill booster to avoid high pressures.

5.2.2 Fire Flow Results

Fire flow testing was also conducted for 2050 Growth cell against FW2 criteria. The simulated fire event was created in the model for 30 minutes at the 60% of peak day demand.

All hydrants within Ōhaupō Road development meets FW2 criteria in 2050. This is due to the similar reason as mentioned above. The boosted flow through the non-return valves is able to provide the required fire flows to Greenhill boosted zone.

6 Conclusions

WSP carried out a hydraulic assessment for the proposed water supply network of the Ōhaupō Road development. The scope of the assessment was to investigate if the proposed development meets minimum pressure requirements and fire flow criteria.

Based on the model results, existing Greenhill boosted zone (supply points on Greenhill Drive) and parts of proposed Ōhaupō Road development do not meet the minimum pressure requirements in 2022. 85% of the hydrants within the proposed development fail to meet FW2 criteria. WSP will investigate the options to resolve these issues in Stage 2.

However, in 2050, Ōhaupō Road development and the overall Greenhill boosted zone meet the minimum pressure requirement of 20m and FW2 fire flows. This is due to the Greenhill boosted zone being a non-closed zone and allowing extra flow from boosted Te Awamutu supply through the non-return valves to meet the additional demands.

As the assessment identified the proposed development failed to meet FW2 it is proposed to check pipe diameters as part of Sage 2, once minimum pressure has been achieved. Refer to the proposed recommendations on how minimum pressure will likely be achieved.

Based on this assessment we assume that the water demand from the development can be sufficiently catered for by the Water Treatment Plants servicing Te Awamutu.

In addition, there were no adverse effects on the wider Te Awamutu network as a result of the proposed Ōhaupō Road development in both 2022 and 2050.

7 Recommendations

To improve the minimum pressure and fire flow issues outlined above, we recommend investigating the options below, as part of Stage 2 of this project.

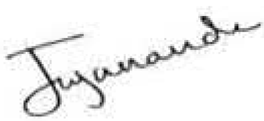
- Confirm the current pump controls of Greenhill booster pump with WDC and update the controls in the model if required. Otherwise, replace the existing pump with a new pump that could provide required flows and head.
- Make the Greenhill boosted zone a closed zone by closing the non-return valves located near Taylor Avenue/ George Melrose Drive intersection.
- Request WDC to confirm if there is an existing cross connection between the Taylors Hill fire pump and Greenhill boosted zone. If not make the cross connection to provide fire flow.
- Change/update the recommended pipe sizes if required to improve LoS or fire flow in Stage 2.

Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for BTW Company Ltd ('**Client**') in relation to assess the impact of the Ōhaupō Road development on the current and future Te Awamutu wastewater networks ('**Purpose**') and in accordance with the Water and Wastewater Modelling Assessment – 2025 Ōhaupō Road Development Offer of Service dated 21/07/2022. WSP, as per Waipa District Council's comments, acknowledge that the limitation that the modelling has not considered potential intensification due to the implementation of the new Medium Residential Density Standards permitting greater intensification by way of Plan Change 26 that WDC has given effect to. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

In preparing the models on which this report is based, WSP has relied upon data, surveys, analyses, designs, plans and other information ('**Client Data'**) provided by or on behalf of the Client. Except as otherwise stated in the Report, WSP has not verified the accuracy or completeness of the Client Data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this Report are based in whole or part on the Client Data, those conclusions are contingent upon the accuracy and completeness of the Client Data. WSP will not be liable in relation to incorrect conclusions or findings in the Report should any Client Data be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

Prepared by:



Pramodi Galabadage

Engineer – Water

Reviewed by:

Jivir Viyakesparan

Principal Engineer

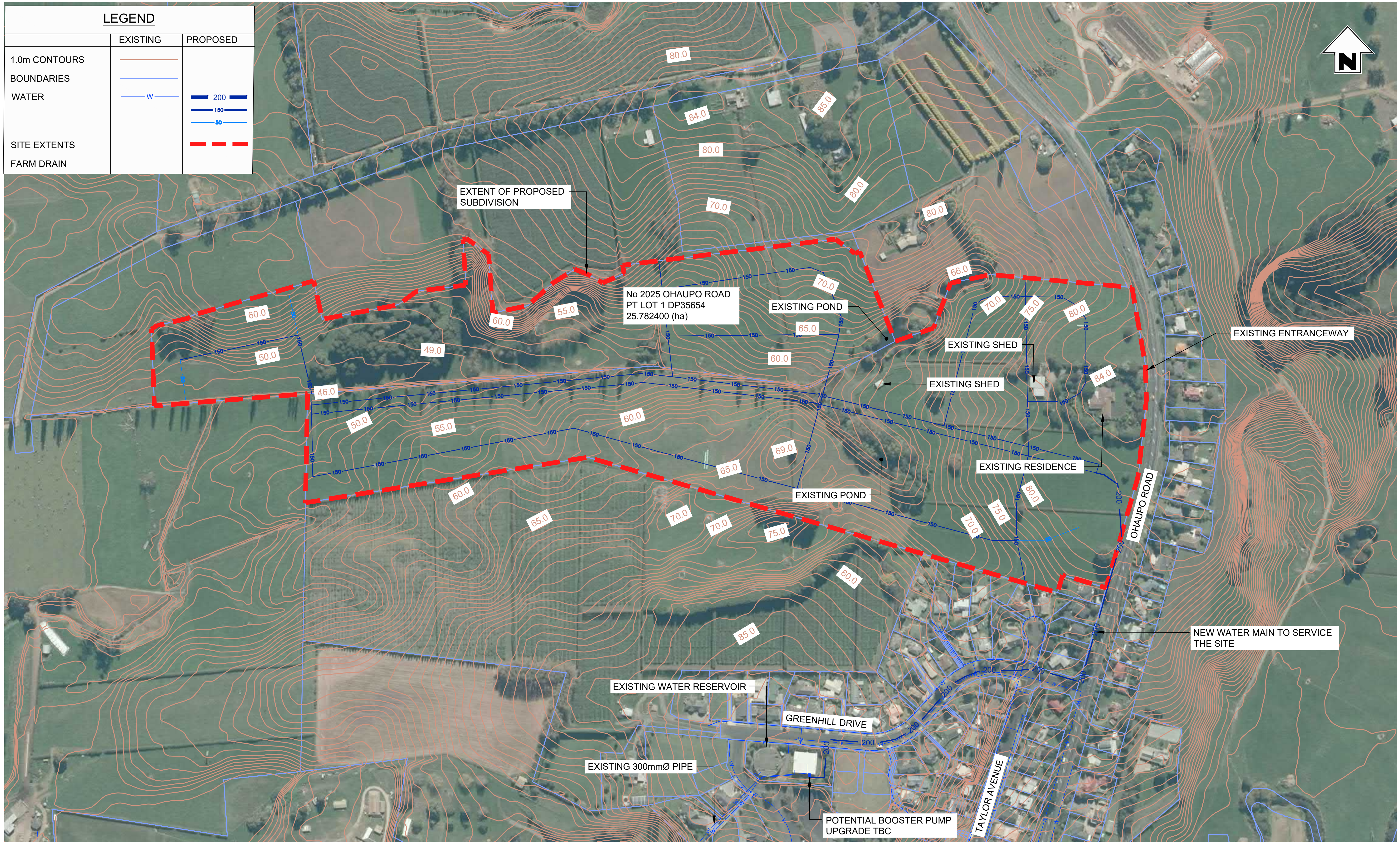
Approved for Release by:

James Cassidy

Work Group Manager – Water Resources

Appendix A

Ōhaupō Road Development Water Reticulation Plan



40 0 40 80 120 160 200m

SCALE 1 : 4000

Disclaimer:
Areas and dimensions may be subject to scale error.
Scaling from this drawing is at the users risk.

SERVICES PLAN - WATER

SCALE 1:4000

ISSUED FOR APPROVAL

BTW COMPANY

SURVEYING
ENGINEERING
PLANNING
ENVIRONMENT

NO	DATE	BY	CHKD.	APPR.	OPER.	DESCRIPTION
.	.	.	.	.	.	.
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A2	07/2022	MD	MD	.	.	INDICATIVE INTERNAL WATER PIPE LAYOUT
A1	11/21	HB	MD	MD	.	ISSUED FOR APPROVAL
A	11/21	HB	MD	MD	.	ISSUED FOR APPROVAL

REVISIONS

NUMBER	TITLE

REFERENCE DRAWINGS

GENERAL NOTES
1. Coordinates in terms of : NA
2. Elevations in terms of : NA
3. Contour interval is : NA

LOCATION	2025 OHAUPO ROAD	
PROJECT No.	211365	
A3 SCALE	AS SHOWN	
SURVEYED	-	-
DRAWN	HB	11/21
CHECKED	MD	11/21

TITLE
ULTIMATE GLOBAL GROUP
FESIBILITY OF PROPOSED SUBDIVISION
SERVICES PLAN - WATER

ORIGINAL SIZE	DRAWING No	SHEET	REVISION
A3	211365.01	C03	A2

File Name: C:\12d\data\BTW12D\211365 - Ultimate Holdings Ltd, Hamilton_4164\07 Drawings\211365-01 SITE-PLAN.dwg - SHT 3 Plot Date: 05/07/2022 Plot Time: 09:44

To:	Te Awamutu Developments Limited		
From:	Mathew Dickey (BTW Company Limited)		
Date:	6th December 2022	BTW Job Number:	211365

Subject: Wastewater Servicing Assessment – Residential Subdivision - 2025 Ōhaupō Road

EXECUTIVE SUMMARY

BTW Company Limited (BTW) have been engaged by Te Awamutu Developments Limited, to undertake a wastewater servicing assessment of the property located at 2025 Ōhaupō Road, Te Awamutu, to determine the feasibility of servicing a proposed residential lifestyle village subdivision via the existing Waipā District Council (WDC) wastewater reticulation.

The wastewater modelling for this assessment was completed by WSP consultants, with development flow information, preliminary reticulation layout, and a site Wastewater Pumpstation (WWPS) location provided by BTW to inform the modelling. The outcome of WSP's modelling assessment is attached as Appendix A, with the key outcomes and upgrades recommended from the modelling summarised below.

Modelling Conclusions and Recommendations (Adopted from WSP's Report - Appendix A):

WSP completed a wastewater modelling assessment, delivered through a two-stage modelling process in consultation with WDC and BTW. Overall, to service the wastewater flows for this development, there are two feasible options:

1. Option 1: Discharge all of the new site development flows to the existing gravity network that discharges into the Racecourse Road WWPS and upgrade an approximately 1 km length of existing 225 mm diameter wastewater gravity pipe to a 300 mm diameter size downstream of the Racecourse Road WWPS, as located in Figure 1.
2. Option 2: Discharge 80% of the development flows (from the proposed site WWPS) to the Christie Avenue WWPS conveyance route, with the remaining development flows gravity discharging to the Racecourse Road WWPS conveyance route. This would require the new site WWPS rising main to extend nominally 640 m along Ōhaupō road from the site to the existing wastewater manhole near the intersection of Ōhaupō Road and Racecourse Road (Manhole Asset ID 1090999).

Both options above result in no predicted overflows or freeboard deficiencies (for both the existing and growth network models), therefore complying with WDC's assessment criteria and presenting as feasible options to service the development wastewater flows. The modelling also concludes that the Te Awamutu Wastewater Treatment Plant (WWTP) will be able to cater for the Ōhaupō Road development flows along with the planned growth cells in the 2050 network.

Selection of the preferred option will occur in subsequent design phases. Additionally, as part of the subsequent design phases, it is recommended to conduct a detailed pumpstation capacity assessment to confirm the capacity of the downstream pumpstations (Racecourse Road WWPS and/or the Christie Avenue WWPS) and their capacity to manage for the proposed development flow.

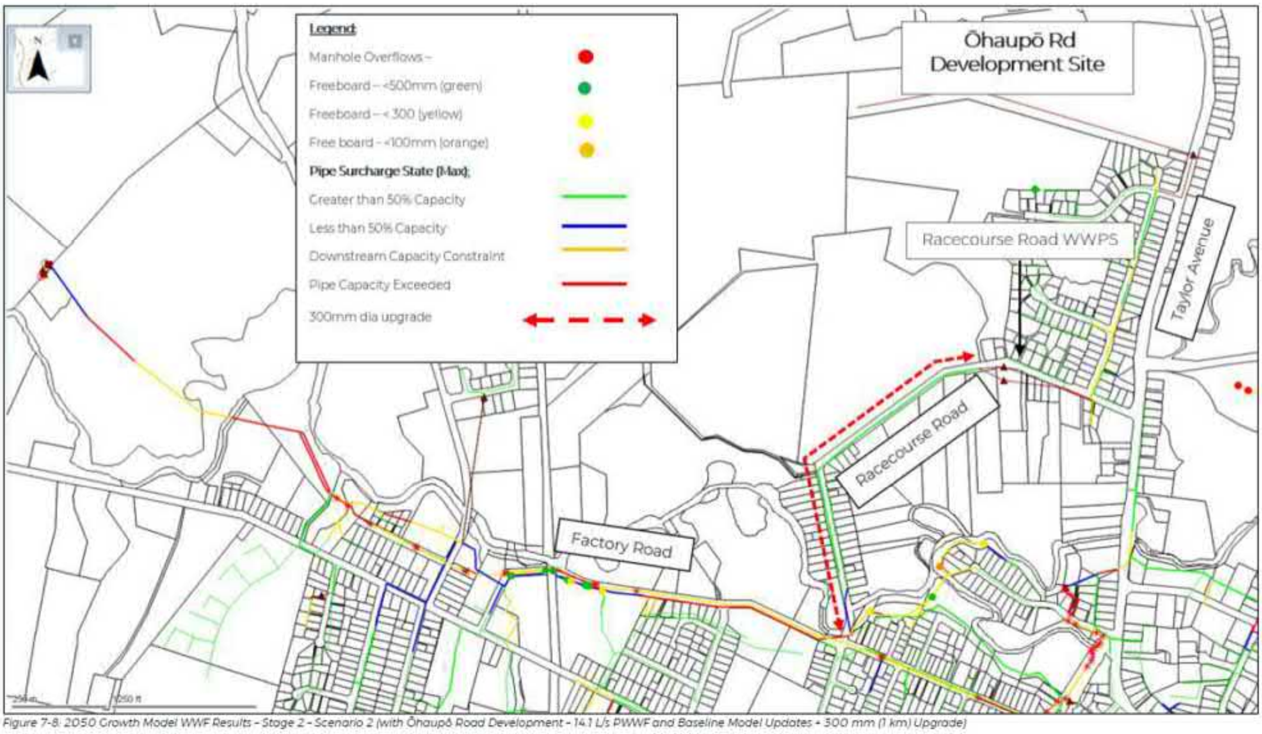

Figure 1: Te Awamutu wastewater modelling output showing the section of existing wastewater pipe to upgrade for Option 1 described above (figure extract from Appendix A).

SITE LOCATION AND DEVELOPMENT INFORMATION

The site is located near the northern town boundary of the Te Awamutu township, as shown in Figure 2. The property assessed is currently in two Lots (Lot 1 DPS 36696 and Part Lot 1 DP 35654). The full site area (of both Lots) is approximately 25.78 Ha total.

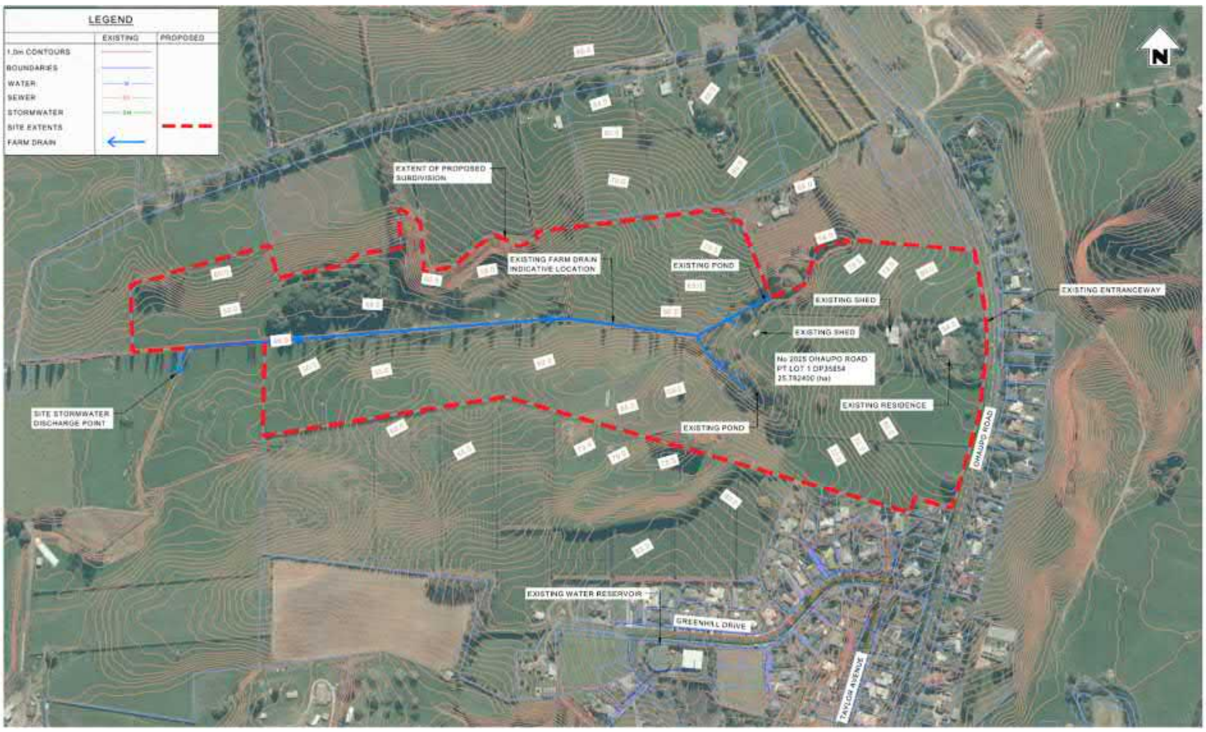

Figure 2: Site plan showing the site location and extents

The site is proposed to be developed into residential housing, with a preliminary estimate of up to 500 residential dwellings proposed by Te Awamutu Developments Limited for the purposes of this wastewater servicing assessment.

EXISTING WASTEWATER INFRASTRUCTURE AND CONVEYANCE TO THE WWTP

The existing wastewater network near the proposed development site is shown in Figure 3.The wastewater discharged from the site will likely be directed west to the manhole on Greenhill Drive (Manhole Asset ID 1090025), which is connected to a 150 mm sewer. Flows once discharged to the sewer network, will travel south along Taylor Avenue, before ultimately arriving at the Te Awamutu Wastewater Treatment Plant (WWTP) in the west of the catchment, approximately 4 km downstream of the initial discharge point. An alternative option for conveying site flows to the Christie Avenue WWPS is also shown in Figure 3.

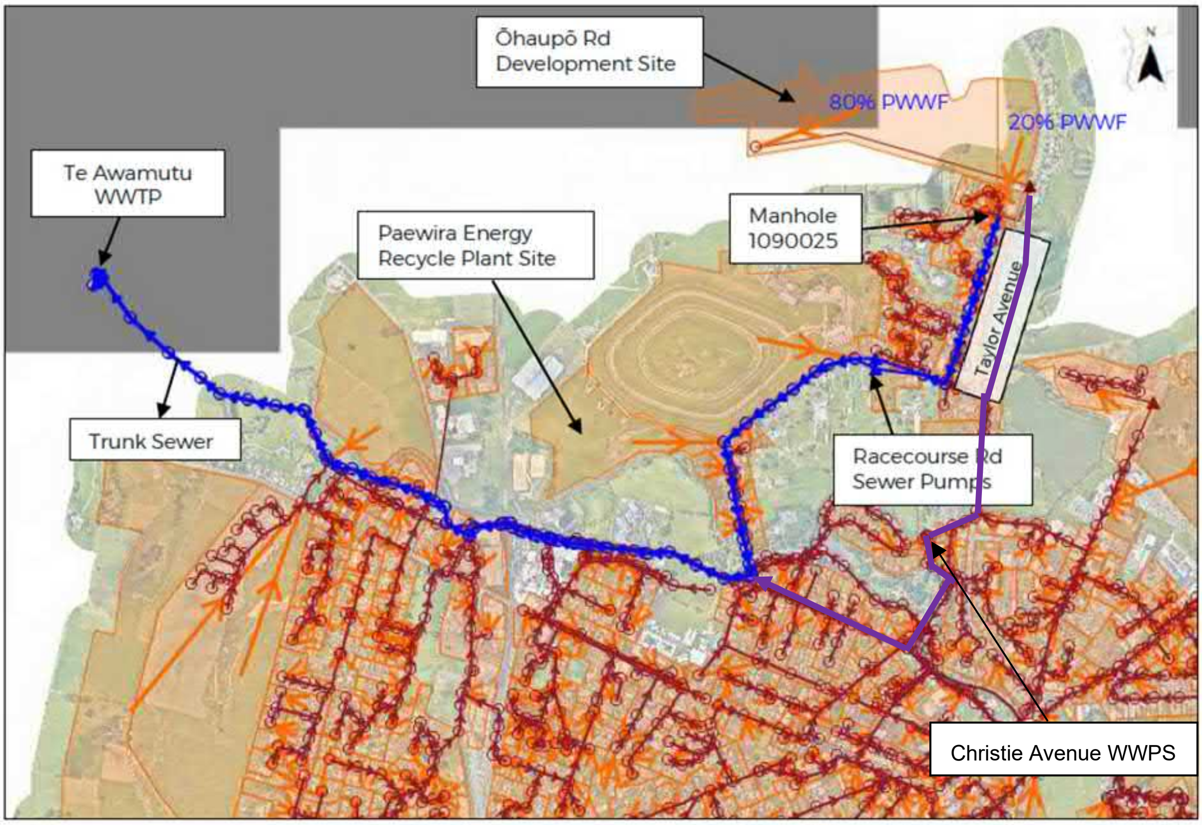

Figure 3: Catchment location plan (figure extract from Appendix A). Conveyance pathway for site wastewater flows to the WWTP shown as blue. Alternative Christie Avenue WWPS conveyance pathway shown as purple.

PRELIMINARY SITE DEVELOPMENT WASTEWATER INFRASTRUCTURE LAYOUT

A wastewater servicing schematic for the site is shown in Figure 4. The site is assessed to have an elevated area on the eastern side, which initially appears to be feasible to dispose of wastewater via gravity sewer, discharging into the existing wastewater gravity reticulation on Greenhill drive (yellow shaded area). The remainder of the site (blue shaded area) would likely have an internal gravity reticulation flowing into a new WWPS located on the western side of the site, correlating to the area with the lowest site elevation. The WWPS would pump site wastewater via a rising main, to either discharge into the existing Greenhill Drive gravity wastewater network, or alternatively via a new connection to the Christie Avenue WWPS gravity network on Ōhaupō Road.

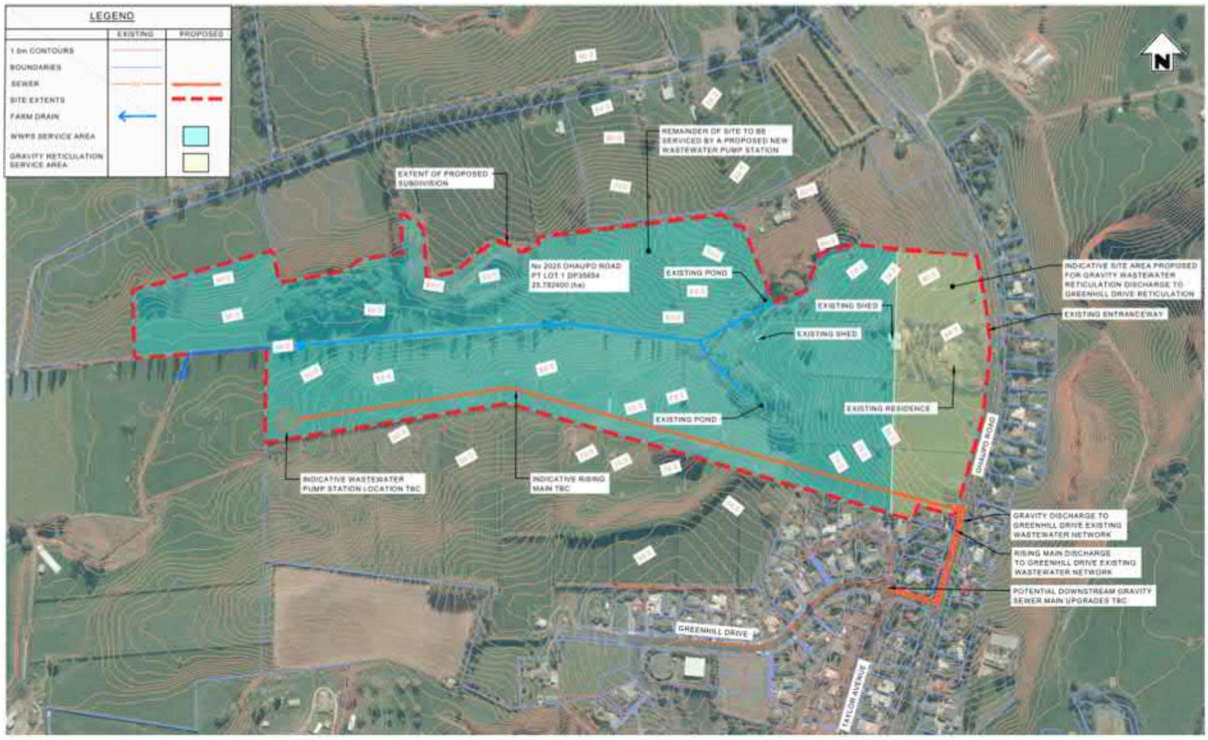

Figure 4: Wastewater disposal schematic to service the proposed site development.

WASTEWATER DESIGN PARAMETERS

All design parameters were generally taken from the WLASS RITS, Section 5 Wastewater, version May 2018. Where suitable parameters did not exist in the RITS, then parameters were taken from NZS 4404:2010 Land Development and Subdivision Infrastructure.

Table 1 describes some of the key assumed parameters used in this wastewater assessment:

Table 1: Key design parameters assumed.

Parameter	Value required by specification	Reference specification
Design life	100 years	RITS 5.2.1
Average Daily Flow (Domestic)	200 litres per person per day	RITS 5.2.4.2
Infiltration allowance	2,250 litres per hectare per day	RITS 5.2.4.2
Surface water ingress allowance	16,500 litres per hectare per day	RITS 5.2.4.2
Peaking factor	As per specific value in Table	RITS Table 5-2
Population equivalent	As per specific value in Table	RITS Table 5-3
Persons per dwelling	2.7	RITS Table 5-3 / NZS 4404:2010 5.3.5.1
ADF, PDF and PWWF	As per formulas	RITS Equations 5-1, 5-2, 5-3

WASTEWATER DISPOSAL – ESTIMATED SITE FLOWS

Wastewater flows for the Peak Wet Weather, Average Daily and Peak Daily Flow scenarios were calculated using the following formulae obtained from section 5.2.4.2 of RITS, as shown in Figure 5.

Average Daily Flow (ADF)

The Average Daily Flow is calculated as the sum of the infiltration allowance and the daily wastewater flow:

Equation 5-1: Average daily flow (ADF)

ADF (m^3*/day*) = *(infiltration allowance × catchment area) + (water consumption × population equivalent)*

Peak Daily Flow (PDF)

The system shall achieve a daily self-cleaning velocity the Peak Daily Flow.

Equation 5-2: Peak daily flow (PDF)

PDF (L/sec) = ((infiltration allowance × catchment area) + (peaking factor × water consumption × population equivalent)) ÷ 86400

Peak Wet Weather Flow (PWWF)

The system shall accommodate the design Peak Wet Weather Flow without surcharge.

Equation 5-3: Peak wet weather flow (PWWF)

PWWF (L/sec) = ((infiltration allowance × catchment area) + (surface water ingress × catchment area) + (peaking factor × water consumption × population equivalent)) ÷ 86400

Figure 5: Extract from RITS: Section 5.2.4.2

Allowing for 15% stormwater reserve area, the wastewater catchment area is estimated at 21.9 Ha. The ADF, PDF and PWWF estimated for the site is calculated as follows:

$$ADF = (2{,}250\ L/Ha/day\ x\ 21.9\ Ha) + (500\ Dwellings\ x\ 2.7\ People\ x\ \ 200\ L\ /\ person\ /\ day)$$

$$ADF = 49.3\ m^3/day + 270\ m^3/day$$

$$ADF = 319.3\ m^3/day$$

$$PDF = \frac{(2250\ L/Ha/day\ x\ 21.9\ Ha) + (3.0\ PF\ x\ 500\ Dwellings\ x\ 2.7\ People\ x\ \ 200\ L\ /\ person\ /\ day)}{86{,}400}$$

$$PDF = 9.95\ L/sec$$

$$PWWF = \frac{(2250\ L/Ha/day\ x\ 21.9) + (16{,}500\ x\ 21.9) + \ (3.0\ \ PF\ x\ 500\ Dwellings\ x\ 2.7\ People\ \ x\ \ 200\ L\ /\ person\ /\ da}{86{,}400}$$

$$PWWF = \frac{(49{,}275\ L\ /\ day) + (361{,}350\ L/day) + \ (810{,}000\ L/day)}{86{,}400}$$

$$PWWF = 14.1\ L/sec$$

WASTEWATER SUPPLY ASSESSMENT AND MODELLING RESULTS

Overall, the wastewater servicing assessment and hydraulic modelling completed has confirmed that servicing wastewater flows for the proposed residential lifestyle village development via the Te Awamutu town wastewater network (allowing for 500 residential dwellings) is feasible through either of the two options listed below:

1. Option 1: Discharge all of the new site development flows to the existing gravity network that discharges into the Racecourse Road WWPS and upgrade an approximately 1 km length of existing 225 mm diameter wastewater gravity pipe to a 300 mm diameter size downstream of the Racecourse Road WWPS, as located in Figure 1.
2. Option 2: Discharge 80% of the development flows (from the proposed site WWPS) to the Christie Avenue WWPS conveyance route, with the remaining development flows gravity discharging to the Racecourse Road WWPS conveyance route. This would require the new site WWPS rising main to extend nominally 640 m along Ōhaupō road from the site to the existing wastewater manhole near the intersection of Ōhaupō Road and Racecourse Road (Manhole Asset ID 1090999).

Both options above result in no predicted overflows or freeboard deficiencies (for both the existing and growth network models), therefore complying with WDC's assessment criteria, and presenting as feasible options to service the development wastewater flows. The modelling also concludes that the Te Awamutu Wastewater Treatment Plant (WWTP) will be able to cater for the Ōhaupō Road development flows along with the planned growth cells in the 2050 network.

Selection of the preferred option will occur in subsequent design phases. Additionally, as part of subsequent design phases, it is recommended to conduct a detailed pump station capacity assessment to confirm the capacity of the downstream pump stations (Racecourse Road WWPS and/or the Christie Avenue WWPS) and their capacity to manage for the proposed development flow.

Refer to Appendix A for a detailed report of the wastewater servicing modelling results, recommendations, and conclusions.

APPENDIX A WASTEWATER MODELLING ASSESSMENT (WSP 2022)

Memorandum

To	Mathew Dickey
Copy	James Cassidy, Charlotte Mills, Stephanie Cheevers, Melissa Allfrey, Harry Baxter
From	Haiming Li
Office	Hamilton
Date	10 November 2022
File/Ref	3-39619.00
Subject	Wastewater Hydraulic Assessment – 2025 Ōhaupō Road Development
Status	Stage 1 and 2 Report (Final)

1 Introduction

Ultimate Holdings Limited (UHL) is proposing a private plan change residential subdivision at 2025 Ōhaupō Road, Te Awamutu, as shown in Figure *1-1*. The development site is not within the current Waipa District Council's planned growth areas (not in the 2050 masterplan model).

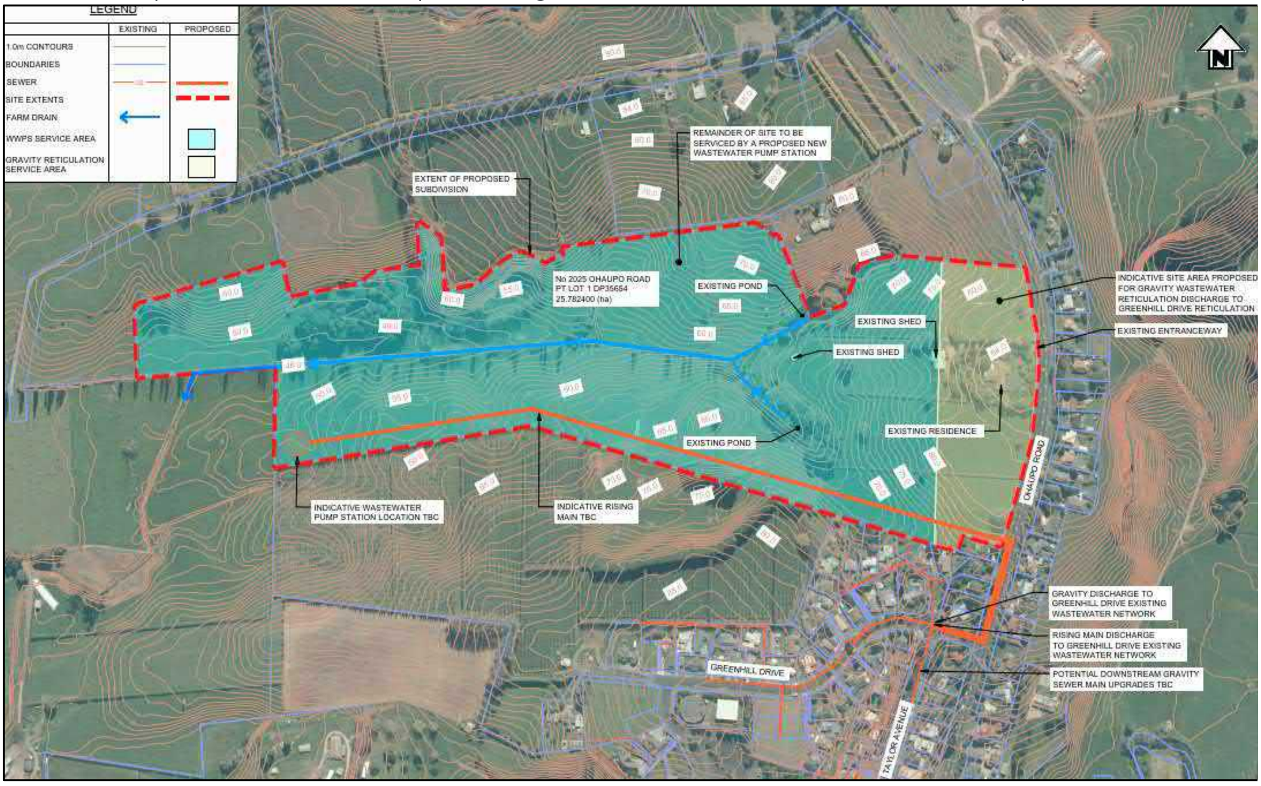

Figure 1-1 *: Location of Development*

There are two stages to this project. Stage 1 is to assess the impact of the proposed development on the current/future wastewater (WW) networks and Stage 2 is an options

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assessment based on the modelling results from Stage 1. This memorandum details both stages assessments and outcomes. BTW Company Ltd. (BTW) have engaged WSP on this project on behalf of the client (UHL).

1.1 Stage 1 – Impact Assessment

The objectives of Stage 1 assessment are as follows, using the Waipa District Council (WDC) 2022 wastewater base model (existing network) and 2050 wastewater future growth model (growth network), separately:

1. Scenario 1 - Assess the impact of all the 2050 growth masterplan demands on the 2022 model as a baseline scenario in the existing model network under the 5-year ARI design event. The objective is to assess the capacity of the existing pipe network to accommodate for the planned future developments.

2. Scenario 2 - Assess the impact of all the 2050 growth masterplan demands and the Ōhaupō Road development demand in the existing network under the 5-year ARI design event, using a development peak wet weather flow (PWWF) of 14.1 L/s. Flows will be discharged at manhole node 1090025. The objective is to assess the capacity of the existing pipe network to accommodate for the future developments and the Ōhaupō Road development.

3. Scenario 3 - Assess the impact of the Ōhaupō Road development on the growth network (with 2050 masterplan upgrades included) in the 5-year ARI design event, using a development peak wet weather flow (PWWF) of 14.1 L/s, discharging flows at manhole node 1090025. The objective is to assess if there is capacity in the 2050 pipe network to accommodate for the Ōhaupō Road development.

4. Conduct a capacity assessment of the wastewater treatment plant (WWTP) in the growth network (Scenario 3), using (daily) volumes and instantaneous peak flow rates only.

As informed by WDC, WSP has included the flow from the proposed Paewira energy recycle plant (at the border of T13 growth cell) in this assessment. Table 1-1 lists the PWWFs for these two developments. The Paewira discharge point is downstream of the Racecourse Road pump station.

Table 1-1: Development Flows

Development Scenario	Peak Wet Weather Flow (L/s)
2025 Ōhaupō Road Development (Scenarios 2 & 3)	14.10
Paewira Energy Recycle Plant (Scenarios 1, 2 & 3)	0.14

1.2 Stage 2 – Optioneering Assessment

Firstly, the objective of Stage 2 is to update the model with the following, based on the Stage 1 assessment results and the discussion with BTW and WDC:

- Adjust the proposed WWPS parameters as recommended by BTW as per email dated 23/08/2022.
- Update the 2022 base model and the 2050 growth model with the latest Racecourse Road WWPS information.
- Resolve the negative pipe gradings by interpolation.

The above items are discussed in more detail in Section 6.

After the above updates are made, the following optioneering scenarios will be run to access if the Te Awamutu wastewater network is able to accommodate for the Ōhaupō Road development flow without causing unplanned sewer overflows or unacceptable residual freeboard level.

- Scenario 1: 2022 base model network and 2050 growth model network both with the Ōhaupō Road development with the above three model updates (baseline).
- Scenario 2: Increase the Racecourse Road WWPS pump flow rate and upgrade the downstream pipe network if needed (in Stage 2 Scenario 1 network).
- Scenario 3: Change the Ōhaupō Road development to discharge 80% of its proposed flow to the sewer main (asset ID: 1331069) on Ōhaupō Road (upstream of Christie Avenue WWPS), with 20% draining via gravity to manhole 1090025 (the originally proposed discharge point located at the upstream of Racecourse Road WWPS) in Stage 2 Scenario 1 network.

1.3 Waipa District Council Overflow and Freeboard Criteria

WDC has advised the following assessment level of service criteria:

- no unplanned sewage overflows, and;
- no manholes with freeboard < 300 mm

2 Catchment Description

The existing wastewater network near the proposed development site is shown on Figure 2-1. The wastewater discharged from the site will be directed west to the manhole (asset ID: 1090025) on Greenhill Drive, which is connected to a 150 mm sewer. Flows once discharged to the sewer network will travel south along Taylor Avenue, before ultimately arriving at the Te Awamutu wastewater treatment (WWTP) in the west of the catchment, approximately 4 km downstream of the initial discharge point.

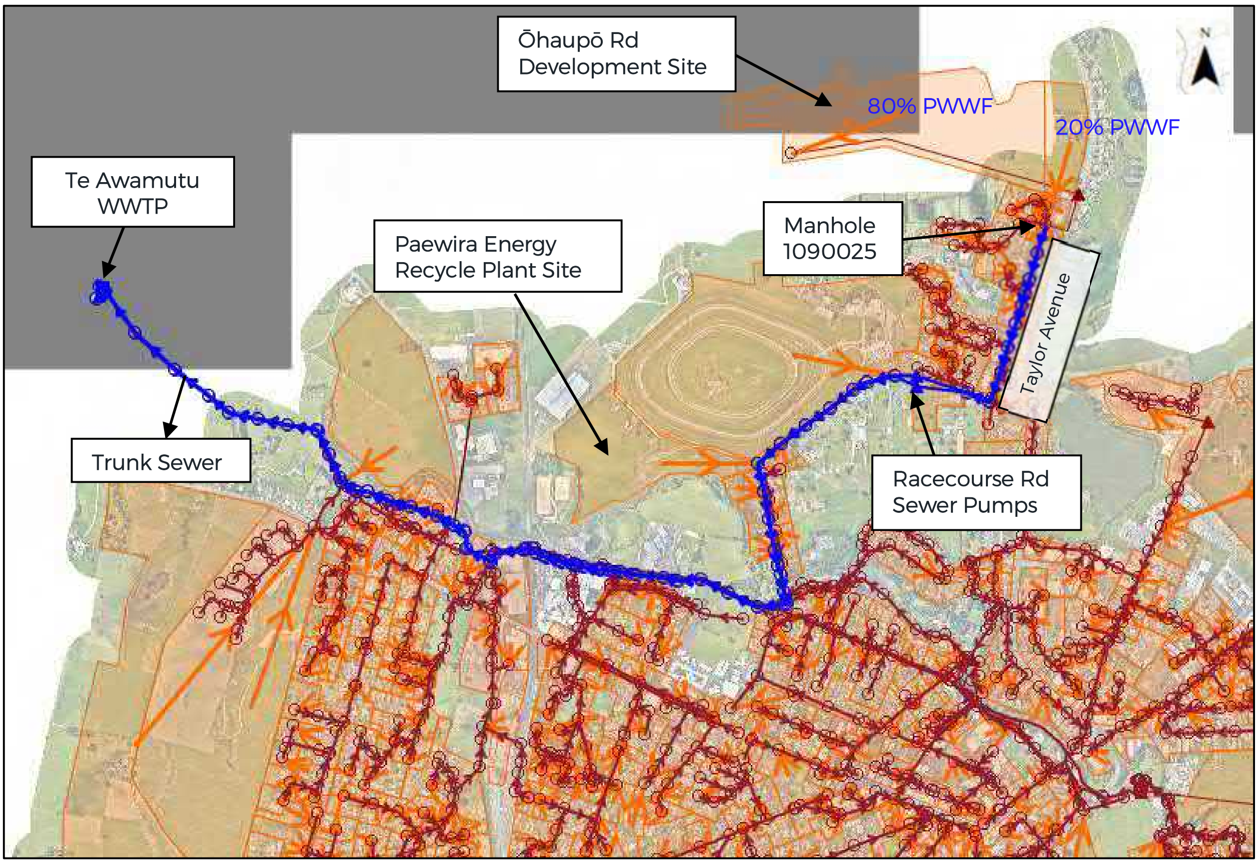

Figure 2-1 : Catchment Location Plan (downstream pipes shown in blue)

3 Assessment Methodology

The *2022 Te Awamutu* network model was applied in this investigation. This model was built and calibrated to observed flows in July 2019, with minor updates to the model pipe network completed in April 2020. There were three model updates after the model build and calibration and Table 3-1 summarises the previous model update details.

Table 3-1: Previous Model Update Details

Model Update	Scope Details
2020	WW assets constructed up to March 2020 and calibrated to 2019 network flows.
2021	WW assets constructed up to July 2021 and calibrated to 2019 network flows.
2022	WW assets constructed up to April 2022 with a calibration review of flow data between June and August 2021.

The *2050 Te Awamutu* network model was also used in this investigation and includes future growth cells and planned network upgrades up to 2050 (as part of the 2020 master planning work).

The following methodology was completed to assess the impact of the proposed development on the wastewater networks.

3.1 Stage 1 - Existing Network Assessment

- Model scenarios 1 and 2 were created in the existing *Te Awamutu 2022* model network (WSP model reference: Waipa WW Models (2019)). All modelling was completed using InfoWorks ICM version 9.0.
- The model scenarios were developed from the *base* network with all future growth cells and the Paewira energy cycle plant development being added.
- As per BTW's instruction, 80% of the PWWF provided for the development was discharged to the proposed development wastewater pumping station and then to manhole 1090025. The remaining 20% of the PWWF was loaded directly to manhole 1090025.
- Simulations for both the *base* network and network with the inclusion of flows from the development site were run to assess the impact of flows on the network for the WWF scenario only. Model simulations were run with WDC's design event for wastewater networks (2 hour 1 in 5-year average recurrence interval).

3.2 Stage 1 - Future Growth Network Assessment

- Model scenario 3 was created in the existing *Te Awamutu 2022* model network (WSP model reference: Waipa WW Models (2019)). All modelling was completed using InfoWorks ICM version 9.0.
- The model scenarios were developed from the *2050 Network and Growth* model with the Paewira energy cycle plant development, where all future growth cells and network upgrades were applied.
- As per BTW's instruction, 80% of the PWWF provided for the development was discharged to the proposed development wastewater pumping station and then to the manhole 1090025. The remaining 20% of the PWWF was loaded directly to manhole 1090025.
- Simulations for both the *2050 Network and Growth* network and the network with the inclusion of flows from the development site were run to assess the impact of flows on the network for the WWF scenario. Model simulations were run with

WDC's design event for wastewater networks (2 hour 1 in 5-year average recurrence interval).

3.3 Stage 1 - Wastewater Pumping Station Parameters

Table 3-2 summarises the sewer pump and wetwell details for the proposed development in Stage 1.

Table 3-2: Modelled Ōhaupō Sewer Pump and Wetwell Details

Wetwell		Notes:
Diameter (m):	1.8	As per the minimum diameter specified in RITS.
Depth (m):	4.0	Same as Tokanui Wetwell (WSP previous project).
Ground Level (m AD):	51.0	From the surface data provided by BTW.
Roof Level (m AD):	51.2	0.2 m above the ground level to avoid rainwater getting in and people will not reverse their car on the lid.
Floor Level (m AD):	47.2	4.0 m below the roof level.
Pump		Notes:
Pump Rate (L/s):	12.0	80% of the development PWWF.
On Level (m AD):	48.2	1.0 m above wetwell floor level.
Off Level (m AD):	47.8	0.6 m above wetwell floor level.

3.4 Analysis

The following analysis has been undertaken for Section 3.1 and 3.2;

- Potential network constraints downstream of the proposed development connection were assessed.
- The assessment of the impact of the proposed development has been undertaken by comparing the wastewater network performance pre- and post-development in terms of:
- Overflows,
- Pipe filling: when the maximum pressure (Hmax) is higher than the pipe diameter (Diam), the pipe is surcharged by downstream capacity constraints, and,
- Pipe capacity: When the maximum flow (Qmax) is higher than the maximum theoretical capacity (Qcap), the pipe capacity is exceeded.
- Pump station capacity assessment on Racecourse Road pump station by comparing the pump rate and the predicted PWWF to the pump station.
- Table 3-3 below summarises the different pipe conditions.

Table 3-3: Gravity Pipe Conditions

Pipe State	Criteria
Free Flow	(Qmax/Qcap < 0.5 AND Hmax/Diam < 0.5)
Free Flow	(Qmax/Qcap < 1 AND Hmax/Diam < 1)
Downstream Capacity Constraint	(Qmax/Qcap < 1 AND Hmax/Diam > 1)
Pipe Capacity Exceeded	(Qmax/Qcap > 1 AND Hmax/Diam > 1)

4 Assumptions

The following assumptions have been made in completing this work:

- The *2022 Te Awamutu* model represents the best available data for Te Awamutu wastewater network.
- The provided PWWF from the development site has been applied to the network as a constant flow. Flows from the development have been split into two discharges:
    - 80% of the flow has been assumed to be pumped and 20% of the flow will drain by gravity to Ōhaupō Road. The connection point from both discharges will be to the same manhole (Figure 2-1).
- This assessment was completed for existing and future growth scenarios, which include all growth cells and the Paewira Energy Recycle Plant development as per WDC request. For the future growth scenario, the model includes proposed upgrades from the Waipa Three Waters Master Plan 2020 and additional growth cells.
- As per the OOS, WSP conducted a capacity assessment of the wastewater treatment plant (WWTP), using (daily) volumes and instantaneous peak flow rates only.

5 Stage 1 - Model Results

Result maps (Figure 7-1 - Figure 7-4) are attached in Appendix A.

5.1 Stage 1 - Scenarios 1 & 2 – Existing Network (WWF)

Figure 7-1 (Appendix A) provides an overview of the model WWF performance with no flow contribution from the Ōhaupō Road development. Figure 7-2 provides an overview of the model performance with a constant flow contribution of 14.1 L/s (PWWF) from the Ōhaupō Road development. The following is a high-level overview of the model results:

- Figure 7-1 (Appendix A) shows surcharge that impacts the trunk sewer for some extents of Factory Road. However, no overflow is predicted.
- With the additional flow contribution of the 14.1 L/s from the Ōhaupō Road development, the number of pipes predicted to surcharge increases by 10. The increase in surcharge is general located on Taylor Avenue and Racecourse Road, which is downstream of the proposed development discharge point on Taylor Avenue. Refer to Figure 7-2 (Appendix A) for the locations of surcharge increases.
- The number of sewer overflows are increased by 3 in the post-development network.
- Table 5-1 provides a high-level overview of the model results discussed above.

There are some pipes with negative grades found at the downstream network (shown in Figure 7-1), which caused constraints in the network. The flag data source of the negative grade pipes were also reviewed. It was identified that the invert levels were either inferred or interpolated from the invert levels of the connected manholes or from the GIS data.

There is also a WWPS at the downstream of the proposed development (refer to Figure 2-1 for details) on Racecourse Road. The duty pump rate is 14 L/s with the current predicted PWWF of 11.5 L/s in Scenario 1 (pre-development). With the proposed development flow, the predicted PWWF of this pump is increased to be 25.6 L/s, which exceeds the current duty pump rate. The total capacity of the pump station with two pumps running is 24 L/s, which is also below the predicted PWWF, however, no overflows are predicted upstream of the pump station.

5.2 Stage 1 - Scenario 3 - Future Growth Network (WWF)

An assessment was undertaken, using the future growth model, to assess if the future network performance with the Ōhaupō Road development flow of 14.1 L/s. It is noted this assessment includes all currently proposed future masterplan developments and upgrades in the Te Awamutu catchment. The pump rate of the Te Awamutu WWTP is also increased in the growth network to accommodate for future masterplan developments. The following is a high-level overview of the model results:

- Figure 7-3 (Appendix A) shows that there is no unplanned overflows in the pre-development 2050 network.
- Figure 7-4 (Appendix A) shows that surcharge impacts the trunk sewer along Factory Road. There is slight improvement in surcharge from the existing network scenario due to the proposed upgrade to the pump at the WWTP inlet. The network on Racecourse Road is also suffers from extensive surcharge.
- Three overflows are predicted on Racecourse Road, which are at downstream of the Racecourse Road sewer pump station. The surcharge state of the trunk sewer is also increased.
- In the 2050 network, there is no masterplan upgrade to the Racecourse Road pump station and no increase in flows from its upstream network. Therefore, the predicted PWWF inflow to this pump station is still above its duty rate as per the scenario 2 result.

Table 5-1: Simulation Results Overview

Scenario	Increase in Number of Overflows (No.)	Increase in Overflow Volume (m^3)	Increase in Number. of Surcharged Pipes (No.)
2022 Network (WWF) + 14.1 L/s Ōhaupō Flows	3	45	11
2050 Network (WWF) + 14.1 L/s Ōhaupō Flows	3	45	13

5.3 Te Awamutu WWTP Capacity Review (2050 Growth Scenario)

The capacity of the Te Awamutu WWTP was reviewed, using the daily volumes and instantaneous peak flows for the 2050 growth scenario. Table 5-2 below summarises the review results. Both modelled daily volume and modelled instantaneous flows are predicted to be below the designed parameters. This suggest the WWTP will be able to cater for the Ōhaupō Road development flow along with the planned growth cells.

Table 5-2: Te Awamutu WWTP Capacity Review

	PWWF (m^3/day)	Instantaneous Peak Flow (L/s)
Designed Flows to WWTP (2050 projection)	24,256	388
Modelled Flows to WWTP with Ōhaupō Flows (scenario 3 - 2050 growth network)	14,667[1]	357
1. The 5-year 2-hour rainfall event is the critical duration for the system based on the instantaneous flow to WWTP. But it's not necessarily the worst-case volume for WWTP.		

Te Awamutu WWTP is designed for an instantaneous PWWF of 388 L/s into its inlets work. However, the treatment is limited to 21,000 m^3/day through the WWTP due to the consented maximum daily discharge to the Mangapiko stream (currently 21,000 m^3/day or 280 L/s). The influent PWWF will be attenuated by the Wastewater Overflow Ponds, if the flow is greater than the maximum daily discharge.

6 Stage 2 – Model Results

The following section provide an overview of the model updates and optioneering work undertaken as part of Stage 2 of the project.

Stage 2 Optioneering assessment result maps (Figure 7-5 - Figure 7-10) are attached in Appendix A.

6.1 Post-Stage 1 Model Updates

A meeting was held with WDC and BTW to discuss the Stage 1 model results on 2 September 2022. During the meeting, the following model updates were agreed for the baseline model as part of the Stage 2 assessment:

- Update, where practicable, the 2022 base model and the 2050 growth model with the latest Racecourse Road WWPS operation data provided by WDC. Refer to Table 6-1 for details.
- Resolve the negative pipe grades by interpolation, between node 1092710 and node 1090126 on Racecourse Road and between node 1093690 and node 1091022 on Factory Road . Refer to *Figure 6-1* and *Figure 6-2* for their locations.

Table 6-1: Racecourse Road Pump Station Update

Pump Rate:		Notes:
Duty Pump:	27 L/s	The duty pump was previously set at 14 L/s

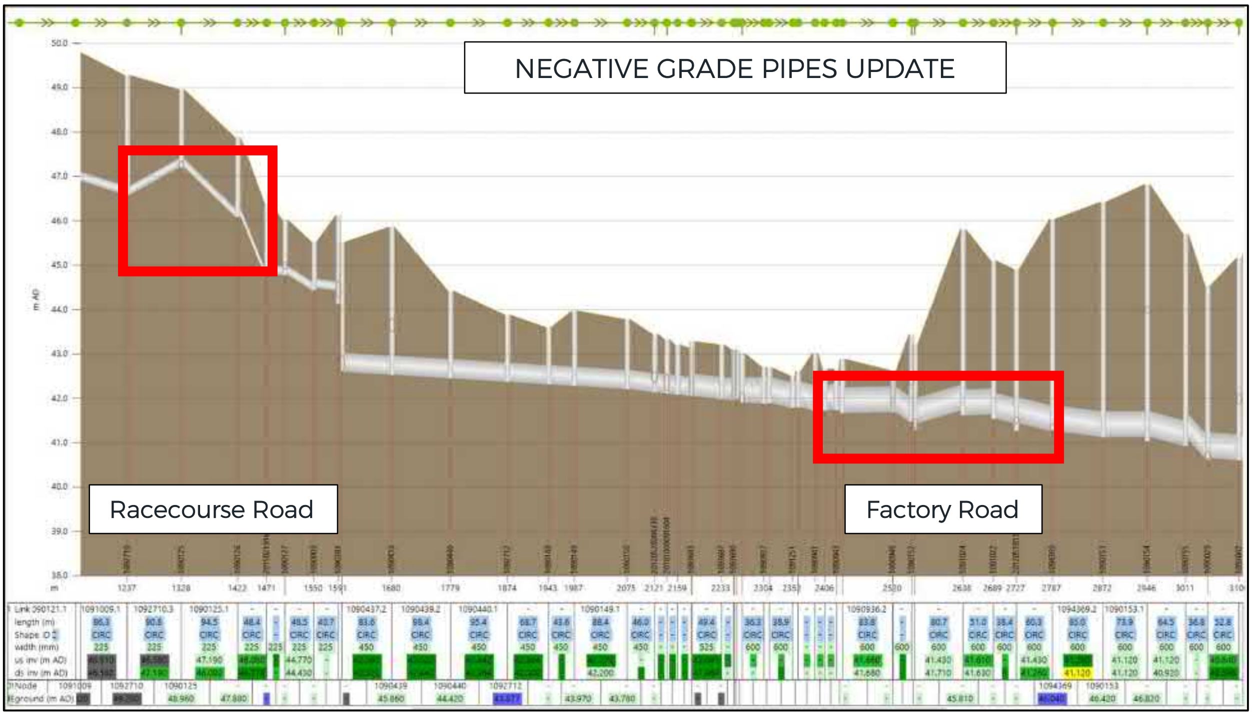

Figure 6-1: Negative Grade Pipes Downstream of the Ōhaupō Road Development Before Model Update

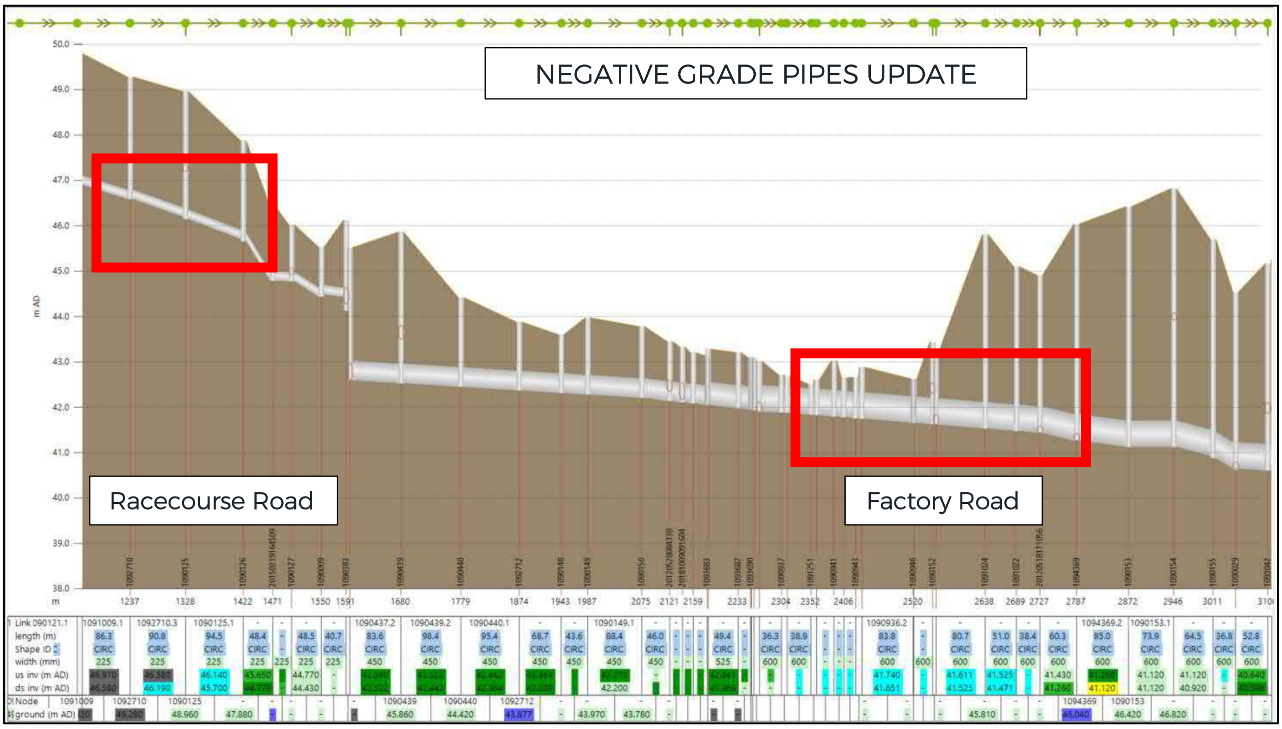

Figure 6-2: Negative Grade Pipes Downstream of the Ōhaupō Road Development After Update

In addition, BTW requested (via email dated 23/08/2022) that the following baseline updates were made to the modelled Ōhaupō Road development WWPS. These updates had a negligible impact on the model performance. However, the revised parameters are closer to the preferred final WWPS design. Refer to Table 6-2 for details of the updates made.

Table 6-2: Updated Modelled Ōhaupō Sewer Pump and Wetwell Details

Wetwell		Notes:
Diameter (m):	2.2	As per BTW request
Depth (m):	5.0	As per BTW request
Floor Level (m AD):	47.2	As per BTW request
Pump		Notes:
On Level (m AD):	47.05	As per BTW request
Off Level (m AD):	46.45	As per BTW request

6.2 Stage 2 - Scenario 1 – Existing & Future Growth Networks (WWF)

Figure 7-5 and Figure 7-6 provide a high-level model network performance overview for the 2020 updated baseline model network and the updated 2050 growth model network, separately.

The model results show there are two unplanned overflows on Racecourse Road and manholes with freeboard < 300 mm. Therefore, this scenario results do not meet the WDC's overflow and freeboard criteria.

It is further noted that there is predicted freeboard < 300 mm between manholes 1094160 and 1090949. However, this section of the sewer network still has capacity. This freeboard issue has been created due to the sewer network having very little cover. Refer to Figure 7-5 and Figure 7-6 for their locations.

WSP has consulted this finding with WDC. It has been agreed that this freeboard deficiency is a historical issue (these manholes are sealed both in the model and in reality) and won't impact on the results of this project.

6.3 Stage 2 – Scenario 2 - Existing & Future Growth Networks (WWF)

The scenario included the model updates outlined in Section 6.1 and pipe upsizing from 225 mm to 300 mm from nodes 1090117 to 1090383 on Racecourse Road.

Figure 7-7 and Figure 7-8 provide a high-level model network performance overview for the 2020 updated baseline model network and the updated 2050 growth model network, separately.

The model results predict there is no overflows or the freeboard deficiency issue. Therefore, this scenario results comply with the WDC's overflow and freeboard criteria.

6.4 Stage 2 - Scenario 3 - Existing & Future Growth Networks (WWF)

The scenario included the model updates outlined in Section 6.1, and a negative grade on a section of pipes (asset ID: 133033), located at upstream of Christie Avenue WWPS, was removed.

Figure 7-9 and Figure 7-10 provide a high-level model network performance overview for the 2020 updated baseline model network and the updated 2050 growth model network, separately.

The model results predict there is no overflows or the freeboard deficiency issue. Therefore, this scenario results comply with the WDC's overflow and freeboard criteria.

7 Conclusions

Based on the assessment detailed above, the following conclusions are made:

7.1 Stage 1 - Conclusions

7.1.1 Stage 1 - Scenarios 1 & 2 – Existing Network (WWF)

A review of the model WWF post-development scenario with a proposed Ōhaupō Road development flow of 14.1 L/s, discharged at manhole 1090025 on Greenhill Drive, has predicted that network surcharge will increase. Surcharge on Racecourse Road have significantly increased due to the development flow along with three overflows being predicted by the model.

An existing WWPS on Racecourse Road is subject to a significant increase in flows with the addition of the Ōhaupō Road development.

7.1.2 Stage 1 - Scenario 3 - Future Growth Network (WWF)

An assessment was undertaken, using the future growth model scenario, to assess the future network performance with the proposed Ōhaupō Road development.

The network surcharge is predicted to be increased on thirteen pipes, and three overflows are predicted due to the additional Ōhaupō Road development flow of 14.1 L/s.

The trunk sewers along Factory Road and Racecourse Road remain under capacity even with a proposed upgrade to the pump at the WWTP inlet. An existing WWPS on Racecourse Road is subject to a significant increase in flows with the addition of the Ōhaupō Road development. Further investigation into the WWPS design and if an upgrade is necessary is recommended.

7.1.3 Te Awamutu Wastewater Treatment Plant Capacity Review

A capacity assessment of the Te Awamutu WWTP was conducted, using the daily volumes and instantaneous peak flows. It is predicted that the WWTP will be able to cater for the Ōhaupō Road development flow along with the planned growth cells in the 2050 network. However, this will be subject to any future unplanned development in the network.

7.2 Stage 2 - Conclusions

7.2.1 Stage 2 - Scenario 1 – Existing and Future Growth Networks (WWF)

Both 2022 base model and 2050 growth model predict unplanned overflows and freeboard deficiency issues on Racecourse Road, with the updates applied as outlined in Section 6.1 and the inclusion of the Ōhaupō Road development flow of 14.1 L/s.

7.2.2 Stage 2 - Scenario 2 – Existing and Future Growth Networks (WWF)

There are no unplanned overflows or freeboard deficiency issues predicted in the 2022 base model or the 2050 growth model network by:

- Updating the models as outlined in Section 6.1 with the inclusion of the Ōhaupō Road development flow of 14.1 L/s.
- Upsizing the sewer pipes (from 225mm to 300mm) from nodes 1090117 to 1090383 on Racecourse Road.

7.2.3 Stage 2 - Scenario 3 – Existing and Future Growth Networks (WWF)

There are no unplanned overflows or freeboard deficiency issues predicted in the 2022 base mode or the 2050 growth model network by:

- Updating the models as outlined in Section 6.1 with the inclusion of the Ōhaupō Road development flow of 14.1 L/s.
- Discharging 80% of the development flow to Christie Avenue WWPS and the remaining development flow to manhole 1090025 via gravity.

7.2.4 Feedback from WDC

- WDC has reviewed Stage 2 scenario 2 results on the 21st of October 2022 and are happy with the proposed solution.
- WDC has reviewed the draft Stage 2 memo and are happy with the modelled solutions, as per the email on the 7th November 2022.
- It is recommended to conduct a detailed pump station capacity assessment to confirm the capacity of the downstream pump stations (Racecourse Road WWPS or Christie Avenue WWPS) and their capacity to manage for the proposed development flow. The pump station capacity assessment is recommended to be undertaken as part of subsequent phases of the detailed design.

Disclaimers and Limitations

This report (‘**Report**’) has been prepared by WSP exclusively for BTW Company Ltd (‘**Client**’) in relation to assess the impact of the Ōhaupō Road development on the current and future Te Awamutu wastewater networks (‘**Purpose**’) and in accordance with the Water and Wastewater Modelling Assessment – 2025 Ōhaupō Road Development Offer of Service dated 21/07/2022. The findings in this Report are based on and are subject to the assumptions specified in the Report and the Cambridge and Te Awamutu Wastewater Model Build, Calibration and System Assessment Report, July 2019. WSP, as per Waipa District Council’s comments, acknowledge that the limitation that the modelling has not considered potential intensification due to the implementation of the new Medium Residential Density Standards permitting greater intensification by way of Plan Change 26 that WDC has given effect to. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

In preparing the models on which this report is based, WSP has relied upon data, surveys, analyses, designs, plans and other information (‘**Client Data’**) provided by or on behalf of the Client. Except as otherwise stated in the Report, WSP has not verified the accuracy or completeness of the Client Data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this Report are based in whole or part on the Client Data, those conclusions are contingent upon the accuracy and completeness of the Client Data. WSP will not be liable in relation to incorrect conclusions or findings in the Report should any Client Data be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

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Appendix A
Model Result Maps

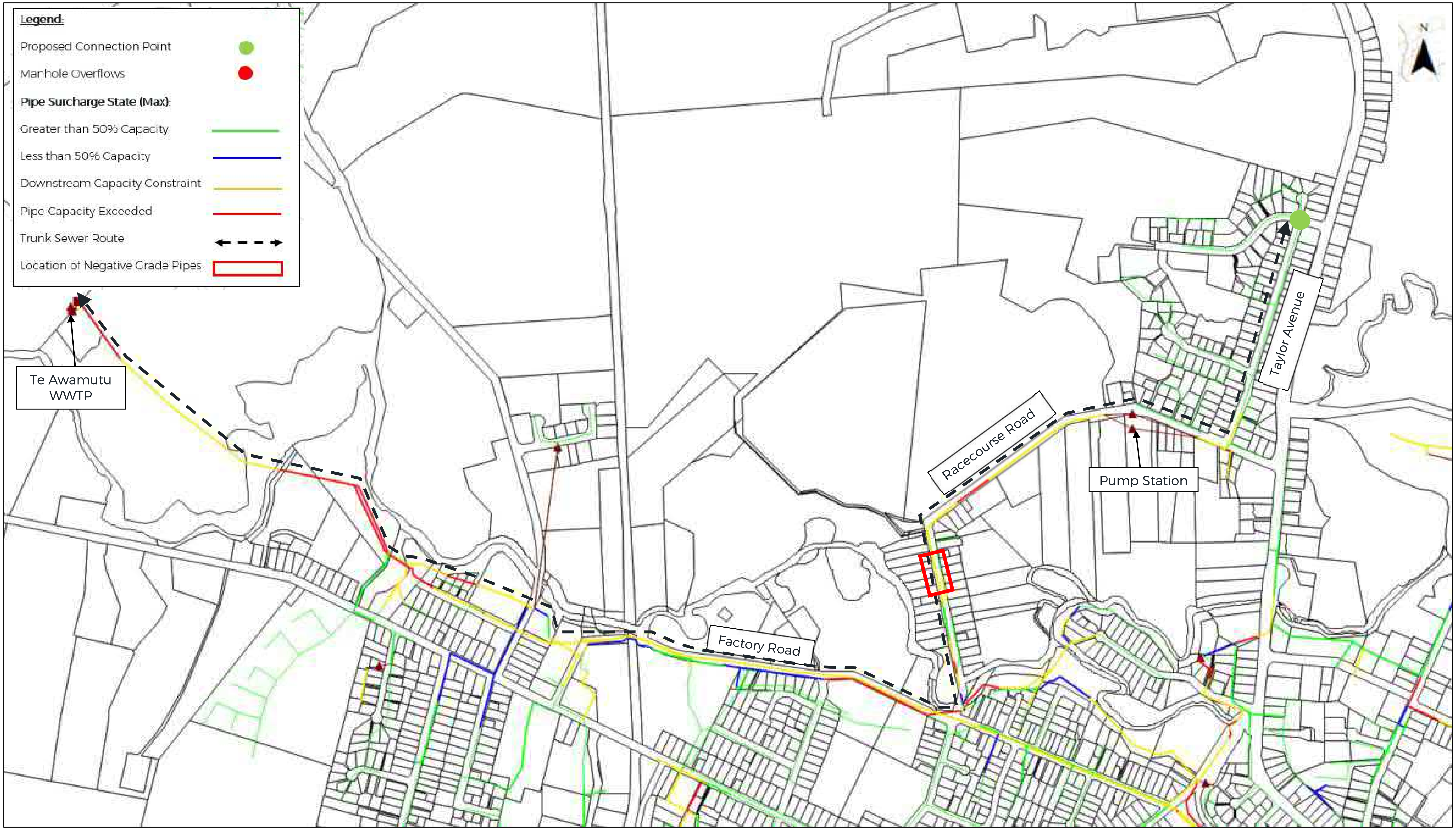

Figure 7-1: 2022 Base Model WWF Results –Stage 1 - Scenario 1 (without Ōhaupō Road Development)

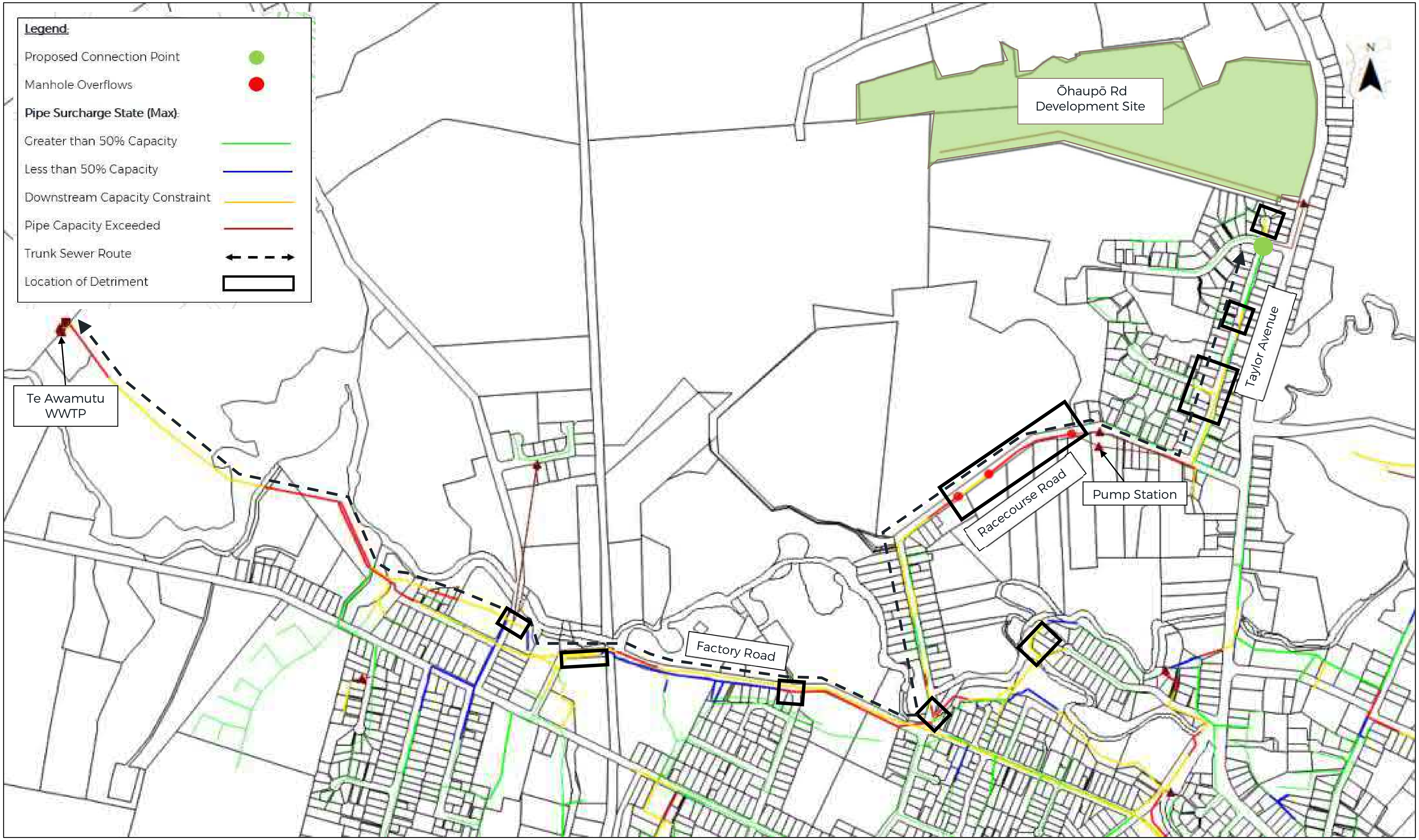

Figure 7-2: 2022 Base Model WWF Results – Stage 1 - Scenario 2 (with Ōhaupō Road Development – 14.1 L/s PWWF)

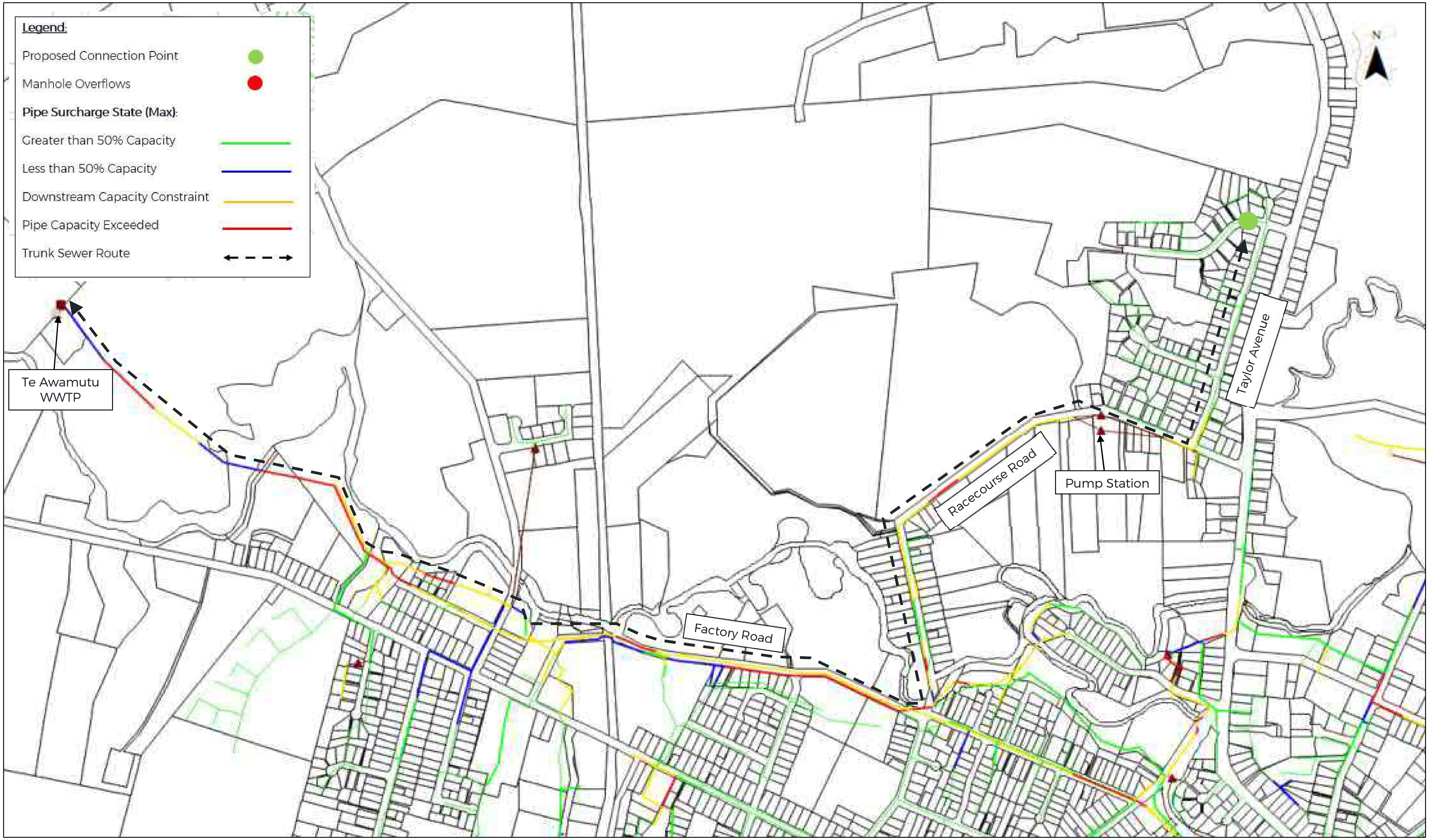

Figure 7-3: 2050 Growth Model WWF Results – Stage 1 - Scenario 3 (without Ōhaupō Road Development)

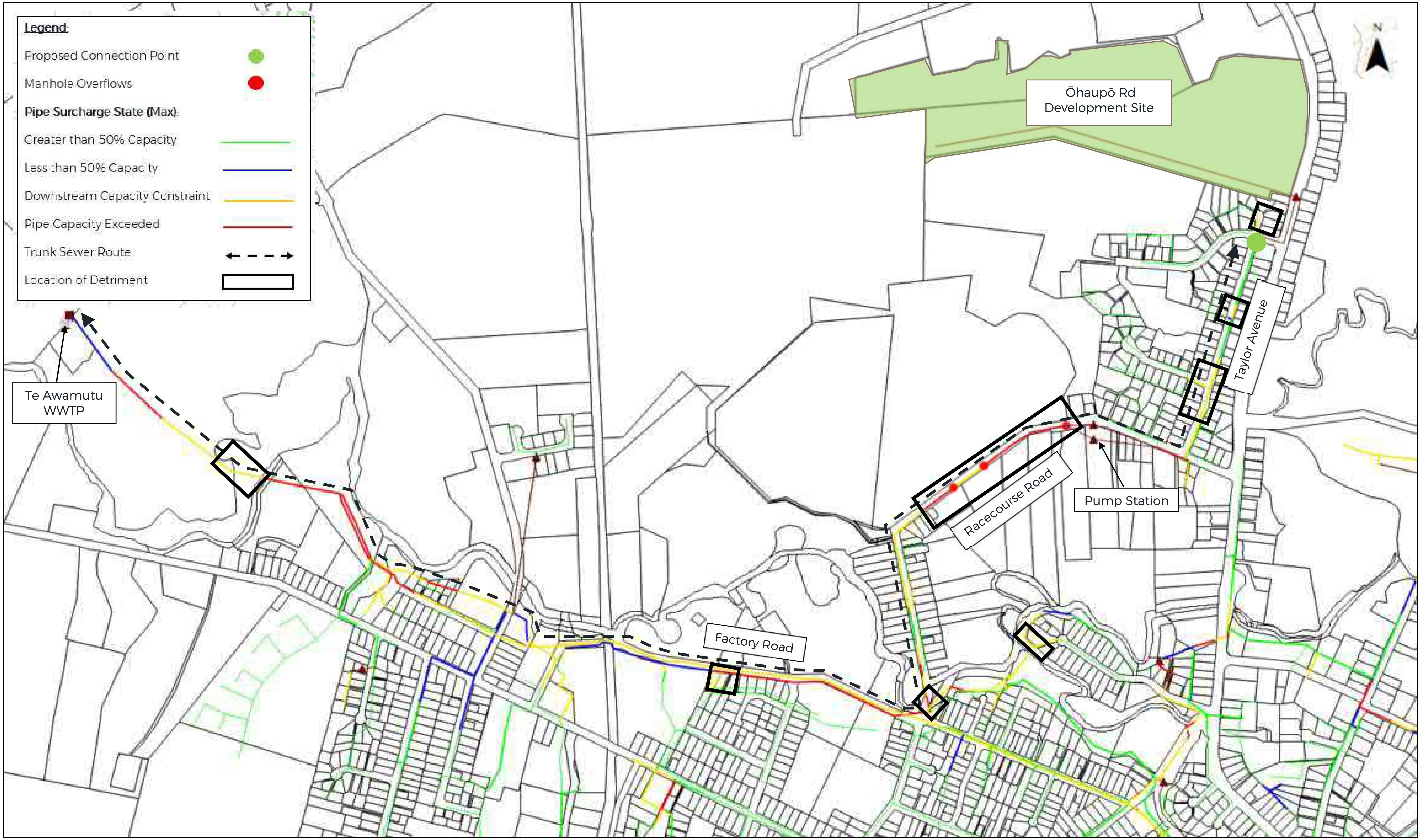

Figure 7-4: 2050 Growth Model WWF Results – Stage 1 - Scenario 3 (with Ōhaupō Road Development – 14.1 L/s PWWF)

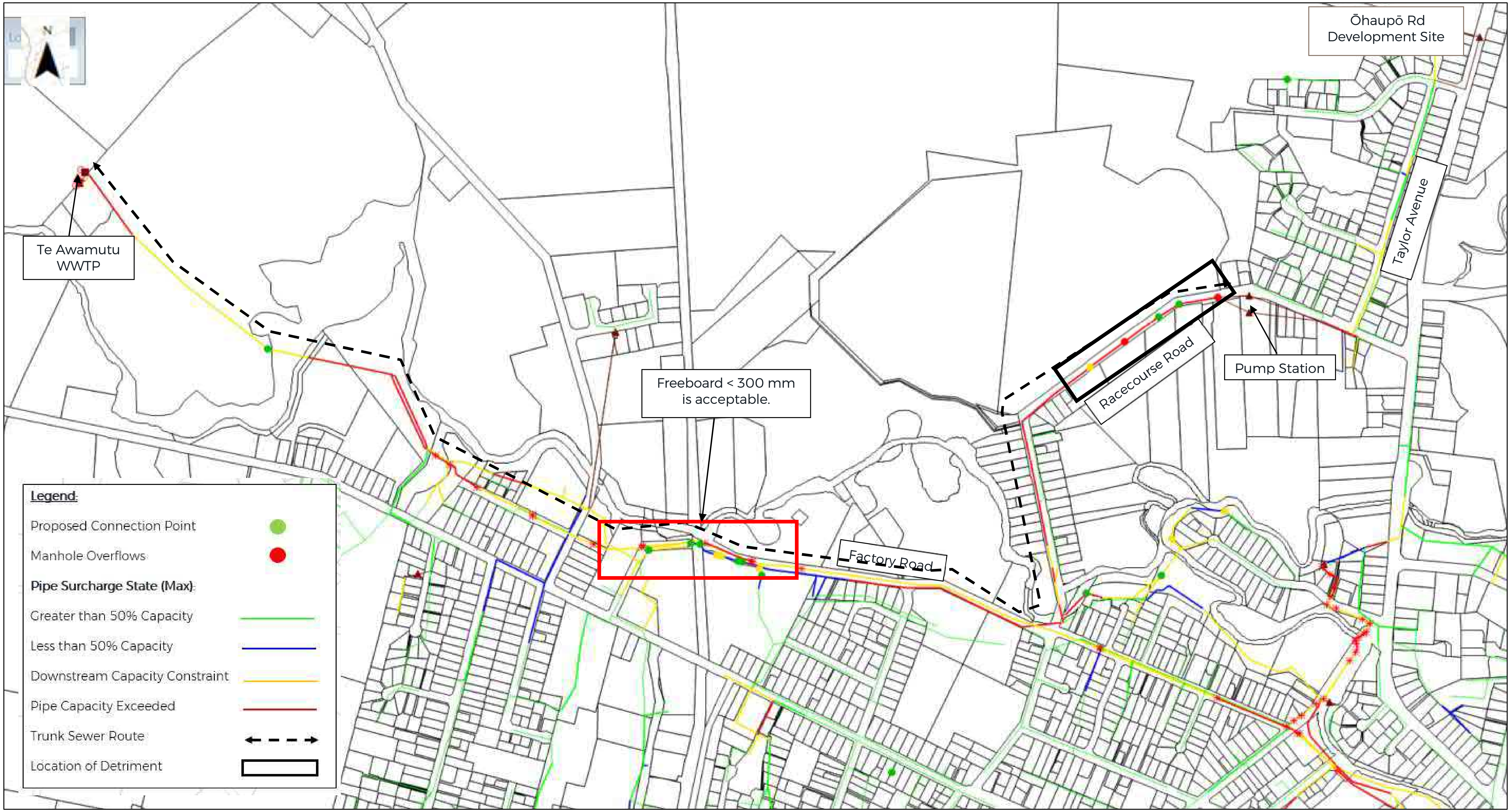

Figure 7-5: 2022 Base Model WWF Results – Stage 2 – Scenario 1 (with Ōhaupō Road Development – 14.1 L/s PWWF and Baseline Model Updates)

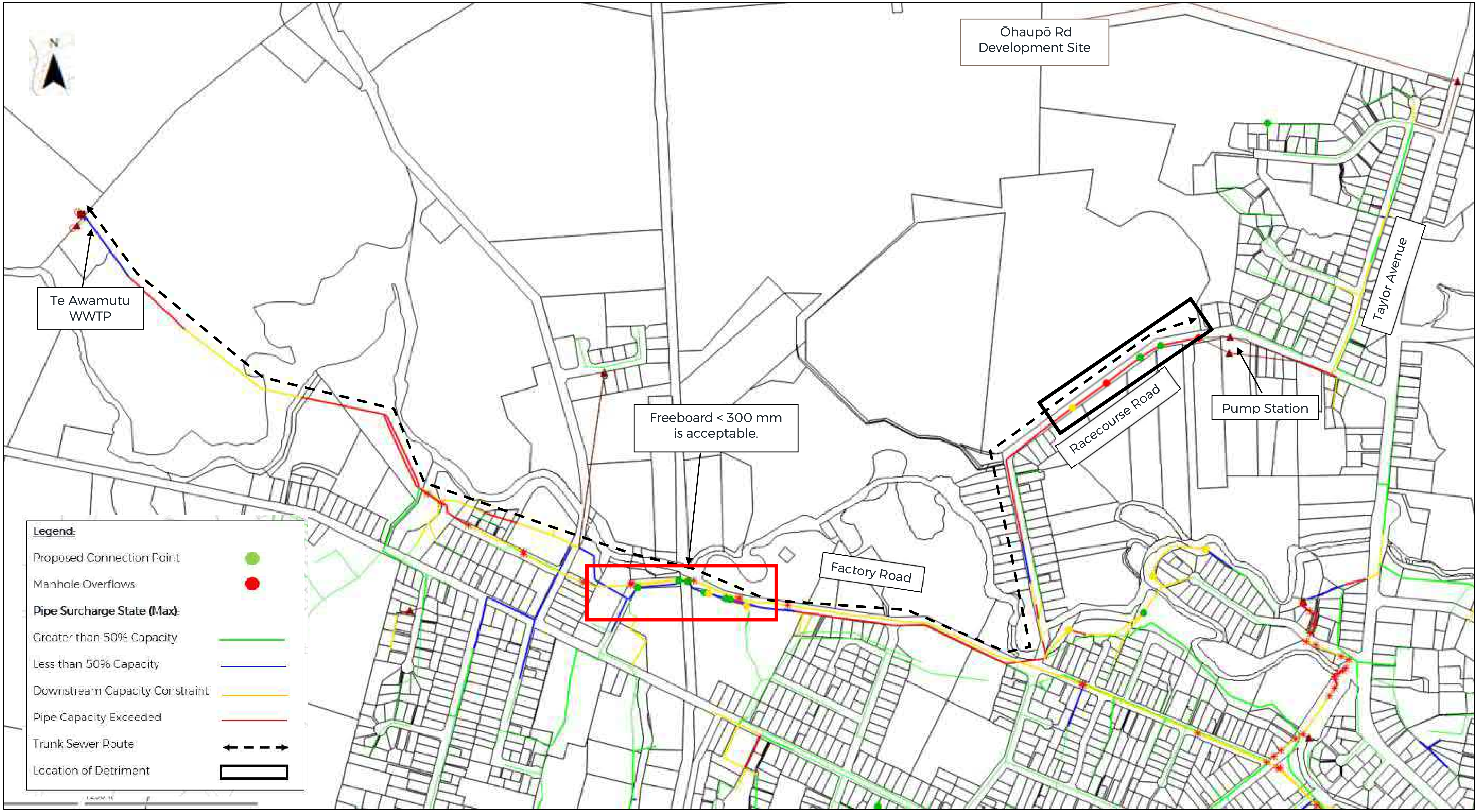

Figure 7-6: 2050 Growth Model WWF Results – Stage 2 – Scenario 1 (with Ōhaupō Road Development – 14.1 L/s PWWF and Baseline Model Updates)

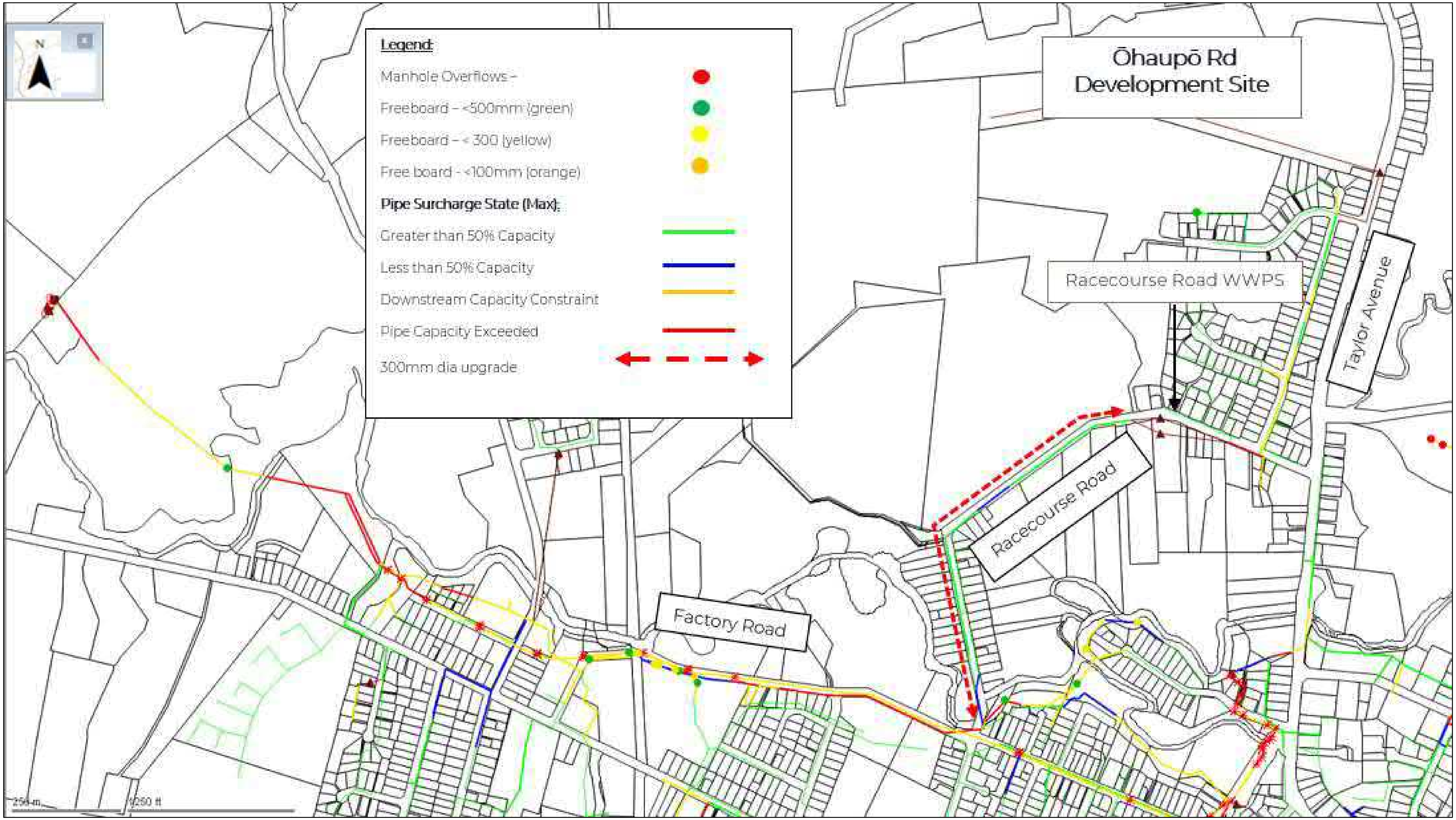

Figure 7-7: 2022 Base Model WWF Results – Stage 2 – Scenario 2 (with Ōhaupō Road Development – 14.1 L/s PWWF and Baseline Model Updates + 300 mm (1 km) Upgrade)

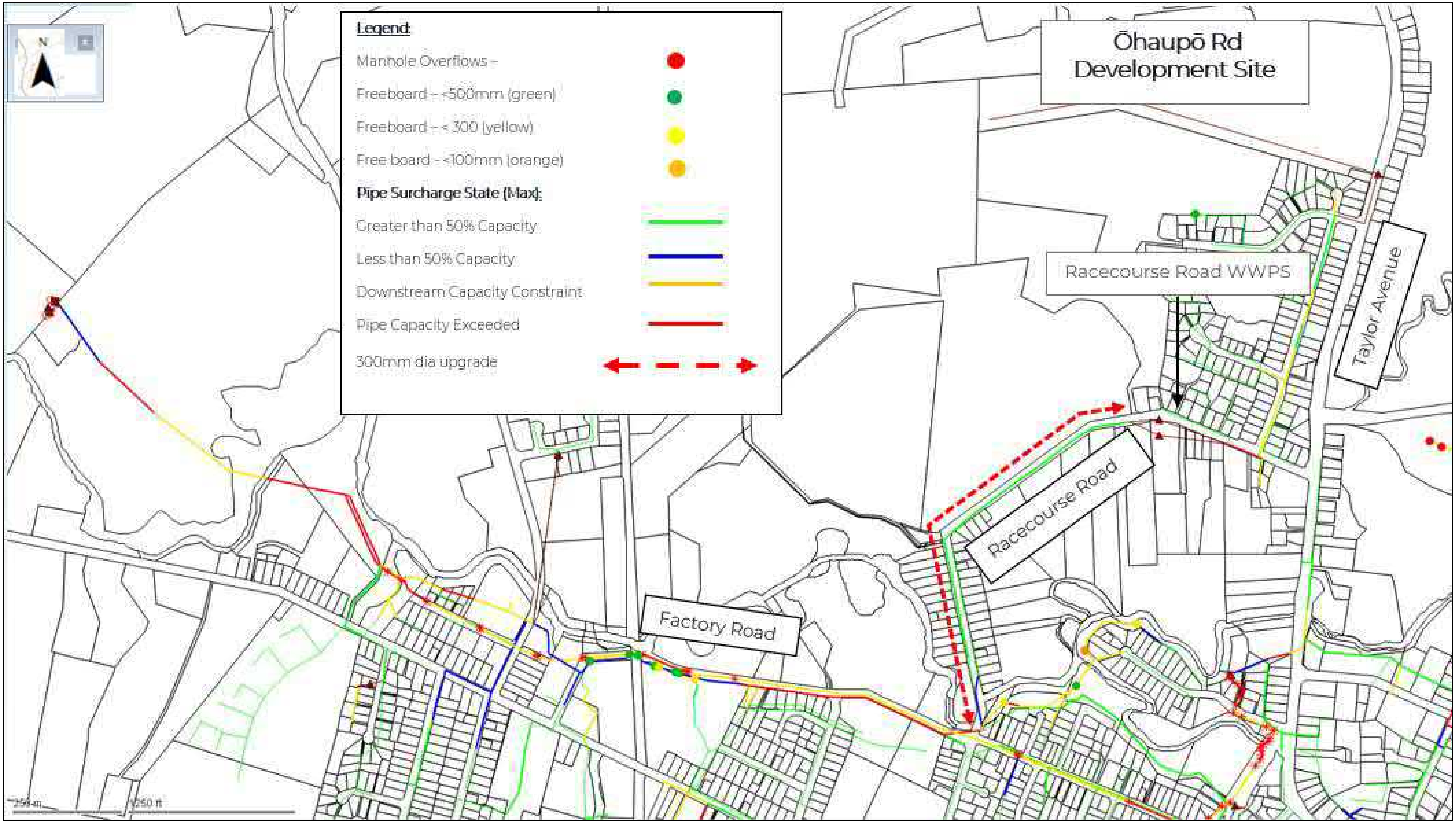

Figure 7-8: 2050 Growth Model WWF Results – Stage 2 – Scenario 2 (with Ōhaupō Road Development – 14.1 L/s PWWF and Baseline Model Updates + 300 mm (1 km) Upgrade)

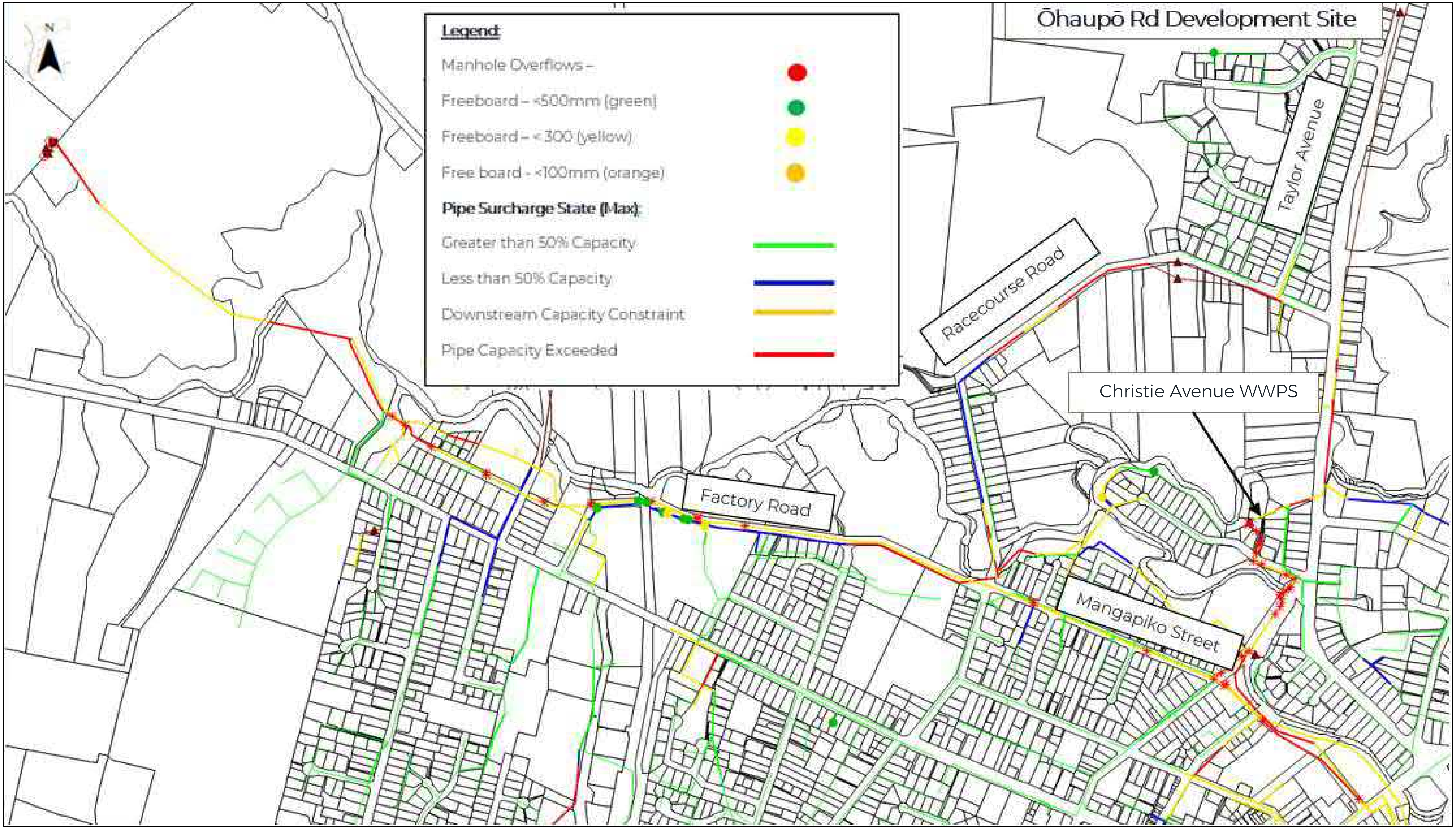

Figure 7-9: 2022 Base Model WWF Results – Stage 2 – Scenario 3 (with Ōhaupō Road Development – 14.1 L/s PWWF, Baseline Model Updates with Racecourse Road WWPS and Christie Avenue WWPS Split)

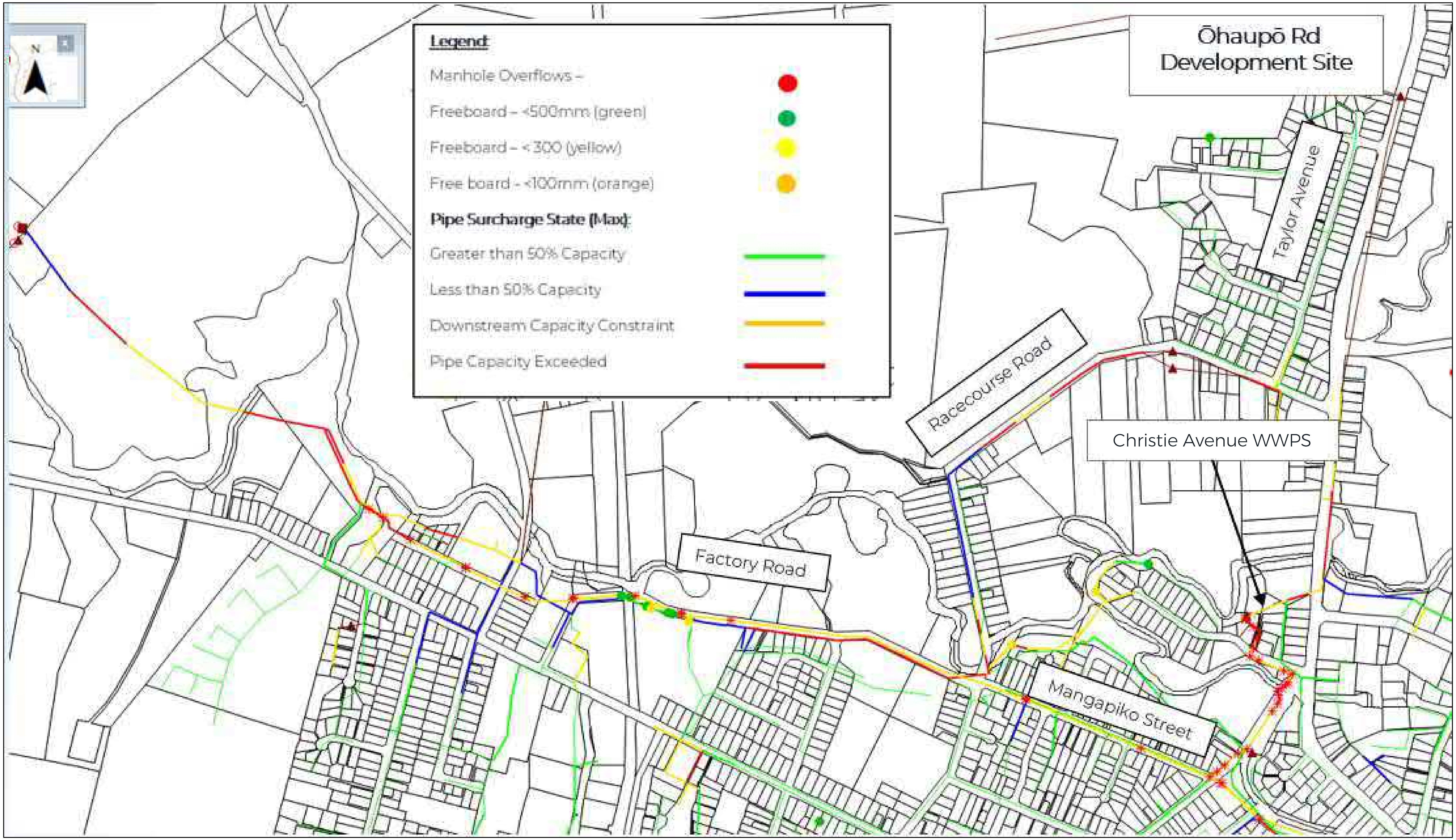

Figure 7-10: 2050 Growth Model WWF Results – Stage 2 – Scenario 3 (with Ōhaupō Road Development – 14.1 L/s PWWF, Baseline Model Updates with Racecourse Road WWPS and Christie Avenue WWPS Split

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