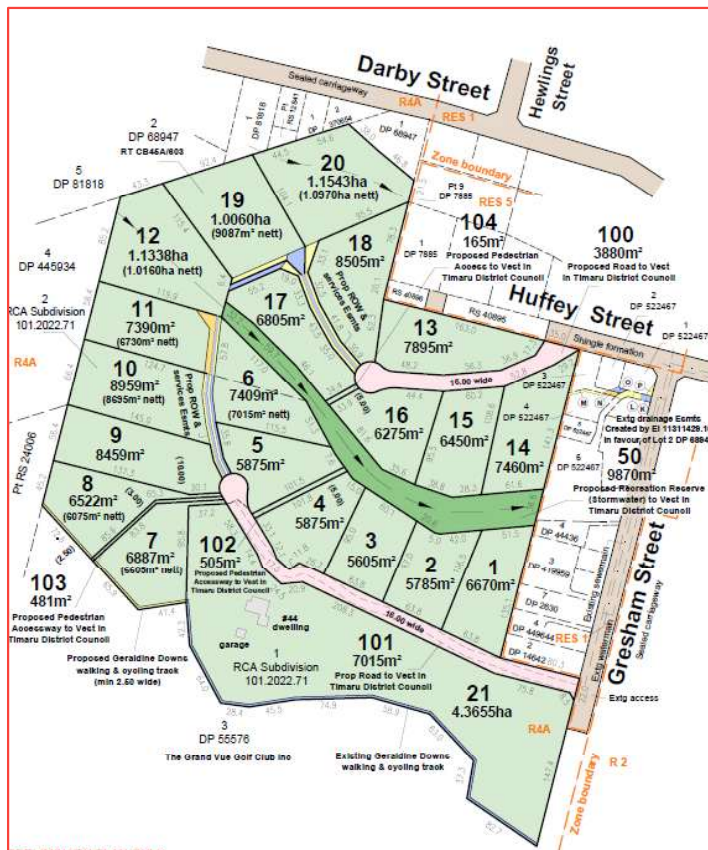


Project Number: 3-c2419.09

Geraldine Development Capacity Assessment

30 November 2022

CONFIDENTIAL



Gresham Street, Geraldine

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Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for Timaru District Council ('**Client**') in relation to a Network Capacity Assessment for Gresham Street, Geraldine ('**Purpose**') and in accordance with the existing *ACENZ Form of Agreement for Engagement of Consultant between Timaru District Council and WSP* signed 29 April 2011 and *Offer of Service dated 9 September 2022 for '44 Gresham Street, Geraldine Development Capacity Assessment'*. The findings in this Report are based on and are subject to the assumptions specified in the Report and the Offer of Services dated September 2022. 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 Report, 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.

Executive Summary

Timaru District Council (Council) wished to quantify the impact of a residential development in Geraldine on the existing water and wastewater networks. The development is located on Huffey Street and will comprise 20 lots.

Additionally, Council wanted to identify any predicted network problems as a result of the future growth areas, and intensified existing development and to identify potential opportunities to mitigate the impact of this future development.

Six development areas (planned growth) were identified; one consented, and five future growths.

Water

The Gresham Street development is located at a high elevation and will require a booster pump to service. The new booster pump station at Hewlings Street (under construction) can service this new development (connected via a pipe upgrade to the service connection at 1 Darby Street to DN 180 PE 100 PN 12.5) with no adverse effect on the existing performance of the water supply network. Alternatively, a local booster pump can be installed, and the development serviced from the existing 100 mm diameter main in Huffey Street.

There are some existing fireflow issues in the network, with some hydrants unable to meet FW3 firefighting requirements.

The existing network is not capable of supplying ultimate planned growth, with undersized pipes causing large headlosses and pressures well below the 200 kPa level of service across the network. Upsizing of approximately 3.8 km of mains in the network has been identified as an initial solution to resolve these capacity issues.

Wastewater

While not significantly impacting the local network, the addition of the Gresham Street development will exacerbate the existing surcharge and manhole overflows predicted downstream in the catchment.

Across the whole catchment, intensification and future growth is predicted to result in an increase in manhole overflows and associated spill volumes. To mitigate this, upsizing of approximately 6.1 km of wastewater network may be required.

The modelling has identified that the predicted future flows at the syphon are higher than predicted previously. The model results do not show a need to upsize the new syphon to cater for the increase in flow, however we recommend the design team confirm that no changes to their design are required.

It is recommended that all water and wastewater infrastructure upgrades are optimised to allow for phasing of the development areas.

1 Introduction

WSP was approached by Timaru District Council (Council) to provide engineering services to quantify the impact of a residential development on the existing wastewater and water networks.

The development is located at 44 Gresham Street in Geraldine. It will comprise an additional 20 residential lots and will connect to Huffey Street (water) and discharge to either or both Huffey Street and Gresham Street (wastewater). Figure 1-1 shows the site's location with the existing water and wastewater networks.



Figure 1-1: Location of Development Site and Existing Assets

2 Assessment Methodology

2.1 Ultimate Growth Areas

In addition to Gresham Street, one other consented development area was identified:

- Majors Road – 32 lots

Council provided five further future growth areas:

- Huffy Street – 10 lots
- Orari Station Road – approx. 66 lots
- Templer Street – approx. 666 lots
- Scotts Farm – approx. 133 lots
- Young Farm - approx. 167 lots

All identified development and growth areas are shown in Figure 2-1.

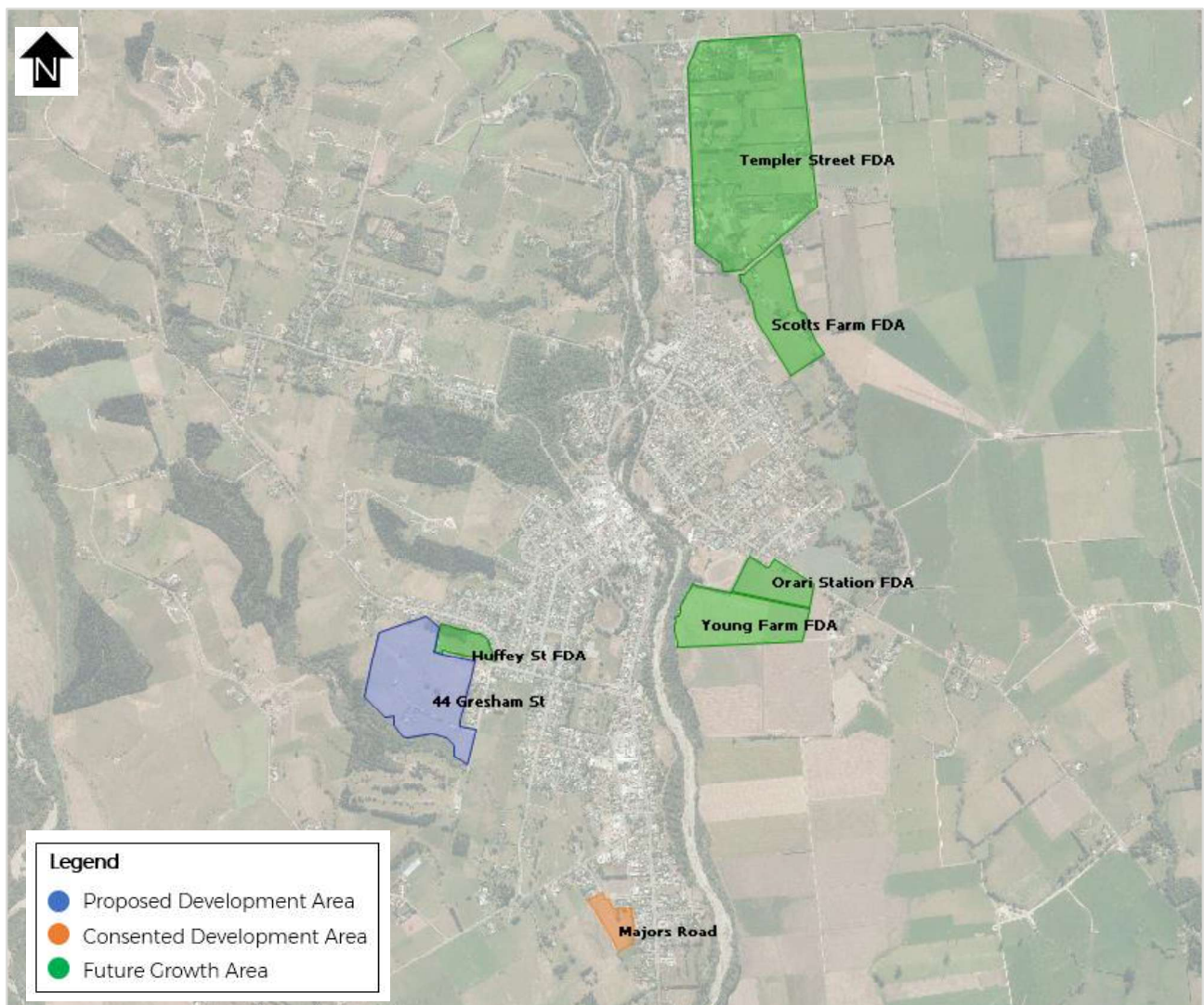


Figure 2-1: Location of Development and Future Growth Areas

Populations for each development area were derived using a value of 2.3 people per lot, based on Figure 3-4 of *Timaru District Council – Population and Household Projections 2013-2063* (Jackson, August 2014). Modelled populations are presented in Table 2-1. Where the number of lots was not identified in the provided data, these were taken to be 12 lots per hectare.

Table 2-1: Modelled Population Calculations

Area	Type	Approx. Size (Ha)	No. of Lots	Calculated Population
Gresham Street	Proposed	-	20	46
Majors Road	Consented	-	32	74
Orari Station	Future	5.5	66	152
Huffey Street		-	10	23
Templer Street		55.5	666	1532
Scotts Farm		11.1	133	305
Young Farm		13.9	167	383

2.2 Water Network

Using the existing Geraldine Shadow Calibrated model from 2012, amended for Geraldine Reservoir Low Pressure Issues in 2016; the base model was updated with new developments as described in Table 2-1.

These developments were assigned the *Geraldine Domestic* demand profile, with a specific consumption of 1368 L/prop/day. Additional leakage was applied at a rate of 26 L/prop/day

The demand through Tripp Street transfer node was set based on the future full allocation for Geraldine Downs and Geraldine Flats.

The local reticulation and proposed pump station servicing low pressure properties on Hewlings Street and Darby Street have been incorporated into the model based on Watermain Upgrade Plans and Hewlings Street Pump Station Design report and plans.

The following scenarios were set up for servicing Gresham Street development:

- Development serviced off Huffey Street – a local booster pump will be required for this scenario.
- Development serviced off Darby Street – potential changes to the operation of Hewlings Street booster pump will be required.

The Gresham Street development was set at an elevation of 170 m, as the highest elevation in the proposed section.

2.3 Wastewater Network

Using the existing Inland Towns wastewater model, calibrated in 2021, the base model was first updated with the new syphon under the Waihi River.

A new Growth scenario “*Inland Towns Ultimate Growth*” was created, and all identified developments added using new sub-catchments. Per capita flow rates, inflow and infiltration (I&I) and baseflows have been set using the calibrated values for the surrounding sub-catchments. This assumes that the future network will be as “leaky” as the current situation, and that no I&I reduction works have been undertaken.

Existing sub-catchments falling within District Plan zone “*General Residential Zone*” were assessed to determine their current population density. Those sub-catchments with a density less than 27.6 people per hectare were identified and their populations increased appropriately to meet the desired population density. This resulted in an increase in population of 1,240.

3 Results

3.1 Water Network

The base model and growth scenarios for the water network were run using the ADPW demand model. The following sections discuss the impact of the developments on the wider network with regards to:

- 200 kPa level of service pressure
- Reservoir operation and storage time
- Pump performance
- Fire flow requirements:
 - FW2 – 25 L/s with residual minimum pressure, at two-thirds of peak demand
 - FW3 – 50 L/s with residual minimum pressure, at two thirds of peak demand. FW3 fireflow requirements have been assessed at Talbot Street hydrant (FH90279) and near Geraldine Primary School (FH90075)

3.1.1 Base Model

The base model predicts existing pressure level of service and fireflow issues, shown in Figure 3-1:

- FW3 requirements are unable to be met at Talbot Street or Geraldine Primary School.

The impact of the Gresham Street development has been assessed for both connection options at Huffy Street and Hewlings St / Darby St.

Table 3-1: Base Model Results - Water

Parameter	Scenario A – connection to Huffy St	Scenario B – connection via Hewlings St / Darby St upgrades
Pressure level of service	No decrease in pressure level of service in the wider network.	No decrease in pressure in the wider network. The DN 25 service connection on Downs Rd will require upsizing to DN 180 PE 100 PN 12.5 or equivalent to supply the 44 Gresham St development (including fireflow).
Reservoir Operation	Operates within normal range and maintains level.	Operates within normal range and maintains level.
Pump Performance	A local booster pump is required to service the Gresham St development due to elevation differences (highest ground elevation in Gresham St development is 170 m compared to 44 m of pressure at connection point elevation of 120 m. This booster pump would be required to provide low flows (1 L/s maximum with Gresham St, 1.6 L/s with Gresham St and Huffy St) and approximately 25 m head.	Hewlings St booster pump provides up to 26 m lift (target outlet pressure 75 m). Booster pump operates with flow increased by 0.6 L/s at peak time (to 2.3 L/s).
Fireflow	No change	No change

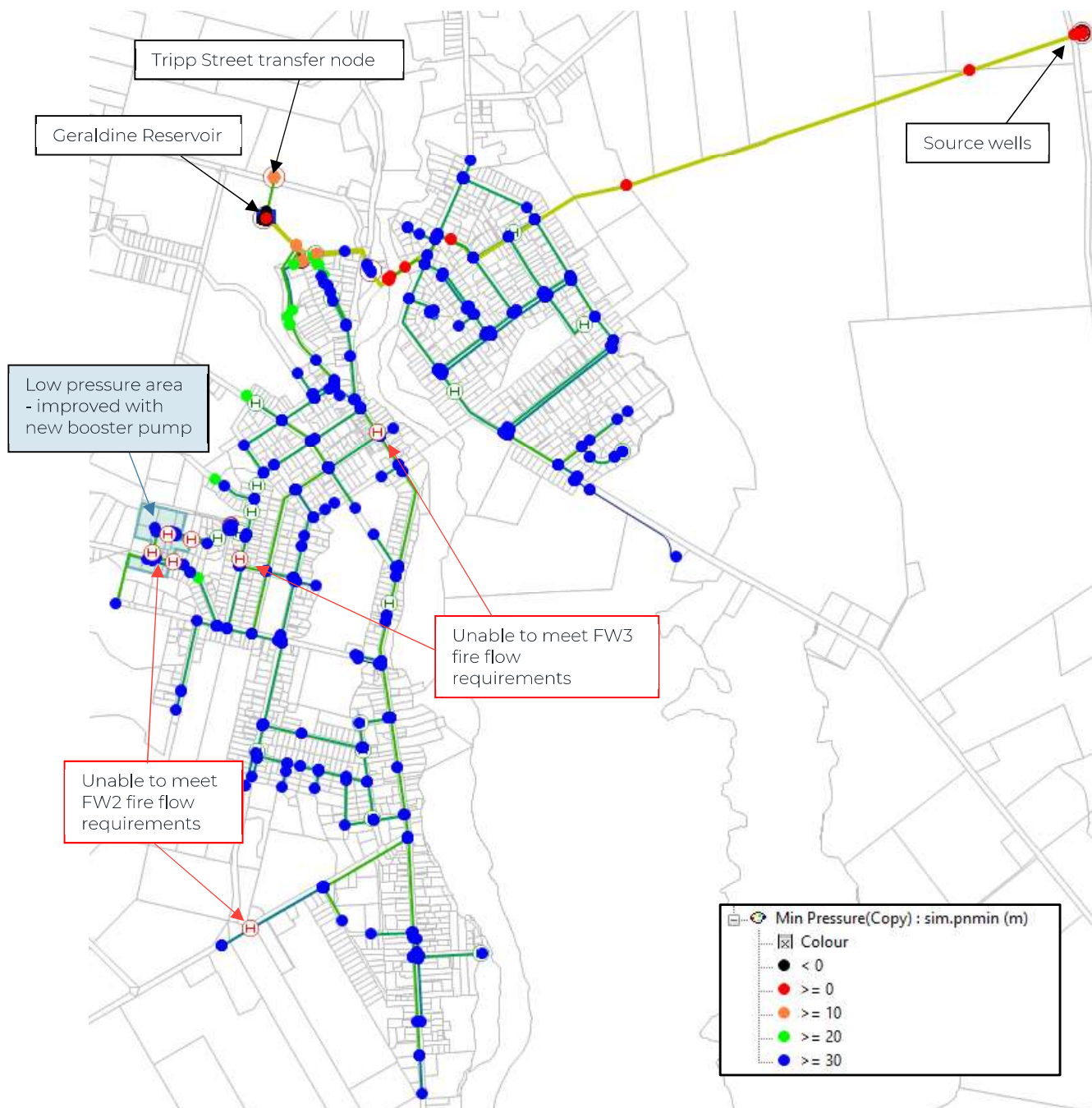


Figure 3-1: Base model pressure and fireflow results

3.1.2 Ultimate Growth

The ultimate growth scenario encompasses the developments described in Table 2-1. 44 Gresham Street development has been allocated to Darby Street.

The impact of all developments on the network is shown in Figure 3-2.

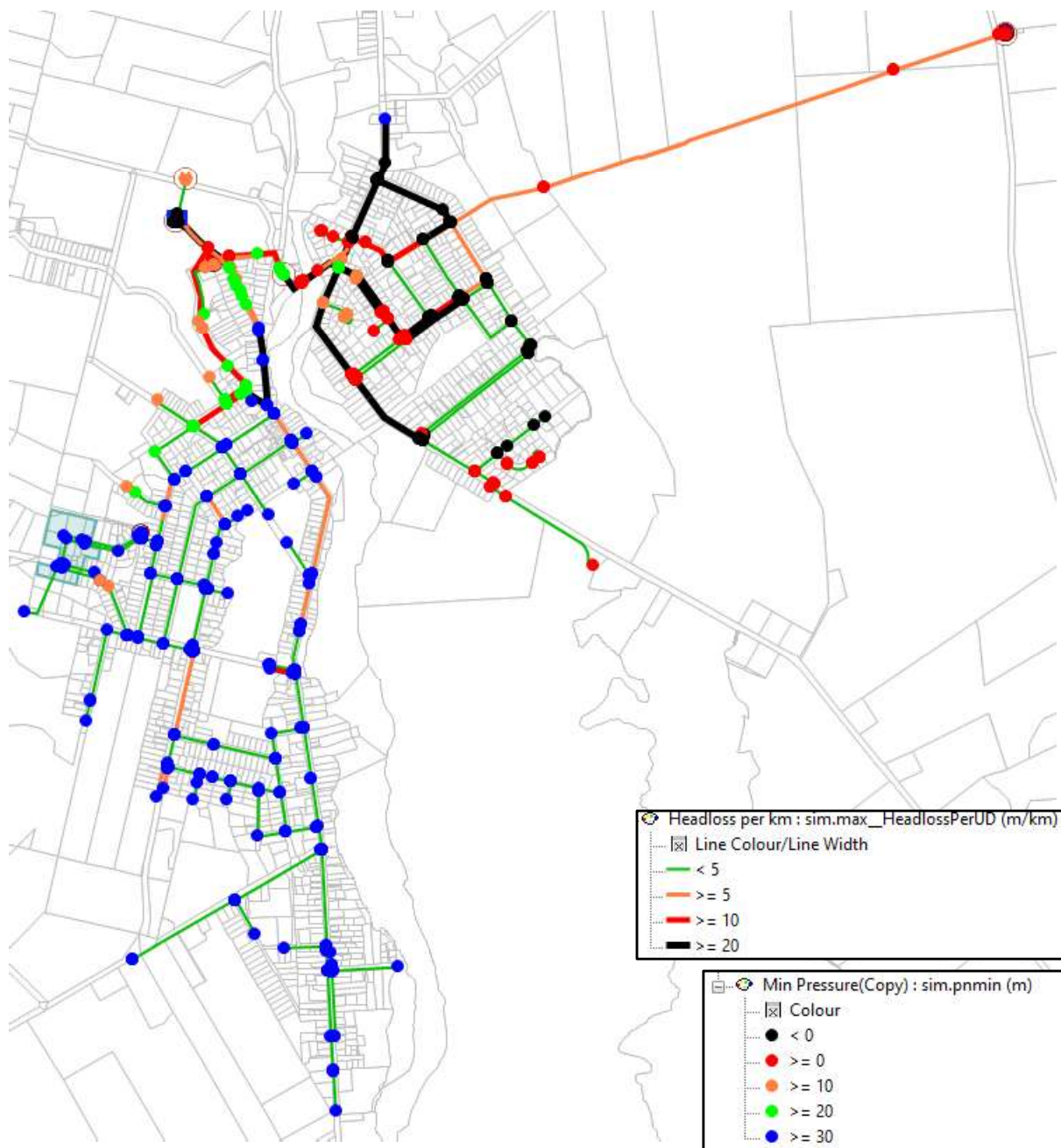


Figure 3-2: Network results with all future developments

The existing network is not capable of servicing the ultimate planned growth:

- Significant areas that fail to meet 200 kPa level of service pressure due to large headlosses in the reticulation are observed in the north-east of Geraldine.
- Geraldine Reservoir levels drops below typical levels (4,388 mm depth, typically operated between 5,127 mm and 5,433 mm) but recovers by the end of the day.
- Hewlings Street booster pump has been set up with target outlet pressure at 75 m.
- Additional hydrants are unable to provide FW2 fireflows in north-east Geraldine as shown in Figure 3-3. This is primarily due to increased headlosses in the network.

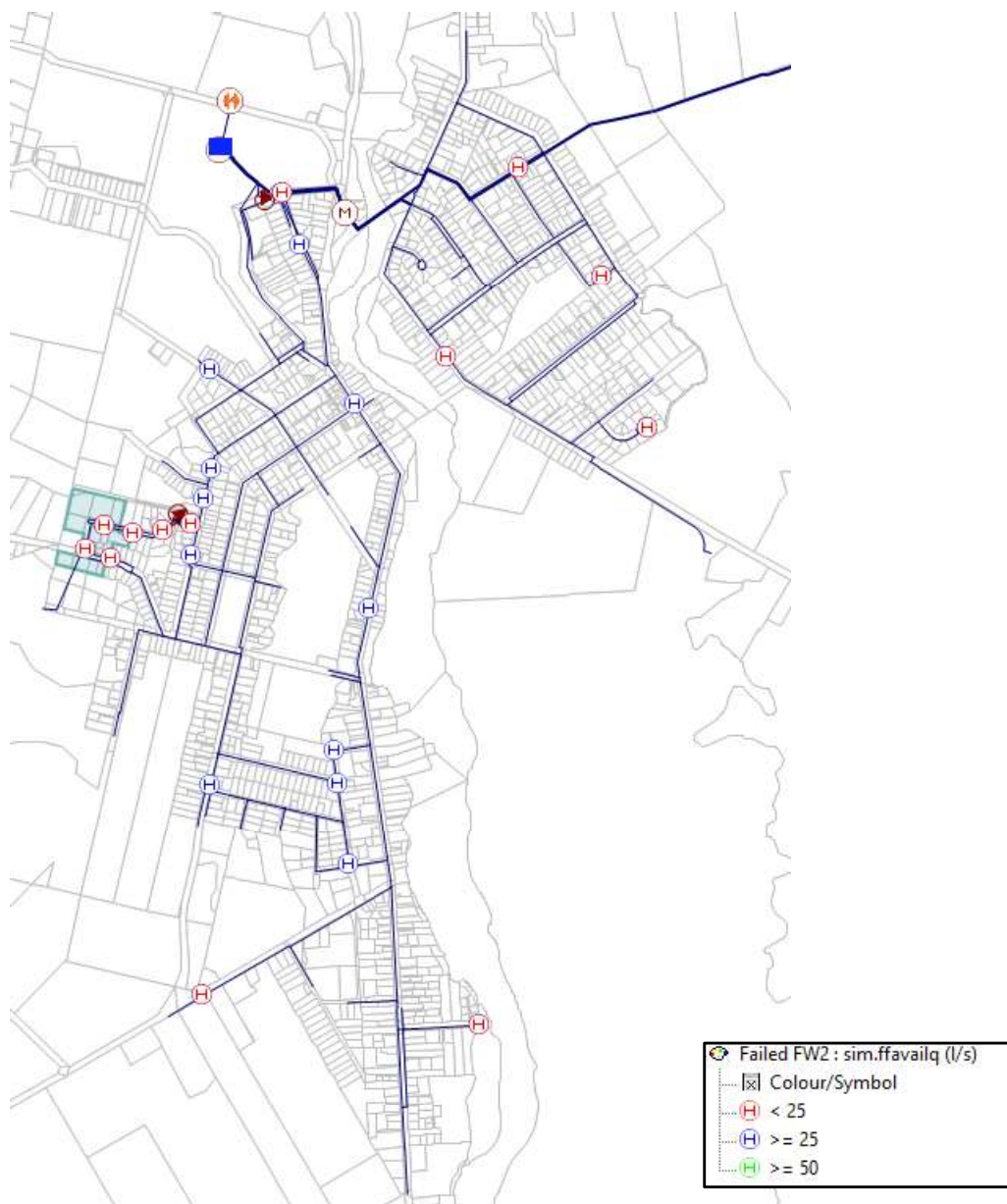


Figure 3-3 Hydrants fireflow availability with ultimate planned growth

3.2 Wastewater Network

The base model and the growth scenarios for the wastewater network were simulated with a 24-hour 5-year ARI design event, with inclusion for climate change to 2090. The following sections discuss the performance of the network with the addition of the Gresham Street (and Huffey Street) developments and the ultimate growth network.

3.2.1 Gresham Street

The impact of the Gresham Street development on the wastewater network has been assessed alongside the Huffey Street development, as they both discharge to the same pipeline.

In the base model, there are already surcharging, or close to surcharging, manholes during the design event. Figure 3-4 shows the extent of the pipeline (in red) used for the assessment of the developments' impacts. There is one manhole predicted to spill in the base model, with a predicted spill volume of approximately 12 m³.

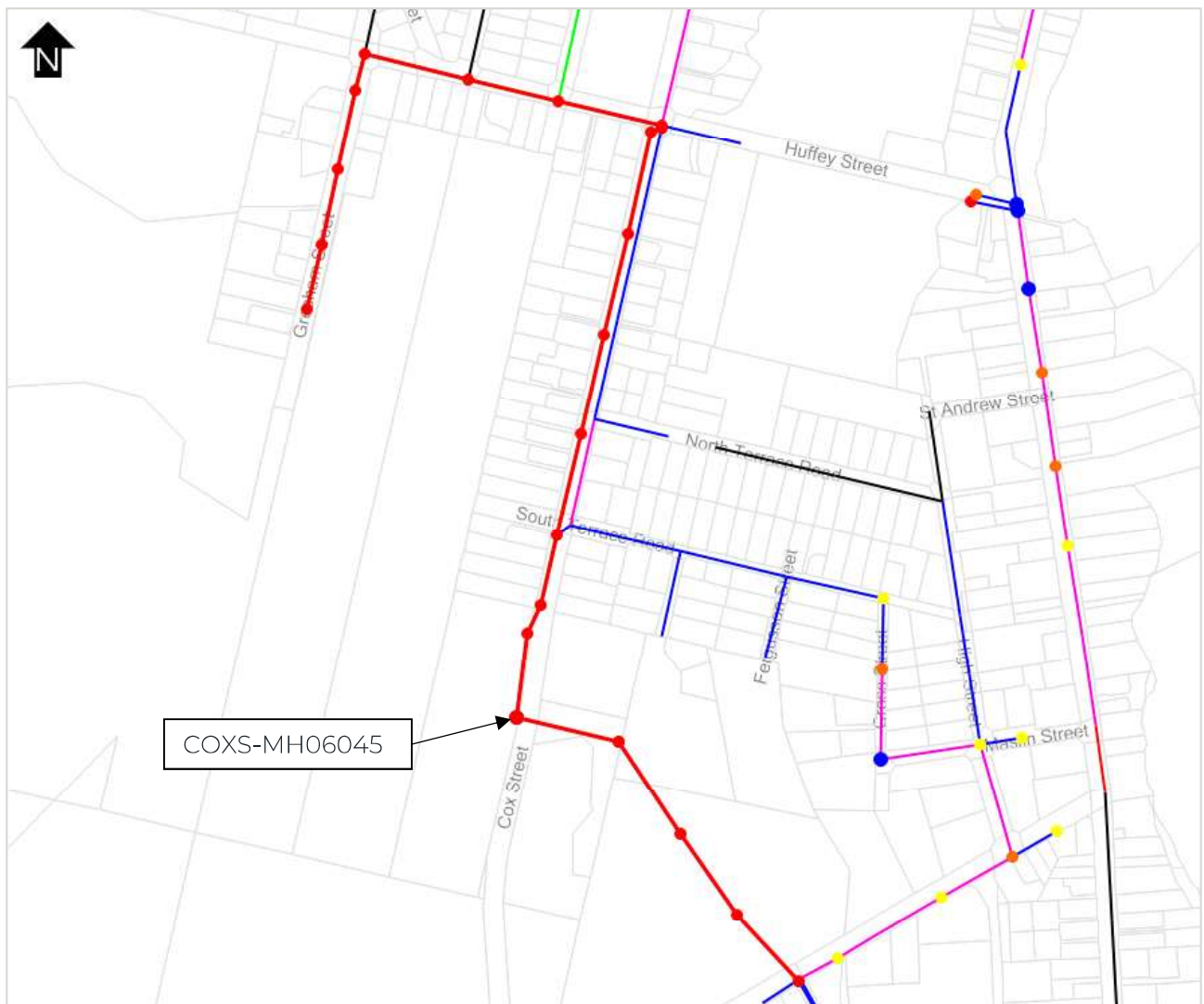


Figure 3-4: Location of Long-section from Gresham Street

The following long-section in Figure 3-5 shows the predicted capacities for the base (blue) and growth (red) scenarios. This shows that the flows within the pipeline on Gresham and Huffey Streets are not significantly affected by the addition of the developments, although the flow on Gresham Street has doubled and the predicted spill volume from COXS-MH06045 has increased to 66 m³.

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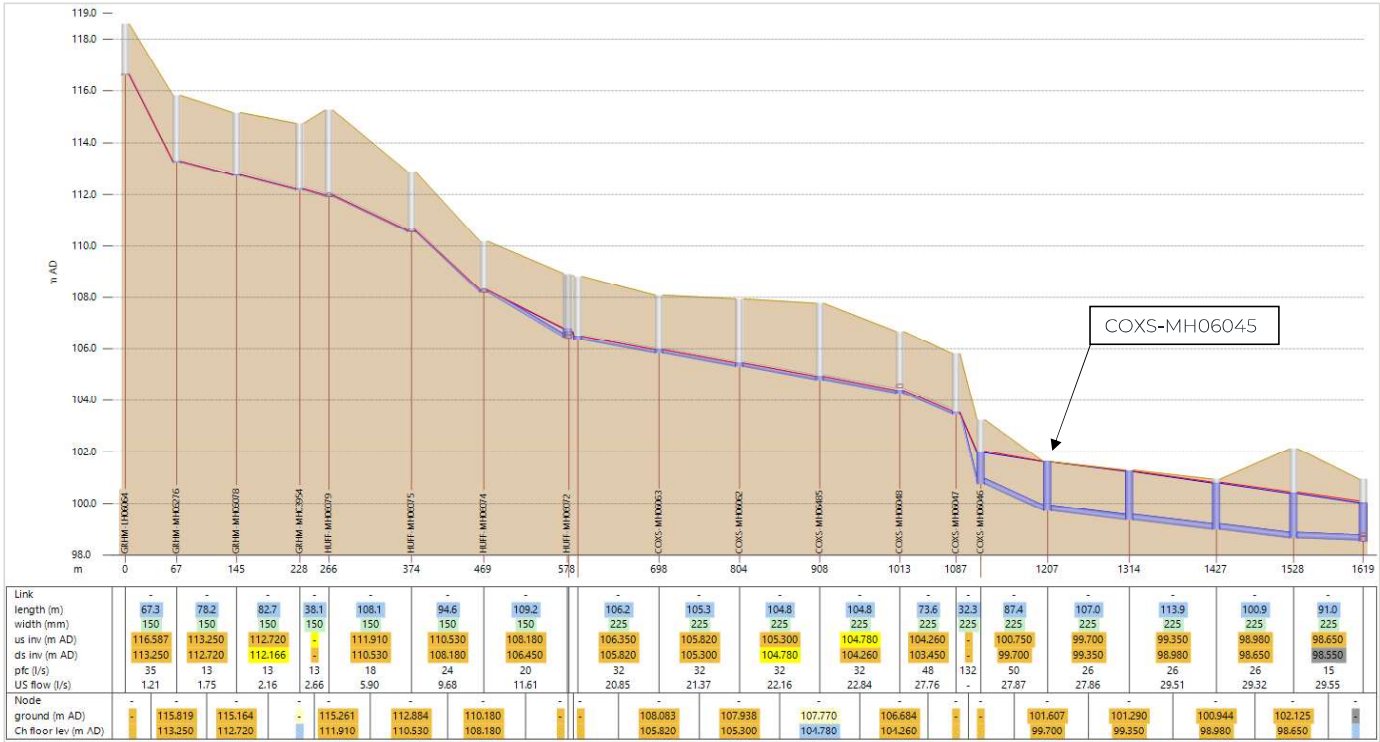


Figure 3-5: Comparison of Peak Flows on Gresham and Huffey Streets between base model (blue line) and Ultimate Growth scenario (red line)

3.2.2 Ultimate Growth

The assessment of the Ultimate Growth scenario has been undertaken across the whole of the Geraldine wastewater network. Table 3-2 presents a comparison of the results for the two scenarios in terms of available network capacities. The numbers in brackets represent the percentage of the network. These results are displayed visually in Figure 3-6.

Table 3-2: Capacity Assessment Results

Peak Flow Criteria	Base Model		Ultimate Growth Scenario	
	Number of Pipes (%)	Length of Pipes (m) (%)	Number of Pipes (%)	Length of Pipes (m) (%)
Flow Depth < 50% of pipe diameter	244 (56)	16992 (55)	185 (43)	12266 (40)
Flow Depth = 50 – <70% of pipe diameter	32 (7)	2484 (8)	44 (10)	3722 (12)
Flow Depth = 70 – <100% of pipe diameter	6 (1)	353 (1)	7 (2)	635 (2)
Pipe surcharged by backwater condition (Slope HGL < pipe grade)	88 (20)	6464 (21)	116 (27)	8343 (27)
Pipe surcharged due to limited capacity (Slope HGL < pipe grade)	62 (14)	4716 (15)	80 (19)	6044 (20)
	No. of Overflows (%)	Volume of Overflows (m ³)	No. of Overflows (%)	Volume of Overflows (m ³)
	12 (3)	805	13 (3)	1310



Figure 3-6: Comparison of Network Performance: Base (left) against Ultimate Growth (right)

By reviewing the above figure, the most significant increases in surcharge are shown in the north-east of Geraldine where the large growth areas of Templer Street, Orari Station, Young Farm and Scotts Farm will contribute to the network.

4 Future-Proofing the Geraldine Networks

4.1 Water Network

The ultimate planned growth scenarios are unable to be serviced by the existing network, due to undersized pipes resulting in large headlosses and low pressures.

The consent for water take is a maximum combined rate of 80 L/s and limited by volume depending on flow in Temuka River. With all planned growth the peak flow rate does not exceed 80 L/s, or any of the stated volume limitations.

Figure 4-1 shows the potential pipe upgrades, with locations of future developments and peak flows.

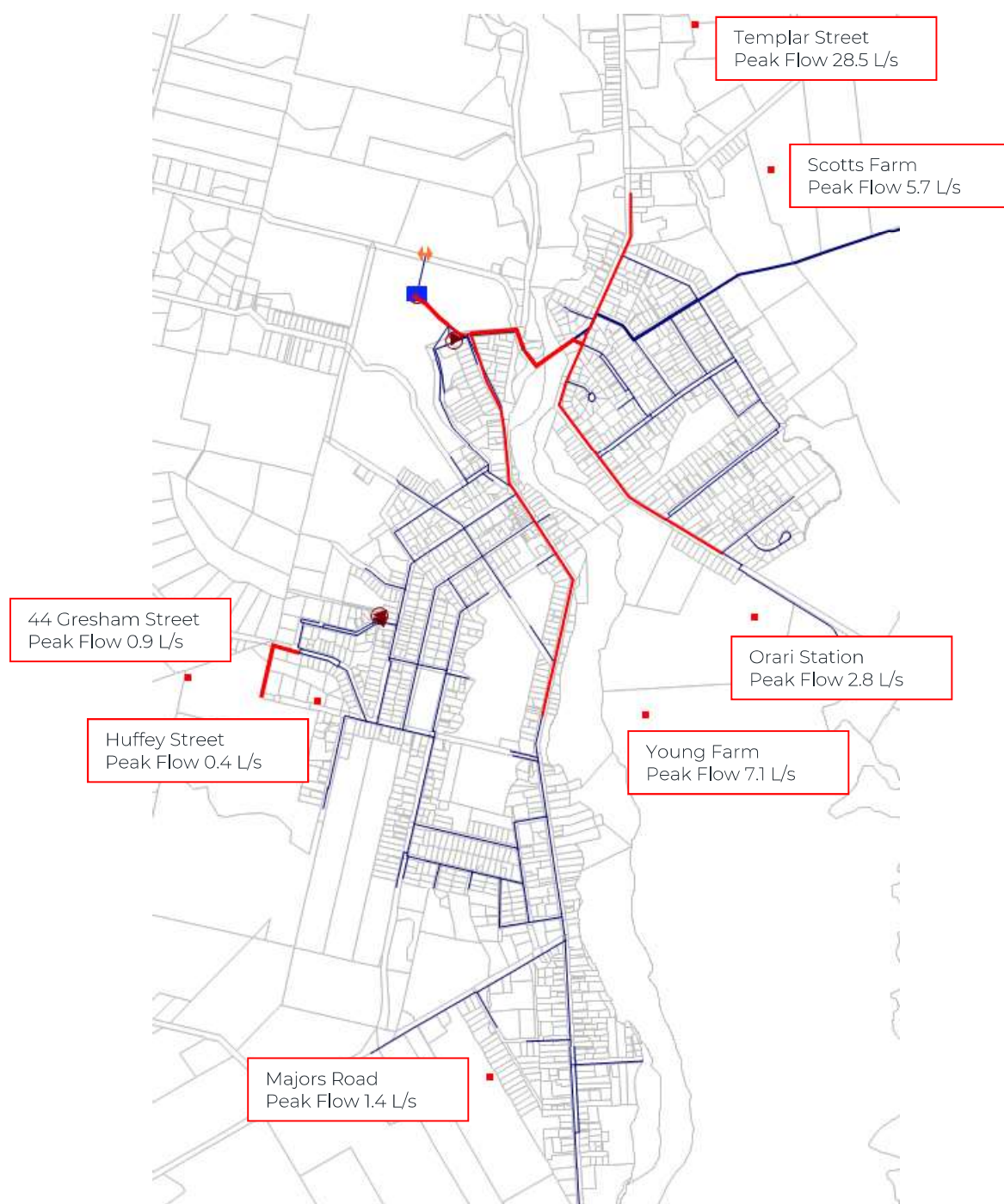


Figure 4-1 Upgrades for servicing future developments

Upsizing these pipes as described in Table 4-1 allows pressure level of service requirements to be met at all properties, including new developments.

The booster pump at Hewlings Street is capable of supplying both Gresham Street and Huffey Street developments.

The pipe upgrades improve fireflows, although FW3 is still not possible where required.

Table 4-1: Potential Pipe Upgrades

Proposed Diameter PE 80 PN12.5 or similar	Location	No. of Pipes	No. Valves	Length of Pipe (m)
110	Darby Street connection for 44 Gresham Street	1	0	90
180	McKenzie Street	16	6	1000
180	MacDonald Street – SH79 – Talbot Street	26	10	1406
250	SH79 (McKenzie St to Templer St)	10	5	615
355	Geraldine Reservoir – Bridge St – Tripp St – SH70 (to McKenzie St)	18	6	735

A larger reservoir may be required in the future to allow the level to be maintained within normal operating range. In this scenario, the level recovers completely even across a long period so is not at risk of emptying.

The optimisation of the infrastructure upgrades should be further investigated to take into account the anticipated phasing of developments.

4.2 Wastewater Network

The combination of the quantity of planned future growth in Geraldine, and the existing capacity issues within the wastewater network, result in a network that is predicted to experience frequent surcharging and overflows.

Figure 4-2 shows the predicted surcharge and overflows for the 24-hour 5-year ARI design event, with inclusion for climate change to 2090. There are 13 manholes predicted to spill with a total spill volume of approximately 1,310 m³.

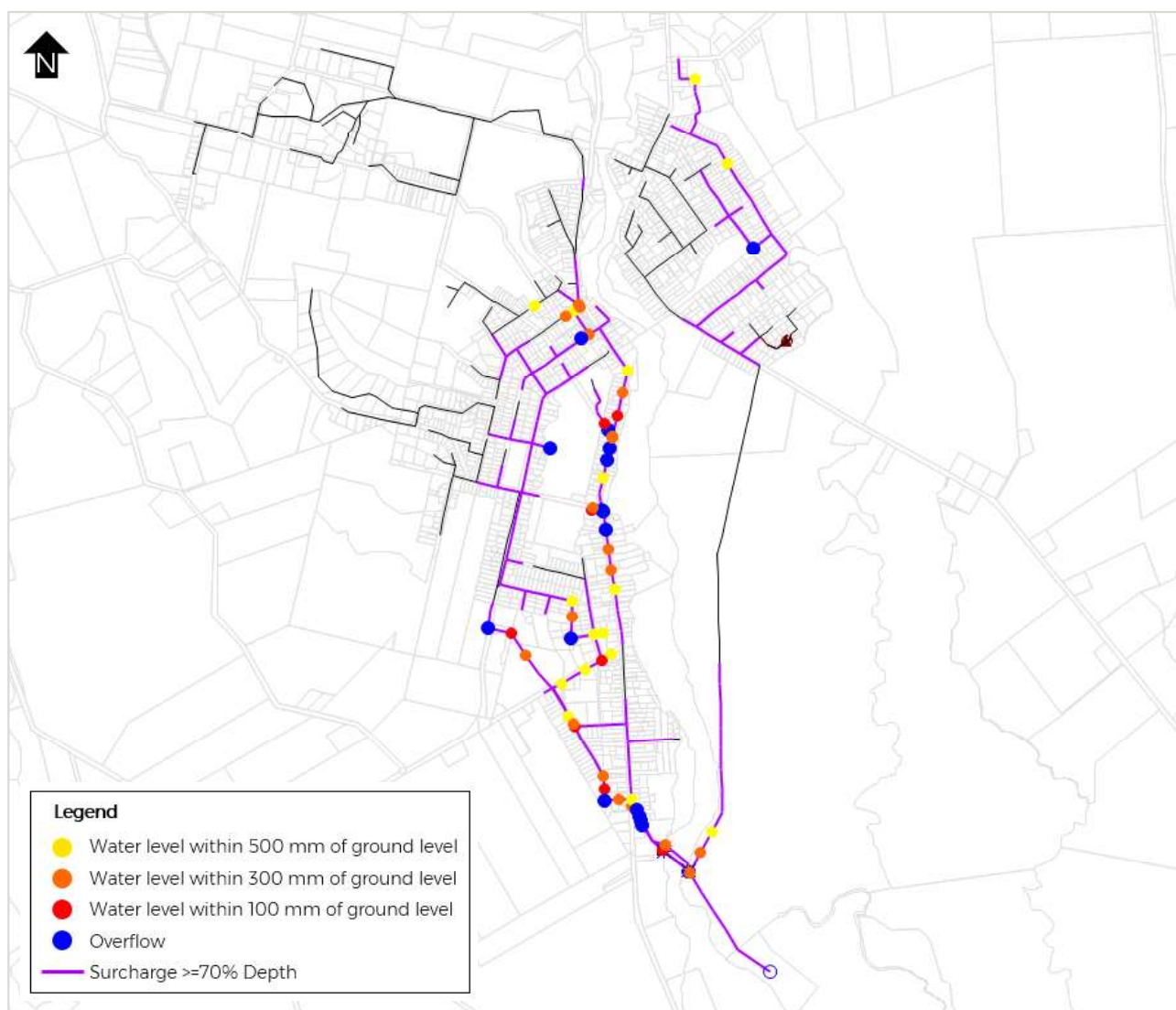


Figure 4-2: Extent of Predicted Surcharge and Overflows

To identify the extent of upsizing that would be required to remove all overflows and reduce surcharge at these locations to less than 70% depth, a number of iterations were undertaken. An “Ultimate” solution for Geraldine involves upsizing a significant portion of the network.

The potential for upsizing the proposed, third, syphon beneath the Waihi River was investigated, and discounted. There is little improvement in the predicted surcharge levels across the network if the syphon is upsized to a 375 mm diameter. The design report (WSP, April 2022) identified the total peak flow through the three syphons as 104 L/s; for comparison, the model is predicting 114 L/s through the syphons. During the storm event used for this assessment, the third syphon is predicted to run at its pipe full capacity of 79 L/s. It is recommended that the impact of these increased flows are discussed with the design team prior to construction.

No amendments to the existing syphons, or changes to either the vertical or horizontal alignments of the network were considered. The potential for the Geraldine oxidation ponds and Inland Towns pipeline to receive the increased flows has not been assessed. The model currently predicts flows to the oxidation ponds of approximately 85 L/s, increasing to 145 L/s with all suggested upsizing in place. These would be investigated in greater detail should any improvements progress to the design stage.

Table 4-2 shows a summary of the potential upgrades required.

Table 4-2: Potential Upsizing

Proposed Diameter (mm)	Length of Pipe (m)
225	3,195
300	1,675
375	760
450	435

Figure 4-3 shows the extent of the necessary upsizing to eliminate overflows from the Geraldine network.



Figure 4-3: Extent of Potential Upsizing (red) to Remove Overflows

Figure 4-4 shows the performance of the Ultimate Growth network if all proposed upsizing takes place. Further improvements will be possible if amendments to vertical and horizontal alignments are also considered, particularly in the area immediately upstream of the siphons.



Figure 4-4: Predicted Network Performance after Upsizing

5 Recommendations

5.1 Water

Based on the hydraulic modelling results described in this report, we recommend the following actions:

- Council to confirm flows and pressures at the Hewlings Street pumping station once commissioned, including hydrant flow and pressure tests on Hewlings and Darby Street.
- If Gresham Street development can be supplied from the new Hewlings Street pump station, then an extension and upgrade of service connection at 1 Darby Street to DN 180 PE 100 PN 12.5 will be required.
- Master planning to be undertaken to inform optimisation of phasing of future development areas. This should include upgrades required for supplying fireflow requirements, upgrades for new developments, and assessment of reservoir capacity.

5.2 Wastewater

- Council to review the potential for, and likely impact of, increased flows into Geraldine oxidation ponds and the Inlands Towns Pipelines. Inflow and infiltration (I&I) reduction may need to be looked at if the downstream system does not have capacity for the increased flows. I&I reduction could also reduce the required upgrade pipe sizes.
- Council have the syphon design team review if the increased flow to the syphon require a change to the syphon design.

6 Assumptions and Exclusions

As detailed in the Offer of Service, the following assumptions and exclusions apply:

6.1 Water

- 1 The Geraldine Shadow Calibrated 2012 water model (amended for modelling Geraldine Res Low Pressure Issues in 2016) in Infoworks WS Pro 2023.0.0 was used for this assessment. Previous modelling work is described in *DRAFT 3 – Geraldine Low Pressure Issues Investigation* (Opus, 2018) and proposed booster pump station requirements in *Darby Hewlings Street Booster Requirements* (WSP Opus, 2019) and *Hewlings Street Pump Station Design* (WSP, 2021). This pump station was designed and submitted for tender in Contract 2588 by WSP in May 2022. These reports contain previous modelling assumptions that will be carried through to this project. Key assumptions are listed below:
 - (a) Hewlings Street pump station was located as shown in For Tender documents, sized as specified in Hewlings Street PS Design memorandum Section 3.1 with one domestic pump (Grundfos CRE15-4 NPV-F-A-E-HQQE 4kW) and one fire pump (Southern Cross Starline ISO2585 100x80-160 pump) and controlled as described in Section 3.2.
 - (b) Reticulation pipework on Hewlings and Darby Street was upgraded to DN 150 PVC-U pipe, and a new valve installed to isolate the lower section of Darby Street from new pump station.
 - (c) The Geraldine reservoir operation has been adjusted to operate at full depth, within the top 500 mm of the reservoir.
- 2 Growth in Geraldine was included as described in Section 2.1. Additional leakage was included on these new demand nodes at a rate of 26 L/property/day.
- 3 Growth in the Geraldine Flats and Geraldine Downs areas was based on the future full allocation demand estimated for the Te Moana water supply (obtained from the latest Te Moana / GAWWS hydraulic model).

6.2 Wastewater

- 1 The Inland Towns wastewater model, modelled in InfoWorks ICM 11.0.4, was used for this assessment, and is described in the *Inland Towns Wastewater Model: Model Build, Calibration, and System Performance Report* (WSP, December 2021). This report contains assumptions and limitations that apply to this project. The key assumptions and limitations from this are listed below (note that these are not all the assumptions, just key assumptions relevant to this assessment):
 - (a) Baseflow was assumed to be constant, i.e. it does not vary seasonally with changes in the water table.
 - (b) Model calibration was undertaken using data obtained from a short-term flow survey between April and September 2020. A good calibration was achieved.
 - (c) Calibration parameters were averaged over the upstream monitored catchment; hence confidence is high at the flow monitoring location and decreases in the upstream branches. The model predictions of peak flows, depths, velocities, etc. are more accurate for the trunk sewer system and less accurate for the local reticulation in the upper sections of larger catchments. Therefore, consideration should be given as to the confidence in flows at the location of interest; generally, the further away from the flow monitor, the lower the confidence in the flow.

- 2 The climate change adjusted rainfall was from *High Intensity Rainfall Design for Timaru District* (TDC, 23 April 2019). This is based on the now outdated 2008 Ministry for the Environment guidance. Updated guidance was released in 2018 which may increase climate change rainfall based on the climate change scenario Council decide to use.
- 3 Populations were set assuming 2.3 people per lot. The 2.3 people per lot was estimated using Figure 3-4 of *Timaru District Council – Population and Household Projections 2013-2063* (Jackson N. O., August 2014). This represents a more conservative figure than the current average Geraldine modelled value of 1.9 people per lot.
- 4 Flows from existing development were as per the calibrated model, though the population has been increased as per Section 2.3.
- 5 Inflow and infiltration (I&I) and baseflow for future growth areas was set assuming the calibrated values for the current catchment. This assumes the future network will be as leaky as the current situation and no I&I reduction has been undertaken. This will correspond to significantly higher flows than using NZS 4404, thus representing a conservative situation.
- 6 Other than the inclusion of the above discussed flows and addition of the new syphon under the Waihi River, no other amendments will be made to the model.
- 7 For upsizing, only increased pipe sizes and an additional syphon have been utilised, and the outfall to the oxidation ponds was set to a free discharge. No amendments to vertical or horizontal alignments of the network have been considered at this time.

6.3 Exclusions

The following items were excluded from our Offer:

- Any design, associated desktop study, and site investigations.
- Meetings in Timaru.
- Assessment of the impact on the Geraldine oxidation ponds and Inland Towns pipeline.
- Optimisation of upgrades.

These exclusions can however be undertaken by WSP to a negotiated agreement with Council.

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