APPLICATION OF NEW ZEALAND METADATA STANDARDS – OVERCOMING POTENTIAL SHORTCOMINGS

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ABSTRACT (500 WORDS MAXIMUM)

This paper provides an overview of the national metadata standards for three waters and provides a case study describing how the standards were applied to assign criticality ratings to three waters pipelines. The paper discusses potential shortcomings with the standards and discusses how these were overcome whilst retaining the overall intent of the standards.

The Auditor General has observed that "although local and central government authorities tend to have a lot of data, there is little evident to suggest they use the best data to support decision-making." Across New Zealand data is collected in different ways and described differently. Sometimes the right data to make informed decisions is not captured.

To help address this LINZ and MBIE commissioned the development of the national metadata standards, working with local councils and central government agencies to develop standards for the three waters (potable, waste and storm) networks, and for residential and light commercial buildings.

The standards, that were published in 2017, cover as-constructed data which is information that can be collected when infrastructure is constructed, e.g. physical data such as pipe material. The standards also define common asset management schema for defining and reporting on aspects such as condition, performance, criticality, financial performance.

The standards are intended to provide data consistency across government agencies and local authorities and enable data to be shared, aggregated and analysed in more detail than is currently possible, ultimately, contributing to more informed, evidence based decision making.

This paper will help water authorities understand how the standards can be applied to their organisations in a manner that provides the national consistency intended by the standards whilst addressing the particular characteristics and challenges of individual networks.

KEYWORDS

New Zealand Metadata Standards, potable water, stormwater, wastewater, pipe criticality

PRESENTER PROFILE

Berna is an Environmental Engineer and GIS specialist with international experience in Lebanon, Jamaica, and Malaysia. Following a Masters degree in Hydroinformatics and Water Management in Europe, Berna joined the environmental team at WSP OPUS. Her background is focused on water supply, flood modelling, and asset management.

1 INTRODUCTION

Managing assets efficiently is largely dependent on knowing our assets. Asset managers heavily rely on asset data every day to make informed decisions about important investments. In the field of computer science, the expression "garbage in, garbage out" is often encountered at the early stages of a computer programmer's education. It emphasizes on a very simple yet very important message: no matter how good your program is, the quality of your output will depend on the quality of your input. This concept is not limited to the computing industry. It can be applied to any field, such as infrastructure asset management.

Although large amounts of data are available across local authorities, data is not stored consistently, and key information is sometimes missing. The New Zealand Asset Metadata Standards (NZAMS) were developed by LINZ (Land Information New Zealand) and MBIE (Ministry of Business, Innovation and Employment) to help improve the quality of recorded asset data. Storing data in a consistent way across government agencies and local authorities facilities the analysis and sharing of data. This eventually leads to improved and better informed decision making.

The standards were published in 2017 and cover the three waters infrastructure (potable, waste, and storm) assets, and residential and light commercial buildings. Contents include data storage such as assets physical attributes, and asset management schema amongst which criticality.

Waimate District Council (WDC) applied the standards for determining their three waters pipe and open drain assets criticality. This assessment will form the initial basis for Council to further enhance resilience through the development of risk mitigation strategies for the operation, maintenance, and renewal of all critical assets. Available hydraulic models and GIS asset data were used for the assessment. Criticality was determined for wastewater and stormwater pipe and open drain assets for Waimate (2017 population: 3,000). Potable water pipe criticality was determined for Waimate and the six rural water supplies operated by WDC (2017 population: 6,001). The process identified shortcomings that were overcome by developing a "customized" methodology to assign pipe criticality that provided better asset insights for council.

2 NZAMS CRITICALITY

Read, H. and Havakis, G. (2017) define asset criticality in the NAMS as "the significance of the removal of any individual component or asset to the ability of any part of a network or portfolio to deliver the service it was designed to perform".

The document also defines two rating systems for the asset end users, which are used to define asset criticality:

- Residential Population Rating
- Facility Importance Rating

2.1 RESIDENTIAL POPULATION RATING

This element depends on "the number of people affected by the removal of the asset". The residential population rating system shown in Table 1 is defined for populations served by any of the three waters assets:

Table 1: NZAMS Residential Population Rating System

Code	Description	Small Population (<20,000 people)	Medium Population (<100,000 people)	Large Population (>100,000 people)
1	Very Low	0–50	0–50	0–50
2	Low	51–100	51–250	51–500
3	Medium	101–1,000	251–2,500	501–5,000
4	High	1,001–5,000	2,501–10,000	5,001–50,000
5	Very High	5,001–10,000+	10,001–50,000+	50,001–250,000+

2.2 FACILITY IMPORTANCE RATING

This element depends on "the importance of facilities based on the role they play in enabling the community to function. The facility with the highest importance that is affected by the removal of the asset determines this value".

The facility importance rating system shown in Table 2 is defined for facilities served by any of the three waters assets.

Table 2: NZAMS Facility Importance Rating System

Code	Description	Detailed Description
1	Facilities of low value to communities	• Machinery / tool storage sheds • Garages • Glasshouses • Residential properties
2	Facilities of medium value to communities	• Public toilets & changing rooms • Arts facilities / community halls / centres • Sports clubrooms
3	Facilities of high value to communities	• Primary schools, colleges or adult education facilities • Health care facilities for example with a capacity of 50 or more resident patients but not having surgery or emergency treatment facilities • Airport terminals, principal railway stations for example with a capacity greater than 250 • Correctional institutions • Emergency medical and other emergency facilities not designated as post-disaster • Power-generating facilities, water treatment and wastewater treatment facilities and other public utilities not designated as post-disaster
4	Facilities with very high value or post-disaster functions	• Facilities designated as essential facilities • Facilities with special post-disaster function • Medical emergency or surgical facilities • Emergency service facilities such as fire, police stations and emergency vehicles garages • Utilities or emergency supplies or installations required as backup facilities for post-disaster response • Designated emergency shelters, designated emergency centres and ancillary facilities
5	Special facilities	• Facilities above and beyond category 4 such as munition storage and critical data centres

2.3 GLOBAL CRITICALITY RATING

The criticality of any asset is determined by multiplying the residential population rating by the facility importance rating. Table 3 shows the global criticality rating.

Table 3: NZAMS Global Criticality Rating

Code	Description	Comment
1	Very Low	Combined Score = 1-3
2	Low	Combined Score = 4-6
3	Medium	Combined Score = 8-10
4	High	Combined Score = 12-16
5	Very High	Combined Score = 20-25

3 DETERMINING PIPES CRITCALITY

3.1 WASTEWATER PIPES

For wastewater assets, the hydraulic model was used for the pipe criticality analysis. The Waimate wastewater model was built in 2009, with an approximate population of 3,000.

The wastewater pipes were assessed based on population and key facilities following the NZAMS. Unlike water networks, wastewater networks are branched and therefore a pipe failure in the downstream end of the network would be more critical than a pipe failure in the upstream branches. The NZAMS methodology produced good results and identified pipes across four criticality ratings. Figure 1 shows the pipe length distribution across the different criticality categories. Figure 2 shows an overview plan of the criticality rating.

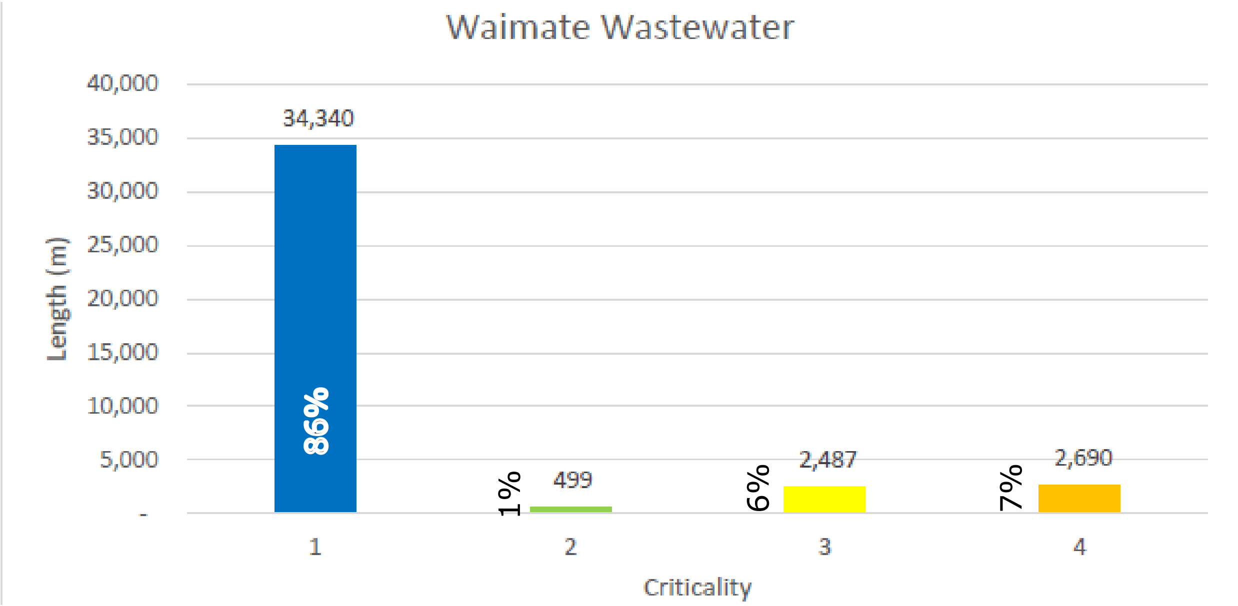

Figure 1: Waimate Wastewater Pipes NZAMS Criticality and Lengths Distribution

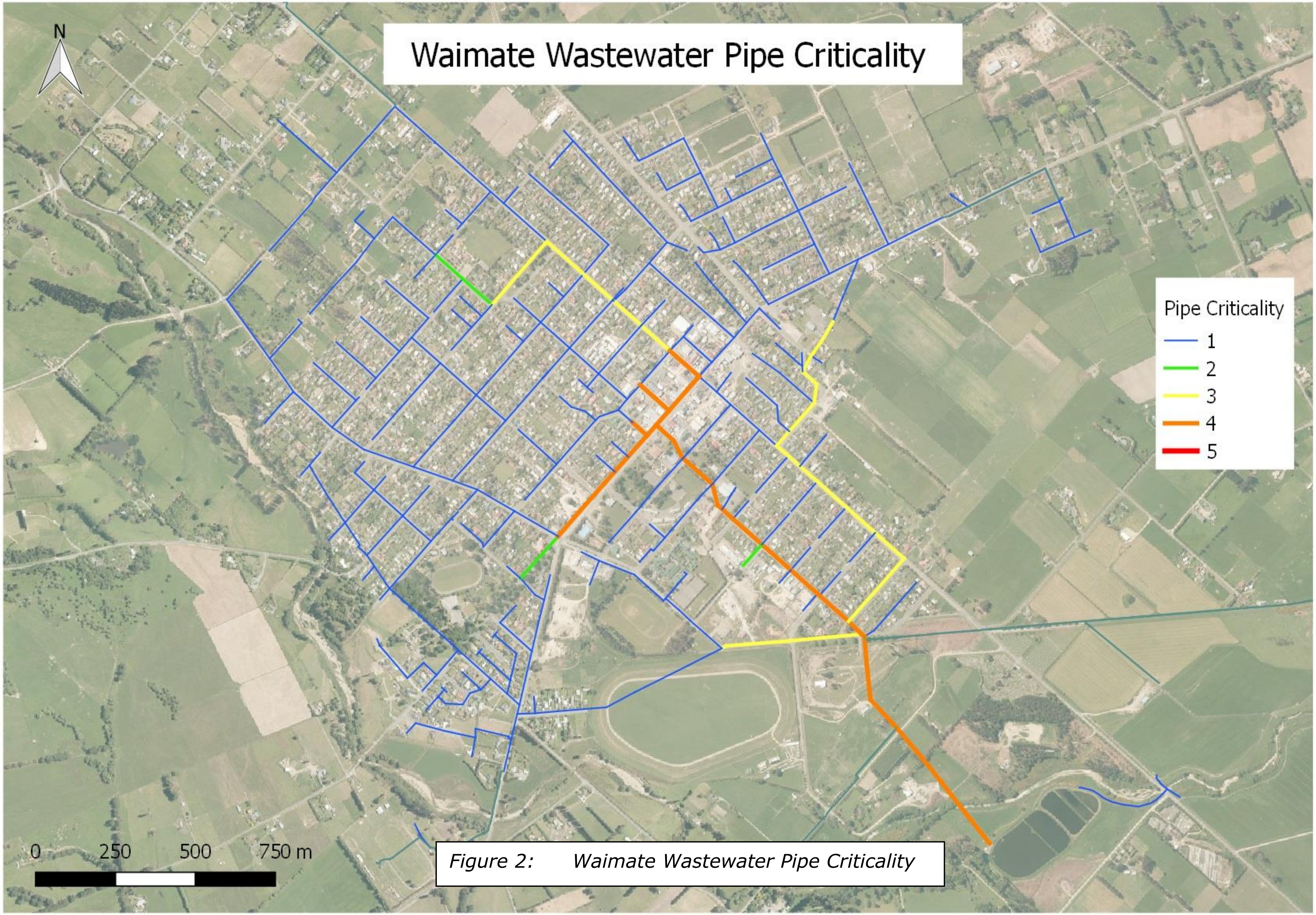

Figure 2: Waimate Wastewater Pipe Criticality

3.2 STORMWATER PIPES AND OPEN DRAINS

For stormwater pipes, the Waimate hydraulic model was used for the pipe criticality analysis. As the model didn't have any associated population data, the wastewater model subcatchment and population data were used to estimate the population served by each stormwater pipes.

Stormwater data in WDC's GIS was found to include more assets than the stormwater hydraulic model. These were assessed seperately.

For stormwater open drains and pipes data which was obtained from WDC's GIS, the approximate population was determined by delineating the general catchments. The population in each catchment was approximated from the wastewater model catchments.

For stormwater assets that fell outside of the model area, an approximate residential population rating was assigned by estimating the population served by each cluster of assets. Due to the uncertainty around the population assigned to each stormwater asset, the maximum catchment population was assigned to each asset in a particular catchment.

The stormwater assets were assessed based on population and key facilities following the NZAMS. Similarly to wastewater networks, stormwater networks are branched and therefore a pipe failure in the downstream end of the network would be more critical than a pipe failure in the upstream branches. The NZAMS methodology produced good results and identified pipes across 4 criticality ratings

Figure 3 shows the model pipe length distribution across the different criticality categories.

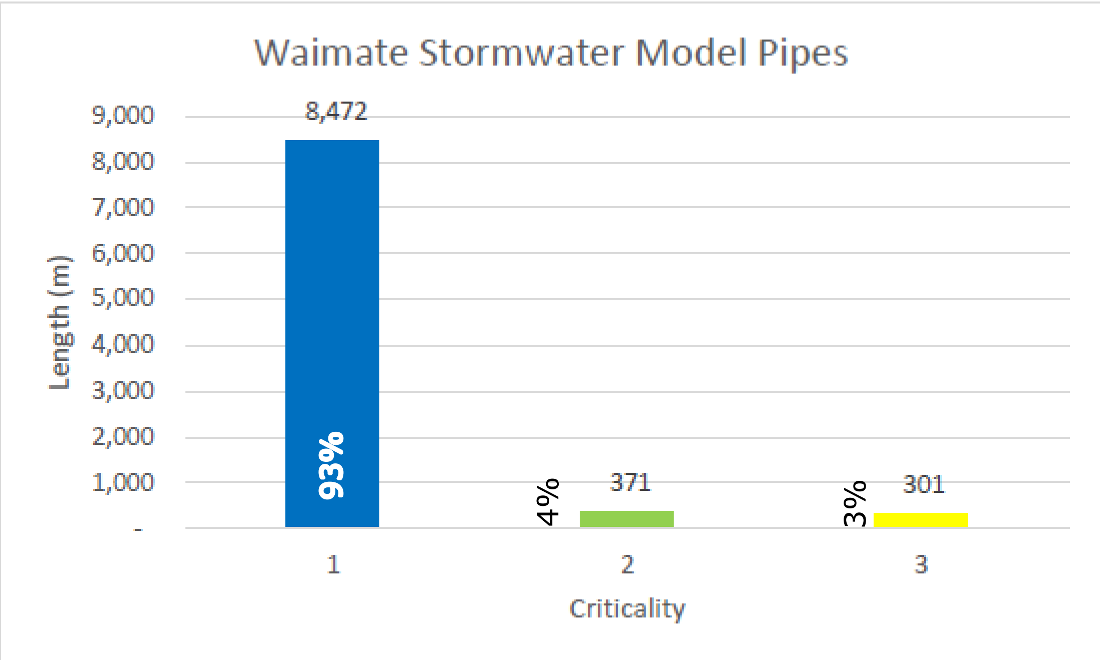

Figure 3: Waimate Stormwater Model Pipes Criticality and Lengths Distribution

Figure 4 and Figure 5 show the pipe length distribution across the different criticality categories respectively for the GIS stormwater open drains and GIS stormwater pipes.

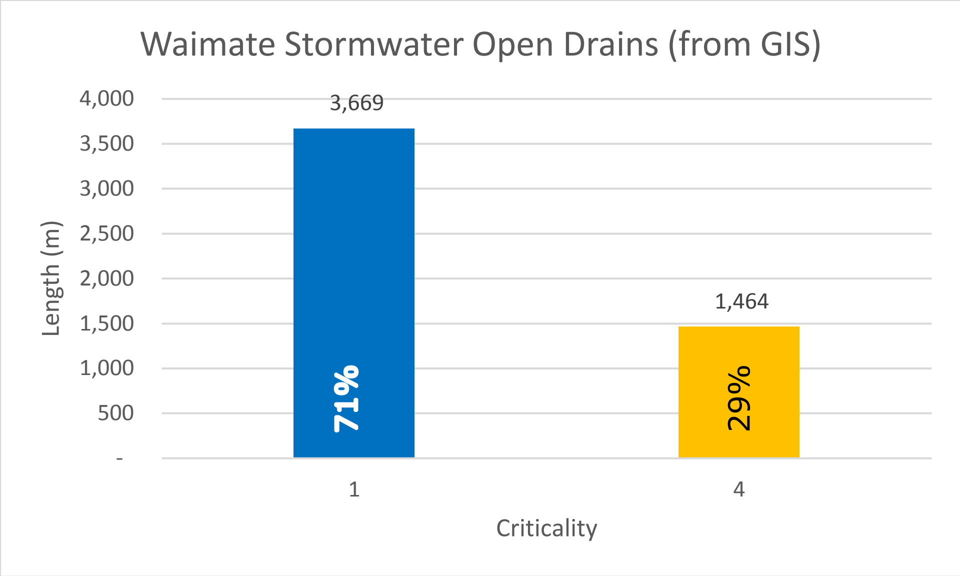

Figure 4: Waimate Stormwater Open Drains Criticality and Lengths Distribution

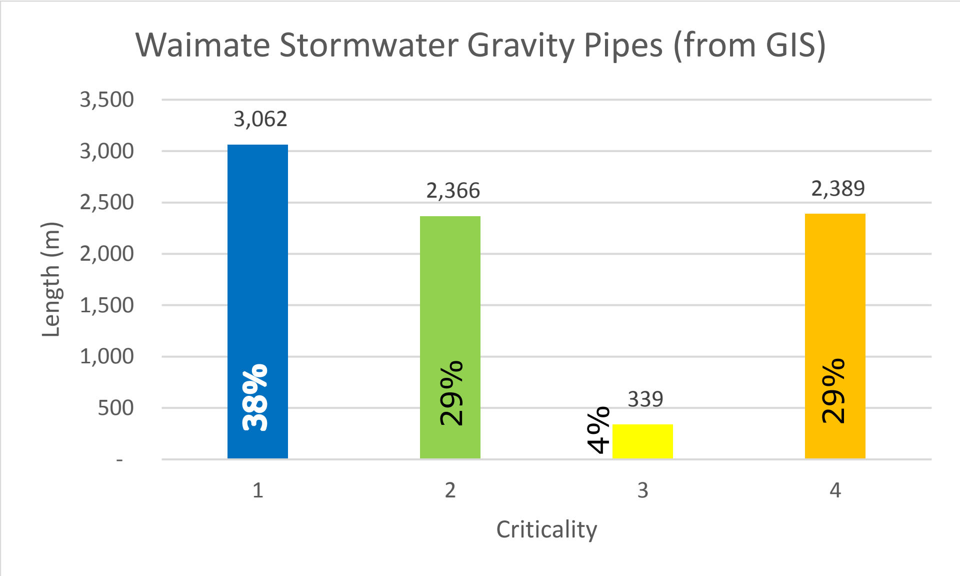

Figure 5: Waimate Stormwater GIS Gravity Pipes Criticality and Lengths Distribution

Figure 6 shows an overview plan of the criticality results for the stormwater pipe and open drain assets in the hydraulic model.

Figure 7 shows an overview plan of the criticality results for the GIS stormwater open drains and GIS stormwater pipes.

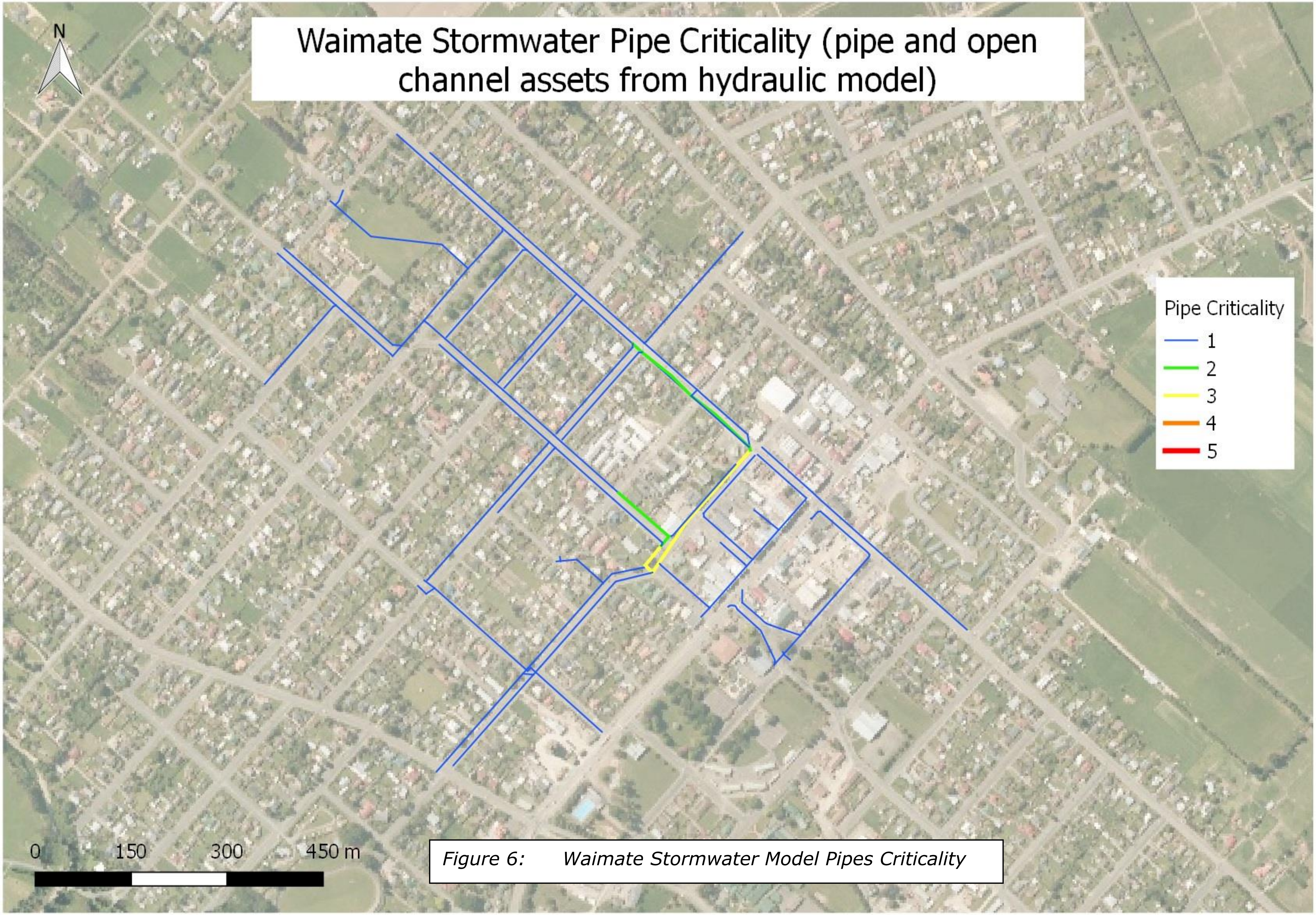

Figure 6: Waimate Stormwater Model Pipes Criticality

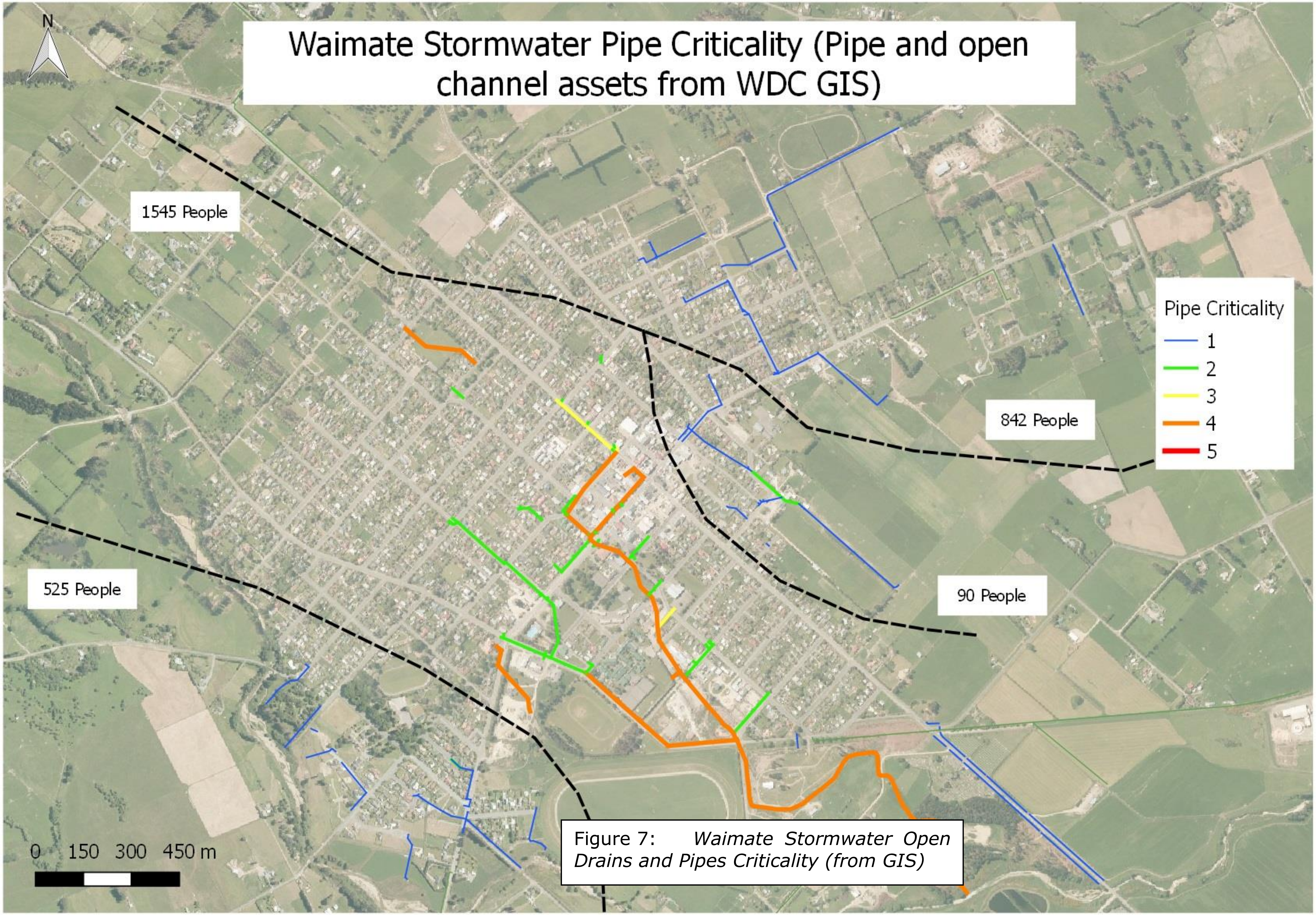

Figure 7: *Waimate Stormwater Open Drains and Pipes Criticality (from GIS)*

3.3 POTABLE WATER PIPES – NZAMS SHORTCOMINGS

The hydraulic models were used for the pipe criticality analysis. The latest population figures were adopted and applied against the number of connections in the hydraulic models.

Because of the looped nature of the Waimate urban network system and its multiple supply points, it was estimated that most pipes in Waimate would have a residential population rating of 1. Table 4 shows the pipe percentage against the number of people affected by a loss of asset.

Table 4: Population Affected and Pipe Lengths Percentage

Population Affected	Pipes %
<35 (Criticality 1)	97%
35-50 (Criticality 1)	1%
51-100 (Criticality 2)	1%
>100 (Criticality 3)	0%

Based on the NZAMS, the criticality rating for Waimate pipes would therefore be predominantly determined by the facility importance rating. To avoid this, an additional criticality rating component was considered for the Waimate water supply pipe assets. Pipes were given a diameter based criticality rating. The greater criticality rating between the NZAMS residential population rating and the diameter rating was adopted. This rating was then combined with the facility importance rating to determine the global criticality.

Table 5 shows the distribution of pipe lengths and percentages across the five criticality categories for the urban network using the proposed diameter criticality rating system.

Table 5: Water Supply Urban Network Diameter Criticality and Pipe Lengths

Criticality; Nominal Diameter	Pipe Length (m)	Pipe %
1; <63	4,755	8%
2; 63-80	4,314	7%
3; 100	28,391	48%
4; 150-200	16,037	27%
5; >200	5,676	10%
Total	59,174	100%

A different diameter rating was adopted for the rural supplies. Table 6 shows the distribution of pipe lengths and percentages across the five criticality categories for the rural networks using the proposed diameter criticality rating system.

Table 6: Water Supply Rural Networks Diameter Criticality and Pipe Lengths

Criticality; Nominal Diameter	Pipe Length (m)	Pipe %
1; 15	71,831	9%
2; 20	162,612	20%
3; 25-50	449,579	54%
4; 60-110	103,436	12%
5; >=150	42,272	5%
Total	829,730	100%

The following methodology was adopted for water supply pipe criticality rating:

1- Population / diameter criticality:

a. Adopt the NZAMS residential population rating

b. Apply the diameter criticality rating

c. Choose the greater criticality between the residential population and the diameter criticalities

2- Facility importance rating:

a. Adopt the NZAMS facility importance rating

3- Combined criticality:

a. This is the product of the outcomes from residential population / diameter criticality and facility importance rating.

b. Adopt the NZAMS global criticality rating

4- Apply engineering judgment: verify the outcome. If necessary, adjust the criticality of pipes that were not captured appropriately by 1-3 process

Engineering judgement was applied to adjust some pipes criticality. These mainly include major supply pipes from the reservoirs/ sources/ pump stations to the reticulation, and a few other pipes where the criticality has increased.

This methodology provided results that classified pipe criticality across the five ratings.

Figure 8 shows the pipe length distribution across the different criticality categories for the Waimate water supply.

Figure 9 shows an overview plan of the final criticality assessment results for the Waimate water supply.

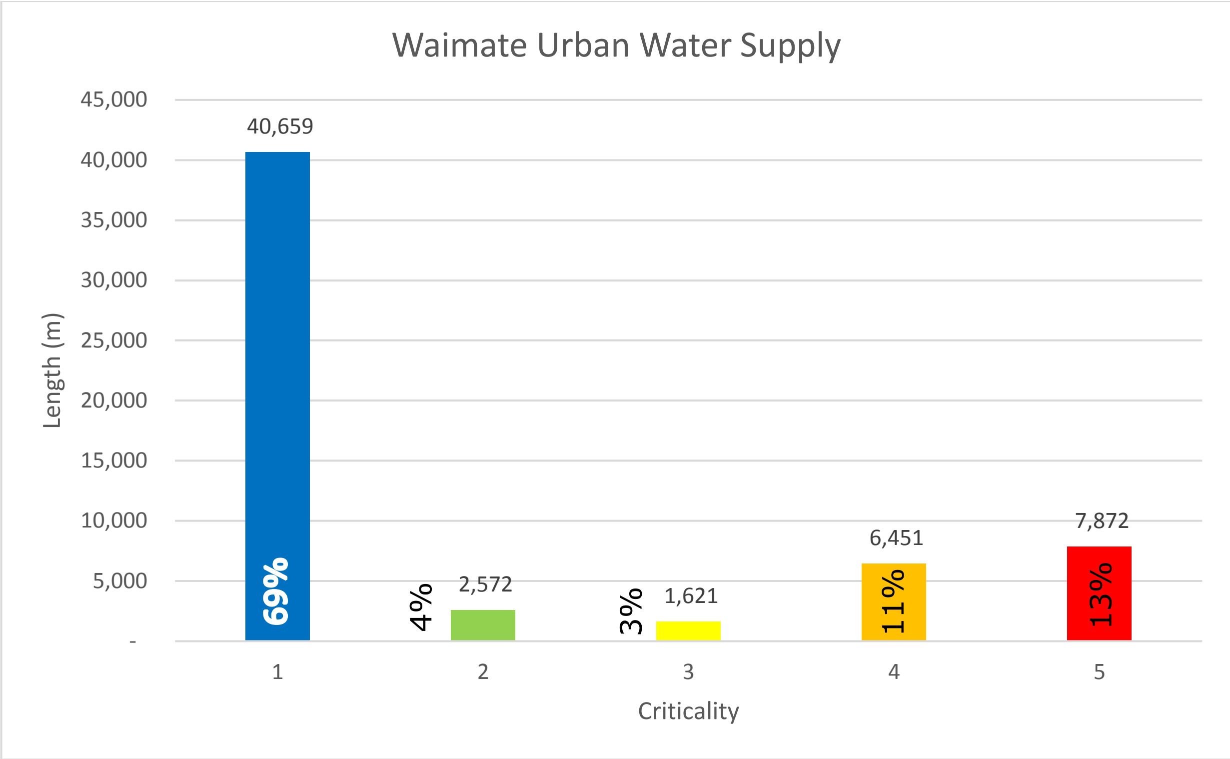

Figure 8: Waimate Urban Water Supply Pipes Criticality and Lengths Distribution

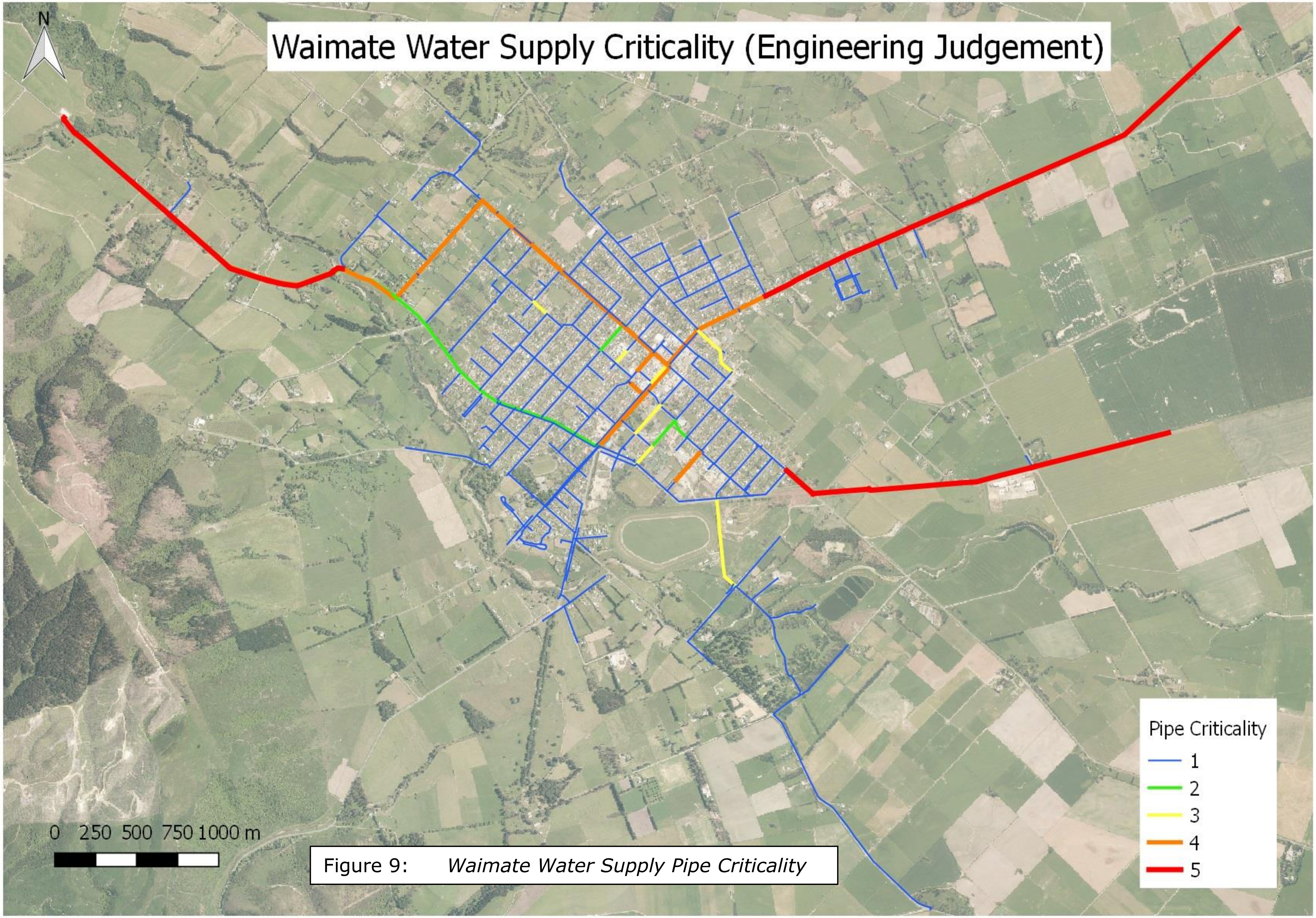

Figure 9: *Waimate Water Supply Pipe Criticality*

4 CONCLUSIONS

The NZAMS was used to determine the criticality for Waimate's three waters pipes and open drains assets. The outcome of this study can be used with the support from a condition management program for critical infrastructure to help Council improve their renewals planning. It will also help plan around supplying critical customers and key facilities following a critical asset failure. In other words, this assessment forms the initial basis for Council to further enhance resilience through the development of risk mitigation strategies for the operation, maintenance, and renewal of all critical assets.

Shortcomings were identified for the potable water pipes following the NZAMS methodology. This was due to the looped nature of the water supply network, which resulted in 97% of the potable water pipes having a residential criticality rating of 1 (lowest criticality). This showed that the NZAMS rating system for water supply pipes was not showing critical pipes for the water networks. In order to better differentiate pipe criticalities, an additional diameter based component was included in the rating system for water supply pipes. Engineering judgement has also been applied to adjust the pipe criticality for some water supplies pipes.

The NZAMS was adopted for the wastewater pipe assets and for the stormwater open drains and pipes assets, without any modifications. This resulted in a sensible spread of pipe criticality for the wastewater and stormwater networks.

This case study shows that the NZAMS could be applied to three waters infrastructure assets, and potential shortcomings with the standards could be overcome whilst retaining the overall intent of the standards.

Different approaches could be adopted for different supplies in determining pipe criticality. Feedback from organisations applying the sandards could be captured to refine the national standards and provide consistency in their application.

This study is limited to the pipe criticality schema of the standards, however the other components of the standards could be subject to refinement if other shortcomings are observed during the application of the standards.

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Read, H. and Havakis, G. (2017) 'New Zealand Asset Metadata Standards – Potable Water' Volume 2 Asset Management and Performance, 1.0, New Zealand Treasury – National Infrastructure Unit, 11, 30, 31, 74, 76.