Modelling Group
WATER NEW ZEALAND

Modelling Symposium

Smart use of model outputs (digitization, GIS)

Presented by
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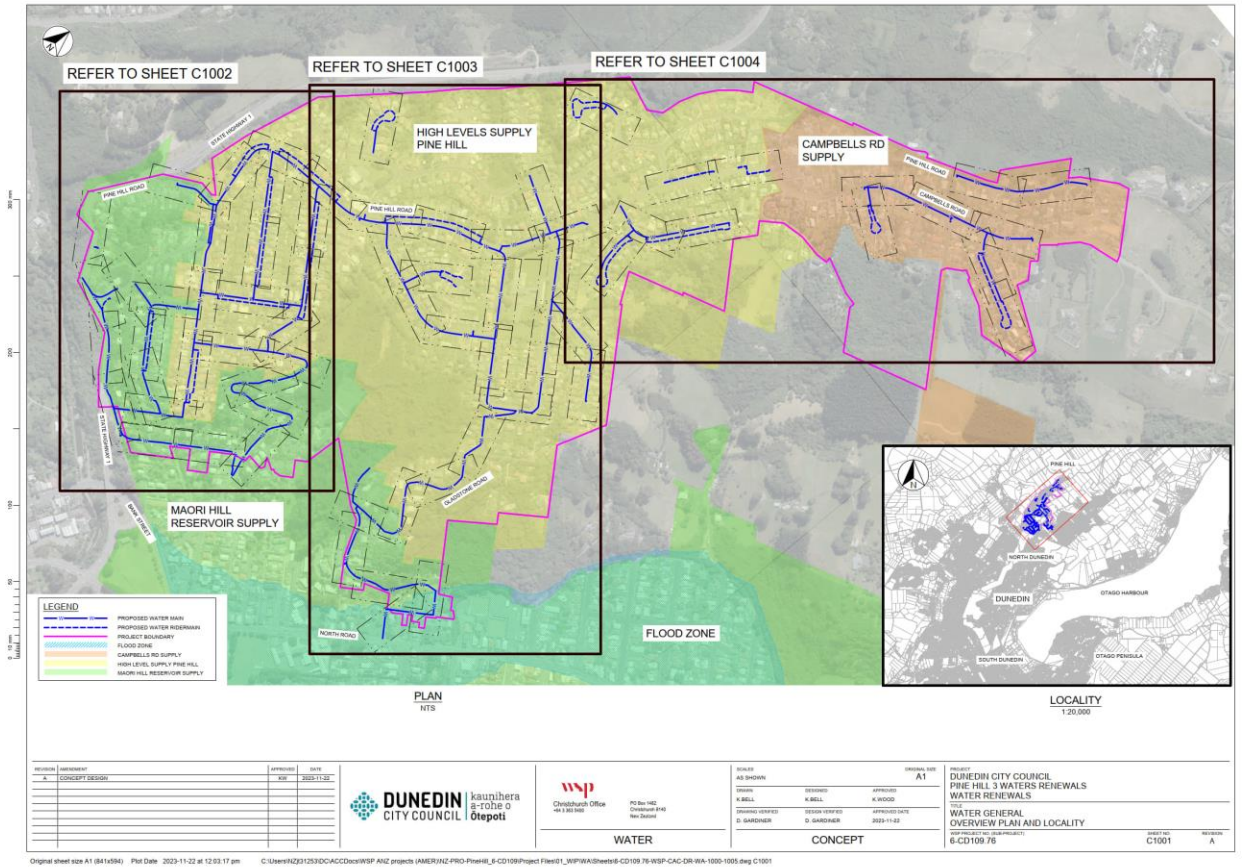
water NEW ZEALAND
The New Zealand Water & Wastes Association Waiora Aotearoa

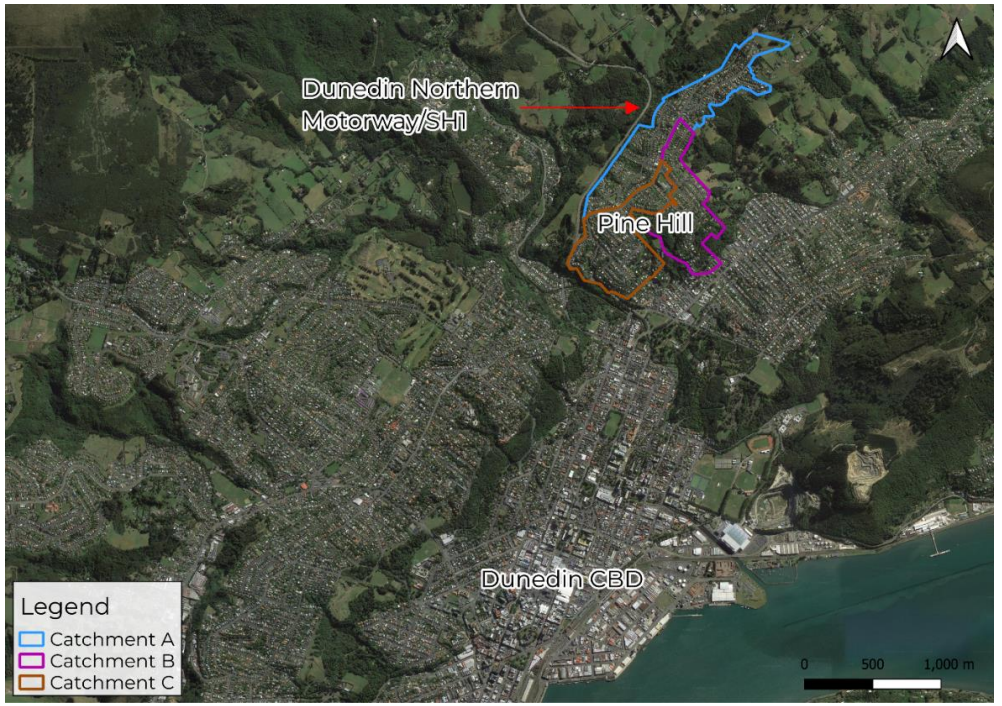
Objective

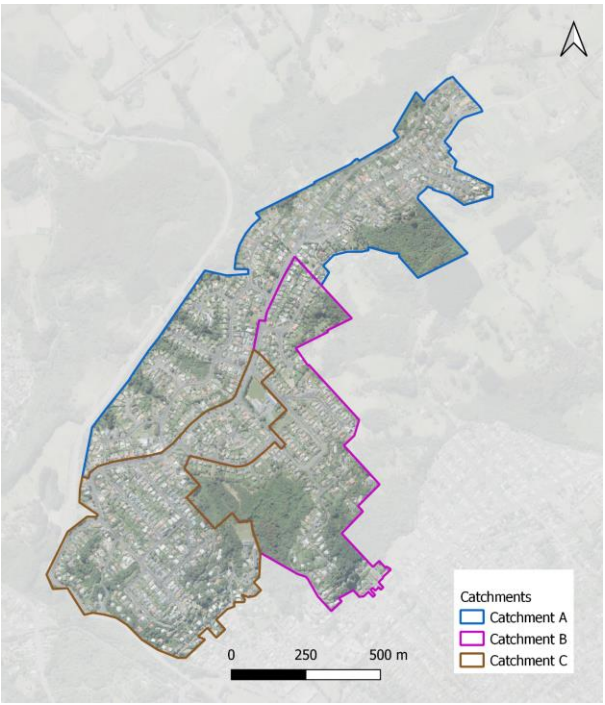
- To produce a concept design for 3 waters network renewals considering a range of inputs to maintain levels of service and achieve strategic outcomes for DCC.
- Work closely and collaboratively with DCC and ECI McConnell Dowell (ECI) & Citycare (O&M), sharing and adopting lessons from the wider team including other panel consultants.
- Enabled collaboration across WSP's national team.



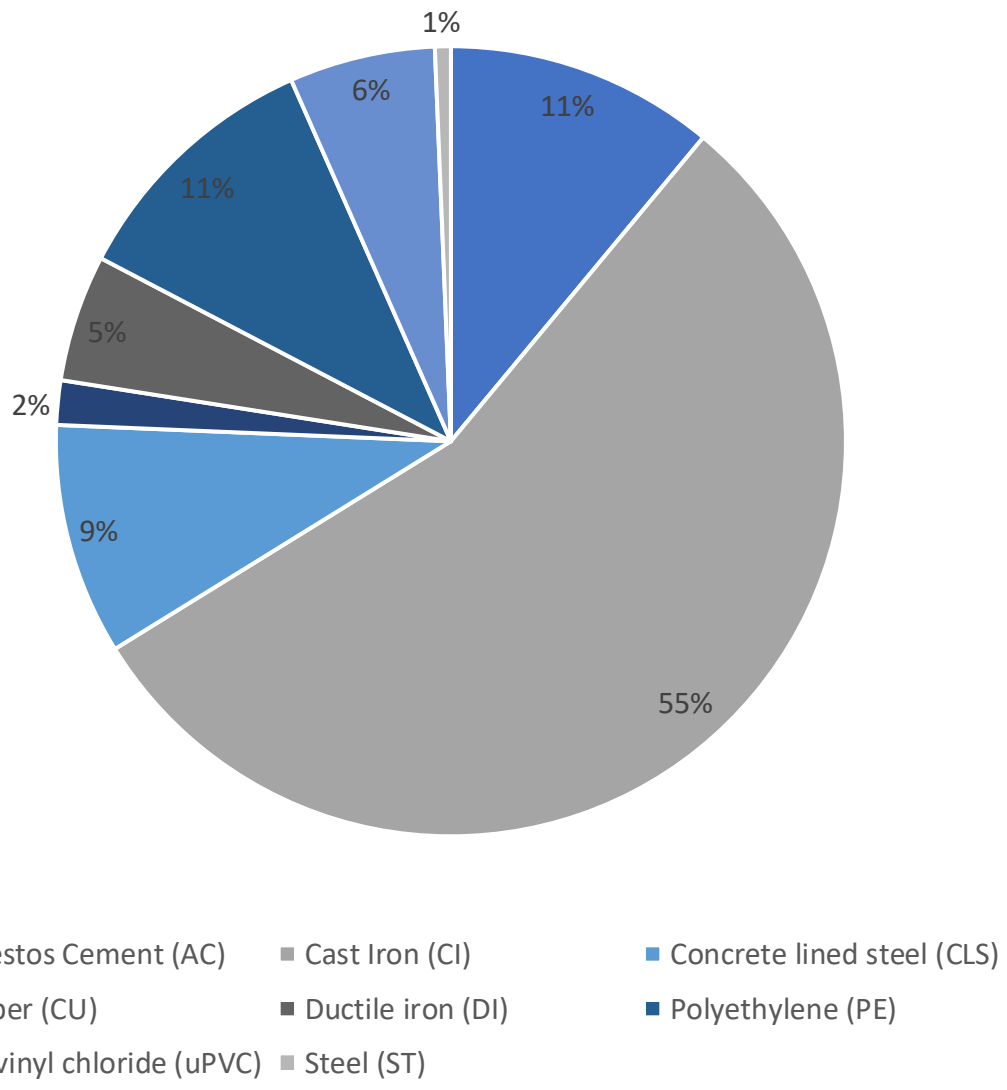
Pinehill, Dunedin

- Three waters renewals (WS, WW and SW)
- Approximately 47km of wastewater, stormwater, and water supply pipelines
- 1,140 predominately residential properties





Water supply pipe material



Cast iron (55%), asbestos cement (11%), PE (11%)

Pipes installation range: 1929 to 2022

Approximately 36% of the piped network aged >80 year

Renewal of 3 Water pipelines based on:

Age
>80 years but also based on pipe material expected life (AC pipe consider >60 years)

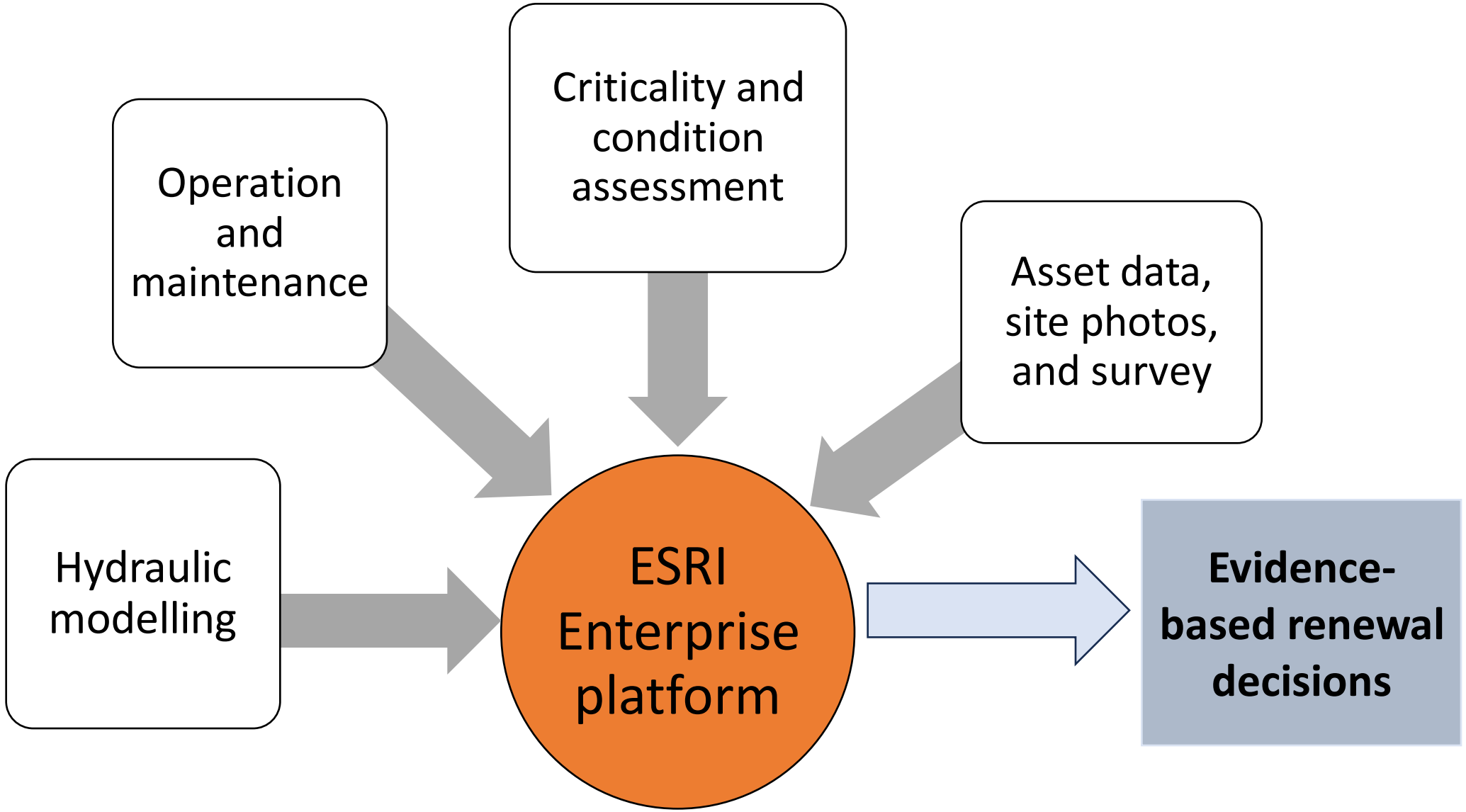
Condition/material
Assets in poor condition
Remove Asbestos Cement in private land

Capacity (Current & 50 Year)
Upgrades to prevent surcharges (WW) Fire supply and residential water supply (WS)

GIS, PiPyR and limited input from CCTV footage

GIS and modelling

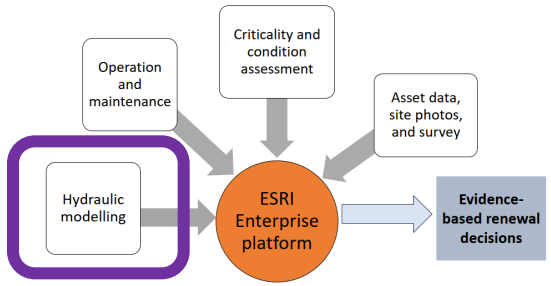
Renewal of assets
Relocate assets out of private property
Replacement of assets using trenched methods where possible
Early ECI (McConnell Dowell (ECI) & Citycare (O&M) engagement for constructability


Operation and maintenance
Criticality and condition assessment
Asset data, site photos, and survey
Hydraulic modelling
ESRI Enterprise platform
Evidence-based renewal decisions

Hydraulic Modelling -

Hydraulic performance grade

- System performance assessment for Planning horizons: 2018 and 2073 (50-year)
- Define the performance criteria
- Simplistic 1 to 5 scores
- Sensitivity testing
- Linking the modelling outputs to GIS



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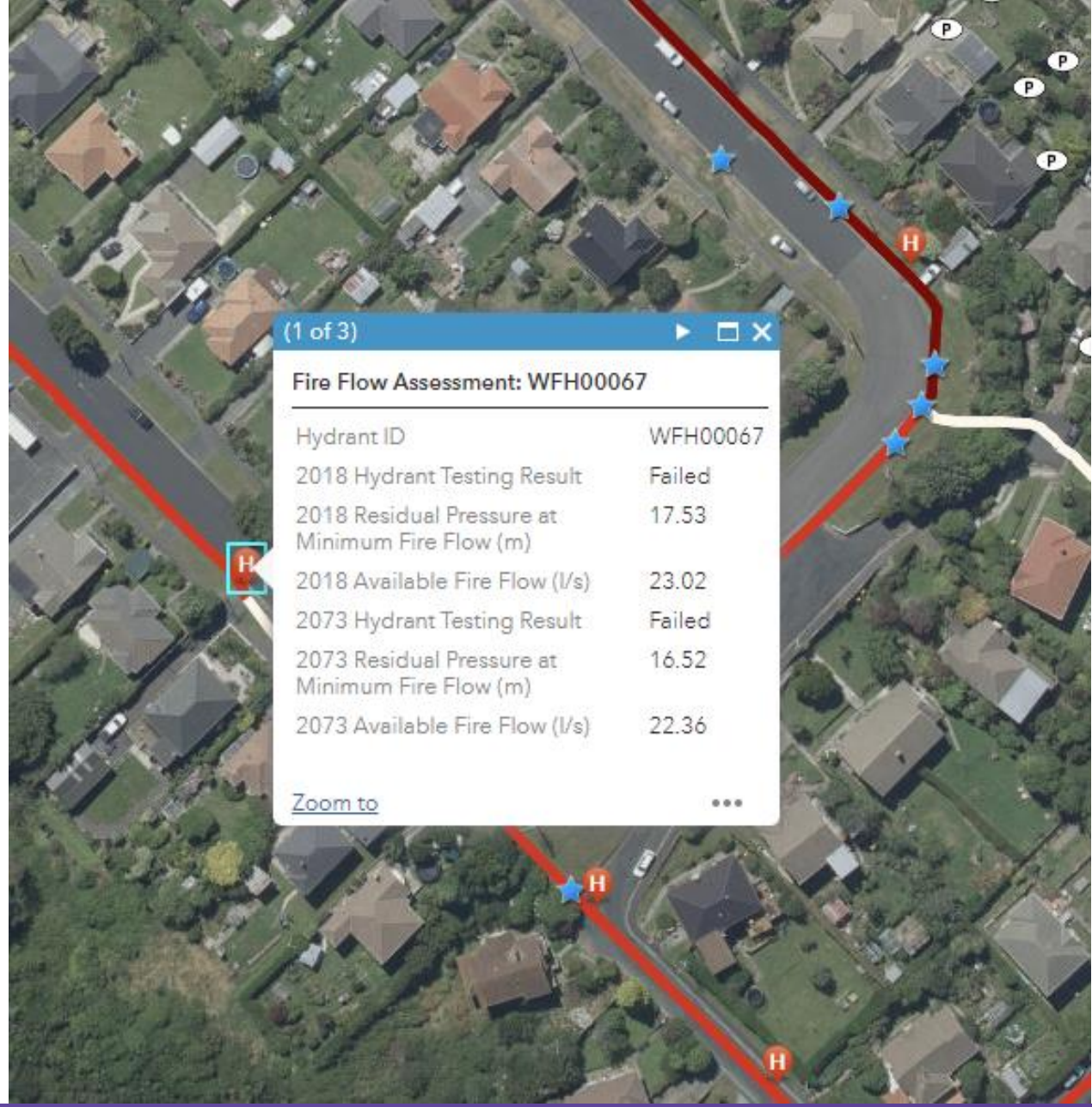
From Node ID	To Node ID	Diameter (mm)	Length (m)	Max Headloss per Unit Distance (m/km)	Max Headloss (m)	Maximum High Pressure (m)	Maximum Pressure Criticality	Minimum Low Pressure (m)	Max Flow (l/s)	Min Flow (l/s)	Max Velocity (m/s)	Min Velocity (m/s)
WSConnector93880	WSMeter0007X	256.0	0.66	90.66	0.06	78.76	0.00	71.98	300.97	68.92	5.85	1.34
WSMeter0007Y	WSConnector93879	256.0	0.31	90.66	0.03	76.15	0.00	67.33	300.97	68.92	5.85	1.34
WSConnector5016	WSConnector4849	96.5	1.50	26.74	0.04	84.03	0.00	69.88	10.43	9.32	1.43	1.27
WSConnector4795	WSConnector4796	96.5	1.07	26.74	0.03	66.02	0.00	56.30	10.43	9.32	1.43	1.27
WSConnector94480	WSConnector94479	260.4	6.35	15.46	0.10	3.14	0.00	0.54	86.10	67.47	1.62	1.27
WSConnector10890	WSConnector10890	169.9	17.33	133.33	2.31	2.93	0.00	0.29	125.54	-106.26	5.54	1.26
WSConnector4849	WsValve3567FR	96.5	5.75	22.59	0.13	84.03	0.00	69.43	9.57	9.17	1.31	1.25
WsValve3567TO	WSConnector4893	96.5	86.45	22.07	1.91	83.51	0.00	63.64	9.45	9.15	1.29	1.25
WSConnector4893	WsHydrant1366	96.5	36.84	21.17	0.78	77.83	0.00	61.63	9.25	9.11	1.27	1.24
WsHydrant1366	WSConnector4898	96.5	55.86	20.68	1.16	75.84	0.00	58.75	9.14	9.08	1.25	1.24
WSConnector70866	WsValve30654FR	200.0	12.68	11.30	0.14	82.94	0.00	62.16	47.36	38.86	1.51	1.24
WSConnector10541	WSEndCap32065	20.0	31.14	2854.25	88.88	78.29	0.00	-10.00	2.02	0.39	6.42	1.23
WSConnector11137	WsValve44055TO	315.8	0.41	7.44	0.00	81.78	0.00	70.35	141.21	95.46	1.80	1.22
WSConnector65428	WSConnector65426	315.8	13.02	7.44	0.10	81.72	0.00	70.06	141.21	95.46	1.80	1.22
WSConnector70868	WSConnector70867	202.2	2.62	8.72	0.02	82.78	0.00	62.09	47.36	38.86	1.47	1.21
WsVal												1.20
WsVal												1.20
WsPur												1.20
WSCor												1.19
WsWel												1.17
WsVal												1.17
WSCor												1.17
WSCor												1.17
WSConnector94472	WSConnector94471	200.0	2.53	7.13	0.02	3.40	0.00	0.87	37.36	36.63	1.19	1.17
WSConnector94471	WsValve37176FR	200.0	2.32	7.13	0.02	.35	0.00	0.78	37.36	36.63	1.19	1.17
WsValve37176TO	WSConnector94470	200.0	2.32	7.13	0.02	.25	0.00	0.77	37.36	36.63	1.19	1.17
WsHydrant1367	WSConnector5024	96.5	24.19	19.61	0.47	.32	0.00	52.71	8.90	8.45	1.22	1.16

Asset ID	Max Headloss	Max Velocity	High Pressure	Low Pressure	Pressure Variance
286148	2	1	5	1	2

Hydraulic Assessment	Weightings (%)
Maximum Headloss	30
Maximum Velocity	30
High Pressure	10
Low Pressure	20
Pressure Variance	10
Total	100

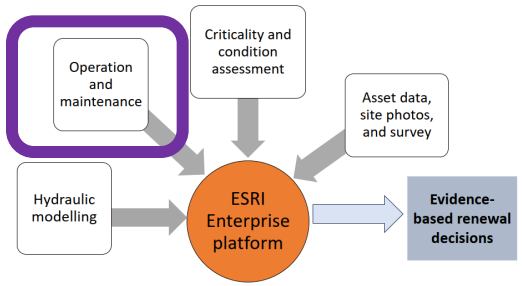
Fire flow assessment

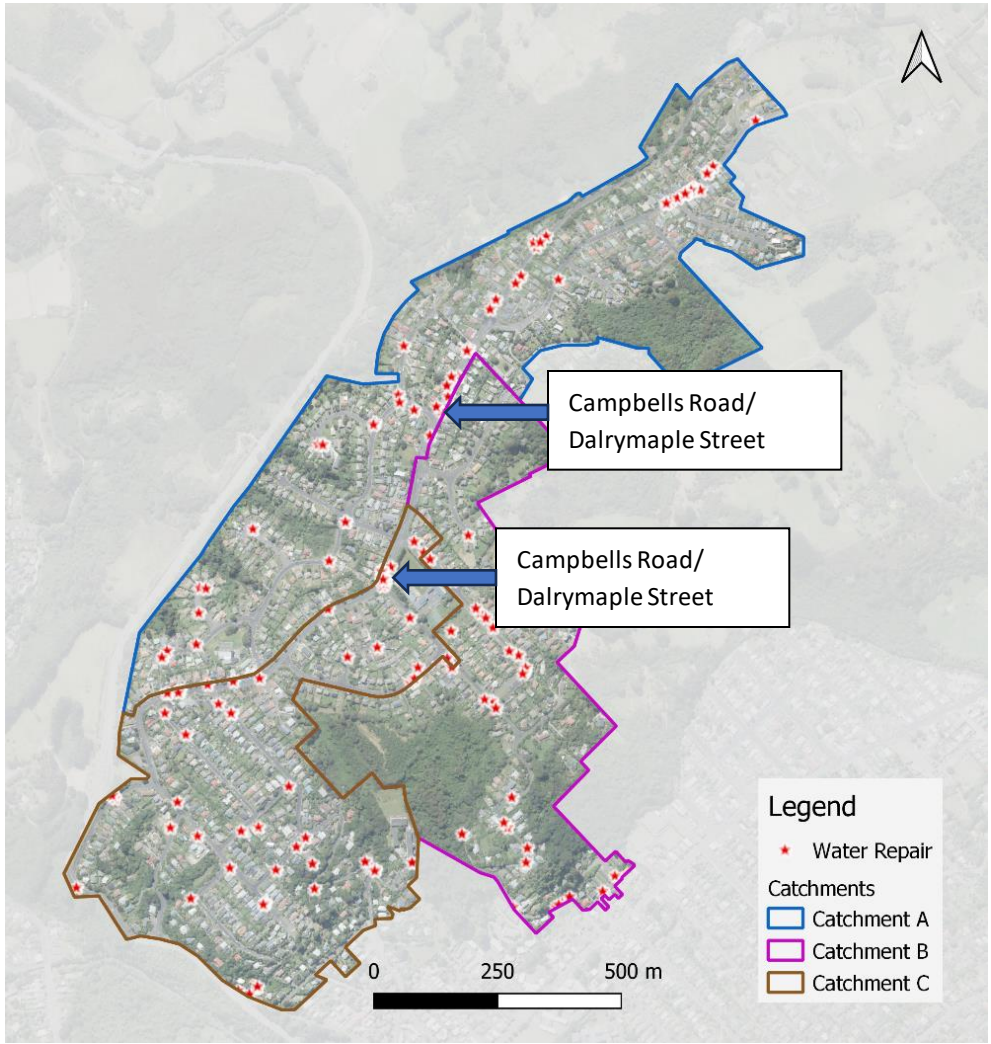
- Council adopted FW2 network wide classification (CoP)
- To apply score the available fire flow, we applied:
  - Pass = 1
  - Fail = 5
- Marginal difference between growth scenarios
- Hydrant available fire flow GIS layer = Support FENZ



Operation and maintenance -
Operational performance grade

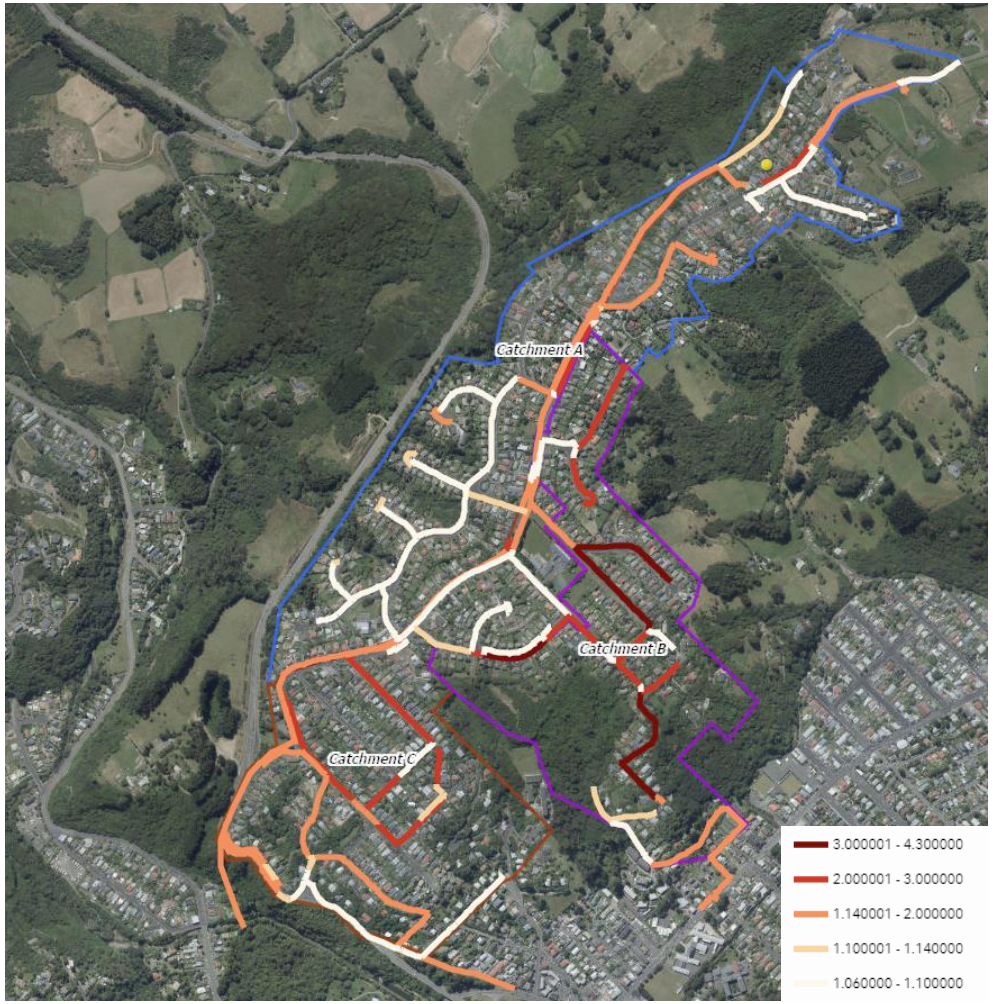
- Repairs identified and overlaid with work orders (2019-23)
- No. of breaks (burst frequency) = operational performance grade (1, 3, 5)
- Cross referenced against condition grade





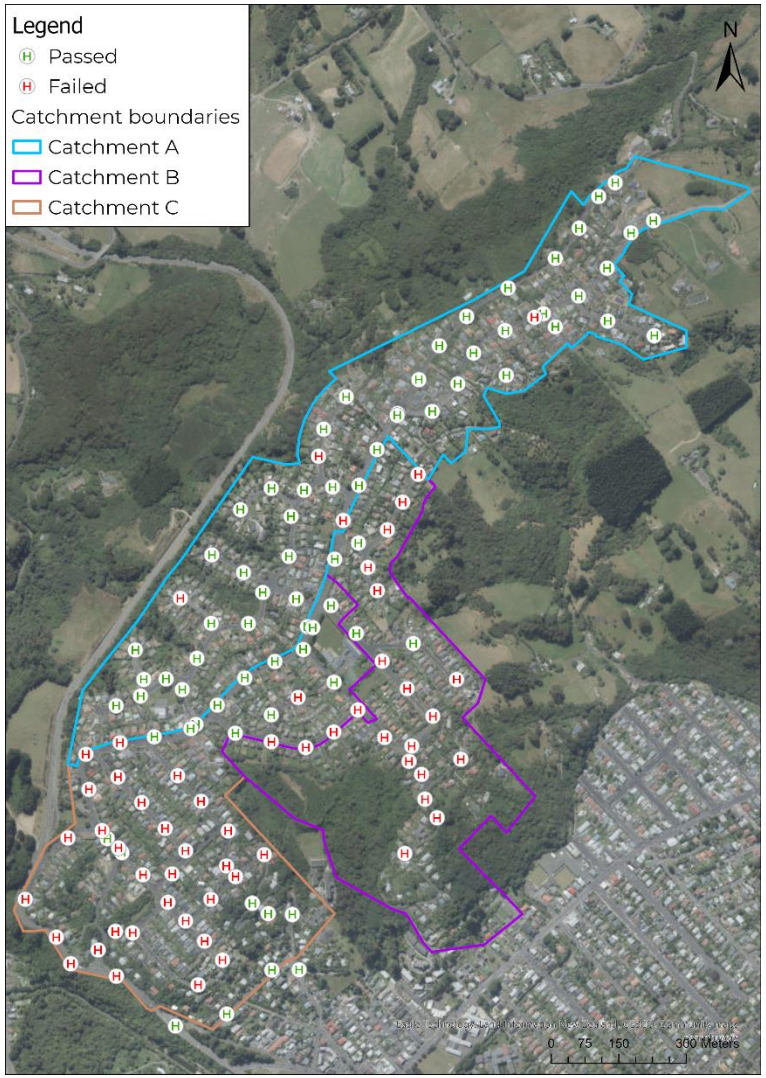
Prioritisation

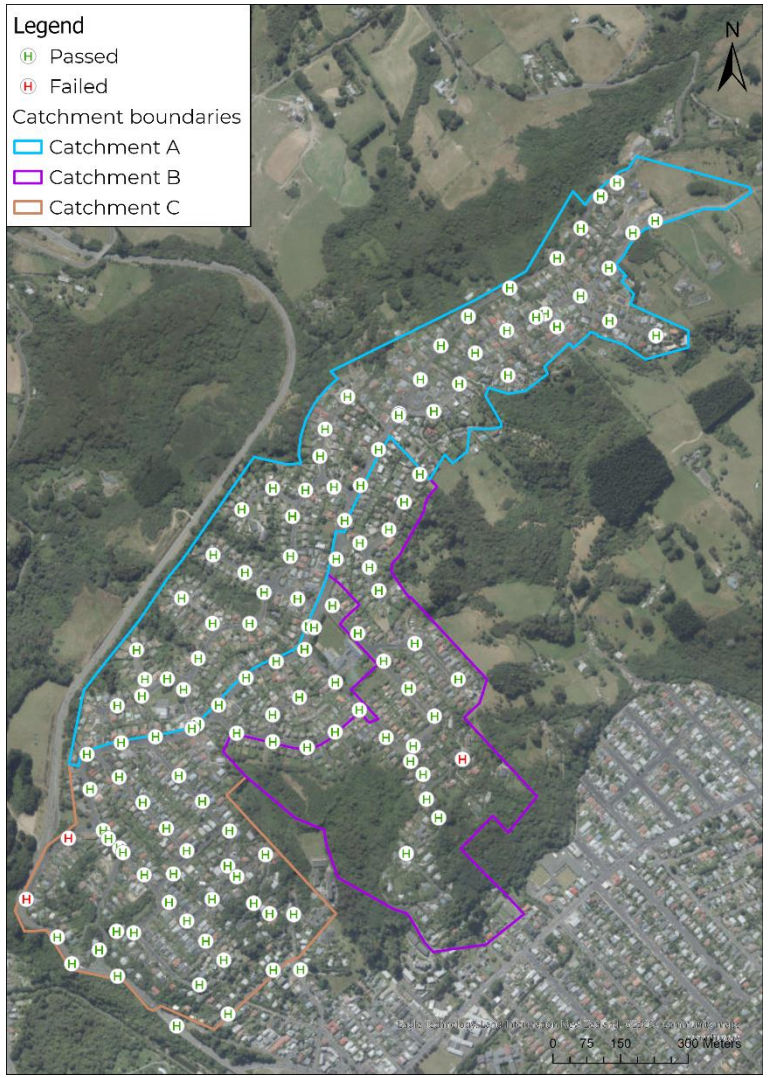
- Hydraulic performance grade (1-5)
- Fire flow grade (Pass / Fail)
- Operational performance grade – assets reaching the end of their asset life, pipes > 6 breaks
- Workshop with Council – to agree weighting
  - Hydraulic – 20%
  - Fire flow – 40%
  - Operational – 40%



Renewals approach

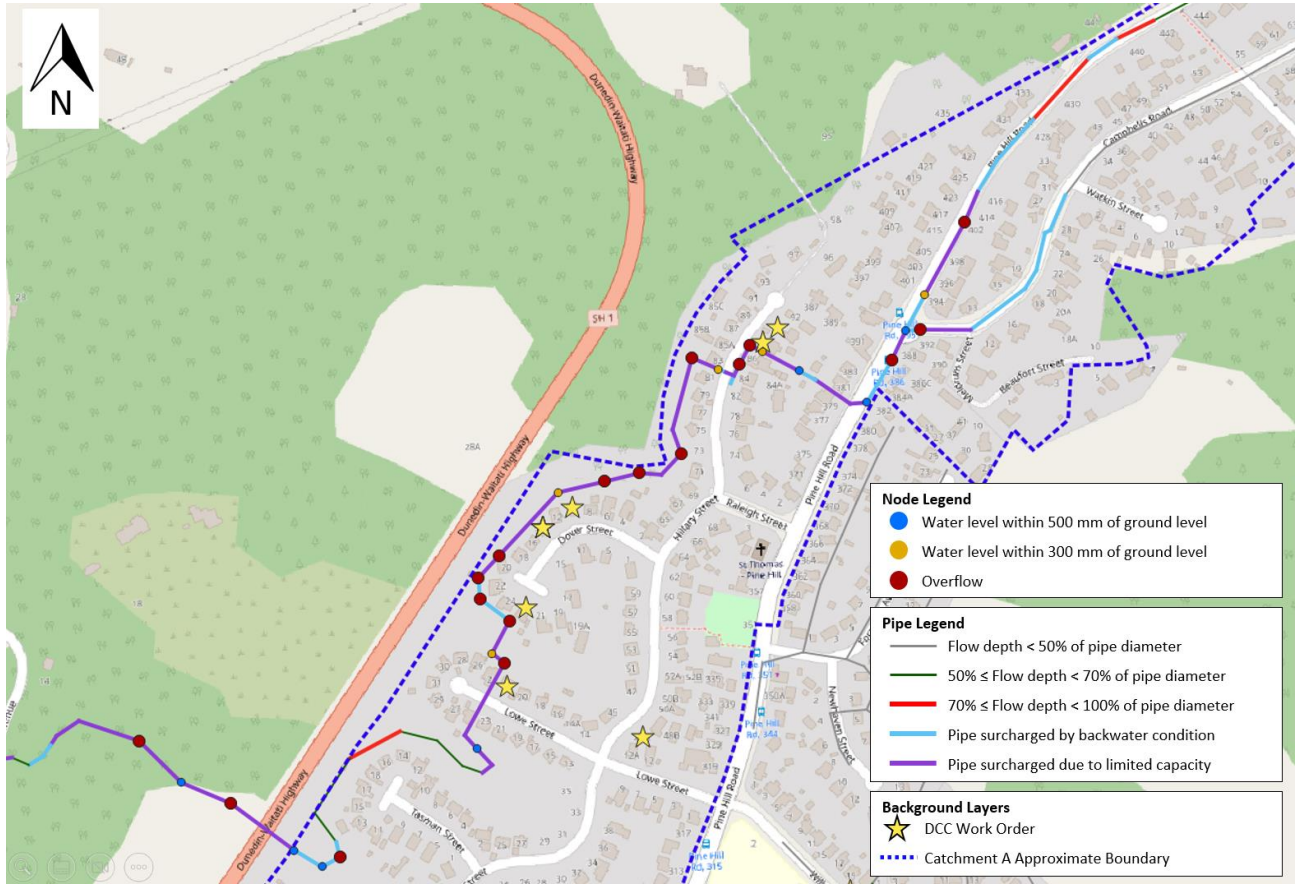
- Growth minimal impact
- Hydraulic performance grade (1-5)- Generally good (peak residential demand)
- Firefighting grade (Pass- Fail 25L/s)- Several failed hydrants mainly Catchment B and C.
- Aging infrastructure/high burst frequency
- Design upgrades modelled





Wastewater modelling

- InfoWorks ICM model used to assess capacity of the existing network
- DCC Work Orders (sewer overflows, blockages) were georeferenced and used to validate model outputs
- Network capacity considered in evaluating renewal options, identifying where pipes require upsize or where rehabilitation methodologies that may decrease capacity (ex. Liners) should be avoided
- Model used to develop renewal alignments.



Criticality and condition assessment

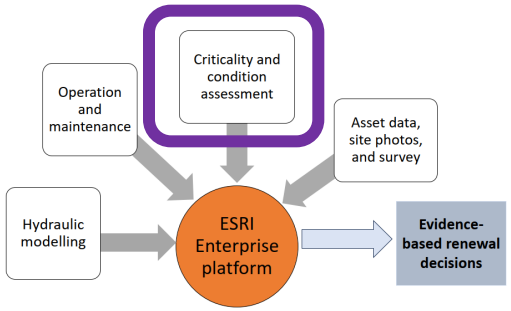
GIS based Pipeline Priority and Renewals (PiPyR) tool uses multi-criteria analysis (MCA)

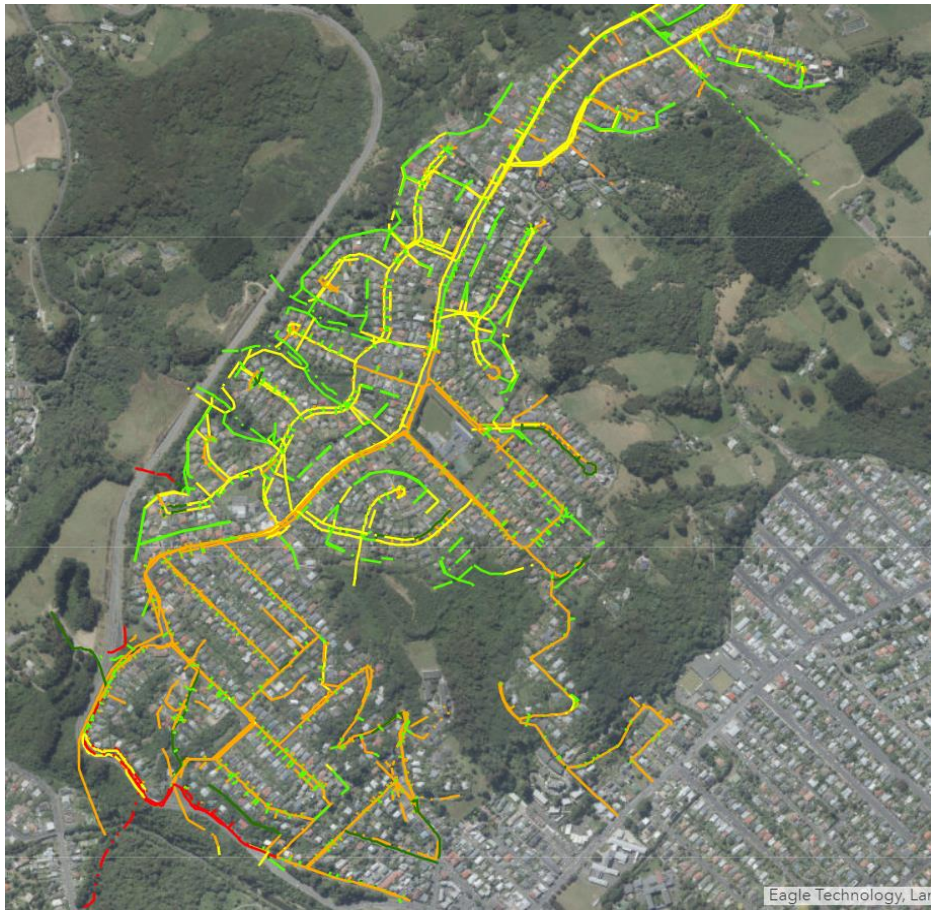
Condition grade : aged-based condition assessment using pipe behaviour data for the age of materials

Criticality grade: Pipe diameter, pipe type, high-level renewal costs and location, (i.e., proximity to CBD, waterways, and other key infrastructure)

Priority = Condition X Criticality

Priority 1 and 2 assets – considered for renewal for the project

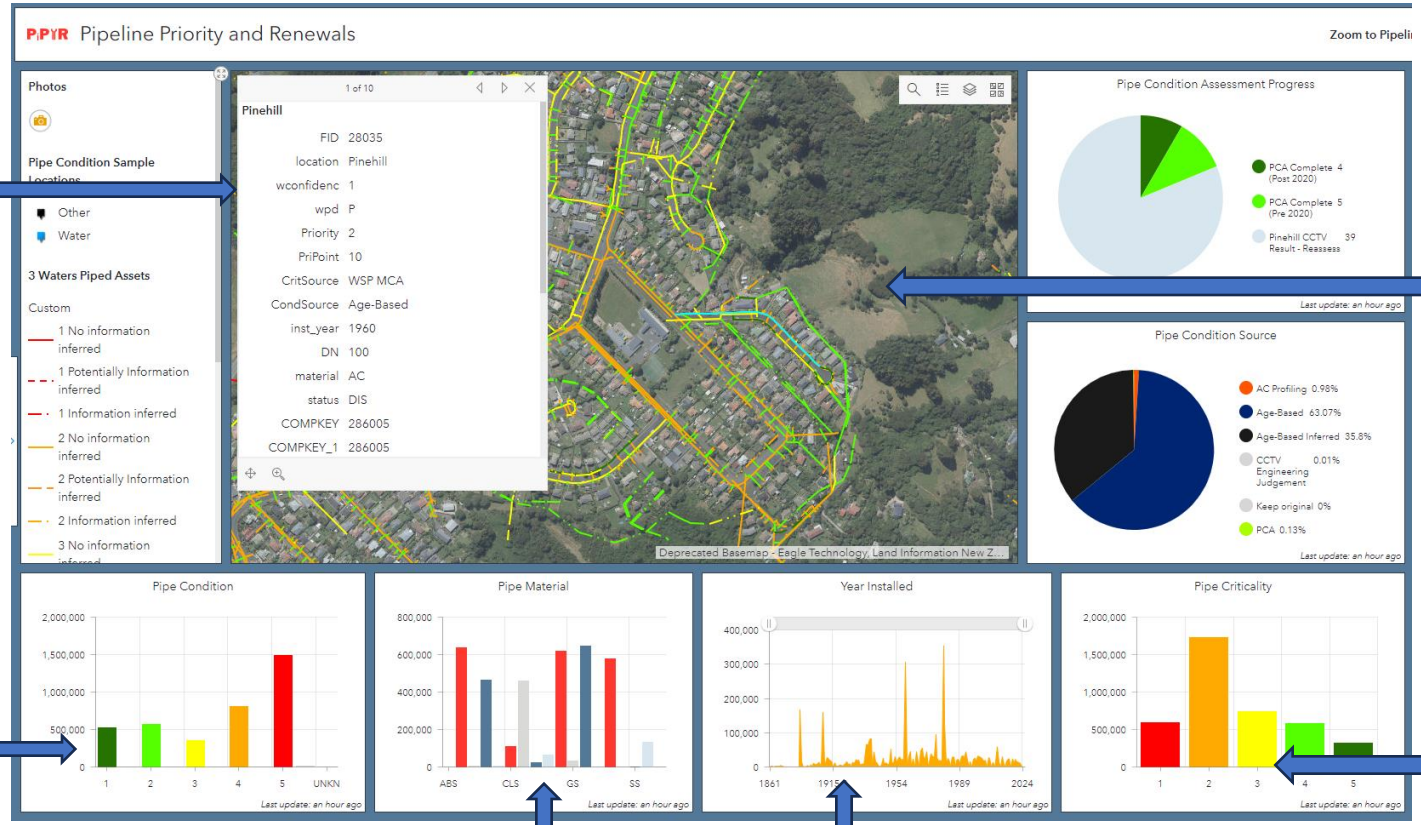




Prioritisation Description	Prioritisation Grade	Score range*
Very High	1	16-25
High	2	10-15
Medium	3	6-9
Low	4	3-5
Very Low	5	1-2

Priority 5
Priority 4
Priority 3
Priority 2
Priority 1

PiPyR- GIS dashboard



Asset summary

Priority rating spatially referenced

Pipe condition

Pipe criticality

Pipe material / year installed

Condition - 5

Criticality - 2

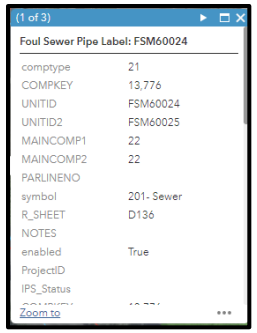
Prioritisation Grade - 2

Fault data

Performance grade – 4.4 (1)

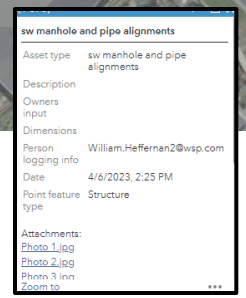
Asset data, site photos, and survey

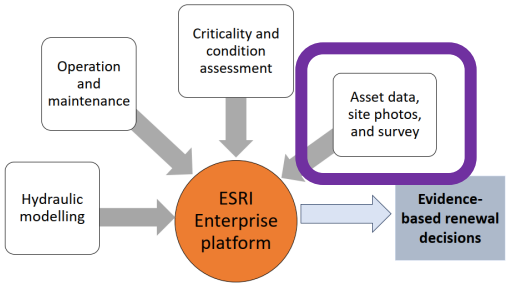
Asset summary



Site photos

Manhole survey



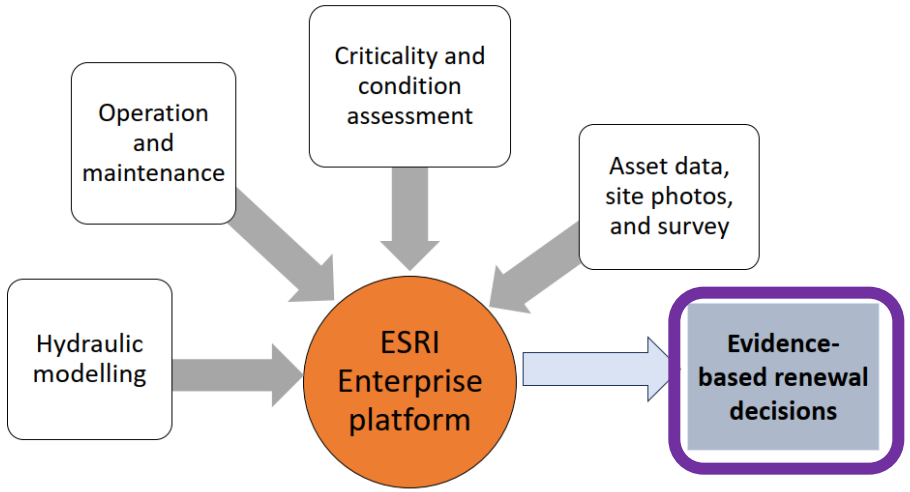


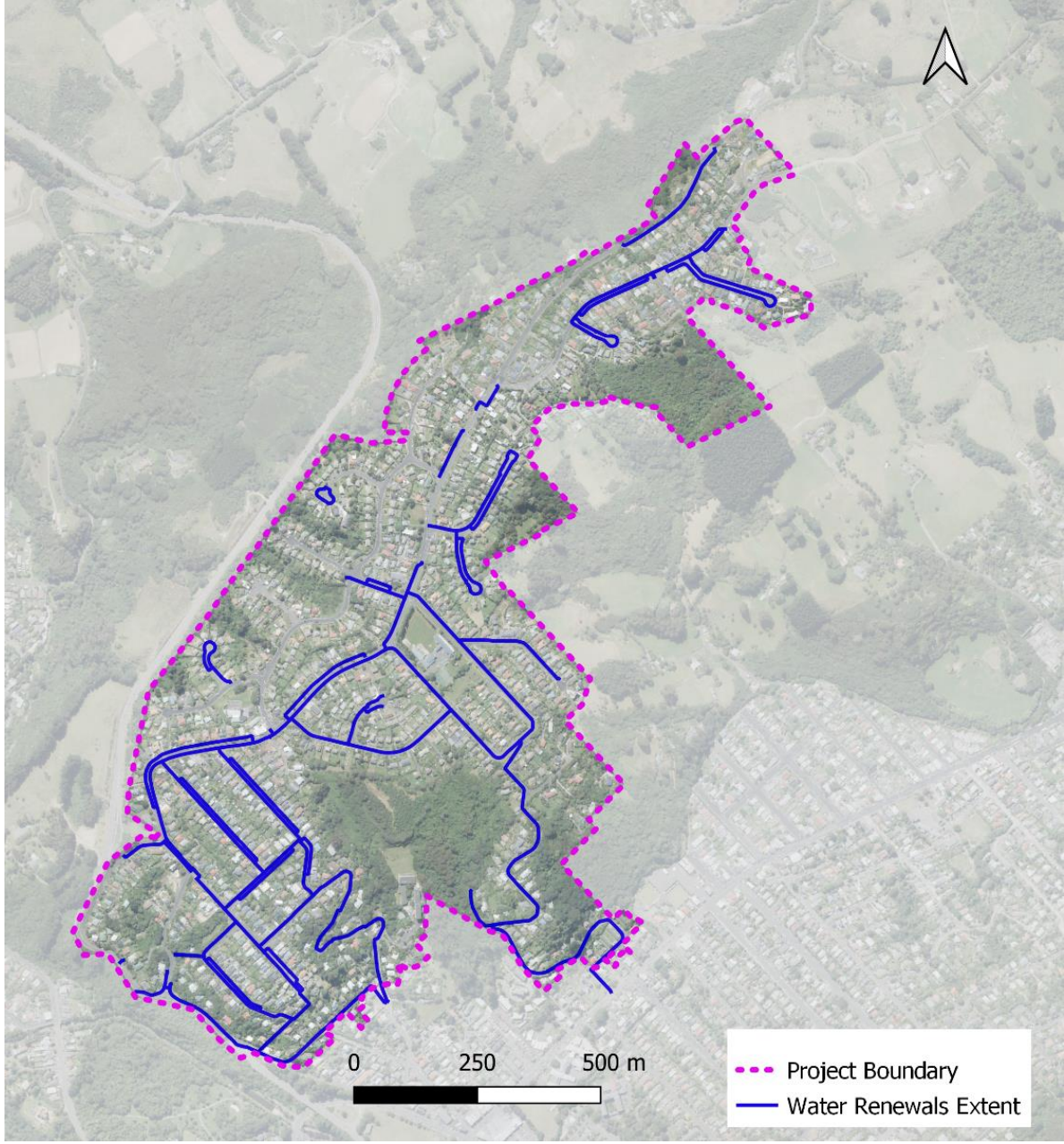
Concept design and next steps

- Visual tool for all to display data and information
- Integrated both the PiPyR and modelling performance grades
- Operations workshop to refine process
- ECI with the contractor (McConnell Dowell) and DCC's O&M contractor (CityCare) through this platform and workshops
- Proposed pipe condition assessment (PCA) programme – to improve confidence in the 'age-based inferred' to support the renewals prioritisation

Concept design and next steps, cont'd

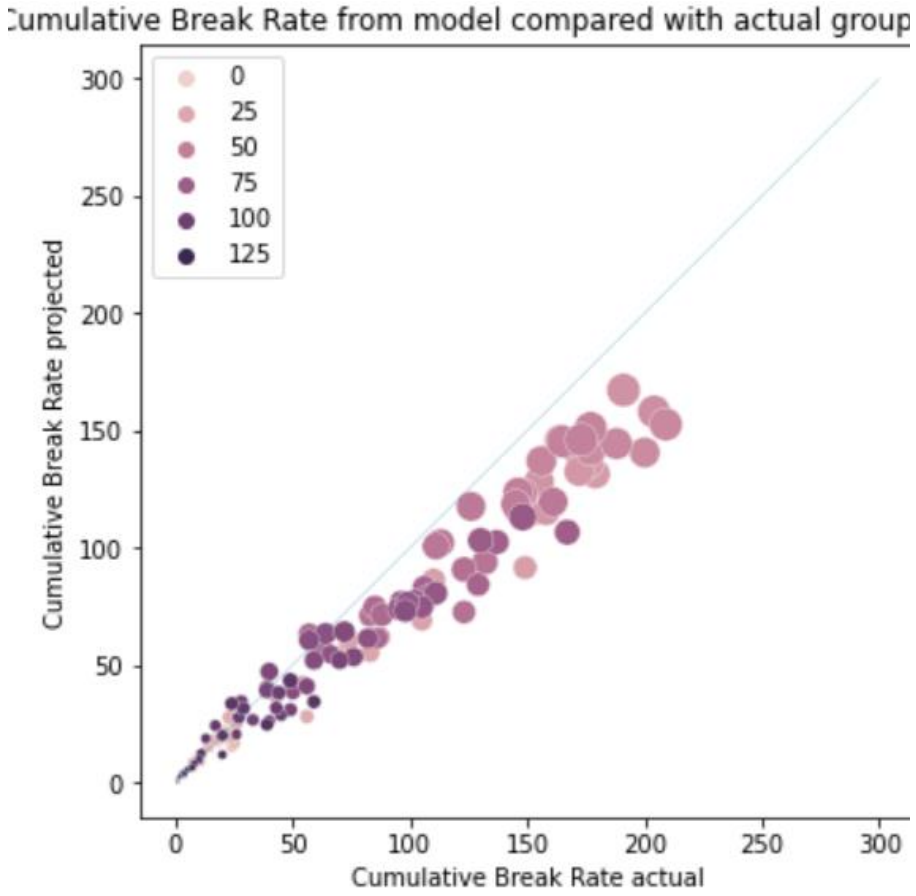
- Optimisation of pressure zones / remove dead ends
- CI pipelines to progress to detailed design
- Hydrants testing to validate model outputs
- Renewal of approx. 8 km of water mains





Future development

- Apply to other catchments/zones, network-wide
- Applying other modelling related outputs: water age/water quality, criticality link analysis
- Exploring how we can integrate WSP's machine learning tool outputs:
  - likely locations of leaks within the network
  - future pipe failures and the cost of replacement against future repairs
- Customer focused – understand the level of disruption
- Operational validation - operators, right size data



Project benefits

- Layering of information
- Spatially accurate
- Effective communication / visual tool
- Easier to integrate with other projects
- Consistent / defendable approach

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Thank you!
Questions? Patai?

water
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