Christchurch City Council

Wastewater Overflow Consent

Community Stakeholder Workshop – 30 November 2016

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WCS ENGINEERING

Workshop Agenda

1. Introductions
2. Context and Objectives
3. Existing System Performance – Hydraulic Modelling Results
4. Optimised Capital Improvement Plan – Preliminary Solutions
5. Ecological Effects of Overflows
6. Waterway Values Survey Results
7. Wet Weather Overflow Prioritisation Framework
8. Discussion
9. Next Steps

Context and Objectives of Stakeholder Workshop

Key Messages

1. Today's objective is to present work done to date and to review the proposed framework for prioritising wet weather overflows and to seek community feedback as part of the consenting process.

2. The existing wastewater network is generally compliant with the current consent targets for number of overflow events to each receiving environment.

3. The vast majority of wet weather overflows can be cost effectively reduced to achieve the long-term objectives of the current consent however some locations provide a low return on investment and alternative management approaches could be considered.

Existing System Performance / Hydraulic Modelling

Hydraulic Modelling Topics Covered:

1. Key terminology
2. Model development and verification
3. Wet weather overflow volume and frequency results
4. Comparison with current consent targets for 2016

Existing System Performance / Hydraulic Modelling

Key Terminology

1. Hydraulic Model – Computer model of the wastewater network calibrated for dry weather and wet weather flow
2. Model Calibration – Based on real-life flow monitoring of the wastewater network to ensure the hydraulic model provides a reasonable representation of the actual system
3. Existing system model – Based on 2016 population. Including recently constructed infrastructure and infrastructure to be implemented in the near future.
4. Long-term simulation (LTS) of historical rainfall – Used to assess overflow volumes and frequencies by running 15-year rainfall data (2000 to 2014 inclusive). The 15-year rainfall data is applied to the existing system model to determine the "existing system performance"
5. Outfall discharge – Wet weather overflow from a constructed outfall
6. Manhole flooding – Wet weather overflow from a manhole
7. Receiving environment – e.g. Heathcote River, Avon River (referred to as "location" in consent condition 4)
8. Overflow event – When one or more outfalls discharge to a receiving environment

Existing System Performance / Hydraulic Modelling

Key Terminology

9. Design Storm – Single rainfall event used to plan capital improvements
    a) 6-month Average Recurrence Interval (ARI) design storm
    b) 1-year Average Recurrence Interval (ARI) design storm
    c) 3-year Average Recurrence Interval (ARI) design storm

    * Note: 3-year ARI design storm is used to plan improvements to achieve approximately 2-year overflow return period based on long-term simulation of actual rainfall data

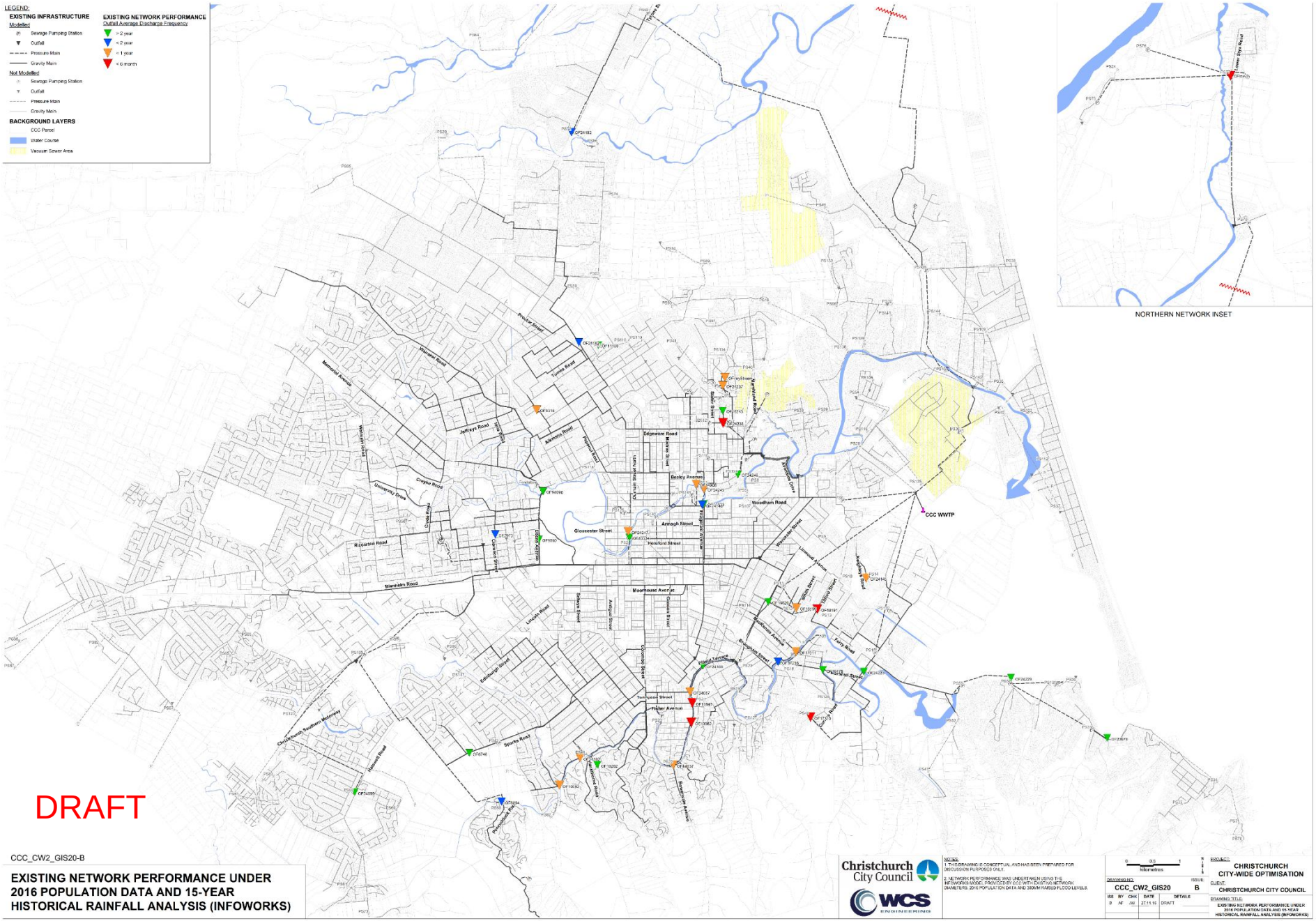
Existing System Performance / Hydraulic Modelling

Model Development and Calibration

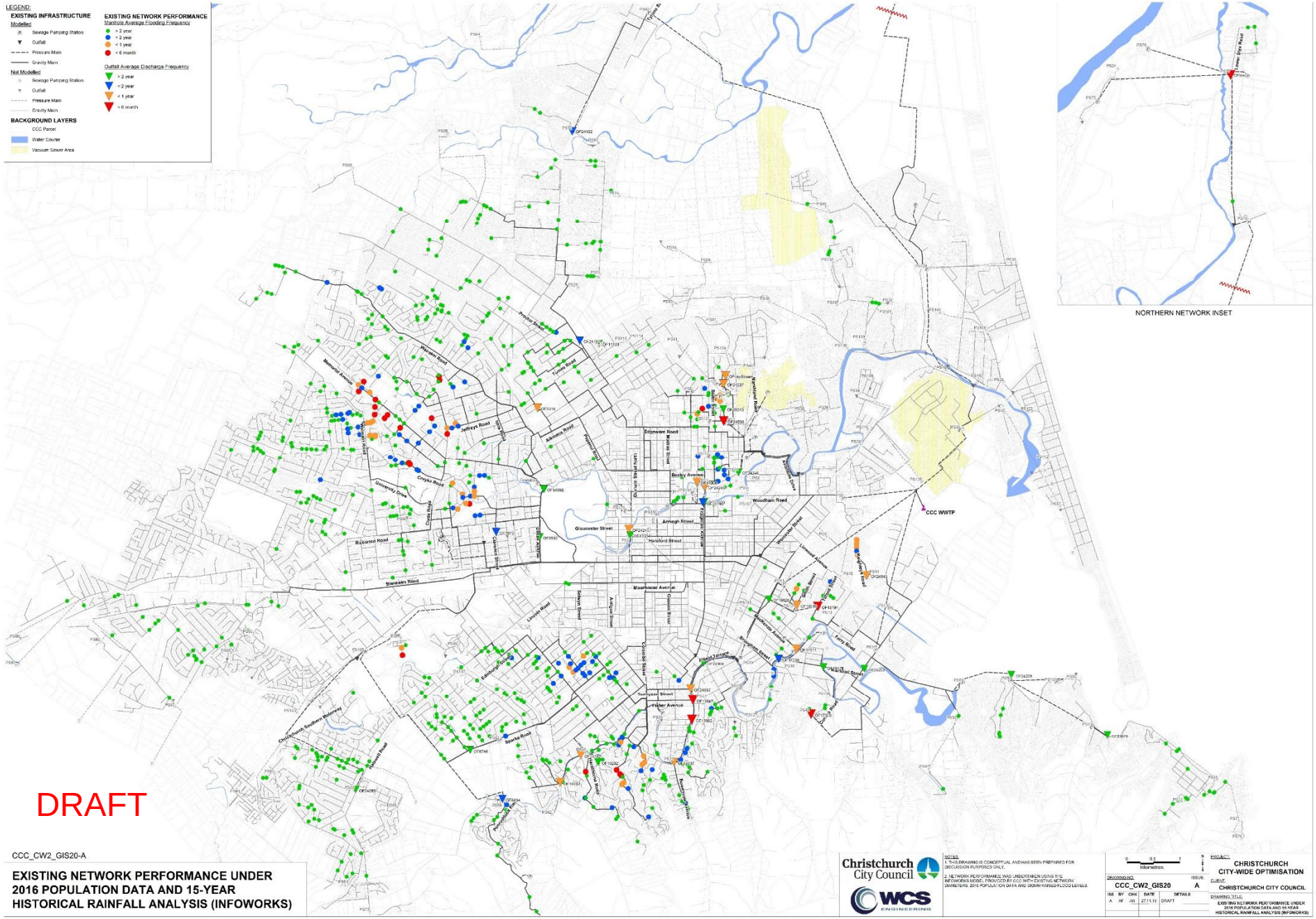
- Detailed model development and calibration in 2011
- Flow monitoring performed in 2013/2014 to update the model calibration post earthquake
- 2016 post earthquake rebuild model includes extensive survey data and numerous changes to reflect the existing system
- 2016 population growth predicted based on 2013 census
- 2016 model calibration provides a reasonable representation of the existing system performance however:
  - The wastewater network has been in a continuous state of flux since the earthquake; and
  - There were limited flow monitoring sites in the 2013/2014 flow monitoring

  à Detailed flow monitoring and model calibration update proposed for 2018

Existing System Performance – 2016 Population, 15-Year Simulation Model Results (Outfall Discharge Only)



Existing System Performance – 2016 Population, 15-Year Long Term Simulation (LTS) Model Results



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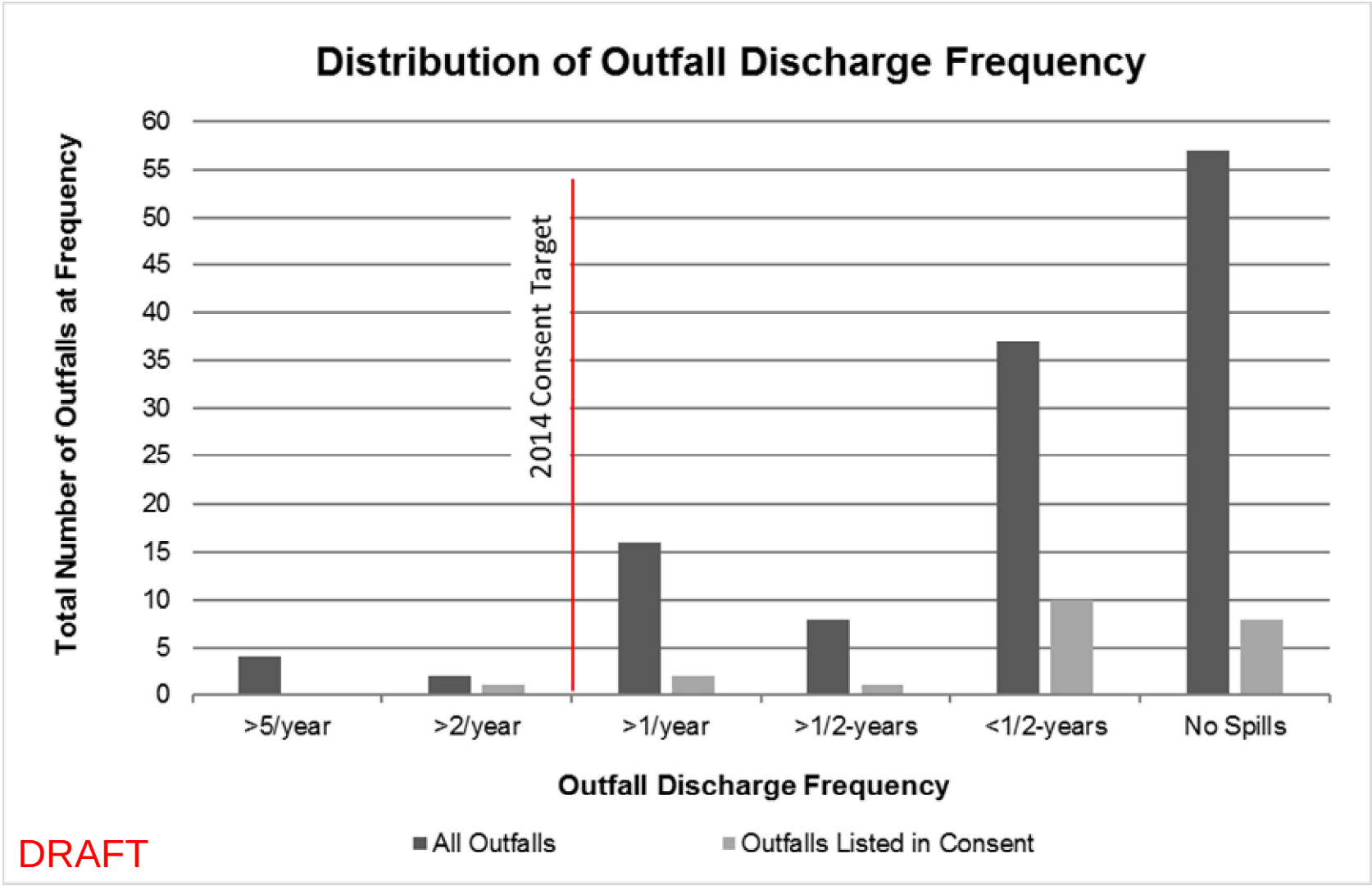
EXISTING NETWORK PERFORMANCE UNDER 2016 POPULATION DATA AND 15-YEAR HISTORICAL RAINFALL ANALYSIS (INFOWORKS)


Distribution of Outfall Discharge Frequency
Total Number of Outfalls at Frequency
60
55
50
45
40
35
30
25
20
15
10
5
0
2014 Consent Target
>5/year
>2/year
>1/year
>1/2-years
<1/2-years
No Spills
Outfall Discharge Frequency
All Outfalls
Outfalls Listed in Consent
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Optimised Capital Improvement Plan – Preliminary Solution

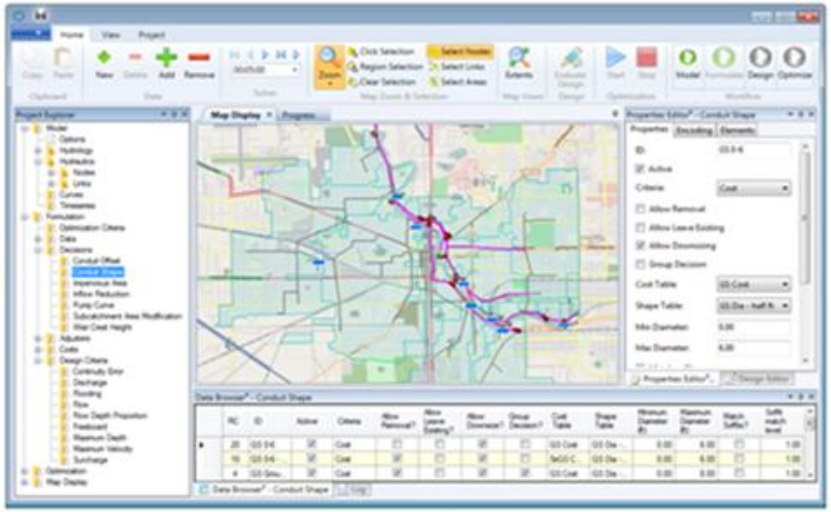
Optimisation Topics Covered:

1. Overview of Optimisation
2. Improvement Alternatives Considered
3. 36-Month ARI Design Storm Preliminary Solution
4. Return on Investment (Cost per Volume Overflow Removed)

Overview of Optimisation

- Hydraulic Model
- Improvement Options
- Capital and O&M Costs
- Design Criteria

Formulate



Optimizer WCS™

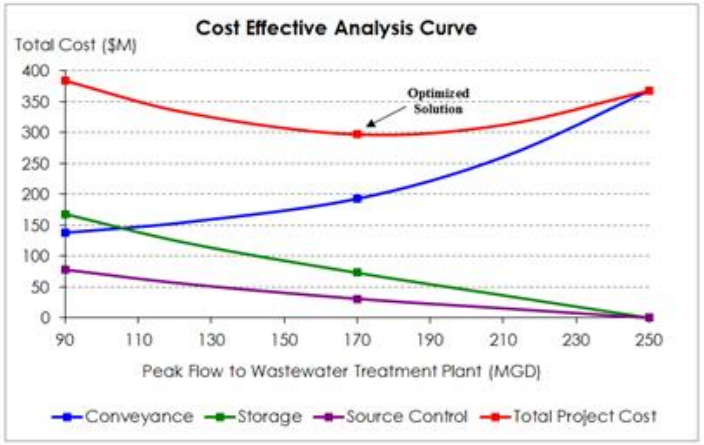
Run

Review

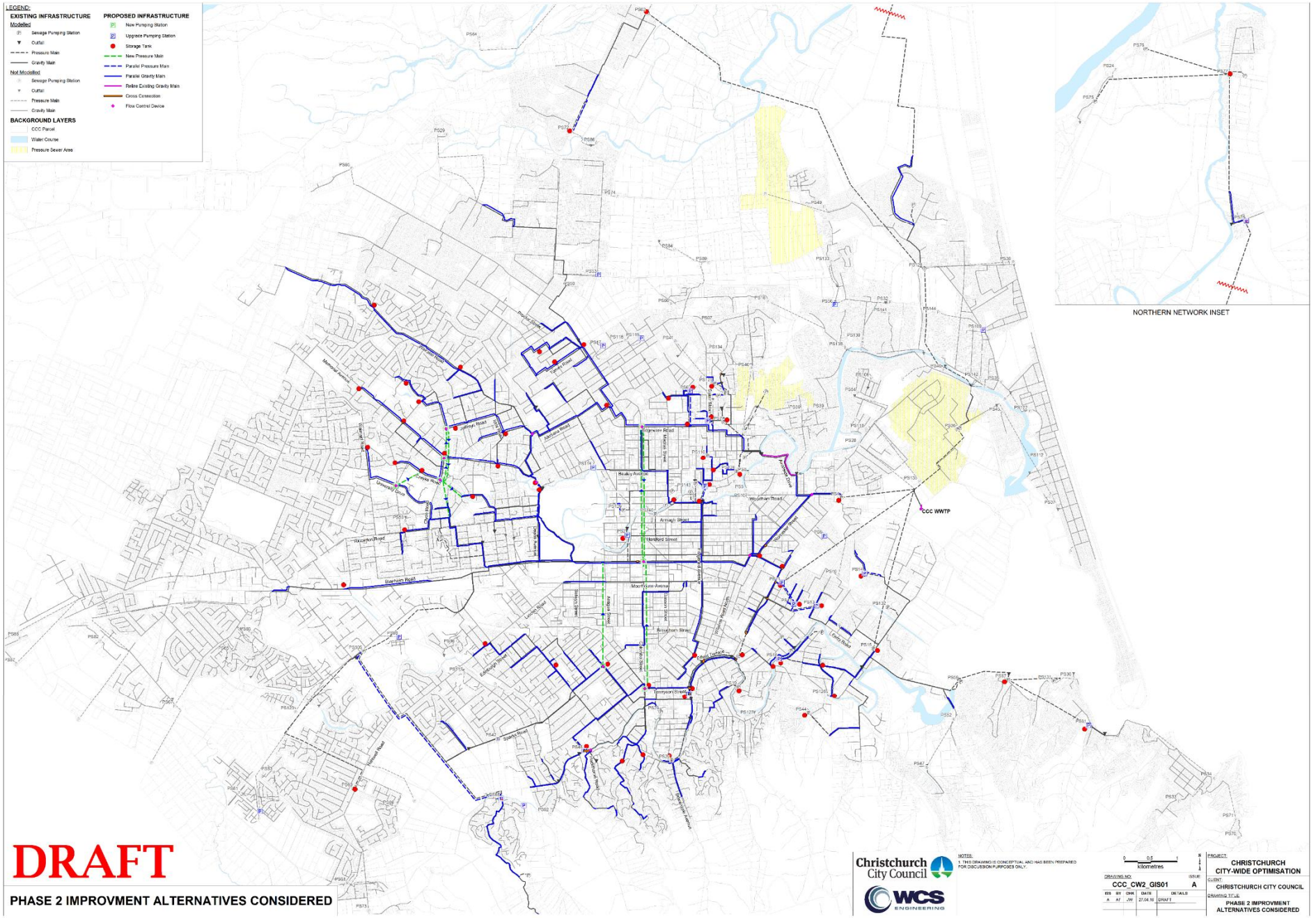
Refine

Scenarios / Sensitivity Analyses

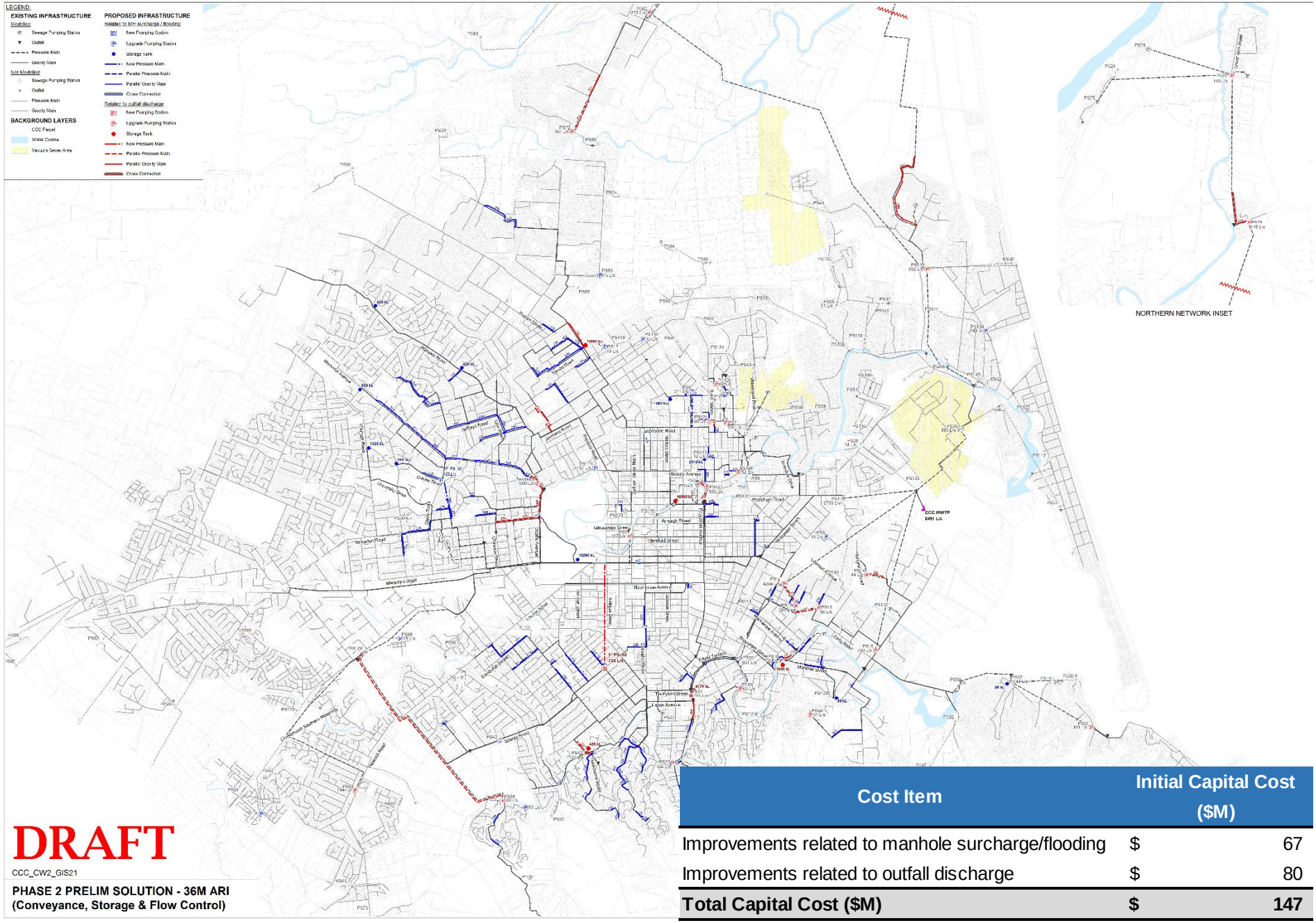
Cost Item	Baseline Solution ($M)	Optimized Solution ($M)
Grey Infrastructure	305.33	195.07
Real Time Control	0.00	2.67
Green Technology	0.00	27.39
Total Construction Cost	305.34	225.13
Eng/Leg/Adm. (20%)	61.07	45.03
Total Capital Cost	366.40	270.16
Present Worth O&M	45.61	29.40
TOTAL PROJECT COST	**412.01**	**299.56**
Saving	112.46	27%



Preliminary Optimisation Improvement Alternatives – Pipe, Pump, Storage, Flow Diversion (I/I Removal Pending)

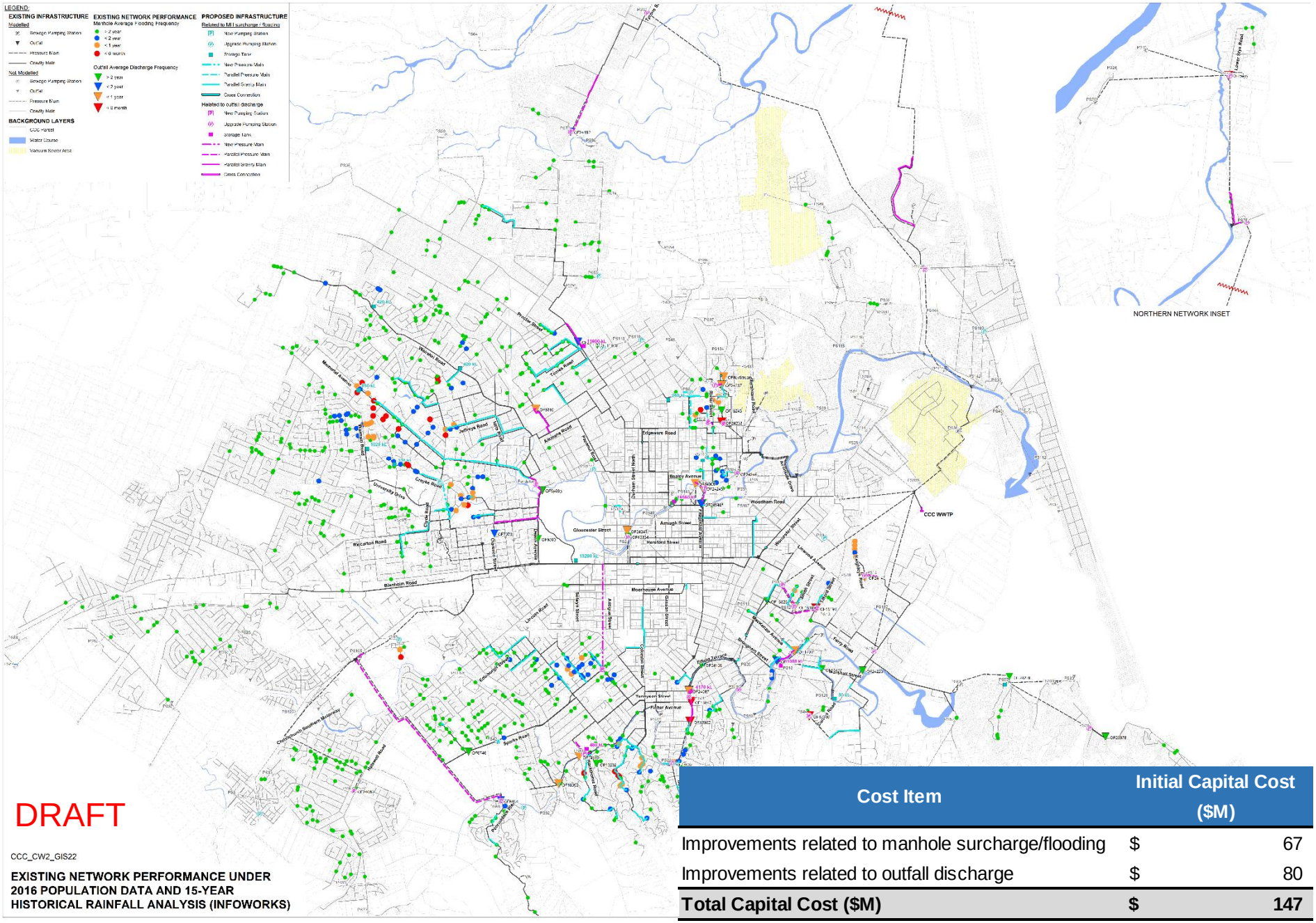


Phase 2 Prelim Solution – 2068 Population, 3-Year Average Recurrence Interval (ARI) Design Storm



Cost Item		Initial Capital Cost ($M)
Improvements related to manhole surcharge/flooding	$	67
Improvements related to outfall discharge	$	80
Total Capital Cost ($M)	**$**	**147**

Phase 2 Prelim Solution – 2068 Population, 3-Year Design Storm (Showing Existing System Overflows)



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EXISTING NETWORK PERFORMANCE UNDER 2016 POPULATION DATA AND 15-YEAR HISTORICAL RAINFALL ANALYSIS (INFOWORKS)

Cost Item		Initial Capital Cost ($M)
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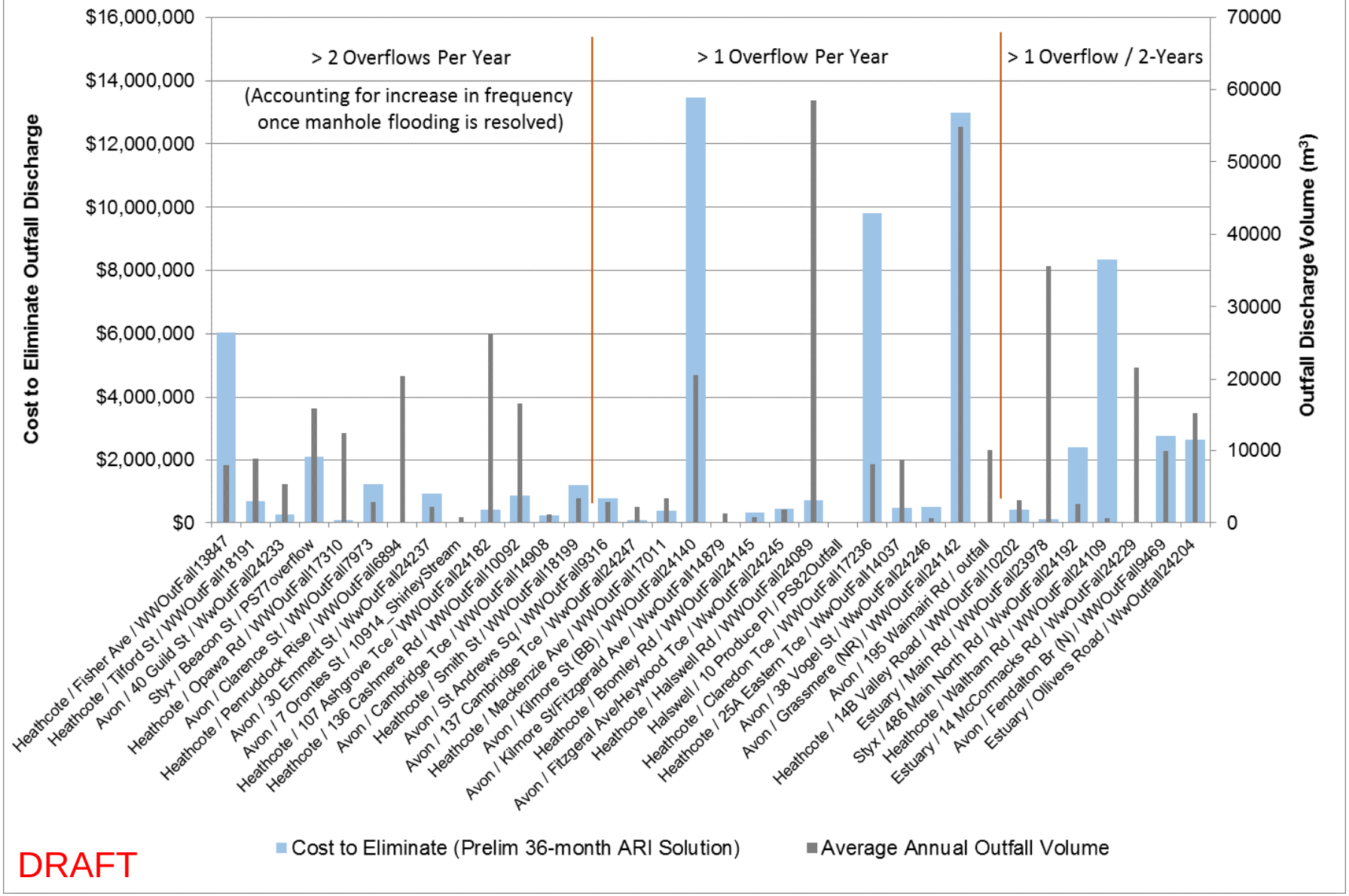
Outfall Volume and Cost to Abate



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Summary of Preliminary Modelling and Optimisation Results

1. Out of 126 Constructed Outfalls, approximately 30 are active more frequently than once every two years and 6 more frequently than once every six months
2. Once manhole flooding is resolved, the number of outfalls that are active once every two years increases to approximately 38
3. 18 of these are relatively cost effective to address, achieving >70% overflow volume reduction in under 15% of the total cost
4. Of the remaining outfalls shown in the table below, seven account for the bulk cost
5. Environmental, cultural, community and other values will be considered to develop a comprehensive framework for prioritising all overflow abatement expenditure

Outfall Referemce	LTS Return Period (Worst)	Max Average Annual Volume (m^3)	Cost to Eliminate 2068, 36-Month ARI Overflow	$/$m^3$ Abated
Avon / Kilmore St (BB) / WWOutFall24140	0.51	20,541	$ 13,462,117	$ 655
Avon / Grassmere (NR) / WWOutFall24142	0.78	54,900	$ 12,975,088	$ 236
Heathcote / Claredon Tce / WWOutFall17236	0.70	8,149	$ 9,820,455	$ 1,205
Heathcote / Waltham Rd / WWOutFall24109	1.21	665	$ 8,342,818	$ 12,550
Heathcote / Fisher Ave / WWOutFall13847	0.43	7,911	$ 6,044,715	$ 764
Avon / Fendalton Br (N) / WWOutFall9469	1.58	9,875	$ 2,751,062	$ 279
Styx / 486 Main North Rd / WwOutFall24192	1.12	2,668	$ 2,395,988	$ 898
Avon / Clarence St / WWOutFall7973	0.30	2,929	$ 1,236,457	$ 422
Heathcote / Smith St / WWOutFall18199	0.39	3,421	$ 1,189,404	$ 348
Avon / 30 Emmett St / WwOutFall24237	0.34	2,162	$ 926,918	$ 429
Avon / St Andrews Sq / WWOutFall9316	0.44	2,818	$ 779,698	$ 277
Avon / 38 Vogel St / WwOutFall24246	0.74	584	$ 499,447	$ 855
Avon / Fitzgeral Ave/Heywood Tce / WwOutFall24245	0.57	1,783	$ 437,712	$ 245
Heathcote / Bromley Rd / WWOutFall24145	0.57	768	$ 340,659	$ 444

Waterway Values survey

- Online survey

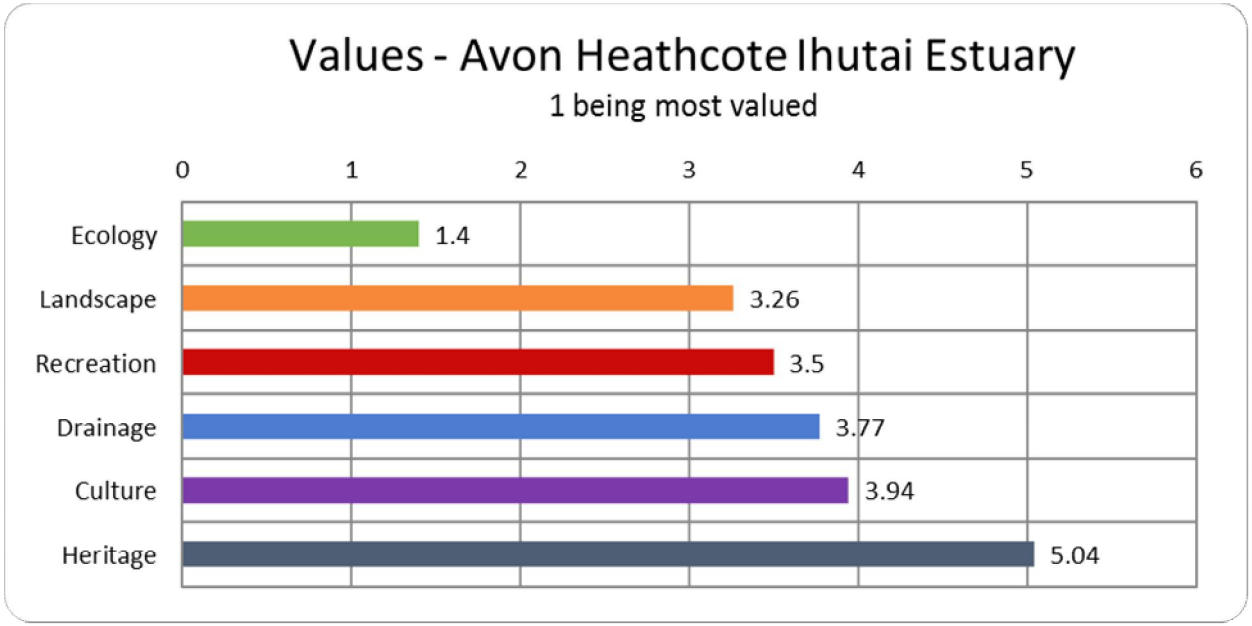
  November 2016

- Values ranking for

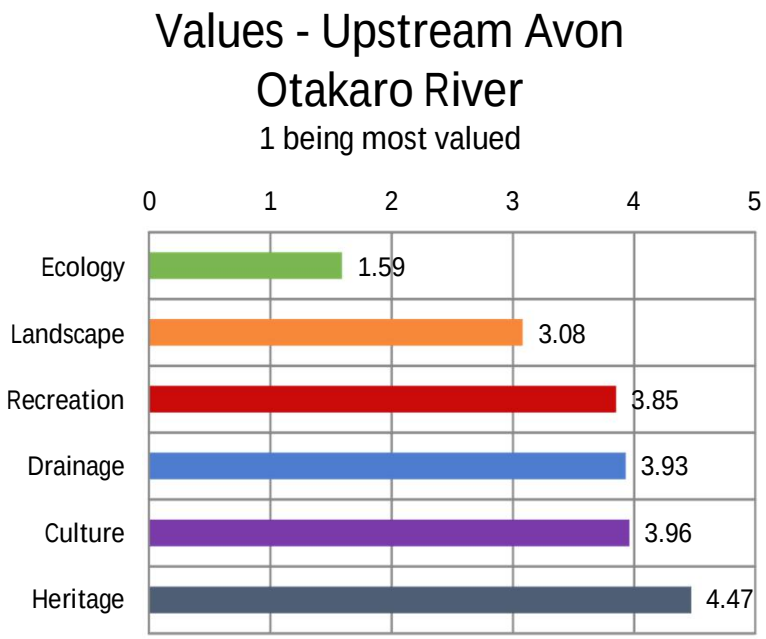
  waterways

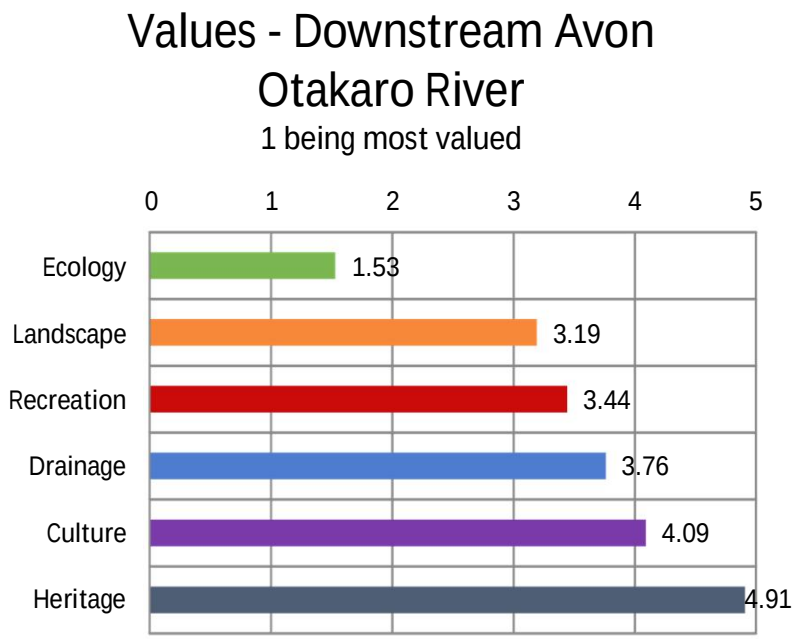
- Free text comments

Values survey results - Estuary

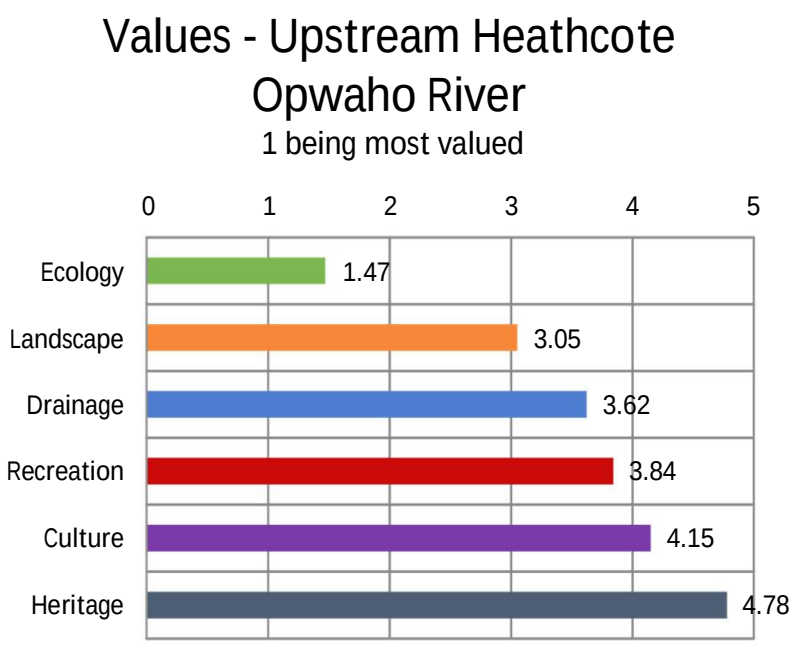


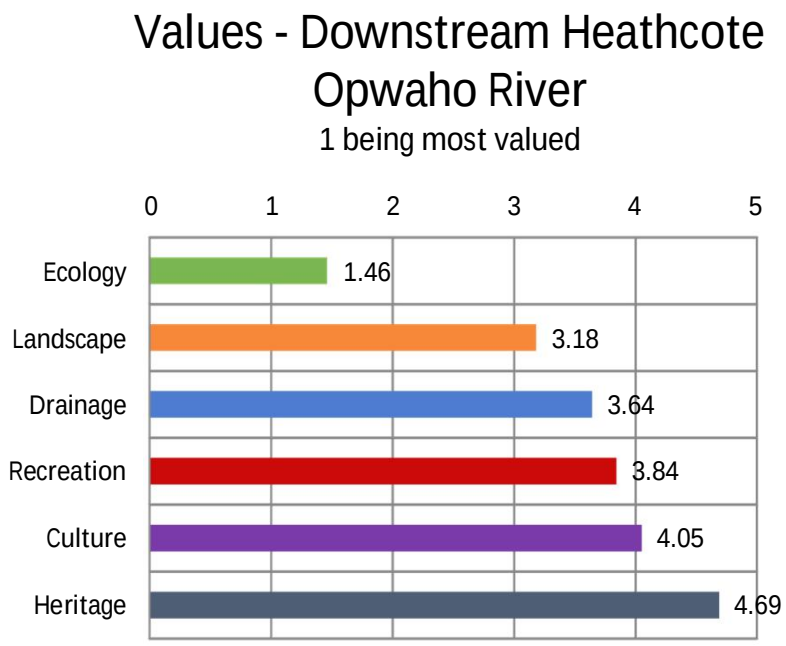
Values survey results - Avon



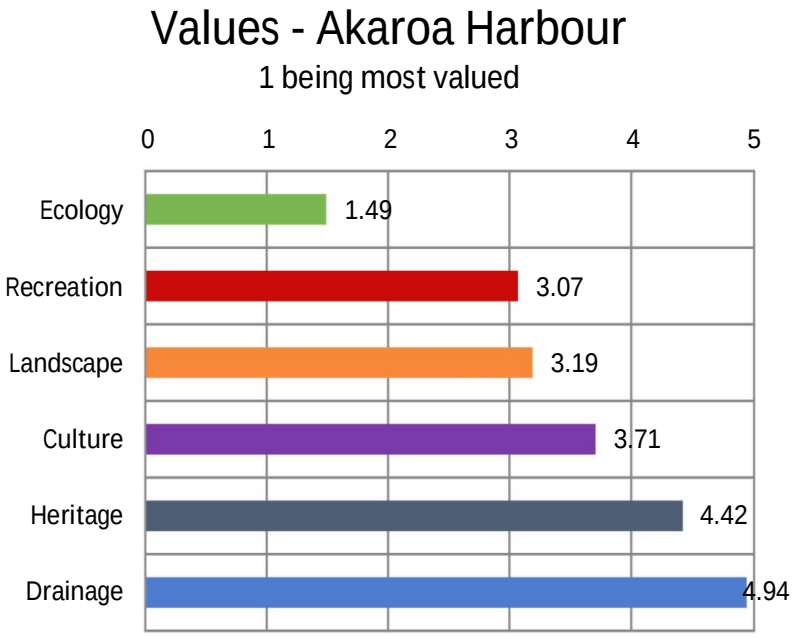


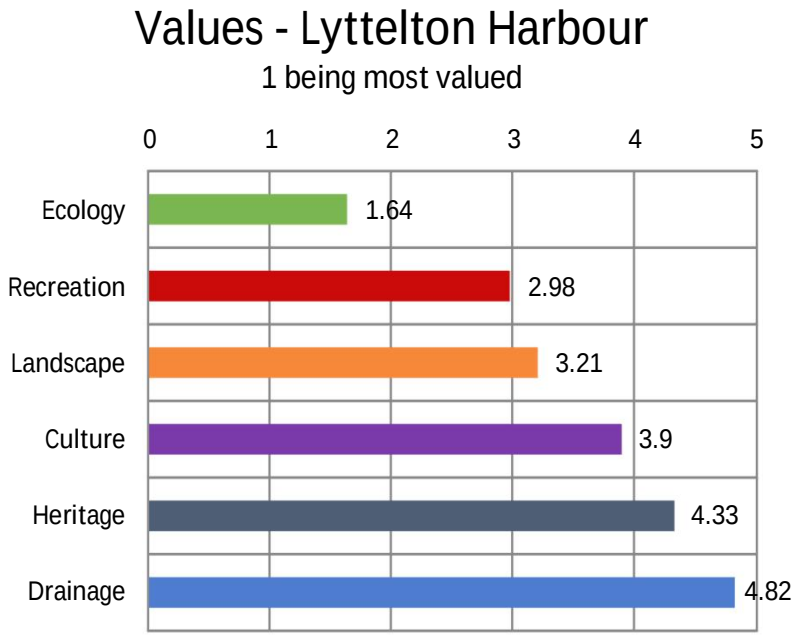
Values survey results - Heathcote





Values survey results - Harbours





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Waterway Catchments & Monitoring Sites

Prioritisation Framework

Justine Bennett

30 November 2016

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Overflow Location Prioritisation

Objectives –

- To prioritise overflow locations based on 4 well beings
  - Cultural
  - Social (community)
  - Environmental
  - Financial

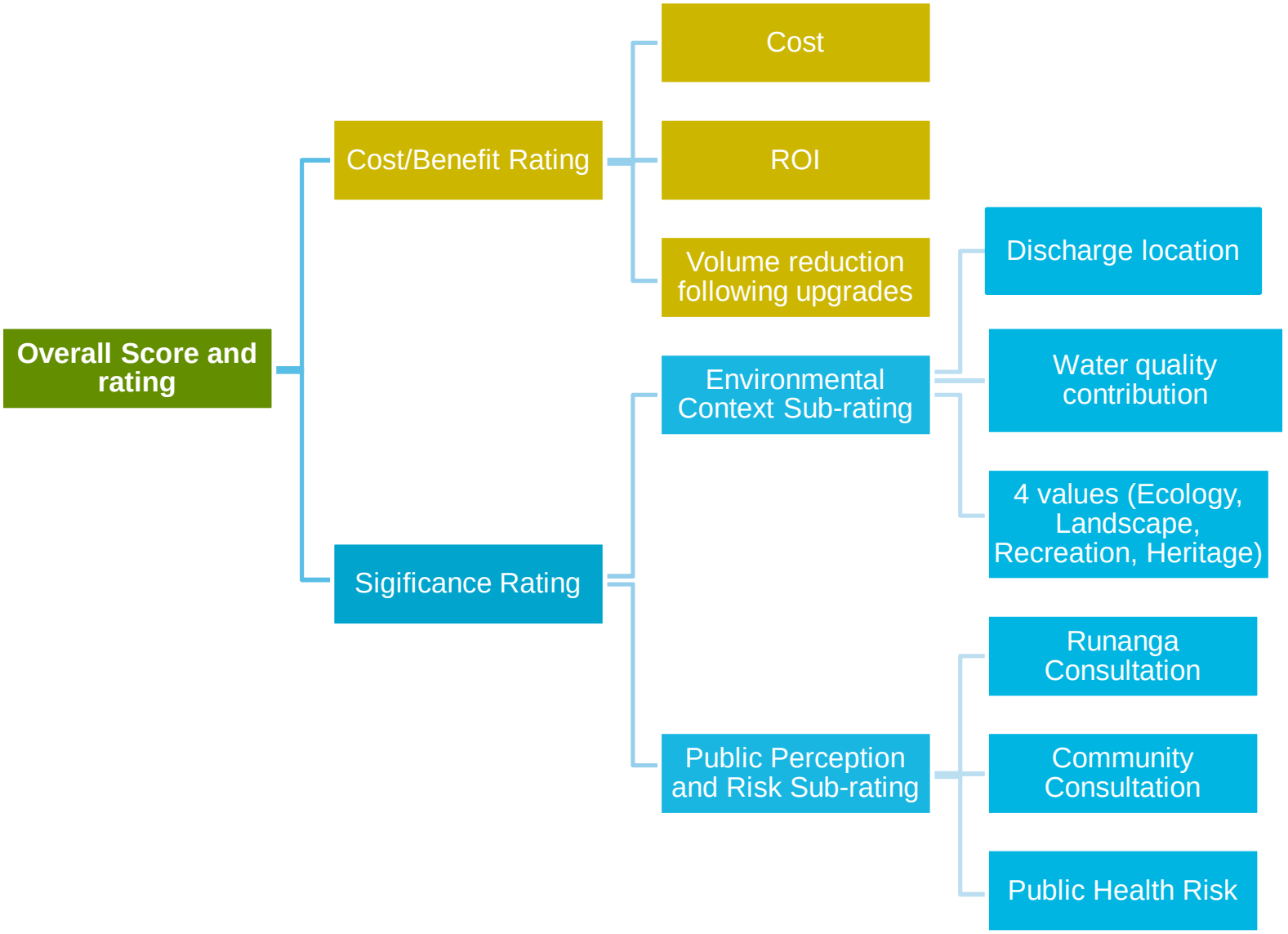
- Assign cumulative significance/value for each overflow location

- Balance individual location values with cost effectiveness of capital works to remediate

- Build on the WCS modelling work to provide values based on the 36-month ARI event

- Feed forward into overflow management process to support a Network Discharge Consent.

Prioritisation Process



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Environmental Context Sub-rating

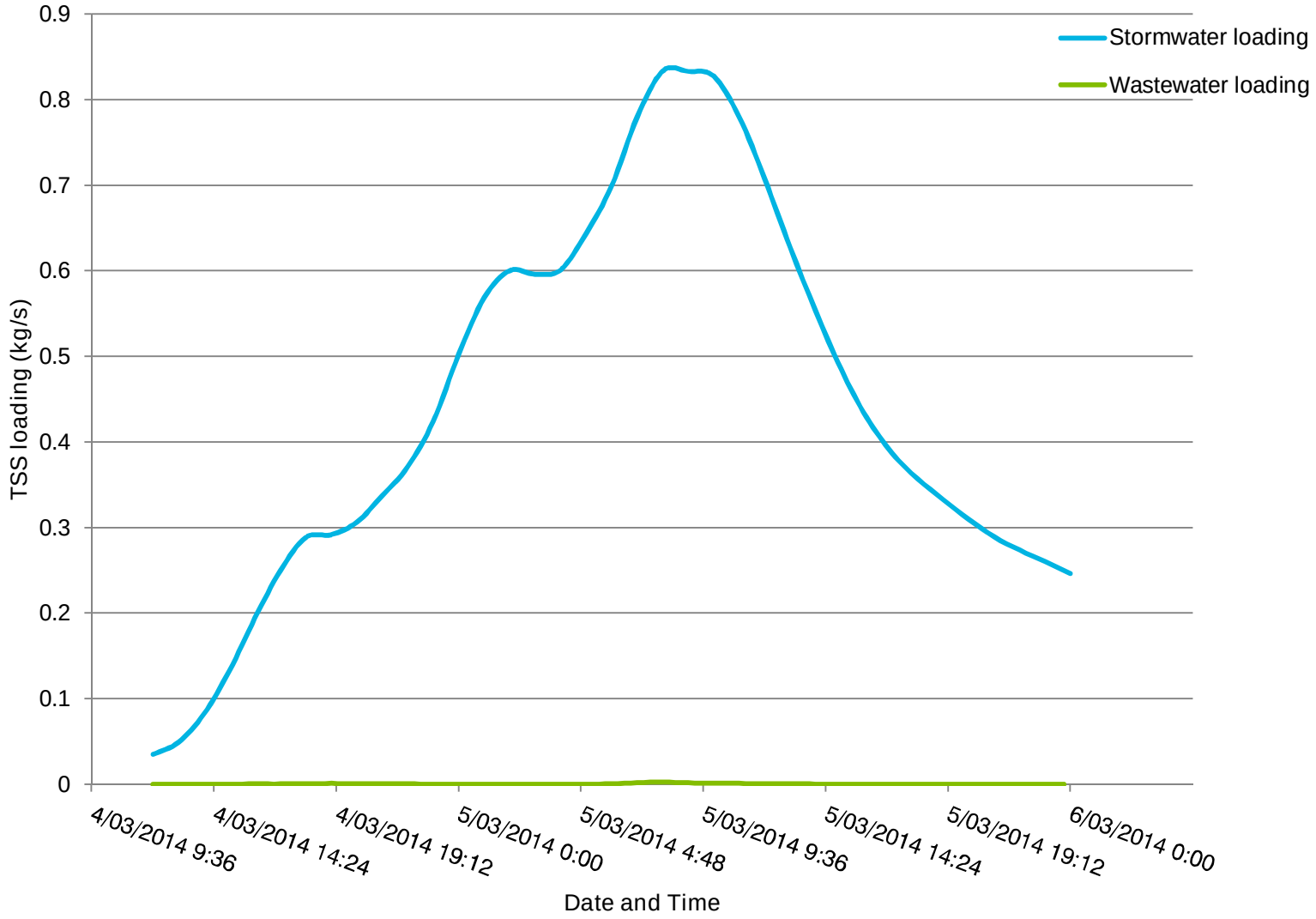
- Discharge Location – to pipe or stream
- Ecology
- Landscape
- Recreation and Heritage
- Cultural addressed in Public Perception component
- Water Quality

Water Quality

Water Quality

- Wastewater annual loadings and contributions calculated direct from the outputs of the modelling
- Baseline water quality review in relation to water quality limits Land & Water Regional Plan – elevated nutrients, suspended solids, heavy metals and zinc, microbial pollutants, biological oxygen demand (BOD)
- Contribution related to stormwater runoff from the contributing catchments. Relative contribution of total suspended solids, E. coli and BOD is low.

Examples of relative loading – total suspended solids



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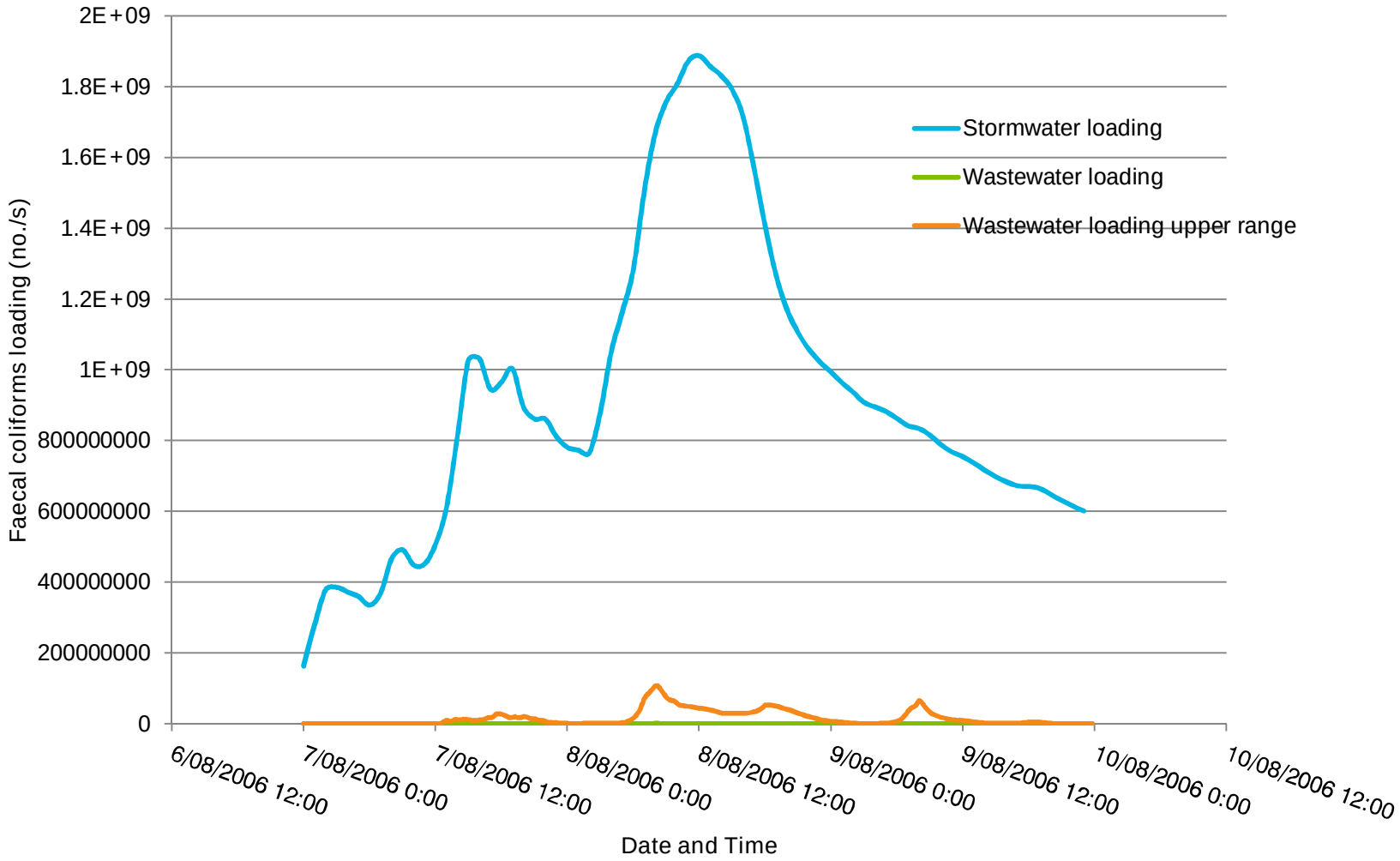
Examples of relative loading - E. coli



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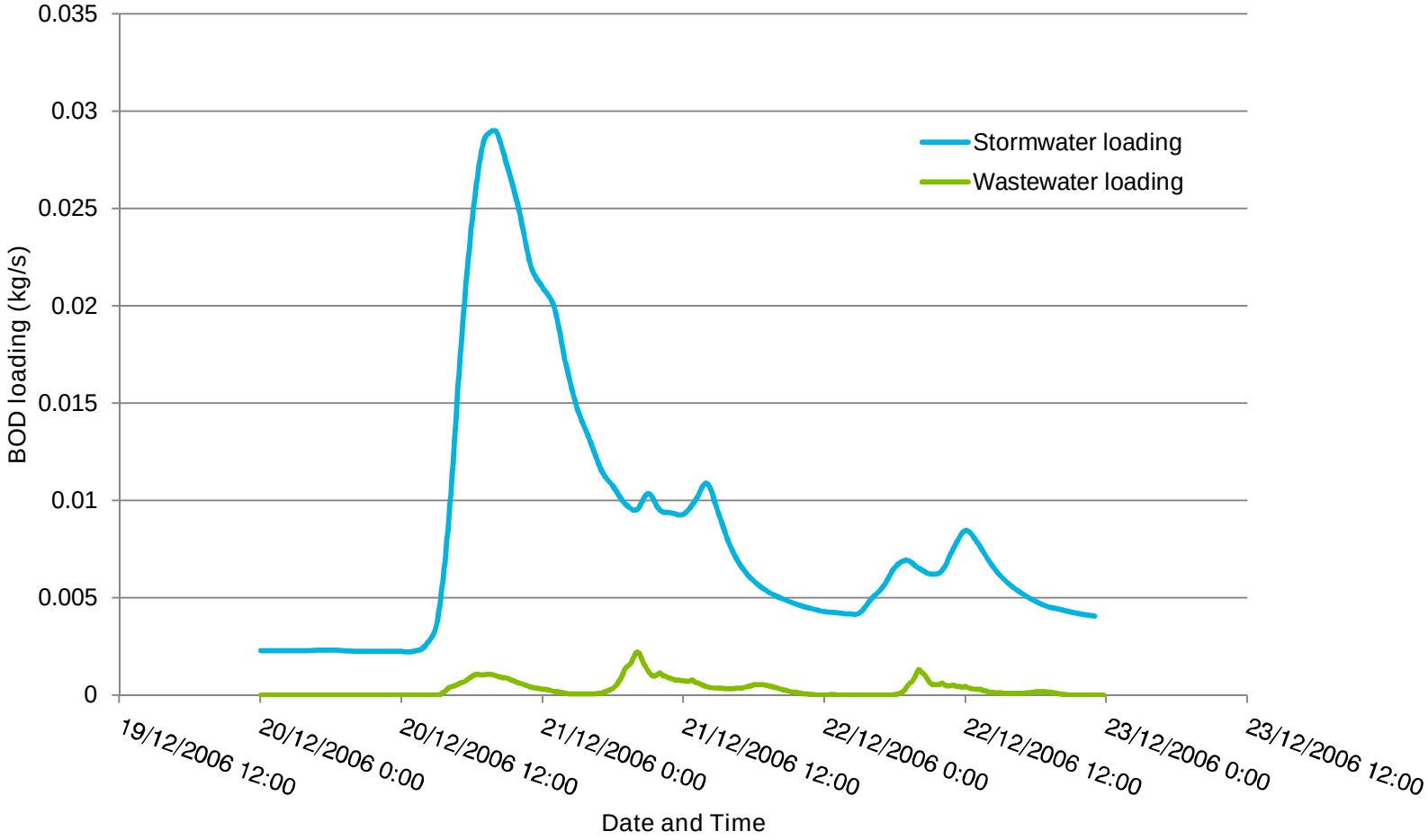
Examples of relative loading - BOD



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Environmental Context Sub-rating

5 Values

- Ecology, Landscape, Recreation, Heritage and Culture
- Assessment of post-earthquake condition of Christchurch's waterways
- High level assessment approach – best judgement, subjective evaluation on a 1-5 grading scale
- 1 – very good
- 5 – very poor

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Public Perception and Risk Sub-rating

Public Health Risk

- Conservative approach – assumes maximum over flow occurs in low river flow conditions (1 year ARI event)
- Coliform concentration
  - Based on the wastewater modelling input, overflow frequency, WQ results and dilution factors (within the network and in the receiving water body)
- Annual overflow frequency
  - From wastewater model results
- Recreation value of the waterway
  - From 5 values assessment
- Less than 5 locations with relatively high risk profile
- Background levels of indicator organisms high – wildfowl and farming. Some presence of human indicators in wet weather.

Cost/Benefit Rating

Cost

- Lump sum cost of upgrades

Return on Investment (ROI)

- Cost per unit volume ($/$m^3$) overflow reduced

Volume reduction following upgrades

- Volume that is no longer released as overflow is no longer triggered in 36 month event.

Results

Preliminary assessment of the outfall sites:

- 4 High priority sites
- 14 Moderate priority sites
- 30 Low priority sites

Thank You

30 November 2016