Metro Vancouver Asset Management Tools:

REALIZING THE POTENTIAL TO IMPROVE ACCURACY OF LONG-TERM FINANCIAL PLANNING

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metrovancouver
SERVICES AND SOLUTIONS FOR A LIVABLE REGION

Agenda

- MV Background and Needs
- Methodology
- Tool Output
- Challenges and Limitations
- Next Steps

MV Background and Needs

Metro Vancouver

- 21 municipalities, one Electoral area and one Treaty First Nation
- Provides water (1070MLD/280 MGD), sewer (1230 MLD/330MGD) and stormwater services to 2.5M people
- 5 Year Capital Plan (2020-2024)
  - LWS: $3.4B
  - WS: $2.4B

Key Assets:

- LWS: 5 WWTPs, 33 PSs, over 500km of sewers
- WS: 5 Dams, 2 WTPs, 19 PSs, 26 reservoirs, 8 Rechlorination facilities, over 500km of water mains

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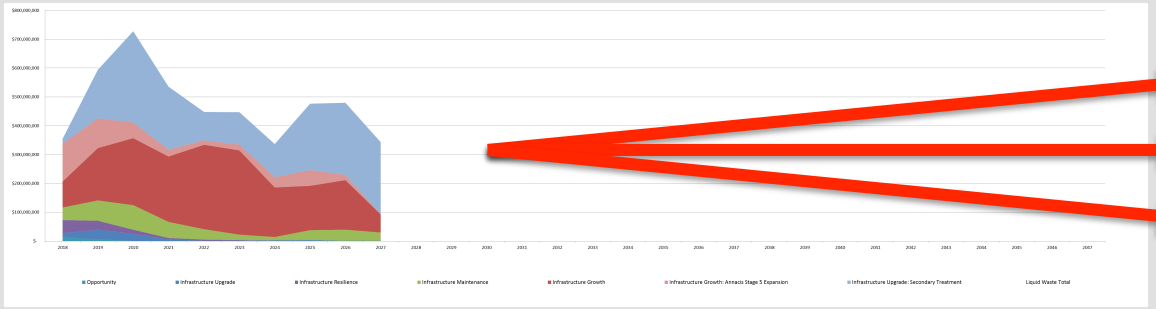
Capital Planning

- Annual Capital Planning Process
- Program Drivers
  - Growth: Enable current service levels to be provided to increased population
  - Upgrade: Provide enhanced levels of service to customers
  - Maintenance: Continue to provide current services with current asset base
  - Resilience: Address a known vulnerability to a major adverse event
- (2018-2019) 30 Year Finance Outlook - Longer term outlook until 2050
- Identified key requirements in Growth, Upgrade and Resilience areas
- Require to estimate Maintenance needs



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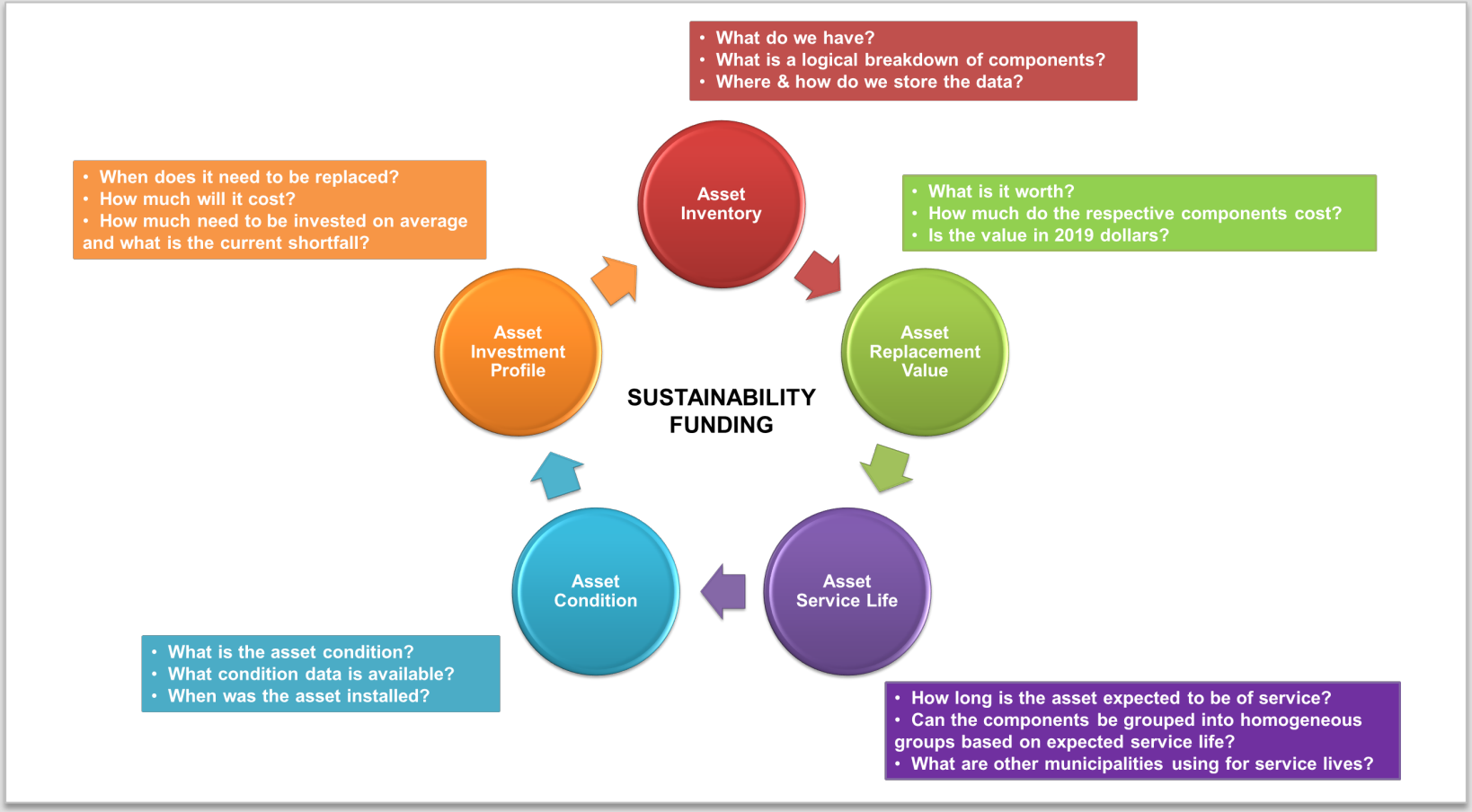
Tool Requirements

- Provide a 30 year reinvestment forecast for Maintenance program
- Analyze existing condition information and estimate remaining service life
- Determine timeline for replacement
- Visualize year over year required reinvestment level and annualized spending
- Simulate reinvestment scenarios based on parameters
- Be user-friendly
- Be easily updatable

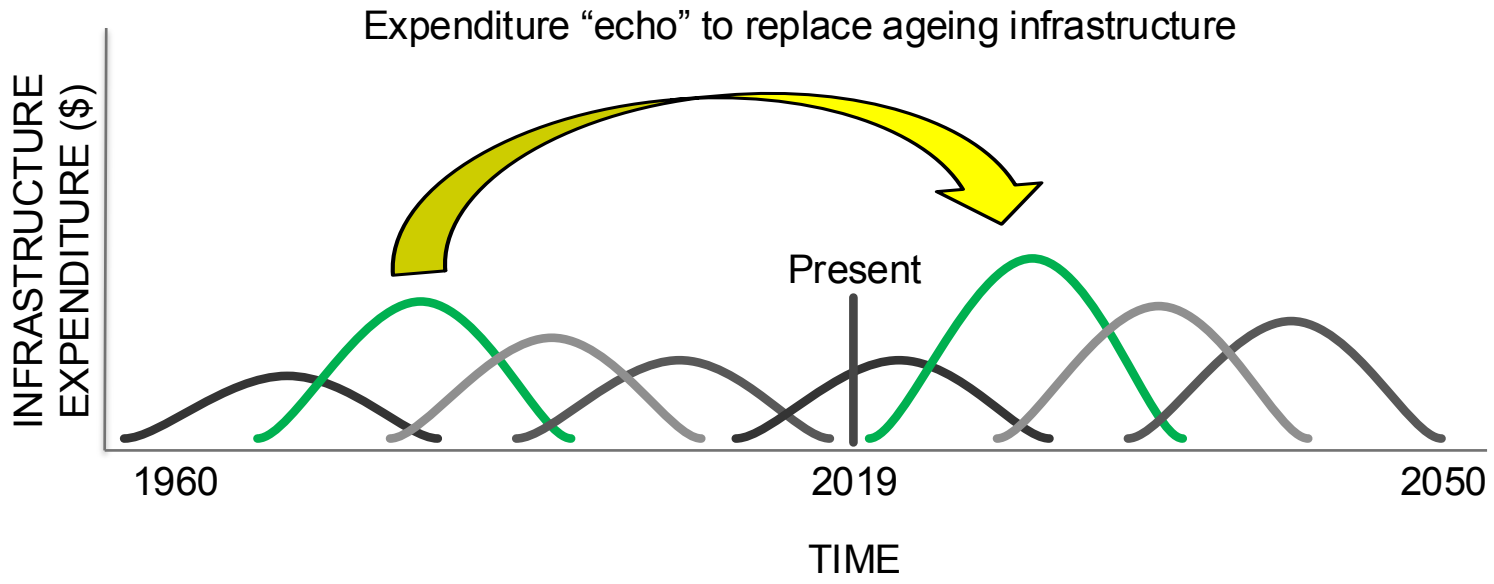
Methodology

Sustainability Funding Cycle



Background: National Research Council of Canada (NRC); National Guide to Sustainable Municipal Infrastructure ("InfraGuide")

Expenditure “Echo” to Replace Ageing Infrastructure



Assumptions

- Assets have finite life
- Different assets have different life expectancies
- Replacement date is driven by age and ESL
- Assets are maintained at condition level 4 or better
- Assets are linearly deteriorated: Condition level 4 → 20% of remaining ESL
- Assets are replaced based on the “like for like” approach
- Assets scheduled for major upgrade/replacement will not require any maintenance driven replacement before 2050 (i.e. excluded from the analysis)

Key Parameters - Expected Service Life

Sewer Mains

Abbr.	Material	ESL (yrs.)
AC	Asbestos Cement	138
CI	Cast Iron	115
CONC	Concrete	114
DI	Ductile Iron	115
FGRP	Fiberglass Reinforced Plastic	115
OTH	Other	75
PVC	Polyvinyl Chloride	75
RCON	Reinforced Concrete	114
Steel	Steel	115
STL	Steel	115
UNK	Unknown	75
VC	Vitrified Clay	136

Source: National Research Council of Canada (NRC)

Pump Stations

Discipline	ESL (yrs.)	Cost (%)
Civil	50	50%
Electrical	30	10%
Instrumentation	15	5%
Mechanical	30	30%
Communication	15	5%

WWTP

Discipline	ANI	NWL	ION	LNG	LUI
Civil	50%	64%	44%	50%	50%
Electrical	10%	14%	28%	10%	10%
Instrumentation	5%	1%	2%	5%	5%
Mechanical	30%	22%	27%	30%	30%
Communication	5%	0%	0%	5%	5%

% Replacement by Other Programs

FSA	LSA	NSA	VSA
86%	100%	35%	16%

Key Parameters - Asset Condition Grades

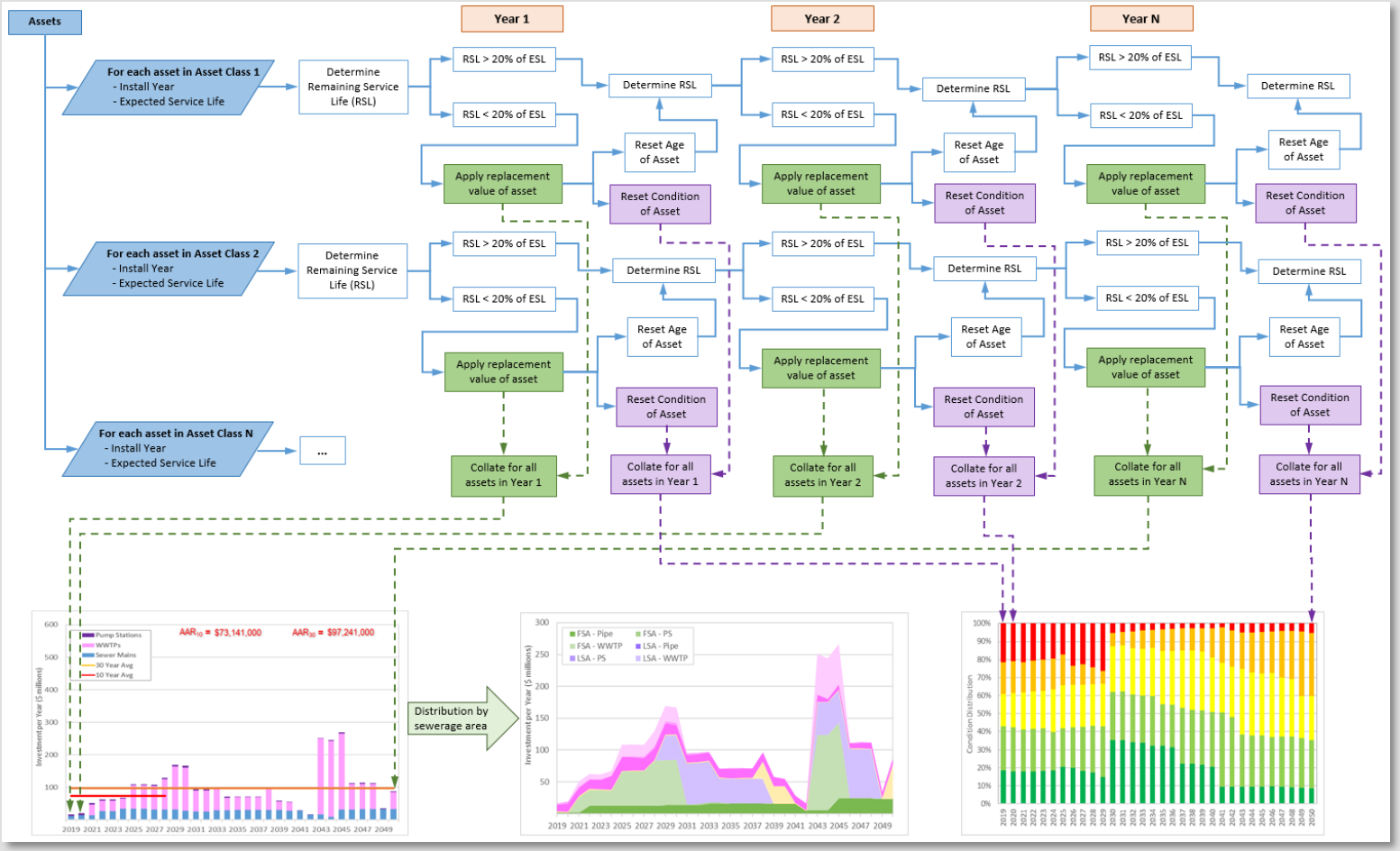
Grade	Condition	% of ESL Remaining	Description
1	Very Good	80 – 100%	Fit for the future
2	Good	60 – 79%	Adequate for now
3	Fair	40 – 59%	Requires attention
4	Poor	20 – 39%	Increasing potential of affecting service
5	Very Poor	< 20%	Unfit for sustainable service

Source: The Canadian Infrastructure Report Card (CIRC)

Data Sources

- GIS
- EAM
- Engineering drawings
- Engineering & Construction historical construction costs
- Unit costs
- Condition assessment reports

IMA Tool Calculation Procedure



Tool Output

LWS 30 Year IMA Tool Interface

30 Years LWS Capital Spending Projection - Maintenance Program

Current year: 2018 (1)

Linear Assets

Min. Condition Score: 4 (2) Average Age: 42 Total Repl. Cost: $10,506 M

Unit Repl. Cost: $12.9 /mm Ø/LM (3)

20% ESL: 20 years (4)

% Replacement by Other Programs	FSA	LSA	NSA	VSA
	20%	70%	30%	50%

(7)

Pump Stations

Min. Condition Score: 4 (2) Average Age: 42 Total Repl. Cost: $313 M

Unit Repl. Cost: $20,000 /HP (3)

PS ESL and Replacement Cost Distribution

Class	ESL (yrs) (5)	Cost (%) (6)	20% ESL (4)
Civil	50	50%	10
Electrical	30	10%	6
Instrumentation	15	5%	3
Mechanical	30	30%	6
Communication	15	5%	3

% Replacement by Other Programs	FSA	LSA	NSA	VSA
	86%	100%	35%	16%

(7)

WWTP

Min. Condition Score: 4 (2) Average Age: 31

% Replacement by Other Programs	FSA	LSA	NSA	VSA
Before New by	80%	0%	100%	80%
After New by	0%	0%	0%	0%

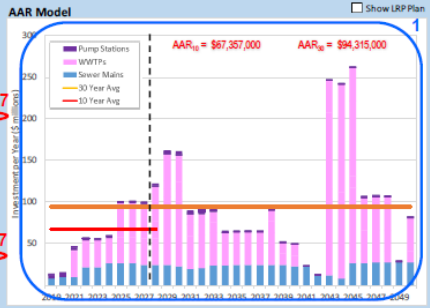
(7)

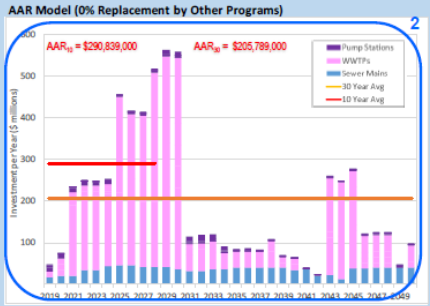
WWTP Renovation Date, ESL and Replacement Cost Distribution

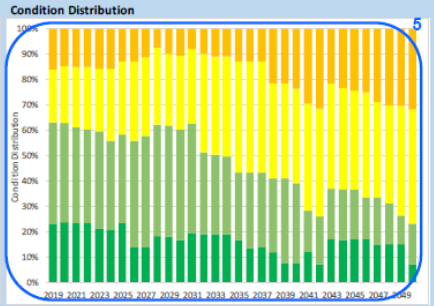
	ANI	NWL	ION	LNG	LUI
New by (8)	2030	2030	2030	2025	

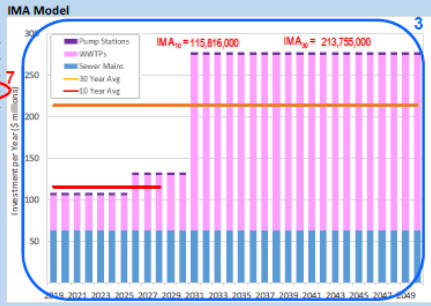
Replacement Cost ($M)						Total
Old Replacement Cost	$2,171	$156	$790	$270	$779	$4,166
New Replacement Cost	$2,800	$750	$1,900	$790	$779	$7,019

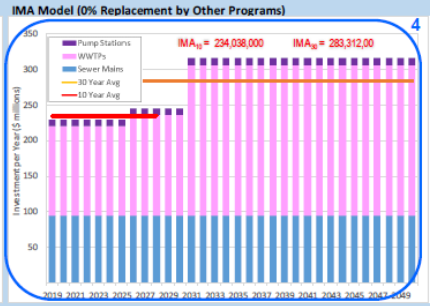
Class	ESL (yrs) (5)	Replacement Cost Distribution (%) (6)					20% ESL (4)
Civil	50	50%	64%	44%	50%	50%	10
Electrical	30	10%	14%	28%	10%	10%	6
Instrumentation	15	5%	1%	2%	5%	5%	3
Mechanical	30	30%	22%	27%	30%	30%	6
Communication	15	5%	0%	0%	5%	5%	3

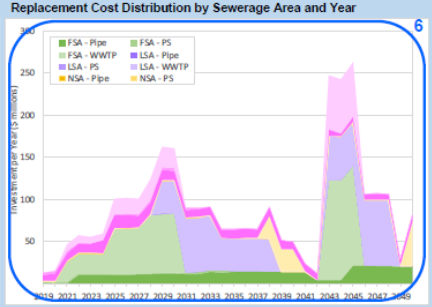












Linear Assets, PS and WWTP Replacement Cost Distribution by Sewerage Area and Year

Program	Area	Asset Type	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
Maintenance	NSA	Pipe	99,090	103,709	103,709	339,170	339,170	346,799	346,799	365,843	379,004	379,004	379,004	379,709	379,709	379,709	379,494	379,494	379,494	379,494	280,619	280,619	280,619	276,000	276,000	40,539	41,565	33,936	85,196	66,152	52,991	52,991	52,99
Maintenance	VSA	Pipe	7,261,997	9,311,891	9,311,891	10,326,929	10,414,325	15,199,595	15,399,775	15,399,775	13,389,292	13,404,783	12,804,375	10,398,184	8,259,292	8,733,659	9,331,510	9,537,607	########	10,399,909	10,399,909	10,394,242	10,394,242	8,344,347	8,385,957	7,358,044	7,805,832	3,020,579	5,383,379	5,383,379	6,392,479	6,376,987	6,862,73
Maintenance	FSA	Pipe	887,571	888,747	889,291	10,504,712	10,504,712	10,504,712	10,504,712	10,523,002	11,111,277	11,111,486	11,726,661	11,790,564	11,406,700	11,427,181	13,739,659	13,488,062	########	14,030,881	14,055,872	14,056,478	13,903,419	13,913,780	13,966,787	4,351,366	4,351,366	4,490,953	21,418,479	21,401,602	20,844,450	20,870,294	20,256,21
Maintenance	LSA	Pipe	0	0	0	0	0	0	0	0	137	137	4,861	4,861	6,785	6,785	6,785	6,785	6,785	6,785	6,785	6,785	6,785	6,785	6,785	6,785	6,785	6,785	6,785	6,785	6,648	6,648	1,92
Maintenance	NSA	PS	738,833	738,833	738,833	1,020,500	845,000	845,000	0	0	234,000	286,000	286,000	437,667	437,667	437,667	52,000	52,000	52,000	52,000	333,667	281,667	281,667	0	0	69,333	69,333	221,000	221,000	221,000	0	563,33	
Maintenance	VSA	PS	2,583,000	2,725,800	2,016,000	1,365,000	214,200	50,400	974,400	1,481,200	2,489,200	3,144,400	3,410,400	3,948,000	3,175,200	2,410,800	915,600	840,000	982,800	932,400	176,400	0	0	0	0	0	462,000	728,000	1,232,000	879,200	1,243,200	756,000	898,80
Maintenance	FSA	PS	1,719,947	1,333,547	1,346,893	1,374,800	1,400,000	1,455,720	838,320	995,867	735,233	721,700	1,421,653	1,425,387	1,724,053	2,274,067	2,285,827	2,052,493	696,360	905,707	580,440	376,040	557,667	548,333	688,333	396,200	396,200	132,440	247,240	326,573	811,533	826,467	759,26
Maintenance	LSA	PS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Maintenance	NSA	WWTP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26,333,333	26,333,333	26,333,333	0	0	0	0	0	0	0	0	
Maintenance	VSA	WWTP	0	0	7,900,000	7,900,000	7,900,000	7,900,000	18,433,333	18,433,333	18,433,333	23,700,000	23,700,000	23,700,000	0	0	0	0	0	0	0	0	0	0	0	0	63,333,333	63,333,333	63,333,333	0	0	0	
Maintenance	FSA	WWTP	0	0	24,310,000	24,310,000	24,310,000	23,270,000	54,296,667	54,296,667	54,296,667	69,810,000	69,810,000	69,810,000	0	0	0	0	0	0	0	0	0	0	0	0	118,333,333	118,333,333	118,333,333	0	0	0	
Maintenance	LSA	WWTP	0	0	0	0	0	0	0	0	0	0	38,950,000	38,950,000	64,916,667	64,916,667	64,916,667	38,950,000	########	38,950,000	38,950,000	38,950,000	0	0	0	0	51,933,333	51,933,333	51,933,333	77,900,000	77,900,000	77,900,000	

WS 30 Year IMA Tool Interface

30 Years WS Capital Spending Projection - Maintenance Program

Current year: 2018 (1)

Linear Assets

Min. Condition Score	4 (2)	20% ESL	20 (4) yrs
Unit Repl. Cost	$8.5 (3) /mm Ø/LM	Total Repl. Cost	$5,340 M
% Repl. by Other Prg-s	0% (7)		
Average Age	44 (3) yrs		

Pump Stations

Min. Condition Score	4 (2)		
Unit Repl. Cost	$9,500 (3) /HP		
% Repl. by Other Prg-s	18% (7)		
Average Age	17 (2) yrs	Total Repl. Cost	$447 M

PS ESL and Replacement Cost Distribution

Class	ESL (yrs) (5)	Cost (%) (6)	20% (4)	ESL
Civil	50	50%	10	yrs
Electrical	30	10%	6	yrs
Instrumentation	15	5%	3	yrs
Mechanical	30	30%	6	yrs
Communication	15	5%	3	yrs

Reservoirs

Min. Condition Score	4 (2)		
Unit Repl. Cost	$2,000,000 (3) / ML		
% Repl. by Other Prg-s	0.5% (3)		
Average Age	38 yrs	Total Repl. Cost	$1,436 M

Reservoir ESL and Replacement Cost Distribution

Class	ESL (yrs) (5)	Cost (%) (6)	20% (4)	ESL
Civil	50	50%	10	yrs
Electrical	30	10%	6	yrs
Instrumentation	15	5%	3	yrs
Mechanical	30	30%	6	yrs
Communication	15	5%	3	yrs

Re-Chlorination Facilities

Min. Condition Score	4 (2)		
% Repl. by Other Prg-s	0% (5)		
Average Age	20 yrs	Total Repl. Cost	$18 M

RCF ESL and Replacement Cost Distribution

Class	ESL (yrs) (5)	Cost (%) (6)	20% (4)	ESL
Civil	50	50%	10	yrs
Electrical	30	10%	6	yrs
Instrumentation	15	5%	3	yrs
Mechanical	30	30%	6	yrs
Communication	15	5%	3	yrs

Dams

Min. Condition Score	4 (2)	ESL	125 (4) yrs
% Repl. by Other Prg-s	0% (7)	20% ESL	20 yrs
Average Age	61 yrs	Total Repl. Cost	$1,217 M

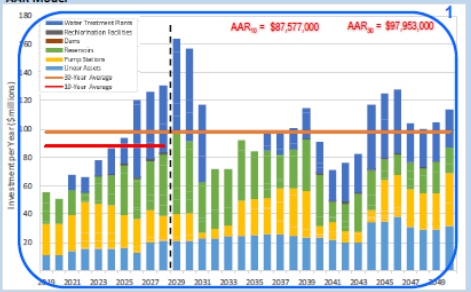
WTP

Min. Condition Score	4 (2)		
% Repl. by Other Prg-s	0% (7)		
Average Age	14 yrs	Total Repl. Cost	$762 M

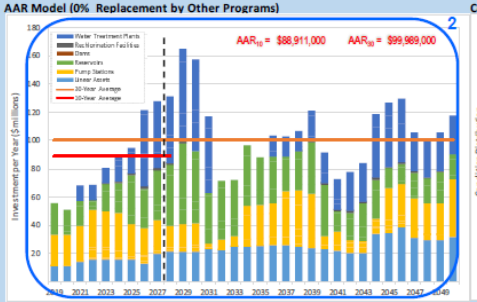
WTP ESL and Replacement Cost Distribution

Class	ESL (yrs) (5)	Cost (%) (6)	20% (4)	ESL
Civil	50	50%	10	yrs
Electrical	30	10%	6	yrs
Instrumentation	15	5%	3	yrs
Mechanical	30	30%	6	yrs
Communication	15	5%	3	yrs

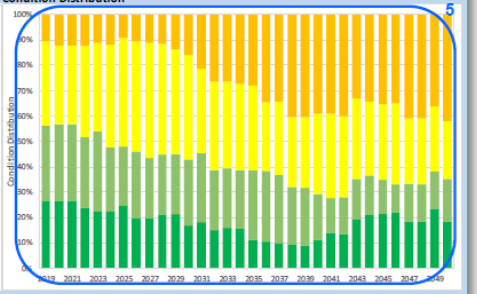
AAR Model (Show LRP Plan) (1)



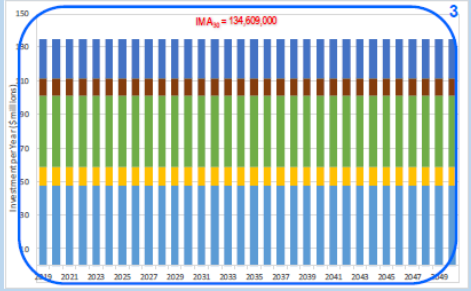
AAR Model (0% Replacement by Other Programs) (2)



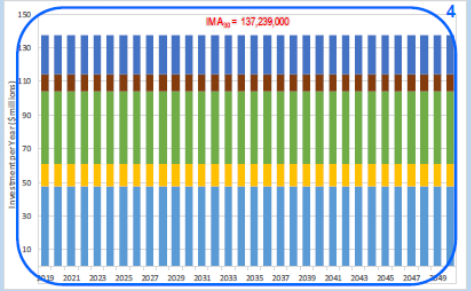
Condition Distribution (5)



IMA Model (3)



IMA Model (0% Replacement by Other Programs) (4)



Challenges and Limitation

Challenges and Limitations

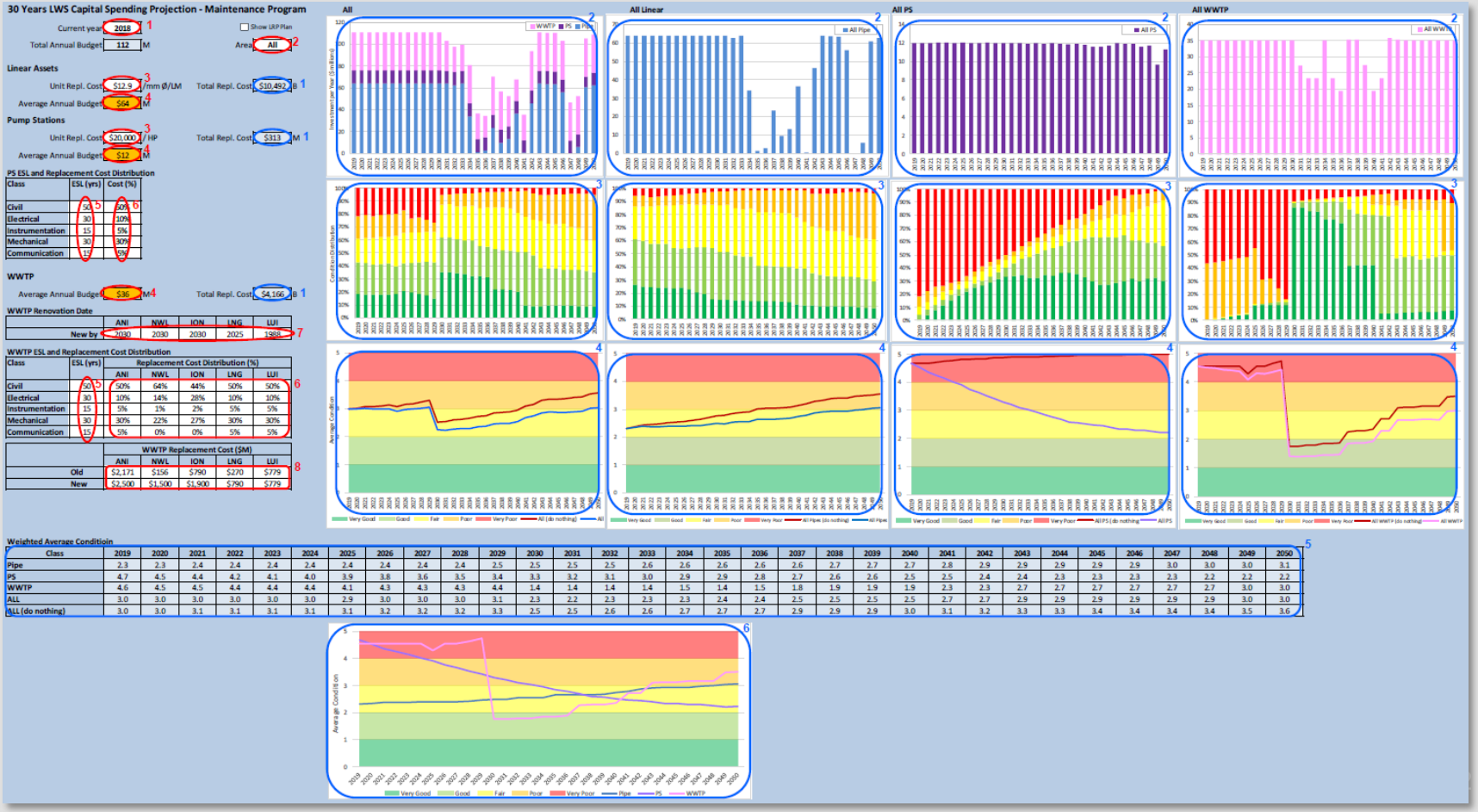
- Facility/Discipline-based reporting (top-down approach)
- Lack of (inspection-based) condition data
- Uncertainty of replacement cost data (e.g. $/HP for pump stations)
- Replacement-based forecast
- Facility criticality (CoF) not considered
- No corridor management considered

Next Steps

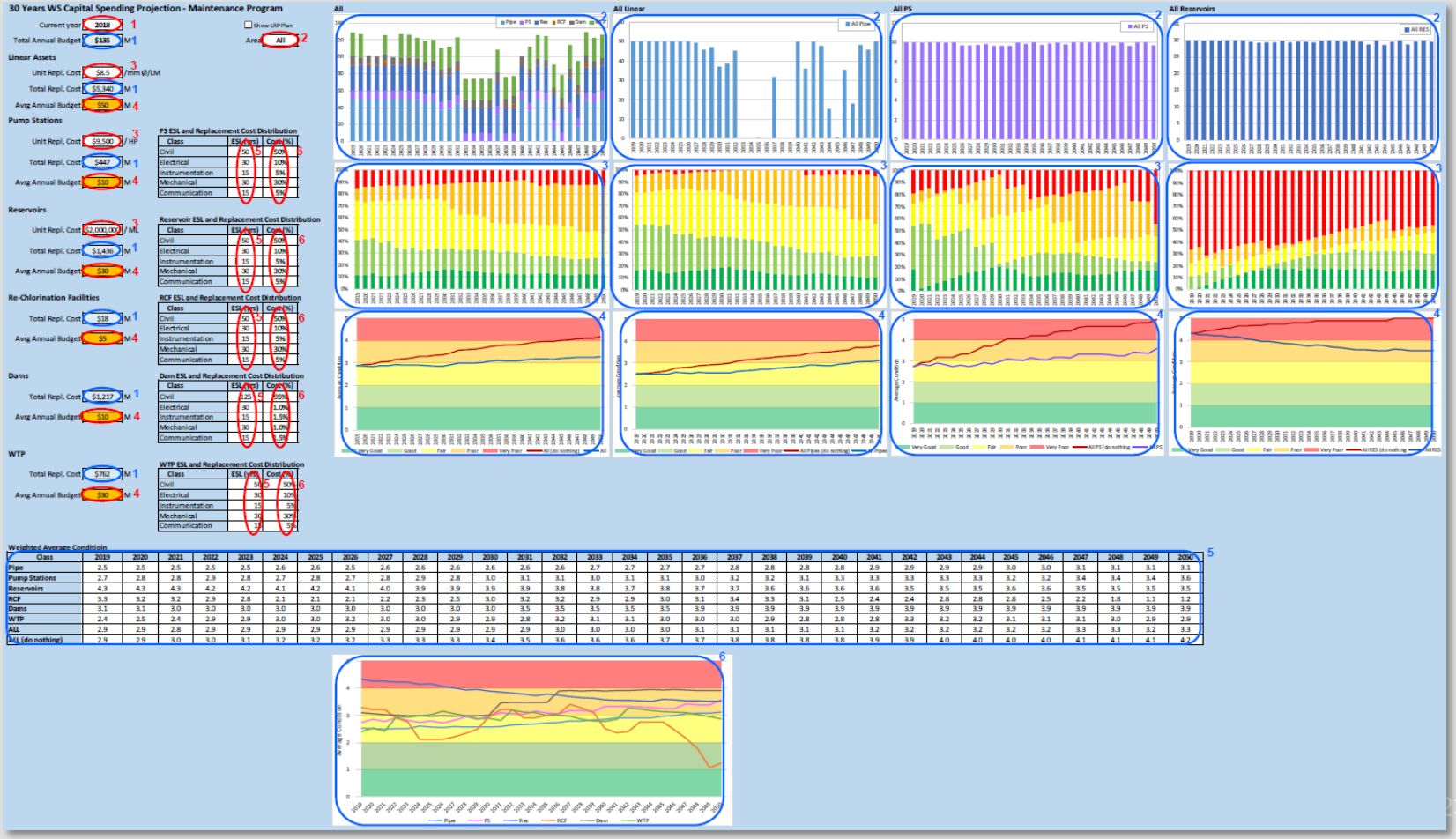
Next Steps

- Update asset inventory
- Verify and update asset replacement cost both at asset and facility levels
- Update criticality and risk data
- Implement condition assessment program
- Develop deterioration analysis modules (e.g. Weibull Distribution, Markov Model)
- Test the State of Good Repair (SOGR) decision support tool

LWS 30 Years SOGR Tool Interface

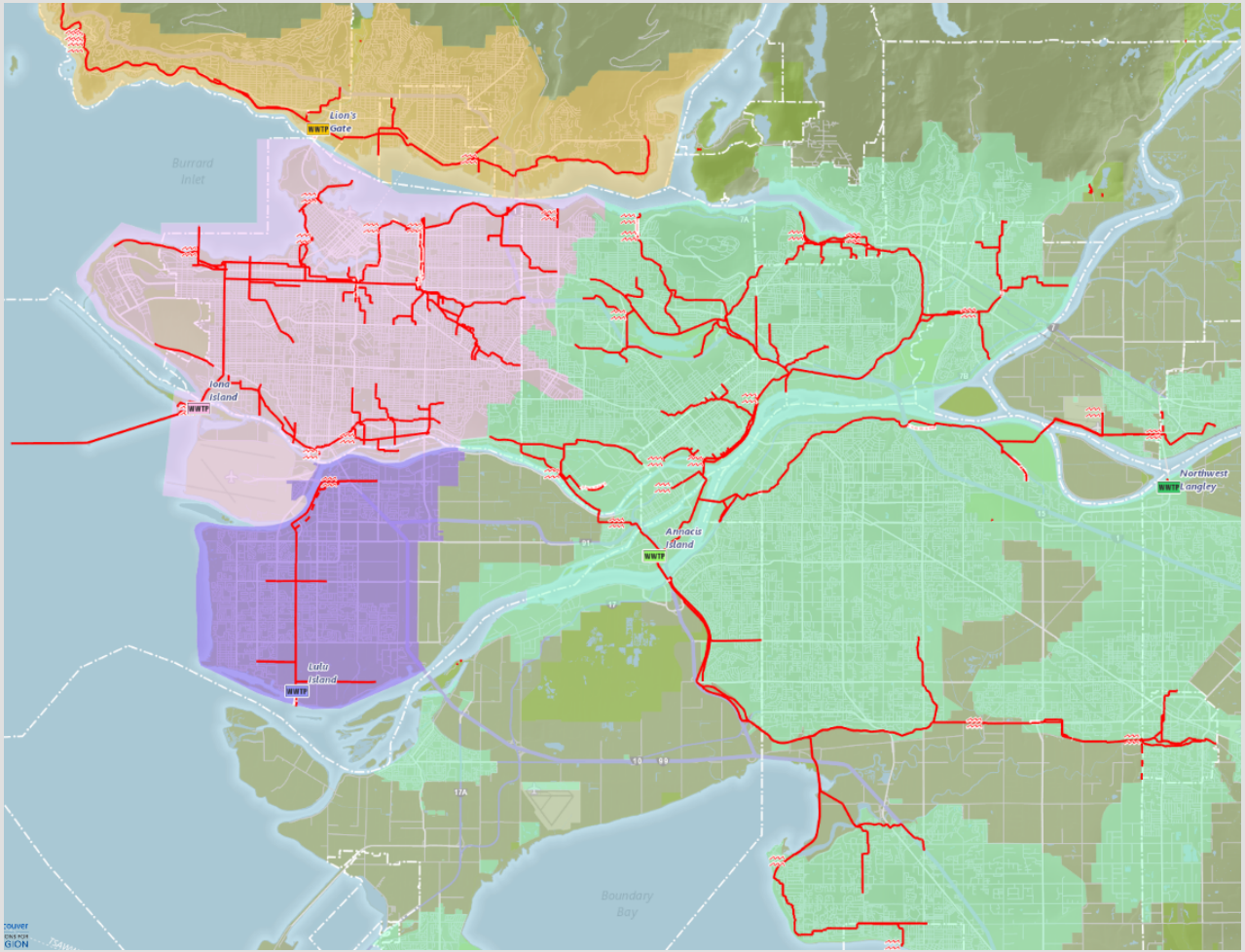
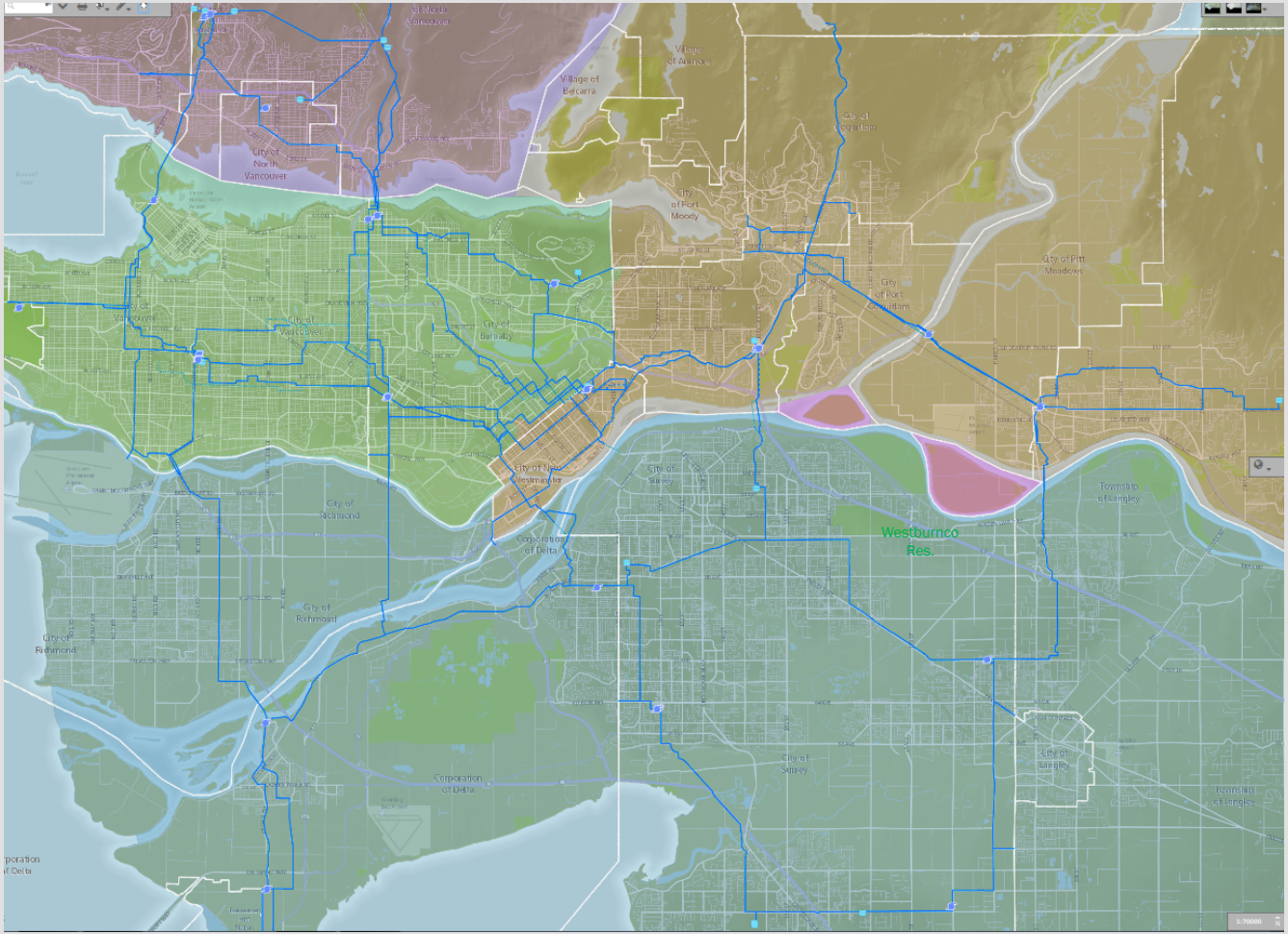


WS 30 Year SOGR Tool Interface



Questions?

Metro Vancouver LWS Areas



Metro Vancouver WS Areas