Update on Conveyance Short List

Comox Valley
REGIONAL DISTRICT

TACPAC Shortlist

- March 22, 2019 TACPAC evaluated and recommended this conveyance shortlist:
  - 2A – overland forcemain
  - 3 A,B,C → optimal tunneling
  - 4A – Northside forcemain
- All viable options cross KFN IR1
- KFN concerns over impacts of existing & future line across IR1

Consultation with KFN

- Preliminary agreement reached between CVRD & KFN
- KFN provided support for next phase of LWMP
- Option 4A removed from shortlist:
  - Lowest scored option carried forward in shortlist (by far)
  - 40% higher capital costs
  - Higher lifecycle costs
  - No possibility of project phasing

Category	Weight	2A	3A	3B	3C	4A
Technical & affordability	63	44	45	45	52	29
Economic, enviro, & social	37	19	18	19	19	18
Total	100	63	63	64	71	47

Optimal Tunnelling Option

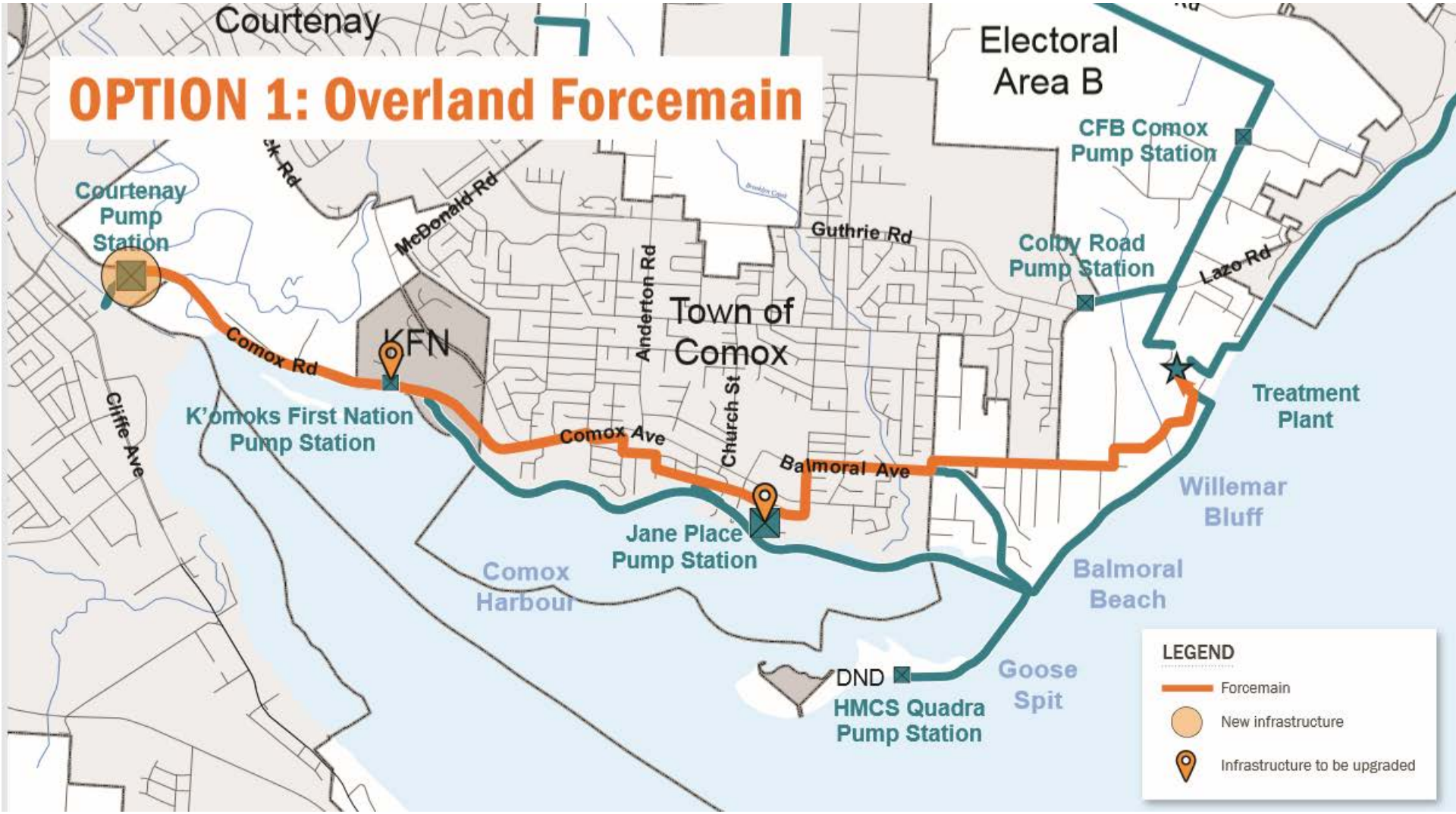
Two key advancements:

1. Horizontal directional drilling
   - Significantly reduce capital cost of tunneling
2. Confirmed existing forcemain can comfortably handle increase in working pressure
   - Opens up the possibility of continued use of a portion of the existing forcemain still in good condition

Optimal Tunnelling Option: phased

Two key conclusions:

1. Optimal tunnelling concept can be completed in two phases:
   - Phase 1- Central Comox to CVWPCC
   - Phase 2- Courtenay pump station to central Comox
2. A phased approach could be optimal:
   - Earliest decommissioning of Willemar Bluffs section
   - Use 15-20 years of remaining service life of estuary section
   - Spreads out massive capital costs over longer timeframe



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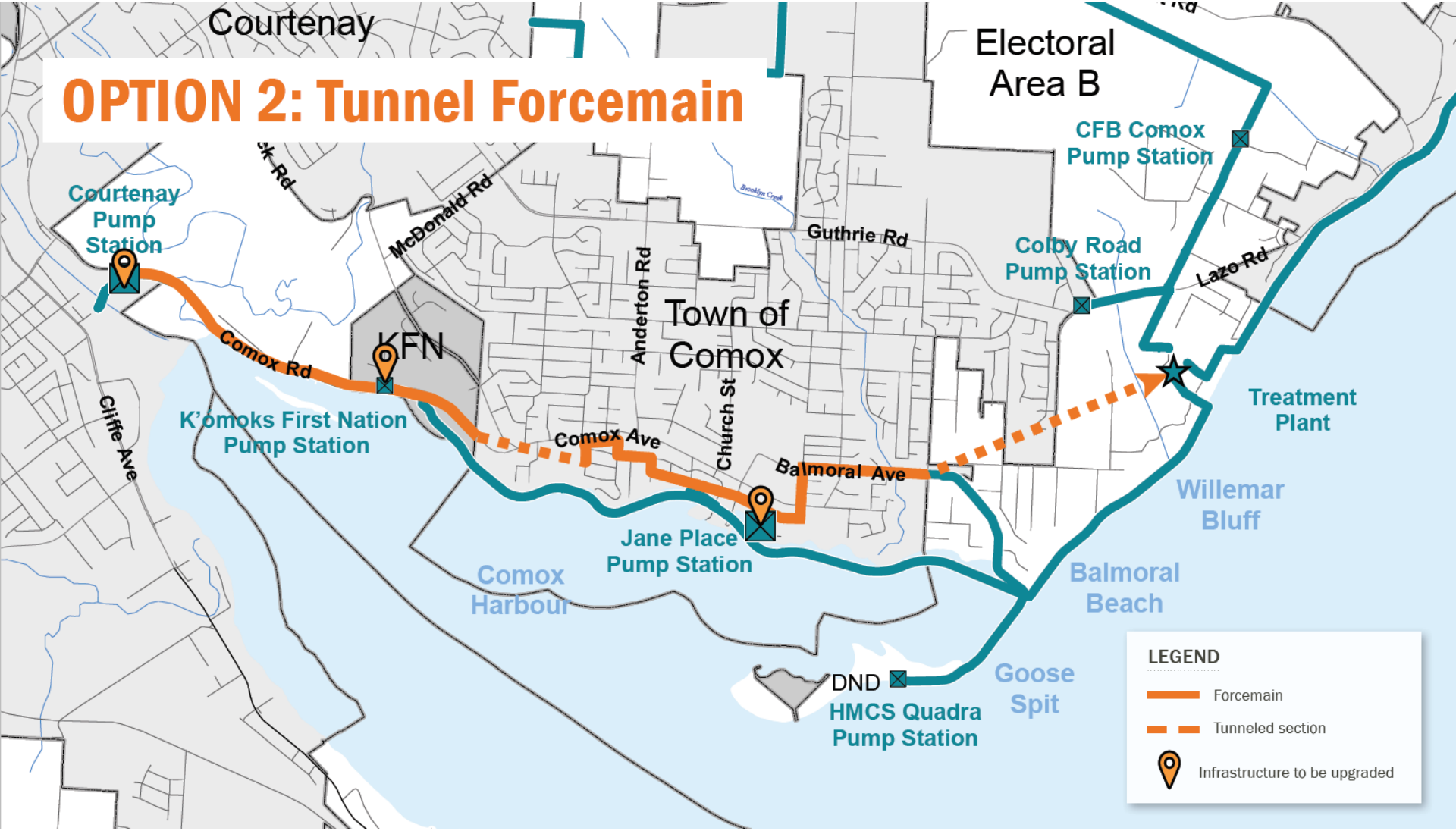
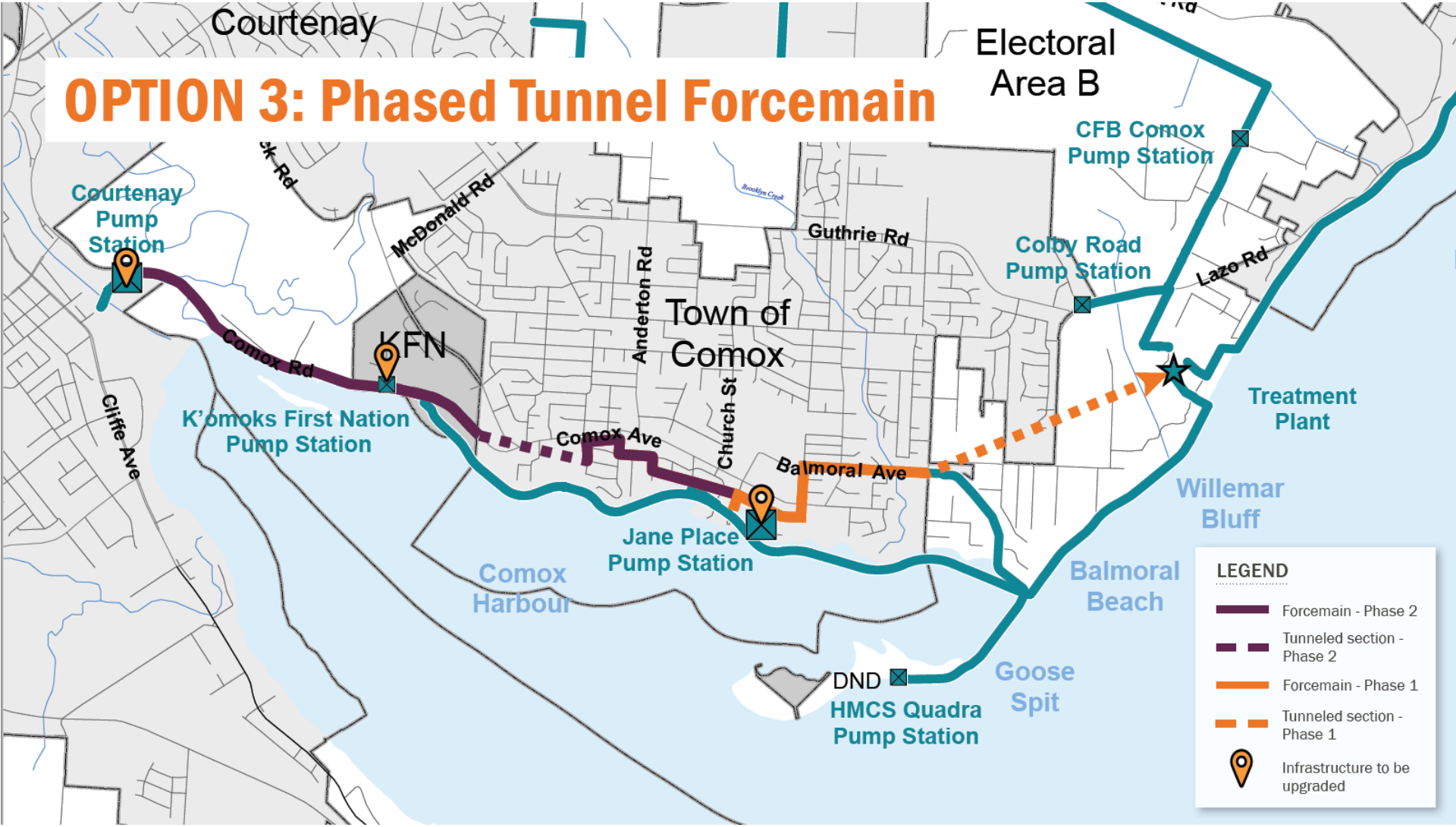
OPTION 2: Tunnel Forcemain



OPTION 3: Phased Tunnel Forcemain



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Summary

- KFN consultation & WSP analysis have allowed us to optimize shortlist
- Three Shortlist Options for TACPAC Evaluation in April/May:
    1. Overland forcemain (previously 2A)
    2. Optimal tunnelling concept (previously 3)
    3. Optimal tunnelling concept with two phase implementation

2020 Schedule

March	SC approval of shortlist/Completion of detailed studies/Initiate online consultation
Early April	TACPAC Meeting No. 10, conveyance evaluation and ranking
Mid-April	Facilitated public session No. 4 to review conveyance options/End public consultation
May	TACPAC Meeting No. 11, final evaluation and recommendation of preferred option.
June	Recommend preferred conveyance option and assent process to CVSC.
Fall	Completion of Stage 2 LWMP report, for approval by CVSC and submission to BC Ministry of Environment.

Stage 2 Wastewater Treatment Level Assessments

March 4th, 2020

Discussion Points for Wastewater Treatment

- Higher effluent quality = higher cost
- Capital cost for treatment often supported by grants
- Operating costs entirely borne by local government
- Emerging contaminants – treatment processes are still in development and effectiveness is uncertain
- Future proofing of facilities when designing upgrades and expansions recommended (i.e., allow for additional processes to be added or existing processes replaced later on when new technologies are proven)

Regulatory Requirements

Federal Regulation

Wastewater Systems Effluent Regulation (WSER)

Regulated Compounds:

- **TSS = 25 mg/L** (Monthly Av)
- **cBOD$_5$ = 25 mg/L** (Monthly Av)
- Total Residual Chlorine
- Un-ionized Ammonia

Provincial Regulation

Municipal Wastewater Regulation (MWR)

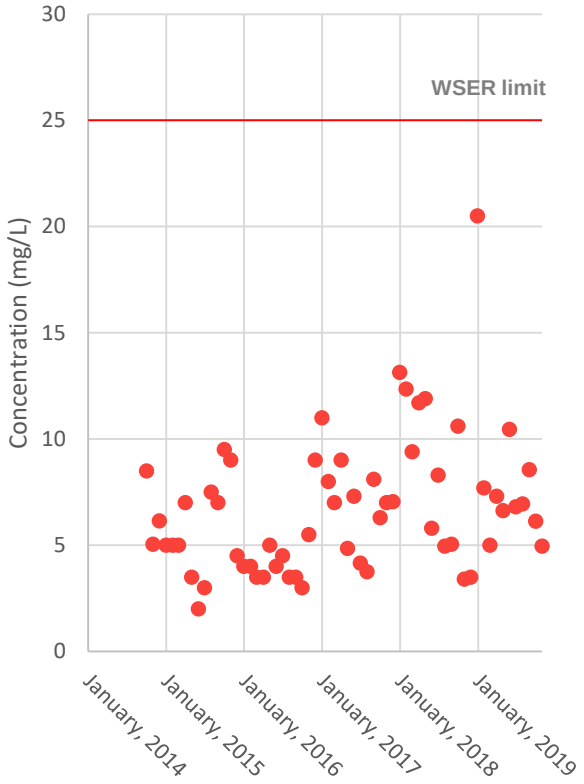
Regulated Compounds:

- **TSS = 45 mg/L** (Max Day)
- **cBOD$_5$ = 45 mg/L** (Max Day)
- pH
- Total Phosphorus
- Ortho-phosphate

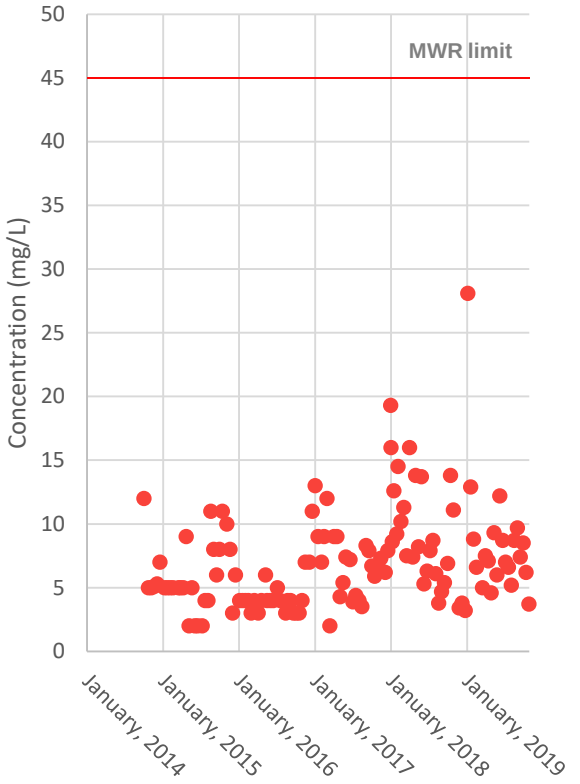
The CVWPCC discharge is not currently registered under the MWR.

CVWPCC Effluent Quality for cBOD5

Effluent Monthly Average $cBOD_5$ Concentration from 2014 to Present

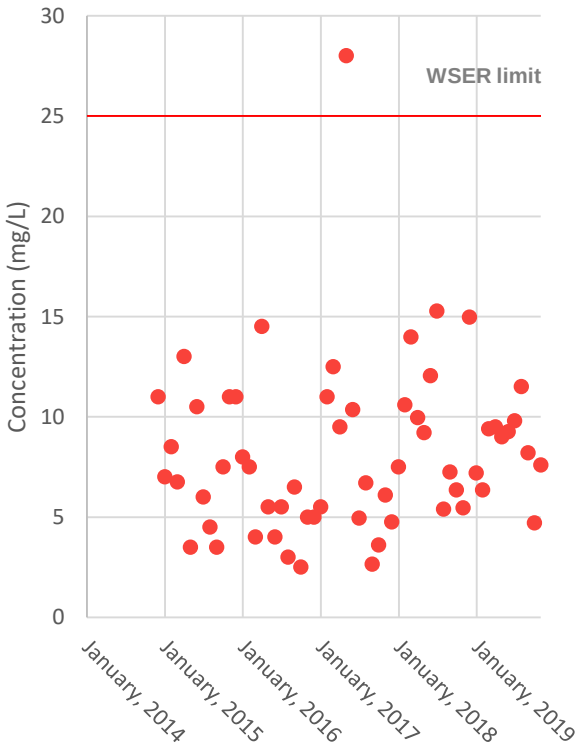


Effluent Daily $cBOD_5$ Concentration from 2014 to Present

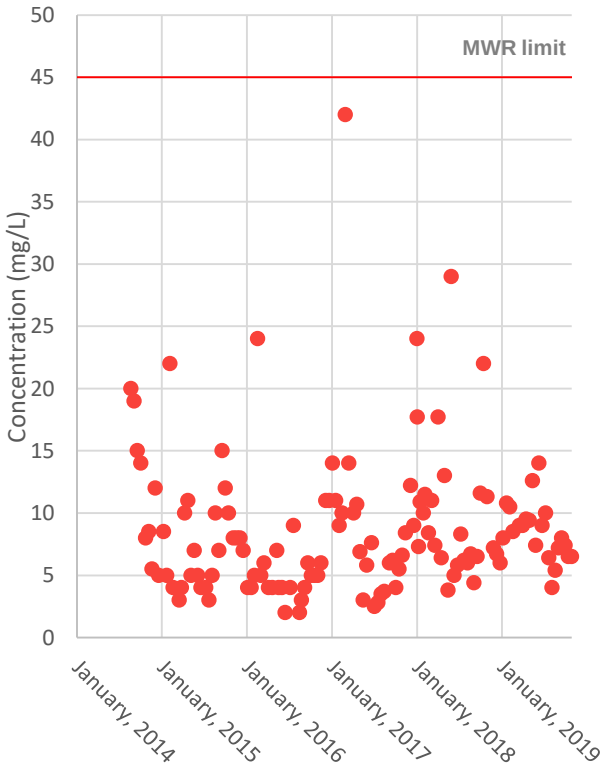


CVWPCC Effluent Quality for TSS

Effluent Monthly Average TSS Concentration from 2014 to Present



Effluent Daily TSS Concentration from 2014 to Present

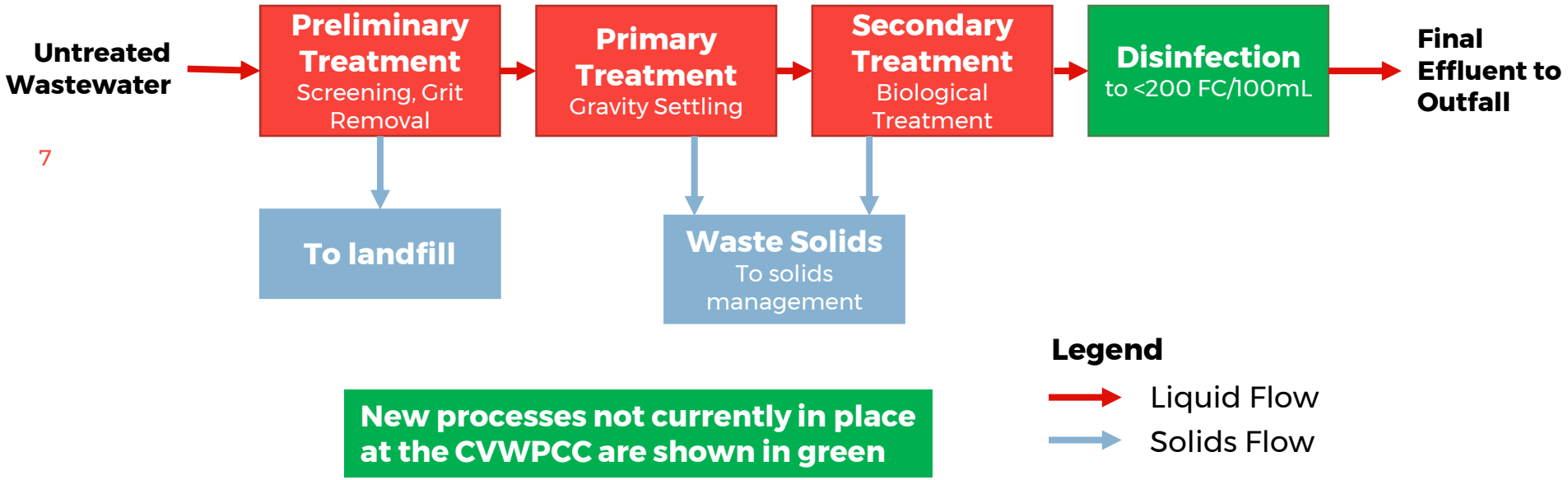


CVWPCC Removal Rates of TSS and $cBOD_5$ from Wastewater

	TSS	$cBOD_5$
Removal Rate	> 95%	> 93%
Average Effluent Concentration	< 9 mg/L	< 8 mg/L

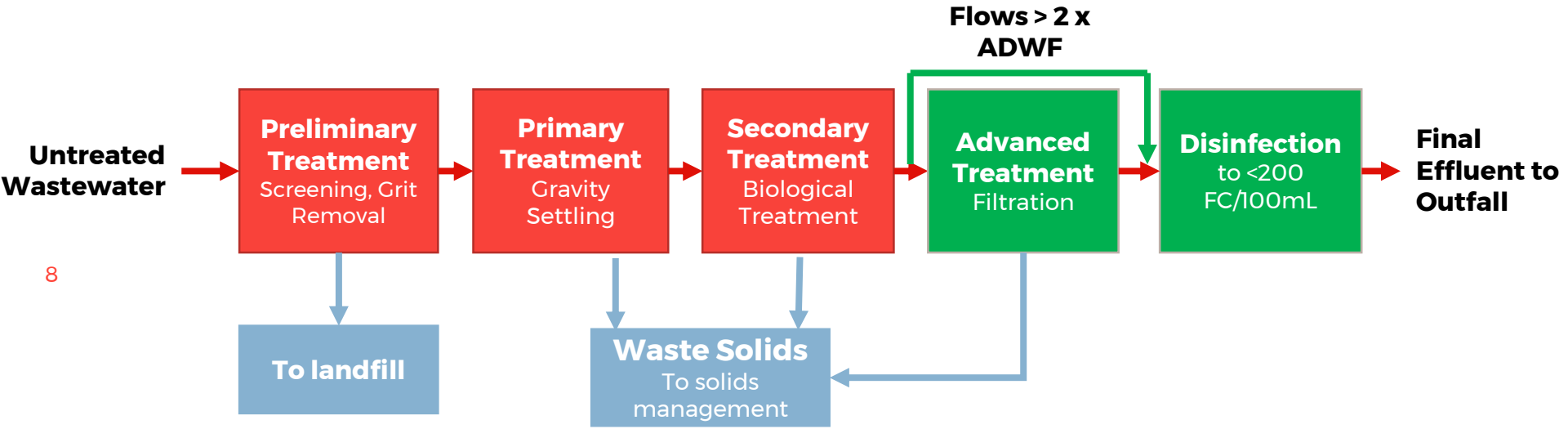
Period of record from Oct 2014 to Dec 2017

Option 2
Secondary Treatment for all Flows + Disinfection



New processes not currently in place at the CVWPCC are shown in green

Option 3
Advanced Filtration for up to 2xADWF + Disinfection

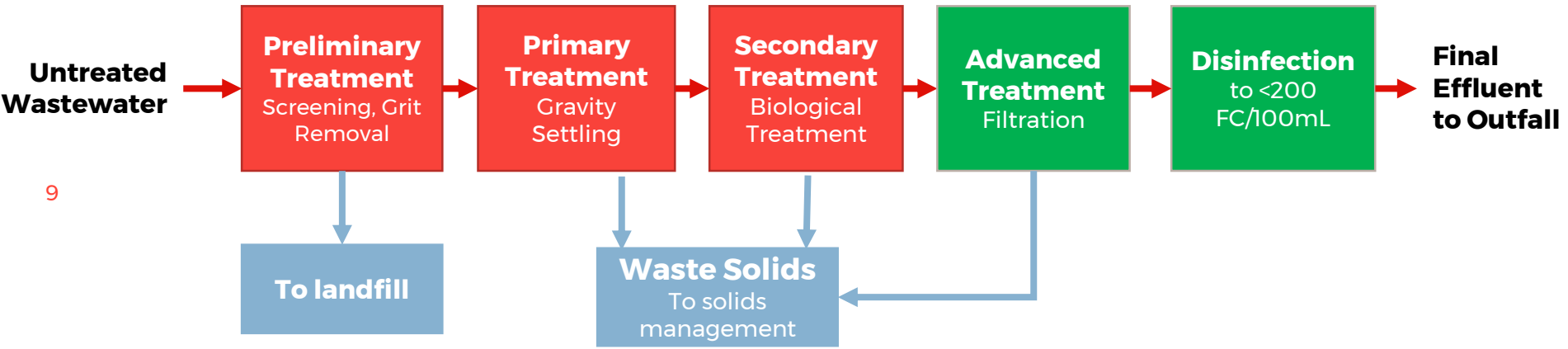


Legend

- Liquid Flow
- Solids Flow

New processes not currently in place at the CVWPCC are shown in green

Option 4
Advanced Filtration for all Flows + Disinfection



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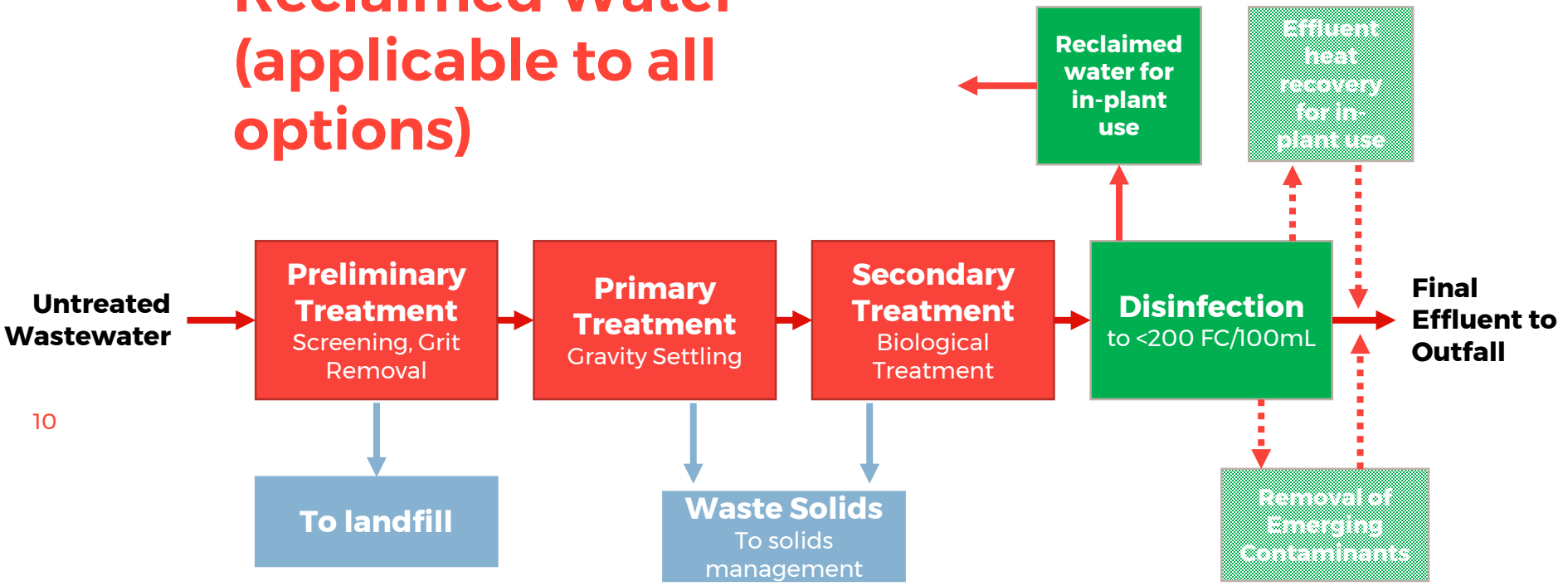
Option 5 Reclaimed Water (applicable to all options)



Note: new processes not currently in place at the CVWPCC are shown in green

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Cost Estimates for Comparison of Treatment Level Options

- Based on CVWPCC upgrade to meet projected 2040 flow and load
- Replacement/refurbishment of existing facilities and equipment not incl.
- Assume continued use of existing processes and technologies
- Effluent UV disinfection to meet regulatory requirements for shellfish protection (fecal coliforms) is included for all options
- Configuration and site layout of upgraded facilities TBD before detailed design of next plant upgrade – based on assumptions for now
- Cost estimates do not include ground improvements for seismic resilience (requires site investigation and earthquake modelling)
- Outfall improvements are required but this will not be affected by the selected level of treatment

Wastewater Treatment Level Options

	OPTION 2 SECONDARY TREATMENT W/ DISINFECTION BASE CASE	OPTION 3 ADVANCED TREATMENT FOR 2XADWF	OPTION 4 ADVANCED TREATMENT FOR ENTIRE FLOW
Sub-Total CVWPCC Upgrade Capital Costs	$ 29,700,000	$ 38,000,000	$ 40,300,000
Subtotal Reclaimed Water (Option 5)		$800,000	
Total	$ 30,500,000	$ 38,800,000	$ 41,100,000

Option 2 – Secondary Treatment + Disinfection Benefits and Risks

Benefits:

- Upgrade path to meet capacity and regulatory requirements for the next 20 years
- Secondary treatment typically removes 90% of organic material and solids on average
- The CVWPCC currently achieves greater than 95% removal of TSS and greater than 93% removal of $cBOD_5$
- Typical CVWPCC effluent quality for daily $cBOD_5$ is consistently less than 20 mg/L and TSS less than 25 mg/L, with average values less than 10 mg/L
- Secondary treatment removes 80-95% of microplastics on average
- Disinfection to meet shellfish standards
- Reclaimed water can be incorporated.
- Design can incorporate space for installation of disk filters if required in the future.

Risks:

- Capital costs are dependent on condition assessment and outcome of a Pre-design study.

Option 3 – Secondary Treatment + Effluent Filtration for 2xADWF + Disinfection Benefits and Risks

Benefits:

- Base case secondary treatment upgrades apply
- Advanced treatment (filtration) for up to 2xADWF accounts for approximately 99% of the annual flow being treated to advanced standards.
- Addition of advanced treatment filtration removes 96% of organic material and solids on average, a marginal increase of 6% over secondary treatment
- Typical effluent quality for up to 2xADWF for daily $cBOD_5$ and TSS consistently less than 10 mg/L, with average values less than 5 mg/L
- Addition of disk filters removes 95-97% of microplastics on average, a marginal increase of 15-17% over secondary treatment
- Large scale effluent reuse can be implemented

Risks:

- Capital cost premium of approximately $8.3M for addition of disk filters to treat 2xADWF
- Increase in operational costs
- Advanced treatment to the level provided by disk filters is not a regulatory requirement
- Without a user for the reclaimed water, costs may not be justified at this point in time

Option 4 – Secondary Treatment + Effluent Filtration for Entire Flow + Disinfection Benefits and Risks

Benefits:

- Base case secondary treatment upgrades apply
- Addition of disk filters removes 96% of organic material and solids on average, a marginal increase of 6% over secondary treatment
- Addition of advanced treatment filtration removes 95-97% of microplastics on average, a marginal increase of 15-17% over secondary treatment
- Large scale effluent reuse can be implemented
- Typical effluent quality for entire flow for $cBOD_5$ and TSS consistently less than 10 mg/L, with average values less than 5 mg/L.

Risks:

- Capital cost premium of approximately $10.6M for addition of disk filters to treat the full flow
- Increase in operational costs
- Advanced treatment to the level provided by disk filters is not a regulatory requirement
- Without a user for the reclaimed water, costs may not be justified at this point in time

Studies in Advance of Detailed Design for CVPCC Upgrade

- **Pre-design/Master Plan**
  - Develop site layout and staging for long-term future
  - Process selection and process design
  - Cost Estimates
- **Condition Assessments**
  - Major Equipment
  - Concrete Structures and Tanks
  - Buildings
- Site subsurface investigation and earthquake modelling to develop recommendations and costs for ground improvements (if required)

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Liquid Waste Management Plan - Stages 1 & 2

WSP

Resource Recovery Discussion

March 4th, 2020

Resource Recovery Options

- use of reclaimed effluent for irrigation or other purposes;
- installation of heat exchangers in the wastewater stream for heating and cooling of buildings;
- production of biogas (methane) through treatment of waste solids, which can be used in combustion facilities designed for cogeneration of electrical power and heat or in boilers for hot water heating systems or for sale to the local utility;
- use of digested waste solids as a natural solid conditioner/fertilizer, and/or use of waste solids as a feedstock to produce compost for household or commercial use;
- production of mineral pellets rich in nitrogen and phosphorus (struvite) for use as fertilizer; and
- use of hydroelectric turbines to generate electrical power from the outfall discharge.

Reclaimed Water

Benefits:

- offset portable water use at the CVWPCC (equipment sprays, washdown water, landscape irrigation etc.)
- could be a cost effective water source for offsite users (irrigation, industrial use, or stream and wetlands augmentation etc.)
- revenue potential

Considerations:

- adds to the cost of treatment
- must meet water quality requirements (user specific)
- economics strongly influenced by the conveyance distance (capital, O&M costs)
- environmental impacts

Reclaimed Effluent Storage for Irrigation

Reclaimed Effluent for In-Plant Use

Heat Recovery

Heat extracted from wastewater could be used for:

- **space heating (winter):**
  - CVWPCC space heating
  - recreational centre
  - Schools
  - airport
  - houses etc.
- **process heating (year round):**
  - CVWPCC biogas processing
  - lumber drying
  - commercial laundry
  - airport (hot water) etc.

Anaerobic Digestion and Gas Recovery

Beneficial reuse of biosolids

Anaerobic digestrrs

Benefits:

- production of biogas from methane recovery
- revenue from sale of scrubbed biogas
- production of electricity for use at the CVWPCC
- reduced volume of solids
- production of biosolids for use as a soil conditioner and natural fertilizer

Considerations:

- economics of anaerobic digestion and methane recovery depend on service population

Nutrient Recovery

Phosphorus and Nitrogen Recovery as Struvite Fertilizer Pellets

— natural fertilizer that can offset the production and use of chemical fertilizers and generate revenue

Considerations:

— likely not feasible at the CVWPCC at present, due to economies of scale and the treatment processes currently in use

Hydro-electric Turbine for Electrical Power Generation

- in some cases where there is a large elevation difference between the treatment plant and the receiving water (i.e., the land section of the outfall has a steep downward slope), it is possible to install a small hydroelectric turbine to generate electricity

- in the case of the CVWPCC where there is minimal head loss under certain tidal conditions and effluent pumping is required, this type of energy recovery is unlikely to be a viable option

Planning for Resource Recovery

- Future upgrades could include consideration for additional treatment steps and resource recovery facilities (e.g., space on the CVWPCC site or in the plant hydraulic profile)
- Prior to implementation, a detailed study should be completed to evaluate the feasibility and cost benefit of specific resource recovery applications
- The LWMP could include a commitment or recommendation to study the feasibility of specific resource recovery facilities at the CVWPCC

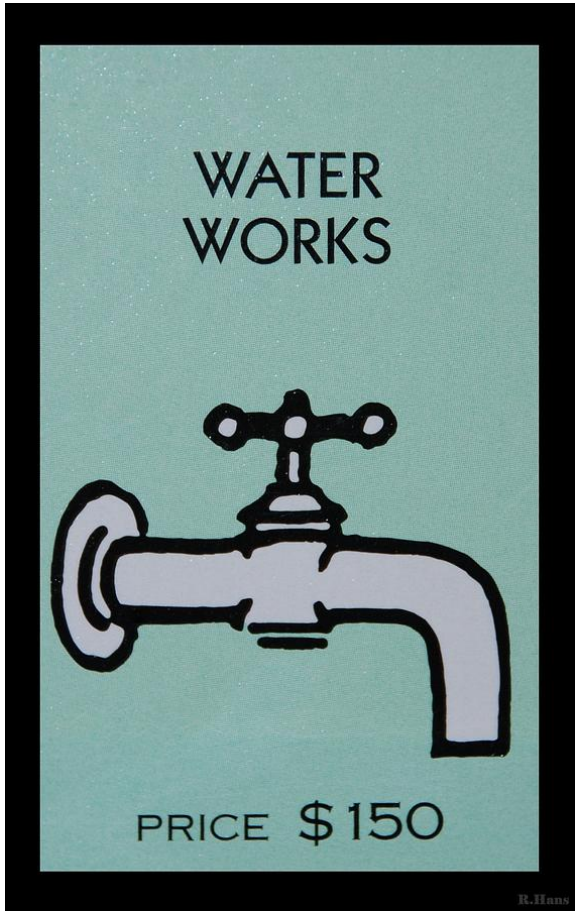
Reclaimed Water Ideas

Brainstorming session at TACPAC 5, Feb 2019;

Wastewater as a Utility

Consider the question if it was a business supplying reclaimed water to customers:

Use Reclaimed Water at *[Location]* by *[User]* for *[Use]*



Results?

Use Reclaimed Water;
at [**14** Locations],
by [**26** Users],
for [**41** Uses].

14,924 theoretical combinations!

Summarised Results

- Group the locations by distance from CVWPCC 0-4km, 4-8km, >8km
- End up with users and uses typically being the same thing e.g. farmer for irrigation.
- 79 meaningful combinations

Summary Table is in WSP Resource Recovery Memo

Use (at each site)	Water Quality Requirement	Volume (m3/day, summer)	Nearby Localities (0-4km)					Farther Localities (4-8km)							Remote Localities (>8km)							
Per site		Greater than X	CVWPCC	Lazo Beach Area	Queen's Ditch farm area	Airport	Comox (Town)	KFN	Estuary Farm area	Courtenay (East)	Crown Isle Resort	Anderton Rd (South of Ryan)	Little River	Courtenay (West)	Anderton Rd (North Ryan)	Portuguese Creek Valley	Royston	Union Bay	Denman Island	Texada Island
Stream augmentation	GEP/IPR	10,000			Y											Y		Y		Y
Agriculture -spray irrigation, field crops	GEP	100			Y				Y			Y	Y		Y	Y	Y	Y	Y	
Concrete mixing	GEP	100												Y						
Airport (all outdoor uses)	GEP	100				Y														
Golf Course (each)	GEP	100				Y	Y				Y					Y				
Wetland augmentation	GEP/IPR	100		Y																
Agriculture - spray irrigation, forage	MEP	100			Y				Y			Y	Y		Y	Y	Y	Y	Y	
Mining	MEP	100																		Y
Irrigation playing field/school	GEP	10					Y			Y	Y	Y		Y			Y	Y		
Airport (all indoor uses)	GEP	10				Y														
Gravel washing	GEP	10								Y				Y						
Dust Control	GEP	10								Y				Y						
Car Wash	GEP	10					?			Y				Y						
Transit bus wash	GEP	10												Y						
Comox marina (boat washing)	GEP	10					Y													
Irrigation - municipal park	GEP	10					Y	Y		Y	Y	Y		Y						
Irrigation - cemetery	GEP	10					?			?				?						
BC Ferries Little River	GEP	10								Y				Y						
Irrigation roadside	GEP	10					Y	Y		Y	Y			Y						
HMCS Quadra	GEP	10					Y													
Tree Farm (Xmas, timber)	MEP	10														Y	Y		Y	Y
Commercial nursery, greenhouse	MEP/GEP	10								Y		Y		Y	Y	Y				
Agriculture- subsurface drip irrig.	MEP	10										Y	Y		Y	Y	Y	Y		
CVWPCC	MEP/GEP	10	Y																	
Industrial process	MEP/GEP/IPR	10								Y				Y						
Commercial laundry	MEP/IPR	10								Y				Y						
Public washrooms	GEP	1					Y	Y		Y	Y		Y	Y				Y		
Rural residential	IPR	1		Y				Y				Y	Y		Y	Y	Y	Y	Y	
Flood irrigation of cranberries	Not allowed	-																		
Approx Total Water (m3/day, summer)				10	100	1000	100	100	10	1000	100	100	100	1000	1000	1000	10,000	1000	1000	100	100

What does it mean?

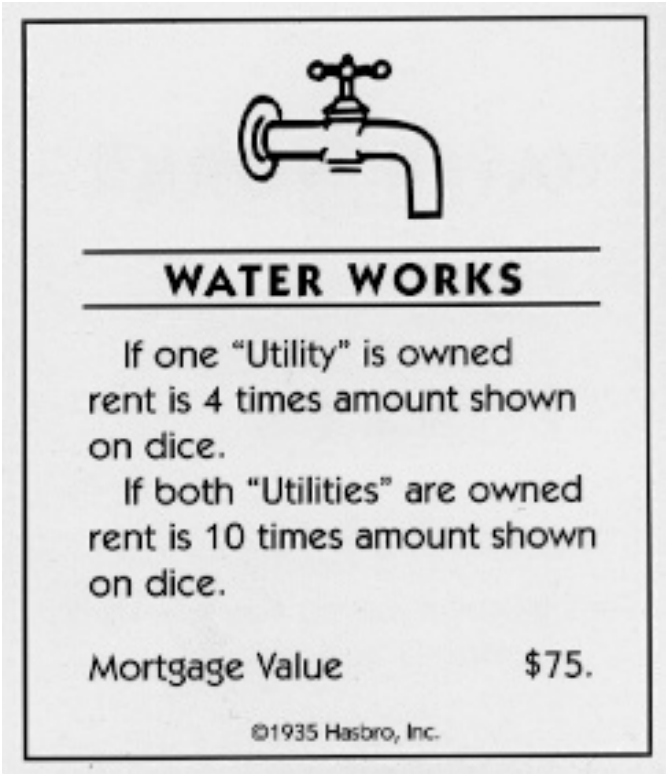
- With the exception of in-plant water use, all the users are external to the CVWPCC
- None of the external water uses result in a treatment or other functional benefit to the CVWPCC or the CV Sewerage Service

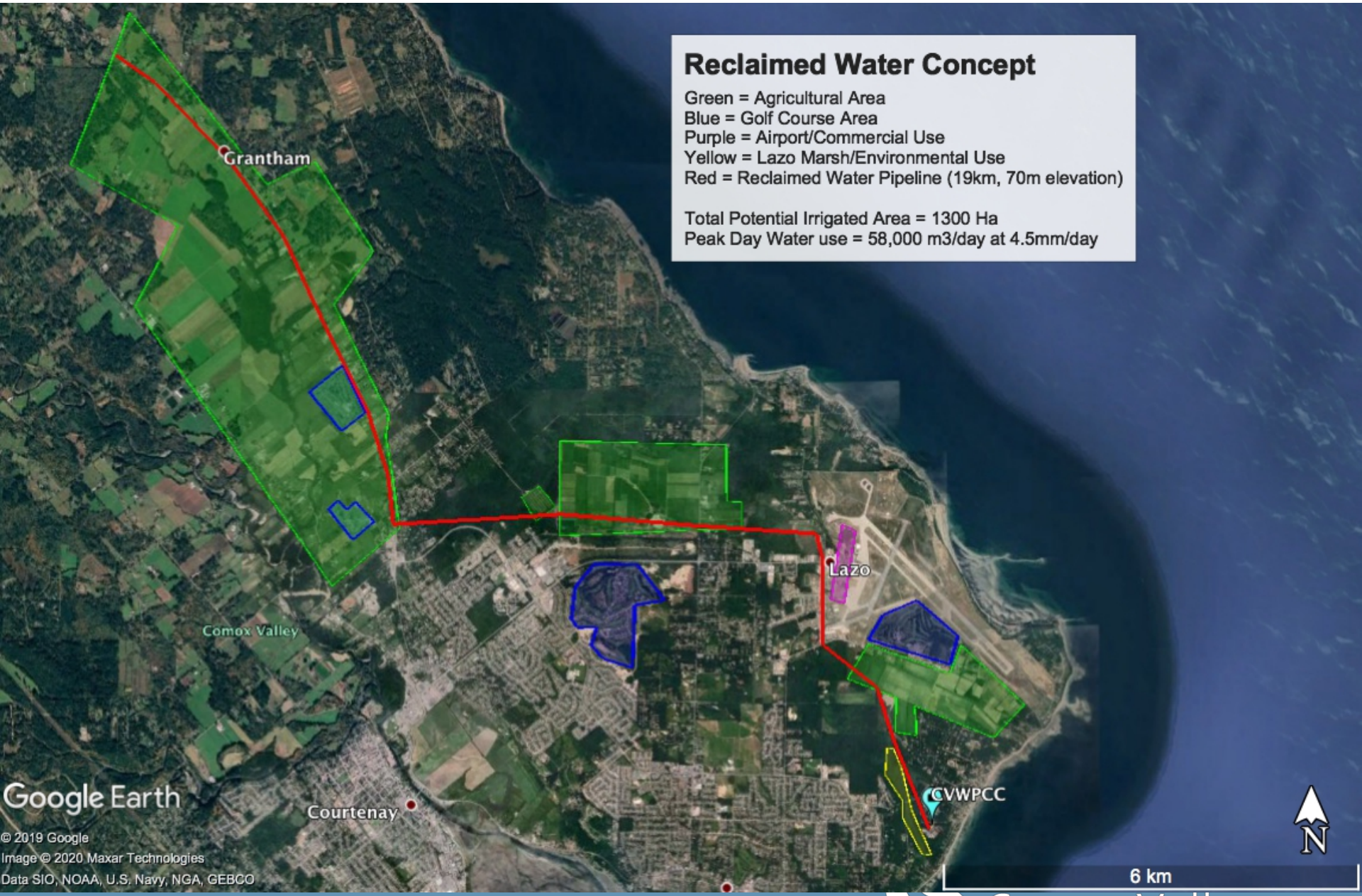
Implementation is thus outside the scope of the LWMP

But a project could be pursued by the external users, if they think it worthwhile…

Potential External Reclaimed Water Utility

- Send reclaimed water to Portuguese Creek watershed, for agricultural irrigation and possibly stream augmentation.
- Distance from CVWPCC to north of Grantham, 19km and 70m elev.
- Pick up other users along the route
- Charge the users for the cost of the scheme





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Summary of Uses

Location	Use	Irrigated Area (ha)	Volume, (m3/day)
Portuguese Creek Area	Ag. Irrigation	800	36,000
Portuguese Creek Area	Stream Aug.	0	?
Crown Isle Golf Course	Public Irrig.	20	900
Ag area north of Crown Isle	Ag. Irrigation	240	10800
Ag area near Queens Ditch	Ag. Irrigation	120	5400
Glacier Greens Golf Course	Public Irrig.	20	900
Airport	Commercial use	0	20
Total		**1200**	**56,020**
CVWPCC Summer Flow			**12,000**

Irrigation use based on 4.5mm/day = 45m3/ha/day

Summary

- Water can be reclaimed by the CVWPCC, but it is up to potential users to “pull” the project, not the CVSS to “push it.

- A treatment upgrade (filtration) would be needed

- The Tsolum River Watershed Study could consider this potential project.