North Okanagan Wastewater Recovery Project

Defining an Affordable Wastewater Solution using VE

Value Factory Session
October 6, 2021

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- Professional Engineer - 39 years
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- SAVE College of Fellows - 2012
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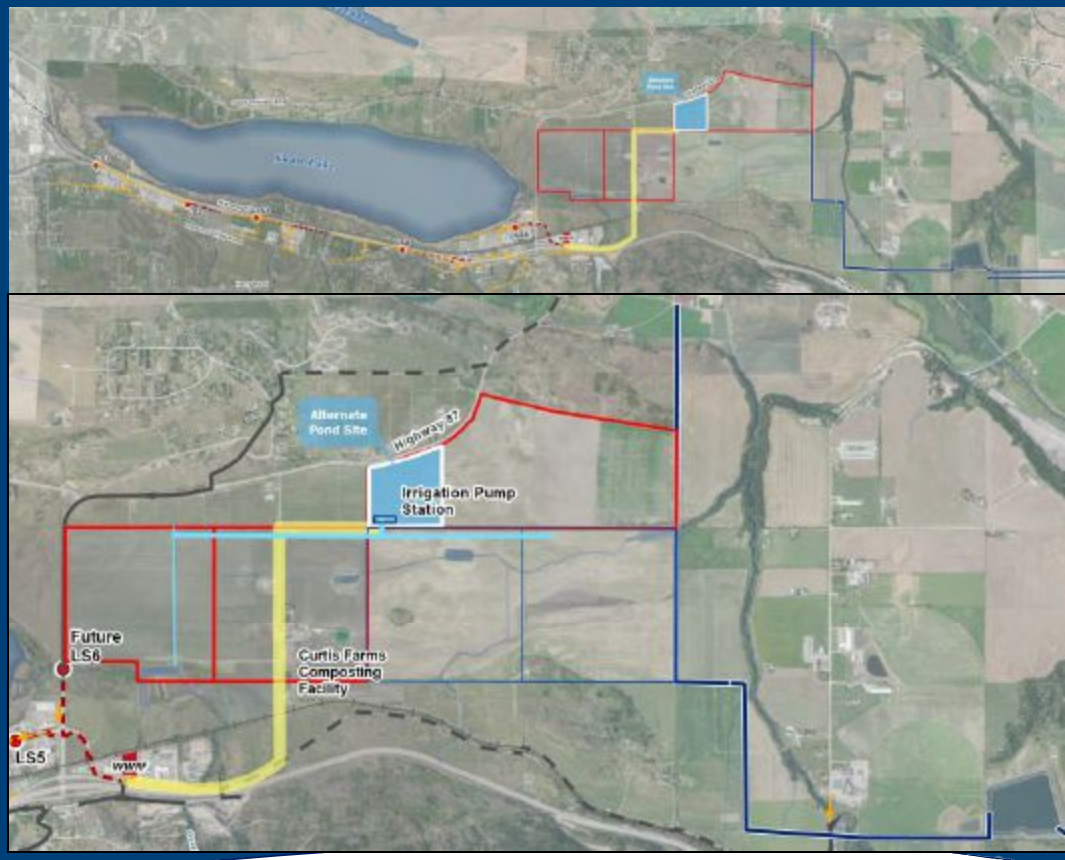
Today's Presentation…

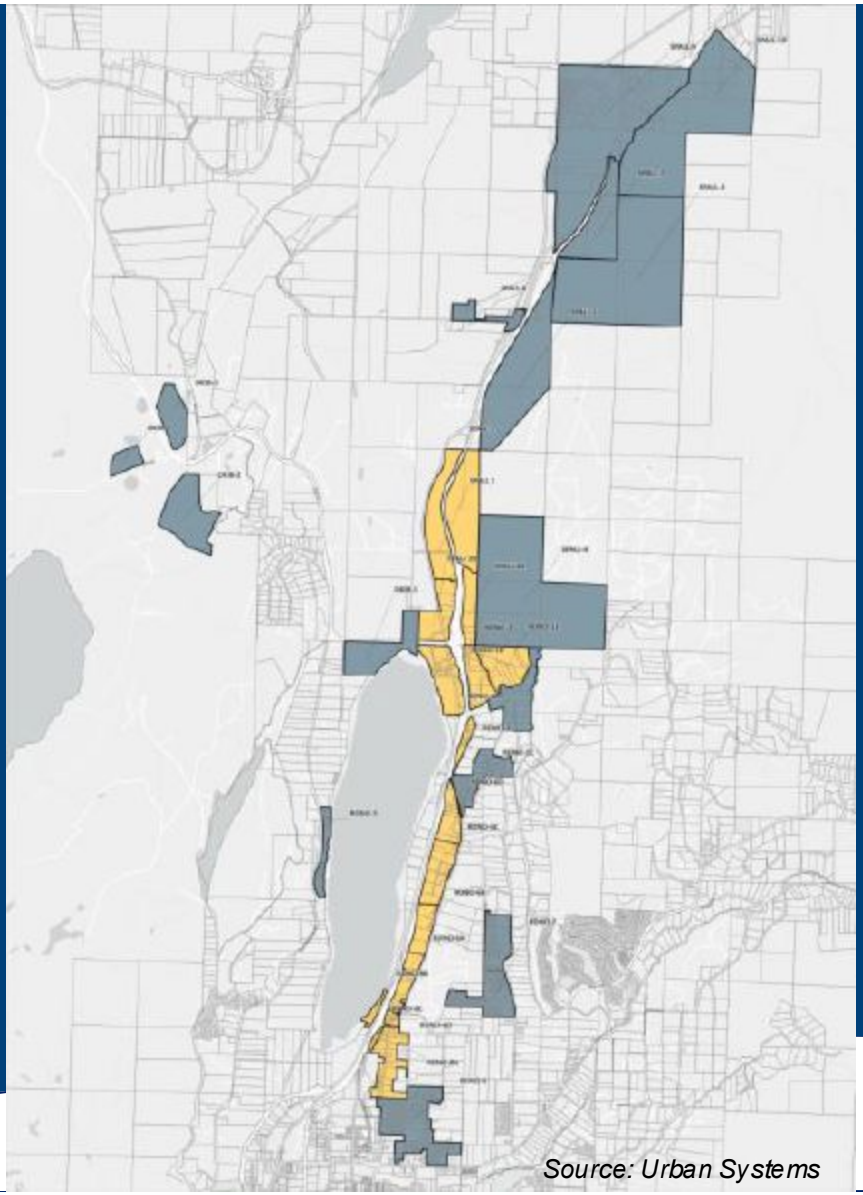
- **Five Aspects:**
  - Project Concept/Challenges
  - VM Strategy
  - Key Value Opportunities
  - Defining Affordable Solutions
  - Project Path-Forward



Project Concept and Challenges

Key Project Goals

- **Support growth**
- **Improve irrigation of agricultural lands**
- **Manage water quality of Swan Lake**
- **Create a regional solution**



Source: Urban Systems

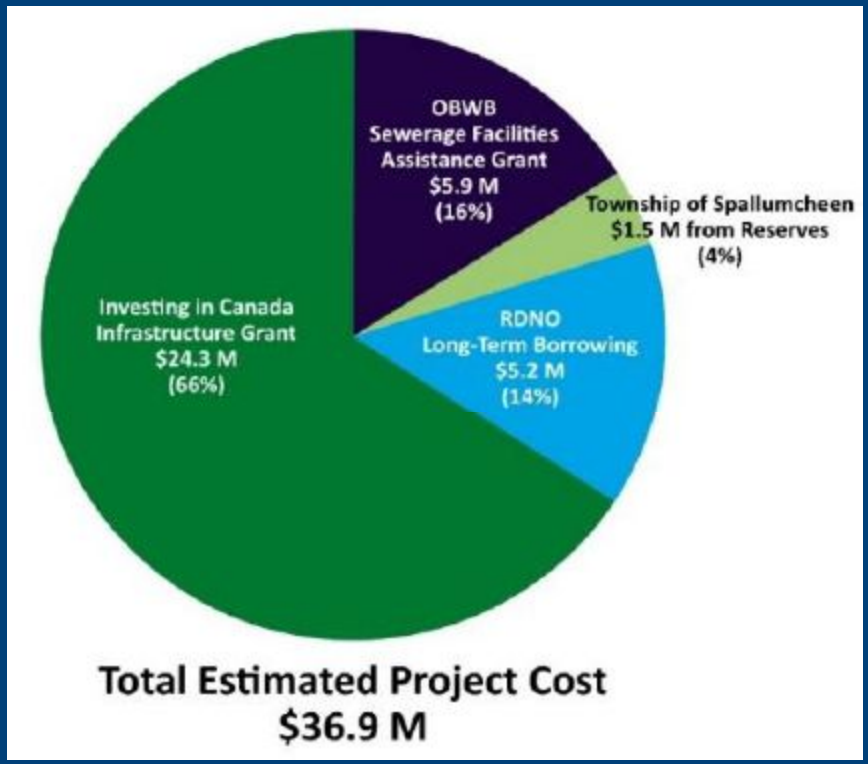
Project Concept

- 16 km of gravity/forcemains, and five lift stations
- 1.7 MLD Sequencing Batch Reactor (SBR) treatment plant
- 285 ML reclaimed water storage pond and distribution

Source: Urban Systems

Capital Funding Summary

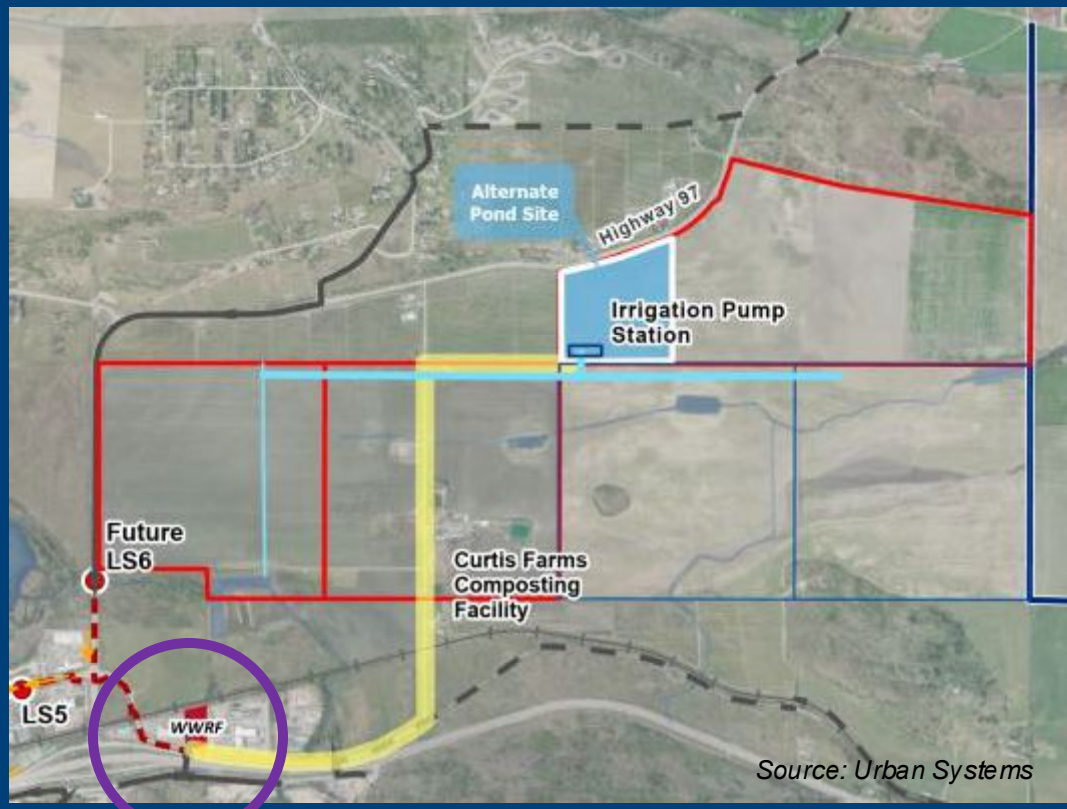
- **2018 estimate of total project cost at $36.9 M**
- **$24.3 M (66%) grant funding (Canadian gov't)**



Source: Urban Systems

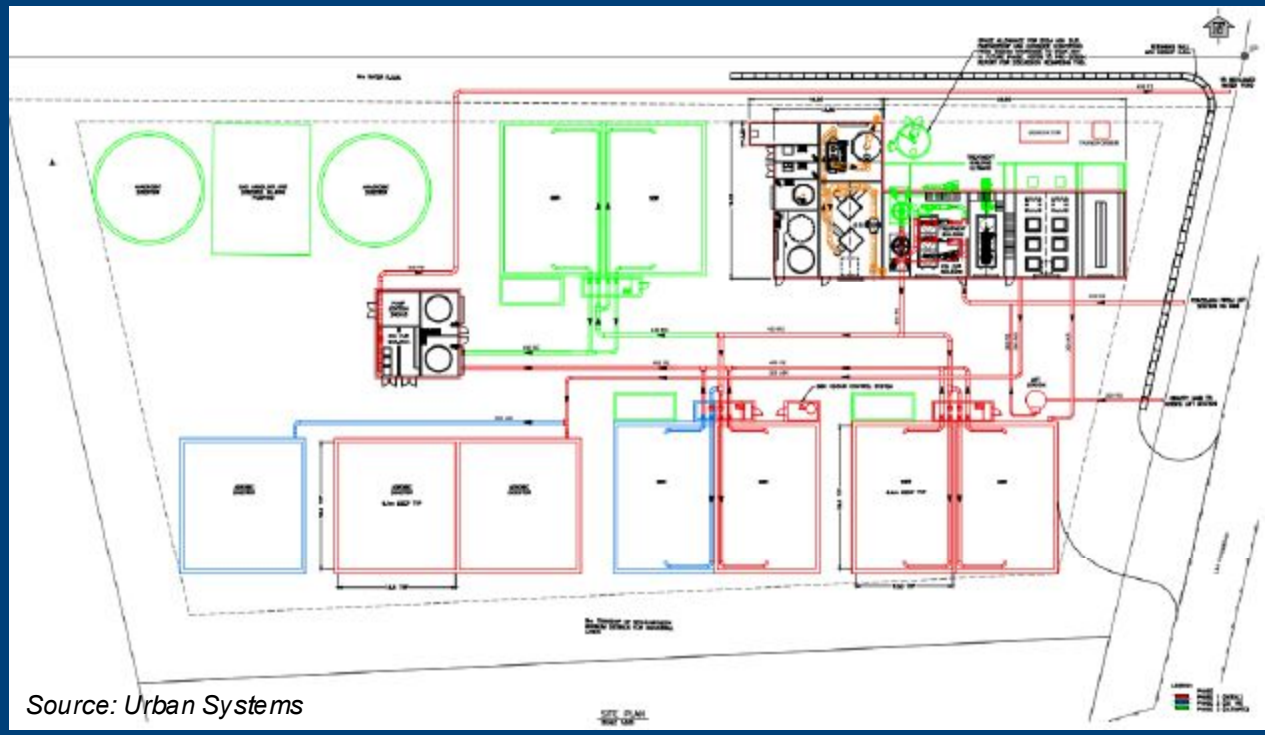
Project Concept

- **Concept development**
  - Potential plant site became available/was purchased before concept developed
  - Site pre-purchased to meet schedule
  - Size and location limited potential alternatives



Project Concept

- **Site**
  - Very restrictive
  - Requires process-intensive solution



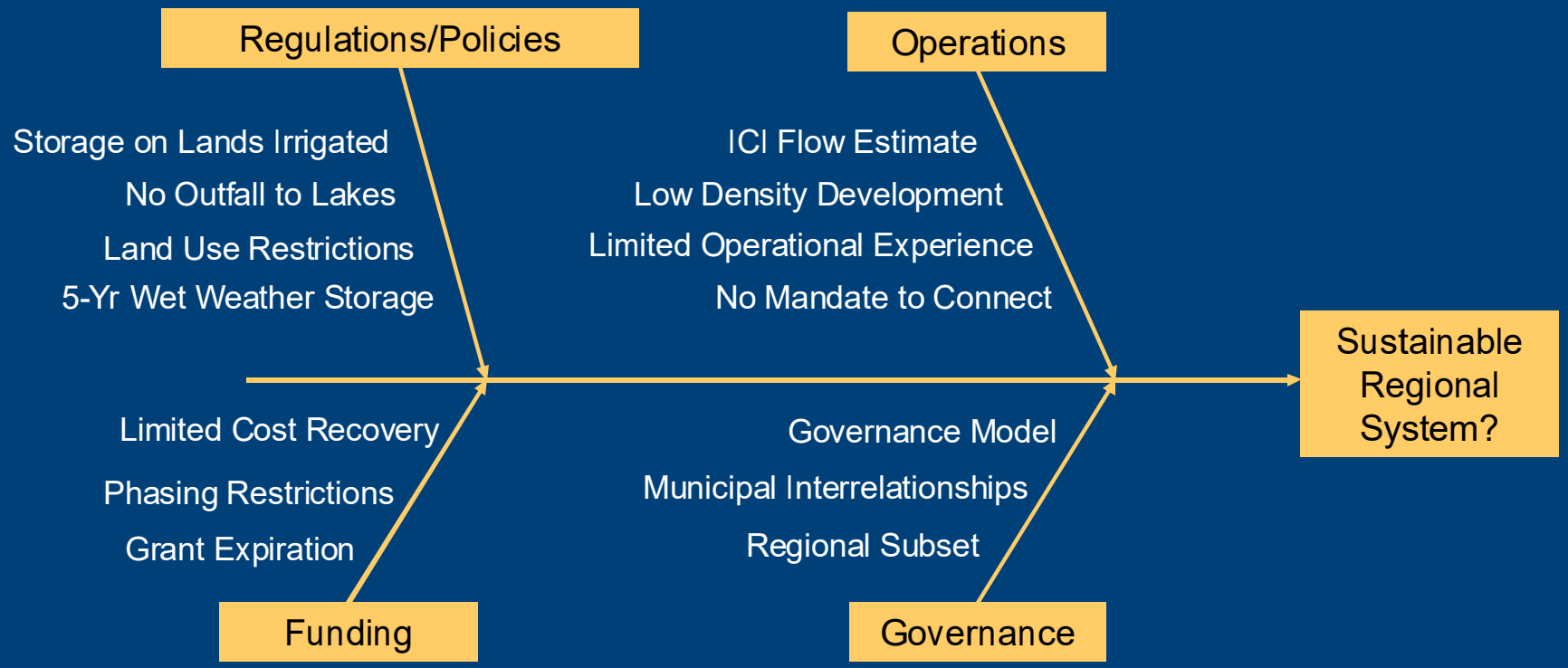
Source: Urban Systems

Cost Estimate

- **2021 estimated total project cost of $48.8 M**
- **Funding shortfall of $11.9 M**
- **No additional grant funding!**

Div	Description	Total	%CST
1	**Wastewater Recovery Facility**		
1.010	General Requirements	$100,000	0.27%
1.020	Removals	$279,000	0.75%
1.030	Site Works	$649,000	1.74%
1.040	Pumping Systems	$1,370,000	3.67%
1.050	WWRF Building	$2,623,000	7.02%
1.060	Treatment Tankage, Process Piping ar	$6,054,000	16.20%
1.070	Electrical	$2,655,000	7.11%
1.080	HVAC	$1,010,000	2.70%
1.090	Misc.	$165,000	0.44%
1.100	Optional	$0	0.00%
	Subtotal	**$14,905,000**	39.89%
2	**Reclaimed Water Storage Facility**		
2.010	General	$0	0.00%
2.020	Reclaimed Water Pond	$6,621,000	17.72%
	Subtotal	**$6,621,000**	17.72%
3	**Irrigation Pumping Station**		
3.010	General	$0	0.00%
3.020	Removals	$63,000	0.17%
3.030	Site Works	$906,000	2.42%
3.040	Irrigation Pump Station Building	$270,000	0.72%
3.050	Process Piping and Equipment	$529,000	1.42%
3.060	Electrical	$280,000	0.75%
3.070	Misc.	$0	0.00%
3.080	Optional	$0	0.00%
	Subtotal	**$2,048,000**	5.48%
4	**Collection System**		
4.010	General	$349,000	0.93%
4.020	Concrete	$4,000	0.01%
4.030	Earthwork	$895,000	2.40%
4.040	Roads and Site Improvements	$3,052,000	8.17%
4.050	Utilities	$0	0.00%
4.060	Sanitary Sewers	$4,824,000	12.91%
4.070	Lift Stations	$4,125,000	11.04%
4.080	Horizontal Drilling	$518,000	1.39%
4.090	Other	$20,000	0.05%
	Subtotal	**$13,787,000**	36.90%
	Construction Subtotal	**$37,361,000**	100.00%
	Total Markups	**$11,468,000**	30.70%
	Project Total	**$48,829,000**	130.70%

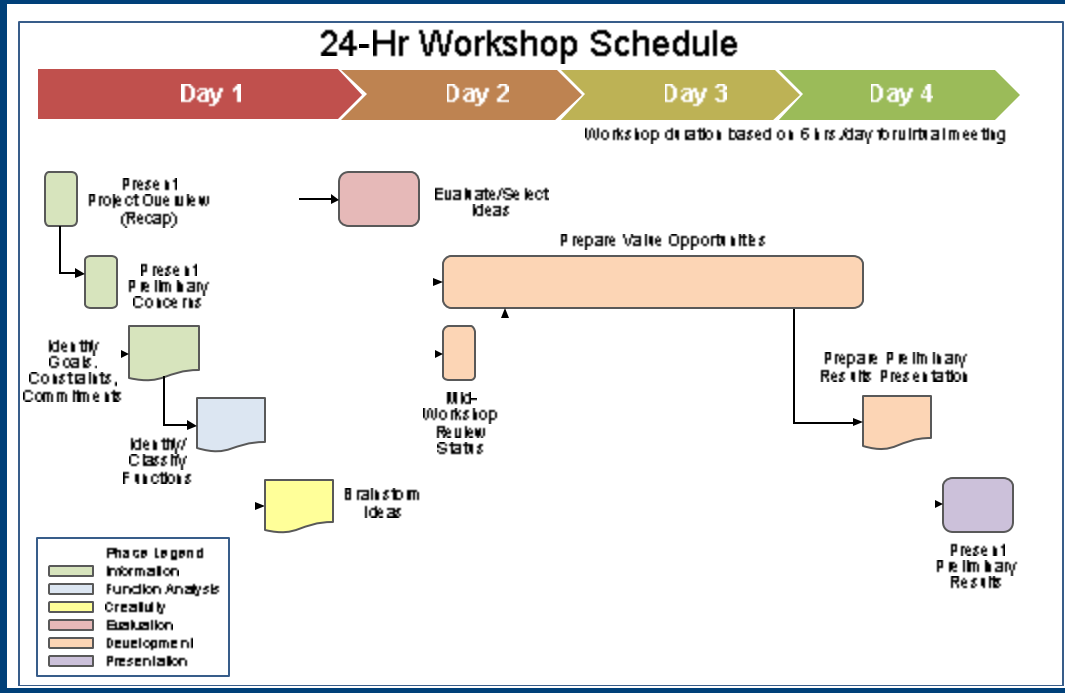
Challenges to Sustainable Regional System



VM Strategy

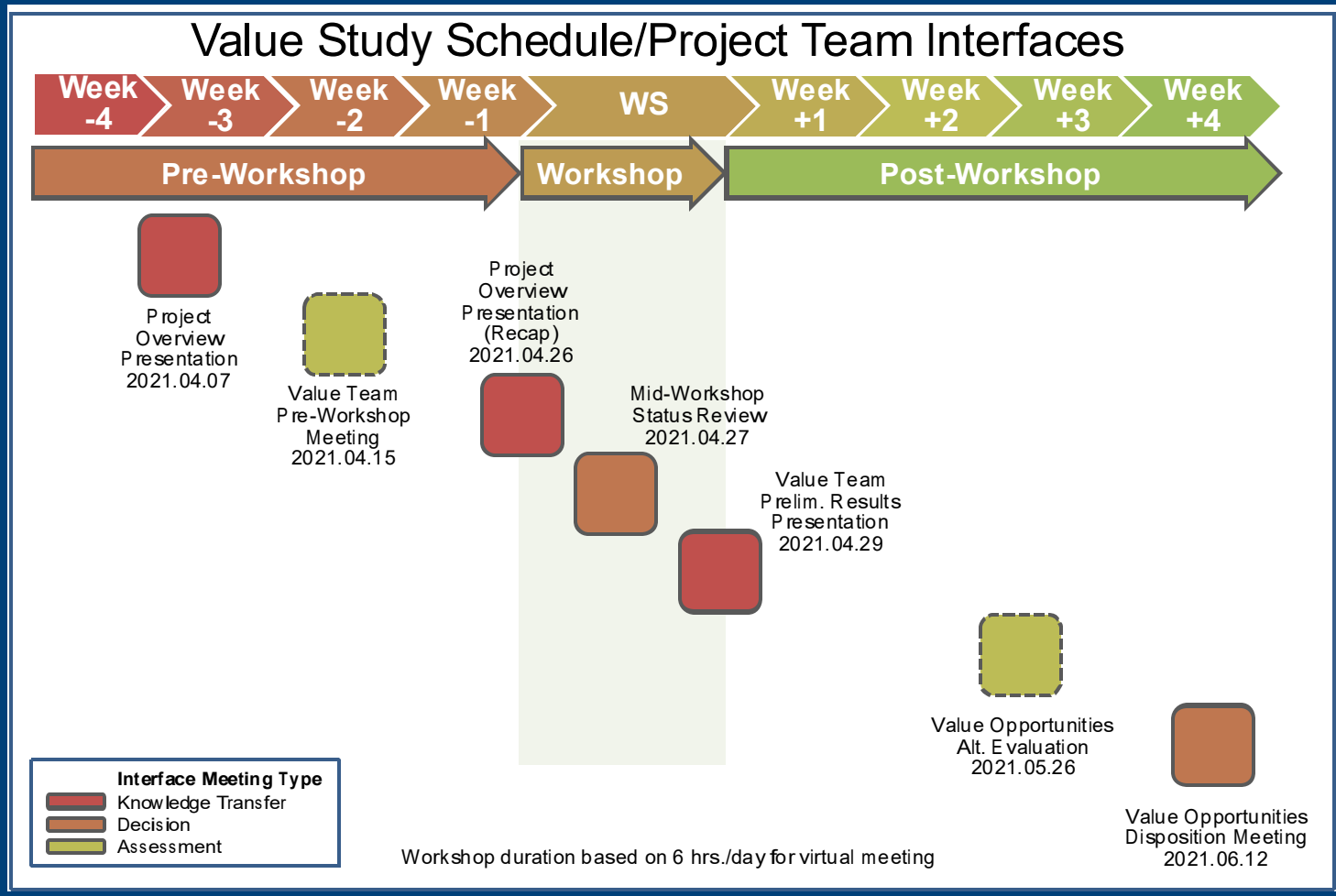
VM Strategy

- **Virtual event**
  - Limit work module durations
  - Lots of breaks
- **Short duration workshop**
  - 24 hours
  - 4 days
- **Scheduling Objective**
  - Maximize Development Phase
  - Enhances value opportunities



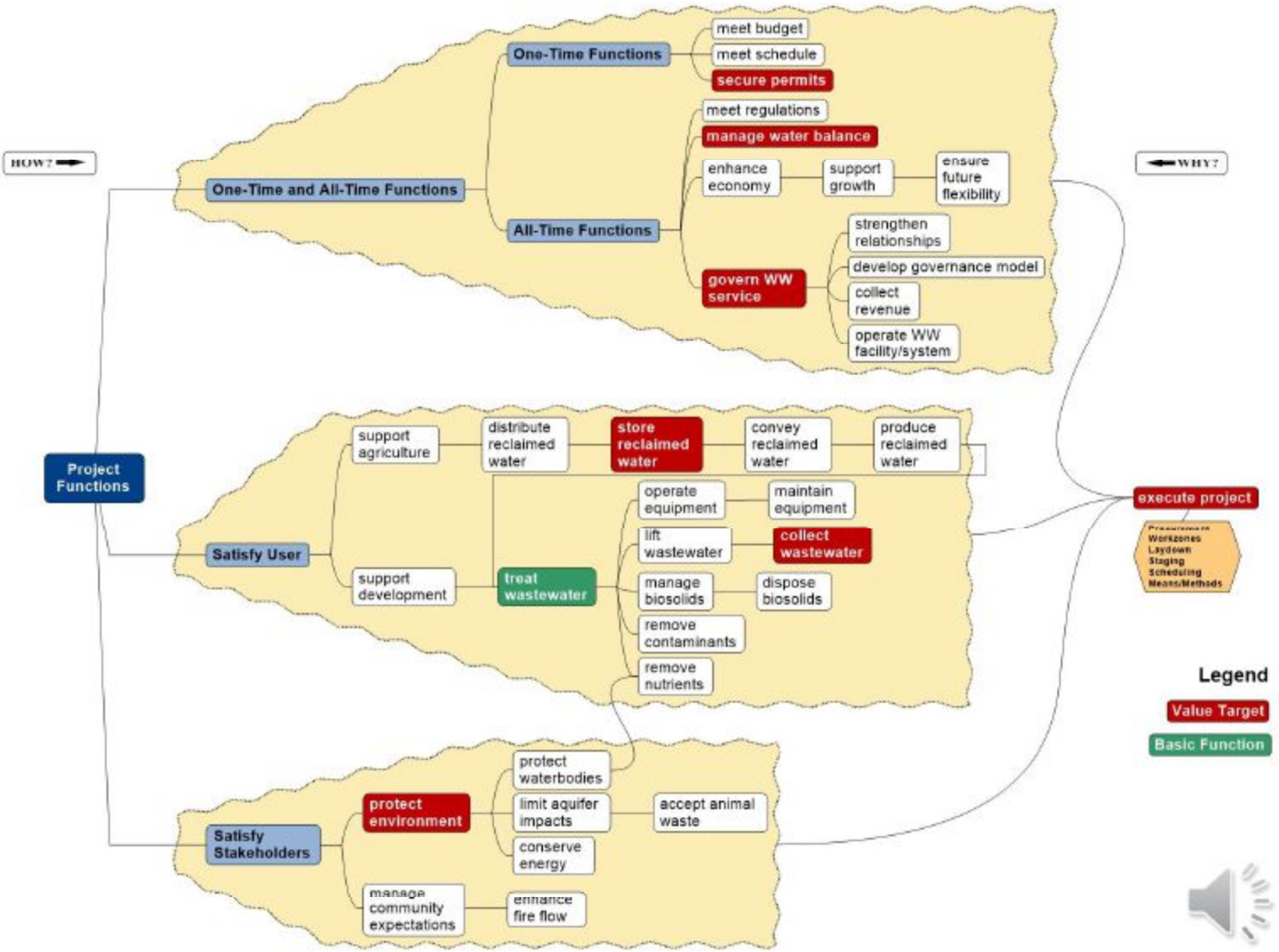
VM Schedule

- **Modifications**
  - Pre-workshop meeting
    - Focused team
    - Ensured readiness
  - Post-workshop evaluation meeting
    - Defined alternative choices



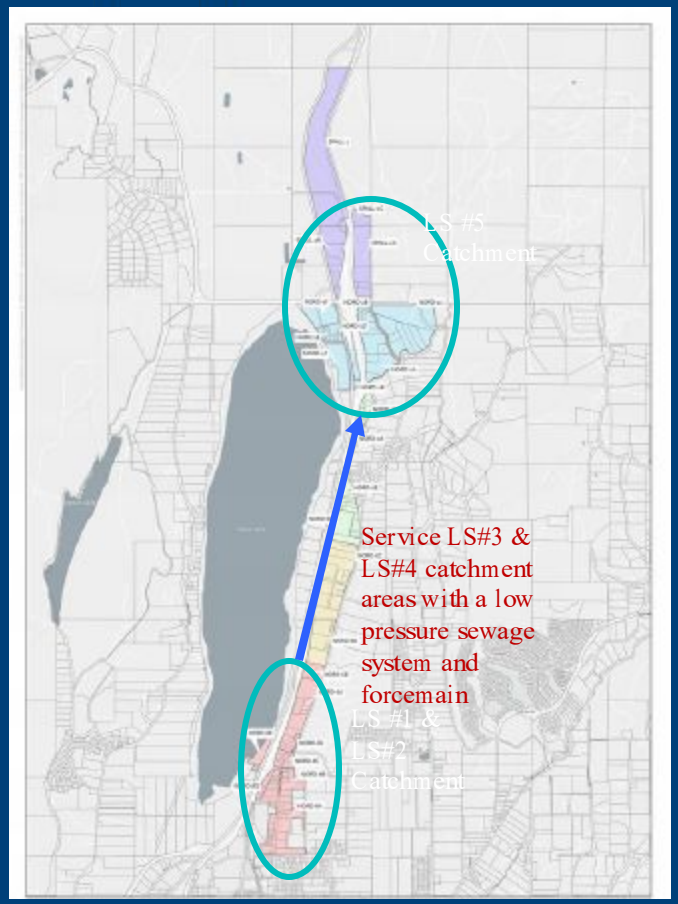
Functions

- **Rapid FAST**
  - Intuitive
  - Engaging
  - Partially pre-built
  - Augment to finalize
  - Colours!



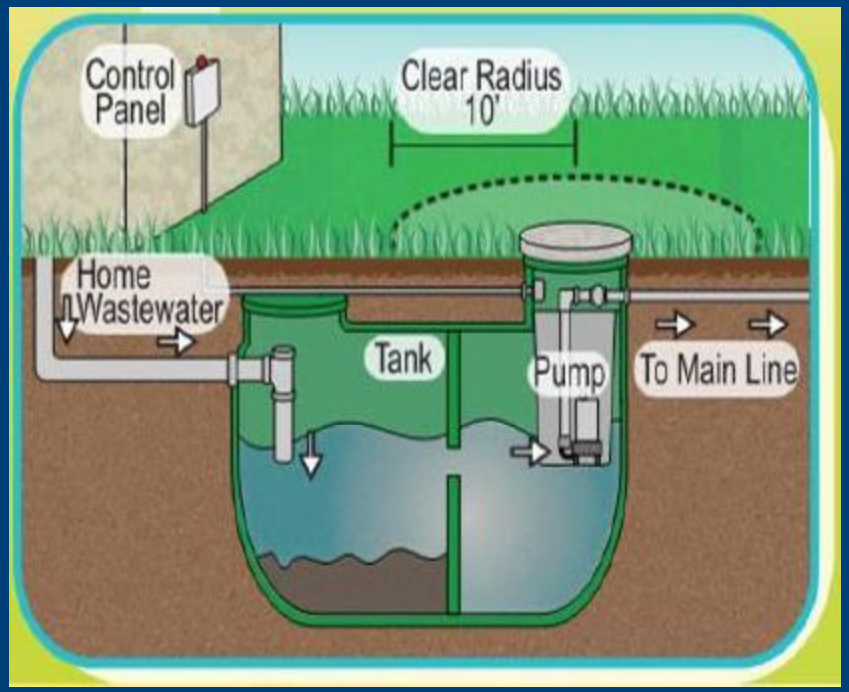
Key Value Opportunities

CW-01 Phase Collection System



- Places gravity sewers only in areas of highest wastewater generation
- Reduces excavation works along Highway 97 corridor
- Simplifies connection of existing holding or septic tanks

CW-10 Greater Use of Low-Pressure Systems



- **Simplifies connection of existing holding or septic tanks**
- **Eliminates most gravity sewers and several lift stations**
- **Reduces excavation works along Highway 97 corridor**

CW-15 Delete LS-1/Use Low Pressure System

- **Simplifies connection of existing holding or septic tanks**
- **Eliminates gravity sewer and one lift station**

CW-18 Pump Commercial Properties to Gravity Sewer

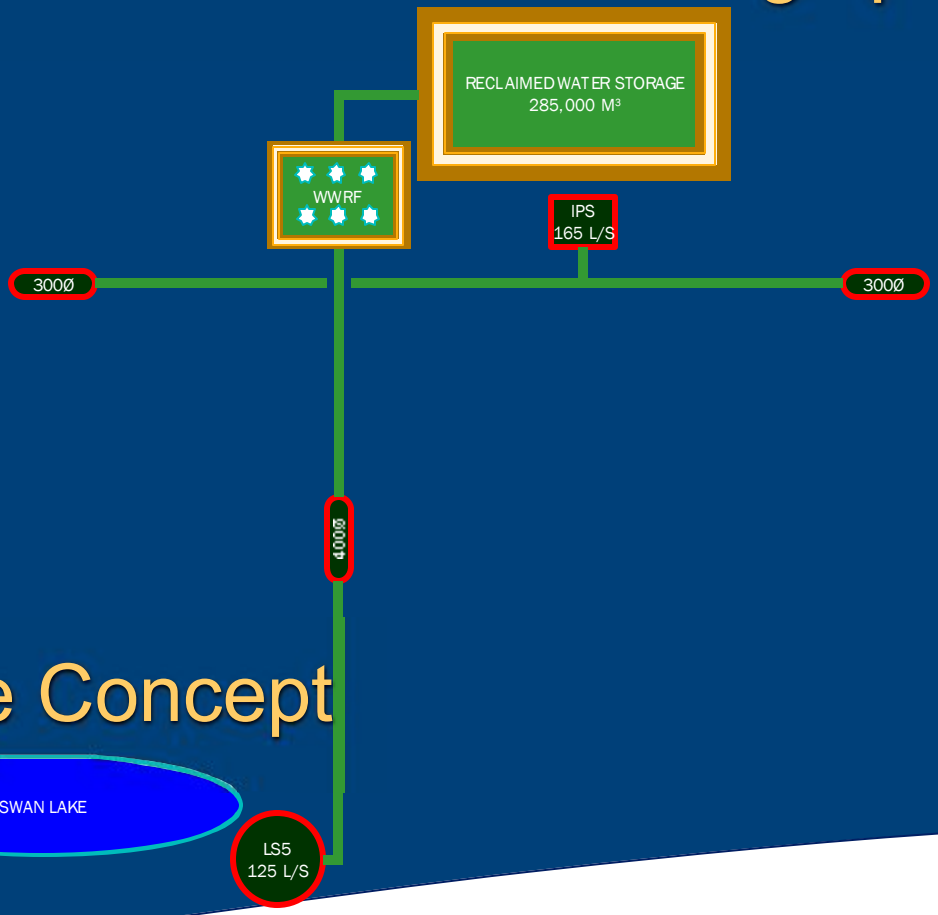
- **Places gravity sewers only in areas of highest wastewater generation**
- **Reduces excavation works along Highway 97 corridor**
- **Simplifies connection of existing holding or septic tanks**

SW-01 Integrate with Armstrong

Order of Magnitude Costs

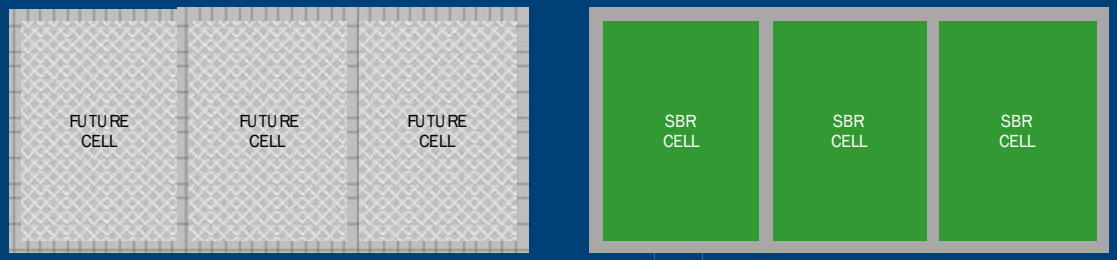
- + $15M - $16M for Armstrong Upgrades
- - $10M - $12M for NOWRP Changes

TW-01 Eliminate mechanical plant and install [aerated] lagoon-based treatment in storage pond cell



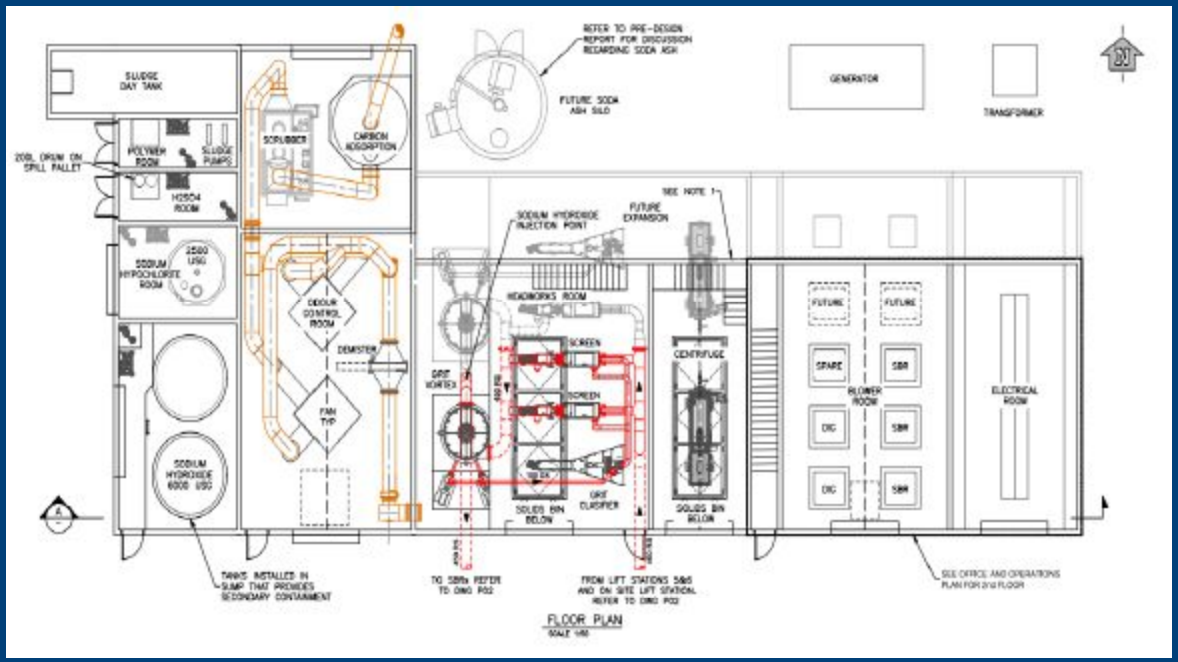
Alternative Concept

TW-05 Optimize SBR treatment system



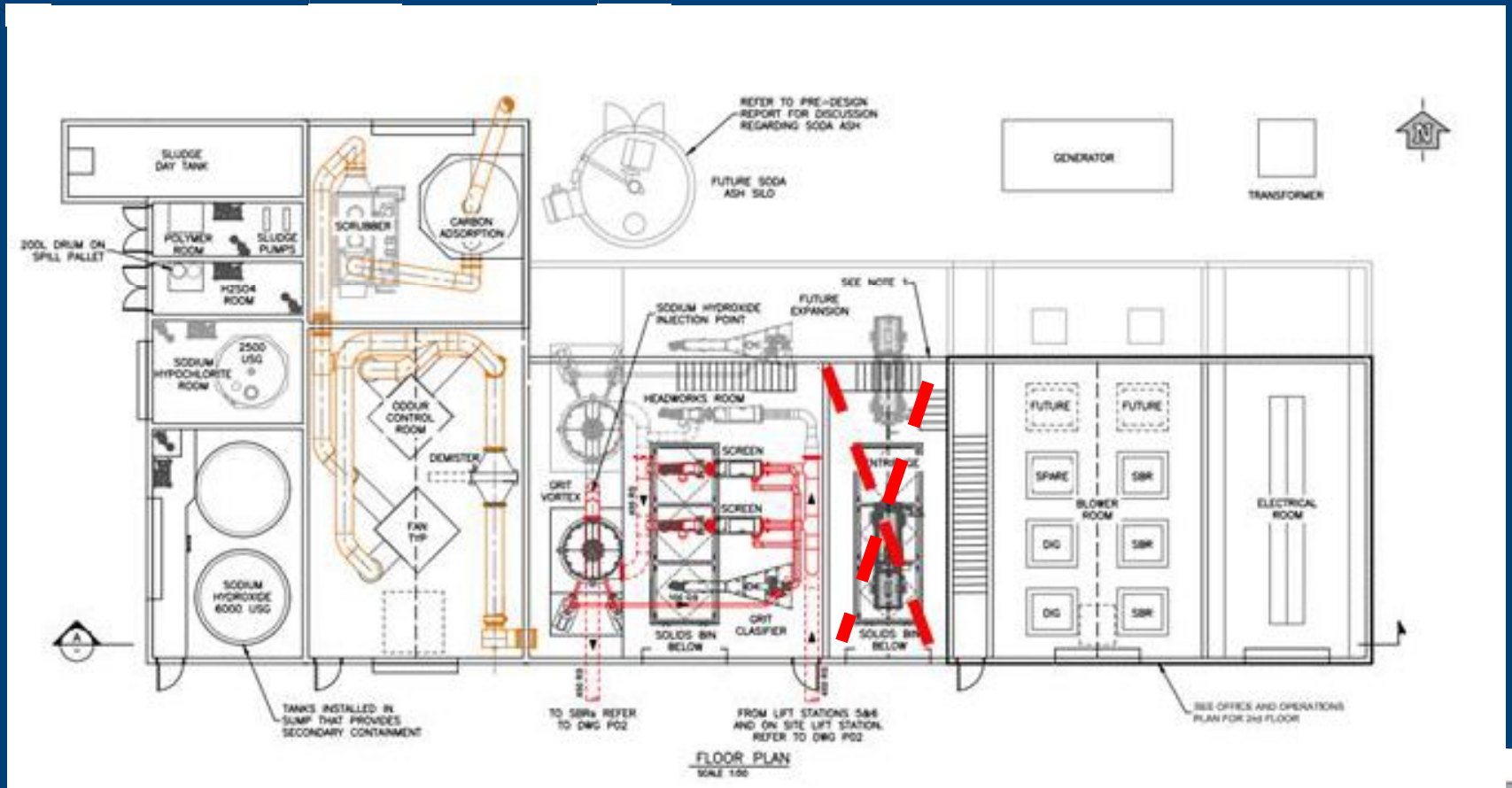
Alternative Concept - ultimate

TW-11 Utilize UV Instead of Hypochlorite

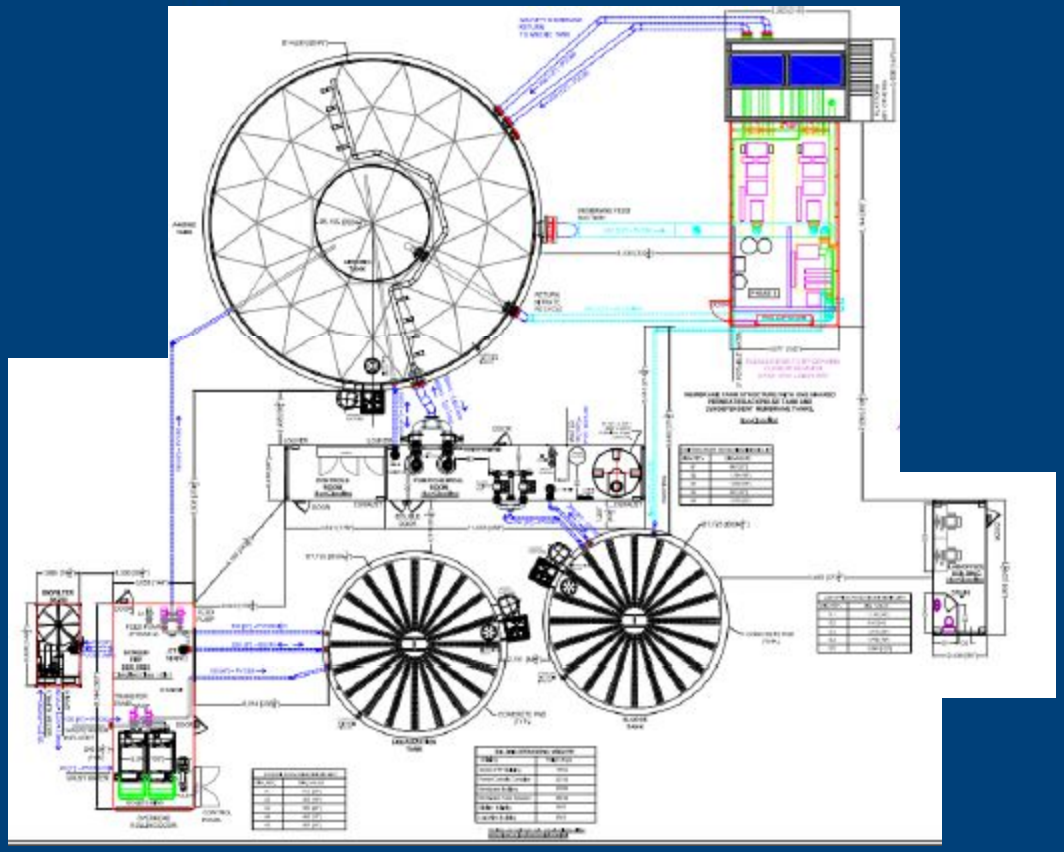


TW-20 Utilize Geotube for Dewatering

TW-20 Utilize Geotube for Dewatering



TW-21 Provide Package Mechanical Treatment Plant



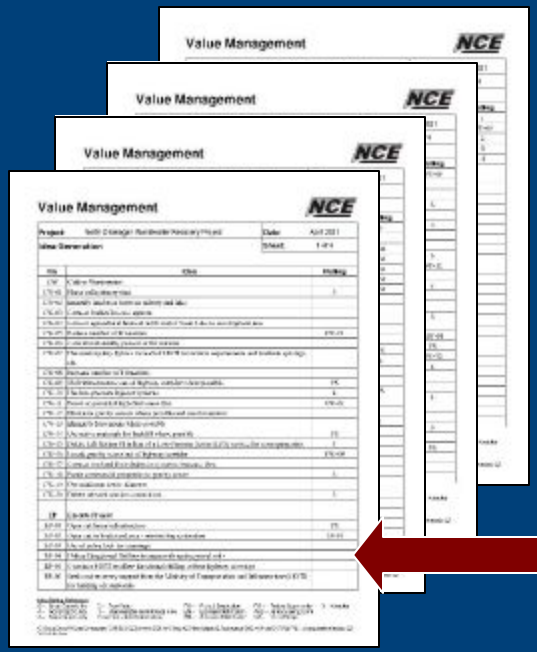
MBR Package Plant Example
Q = 1.63 MLD
Skids = $4.0 M
Total = $8.0 M

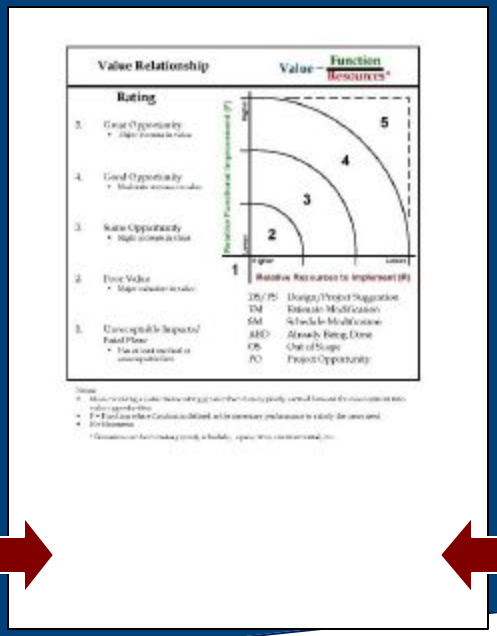
TW-21 Provide Package Mechanical Treatment Plant

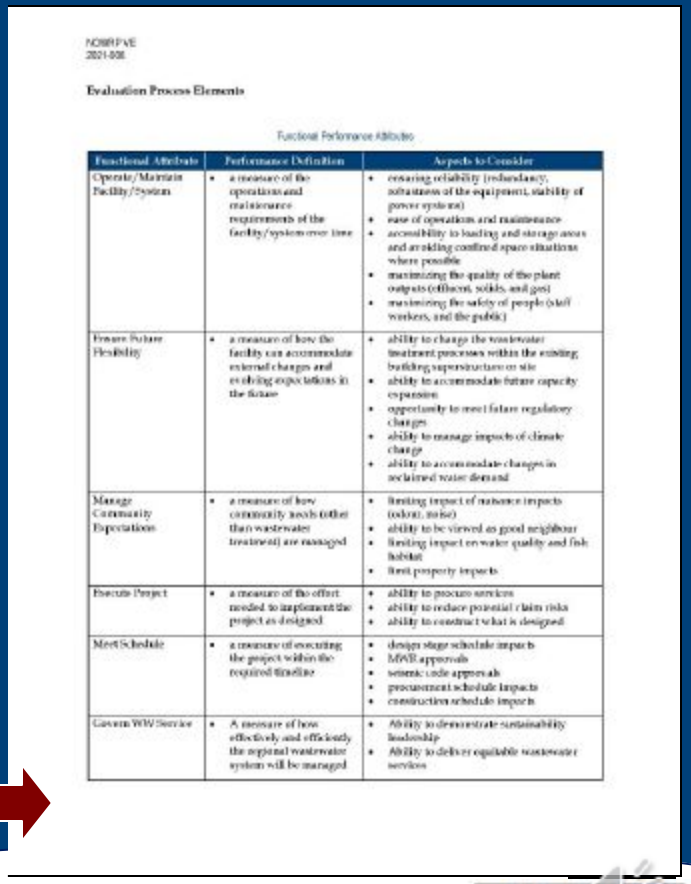
Defining Affordable Solutions

Making Choices

- **Quick but decisive**
- **Rely on specialist expertise**







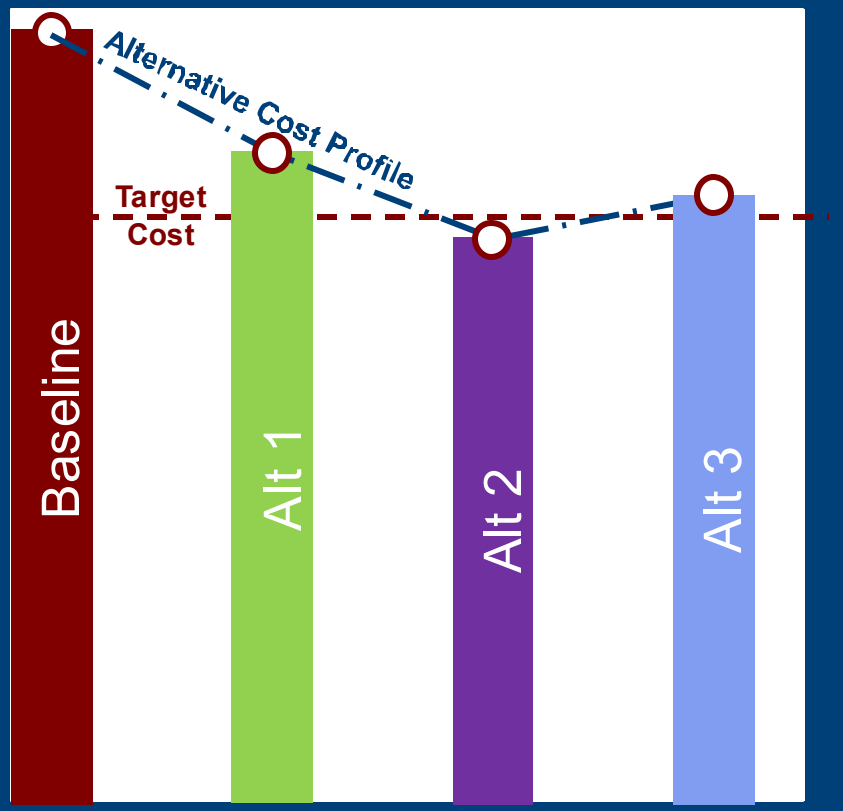
Evaluation Process Elements

Functional Performance Attributes

Functional Attribute	Performance Definition	Aspects to Consider
Operate/Maintain Facility/System	• a measure of the operations and maintenance requirements of the facility/system over time	• ensuring reliability (redundancy, robustness of the equipment, stability of power systems) • ease of operations and maintenance • accessibility to loading and storage areas and avoiding confined space situations where possible • maximizing the quality of the plant outputs (effluent, solids, and gas) • maximizing the safety of people (staff workers, and the public)
Ensure Future Flexibility	• a measure of how the facility can accommodate external changes and evolving expectations in the future	• ability to change the wastewater treatment processes within the existing building superstructure or site • ability to accommodate future capacity expansion • opportunity to meet future regulatory changes • ability to manage impacts of climate change • ability to accommodate changes in reclaimed water demand
Manage Community Expectations	• a measure of how community needs (other than wastewater treatment) are managed	• limiting impact of nuisance impacts (odour, noise) • ability to be viewed as good neighbour • limiting impact on water quality and fish habitat • limit property impacts
Execute Project	• a measure of the effort needed to implement the project as designed	• ability to procure services • ability to reduce potential claim risks • ability to construct what is designed
Meet Schedule	• a measure of executing the project within the required timeline	• design stage schedule impacts • MWR approvals • seismic code approvals • procurement schedule impacts • construction schedule impacts
Govern WW Service	• A measure of how effectively and efficiently the regional wastewater system will be managed	• Ability to demonstrate sustainability leadership • Ability to deliver equitable wastewater services

Making Choices

- **How to meet the budget?**
  - Combining value opportunities
    - Compatible
    - Measurable cost impact
    - Limited schedule impact
  - Target cost review
    - Can new alternatives shift estimate toward target cost?



Evaluation Process – Example

- **Weighted-additive method**
  - Identify performance attributes (criteria)
  - Weight the attributes (capture team member inputs) using Base-100
  - Score the options
    - Always compare to baseline
    - For each performance attribute
      - Baseline rated 5
      - Options rated 0-10 against baseline
    - Calculate and total up scores for each option
- **Best-value selection**
  - Score/LCC

Evaluation Process – Example

Team Member	Key Functional Performance Attributes						Total Weight Assigned
	Operate/ Maintain Facility/System	Ensure Future Flexibility	Manage Community Expectations	Execute Project	Meet Schedule	Govern WW Service	
1	50	25	5	5	10	5	100
2	2	3	10	50	25	10	100
3	25	30	20	20	4	1	100
Total	77	58	35	75	39	16	300
Weight (Norm)*	26	19	12	25	13	**5**	100

1. Weight Performance Attributes

Functional Performance Attributes/Alternatives			Baseline		VE Alt. 1		VE Alt. 2		VE Alt. 3		VE Alt. 4	
Description Treatment Approach Adjustments			SBR Plant		Modified SBR Plant - revise site prep - consolidate tanks - add UV - use Geotubes		Package Plant - revise site prep - add UV - use Geotubes		Aerated Lagoon		Int Aerated Lagoon (integrated w/ other jurisdiction)	
	Criteria	Wt.	Score	Total	Score	Total	Score	Total	Score	Total	Score	Total
1	Operate / Maintain Facility/System	26	5	130	7	182	6	156	9	234	10	260
2	Ensure Future Flexibility	19	5	95	5	95	4	76	7	133	7	133
3	Manage Community Expectations	12	5	60	5	60	5	60	3	36	4	48
4	Execute Project	25	5	125	6	150	7	175	6	150	5	125
5	Meet Schedule	13	5	65	5	65	6	78	4	52	3	39
6	Govern WW Service	5	5	25	5	25	5	25	5	25	7	35
Total		100		500		577		570		630		640
Rank (Best Performance = 1)				5		3		4		2		1

2. Score Options

Cost Component/Alternative	Baseline	VE Alt 1	VE Alt 2	VE Alt 3	VE Alt 4
Description Treatment Approach Adjustments	SBR Plant	Modified SBR Plant - revise site prep - consolidate tanks - add UV - use Geotubes	Package Plant - revise site prep - add UV - use Geotubes	Aerated Lagoon	Int Aerated Lagoon (integrated w/ other jurisdiction)
Baseline Capital Cost	$19,431,000	$17,328,900	$14,143,900	$5,450,000	$9,403,000
Adjustment to Capital Cost					
Total Capital Cost	$19,431,000	$17,328,900	$14,143,900	$5,450,000	$9,403,000
Baseline Future Cost (incl. societal costs)	$0	$0	$0	$0	$0
Adjustment to Future Cost	$11,243,000	$10,861,000	$11,243,000	$4,679,000	$4,679,000
Total Future Cost	$11,243,000	$10,861,000	$11,243,000	$4,679,000	$4,679,000
Total Life Cycle Cost	$30,728,000	$28,778,900	$26,381,900	$10,129,000	$14,082,000
Rank (Lowest Cost = 1)	5	4	3	1	2

3. Score Options

Cost Component/Alternative	Baseline	VE Alt 1	VE Alt 2	VE Alt 3	VE Alt 4
Description Treatment Approach Adjustments	SBR Plant	Modified SBR Plant - revise site prep - consolidate tanks - add UV - use Geotubes	Package Plant - revise site prep - add UV - use Geotubes	Aerated Lagoon	Int Aerated Lagoon (integrated w/ other jurisdiction)
Performance	600	677	670	630	640
Total Life Cycle Cost	$30,728,000	$28,778,900	$26,381,900	$10,129,000	$14,082,000
Value Ratio V – PC	18	20	22	62	46
Value Improvement (over Baseline)	0%	22%	22%	232%	178%
Rank (Most Preferred = 1)	5	4	3	1	2

4. Determine Best Value Option(s)

Making Choices - Collection

Alternative Evaluation Summary - Weighting

Team Member	Key Functional Performance Attributes						Total Weight Assigned
	Operate/ Maintain Facility/System	Ensure Future Flexibility	Manage Community Expectations	Execute Project	Meet Schedule	Govern WW Service	
1	50	25	5	5	10	5	**100**
2	2	3	10	50	25	10	**100**
3	25	30	20	20	4	1	**100**
Total	**77**	**58**	**35**	**75**	**39**	**16**	**300**
Weight (Norm)*	**26**	**19**	**12**	**25**	**13**	**5**	**100**

Alternative Evaluation Summary - Performance

Functional Performance Attributes/Alternatives			Baseline		VE Alt. A		VE Alt. 2 B		VE Alt. C		VE Alt. D	
Description		Collection Approach Adjustments	Gravity/FM		Mod Gravity/FM - Delete LS1 - Pump 7 prop		Mod Gravity/FM - Pump ICI prop		Mod Gravity/FM - Delete LS1/LS3/ /LS4		Low Press. Injector - Smaller LS 1-4 - Pump to FM - Elimin. Gravity Swr	
	Criteria	Wt.	Score	Total	Score	Total	Score	Total	Score	Total	Score	Total
1	Operate/ Maintain Facility/System	26	5	130	6	156	6	156	8	208	3	78
2	Ensure Future Flexibility	19	5	95	5	95	5	95	7	133	5	95
3	Manage Community Expectations	12	5	60	4	48	4	48	4	48	2	24
4	Execute Project	25	5	125	6	150	6	150	8	200	7	175
5	Meet Schedule	13	5	65	5	65	5	65	7	91	7	91
6	Govern WW Service	5	5	25	4	20	4	20	4	20	4	20
Total		**100**		**500**		**534**		**534**		**700**		**483**
Rank (Best Performance = 1)				**4**		**2**		**2**		**1**		**5**

Making Choices - Collection

Alternative Evaluation Summary - Cost

Cost Components/Alternatives	Baseline	VE Alt. A	VE Alt. 2 B	VE Alt. C	VE Alt. D
Description Collection Approach Adjustments	**Gravity/FM**	**Mod Gravity/FM** - Delete LS1 - Pump 7 prop	**Mod Gravity/FM** - Pump ICI prop	**Mod Gravity/FM** - Delete LS1/LS3/ /LS4	**Low Press. Injector** - Smaller LS 1-4 - Pump to FM - Elimin. Gravity Swr
Baseline Capital Cost	$18,020,000	$17,202,000	$14,415,000	$11,763,000	$5,489,000
Adjustment to Capital Cost					
Total Capital Cost	**$18,020,000**	**$17,202,000**	**$14,415,000**	**$11,763,000**	**$5,489,000**
Baseline Future Cost (incl. societal costs)	$0	$0	$0	$0	$0
Adjustment to Future Cost	$3,976,000	$459,000	$3,976,000	$1,914,000	$2,680,000
Total Future Cost	**$3,976,000**	**$459,000**	**$3,976,000**	**$1,914,000**	**$2,680,000**
Total Life Cycle Cost	**$21,996,000**	**$17,661,000**	**$18,391,000**	**$13,677,000**	**$8,169,000**
Rank (Lowest Cost = 1)	**5**	**3**	**4**	**2**	**1**

Alternative Evaluation Summary - Best Value

Cost Components/Alternatives	Baseline	VE Alt. A	VE Alt. 2 B	VE Alt. C	VE Alt. D
Description Collection Approach Adjustments	**Gravity/FM**	**Mod Gravity/FM** - Delete LS1 - Pump 7 prop	**Mod Gravity/FM** - Pump ICI prop	**Mod Gravity/FM** - Delete LS1/LS3/ /LS4	**Low Press. Injector** - Smaller LS 1-4 - Pump to FM - Elimin. Gravity Swr
Performance	**500**	**534**	**534**	**700**	**483**
Total Life Cycle Cost	**$21,996,000**	**$17,661,000**	**$18,391,000**	**$13,677,000**	**$8,169,000**
Value Ratio V ~ P/C	**23**	**30**	**29**	**51**	**59**
Value Improvement (over Baseline)	**0%**	**33%**	**28%**	**125%**	**160%**
Rank (Most Preferred = 1)	**5**	**3**	**4**	**2**	**1**

Making Choices - Treatment

Alternative Evaluation Summary - Weighting

Team Member	Key Functional Performance Attributes						Total Weight Assigned
	Operate/ Maintain Facility/System	Ensure Future Flexibility	Manage Community Expectations	Execute Project	Meet Schedule	Govern WW Service	
1	50	25	5	5	10	5	**100**
2	2	3	10	50	25	10	**100**
3	25	30	20	20	4	1	**100**
Total	**77**	**58**	**35**	**75**	**39**	**16**	**300**
Weight (Norm)*	**26**	**19**	**12**	**25**	**13**	**5**	**100**

Alternative Evaluation Summary - Performance

Functional Performance Attributes/Alternatives			Baseline		VE Alt. 1		VE Alt. 2		VE Alt. 3		VE Alt. 4	
Description		Treatment Approach Adjustments	SBR Plant		Modified SBR Plant - revise site prep - consolidate tanks - add UV - use Geotubes		Package Plant - revise site prep - add UV - use Geotubes		Aerated Lagoon		Int Aerated Lagoon (integrated w/ (Armstrong)	
	Criteria	Wt.	Score	Total	Score	Total	Score	Total	Score	Total	Score	Total
1	Operate/ Maintain Facility/System	26	5	130	7	182	6	156	9	234	10	260
2	Ensure Future Flexibility	19	5	95	5	95	4	76	7	133	7	133
3	Manage Community Expectations	12	5	60	5	60	5	60	3	36	4	48
4	Execute Project	25	5	125	6	150	7	175	6	150	5	125
5	Meet Schedule	13	5	65	5	65	6	78	4	52	3	39
6	Govern WW Service	5	5	25	5	25	5	25	5	25	7	35
Total		**100**		**500**		**577**		**570**		**630**		**640**
Rank (Best Performance = 1)				**5**		**3**		**4**		**2**		**1**

Making Choices - Treatment

Alternative Evaluation Summary - Cost

Cost Components/Alternatives	Baseline	VE Alt. 1	VE Alt. 2	VE Alt. 3	VE Alt. 4
Description Treatment Approach Adjustments	SBR Plant	Modified SBR Plant - revise site prep - consolidate tanks - add UV - use Geotubes	Package Plant - revise site prep - add UV - use Geotubes	Aerated Lagoon	Int Aerated Lagoon (integrated w/ (Armstrong)
Baseline Capital Cost	$19,481,000	$17,828,900	$14,143,900	$5,450,000	$9,403,000
Adjustment to Capital Cost					
Total Capital Cost	**$19,481,000**	**$17,828,900**	**$14,143,900**	**$5,450,000**	**$9,403,000**
Baseline Future Cost (incl. societal costs)	$0	$0	$0	$0	$0
Adjustment to Future Cost	$11,248,000	$10,951,000	$11,248,000	$4,679,000	$4,679,000
Total Future Cost	**$11,248,000**	**$10,951,000**	**$11,248,000**	**$4,679,000**	**$4,679,000**
Total Life Cycle Cost	**$30,729,000**	**$28,779,900**	**$25,391,900**	**$10,129,000**	**$14,082,000**
Rank (Lowest Cost = 1)	**5**	**4**	**3**	**1**	**2**

Alternative Evaluation Summary - Best Value

Cost Components/Alternatives	Baseline	VE Alt. 1	VE Alt. 2	VE Alt. 3	VE Alt. 4
Description Treatment Approach Adjustments	SBR Plant	Modified SBR Plant - revise site prep - consolidate tanks - add UV - use Geotubes	Package Plant - revise site prep - add UV - use Geotubes	Aerated Lagoon	Int Aerated Lagoon (integrated w/ (Armstrong)
Performance	**500**	**577**	**570**	**630**	**640**
Total Life Cycle Cost	**$30,729,000**	**$28,779,900**	**$25,391,900**	**$10,129,000**	**$14,082,000**
Value Ratio V ~ P/C	**16**	**20**	**22**	**62**	**45**
Value Improvement (over Baseline)	**0%**	**23%**	**38%**	**282%**	**179%**
Rank (Most Preferred = 1)	**5**	**4**	**3**	**1**	**2**

Project Path-Forward

Path-Forward

- **Will proceed using Integrated Project Delivery (IPD)**
- **Will further refine and assess two options**

Table 4.1 - Value Opportunity Options

Option	Capital Cost Estimate (Incl. E&C)	Complementary Value Opportunity Options
A	$39,250,000*	Treatment: Aerated Lagoon with filtration*: $13,280,000 (TW-01) Effluent Disposal: Reclaimed Water Storage $5,300,000** (SW-14) with irrigation provided at nominal pressure $370,000 (SW-02) Collection: Low Pressure Sewer for the LS#1-LS#3 catchments areas $9,900,000 (CW-01) Contingency: $6,000,000 Engineering: $4,400,000
B	$42,370,000	Treatment: Mechanical Batch Plant $16,400,000 (TW-21) Effluent Disposal: Reclaimed Water Storage $5,300,000 (SW-14) with irrigation provided at nominal pressure $370,000 (SW-02) Collection: Low Pressure Sewer for LS#1-LS#3 areas $9,900,000 (CW-01) Contingency: $6,000,000 Engineering: $4,400,000

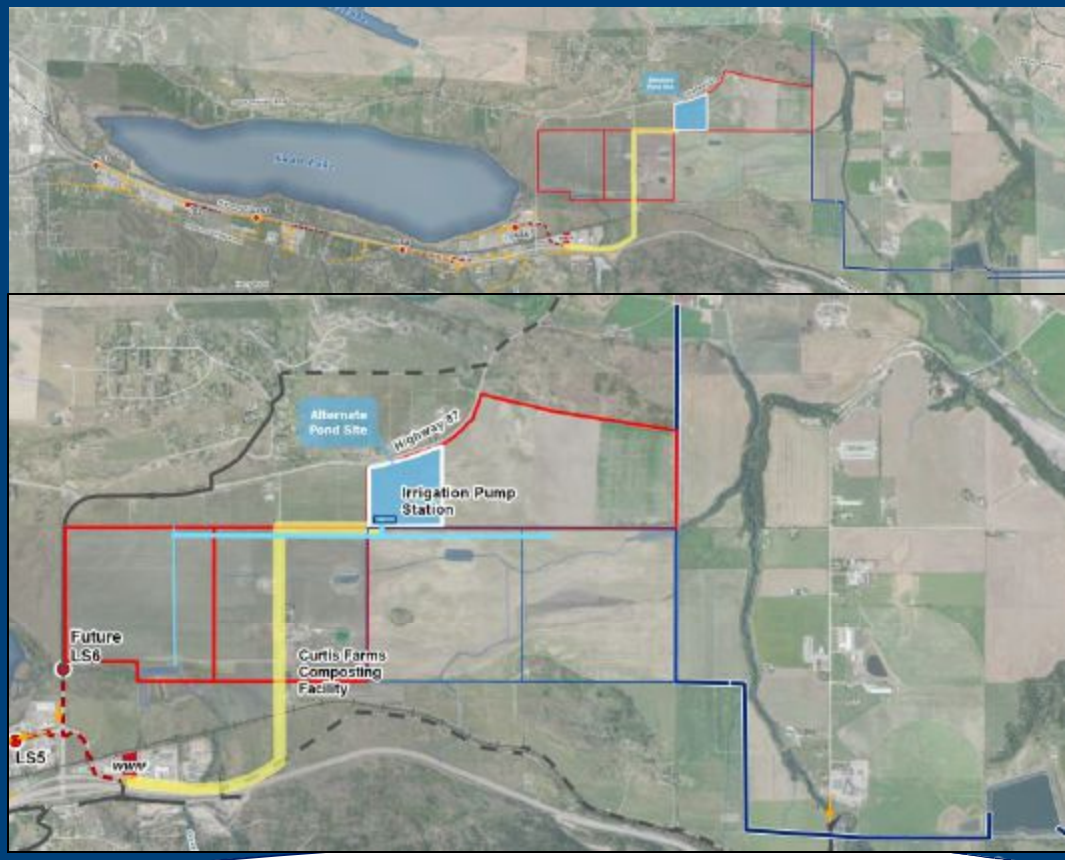
Can be reduced with deletion of filtration by ~$1.5M

**Costs to be confirmed by results of the geotechnical investigation (excepted in Fall 2021)*

Summary

Summary…

- **Five Aspects:**
  - Project Concept/Challenges
  - VM Strategy
  - Key Value Opportunities
  - Defining Affordable Solutions
  - Project Path-Forward



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