FINAL

TM 4.4 – LONG-RANGE PLAN FOR THE DE PERE FACILITY

NEW Water Facility Plan

B&V PROJECT NO. 402658

PREPARED FOR

NEW Water
The brand of the Green Bay Metropolitan Sewerage District

Green Bay Metropolitan Sewerage District

JULY 2021

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Table of Contents

1.0 Introduction and Purpose....1-1

1.1 Drivers for De Pere Facility Improvements....1-2

1.2 Relationship to Overall Facility Plan....1-2

2.0 Background for the Long-Term Vision....2-1

2.1 De Pere Facility Risks and Opportunities....2-1

2.2 Infrastructure Gap Summary....2-2

2.3 Potential Treatment Alternatives and Evaluation Approach....2-4

3.0 Alternative Development....3-1

3.1 Alternative 1 – Simplify and Expand the De Pere Facility....3-1

3.2 Alternative 2 – Build a De Pere Pump Station & Decommission Treatment Facility....3-4

3.3 Alternative Infrastructure Packages....3-9

4.0 Life Cycle Cost Assessment....4-1

4.1 Capital Cost Estimates....4-1

4.1.1 Construction Cost Estimates....4-1

4.1.2 Total Capital Cost Estimates....4-2

4.2 Annual Operating Costs....4-3

4.3 Life-Cycle Costs....4-4

5.0 MUA....5-1

6.0 50-Year Vision....6-1

7.0 Summary and Next Steps....7-1

LIST OF TABLES

Table 2-1 Risks and Opportunities Related to Water Quality and Permitting for Maintaining the De Pere Facility....2-1

Table 2-2 Risks and Opportunities Related to "Outside the Fence" Considerations for Maintaining the De Pere Facility....2-1

Table 2-3 Risks and Opportunities Related to Asset Value and Maintenance Requirements Considerations for Maintaining the De Pere Facility....2-2

Table 2-4 Risks and Opportunities Related to Operations Considerations for Maintaining the De Pere Facility....2-2

Table 2-5 Infrastructure Gap Summary....2-3

Table 2-6 GBF Infrastructure Gap Summary....2-4

Table 3-1 Alternative 1 Unit Process Improvements Summary....3-2

Table 3-2 GBF Infrastructure Gap Summary....3-5

Table 3-3 Alternative 2 Unit Process Improvements Summary....3-6

Table 4-1 Multipliers Used to Determine Total Construction Costs....4-1

Table 4-2 Total Construction Costs for Alternatives 1 and 2 4-1
Table 4-3 Multiplier Used to Determine Total Capital Costs 4-3
Table 4-4 Total Capital Cost Estimates for Alternatives 4-3
Table 4-5 Indicative Operating Costs for Decision Making Related to Alternative 1 and 2 4-4
Table 6-1 50-Year Vision Risks and Opportunities, and Potential Alternative Advantages 6-1

LIST OF FIGURES

Figure 1-1 The Green Bay Facility (GBF) and De Pere Facility (DPF) are Located Approximately 10 Miles Apart, Both Discharging to the Fox River 1-1
Figure 3-1 Alternative 1 De Pere Facility Recommended Improvements 3-3
Figure 3-2 Alternative 1 Green Bay Facility Recommended Improvements 3-4
Figure 3-3 Alternative 2 De Pere Facility Recommended Improvements 3-7
Figure 3-4 Alternative 2 Green Bay Facility Recommended Improvements 3-8
Figure 3-5 Impact of Moving to One Discharge at the GBF on Effluent Phosphorus and Suspended Solids Discharge 3-9
Figure 4-1 Life Cycle Cost for the Two De Pere Facility Alternatives 4-4
Figure 5-1 Baseline Weighted Scores for Alternative 1 and 2 5-3
Figure 5-2 Sensitivity Analysis on Category Weighting for the Final MUA Score 5-3

APPENDICIES

Appendix A 50-Year Vision Notes
Appendix B Additional Notes on Alternative Development
Appendix C Cost Estimate Details
Appendix D MUA Supporting Details

1.0 Introduction and Purpose

The Green Bay Metropolitan Sewerage District, operated under the brand name of NEW Water, collects and treats wastewater from 15 communities in a service area encompassing over 285 square miles with an estimated population of approximately 237,000 in 2019. The NEW Water facility is comprised of the Green Bay Facility (GBF) and the De Pere Facility (DPF), located approximately 10 miles apart (Figure 1-1). The NEW Water treatment facilities receive domestic, commercial, and industrial wastewater as well as hauled-in waste (HW)/high strength waste (HSW). NEW Water administers an industrial pretreatment program that regulates industrial contributors.

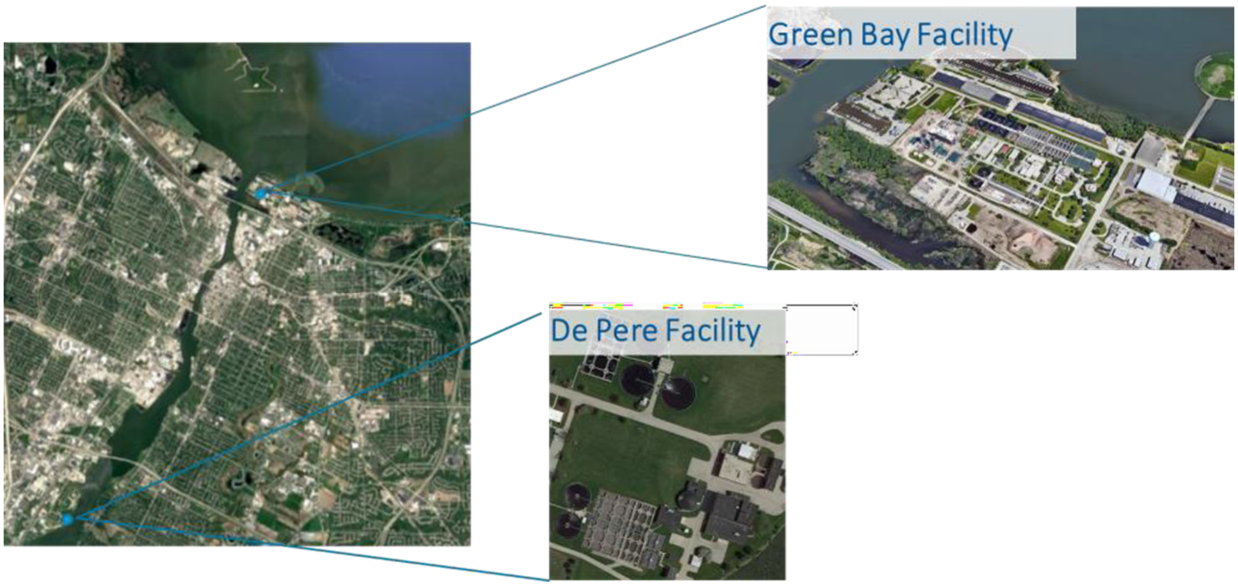

Figure 1-1 The Green Bay Facility (GBF) and De Pere Facility (DPF) are Located Approximately 10 Miles Apart, Both Discharging to the Fox River

The De Pere Facility was originally constructed in 1976, with NEW Water taking responsibility of operations in 2008. The facility currently relies on the Green Bay Facility for solids management via a solids transfer line between the two facilities. Additionally, a small diameter line exists at the De Pere Facility that allows a small flow transfer to the Green Bay Facility. Over the past 12 years of operation, the concept of decommissioning the treatment facilities at the De Pere Facility and centralized treatment at the Green Bay Facility has been discussed as an opportunity to simplify operations and maintenance costs, and potentially decrease the overall cost of operations for NEW Water. There are several drivers that are pushing for a decision on the long-term vision for the De Pere Facility, and this decision impacts the implementation plan and projects for this Facility Plan.

The purpose of this Technical Memorandum (TM 4.4) is provide a long-term recommendation for the De Pere Facility as to whether it should continue to operate as a separate treatment facility or if the flows from the De Pere Facility should be combined with those at the Green Bay Facility.

1.1 Drivers for De Pere Facility Improvements

There are several key drivers that require a decision to be made concerning the future vision for the De Pere Facility:

- Aging infrastructure: aging equipment presents reliability issues, as well as high maintenance requirements
- Operational complexity: dry weather flow operation is stable, but wet weather periods create challenging operational conditions
- Capacity requirements: the existing aeration basins limited capacity, and the intermediate clarifiers create an operational limitation

Addressing these drivers will need to begin soon for the De Pere Facility, and identifying the long- term vision of continuing to invest in two facilities, or combining the two facilities, is needed to develop and enhanced capital improvements plant for NEW Water for the coming decade.

1.2 Relationship to Overall Facility Plan

This TM has been developed as part of Task 4 of the Facility Plan. Task 1 of the Facility Plan is related to project management at execution. Task 2 of the Facility Plan focused on documenting the existing conditions for the NEW Water facilities. The following Task 2 results were used in the overall De Pere Facility evaluation:

- TM 2.1: Flows and Loads – the future conditions for both facilities are used for developing infrastructure requirements through 2040
- TM 2.2: Hydraulic Model – a calibrated hydraulic model was used to identify key hydraulic bottlenecks in the facilities
- TM 2.3: Process Model – the process model was used to develop process limitations at both facilities
- TM 2.4: Regulatory Requirements – future regulatory risks, and the fact that the two facilities operate under a bubble permit for total suspended solids (TSS) and total phosphorus (TP) were identified in TM 2.4
- TM 2.5: Infrastructure Gap Analysis – infrastructure gaps were identified related to either inadequate future capacity or equipment condition.

Task 3 of the Facility Plan identified future drivers, 50-year vision components, and criteria for the Multi-attribute Utility Analysis (MUA) for the NEW Water Facility Plan. Four visioning sessions were held in 2020, and the resulting 50-year vision and MUA approach were documented in TM 3.1. These criteria will serve as part of the evaluation approach for the De Pere Facility in Section 5.

Within Task 4, solutions are being developed to address the infrastructure gaps identified in Task 2 along with the vision developed in Task 3. All recommended improvements in Task 4 will ultimately be impacted by the De Pere Vision. The recommendations developed as part of this TM, and other Task 4 efforts, will be combined as part of Task 5 to develop a comprehensive capital improvements plan and infrastructure roadmap for NEW Water.

2.0 Background for the Long-Term Vision

Developing a long-term vision for the De Pere Facility requires a decision on whether to keep the De Pere Facility in operation or convert the facility to the De Pere Pump Station and treat all flows at the Green Bay Facility. To develop an effective long-term vision, it is important to understand the risks and opportunities related to keep the De Pere Facility in operation; understand the infrastructure gaps at both the De Pere Facility and the Green Bay Facility; and to identify potential treatment paradigms for NEW Water in the future.

2.1 De Pere Facility Risks and Opportunities

Understanding the risks and opportunities presented by maintaining the De Pere Facility provides a starting context for assessing future infrastructure needs. During the Vision Session 3 in June 2020, the risks and opportunities for maintaining the De Pere Facility were discussed in detail (Appendix A). The following Table 2-1, Table 2-2, Table 2-3 and Table 2-4 provide a summary of the risks and opportunities identified in four key categories: water quality and permitting; "outside the fence" considerations; asset value and maintenance requirements; and operational considerations. The risks and opportunities presented in these tables will help shape the more detailed evaluation of maintaining the De Pere Facility or combining flows at the Green Bay Facility presented in the following sections.

Table 2-1 Risks and Opportunities Related to Water Quality and Permitting for Maintaining the De Pere Facility

General Comments	Risks	Opportunities
Bubble permit between the two facilities (TP and TSS) and permit limits established by TMDL	Possibly more legal liability with two discharges.	Two plants may have more flexibility to trade mass between the plants for a mass-based limit
Removing DPF discharge and will likely not a have a significant impact on water quality	Emerging contaminants discharged at two locations could be a future risk.	Additional land area for future tertiary expansion is available at DPF.

Table 2-2 Risks and Opportunities Related to "Outside the Fence" Considerations for Maintaining the De Pere Facility

General Comments	Risks	Opportunities
Land Use. Plant is relatively isolated with mostly park space surrounding it.	Few "outside the fence" risks such as odor.	Little opportunity or interest in land re-use or site redevelopment for alternative purposes.
Customer Preferences. One or two discharges isn't a huge driver for customer decisions.		Little opportunity for reclaimed wastewater from DPF by customers.
General Neighbor Considerations. No major complaints about facility for odor or other.		Potential opportunity for river trail in the future – could be with or without the plant.
Other Decentralization Drivers. No decentralization driver for combining the plants other than what is most efficient.		Two plants provide more resiliency.

Table 2-3 Risks and Opportunities Related to Asset Value and Maintenance Requirements Considerations for Maintaining the De Pere Facility

General Comments	Risks	Opportunities
Intermediate clarifiers are a process capacity limitation.	Too many individual assets at DPF that take too much maintenance time. The GBF and DPF have the same number liquid assets while the GBF is much larger.	Final clarifiers, filters, back end of the facility are considered to be a valuable asset.
Overall Maintenance Requirements. Much maintenance time invested at DPF relative to its size.		Blowers are relatively new and considered a valuable asset.
General Equipment.		IT systems of two plants well tied together. Continue to use recent electrical investments and new generators.

Table 2-4 Risks and Opportunities Related to Operations Considerations for Maintaining the De Pere Facility

General Comments	Risks	Opportunities
Operational challenges are mainly tied to headworks and wet weather operation	Wet weather is a challenge. Large loading swings cause issues.	Flexibility is a benefit; ability to shift load to GBF from mill waste as well as 5 mgd of metro wastewater
	Final clarifiers are used for equalization, but this is operationally intensive. Formal equalization volume could alleviate operational issues during wet weather flow.	Stable operations at lower influent flows (fairly good resilience to swings in industrial loadings)
	Intermediate clarifiers are a critical bottleneck to process stability; high risk operational condition.	Good and stable operations for normal flows

2.2 Infrastructure Gap Summary

TM 2.5 - Infrastructure Gap Analysis identified facility capacity limitations combined with a facility condition assessment. This TM focused on identification of unit process gaps related to capacity, operation and maintenance, and condition. Capacity gaps were developed from comparing future flows and loads to equipment capacity. Operation and maintenance gaps were developed from interviews with plant staff. Condition gaps were based on a combination of plant staff interviews and previous condition assessment work by NEW Water.

A summary of the De Pere Facility gaps are summarized in Table 2-5, and Green Bay Facility gaps are summarized in Table 2-6. A more detailed discussion of each gap is presented in TM 2.5. Capacity gaps were developed based on projected 2040 flows and loads. In general, the De Pere Facility presents wet weather capacity limitations for almost every major unit process, as well as options and maintenance gaps and condition gaps. The Green Bay Facility presents wet weather capacity gaps at the influent and effluent structures, but in general investment would be limited to condition-based improvements at the

Green Bay Facility for current flow projections. This may present an opportunity for average day loading capacity at the Green Bay Facility to “absorb” the De Pere Facility flows and loads under dry weather conditions but would exacerbate current wet weather limitations at the Green Bay Facility.

Table 2-5 Infrastructure Gap Summary

Unit Process	Infrastructure Gap
Influent pumps	**Capacity gap – peak hour flow** Operation and Maintenance gap Condition gap
Influent screens	Operation and Maintenance gap Condition gap
Preliminary treatment units	**Capacity gap – peak day flow** Operation and Maintenance gap Condition gap
Aeration basins	**Capacity gap – average day organic loading** Operation and Maintenance gap
Intermediate clarifiers	**Capacity gap – peak day flow** Operation and Maintenance gap Condition gap
Final Clarifiers	**Capacity gap – peak hour flow** Operation and Maintenance gap Condition gap
Final filtration	**Capacity gap – maximum month flow** Condition gap
UV disinfection	**Capacity gap – peak week flow** Condition gap

Table 2-6 GBF Infrastructure Gap Summary

Unit Process	Infrastructure Gap
Influent pumps	**Capacity gap – peak hour flow** Operation and Maintenance gap Condition gap
Influent screens and grit removal	**Capacity gap – peak hour flow** Operation and Maintenance gap Condition gap
Primary clarifiers	**Capacity gap – peak day flow** Condition gap
North Plant aeration basins	Operation and Maintenance gap Condition gap
North Plant final clarifiers	Operation and Maintenance gap Condition gap
South Plant aeration basins	Condition gap
South Plant final clarifiers	Operation and Maintenance gap Condition gap
UV disinfection	**Capacity gap – peak day flow** Condition gap

2.3 Potential Treatment Alternatives and Evaluation Approach

Broadly, there are two alternatives for the future of the De Pere Facility, as identified during the Vision Workshops in 2020:

1. Alternative 1: Simplify and Expand the De Pere Facility - Continued investment in the existing De Pere Facilities to maintain and expand treatment facilities.

2. Alternative 2: Build a De Pere Pump Station: Decommission the De Pere Facility treatment processes and regionalize treatment at the Green Bay Facility.

Alternative 1 would not be status quo operation of the De Pere Facility, but an investment plan to address the identified infrastructure gaps of the facility. Alternative 1 will include wet weather improvements, capacity expansion, and operational improvements to address Operation and Maintenance Gaps and equipment improvements to address the condition gaps for the De Pere Facility. Alternative 1 also includes required improvements at the Green Bay Facility to meet capacity gaps (although these are more minor), and other improvements to address operation and maintenance and/or equipment gaps. Alternative 2 will include infrastructure to expand the Green Bay Facility capacity to handle flow from the De Pere Facility, as well as currently identified improvements to address existing infrastructure gaps.

During the Visioning Workshops, several sub-alternatives to Alternative 1 were discussed that could result in reduced energy use (A-stage operation), innovative wet weather treatment strategies (high rate wet weather filtration) or potential dry weather treatment at the De Pere Facility and wet weather diversion to the Green Bay Facility. These sub-alternatives should be part of the future considerations for the long-term investment at the De Pere Facility, if the De Pere Facility is maintained, but would only be implemented if they presented a more cost effective or viable option to this base alternative for the De Pere Facility. Once the decision between continuing to operate the De Pere Facility or moving towards a consolidate facility, future investigation and applied research efforts can help to identify the specific of the path forward. The goal of this TM is to identify the broad path forward for NEW Water.

An alternative for re-configurating the De Pere Facility as wet weather only treatment facility was asked to be considered. Dry weather flow would then be pumped to the Green Bay Facility. However, based on the De Pere Facility serving a separated system, it was not considered allowable under current regulations to have dedicated wet weather treatment system.

3.0 Alternative Development

The two alternatives identified in Section 2 were further developed to understand improvement requirements for each. Flow and load projections for both the De Pere Facility and Green Bay Facility systems were used to assess long-term requirements of both facilities. As part of this effort an assessment of average dry weather flows and peak flows for the whole system were coupled with the existing treatment capacity at each facility. Individual treatment processes were assessed for each alternative to identify improvement needs.

3.1 Alternative 1 – Simplify and Expand the De Pere Facility

Continued investment in the De Pere Facility will require a vision that moves the facility towards long-term simplification of operation and increased robustness of unit processes. This alternative focuses on the capacity improvements required to meet future flow projections, address aging infrastructure needs and at the same time reduce maintenance requirements. Key aspects of the Alternative 1 improvements at the De Pere Facility include:

- Upgrading the screening and grit removal facilities, eliminating the preliminary treatment units (PTUs)
- Addition of 2 million gallons (MG) of peak flow equalization, limiting the peak hour flow to 40 mgd
- Addition of a new aeration basin to reduce mixed liquor suspended solids (MLSS) volatility and provide increased redundancy, along with step feed facilities for wet weather operation
- Elimination of the intermediate clarifiers
- Upgrades to the existing final clarifiers (no additional clarifiers required due to peak flow equalization)

It was recognized that the interplant sludge pipeline physical condition will eventually need investment. The evaluation of the pipeline and an estimate of future improvements was considered beyond the scope of this Facility Plan

Table 3-1 summarizes each unit process improvement that is recommended at the De Pere Facility and at the Green Bay Facility for Alternative 1. Major assumptions and notes are provided in the table, with additional details provided schematically in **Appendix B**. A site plan for the De Pere Facility and Green Bay Facility improvements are included in Figure 3-1 and Figure 3-2, with potential phasing indicate by number at each facility. Potential phasing of projects holistically will be discussed in Section 5 as part of the MUA analysis.

Table 3-1 Alternative 1 Unit Process Improvements Summary

Unit Process	De Pere Facility	Green Bay Facility	Assumptions and Notes
Influent Pump Station	Increase capacity to 57 mgd	Increase capacity to 148 mgd	• See TM 4.1 for evaluation and summary
Headworks	Improve existing headworks and add new grit removal equipment; abandon PTUs	• Improve existing headworks • Add sludge screens	• See TM 4.1 for evaluation and summary
Equalization	Construct a 2 MG equalization basin for peak flows	No equalization basin required	• Reduce DPF peak flow capacity requirements to 40 mgd with new EQ downstream of headworks to mitigate peak hour requirements • Consider use of second stage • aeration for EQ
Primary Clarifiers	N/A	• Peak flow primary clarifier diversion • Mechanism rehabilitation	• Primary treatment of peak hour flows, diversion is approximately 28 mgd. • Rehabilitation summarized • in Clarification Study Final Report
Aeration Basins	One new aeration basin	Blower and aeration control improvements	• Aeration basin capacity limits assumes nitrogen removal for organic loading rate (25 lbs BOD/1,000 cu ft-d) • DPF aeration basin addition due to organic loading rate and clarifier solids loading limitations. Assumed 4 MG duplication of existing • basins
Final Clarifiers	Clarifier rehabilitation New RAS pumps and piping	Mechanism rehabilitation	• Rehabilitation summarized in previous Clarification Rehabilitation Study • Abandon intermediate • clarifiers
South Effluent Pump Station		No changes	
Filtration	Filtration rehabilitation	N/A	• DPF filter rehabilitation summarized in memo Tertiary Filtration 30% Design

Unit Process	De Pere Facility	Green Bay Facility	Assumptions and Notes
Disinfection	UV expansion to 40 mgd	New 140 mgd UV disinfection facility	• DPF UV capacity expansion based on projected peak flows • GBF new UV disinfection and abandonment of existing facilities
Thickening	N/A	Facility rehabilitation	• Thickening facility improvements summarized in TM 4.2
Anaerobic Digestion and Solids Handling	N/A	No changes	

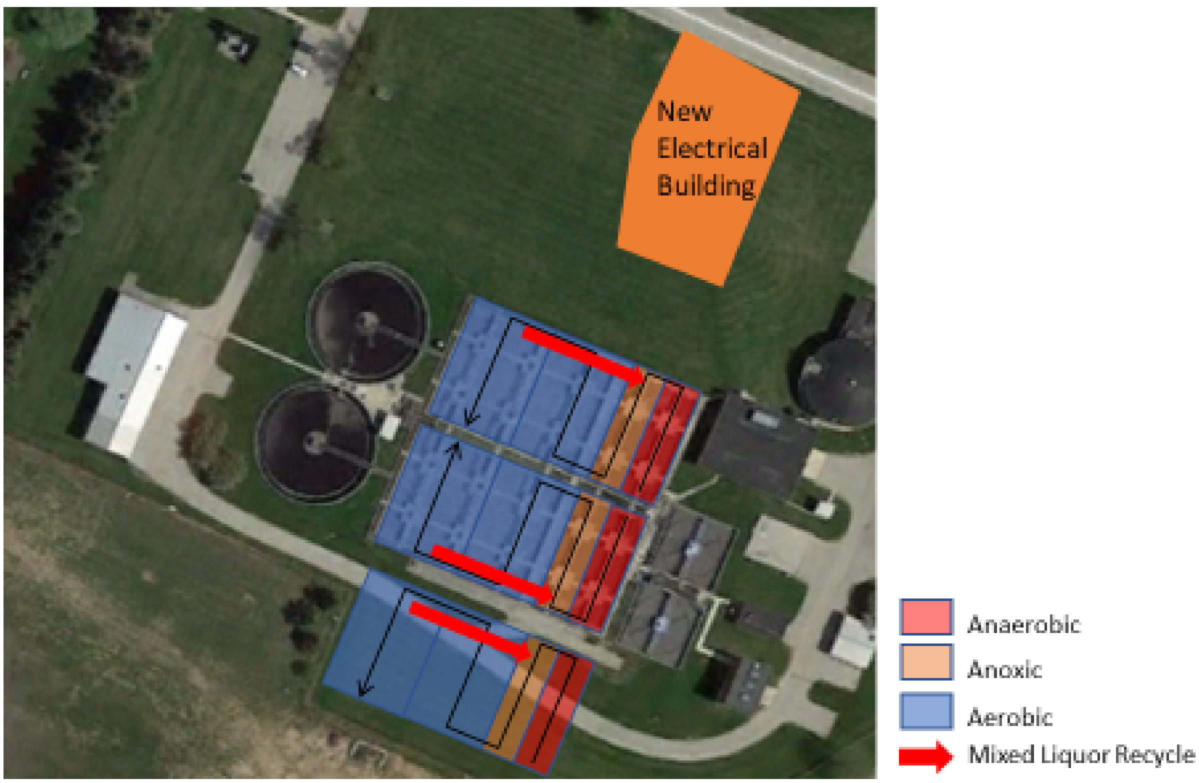

Figure 3-1 Alternative 1 De Pere Facility Recommended Improvements

Figure 3-2 Alternative 1 Green Bay Facility Recommended Improvements

3.2 Alternative 2 – Build a De Pere Pump Station & Decommission Treatment Facility

Alternative 2 for the long-term De Pere Facility vision transfers unit treatment processes to the Green Bay Facility via a transfer pump station located at the De Pere Facility. This alternative focuses on co-locating treatment facilities as an effort to reduce maintenance and operation of two separate facilities. Peak flow equalization is combined with the pump station to limit the pump station to 30 mgd, reducing the pump station capital cost as well as decreasing the wet weather expansion requirements at the Green Bay Facility. The capacity impacts of combining the flows at the Green Bay Facility on capacity requirements are summarized in Table 3-2. Diverting flows from the De Pere Facility to the Green Bay Facility create capacity limitations in all the unit processes at the Green Bay Facility.

Table 3-2 GBF Infrastructure Gap Summary

Unit Process	Infrastructure Gap – Current 2040 Green Bay Facility Loads	Infrastructure Gap – Current 2040 Combined Loads
Influent pumps	**Capacity gap – peak hour flow** Operation and Maintenance gap Condition gap	**Capacity gap – peak day flow** Operation and Maintenance gap Condition gap
Influent screens and grit removal	**Capacity gap – peak day flow** Operation and Maintenance gap Condition gap	**Capacity gap – peak day flow** Operation and Maintenance gap Condition gap
Primary clarifiers	**Capacity gap – peak day flow** Condition gap	**Capacity gap – peak day flow** Condition gap
North Plant aeration basins	Operation and Maintenance gap Condition gap	**Capacity gap – maximum month loading** Operation and Maintenance gap Condition gap
North Plant final clarifiers	Operation and Maintenance gap Condition gap	**Capacity gap – peak day flow** Operation and Maintenance gap Condition gap
South Plant aeration basins	Condition gap	**Capacity gap – maximum month loading** Condition gap
South Plant final clarifiers	Operation and Maintenance gap Condition gap	**Capacity gap – peak day flow** Operation and Maintenance gap Condition gap
UV disinfection	**Capacity gap – peak day flow** Condition gap	**Capacity gap – peak day flow** Condition gap

Alternative 2 addresses primary concerns related to maintenance of the De Pere Facility aging infrastructure because processes at De Pere will be abandoned with a transfer pump station and onsite equalization. Onsite equalization and pumping capacities were optimized to reduce significant infrastructure upgrades at the GBF. Table 3-3summarizes each unit process improvement that is recommended for comparison with each alternative. A site plan for the De Pere Facility and Green Bay Facility improvements are included in Figure 3-3 and Figure 3-4, with potential phasing indicated by number at each facility. Potential phasing of projects holistically will be discussed in Section 5 as part of the MUA analysis.

Table 3-3 Alternative 2 Unit Process Improvements Summary

Unit Process	De Pere Facility	Green Bay Facility	Assumptions and Notes
Influent Pump Station	New 30 mgd transfer lift station and pipeline	Increase capacity to 148 mgd	• See TM 4.1 for evaluation and summary of GBF • Initial lift station and pipeline routing to determine capital costs
Headworks	• No headworks, coarse screens included with influent lift station. • Decommission and demolition existing basins	• Improve existing GBF headworks • Addition of sludge screens • New 30 mgd DPF headworks at GBF	• See TM 4.1 for evaluation and summary
Equalization	Construct 10 MG equalization basin for peak flows	No equalization basin	• Reduce DPF lift station transfer capacity to 30 mgd with addition of onsite equalization • New equalization at DPF parallel to proposed transfer lift station
Primary Clarifiers	N/A	• Existing clarifier mechanism rehabilitation • Addition of two new primary clarifiers	• GBF north plant clarifier mechanism rehabilitation • GBF south plant addition of two 90 ft diameter, 14 ft SWD primary clarifiers
Aeration Basins	Decommission and demolition existing basins	• One new aeration basin • Blower and aeration control improvements	• Aeration basin capacity limits assumes nitrogen removal • GBF south plant addition of one aeration basin configured similar to existing
Final Clarifiers	Decommission and demolition existing basins	• Existing clarifier mechanism rehabilitation • Addition of two new secondary clarifiers at south plant	• GBF existing clarifier rehabilitation summarized in Clarification Study Final Report • GBF south plant addition of two new clarifiers 130 ft diameter, 15 ft SWD • GBF south plant RAS and WAS pump station expansion
South Effluent Pump Station	N/A	Expand to 50 mgd	• Current facility is 18 mgd firm capacity; addition of pumps to meet 50 mgd firm capacity • No pipeline nor wet well improvements assumed

Unit Process	De Pere Facility	Green Bay Facility	Assumptions and Notes
Filtration	Decommission and demolition existing basins	No changes	• No GBF filters assumed due to system adaptive management approach
Disinfection	Decommission and demolition existing basins	New 170 mgd UV disinfection facility	• GBF new UV disinfection and abandonment of existing disinfection
Thickening	N/A	Facility rehabilitation	• Thickening facility improvements summarized in TM 4.2
Anaerobic Digestion and Solids Handling	N/A	No changes	

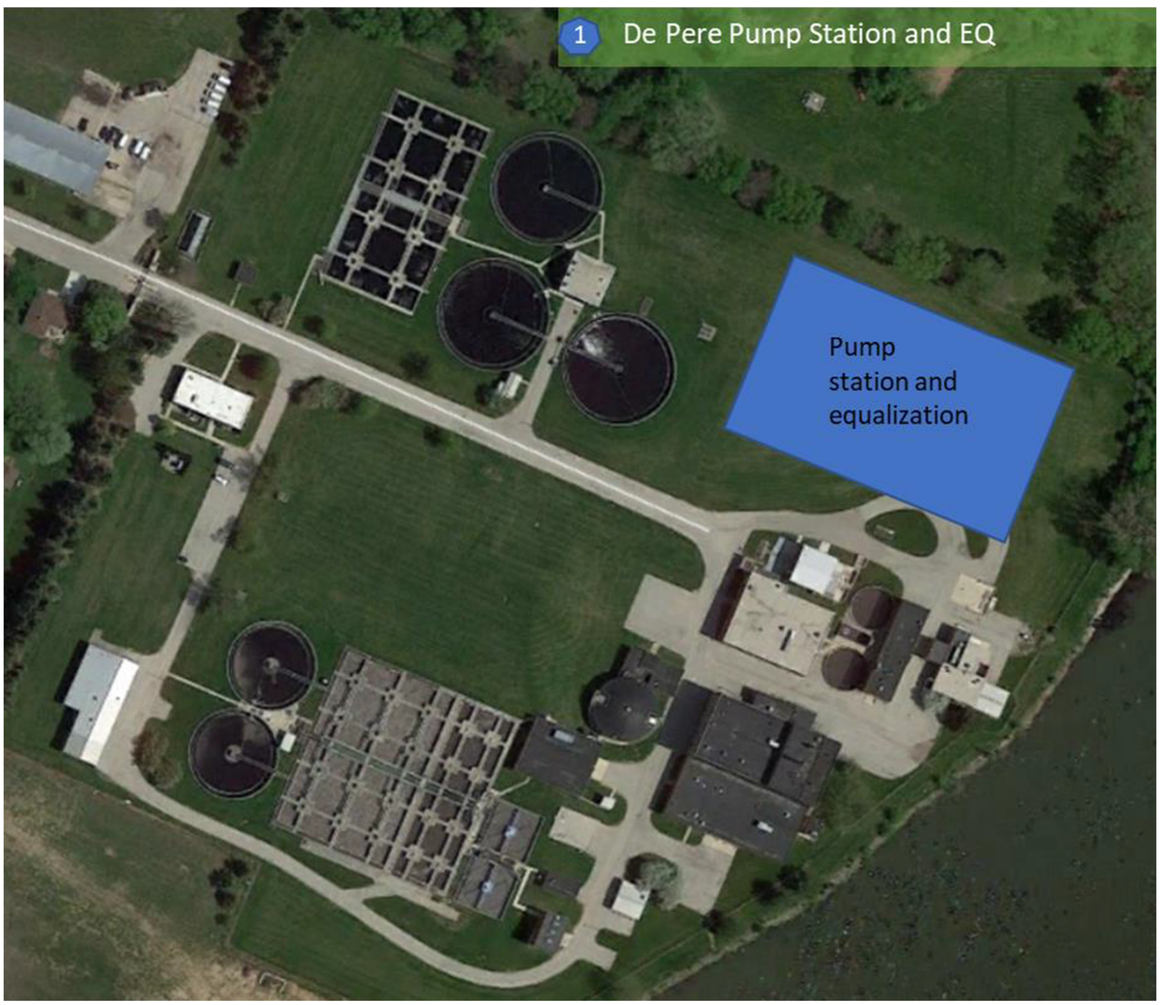

Figure 3-3 Alternative 2 De Pere Facility Recommended Improvements

Figure 3-4 Alternative 2 Green Bay Facility Recommended Improvements

One important impact when the De Pere Facility and Green Bay Facility are combined is that no tertiary filtration will be in place for any portion of the NEW Water flows. This has an impact on the overall NEW Water discharge of total phosphorus and total suspended solids. Based on the following assumptions, the impacts on total phosphorus and total suspended solids mass discharge at NEW Water were estimated:

- Green Bay Facility parameters (10-year average values)
  - Average flow: 28.5 mgd
  - Phosphorus discharge: 0.35 mg/L
  - TSS discharge: 5.8 mg/L
- De Pere Facility parameters (10-year average values)
  - Average flow: 7.8 mgd
  - Phosphorus discharge: 0.18 mg/L
  - TSS discharge: 2.0 mg/L

Based on these values, moving towards a single discharge at the Green Bay Facility (without filtration) would increase the annual phosphorus discharge by approximately 4,0000 pounds and the annual total suspended solids discharge by approximately 89,000 pounds. This represents a 12% increase in phosphorus discharge and a 16% increase in TSS. These impacts would have to be considered as part of the overall adaptive management plan when identifying target watersheds for non-point discharge management. These increases are considered in the MUA in Section 5.

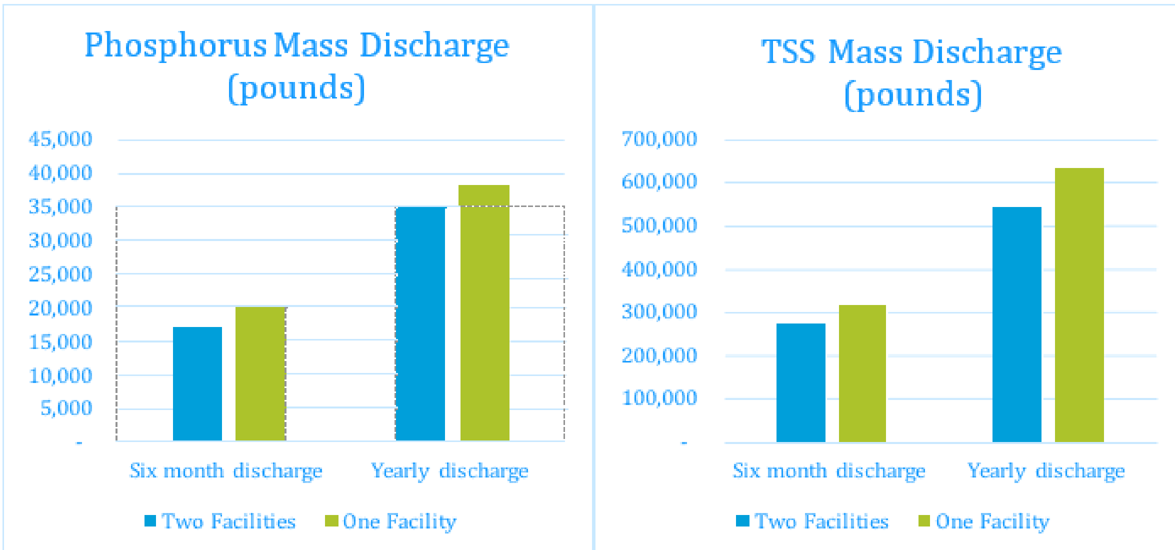

Figure 3-5 Impact of Moving to One Discharge at the GBF on Effluent Phosphorus and Suspended Solids Discharge

3.3 Alternative Infrastructure Packages

Diversion of all flows for treatment at the Green Bay Facility eliminates all treatment processes at the De Pere Facility, but will require significant infrastructure investment at the Green Bay Facility. In the following sections, life cycles costs, MUA, and 50-year vision impacts will be evaluated to inform the decision of the long-term vision of the De Pere Facility based on the above alternatives.

4.0 Life Cycle Cost Assessment

Estimated life cycle costs were developed based on total capital costs for each alternative, along with major operating costs for major equipment operation. Capital phasing was not considered as a part of the life cycle cost but will be considered as part of the MUA.

4.1 Capital Cost Estimates

4.1.1 Construction Cost Estimates

Construction costs were calculated utilizing construction costs from previous projects completed, similar construction projects completed elsewhere in the past two years, typical installed costs observed from past project experience, pricing for the main process equipment and previous estimates completed for NEW Water. Total construction costs were estimated using the percentages listed in Table 4-1. Construction cost estimates for each are summarized in Table 4-2. Additional cost estimate details are included in Appendix C.

Table 4-1 Multipliers Used to Determine Total Construction Costs

Component	Multiplier	Value Multiplied Against
Installation	30%	Equipment
Mechanical	20%	Equipment + Installation
Electrical and I&C	20%	Equipment + Installation
Contractor Overhead and Profit	25%	Installed equipment cost
Contingency	50%	Installed cost + Overhead

Table 4-2 Total Construction Costs for Alternatives 1 and 2

Unit Process	Alternative 1 – Simplify and Expand De Pere Facility	Alternative 2 – Build De Pere Pump Station & Decommission Treatment Facility	Assumptions and Notes
GBF - Influent Pump Station	$15,000,000	$15,000,000	*Costs included from TM 4.1
GBF - Headworks	$22,000,000	$53,000,000	*Costs included from TM 4.1 *Alt 2 – 30 MGD Headworks for DPF Flow
DBF - Influent Pump Station and Headworks	$20,000,000	$35,000,000	*Costs included from TM 4.1 *Alt 2 – 30 MGD Pump Station
DPF - Equalization	$7,500,000	$38,000,000	*Alt 1 – 2 MG Basin *Alt 2 – 10 MG Basin *$2 per gallon for basic basin w/o mechanical/electrical/installation

Unit Process	Alternative 1 – Simplify and Expand De Pere Facility	Alternative 2 – Build De Pere Pump Station & Decommission Treatment Facility	Assumptions and Notes
GBF - Primary Clarifiers	$5,900,000	$16,000,000	*Rehabilitation costs from Clarifier Rehabilitation Study prepared by Donohue in 2019 *Alt 1 – 28 MGD bypass around primary clarifiers *Alt 2 – Two new 0.67 MG clarifiers, $2.75 per gallon
GBF - Aeration Basins	$4,300,000	$20,000,000	*Blower and Control improvements costs from CIP *Alt 2 – 3 MG basin, $1.50 per gallon
DPF - Aeration Basins	$20,000,000	-	*4MG basin, $1.50 per gallon
GBF - Final Clarifiers	$20,000,000	$48,000,000	*Rehabilitation costs from Clarifier Rehabilitation Study prepared by Donohue in 2019 *Alt 2 – Two 1.49 MG clarifiers, $2.75 per gallon
DPF - Final Clarifiers	$7,200,000	-	*Rehabilitation costs from Clarifier Rehabilitation Study prepared by Donohue in 2019
GBF - South Effluent Pump Station	-	$2,300,000	*Expand to 50 mgd
DPF - Filtration	$8,000,000	-	*Costs from CIP
GBF - Disinfection	$47,000,000	$56,000,000	*Alt 1 – 140 MGD UV Facility *Alt 2 – 170 MGD UV Facility
DPF - Disinfection	$2,900,000	-	*Expand facility to 40 MGD
GBF - Thickening	$9,900,000	$9,900,000	*Costs included from TM 4.2
Total	**$190,000,000**	**$290,000,000**	-

4.1.2 Total Capital Cost Estimates

Total capital costs were determined using the percentage listed in Table 4-3 to account for design, construction services and administrative costs. The potential cost range shown in Table 4-4 represents the range of project costs as defined for a Class 4 cost estimate (AACE International Recommended Practice No. 18R-97), with the range representing 85 percent to 125 percent of that most probable capital cost.

Table 4-3 Multiplier Used to Determine Total Capital Costs

Component	Multiplier	Value Multiplied Against
Total Capital Cost	25%	Construction Cost (Table 4-2)

Table 4-4 Total Capital Cost Estimates for Alternatives

Infrastructure Package	Potential Capital Cost Range	Most Probable Capital Cost
Alternative 1	$200M to $300M	$240M
Alternative 2	$310M to $450M	$360M

4.2 Annual Operating Costs

The analysis between the two alternatives based on annual operating cost was based on the following major operating parameters and assumptions:

- Total system aeration energy
  - Energy estimates made using existing aeration systems, with the assumption that blowers operate to meet airflow demands, and based on oxygen demand outputs at average day conditions generated from the calibrated process model
  - New blower systems at the Green Bay Facility may decrease the overall energy for aeration, but this was not considered for this level of evaluation
- Total system pumping
  - Alternative 1: influent De Pere Facility pumping and De Pere Facility solids pumping were considered
  - Alternative 2: De Pere pump station pumping to convey flows to the Green Bay Facility included
- Biogas energy
  - Assumed full utilization of produced biogas for energy production
  - Based on current energy recovered per biogas produced
- Operator Staffing Costs.
  - Assumed that no additional operations staff were required to operate and maintain the improvements at the GBF.
  - Assumed that six additional operations staff would be required to maintain the improved DPF.

These factors, while not fully encompassing operational costs, were viewed as the major differentiators for annual operating costs. They should be considered indicative operating costs, enabling a decision between the two alternatives for NEW Water. These indicative operating costs are summarized in Table 4-5.

Table 4-5 Indicative Operating Costs for Decision Making Related to Alternative 1 and 2

	Alternative 1	Alternative 2
Average Aeration Energy (kwh/day)	17,859	14,560
Annual Aeration Cost ($/year)	325,927	265,720
Average Pumping Energy (kwh/day)	3,579	13,423
Annual Pumping Cost ($/year)	65,323	244,962
Average Biogas Energy Production (kwh/day)	-11,538	-13,200
Annual Biogas Value ($/year)	-210,569	-240,900
Net Energy Impact (kwh/d)	9,900	14,783
Annual Net Energy Cost ($/year)	180,682	269,782
Annual Cost of Incremental Operations Staff Labor ($/year)	450,000	450,000

4.3 Life-Cycle Costs

For both alternatives, the 20-year life cycle costs (LCCs) were estimated. The life-cycle cost was based on total construction costs, the indicative operational costs, a 3% interest rate, and a 20-year operating period. The life cycle costs are summarized in Figure 4-1 Life Cycle Cost for the Two De Pere Facility Alternatives.

Figure 4-1 Life Cycle Cost for the Two De Pere Facility Alternatives

5.0 MUA

TM 3.1 established five main categories and then quantitative criteria within each category for the MUA. For Scores were developed for both alternatives based on these criteria. Scores and notes for each category and criteria are provided in Table 5-1, along with the category weights and criterion weights (shown in parentheses).

Table 5-1 MUA Criteria Scores and Notes for the Two Alternatives

Mua Category (In Bold) and Criteria	Alternative 1 – Simplify and Expand the De Pere Facility	Alternative 2 – Build De Pere Pump Station and Decomission Treatment Facility
Financial (30%)		
Life cycle cost rank (5 - low, 1 - high) (60%)	Score: 4 Notes: Lowest life cycle cost	Score: 2 Notes: Highest life cycle cost
Is the cashflow requirement dispersed over time? (5 - phased implementation, 1 - front-end loaded) (40%)	Score: 5 Notes: Allows for the distributed investment in improvements at the DPF and GBF based on need and budget	Score: 3 Notes: Requires significant upfront investment first in the GBF expansion and in the DPF pump station
Operational (25%)		
Human intervention requirements (operation) (5 - low, 1 - high) (50%)	Score: 2 Notes: Simplifies DPF operations, particularly during wet weather, but maintains two facilities. Simplification comes from eliminating intermediate clarifiers, expanding aeration basins, adding filtration capacity, and improving headworks	Score: 5 Notes: Reduces treatment operations to one facility
Human intervention requirements (maintenance) (5 - low, 1 - high) (50%)	Score: 2 Notes: Similar maintenance requirements as current system	Score: 5 Notes: Maintenance reduced to one facility
Environmental (25%)		
New opportunities for resource recovery (5 - high, 1 - low) (20%)	Score: 3 Notes: No major differences in solids produced or resource mass flows	Score: 3 Notes: No major differences in solids produced or resource mass flows
Dependency on external resources (chemicals, polymers, additives) (5 - low, 1 - high) (10%)	Score: 3 Notes: No major differences related to polymer dosing, chemical addition for treatment, or external additives	Score: 3 Notes: No major differences related to polymer dosing, chemical addition for treatment, or external additives
Net impact on energy consumption (KWH/yr) (5 - 5 lowest net energy, 1 - highest net energy) (10%)	Score: 3 Notes: Similar to current energy use for both facilities.	Score: 1 Notes: Increased energy use (pumping) as shown in Table 4-5.

Mua Category (In Bold) and Criteria	Alternative 1 – Simplify and Expand the De Pere Facility	Alternative 2 – Build De Pere Pump Station and Decomission Treatment Facility
Potential impact on nutrient/TSS reduction (pounds/year) (5 - increased removal, 3 - neutral, 1 - increased discharge) (50%)	Score: 3 Notes: Similar to current discharge	Score: 1 Notes: Increased phosphorus and TSS discharge as shown on Figure 3-5.
Community (10%)		
Relinquished assets (5 - low, 1 - high) (40%)	Score: 4 Notes: Abandons existing intermediate clarifiers	Score: 1 Notes: Decommissions the majority of assets at De Pere Facility and represents a "walk away" of assets of significant value.
Socio-economic community benefits or cost (5 - high community benefit, 1 - high community cost) (30%)	Score: 3 Notes: Limits need for expansion near GBF and so allowing existing land owned by NEW Water to be used for other purposes.	Score: 4 Notes: Potential re-purposing of DPF land; centralized odor and noise production at GBF; risk of detrimental impact due to pipeline easements between DPF and GBF
Socio-economic NEW Water benefits or cost (5 - high NEW Water benefit, 1 - high NEW Water cost) (30%)	Score: 4 Notes: Preserves more land for future expansion, increased resilience, maintains 40 mgd of tertiary filtration capacity	Score: 3 Notes: Limits expandability of facilities in the future, no tertiary filtration is maintained, simplifies operations and maintenance
Knowledge/ Information (10%)		
Opportunity for demonstration such as pilot testing (5 - high, 1 - low) (25%)	Score: 4 Notes: Phased implementation provides benefits to testing of innovative technologies before implementation	Score: 2 Notes: Significant up-front investment limits ability to test new technologies and approaches
Opportunity for operational innovation and adaptation (5 - high, 1 - low) (25%)	Score: 3 Notes: No major differences	Score: 3 Notes: No major differences
Ability to operate in a single single-shift operations paradigm (5 - high, 1 - low) (50%)	Score: 2 Notes: Two facilities increase the need for multiple shifts across both plants	Score: 4 Notes: One facility provides the ability for a reduced single-shift staff

Based on the MUA weighting, Alternative 1 has a higher score than Alternative 2 (graphic summary provided in Figure 5-1, with additional information provided in Appendix D). Alternative 2 scores much stronger than Alternative 1 in the operations category, but similar or lower in all other categories. When the category weights are shifted to focus heavily on a financial focus or an environmental focus, a similar outcome is seen for Alternative 1. Weighted scores from this sensitivity analysis are shown in Figure 5-2. This sensitivity analysis suggests that Alternative 1 is a more robust alternative under a variety of different weighting assumptions.

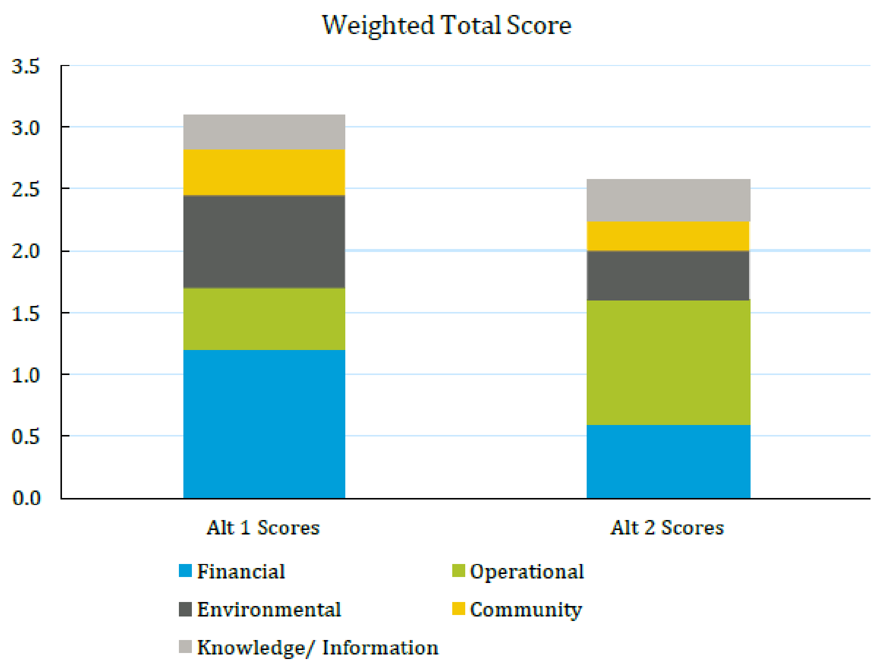

Figure 5-1 Baseline Weighted Scores for Alternative 1 and 2

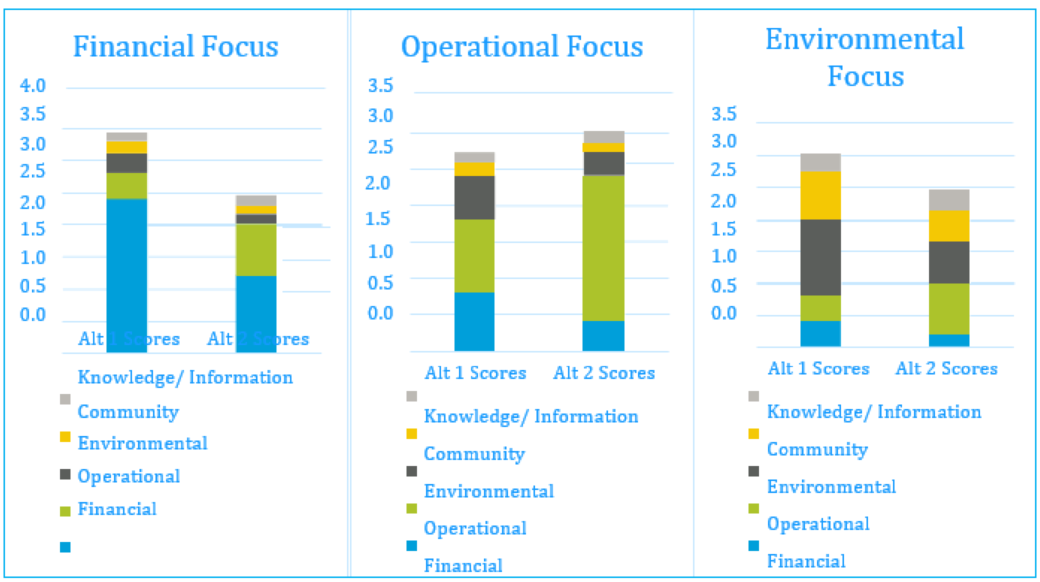

Figure 5-2 Sensitivity Analysis on Category Weighting for the Final MUA Score

6.0 50-Year Vision

To evaluate the ability of current infrastructure investments to position NEW Water for a 50-year vision, a series of risks and opportunities were identified in TM 3.1 Table 6-1 50-Year Vision Risks and Opportunities, and Potential Alternative Advantages, provides these risks and opportunities, as well as an indication of the ability of either alternative to better position NEW Water for a 50-year horizon. Overall, Alternative 1 provides more advantages from a 50-year horizon, although Alternative 2 provides several critical advantages related to workforce management and reducing operational complexity.

Table 6-1 50-Year Vision Risks and Opportunities, and Potential Alternative Advantages

Risk Category	Risk	Likely Response	Facility Plan Opportunity	Is There an Advantage from One Alternative?
Regulatory	New effluent compounds	Tertiary treatment/ membrane filtration	Maintain site footprint, consider as part of DPF improvements	Alternative 1 maintains more land availability
	Effluent nitrogen limits	Aeration basin modifications	Develop plan for basin modifications	No significant advantage
	Microplastics	Tertiary treatment/ membrane filtration	Maintain site footprint, consider as part of DPF improvements	Alternative 1 maintains more land availability
	GHG emission regulations	Reduce use of non-renewable energy	Prioritize alternatives that reduce net energy use	Alternative 1 maintains lower energy use
	New pathogen categories	Elimination of blending; multi-phase disinfection	Maintain flexibility for multi-barrier disinfection	Alternative 2 is more adaptable to multi-phase disinfection due to existing chlorine contact basins
	Chlorides/TDS limitations	Source reduction; advanced filtration	Maintain site footprint, consider as part of DPF improvements	Alternative 1 maintains more land availability
Aging infrastructure	Concrete failure	Repair and maintain	Plan for concrete rehabilitation in all projects	-
Community changes	Increased demand for reuse water	Tertiary treatment/ membrane filtration	Maintain site footprint, consider as part of DPF improvements	Alternative 1 maintains more land availability
	Neighbor impacts, gentrification	More odor control, less noise,	Maintain site footprints	Alternative 2 centralizes potential community impacts

Risk Category	Risk	Likely Response	Facility Plan Opportunity	Is There an Advantage from One Alternative?
Shift in industry/ demographics	Significant reduction in organic loading	Reduction in dry weather hydraulic capacity needs	Phased implementation of organic loading projects	No significant advantage
	Decreased water usage from conservation	Optimization of basin operation	Identify alternatives that provide operational flexibility	No significant advantage
	Rapid population growth	Expansion of facilities	Maintain expansion flexibility	Alternative 1 maintains more land availability
	Shift to residential wastewater flows	Reduced organic strength of wastewater	Phased implementation of organic loading projects	No significant advantage
Climate change	Intense weather patterns	Increased wet weather flow treatment	Prioritize improvements that improve wet weather treatment	No significant advantage
Workforce	Workforce availability (technical skill set)	Alternatives that provide simplified operation	Focus on human intervention requirements of alternatives	Alternative 2 centralizes operations and maintenance
	Reduced human interaction	Alternative 2 centralizes operations and maintenance		No significant advantage

7.0 Summary and Next Steps

A decision on the long-term vision for the De Pere Facility should be made based on three key pieces of information:

- Life cycle costs that include capital investment to make the De Pere Facility a simplified facility with increased capacity (Chapter 4)
- MUA evaluation using NEW Water specific criteria (Chapter 5)
- Impacts on NEW Water's 50-year vision (Chapter 6)

Based on all three of these criteria, Alternative 1 is the recommended alternative for NEW Water because it scores better.

- The 20-year life-cycle cost of Alternative 1 is $100 million lower than Alternative 2. In addition to lower overall costs, Alternative 1 has the significant advantage of being able to phase costs over a 20-year period which Alternative 2 requires most of the capital to be spent at once.
- The overall MUA score for Alternative 1 is higher than Alternative 2. While the operational component score of Alternative 2 is better than Alternative 1, all other scores for Alternative 1 are higher than Alternative 2.
- Alternative 1 provides more land availability to help NEW Water meet future needs at either facility.

The specific recommendations for the improvements to the GBF and the DPF are presented in more detail in the Facility Plan.

Appendix A

Notes from 50-Year Vision Workshop

NEW WATER

GREEN BAY FACILITY & DE PERE FACILITY

50-Year Vision – Session 2

June 2, 2020

NEW Water
The brand of the Green Bay Metropolitan Sewerage District

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WORKSHOP NO. 1 REVIEW

Objectives

1. Develop a vision for development of the GBF and DPF over the coming 50 years that delivers extraordinary value to the Green Bay community.
2. Understand new-term issues and develop plans to address them while retaining future flexibility.
3. Identify actions to be taken now to mitigate future risks and to create future opportunities.
4. Assist New Water to building increased internal capacity, broadly viewed (e.g. staff, capabilities, financial, stakeholder support).

Key Success Factors

1. Clearly understand the current situation. (Workshop No. 1.)
2. Understand the broad goals and objectives of NEW Water internal and external stakeholders. (Workshop No. 2 and following)
3. Understand the range of future issues and possibilities, including uncertainties (Workshop No. 2 and following)
4. Understand constraints and how they can be relaxed (Workshop No. 2 and following)

WORKSHOP NO. 1 REVIEW

Workshop No. 1 - Where is NEW Water at:

- Adaptive Management - uncertainty for future
- R2E2 - Need "debottlenecking" and reliability of solids process, engine reliability
- Flows and Loads - lack of peak flow both plants in 2040, lack of loading capacity at DPF in 2040
- Hydraulic Limitations - peak flows exceed hydraulic capacity
- Future Regulatory Scenarios – separated into near- and long-term considerations

WORKSHOP NO. 1 FEEDBACK

- Clear Articulation of Overall Workshop Goals
- Potential Need for Addition Small Group Discussions
- Re-Prioritize Workshops to Focus on DPF Because its Risks and Opportunties Drive Solution Pathways

A MINOR PIVOT

Session 1: NEW Water Infrastructure Drivers

Session 2: ~~Future of Nutrient Removal~~ De Pere Vision

Session 3: ~~Water Reuse~~, Nutrients, Energy Management and Resource Recovery

Session 4: Water Re-Use, Emerging Concerns and Areas

Session 5: Consolidation of long-term drivers

MEETING OBJECTIVES

1) Complete Infrastructure Gap Summary- Provde a Summary of Key NEW Water Infrastructure Challenges

2) DPF Evauation – Obtain Feedback on:

   a) Three Alternative Futures for DPF

   b) Criteria By Which DPF will be Evaluated

   c) Wet weather regulatory possibilities

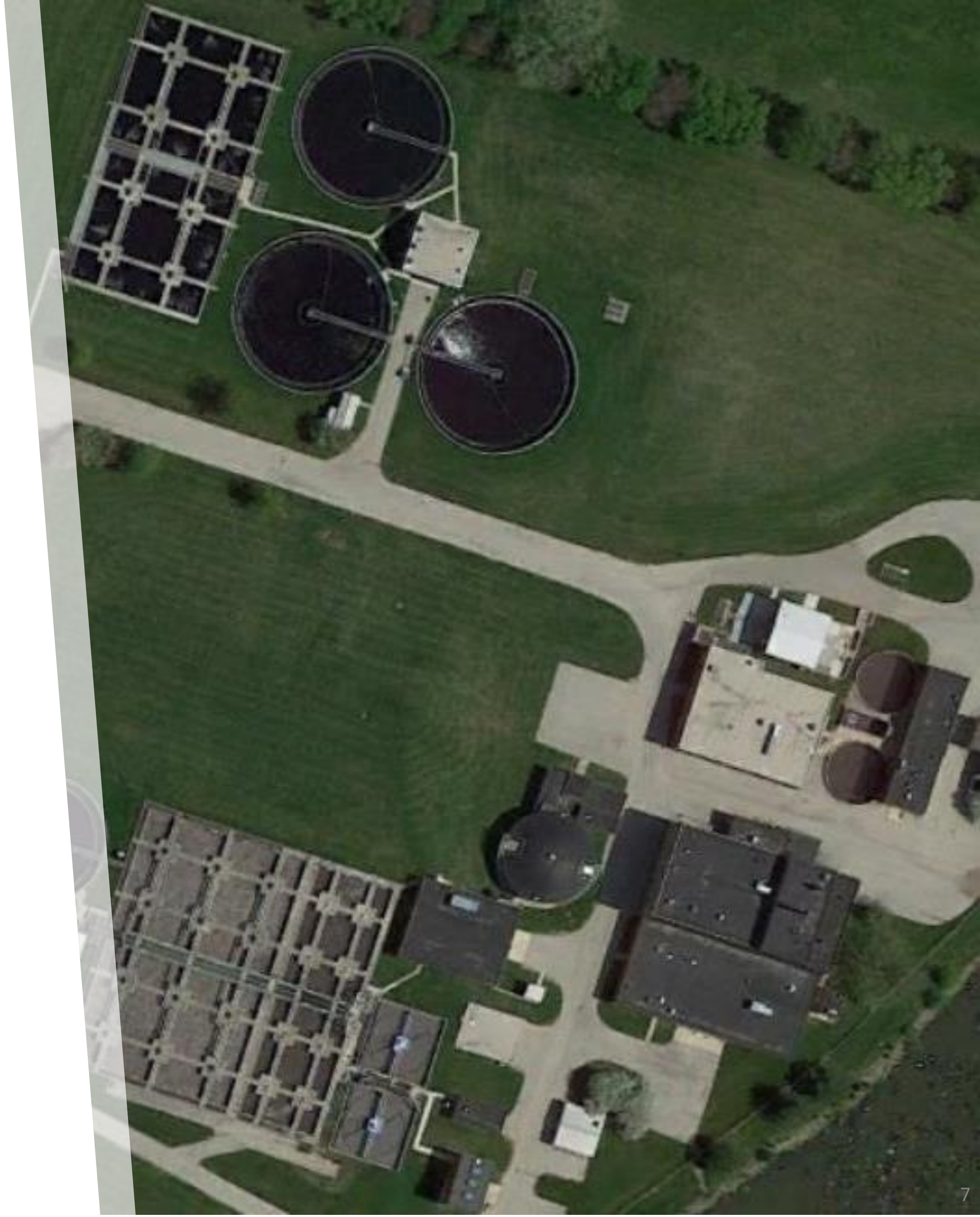
AGENDA

Infrastructure Gaps

De Pere Facility Futures

Risks and Opportunities

Schedule



Infrastructure Gaps

GBF Unit Process Review

Unit Process	Identified Issues
Influent Pumping	Age, peak flow capacity
Screening	Capture performance, peak flow capacity
Grit Removal	Operation, capture performance
Primary Clarifiers	Age, peak flow capacity
Primary sludge pumping	Age, operation
Primary sludge thickening	Age, operation, maintenance, performance
Activated Sludge Aeration	Age, operation, energy
Secondary Clarifiers	Age, flow split, peak flow capacity
RAS and WAS pumping	(South Plant) Age, peak flow capacity
WAS Thickening	Age, operation, maintenance, performance

GBF Unit Process Review (continued)

Unit Process	Identified Issues
Scum Handling (plant wide)	Operation, maintenance, capacity
Chlorine Disinfection	Peak flow capacity
Digestion	
Dewatering	Performance (solids content)
Drying	Performance (solids content)
Incineration	

DPF Unit Process Review

Unit Process	Identified Issues
Influent Pumping	Age, peak flow capacity
Screening	Capture performance, peak flow capacity
Grit Removal	Age, operation, capture performance, peak flow capacity
Activated Sludge Aeration	
Intermediate Clarifiers	Age, peak flow capacity
RAS and WAS pumping	Age (both systems)
Second Stage Aeration	Not used
Final Clarifiers	Age, peak flow capacity
Tertiary Filters	Age, peak flow capacity
UV Disinfection	Peak flow capacity
Scum Handling (plant wide)	Operation, maintenance, capacity

GBF AND DPF INFRASTRUCTURE SUMMARY

Both Plants

1) Peak Flow
2) Aging Assets
3) Screening and Grit Removal
4) Thickening
5) Scum Management

DPF

1) Not Operated as Designed and Not Designed to be Remote

De Pere Facility Futures

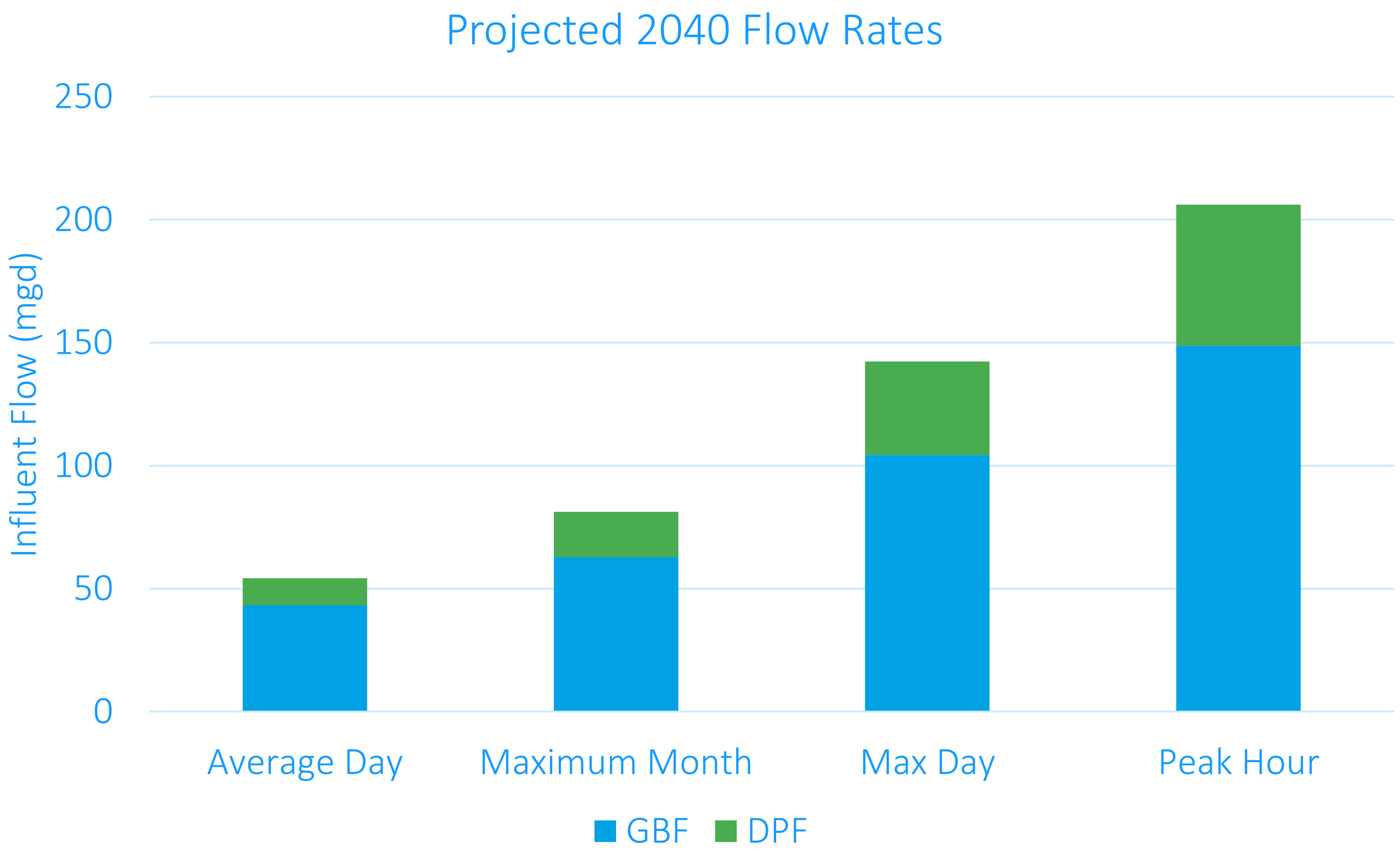
Option 1: Keep 'er moving
- Current CIP plan
- Additional improvements for reliability

Option 2: Pump station
- Large diameter and pump station costs
- Significant GBF expansion

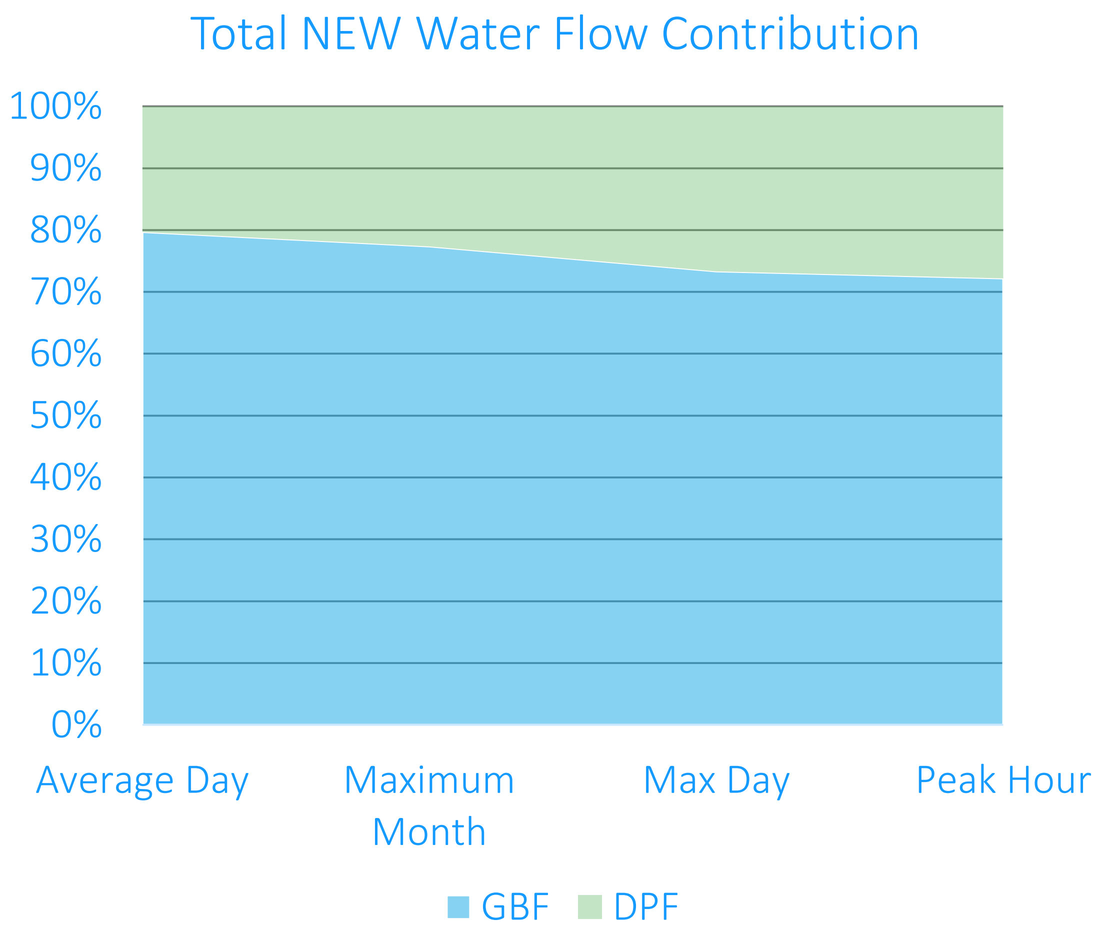
Option 3: A new vision
- New treatment configuration
- Target the initial vision for DPF

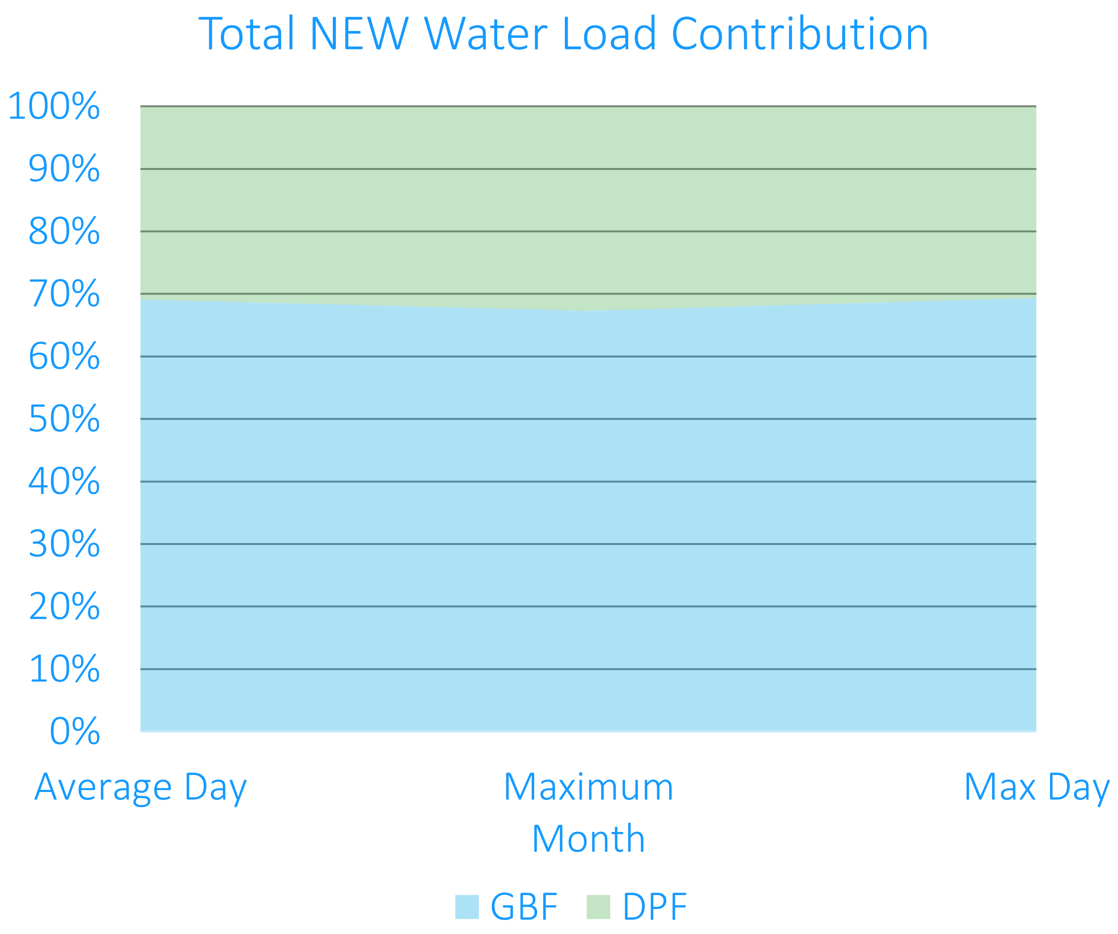
- Option 1: Likely 20-Year Investment for Headworks/AS Upgrades/Filters/UV > $50 million
- Option 2: New Pump Station/Force Main/EQ Basin > $30 million (without GBF Upgrades)
- Option 3: New wet weather plant > $50 million

We discussed numbers for GBF and DPF last time

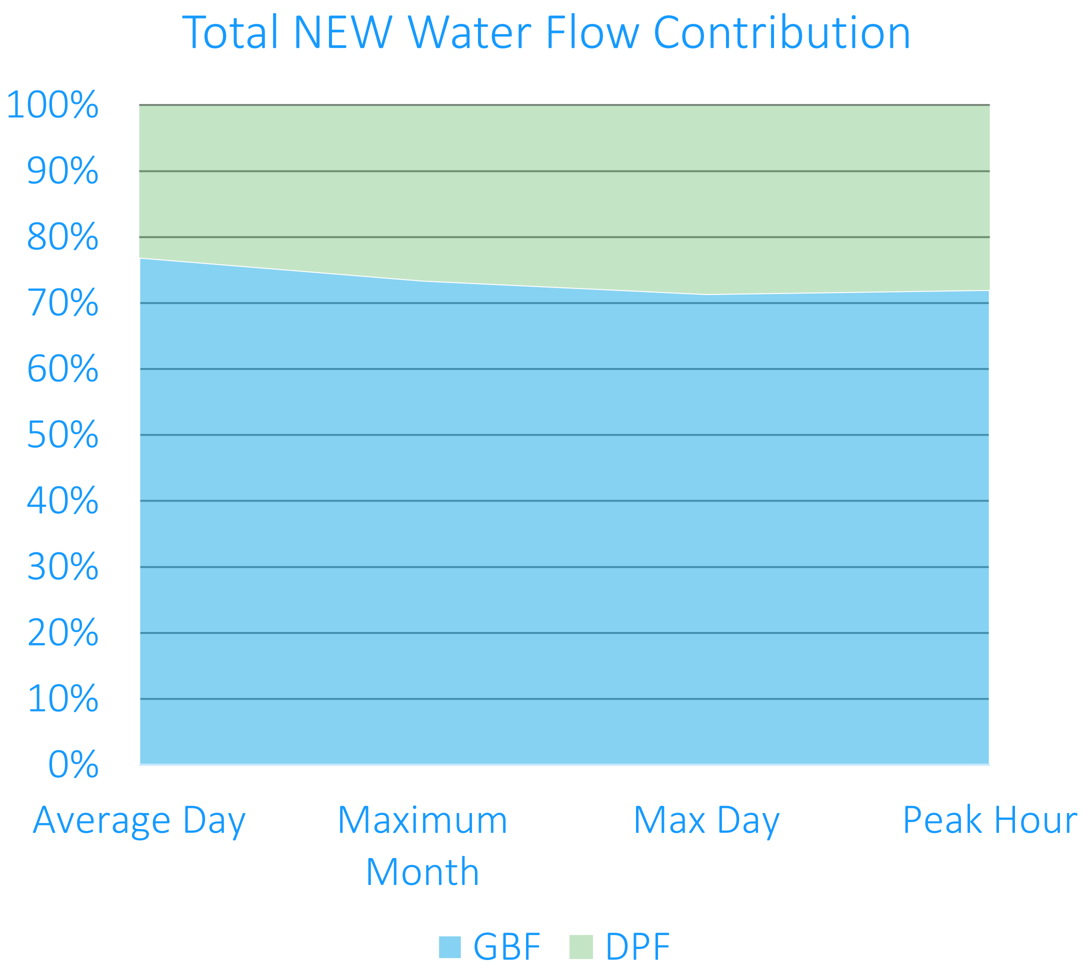


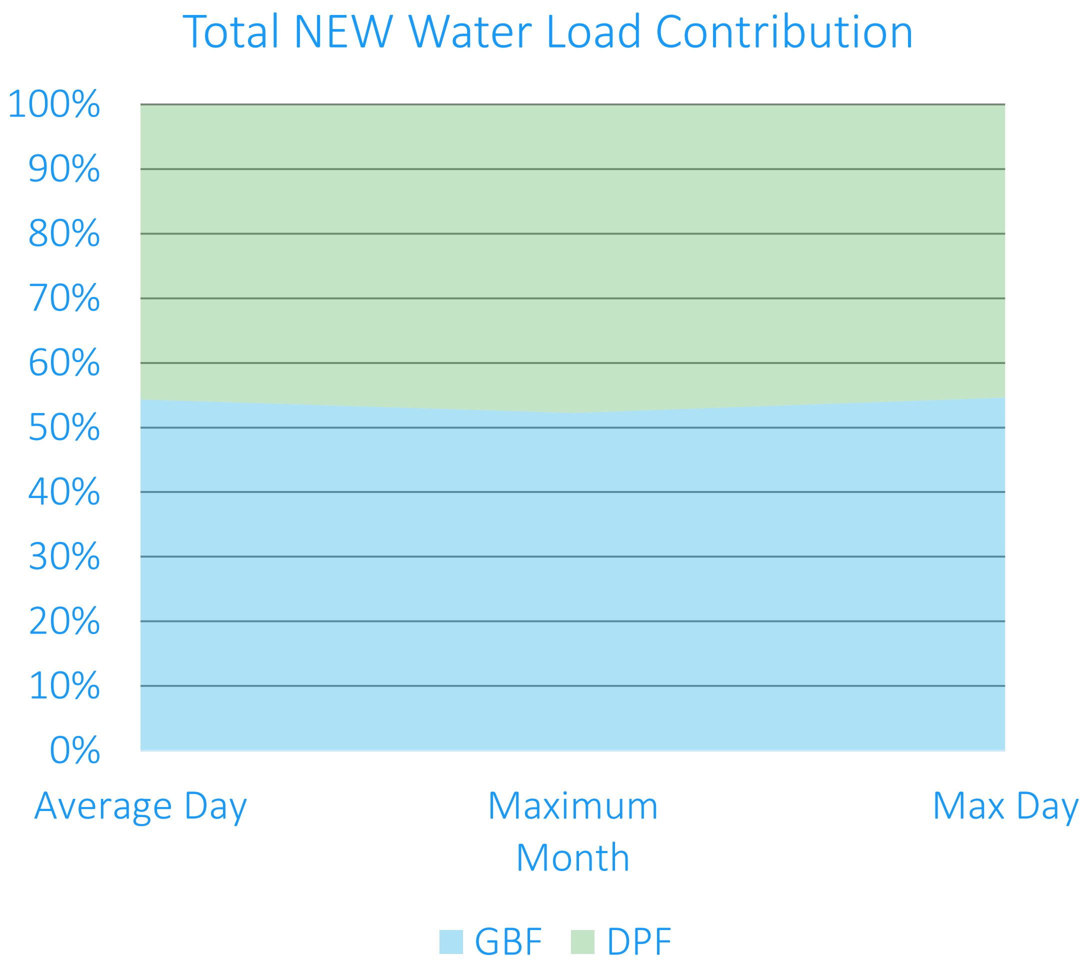
Combining DPF and GBF would require a 32% expansion by 2040…





…by 2070 (which includes the South Bridge growth), DPF would account for 50% of the load





FRAMING THE DPF EVALUATION

1) Is there a water quality benefit for two plants?

2) Is there a customer benefit for two plants? Customer benefit from one plant?

3) Does the DPF have Other Value?

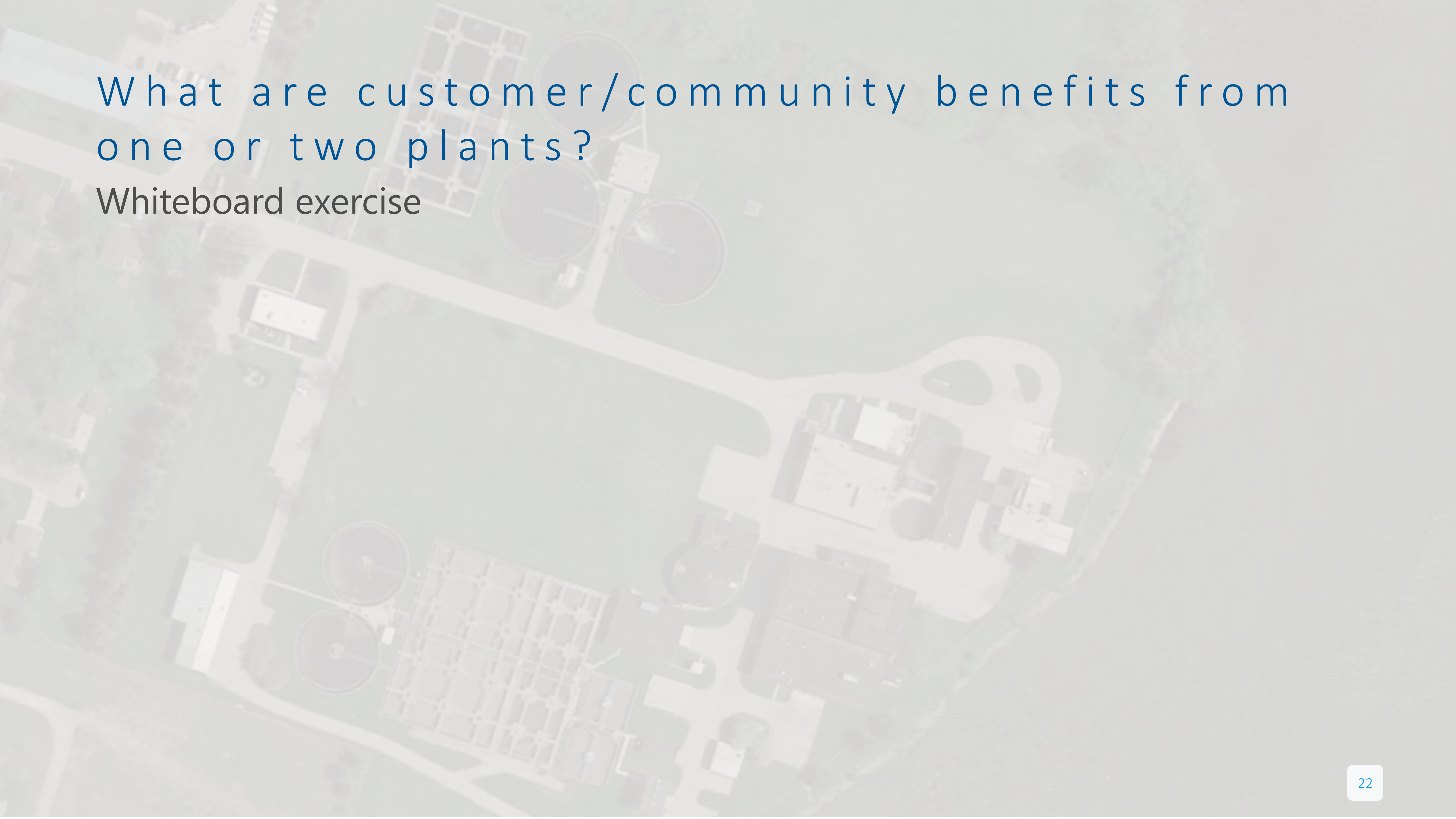
4) What drives the DPF Operational Issues?

5) Understanding the Regulatory Possibilities for Wet Weather Treatment

Is there a water quality benefit to two discharges?

What are customer/community benefits from one or two plants?

Whiteboard exercise



What are the valuable assets at the De Pere Facility?

Whiteboard exercise

What drives the De Pere Facility to require more operational attention than planned?

Whiteboard exercise

Wet Weather

Auxiliary Treatment Facilities

- Permitted use per 40 CFR 122.41(m)
- Wet-weather influent amenable to physical/chemical treatment
  - USEPA (2014), NPDES Experts Forum on Public Health Impacts of Wet Weather Blending (https://www.epa.gov/npdes/npdes-experts-forum-public-health-impacts-wet-weather-blending-documents)
  - USEPA (2007), *Wastewater Management Fact Sheet, In-Plant Wet Weather Peak Flow Management*, EPA 832-F-07-016
  - WEF (2006), *Guide to Managing Peak Wet Weather Flows in Municipal Wastewater Collection and Treatment Systems*
  - USEPA (2004), *Report to Congress, Impacts and Control of CSOs and SSOs*, EPA 833-R-04-001

Many pilot & full-scale studies by B&V and others support the use of physical/chemical auxiliary treatment facilities for wet-weather flows

40 CFR 122.41(m)(1)(i)

promptly submit such facts or information.

(m) *Bypass*—(1) *Definitions*. (i) *Bypass* means the intentional diversion of waste streams from any portion of a treatment facility.

(ii) *Severe property damage* means substantial physical damage to property, damage to the treatment facilities

ticipated bypass, after considering its adverse effects, if the Director determines that it will meet the three conditions listed above in paragraph (m)(4)(i) of this section.

(n) *Upset*—(1) *Definition*. *Upset* means an exceptional incident in which there is unintentional and temporary non-

Diversion means decreasing or cutting off flows to a process unit. Parallel treatment concept does not decrease flows to any portion of the treatment facility.

Do not use the terms *diversion or bypass* if providing auxiliary treatment

40 CFR 122.41(m)(4)(i)(B)

(C) Violation of a maximum daily discharge limitation for any of the pollutants listed by the Director in the permit to be reported within 24 hours. (See § 122.44(g).)

(iii) The Director may waive the written report on a case-by-case basis for reports under paragraph (l)(6)(ii) of this section if the oral report has been received within 24 hours.

(7) *Other noncompliance.* The permittee shall report all instances of noncompliance not reported under

(4) *Prohibition of bypass.* (i) Bypass is prohibited, and the Director may take enforcement action against a permittee for bypass, unless:

(A) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(B) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not

Use of auxiliary treatment facilities is not a bypass

Do not use the terms *diversion or bypass* if providing auxiliary treatment

40 CFR 122.41(m)(2)

damage does not mean economic loss caused by delays in production.

(2) *Bypass not exceeding limitations.* The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of paragraphs (m)(3) and (m)(4) of this section.

(3) *Notice*—(i) *Anticipated bypass.* If

caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

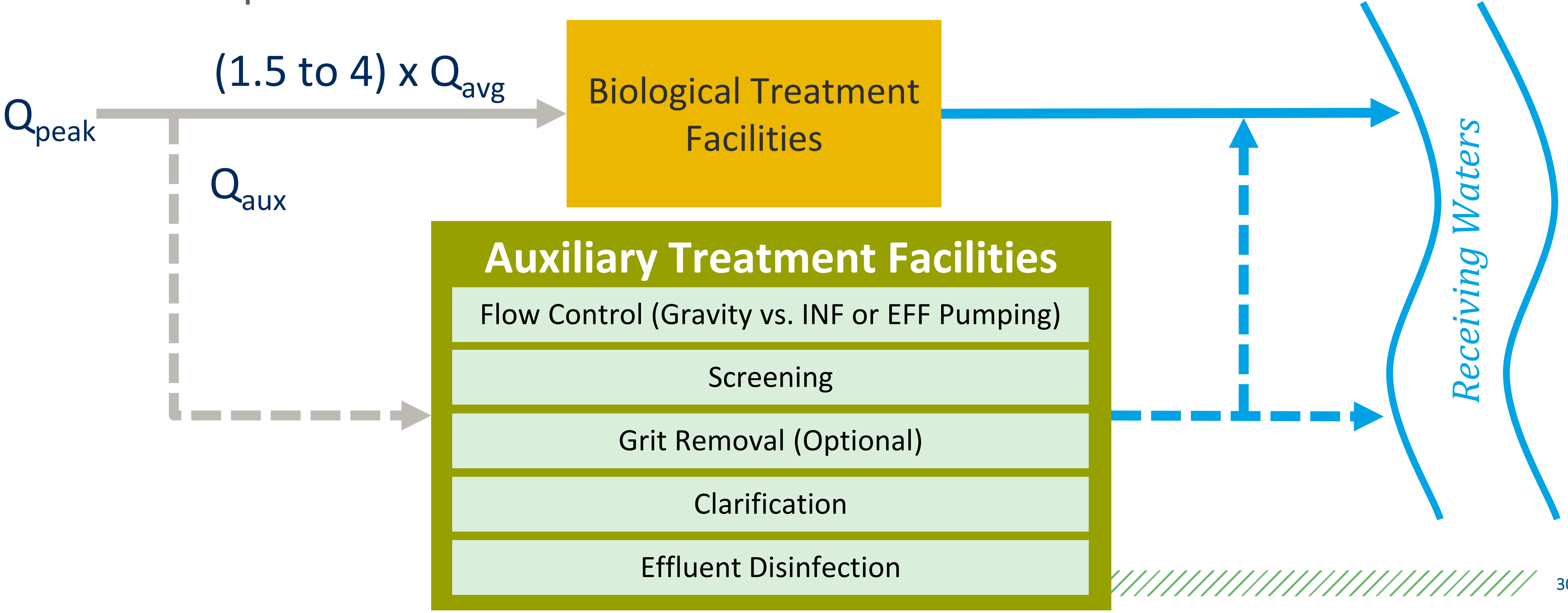
(2) *Effect of an upset.* An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of paragraph (n)(3) of this section are met. No determination made during adminis-

Parallel auxiliary treatment provides essential maintenance of biomass to assure efficient operation

Do not use the terms *diversion or bypass* if providing auxiliary treatment

After optimizing existing storage and treatment infrastructure, consider auxiliary treatment capacity

- Optimize for **intermittent** wet-weather flows
- Complement inherent limitations of biological processes
- Long track record of success
- Small footprint alternatives. Collocated or satellite facilities.



Clarification of Alternatives

Settling-Based	Filtration-Based	Flotation-Based
1. Conventional Settling -Rectangular, Circular, Square, RTB, Shaft	1. Shallow Granular Media	1. Conventional Floatables Removal -Skimmers, Scum baffles
2. Vortex (Swirl Concentrator)	2. Deep Granular Media	
3. Lamella Settler	3. Microscreens, Woven Media -Salsnes Filter, Eco MAT® Filter, Hydrotech Discfilter, SuperDisc™, Forty-X™ Disc, Quantum™ Disk	2. Dissolved Air Flotation (DAF)
4. Chemically Enhanced Settling a. Conventional Basin b. Sequencing Batch - e.g. ClearCove Flatline EPT	4. Floating Media -MetaWater High Speed CSO Filter, BKT BBF-F	
c. Lamella Settler	HRF 5. Pile Cloth Media -AquaPrime™, infini-D™	3. Polymer-aided DAF -Various suppliers
HRC d. Solids Contact / Recirculation - e.g. DensaDeg®, CONTRAFAST®	6. Compressible Media -Fuzzy Filter™, WWETCO FlexFilter™	
e. Ballasted Flocculation - Microsand (e.g. ACTIFLO®, RapiSand™, Densadeg XRC™) - Magnetite (e.g CoMag™)	7. Fixed-Film Contact -Biological Aerated Filter (BAF), BioFlexFilter™	4. Biocontact + DAF -Captivator®
5. Suspended Growth Contact -BIOACTIFLO™, BioMag™, Bio-CES		

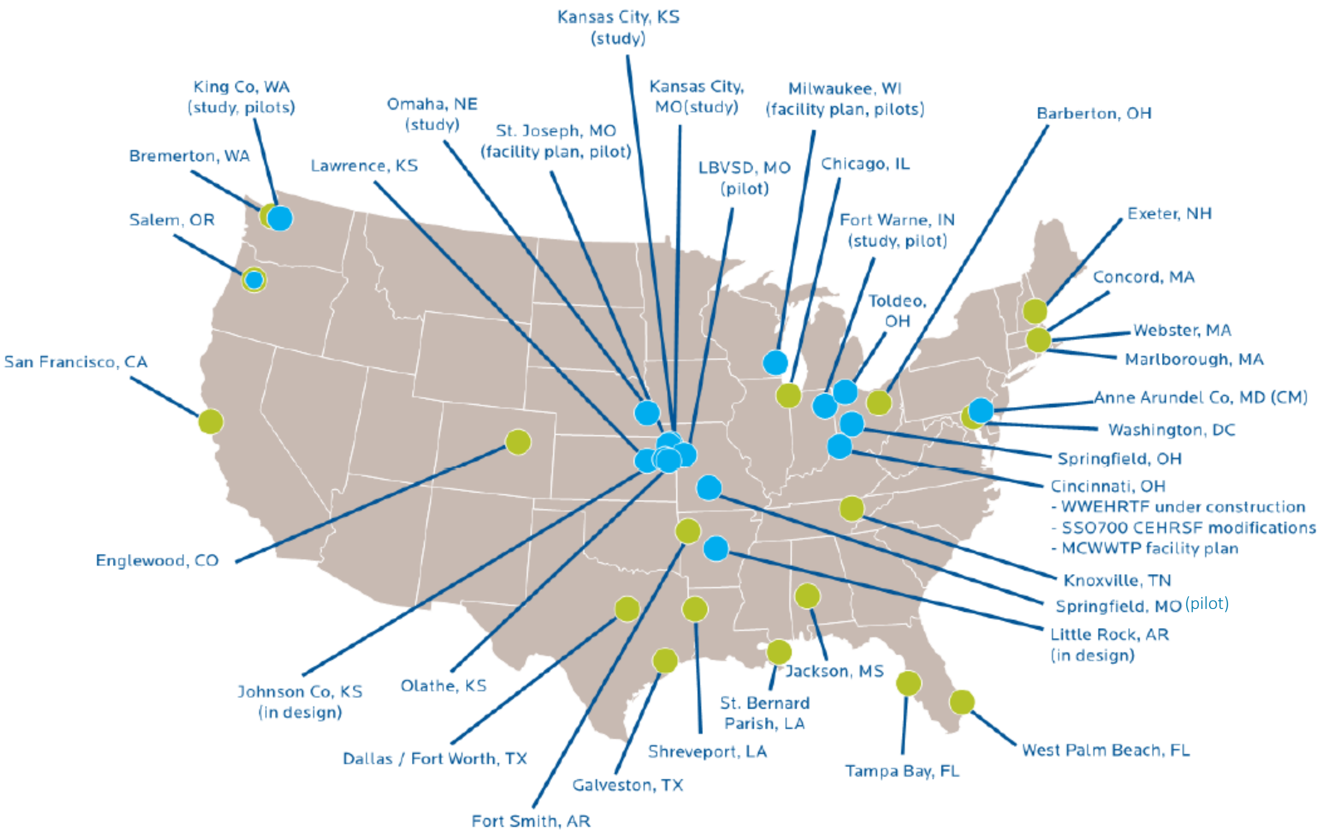
Primary Removal Equivalent * | Small Footprint (High-Rate Treatment) | Enhanced Removal

* If coagulation/flocculation provided, HRT → EHRT (in some cases)

Pilot and Full-Scale EHRT Projects Include:

Full-Scale Auxiliary EHRT Facilities in the U.S.	
EPA Region	State
1	Massachusetts, New Hampshire
2	New York
3	DC, Maryland
4	Florida, Georgia, Mississippi, Tennessee
5	Illinois, Indiana, Ohio, Wisconsin
6	Arkansas, Louisiana, Texas
7	Kansas
9	California
10	Oregon, Washington

- 30+ operating in U.S. since ~1995
- 60+ worldwide



Other Relevant Points

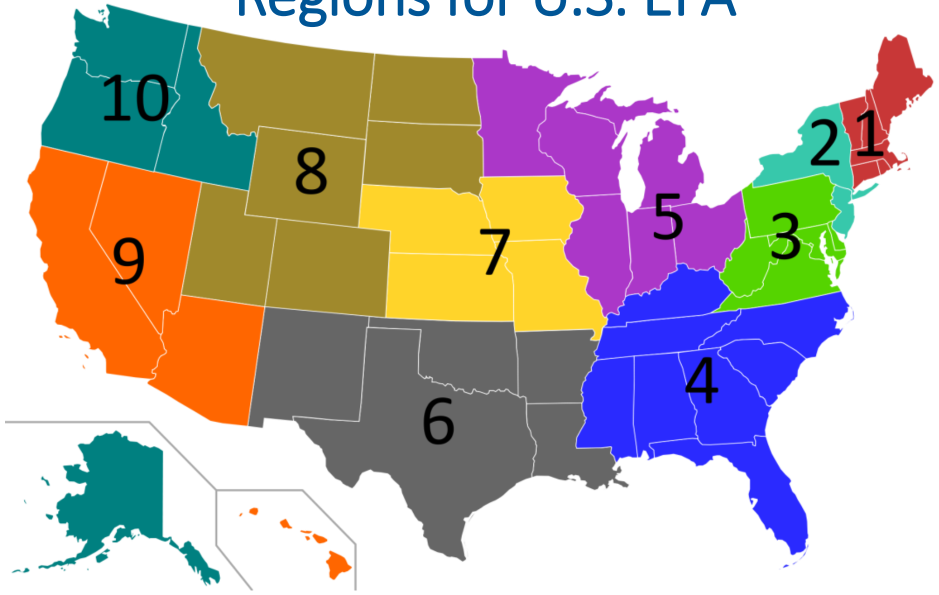
Regulatory Acceptance

- EPA CSO Control Policy - EHRT clearly allowed
- EPA SSO/blending policy - Still under development
  - EHRT allowed in 8th Circuit Court states thanks to *ILOC v. EPA*. Case-by-case elsewhere. Precedents include KS, MA, NH, NY, NJ, OH, OR, TX, WI.
  - *CRR v. EPA* trying to apply *ILOC v. EPA* nationwide

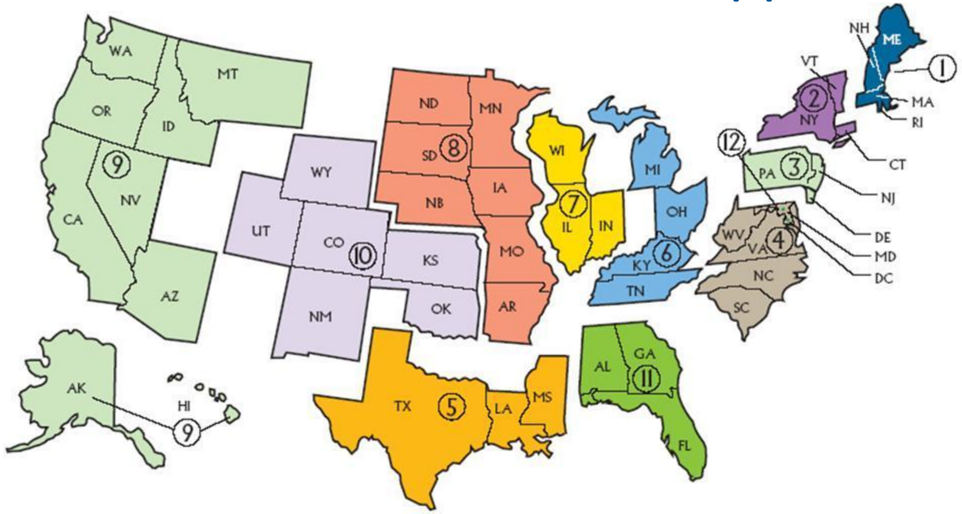
Dual-Use Potential

- Tertiary dual-use increases effluent TSS and P removal. HRF compatible with bio-P or chem-P removal without more coagulant demand.
- Primary dual-use increases raw TSS capture for carbon diversion, energy recovery and reduced secondary BOD load.

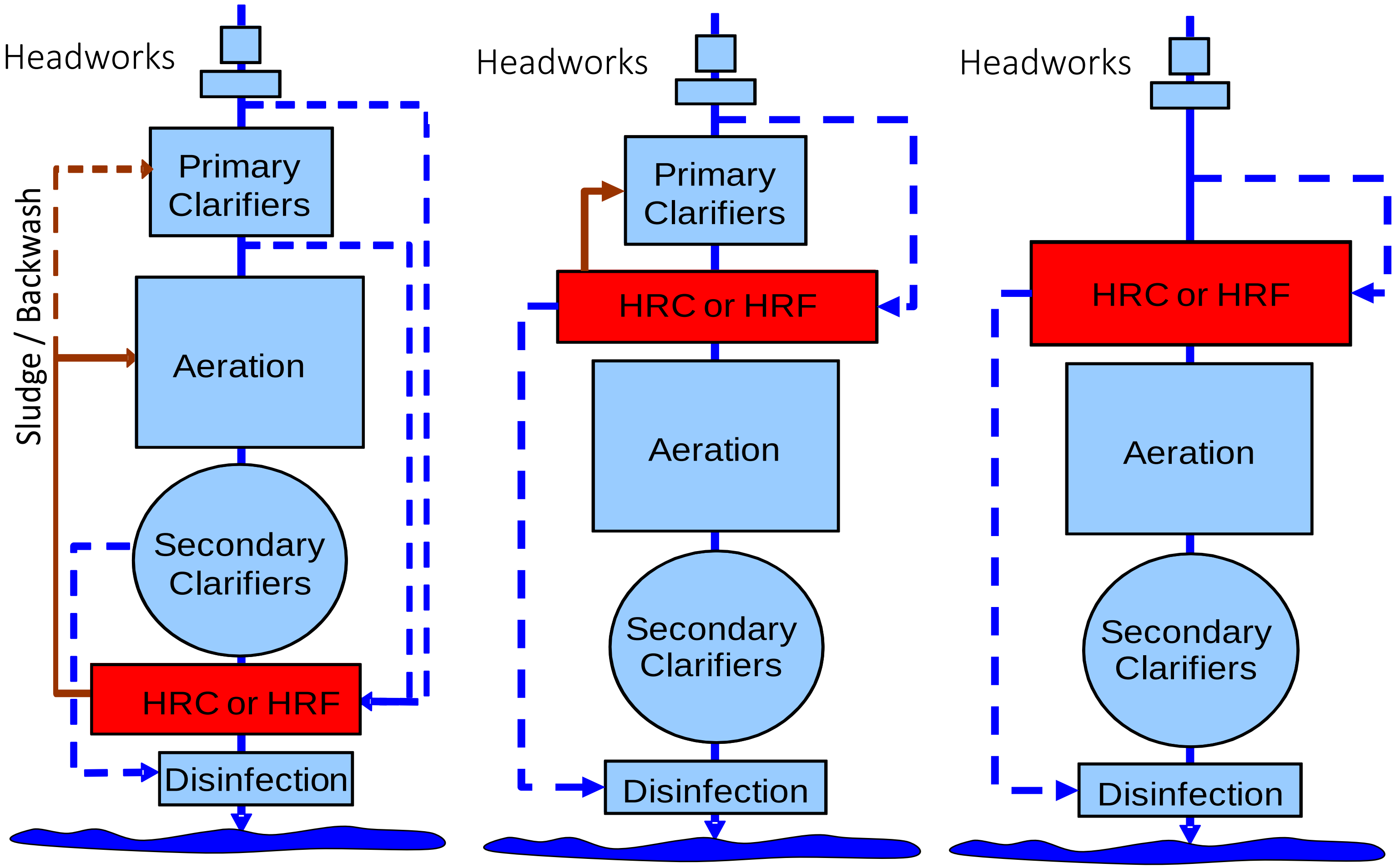
Regions for U.S. EPA



Circuits for U.S. Court of Appeals



Dual-Use Auxiliary Facilities



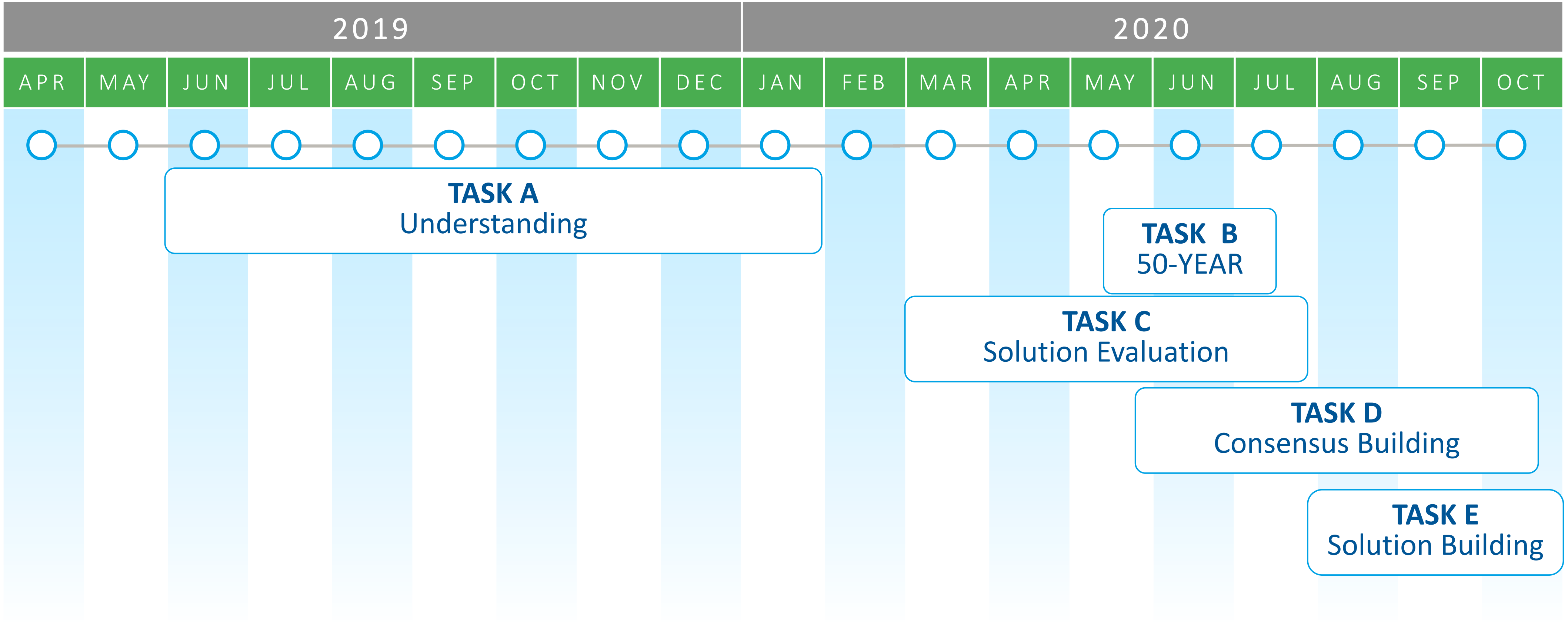
More WRRF benefit from capital investment than just infrequent wet weather

Risks & Opportunities

What are the keys risks and opportunities for the DPF future vision?

Schedule

Project Schedule



NEW WATER

GREEN BAY FACILITY & DE PERE FACILITY

50-Year Vision – Session 3

June 17, 2020

NEW Water
The brand of the Green Bay Metropolitan Sewerage District

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Today's Goals

1. Facility Plan schedule and decision making update
2. Concurrence on options for the DPF and GBF based on Session 2 comments
3. Set the groundwork for future MUA criteria

Facility Plan Roadmap

Task 2
Establishing existing conditions

Task 4
"Early out" analyses (screening, grit, thickening)

Task 3
Session 1
What are the main challenges for NEW Water?

Task 3
Session 2
What are the challenges at DPF?

Task 3
Session 3
What is the process for decision making at DPF?

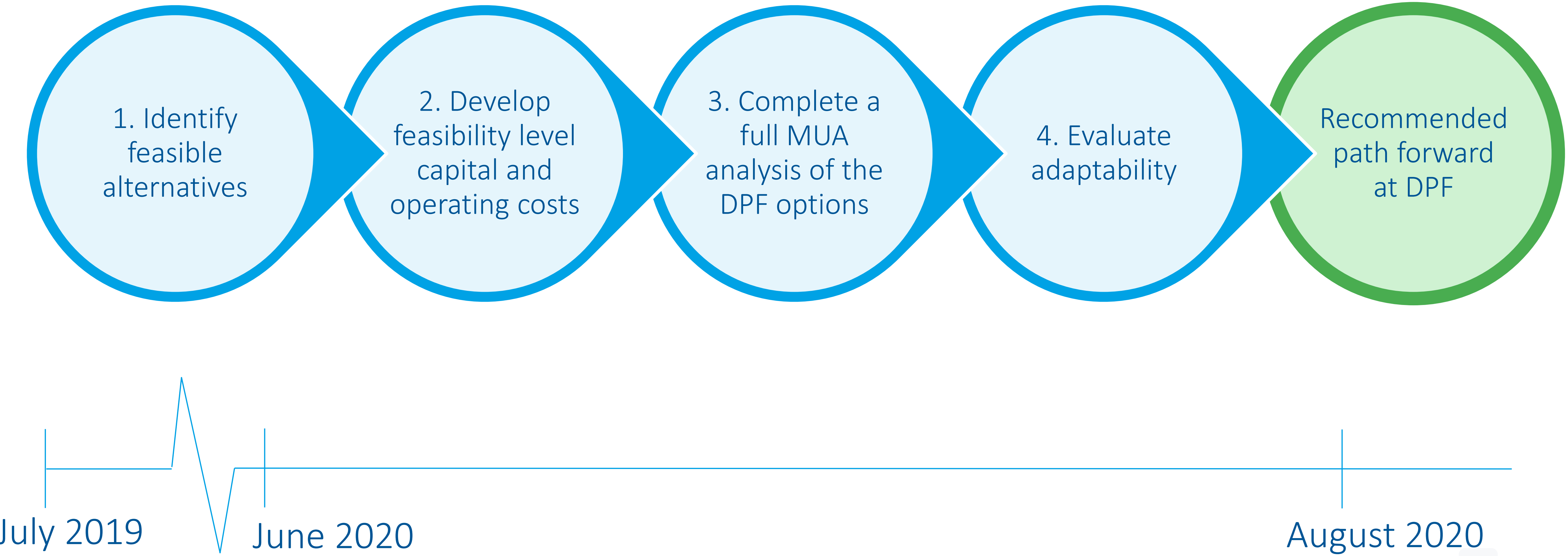
July 2019

April 2020

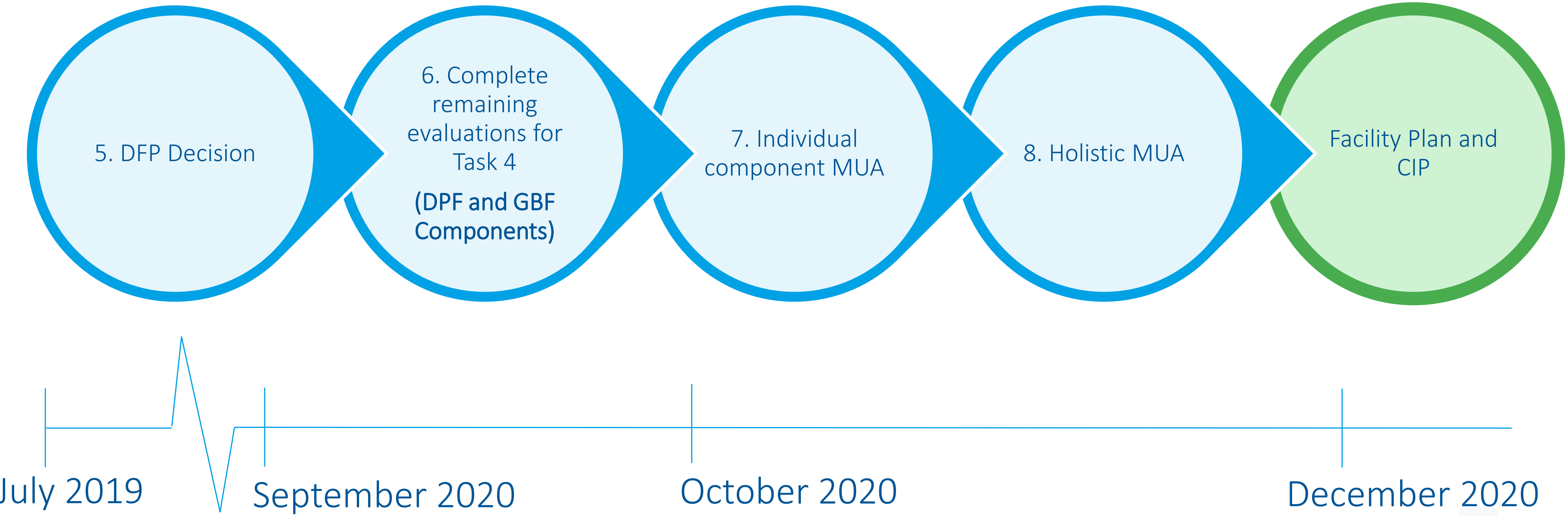
May 2020

June 2020

How do we make a decision on DPF?



What happens after the DPF decision?



1. Identify feasible alternative pathways

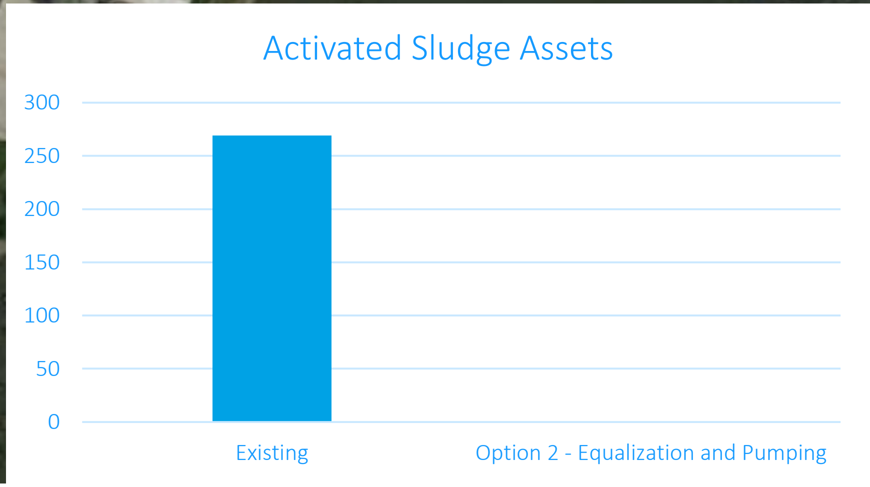
Option 1: Simplify and Expand
- Improved wet weather operation
- Simplify number of unit processes
- Energy efficiency opportunities

Option 2: Pump Station
- No DPF operation
- Significant GBF expansion
- No DFP, but more challenging GBF?

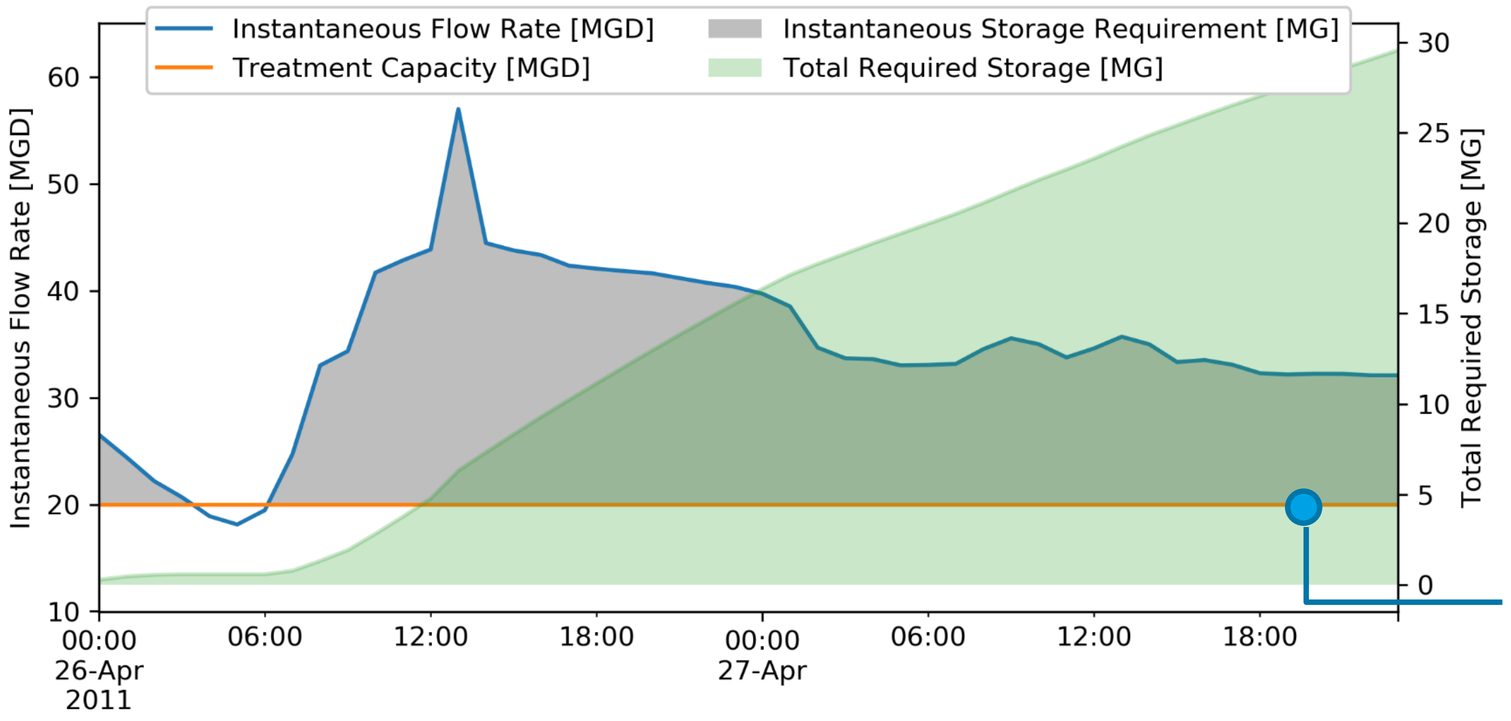
Option 3: A New Vision
- New Treatment Configuration
- Target initial vision for DPF
- Opportunities for resource recovery?

Option 2: Equalize and pump

1. Maintain a headworks facility
2. Develop equalization sizing to limit peak flow impact at GBF
3. Does this really limit rotational assets?



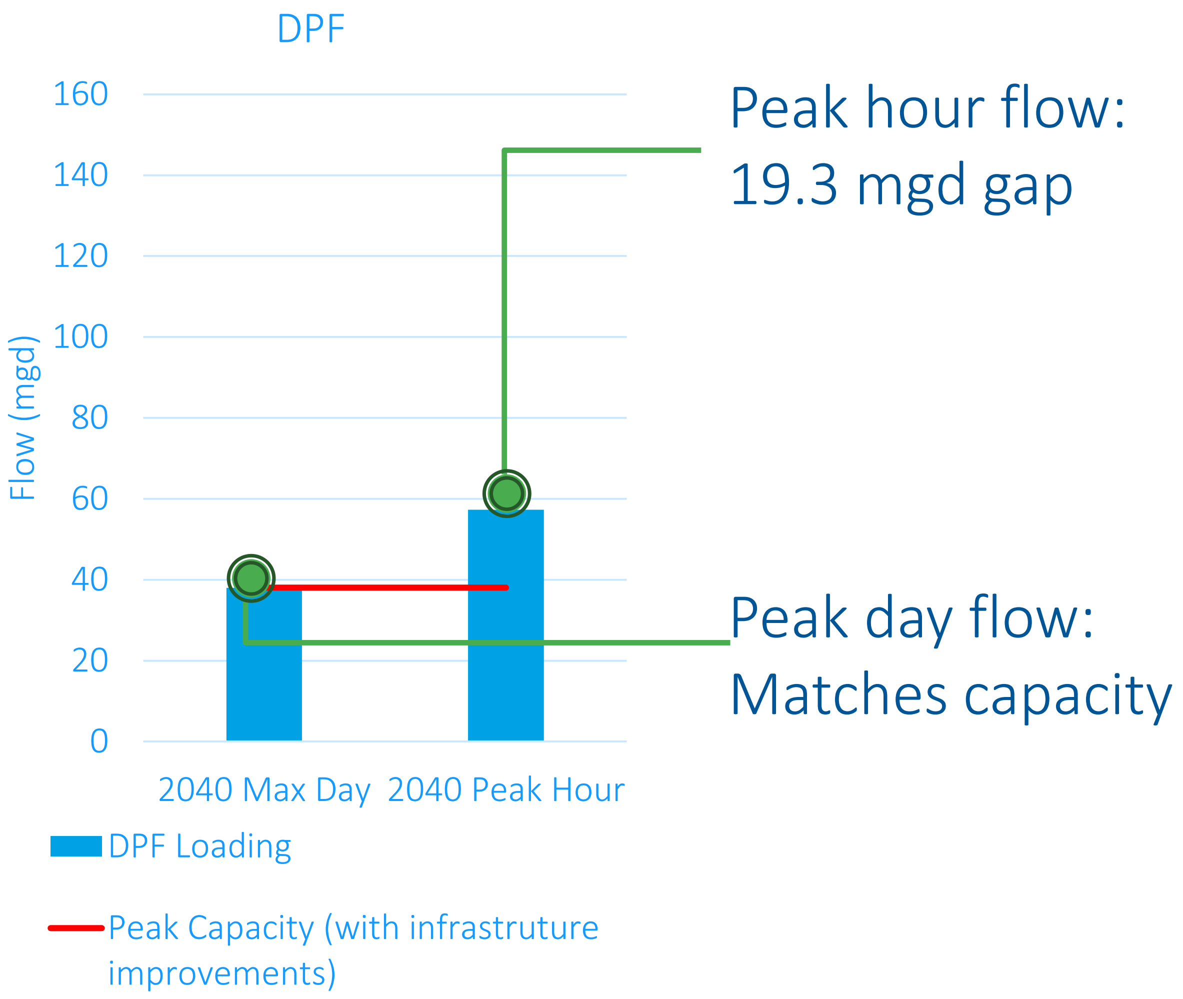
Storage at DPF could limit peak flow impact at GBF

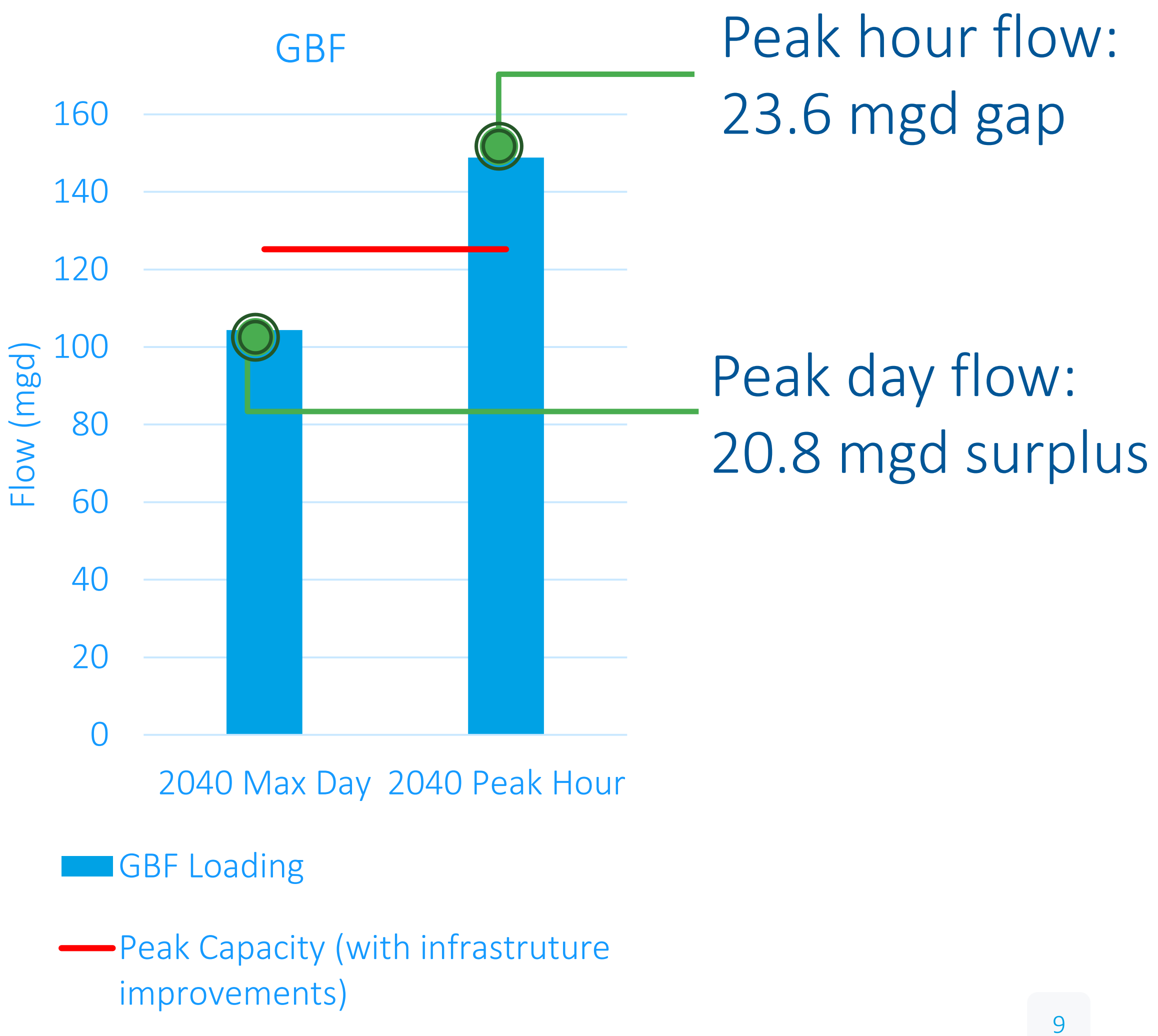


Storage required: Likely more than 30 MG, but how much more?

Flow rate sent to GBF becomes the critical factor

Step 1 - Understanding the context: Future Flows and Loads





Capital Cost

$140M to $240M

Option 2: Equalize and pump

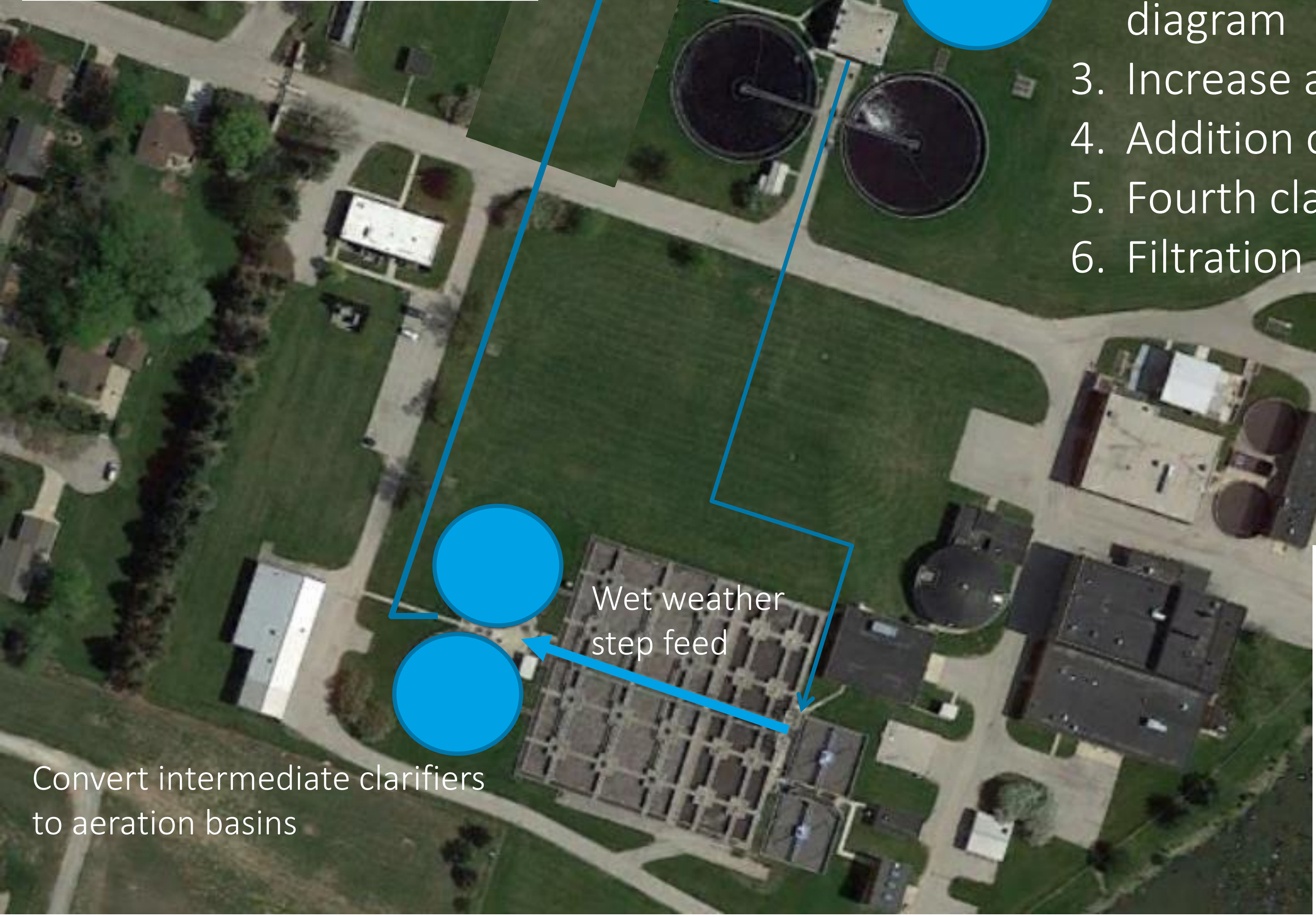
1. DP pump station and force main
2. Small equalization at DPF
3. Capacity expansion at GBF
    1. Headworks
    2. Primary clarifiers
    3. Aeration basin
    4. Final clarifiers
    5. Disinfection

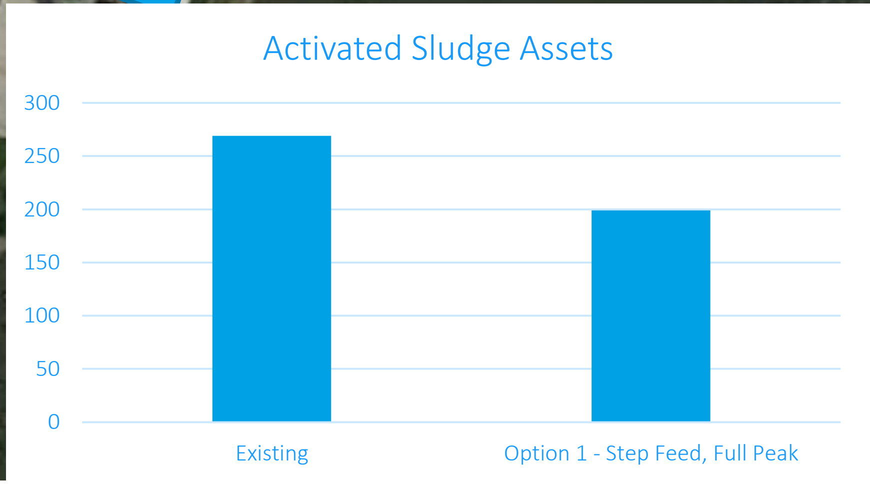
Capital Cost

$80M to $110M

Option 1a: Simplify and expand

1. New headworks
2. Remove intermediate clarifiers from flow diagram
3. Increase activated sludge volume
4. Addition of step feed
5. Fourth clarifier (or equalization)
6. Filtration and UV for tertiary treatment

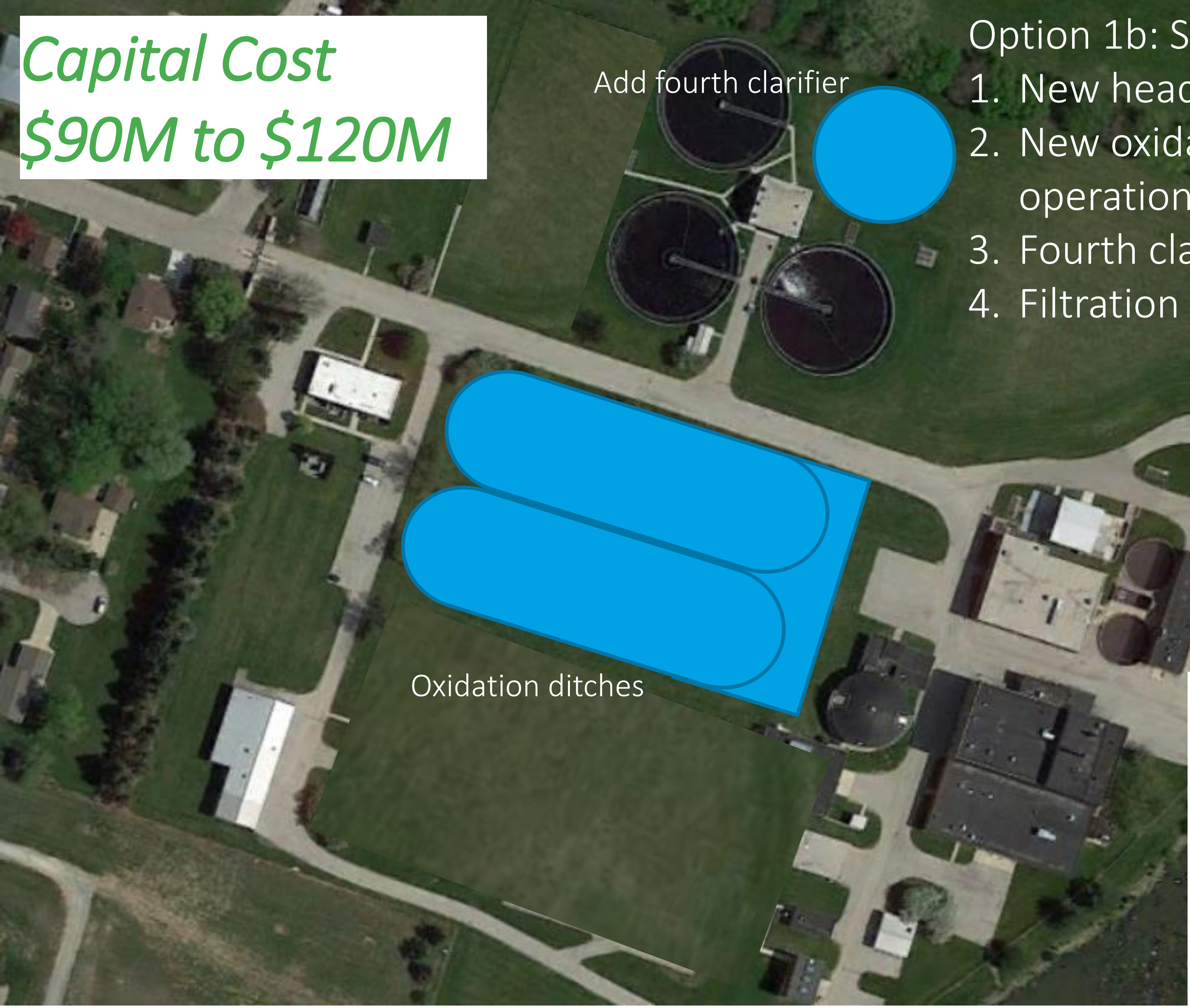


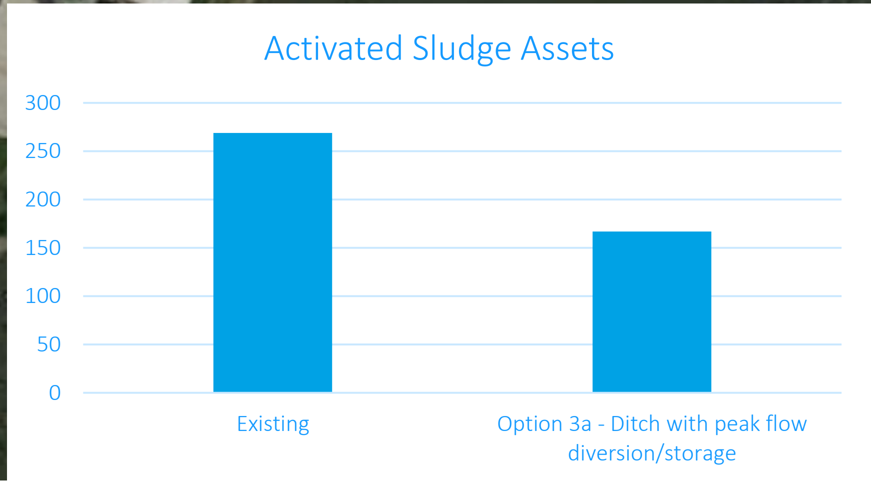


Capital Cost
$90M to $120M

Option 1b: Simplify and expand

1. New headworks
2. New oxidation ditches for simplified operation
3. Fourth clarifier (or equalization)
4. Filtration and UV for tertiary treatment



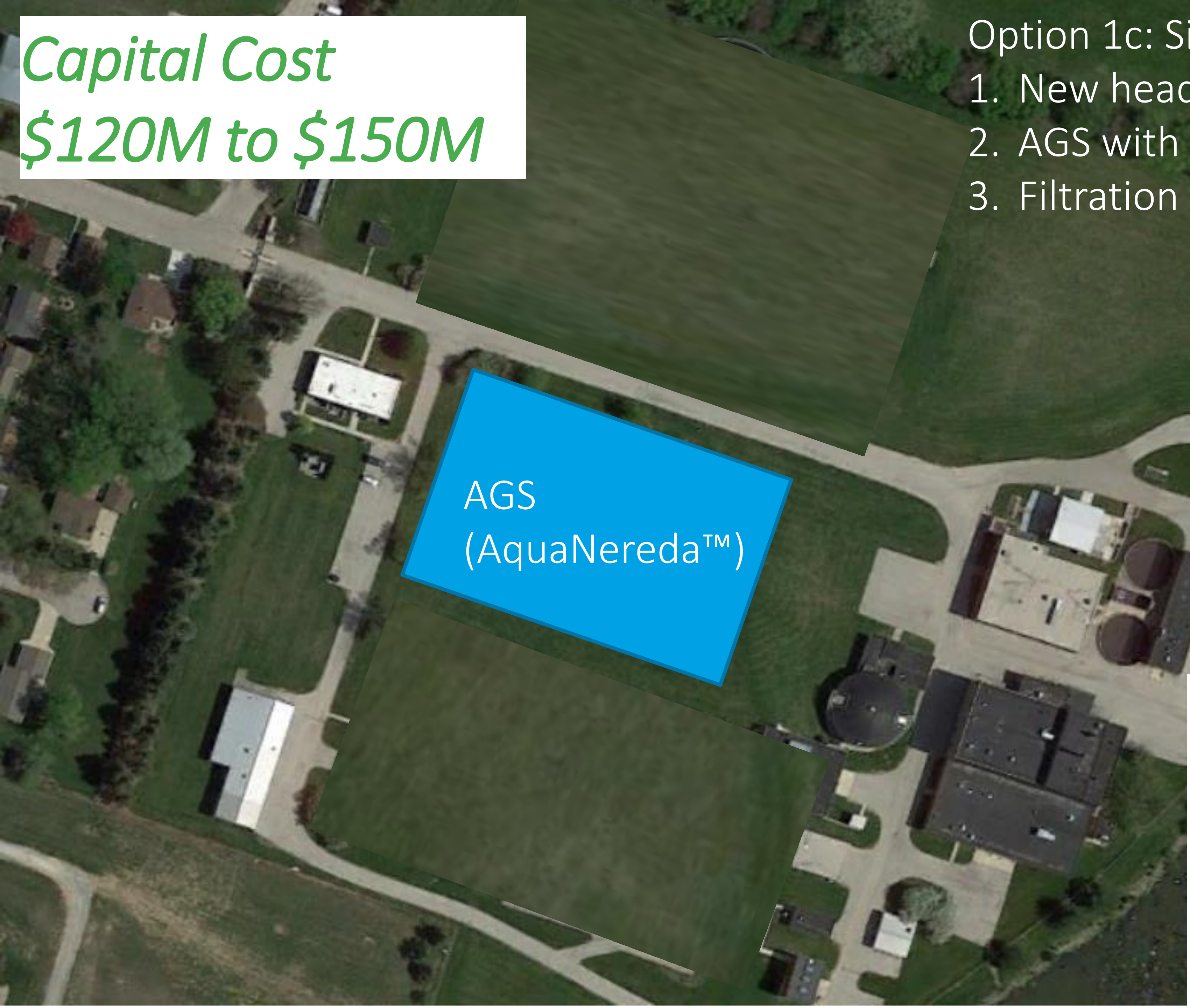


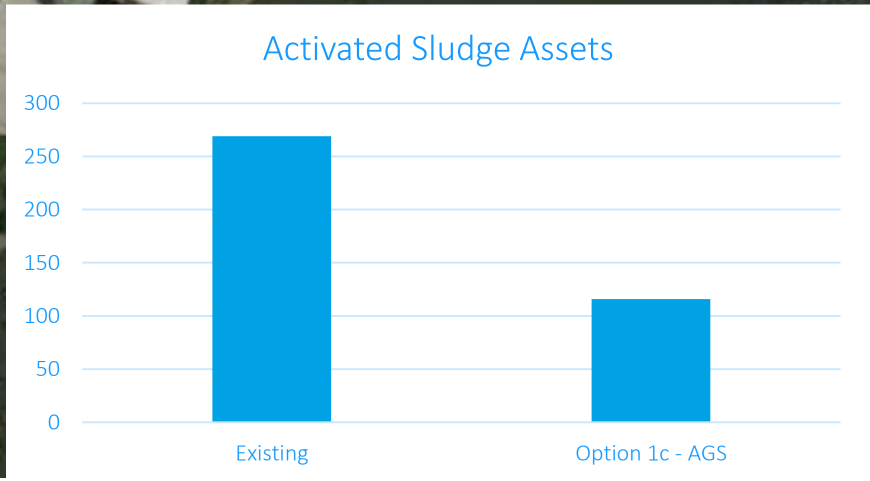
Capital Cost

$120M to $150M

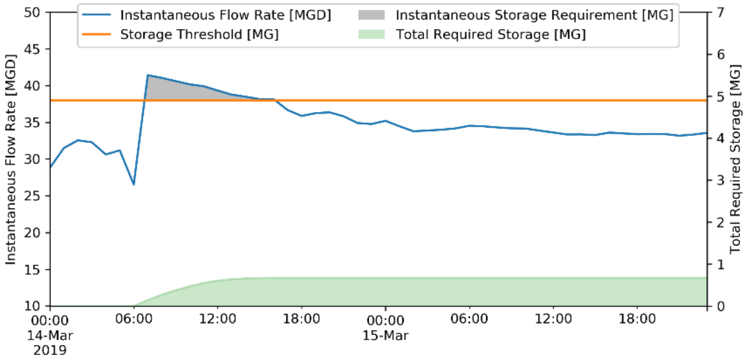
Option 1c: Simplify and expand

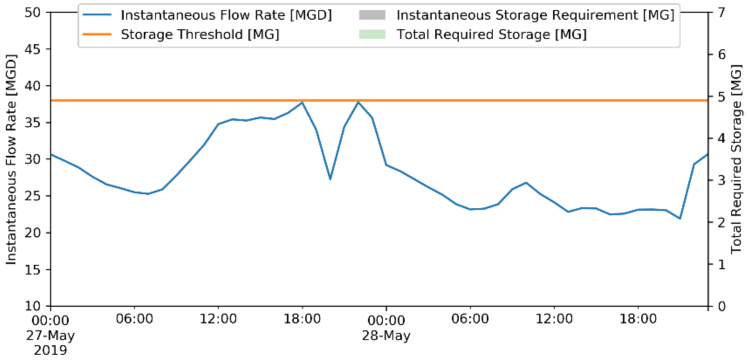
1. New headworks
2. AGS with equalization
3. Filtration and UV for tertiary treatment



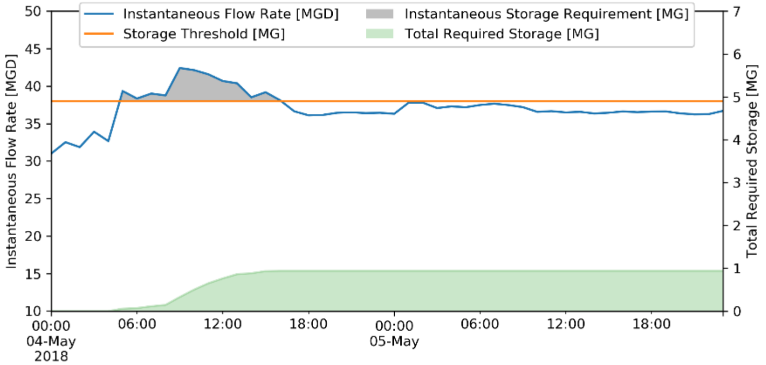


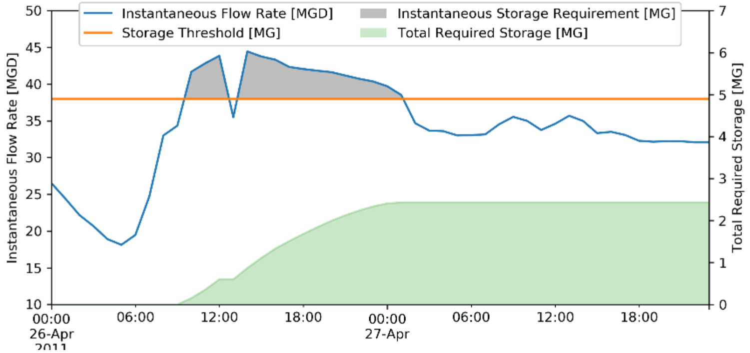
Is it possible to equalize instead of expanding?

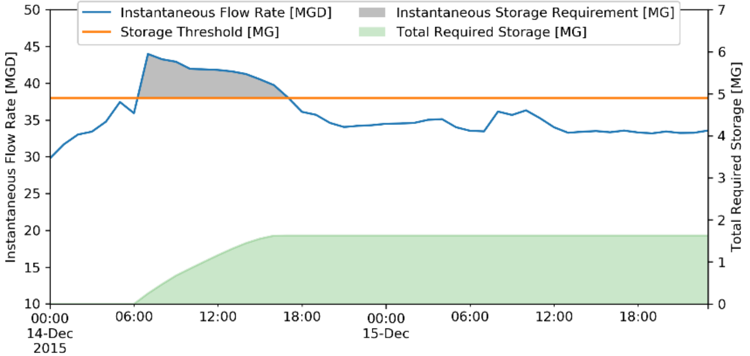


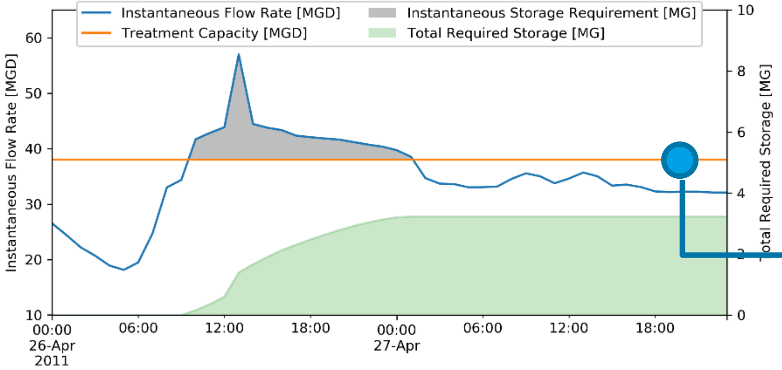


Storage range: 0.6 MG to 3.2 MG









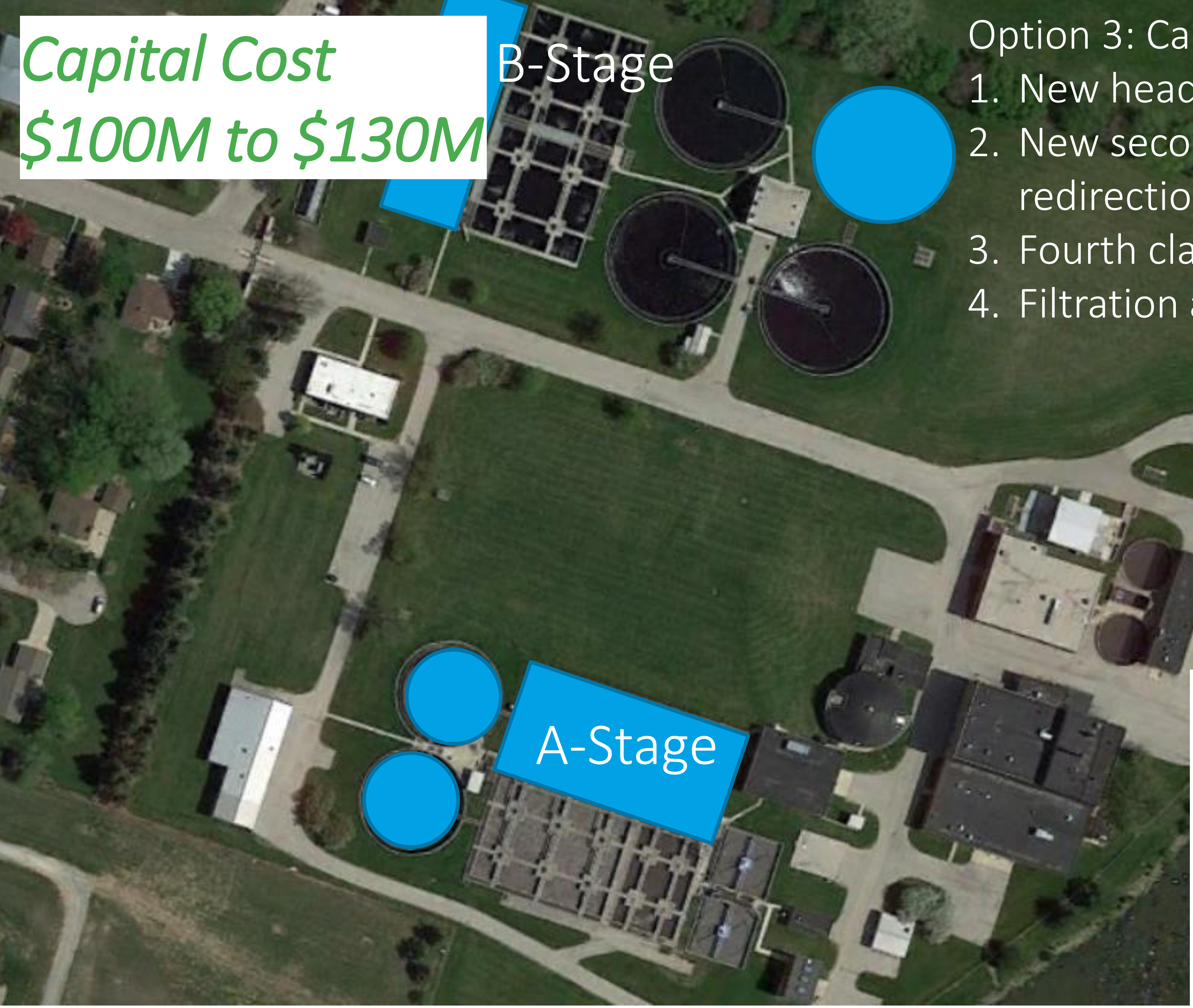
Limits DPF to 38 MGD

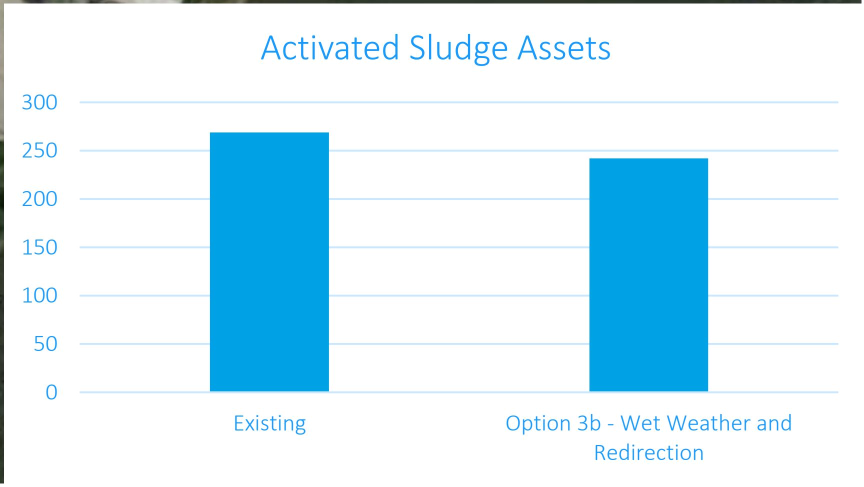
Capital Cost

$100M to $130M

Option 3: Carbon redirection

1. New headworks
2. New secondary process with carbon redirection (maybe A/B?)
3. Fourth clarifier (or equalization)
4. Filtration and UV for tertiary treatment





What is A-stage treatment?

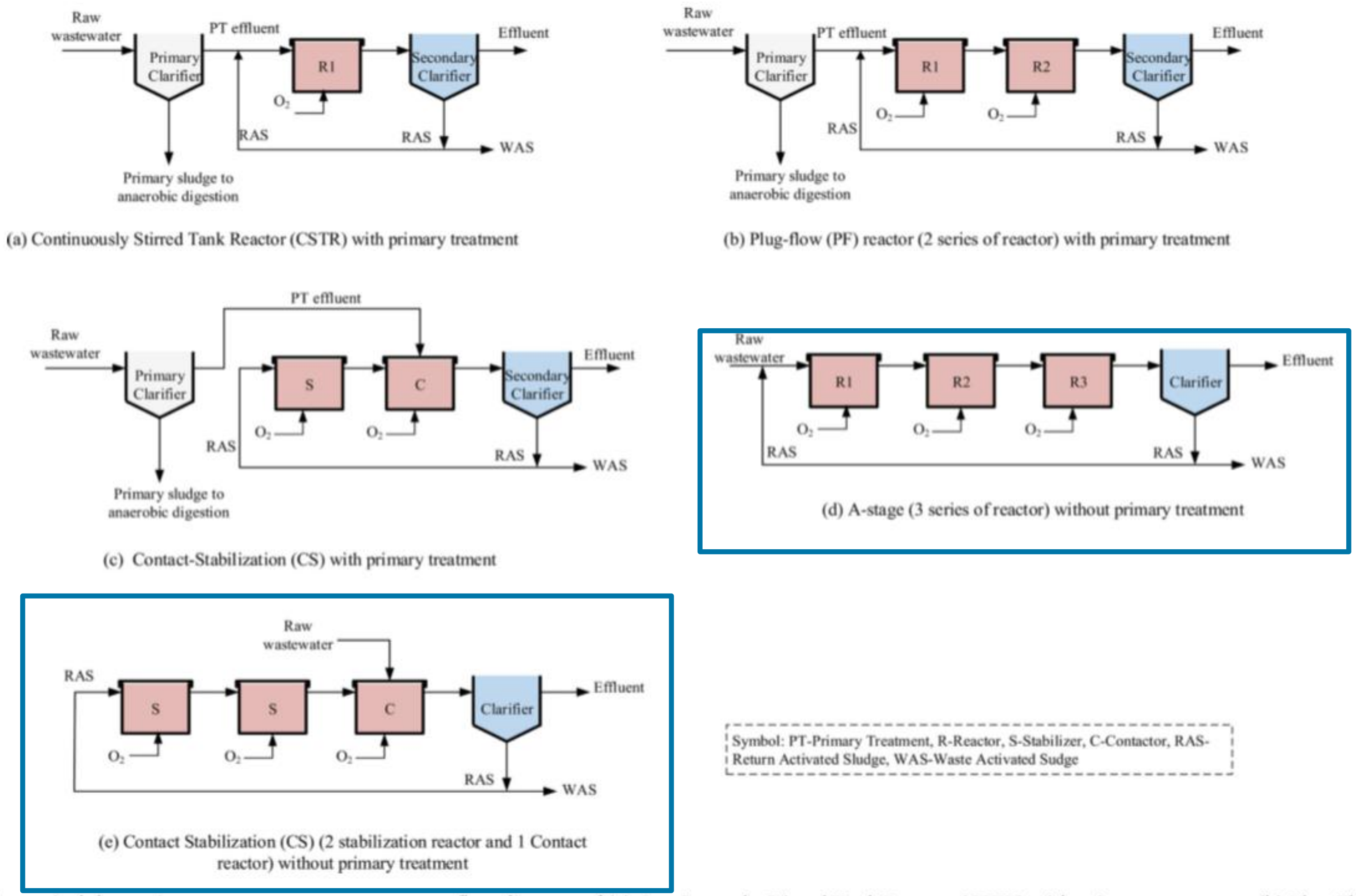
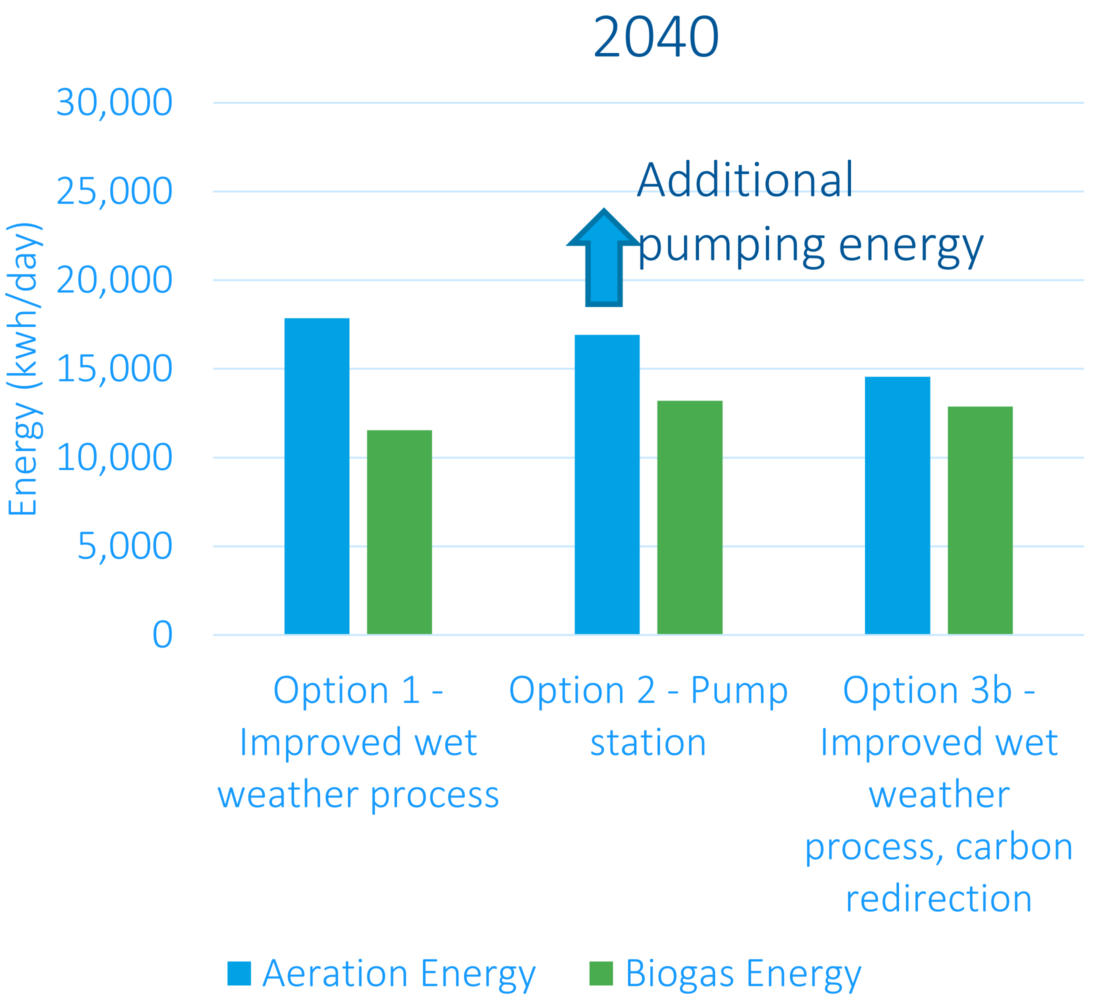


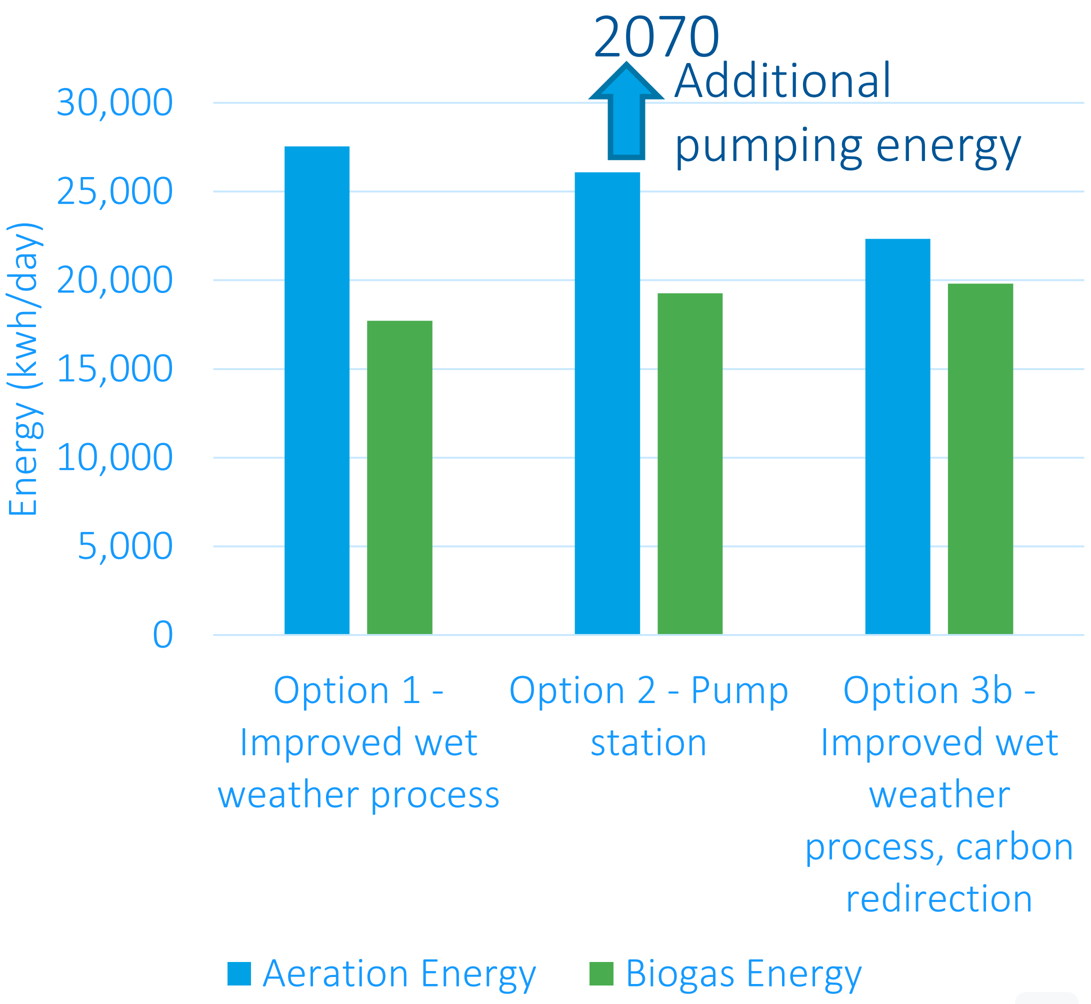
Fig. 1. The typical domestic wastewater treatment process flow diagram of (a) Continuously Stirred Tank Reactor (CSTR) with primary treatment, (b) Plug-Flow (PF) reactor system with primary treatment, (b) Contact-Stabilization with primary treatment, (c) A-stage (without primary treatment) and (d) Contact-Stabilization (CS) without primary treatment.

- High rate activated sludge (HRAS)
  - <1 day SRT
  - <2 hour HRT
- Sorb COD to biological floc
- Divert to anaerobic digestion

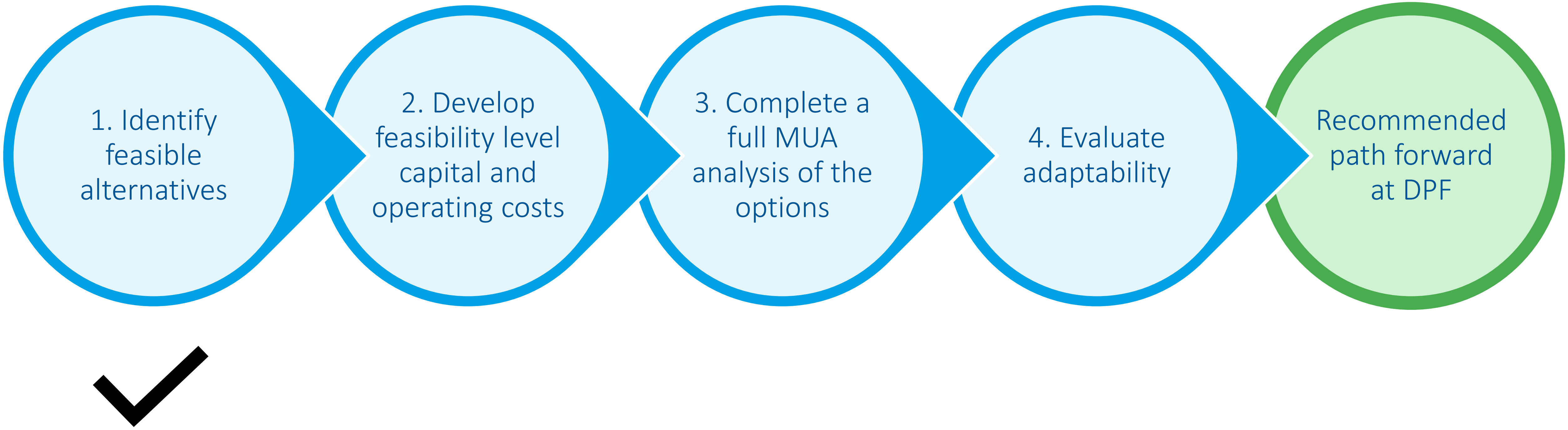
Rahman et al (2020) Journal of Water Process Engineering **36**

Are we focused too much on today, and not on a resource recovery future?





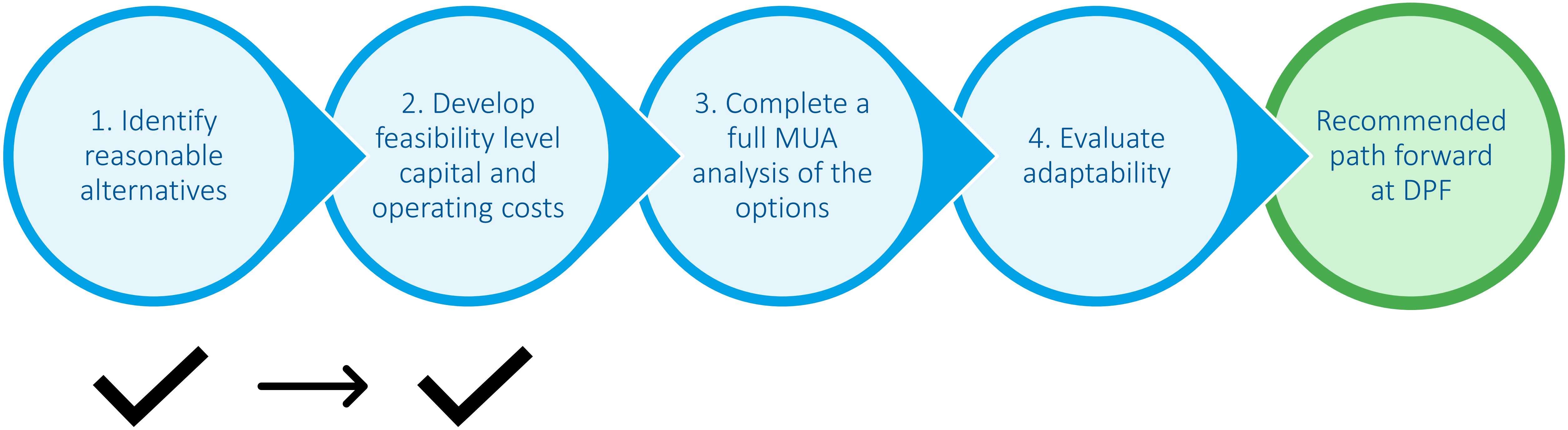
How do we make a decision on DPF?



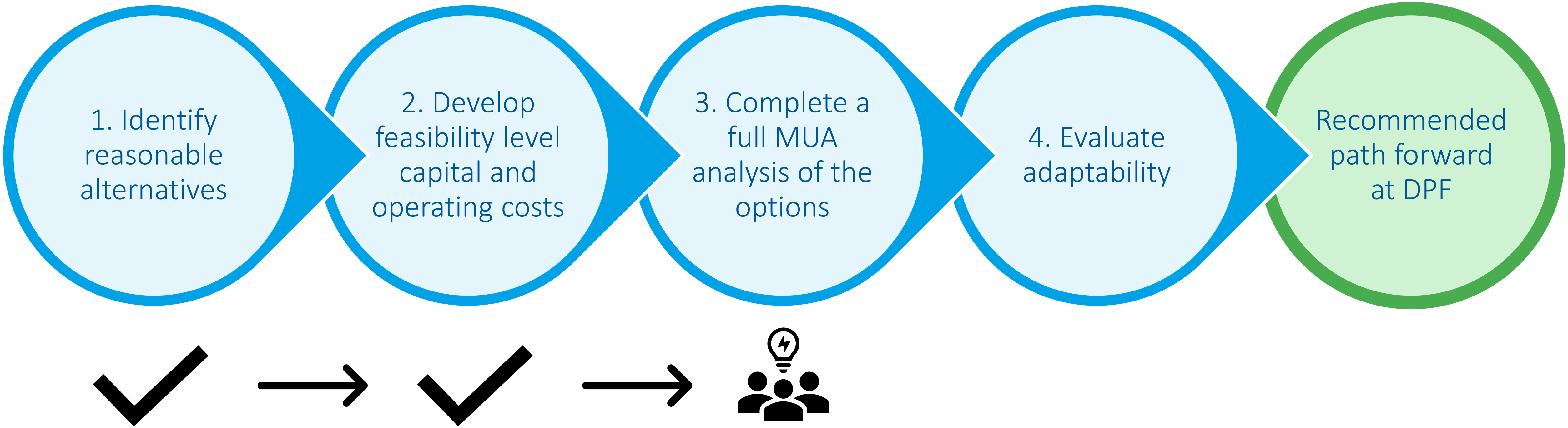
2. Develop feasibility study level capital cost and operating costs

Options	Capital Cost	Main Components
Option 1	$80M to $110M	• Existing CIP (headworks, filters, UV, clarifiers) • Aeration basin improvements • New clarifier
Option 2	$40M to $60M Pump Station and Pipeline $30M to $60M DPF Storage $70M to $120M GBF improvements $140M to $240M Total	• 30 mgd pump station and pipeline • DPF storage • GPF expansion (south primary clarifiers, south aeration basin, south final clarifiers, disinfection) • Headworks expansion
Option 3	$100M to $130M	• Existing CIP (headworks, filters, UV, clarifiers) • Aeration basin improvements (A/B stage) • New clarifier

How do we make a decision on DPF?

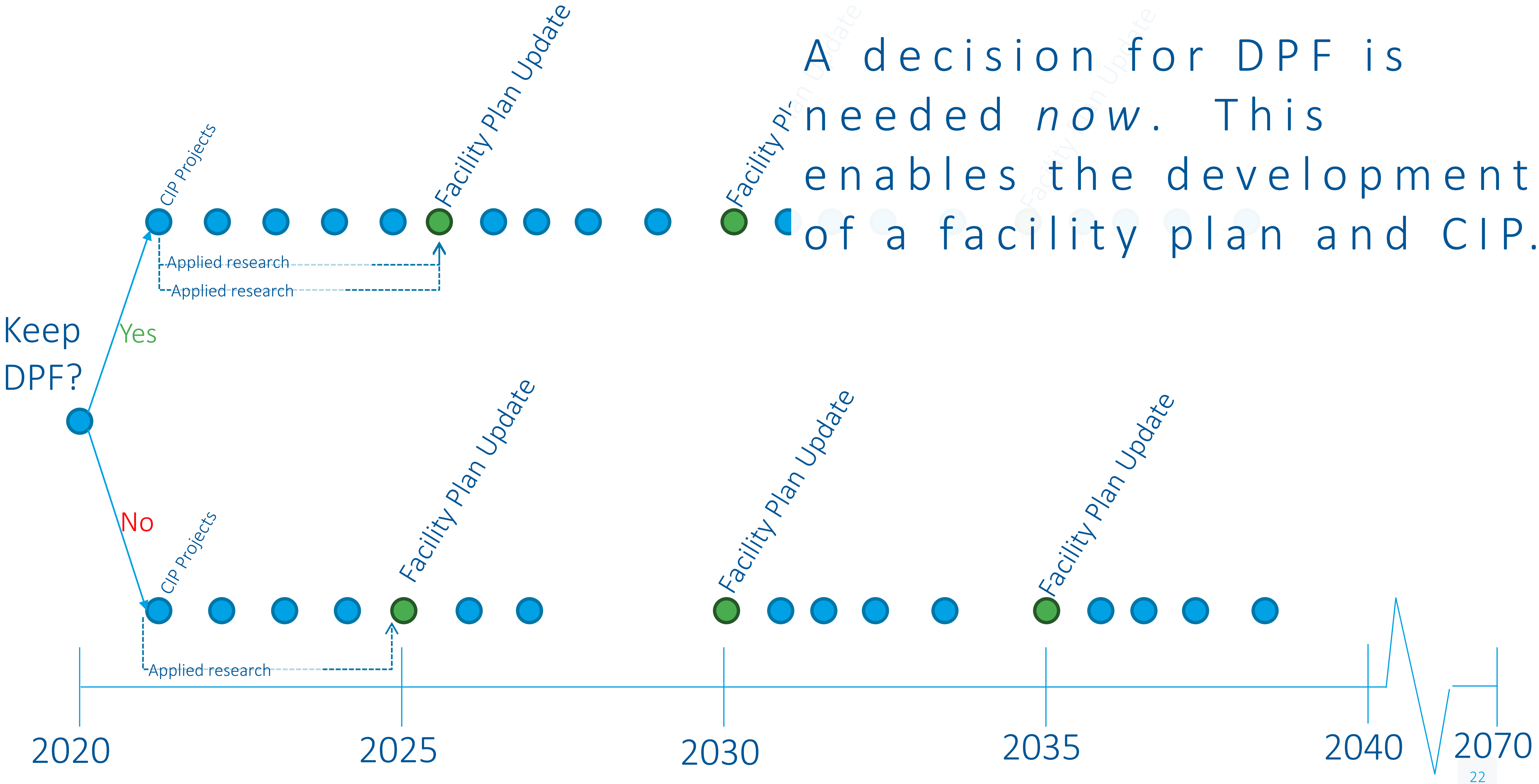


How do we make a decision on DPF?

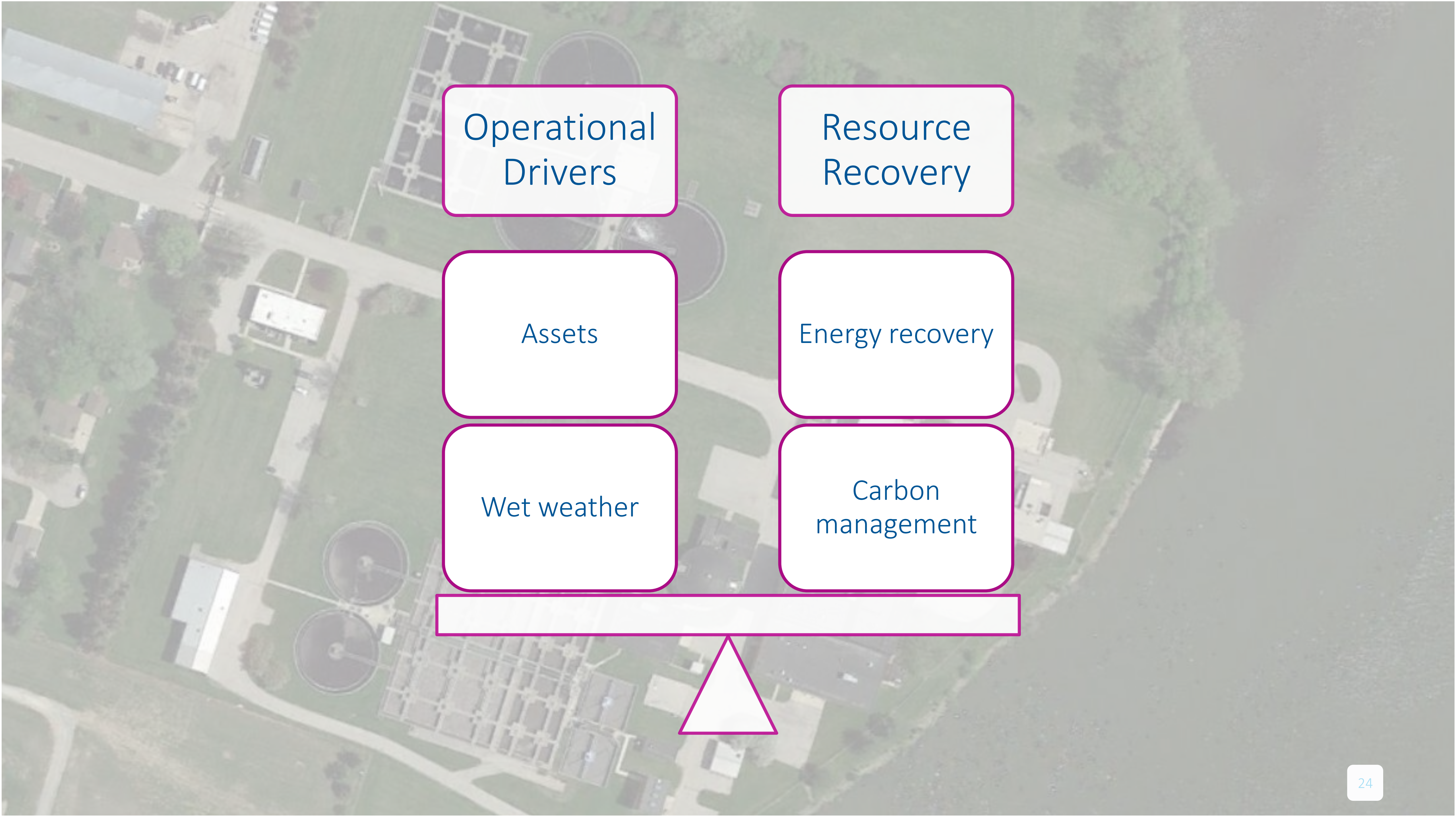


Need for collaborative discussions in the next two sessions

A decision for DPF is needed *now*. This enables the development of a facility plan and CIP.



Risks, Opportunities and MUA


Operational Drivers
Resource Recovery
Assets
Energy recovery
Wet weather
Carbon management

Thinking through MUA criteria will be particularly critical for the DPF vision

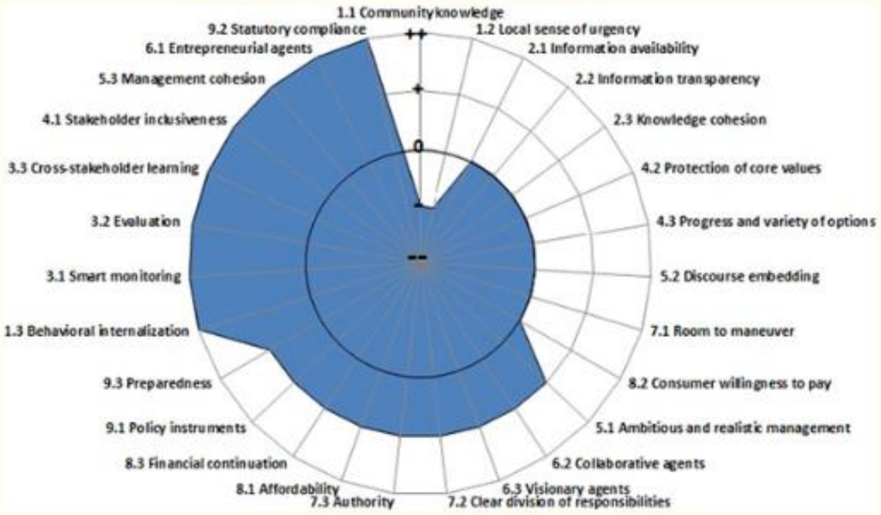
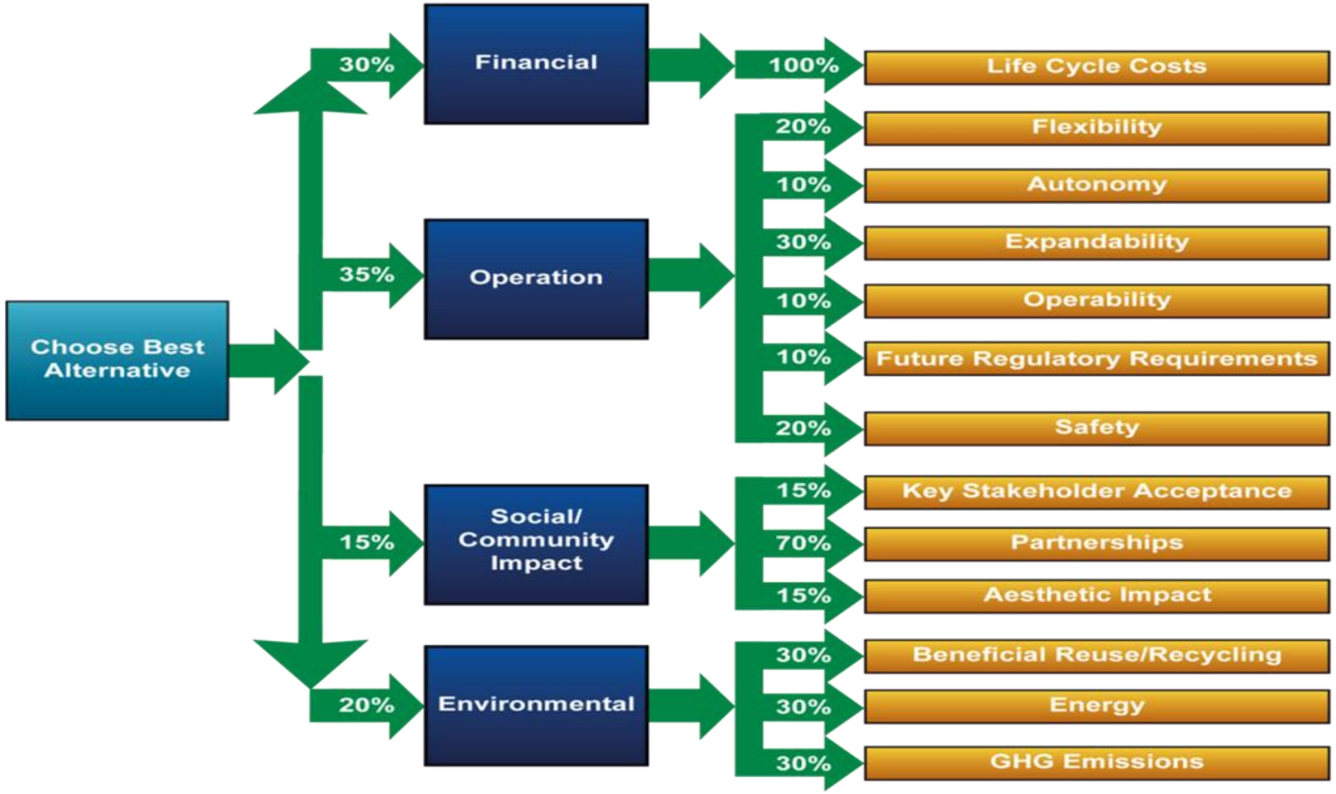


Fig. 2

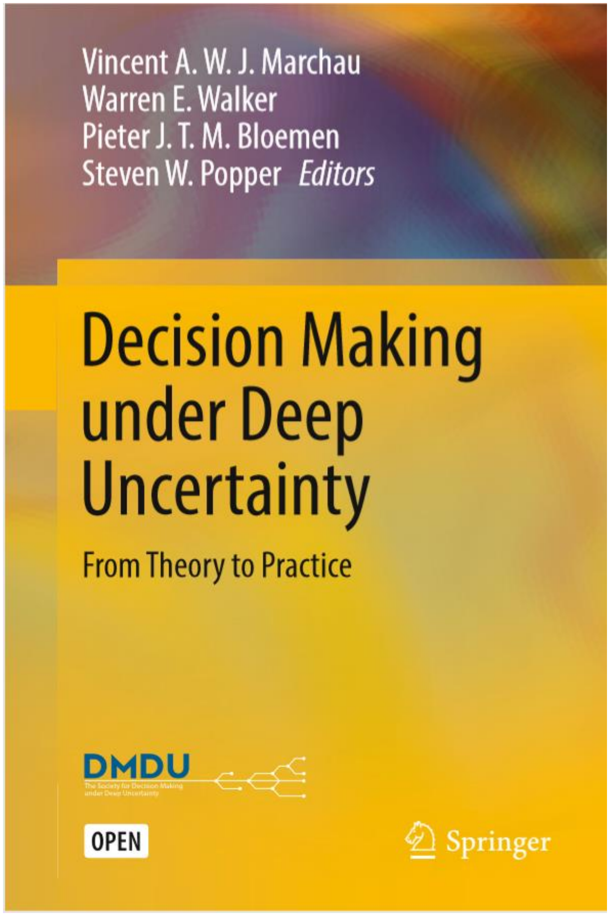
Scores of the 27 indicators of the GCF water governance performance on wastewater treatment for the city of Amsterdam (Koop et al. 2017)



Example output from the Netherlands

R2E2 MUA

Five approaches for decision making in an uncertain world

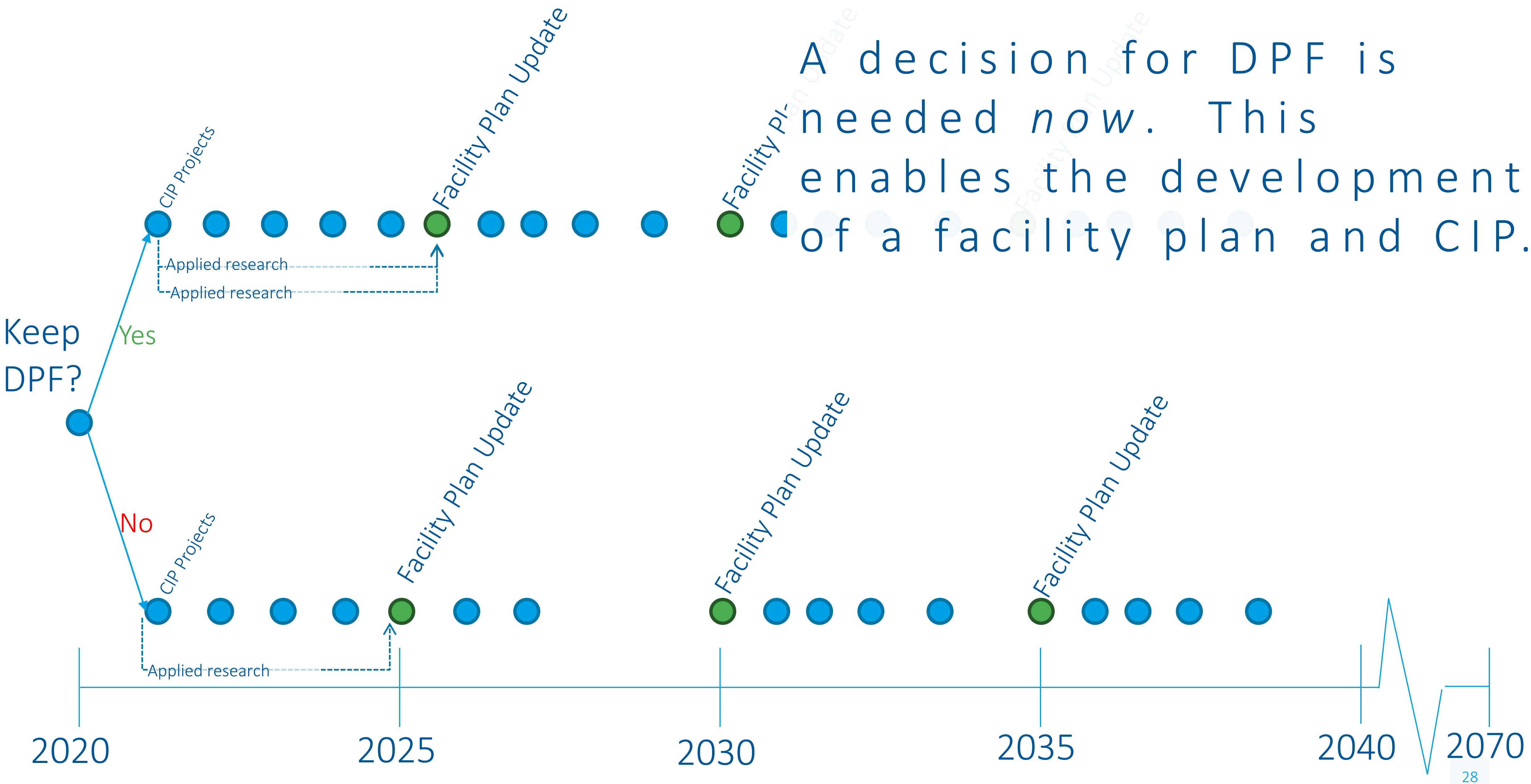


- **Robust decision making (RDM):** stress test alternatives under various scenarios for technical robustness
- **Dynamic adaptive planning (DAP):** implementation of a plan that is adapted over time based on new knowledge
- **Dynamic adaptive policy planning (DAPP):** development of alternative routes as part of DAP
- **Info-Gap Decision Theory (IG):** An info-gap is the disparity between what is know and what needs to be known to make a decision; evaluation of a large range of options computationally
- **Engineering Options Analysis (EOA):** assignment of economic value to technical flexibility

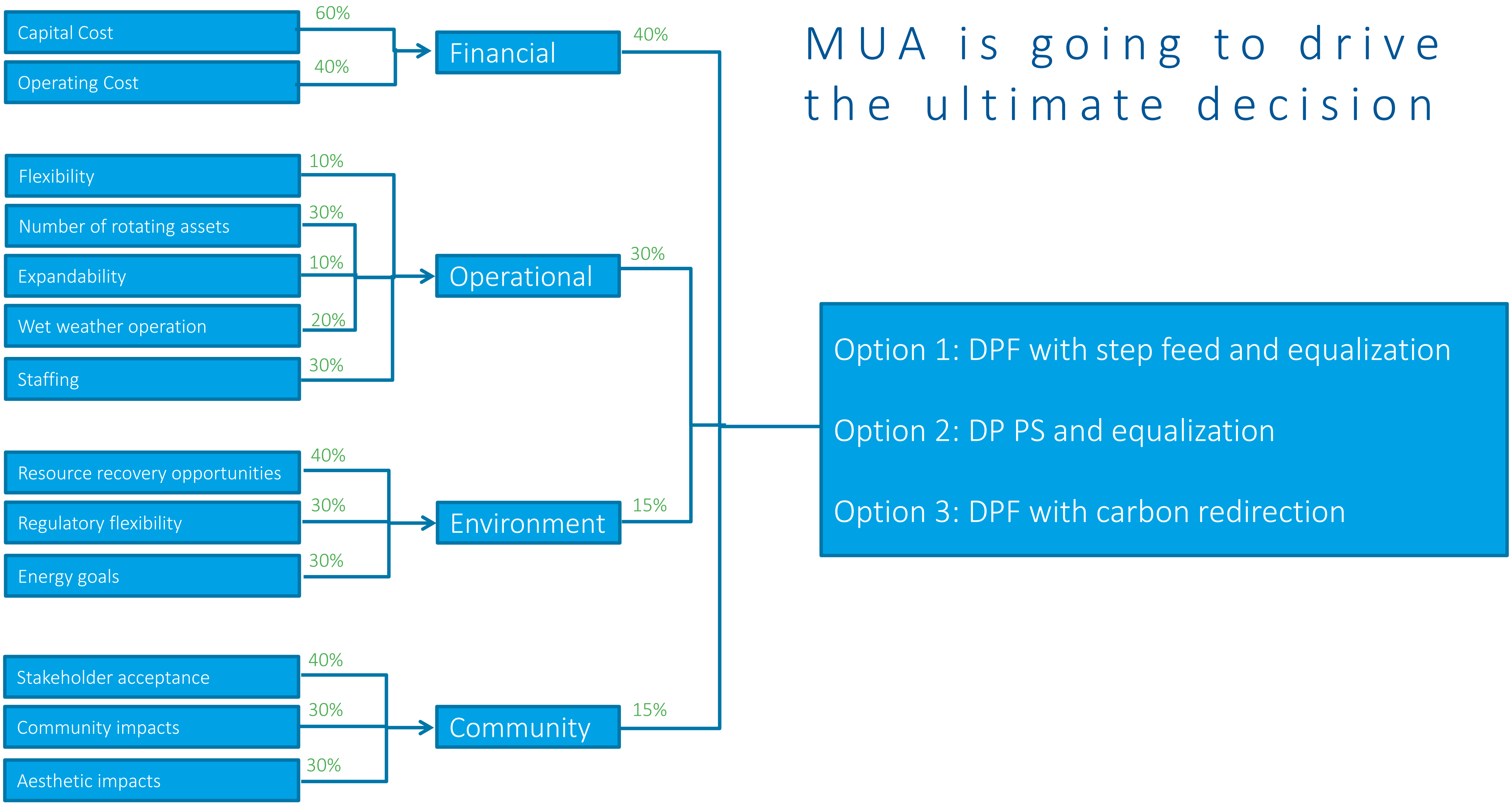
How can dynamic adaptive planning be implemented for NEW Water?

- Specify goals and objectives – Risks, opportunities, and MUA
- Develop an initial plan to meet these goals and objectives – 5-year CIP
- Identifying the vulnerabilities of the plan – Addressed by MUA
- Develop an initial plan of actions to be taken immediately upon implementation to protect it against some of these vulnerabilities – Applied Research Plan
- Establishment of signposts to monitor the remaining uncertain vulnerabilities – Future risks and opportunities
- Continued development of actions to advance the plan as the future becomes more certain – 10-year and 15-year CIP

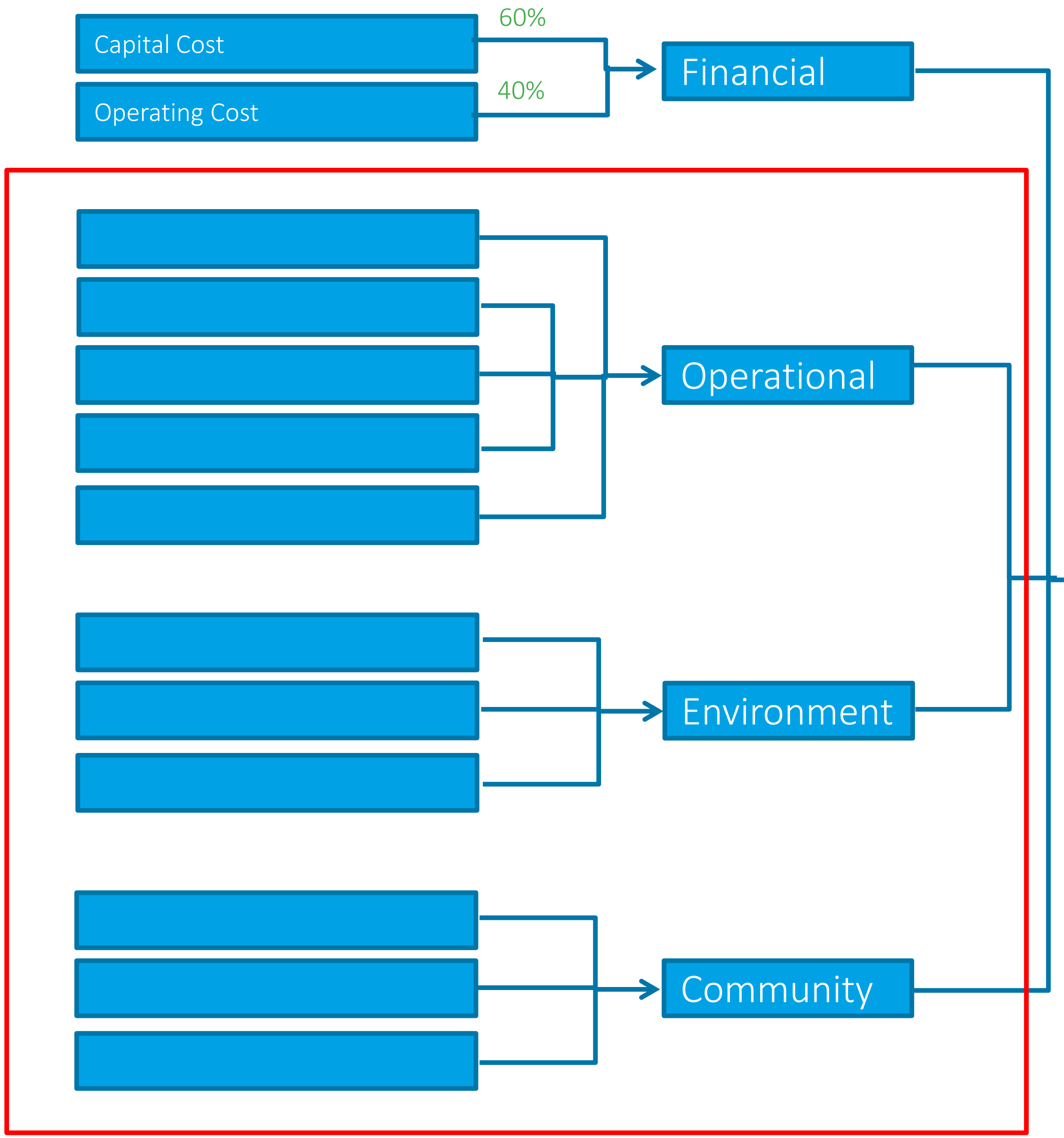
A decision for DPF is needed *now*. This enables the development of a facility plan and CIP.



MUA is going to drive the ultimate decision



MUA is going to drive the ultimate decision

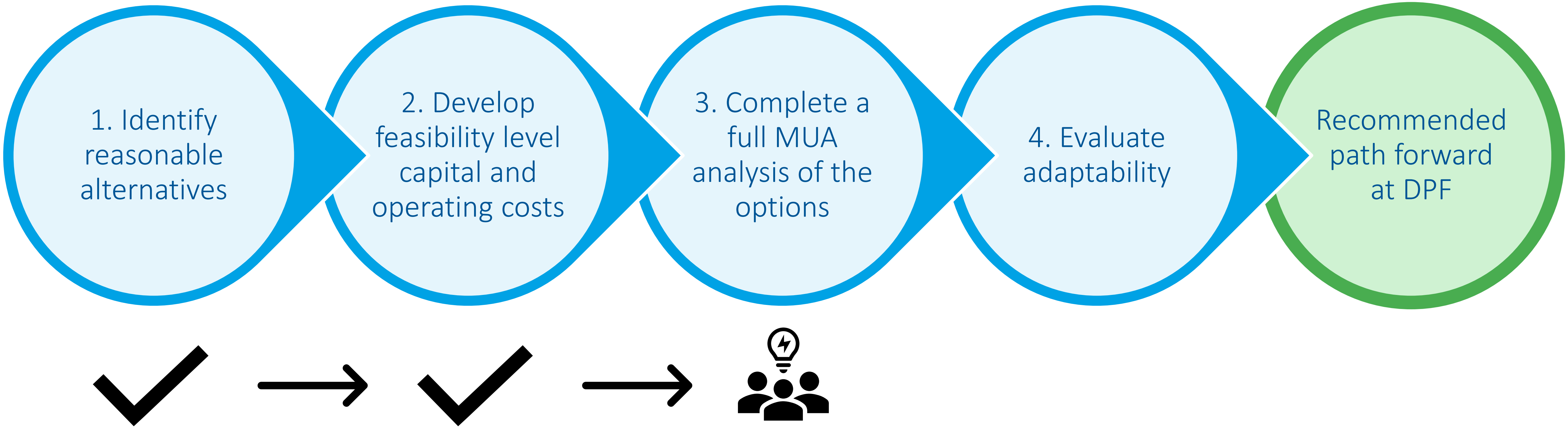


Option 1: DPF with step feed and equalization

Option 2: DP PS and equalization

Option 3: DPF with carbon redirection

How do we make a decision on DPF?



Finalize criteria on July 2, 2020

Session 2 notes

Step 1 - Understanding the context: Future Flows and Loads

DPF Projected Flows and Loads

YEAR	INFLUENT PARAMETER	AVERAGE DAY	MAXIMUM 30-DAY RA	MAXIMUM 7-DAY RA	MAXIMUM DAY	PEAK HOUR
2020	Flow (MGD)	9.5	14.6	17.5	34.2	53.4
	BOD (ppd)	20,862	31,084	36,091	54,659	---
	TSS (ppd)	17,256	35,203	45,556	128,386	---
	NH_3-N (ppd)	1,479	2,263	2,559	3,830	---
	TKN (ppd)	2,378	3,591	4,066	7,562	---
	TP (ppd)	353	515	610	1,132	---
2040	Flow (MGD)	11.0	18.4	21.4	38.0	57.3
	BOD (ppd)	27,442	40,889	47,475	71,899	---
	TSS (ppd)	22,714	46,336	59,964	168,991	---
	NH_3-N (ppd)	1,968	3,011	3,404	5,097	---
	TKN (ppd)	3,194	4,823	5,462	10,157	---
	TP (ppd)	451	735	780	1,448	---

Step 1:Understanding the context: Required Infrastructure Investment

Unit Process	Identified Issues
Influent Pumping	Age, peak flow capacity
Screening	Capture performance, peak flow capacity
Grit Removal	Age, operation, capture performance, peak flow capacity
Activated Sludge Aeration	
Intermediate Clarifiers	Age, peak flow capacity
RAS and WAS pumping	Age (both systems)
Second Stage Aeration	Not used
Final Clarifiers	Age, peak flow capacity
Tertiary Filters	Age, peak flow capacity
UV Disinfection	Peak flow capacity
Scum Handling (plant wide)	Operation, maintenance, capacity

Step 2: What are the risks and opportunities for Keeping DPF?

1) Water quality and permit benefit for two plants?

2) Does the DPF have Other Value? (Outside the fence to customers or neighbors.)

4) Asset Value and Maintenance

5) Operational considerations

6) Understanding the Regulatory Possibilities for Wet Weather Treatment

Is there a water quality benefit to two discharges?

Step 2: Water Quality & Permit Risks and Opportunities for Keeping DPF

Risks

- Possibly more legal liability with two discharges.
- Emerging contaminants discharged at two locations could be a future risk.

General

- Bubble permit between two facilities (TP and TSS) and permit limits established by TMDL
- Removing DPF discharge and moving upstream likely not a huge impact on water quality.
- Potentially worse Fox River water quality if no DPF discharge (mainly suspended solids)

Opportunities

- Two plants may have more flexibility to trade mass between the plants for a mass-based limit

Step 2: Outside the Fence Considerations Risks and Opportunities for Keeping DPF

Risks

- Few "outside the fence" risks such as odor.
- All things equal, one plant is better than two so could possibly eliminate DPF

General

- Plant is relatively isolated with mostly park space surrounding it.
- One or two discharges isn't a huge driver for customer decisions.
- No major complaints about facility
- No decentralization driver for combining the plants.

Opportunities

- Little opportunity or interest in land re-use or site redevelopment for alternative purposes.
- Little opportunity for reclaimed wastewater from DPF by customers.
- Potential opportunity for river trail in the future – could be with or without the plant.
- Two plants provide more resiliency.

Step 2: Asset Value And Maintenance Risks and Opportunities for Keeping DPF

Risks

- Too many individual assets at DPF that take too much operations. The GBF and DPF have the same number liquid assets.
- Much maintenance time invested at DPF relative to its size.

General

- Intermediate clarifiers are a pinch point
- Wet weather flows are challenging.
- Dry weather flow operation is stable.

Opportunities

- Final clarifiers, filters, back end of the facility are valuable,
- Blowers relatively new
- Lots of space for expansion
- Continue to use recent electrical investments and new generators
- IT systems of two plants well tied together

Step 2: Operational Considerations
Risks and Opportunities for Keeping DPF

Risks

- Wet weather is a challenge. Large loading swings cause issues.
- Final clarifiers are used for equalization, but this is operationally intensive. Formal equalization volume could alleviate operational issues during wet weather flow.
- Intermediate clarifiers are a critical bottleneck to process stability; high risk operational condition

General

Opportunities

- Flexibility is a benefit; ability to shift load to GBF from mill waste as well as 5 mgd of metro wastewater
- Stable operations at lower influent flows (fairly good resilience to swings in industrial loadings)
- Good and stable operations for normal flows

NEW WATER

GREEN BAY FACILITY & DE PERE FACILITY

50-Year Vision – Session 4

July 1, 2020

NEW Water
The brand of the Green Bay Metropolitan Sewerage District

BLACK & VEATCH

DONOHUE

Today's Goals

1. Discuss and finalize approach for incorporation of a 50-year vision

2. Finalize criteria and approach for the MUA for the Facility Plan

Looking ahead 50 years

Development of a “technological constellation” to address today and tomorrow

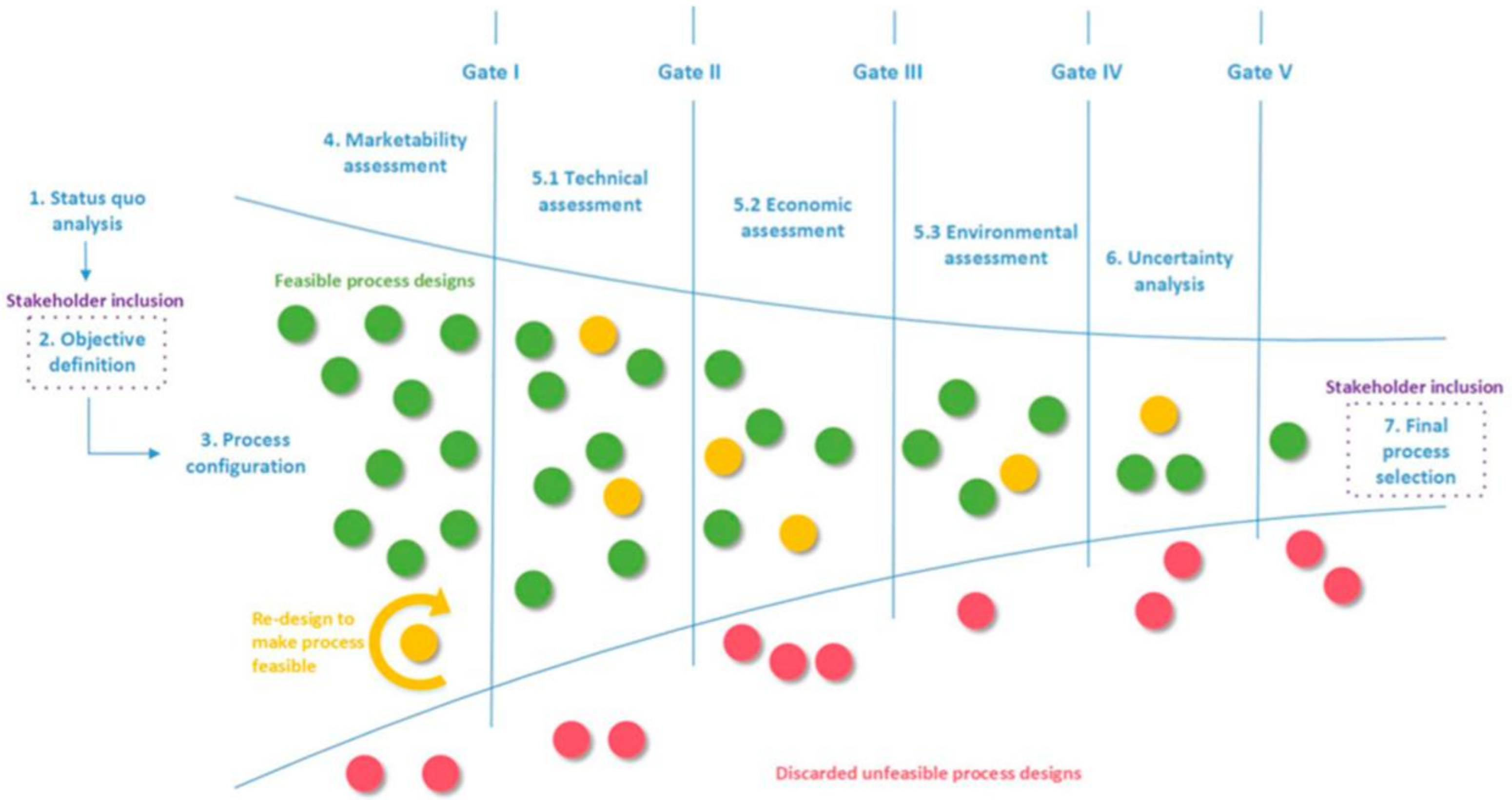
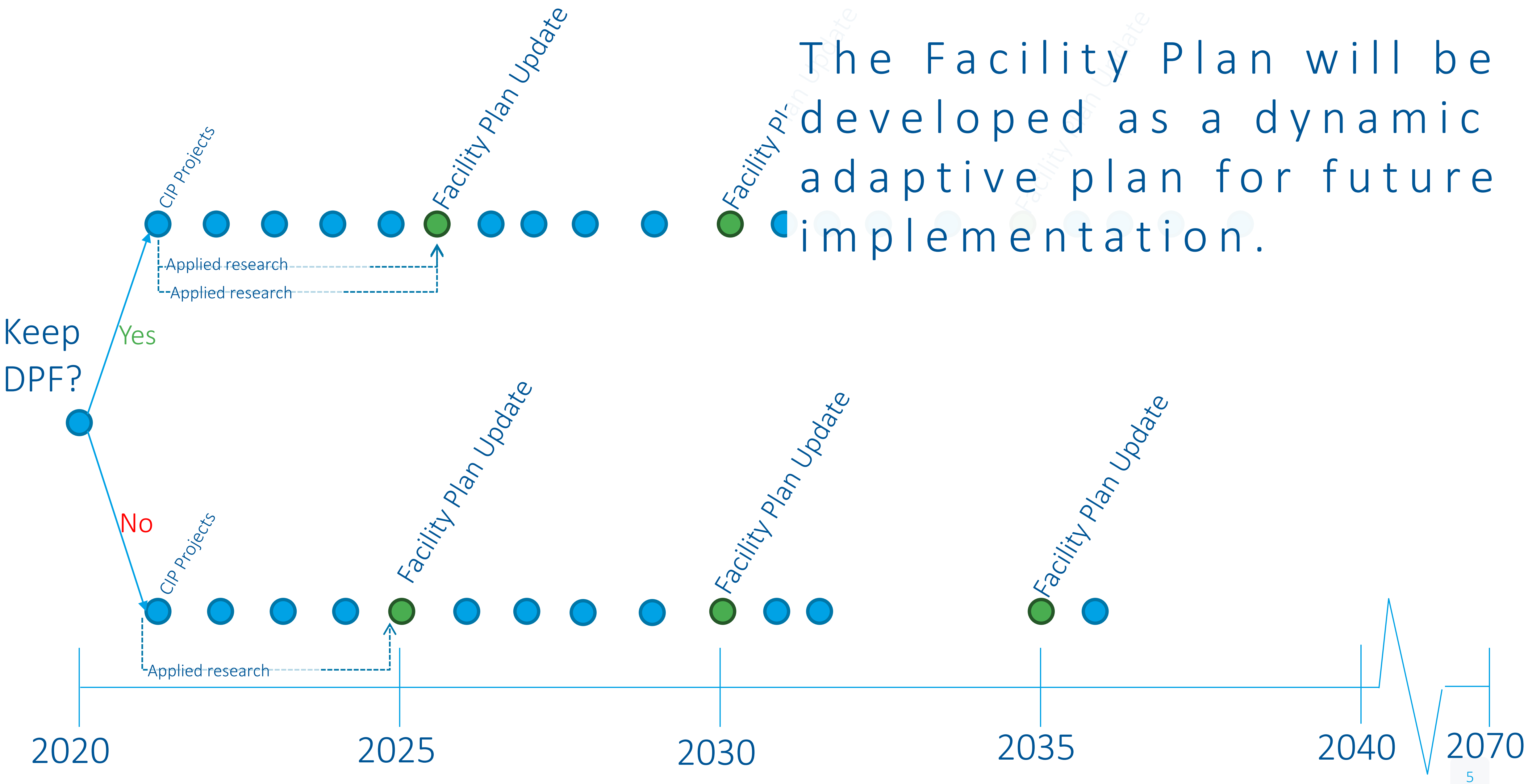


Figure 1. Funnel development and stage gating model adapted from [26] to make it specially applicable for water resource factory (WRF) process design purposes.

Kehrein et al (2020) Sustainability 12, 4168; doi:10.3390/su12104168

Quaglia, A. An Integrated Business and Engineering Framework for Synthesis and Design of Processing Networks. Ph.D.Thesis,DTUChemicalEngineering,DepartmentofChemicalandBiochemicalEngineering, Kgs. Lyngby, Denmark, 2013.

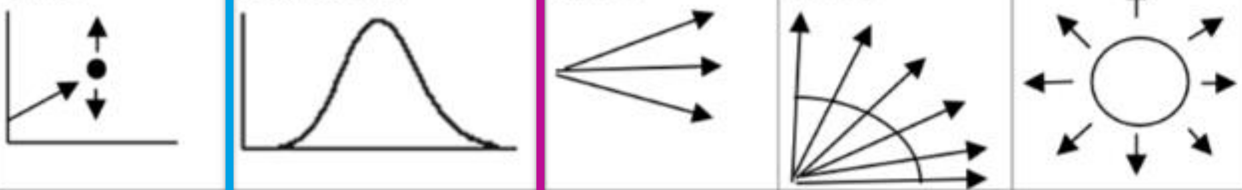


The Facility Plan will be developed as a dynamic adaptive plan for future implementation.

The NEW Water Facility Plan is a combination of facility planning and master planning

Table 1.1 Progressive transition of levels of uncertainty

	Complete determinism	Level 1	Level 2	Level 3	Level 4 (deep uncertainty)		Total ignorance
					Level 4a	Level 4b	
Context (X)		A clear enough future	Alternate futures (with probabilities)	A few plausible futures	Many plausible futures	Unknown future	
System model (R)		A single (deterministic) system model	A single (stochastic) system model	A few alternative system models	Many alternative system models	Unknown system model; know we don't know	
System outcomes (O)		A point estimate for each outcome	A confidence interval for each outcome	A limited range of outcomes	A wide range of outcomes	Unknown outcomes; know we don't know	
Weights (W)		A single set of weights	Several sets of weights, with a probability attached to each set	A limited range weights	A wide range of weights	Unknown weights; know we don't know	



Facility Planning

Master Planning

Relating this concept to a 50-year vision

1. Identify long-term risk categories and risks
2. Develop a likely response
3. Identify a facility plan opportunity

Marchau et al (2019) *Decision Making Under Deep Uncertainty*. Switzerland; Springer.

What can we identify as 50-year risks, and how does NEW Water respond (collaborative discussion)?

Risk category	Risk	Likely Response	Facility Plan Opportunity
Regulatory	New effluent compounds	Tertiary treatment/ membrane filtration	Maintain site footprint, consider as part of DPF improvements
	Effluent nitrogen limits	Aeration basin modifications	Develop plan for basin modifications
	Microplastics	Tertiary treatment/ membrane filtration	Maintain site footprint, consider as part of DPF improvements
	GHG emission regulations	Reduce use of non-renewable energy	

What can we identify as 50-year risks, and how does NEW Water respond (collaborative discussion)?

Risk category	Risk	Likely Response	Facility Plan Opportunity
Aging infrastructure	Concrete failure	Repair and maintain	Plan for concrete rehabilitation in all projects
Shift in industry / demographics	Significant reduction in organic loading	Reduction in dry weather hydraulic capacity needs	Phased implementation of organic loading projects
	Decreased water usage from conservation	Optimization of basin operation	
	Rapid population growth	Expansion of facilities	Maintain expansion flexibility

What can we identify as 50-year risks, and how does NEW Water respond (collaborative discussion)?

Risk category	Risk	Likely Response	Facility Plan Opportunity
Community changes	Increased demand for reuse water	Tertiary treatment/ membrane filtration	Maintain site footprint, consider as part of DPF improvements

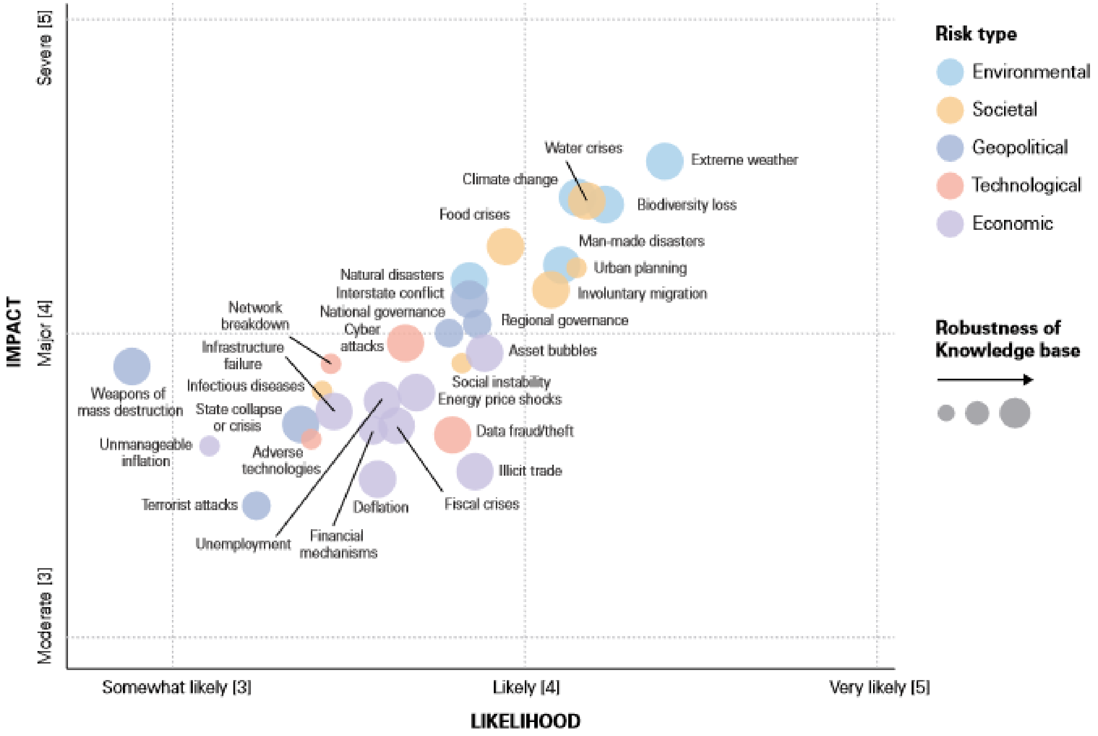
What can we identify as 50-year risks, and how does NEW Water respond (collaborative discussion)?

Risk category	Risk	Likely Response	Facility Plan Opportunity

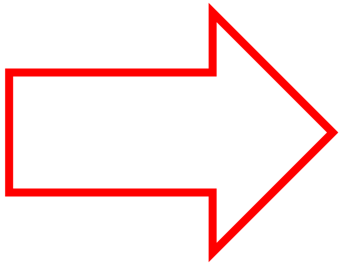
Emerging metrics for decision making

UN SDGs are increasingly being considered as foundation goals

Our Future on Earth presents concepts from the Stockholm Resilience Center



Likelihood and Impact
Mean ranked likelihood and impact of global risks and robustness of the knowledge base surrounding each risk (size of the circle) for the 30 global risks in 5 categories (colors). *Source: Future Earth Global Risks Scientists' Perception survey, 2019*



These five risks, or a subset of them, showed up repeatedly across the different questions of this survey

CLIMATE CHANGE
EXTREME WEATHER
BIODIVERSITY LOSS
FOOD CRISES
WATER CRISES

resilient approaches might be possible where the combined effects are kept in mind with every move

ISI Envision framework can provide additional metrics

Quality Of Life
14 Credits

WELLBEING
- **QL1.1** Improve Community Quality of Life
- **QL1.2** Enhance Public Health & Safety
- **QL1.3** Improve Construction Safety
- **QL1.4** Minimize Noise & Vibration
- **QL1.5** Minimize Light Pollution
- **QL1.6** Minimize Construction Impacts

MOBILITY
- **QL2.1** Improve Community Mobility & Access
- **QL2.2** Encourage Sustainable Transportation
- **QL2.3** Improve Access & Wayfinding

COMMUNITY
- **QL3.1** Advance Equity & Social Justice
- **QL3.2** Preserve Historic & Cultural Resources
- **QL3.3** Enhance Views & Local Character
- **QL3.4** Enhance Public Space & Amenities

QL0.0 Innovate or Exceed Credit Requirements

Leadership
12 Credits

COLLABORATION
- **LD1.1** Provide Effective Leadership & Commitment
- **LD1.2** Foster Collaboration & Teamwork
- **LD1.3** Provide for Stakeholder Involvement
- **LD1.4** Pursue Byproduct Synergies

PLANNING
- **LD2.1** Establish a Sustainability Management Plan
- **LD2.2** Plan for Sustainable Communities
- **LD2.3** Plan for Long-Term Monitoring & Maintenance
- **LD2.4** Plan for End-of-Life

ECONOMY
- **LD3.1** Stimulate Economic Prosperity & Development
- **LD3.2** Develop Local Skills & Capabilities
- **LD3.3** Conduct a Life-Cycle Economic Evaluation

LD0.0 Innovate or Exceed Credit Requirements

Resource Allocation
14 Credits

MATERIALS
- **RA1.1** Support Sustainable Procurement Practices
- **RA1.2** Use Recycled Materials
- **RA1.3** Reduce Operational Waste
- **RA1.4** Reduce Construction Waste
- **RA1.5** Balance Earthwork On Site

ENERGY
- **RA2.1** Reduce Operational Energy Consumption
- **RA2.2** Reduce Construction Energy Consumption
- **RA2.3** Use Renewable Energy
- **RA2.4** Commission & Monitor Energy Systems

WATER
- **RA3.1** Preserve Water Resources
- **RA3.2** Reduce Operational Water Consumption
- **RA3.3** Reduce Construction Water Consumption
- **RA3.4** Monitor Water Systems

RA0.0 Innovate or Exceed Credit Requirements

Natural World
14 Credits

SITING
- **NW1.1** Preserve Sites of High Ecological Value
- **NW1.2** Provide Wetland & Surface Water Buffers
- **NW1.3** Preserve Prime Farmland
- **NW1.4** Preserve Undeveloped Land

CONSERVATION
- **NW2.1** Reclaim Brownfields
- **NW2.2** Manage Stormwater
- **NW2.3** Reduce Pesticide & Fertilizer Impacts
- **NW2.4** Protect Surface & Groundwater Quality

ECOLOGY
- **NW3.1** Enhance Functional Habitats
- **NW3.2** Enhance Wetland & Surface Water Functions
- **NW3.3** Maintain Floodplain Functions
- **NW3.4** Control Invasive Species
- **NW3.5** Protect Soil Health

NW0.0 Innovate or Exceed Credit Requirements

Climate and Resilience
10 Credits

EMISSIONS
- **CR1.1** Reduce Net Embodied Carbon
- **CR1.2** Reduce Greenhouse Gas Emissions
- **CR1.3** Reduce Air Pollutant Emissions

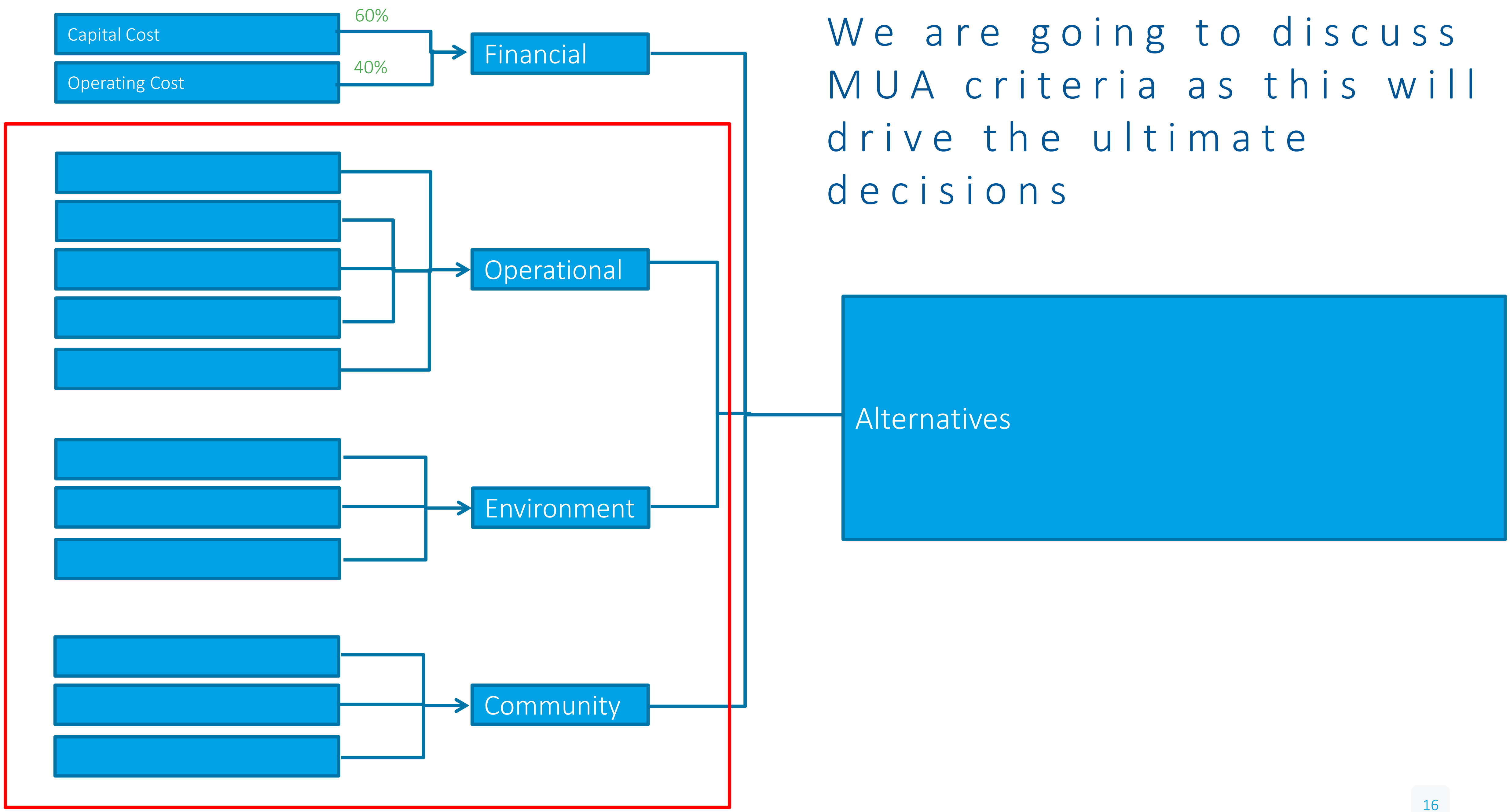
RESILIENCE
- **CR2.1** Avoid Unsuitable Development
- **CR2.2** Assess Climate Change Vulnerability
- **CR2.3** Evaluate Risk & Resilience
- **CR2.4** Establish Resilience Goals and Strategies
- **CR2.5** Maximize Resilience
- **CR2.6** Improve Infrastructure Integration

CR0.0 Innovate or Exceed Credit Requirements

Rewritten
New

NEW Water MUA

We are going to discuss MUA criteria as this will drive the ultimate decisions



Several questions to debate today

- Is resilience and adaptability an *evaluation criteria* or a *non-negotiable, foundational goal*?
- Should a ranking be used for criteria, or a binary (yes/no) approach?
- Are there broad, global categories that will change recommended decisions?

MUA Tool review

Appendix B

Additional Notes on Alternative Development

NEW Water Facility Plan - Alternative 1

GBF

Influent Characteristics

2025	Flow, mgd	BOD, lbs/day
AAD	42	59,800
MM	59.8	81,926
Peak Day	101.3	158,470
Peak Hour	143	

2040	Flow, mgd	BOD, lbs/day
AAD	43.2	61,239
MM	62.8	83,898
Peak Day	104.4	162,284
Peak Hour	148.8	

2070	Flow, mgd	BOD, lbs/day
AAD	47.2	65,880
MM	72.6	90,256
Peak Day	114.2	174,582
Peak Hour	167.7	

FRF	Flow, mgd	PE BOD, lbs/day
AAD	0.7	5897
MM		5897

Process Units

Influent PS → Coarse Screens → Fine Screens → Primary Clarification → Aeration Basins → Secondary Clarification → Disinfection

Influent PS

Flow Basis	Peak Hour	
Existing Capacity	121	mgd
2025 Need	143	mgd
2040 Need	148.8	mgd
2070 Need	167.7	mgd
Gap	27.8	mgd

Coarse Screens

Flow Basis	Peak Hour	
Existing Capacity	240	mgd
2025 Need	143	mgd
2040 Need	148.8	mgd
2070 Need	167.7	mgd
Gap	None	mgd

Fine Screens

Flow Basis	Peak Hour	
Existing Capacity	110	mgd
2025 Need	143	mgd
2040 Need	148.8	mgd
2070 Need	167.7	mgd
Gap	38.8	mgd

Primary Clarification

Number of Units	4	
Surface Area, ea	11,310	sq ft
Average SOR	1,000	gpd/sf
Peak SOR	1,500	gpd/sf
GBF BOD Removal	40%	
DPF BOD Removal	35%	

Flow Basis	Peak Hour	
Existing Capacity	68	mgd
2025 Need	143	mgd
2040 Need	148.8	mgd
2070 Need	167.7	mgd
Gap	80.94	mgd

Flow Basis	Average	
Existing Capacity	45	mgd
2025 Need	42	mgd
2040 Need	43.2	mgd
2070 Need	47.2	mgd
Gap	None	mgd

Aeration Basins

Number of Units, north	4	
Number of Units, south	2	
Volume, each north	558,814	cu ft
Volume, each south	390,460	cu ft
Max Month Loading	25	lbs/1,000 cf-d

Flow Basis	Max Month	
Existing Capacity	75,404	lb/day
2025 Need	55,053	lb/day
2040 Need	56,236	lb/day
2070 Need	64,563	lb/day
Gap	None	lb/day
Gap Volume	None	MG

Secondary Clarification

Number of Units, north	8	
Number of Units, south	2	
Surface Area, each north	12,076	
Surface Area, each south	14,314	sq ft
Average SOR	800	gpd/sf
Peak SOR	1,200	gpd/sf

Flow Basis	Peak Hour	
Existing Capacity	150.3	mgd
2025 Need	143	mgd
2040 Need	148.8	mgd
2070 Need	167.7	mgd
Gap	None	mgd
Gap	State Point	

Flow Basis	Average	
Existing Capacity	100.19	mgd
2025 Need	42	mgd
2040 Need	43.2	mgd
2070 Need	47.2	mgd
Gap	None	mgd

Flow Basis	Peak Day	
Existing Capacity	150.29	mgd
2025 Need	101.3	mgd
2040 Need	104.4	mgd
2070 Need	114.2	mgd
Gap	None	mgd
Peak Hour	State Point	
Peak Day	No	

Disinfection

Number of Units		
Volume, ea	0.88	MG
HRT @ Peak Hour	20	min

Flow Basis	Peak Hour	
Existing Capacity	63	mgd
2025 Need	143	mgd
2040 Need	148.8	mgd
2070 Need	167.7	mgd
Gap	85.4	mgd

DPF

Influent Characteristics

2025	Flow, mgd	BOD, lbs/day
AAD	9.8	22,291
MM	15.4	33,213
Peak Day	35	38,563
Peak Hour	54.3	

2040	Flow, mgd	BOD, lbs/day
AAD	11	27,442
MM	18.4	40,889
Peak Day	38	71,899
Peak Hour	57.3	

2070	Flow, mgd	BOD, lbs/day
AAD	14.2	41,089
MM	26.3	61,222
Peak Day	45.9	17,653
Peak Hour	65.2	

Process Units

Influent PS → Fine Screens → Grit Removal → Primary Clarification → Aeration Basins → Secondary Clarification → Tertiary Filtration → Disinfection

Influent PS

Flow Basis	Peak Hour	
Existing Capacity	40.4	mgd
2025 Need	40	mgd
2040 Need	40	mgd
2070 Need	40	mgd
Gap	None	mgd

Fine Screens

Flow Basis	Peak Hour	
Existing Capacity	59.4	mgd
2025 Need	40	mgd
2040 Need	40	mgd
2070 Need	40	mgd
Gap	None	mgd

Grit Removal

Flow Basis	Peak Hour	
Existing Capacity	30	mgd
2025 Need	40	mgd
2040 Need	40	mgd
2070 Need	40	mgd
Gap	10	mgd

De Pere Flow Through Capacity

Flow Basis	Peak Hour	
Existing Capacity		mgd
2025 Need	40	mgd
2040 Need	40	mgd
2070 Need	40	mgd
Gap		mgd

De Pere Equalization

Volume 1.38 MG

Primary Clarification

Number of Units	0	
Surface Area, ea		sq ft
Average SOR	1000	gpd/sf
Peak SOR	2000	gpd/sf
BOD Removal	0%	

Flow Basis	Peak Hour	
Existing Capacity	0	mgd
2025 Need	40	mgd
2040 Need	40	mgd
2070 Need	40	mgd
Gap	40	mgd

Flow Basis	Average	
Existing Capacity	0	mgd
2025 Need	9.8	mgd
2040 Need	11	mgd
2070 Need	14.2	mgd
Gap	11	mgd

Aeration Basins

Number of Units	2	
Volume, each	486,010	cu ft
Max Month Loading	25	lbs/1,000 cf-d

Flow Basis	Max Month	
Existing Capacity	24,301	lb/day
2025 Need	33,213	lb/day
2040 Need	40,889	lb/day
2070 Need	61,222	lb/day
Gap	16,589	lb/day
Gap Volume	4.96	MG

Secondary Clarification

Number of Units	3	
Surface Area, each	12,272	sq ft
Average SOR	800	gpd/sf
Peak SOR	1000	gpd/sf

Flow Basis	Peak Hour	
Existing Capacity	36.8	mgd
2025 Need	40	mgd
2040 Need	40	mgd
2070 Need	40	mgd
Gap	3.18	mgd
Gap	State Point	

Flow Basis	Average	
Existing Capacity	29.5	mgd
2025 Need	9.8	mgd
2040 Need	11	mgd
2070 Need	14.2	mgd
Gap	None	mgd

Flow Basis	Peak Day	
Existing Capacity	36.8	mgd
2025 Need	0	mgd
2040 Need	0	mgd
2070 Need	5.9	mgd
Gap	None	mgd
Peak Hour	State Point	
Peak Day	No	

Tertiary Filtration

Number of Units	0	

Flow Basis	Peak Hour	
Existing Capacity	0	mgd
2025 Need	40	mgd
2040 Need	40	mgd
2070 Need	40	mgd
Gap	40	mgd

Flow Basis	Average	
Existing Capacity	0	mgd
2025 Need	9.8	mgd
2040 Need	11	mgd
2070 Need	14.2	mgd
Gap	11	mgd

Disinfection

Channels	2	
Capacity per Channel	15.1	mgd

Flow Basis	Peak Hour	
Existing Capacity	30.2	mgd
2025 Need	40	mgd
2040 Need	40	mgd
2070 Need	40	mgd
Gap	9.8	mgd

NEW Water Facility Plan - Alternative 2a

GBF

Influent Characteristics

2025	Flow, mgd	BOD, lbs/day
AAD	42	59,800
MM	59.8	81,926
Peak Day	101.3	158,470
Peak Hour	143	

2040	Flow, mgd	BOD, lbs/day
AAD	43.2	61,239
MM	62.8	83,898
Peak Day	104.4	162,284
Peak Hour	148.8	

2070	Flow, mgd	BOD, lbs/day
AAD	47.2	65,880
MM	72.6	90,256
Peak Day	114.2	174,582
Peak Hour	167.7	

FRF	Flow, mgd	PE BOD, lbs/day
AAD	0.7	5897
MM		5897

Process Units

Influent PS → *Coarse Screens* → *Fine Screens* → *Primary Clarification* → *Aeration Basins* → *Secondary Clarification* → *Disinfection*

Influent PS

Flow Basis	Peak Hour	
Existing Capacity	121	mgd
2025 Need	173	mgd
2040 Need	178.8	mgd
2070 Need	197.7	mgd
Gap	57.8	mgd

Coarse Screens

Flow Basis	Peak Hour	
Existing Capacity	240	mgd
2025 Need	173	mgd
2040 Need	178.8	mgd
2070 Need	197.7	mgd
Gap	None	mgd

Fine Screens

Flow Basis	Peak Hour	
Existing Capacity	110	mgd
2025 Need	173	mgd
2040 Need	178.8	mgd
2070 Need	197.7	mgd
Gap	68.8	mgd

Primary Clarification

Number of Units	4	
Surface Area, ea	11,310	sq ft
Average SOR	1,000	gpd/sf
Peak SOR	1,500	gpd/sf
GBF BOD Removal	40%	
DPF BOD Removal	35%	

Flow Basis	Peak Hour	
Existing Capacity	68	mgd
2025 Need	173	mgd
2040 Need	178.8	mgd
2070 Need	197.7	mgd
Gap	110.94	mgd

Flow Basis	Average	
Existing Capacity	45	mgd
2025 Need	51.8	mgd
2040 Need	54.2	mgd
2070 Need	61.4	mgd
Gap	8.96	mgd

Aeration Basins

Number of Units, north	4	
Number of Units, south	2	
Volume, each north	558,814	cu ft
Volume, each south	390,460	cu ft
Max Month Loading	25	lbs/1,000 cf-d

Flow Basis	Max Month	
Existing Capacity	75,404	lb/day
2025 Need	76641.05	lb/day
2040 Need	82813.65	lb/day
2070 Need	104,357.7	lb/day
Gap	7,409	lb/day
Gap Volume	2.22	MG

Secondary Clarification

Number of Units, north	8	
Number of Units, south	2	
Surface Area, each north	12,076	
Surface Area, each south	14,314	sq ft
Average SOR	800	gpd/sf
Peak SOR	1,200	gpd/sf

Flow Basis	Peak Hour	
Existing Capacity	150.3	mgd
2025 Need	173	mgd
2040 Need	178.8	mgd
2070 Need	197.7	mgd
Gap	28.51	mgd
Gap	State Point	

Flow Basis	Average	
Existing Capacity	100	mgd
2025 Need	51.8	mgd
2040 Need	54.2	mgd
2070 Need	61.4	mgd
Gap	None	mgd

Flow Basis	Peak Day	
Existing Capacity	150.29	mgd
2025 Need	131.3	mgd
2040 Need	134.4	mgd
2070 Need	144.2	mgd
Gap	State Point	mgd
Peak Hour	State Point	
Peak Day	State Point	

Disinfection

Number of Units		
Volume, ea	0.88	MG
HRT @ Peak Hour	20	min

Flow Basis	Peak Hour	
Existing Capacity	63	mgd
2025 Need	173	mgd
2040 Need	178.8	mgd
2070 Need	197.7	mgd
Gap	115.4	mgd

DPF

Influent Characteristics

2025	Flow, mgd	BOD, lbs/day
AAD	9.8	22291
MM	15.4	33213
Peak Day	35	38563
Peak Hour	54.3	

2040	Flow, mgd	BOD, lbs/day
AAD	11	27442
MM	18.4	40889
Peak Day	38	71899
Peak Hour	57.3	

2070	Flow, mgd	BOD, lbs/day
AAD	14.2	41089
MM	26.3	61222
Peak Day	45.9	17653
Peak Hour	65.2	

Process Units

Influent PS → *Fine Screens* → *Grit Removal* → *Primary Clarification* → *Aeration Basins* → *Secondary Clarification* → *Tertiary Filtration* → *Disinfection*

Influent PS

Flow Basis	Peak Hour	
Existing Capacity	40.4	mgd
2025 Need	24.3	mgd
2040 Need	27.3	mgd
2070 Need	35.2	mgd
Gap	None	mgd

Fine Screens

Flow Basis	Peak Hour	
Existing Capacity	59.4	mgd
2025 Need	24.3	mgd
2040 Need	27.3	mgd
2070 Need	35.2	mgd
Gap	None	mgd

Grit Removal

Flow Basis	Peak Hour	
Existing Capacity	30	mgd
2025 Need	24.3	mgd
2040 Need	27.3	mgd
2070 Need	35.2	mgd
Gap	None	mgd

Transfer PS

Flow Basis	Peak Hour	
Existing Capacity		mgd
2025 Need	30	mgd
2040 Need	30	mgd
2070 Need	30	mgd
Gap		mgd

Equalization

Volume	3.71	MG

Primary Clarification

Number of Units	0	
Surface Area, ea		sq ft
Average SOR	1000	gpd/sf
Peak SOR	2000	gpd/sf
BOD Removal	0%	

Flow Basis	Peak Hour	
Existing Capacity	0	mgd
2025 Need	24.3	mgd
2040 Need	27.3	mgd
2070 Need	35.2	mgd
Gap	27.3	mgd

Flow Basis	Average	
Existing Capacity	0	mgd
2025 Need	None	mgd
2040 Need	None	mgd
2070 Need	None	mgd
Gap	None	mgd

Aeration Basins

Number of Units	2	
Volume, each	486,010	cu ft
Max Month Loading	25	lbs/1,000 cf-d

Flow Basis	Max Month	
Existing Capacity	24,301	lb/day
2025 Need	None	lb/day
2040 Need	None	lb/day
2070 Need	None	lb/day
Gap	None	lb/day
Gap Volume	None	MG

Secondary Clarification

Number of Units	3	
Surface Area, each	12,272	sq ft
Average SOR	800	gpd/sf
Peak SOR	1200	gpd/sf

Flow Basis	Peak Hour	
Existing Capacity	44.2	mgd
2025 Need	24.3	mgd
2040 Need	27.3	mgd
2070 Need	35.2	mgd
Gap	None	mgd
Gap	None	

Flow Basis	Average	
Existing Capacity	29.5	mgd
2025 Need	None	mgd
2040 Need	None	mgd
2070 Need	None	mgd
Gap	None	mgd

Flow Basis	Peak Day	
Existing Capacity	44.2	mgd
2025 Need	5.0	mgd
2040 Need	8.0	mgd
2070 Need	15.9	mgd
Gap	None	mgd
Peak Hour	No	
Peak Day	No	

Tertiary Filtration

Number of Units	0	

Flow Basis	Peak Hour	
Existing Capacity	0	mgd
2025 Need	24.3	mgd
2040 Need	27.3	mgd
2070 Need	35.2	mgd
Gap	27.3	mgd

Flow Basis	Average	
Existing Capacity	0	mgd
2025 Need	None	mgd
2040 Need	None	mgd
2070 Need	None	mgd
Gap	None	mgd

Disinfection

Channels	2	
Capacity per Channel	15.1	mgd

Flow Basis	Peak Hour	
Existing Capacity	30.2	mgd
2025 Need	24.3	mgd
2040 Need	27.3	mgd
2070 Need	35.2	mgd
Gap	None	mgd

Appendix C

Cost Estimate Supporting Details

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

OPCC
ALTERNATIVE 1 – SIMPLIFY AND EXPLAND

Process		**Subtotal Cost**		**Total Construction Cost**		**Total Cost**	
GBF Influent Pump Station	$	8,028,900	$	15,054,000	$	18,818,000	
GBF Headworks	$	11,923,600	$	22,357,000	$	27,946,000	
DPF Influent Pump Station and Headworks	$	10,586,400	$	19,850,000	$	24,813,000	
DPF Equalization	$	4,000,000	$	7,500,000	$	9,375,000	
GBF Primary Clarifiers	$	3,123,000	$	5,856,000	$	7,320,000	
GBF Aeration Basins	$	2,275,000	$	4,266,000	$	5,333,000	
DPF Aeration Basins	$	10,920,000	$	20,475,000	$	25,594,000	
GBF Final Clarifiers	$	10,869,000	$	20,380,000	$	25,475,000	
DPF Final Clarifiers	$	3,859,000	$	7,236,000	$	9,045,000	
DPF Filtration	$	4,250,000	$	7,969,000	$	9,961,000	
GBF Disinfection	$	25,000,000	$	46,875,000	$	58,594,000	
DPF Disinfection	$	1,543,600	$	2,894,000	$	3,618,000	
GBF Thickening	$	5,300,000	$	9,938,000	$	12,423,000	*Increased to 25% engineering from TM comments
Other							
Total	**$**	**101,678,500**	**$**	**190,650,000**	**$**	**238,315,000**	
	$	86,426,725	$	162,052,500	$	202,567,750	-15%
	$	127,098,125	$	238,312,500	$	297,893,750	+25%

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

OPCC
ALTERNATIVE 2 – DE PERE PUMP STATION

Process		Subtotal Cost		Total Construction Cost		Total Cost	
GBF Influent Pump Station	$	8,028,900	$	15,054,000	$	18,818,000	
GBF Headworks	$	28,448,200	$	53,341,000	$	66,676,000	
DPF Influent Pump Station	$	18,570,000	$	34,819,000	$	43,524,000	
DPF Equalization	$	20,000,000	$	37,500,000	$	46,875,000	
GBF Primary Clarifiers	$	8,533,700	$	16,001,000	$	20,001,000	
GBF Aeration Basins	$	10,465,000	$	19,622,000	$	24,528,000	
GBF Final Clarifiers	$	25,783,900	$	48,345,000	$	55,597,000	
GBF South Effluent Pump Station	$	1,252,000	$	2,348,000	$	2,935,000	
GBF Disinfection	$	30,000,000	$	56,250,000	$	70,313,000	
Thickening	$	5,300,000	$	9,938,000	$	12,423,000	*Increased to 25% engineering from TM comments
Other							
Total	**$**	**156,381,700**	**$**	**293,218,000**	**$**	**361,690,000**	
	$	132,924,445	$	249,235,300	$	307,436,500	-15%
	$	195,477,125	$	366,522,500	$	452,112,500	+25%

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

Alternatives 1 and 2 - GBF Influent Pump Station and Bar Screens
Firm capacity of 149 mgd - TM 4.1 Baseline Package
OPCC

	Qtny	Units	Rate		Cost	Notes
Influent Pump Station and Bar Screens	1	ls	$ 8,028,900	$	8,028,900	TM 4.1 Baseline Package
Subtotal				**$**	**8,028,900**	
Contractor Overhead and Profit			25%	$	2,007,200	
Subtotal				$	10,036,100	
Contingency			50%	$	5,018,100	
Total Construction Cost				**$**	**15,054,000**	
Engineering			25%	$	3,763,500	
Total Cost				**$**	**18,818,000**	

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

Alternative 1 - GBF Headworks

TM 4.2 - GBF Package 3, and GBF Primary Sludge and WAS Screening
OPCC

	Qtny	Units	Rate	Cost	Notes
GBF Package 3	1	ls	$ 7,750,200	$ 7,750,200	From TM 4.1 - Subtotal Costs
GBF Primary Sludge and WAS Screening	1	ls	$ 4,173,400	$ 4,173,400	From TM 4.1 - Subtotal Costs
Subtotal				**$ 11,923,600**	
Contractor Overhead and Profit			25%	$ 2,980,900	
Subtotal				$ 14,904,500	
Contingency			50%	$ 7,452,300	
Total Construction Cost				**$ 22,357,000**	
Engineering			25%	$ 5,589,300	
Total Cost				**$ 27,946,000**	

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

Alternative 2 - GBF Headworks

Rehabilitate existing headworks with new fine screens in existing channels and new primary grit removal and classification, plus sludge screening for PS and WAS. + New 30 mgd DPF headworks price at GBF
OPCC

	Qtny	Units	Rate	Cost	Notes
Demolition					
Total				$ -	
Sitework					
Total				$ -	
Costs					
GBF Package 3	1	ls	$ 7,750,200	$ 7,750,200	From TM 4.1 - Subtotal Costs
GBF Primary Sludge and WAS Screening	1	ls	$ 4,173,400	$ 4,173,400	From TM 4.1 - Subtotal Costs
Total				**$ 11,923,600**	
Mechanical (large diameter piping)					
Total				$ -	
Equipment					
30 mgd headworks for DPF flow	1	ls	$ 8,474,136	$ 8,474,136	Package 1 from TM 4.1 OPCC for new headworks was 16,185,000 for peak flow of 57.3 mgd, ~halved for 30 mgd peak
			$ -	$ -	
Install			30%	$ 2,542,241	
Subtotal				$ 11,016,377	
Mechanical			25%	$ 2,754,094	
Electrical & I&C			20%	$ 2,203,275	
Site Civil			5%	$ 550,819	
Total				**$ 16,524,565**	
Subtotal				**$ 28,448,200**	
Contractor Overhead and Profit			25%	$ 7,112,100	
Subtotal				$ 35,560,300	
Contingency			50%	$ 17,780,200	
Total Construction Cost				**$ 53,341,000**	
Engineering			25%	$ 13,335,300	
Total Cost				**$ 66,676,000**	

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

Alternative 1 - DPF Pump Station and Headworks
Firm capacity of 58 mgd and rehabilitate existing headworks
OPCC

	Qtny	Units	Rate		Cost	Notes
Influent Pump Station and Bar Screens	1	ls	$ 10,586,400	$	10,586,400	From TM 4.1
Subtotal				**$**	**10,586,400**	
Contractor Overhead and Profit			25%	$	2,646,600	
Subtotal				$	13,233,000	
Contingency			50%	$	6,616,500	
Total Construction Cost				**$**	**19,850,000**	
Engineering			25%	$	4,962,500	
Total Cost				**$**	**24,813,000**	

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

Alternative 2 - DPF Pump Station
New 30 mgd pump station and pipeline
OPCC

	Qtny	Units	Rate	Cost	Notes
Demolition					
			$ -	$ -	
Total				**$ -**	
Sitework					
			$ -	$ -	
Total				**$ -**	
Concrete					
			$ -	$ -	
Total				**$ -**	
Mechanical (large diameter piping)					
48" Forcemain	52,800	ft	$ 300	$ 15,840,000	Based on similar PI in Waukesha
Total				**$ 15,840,000**	
Equipment					
30 MGD Pump Station	1	ls	$ 1,500,000	$ 1,500,000	Based on Ronnekamp estimate
			$ -	$ -	
Install			30%	$ 450,000	
Subtotal				$ 1,950,000	
Mechanical			20%	$ 390,000	
Electrical & I&C			20%	$ 390,000	
Total				**$ 2,730,000**	
Subtotal				**$ 18,570,000**	
Contractor Overhead and Profit			25%	$ 4,642,500	
Subtotal				$ 23,212,500	
Contingency			50%	$ 11,606,300	
Total Construction Cost				**$ 34,819,000**	
Engineering			25%	$ 8,704,800	
Total Cost				**$ 43,524,000**	

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

Alternative 1 - DPF EQ Basin
Construct a 2 MG EQ basin for peak flows
OPCC

	Qtny	Units	Rate	Cost	Notes
Demolition					
			$ -	$ -	
Total				**$ -**	
Sitework					
			$ -	$ -	
Total				**$ -**	
Concrete					
EQ Basin	2,000,000	gal	$ 2.00	$ 4,000,000	Cost from FdL Master Plan
Total				**$ 4,000,000**	
Mechanical (large diameter piping)					
			$ -	$ -	
Total				**$ -**	
Equipment					
			$ -	$ -	
			$ -	$ -	
Install			30%	$ -	
Subtotal				$ -	
Mechanical			20%	$ -	
Electrical & I&C			20%	$ -	
Total				**$ -**	
Subtotal				**$ 4,000,000**	
Contractor Overhead and Profit			25%	$ 1,000,000	
Subtotal				$ 5,000,000	
Contingency			50%	$ 2,500,000	
Total Construction Cost				**$ 7,500,000**	
Engineering			25%	$ 1,875,000	
Total Cost				**$ 9,375,000**	

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

Alternative 2 - DPF EQ Basin
Construct a 10 MG EQ basin for peak flows
OPCC

	Qtny	Units	Rate	Cost	Notes
Demolition					
			$ -	$ -	
Total				**$ -**	
Sitework					
			$ -	$ -	
Total				**$ -**	
Concrete					
EQ Basin	10,000,000	gal	$ 2.00	$ 20,000,000	Cost from FdL Master Plan
Total				**$ 20,000,000**	
Mechanical (large diameter piping)					
			$ -	$ -	
Total				**$ -**	
Equipment					
			$ -	$ -	
			$ -	$ -	
Install			30%	$ -	
Subtotal				$ -	
Mechanical			20%	$ -	
Electrical & I&C			20%	$ -	
Total				**$ -**	
Subtotal				**$ 20,000,000**	
Contractor Overhead and Profit			25%	$ 5,000,000	
Subtotal				$ 25,000,000	
Contingency			50%	$ 12,500,000	
Total Construction Cost				**$ 37,500,000**	
Engineering			25%	$ 9,375,000	
Total Cost				**$ 46,875,000**	

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

Alternative 1 - GBF Primary Clarifiers
28 mgd bypass, clarifier rehab
OPCC

	Qtny	Units	Rate	Cost	Notes
Demolition					
Concrete Removal	1	ls	$ 100,000	$ 100,000	
Total				**$ 100,000**	
Sitework					
Excavation and Backfill	900	cy	$ 50	$ 45,000	
Bypass Pumping	1	ls	$ 250,000	$ 250,000	
Total				**$ 295,000**	
Concrete					
Clarifier Rehabilitation	1		$ 1,857,000	$ 1,857,000	From Clarifier Rehabilitation Study
Bypass	1		$ 300,000	$ 300,000	prepared by Donohue in 2019
Total				**$ 2,157,000**	
Mechanical (large diameter piping)					
48-Inch Pipe	600	lf	$ 800	$ 480,000	
Total				**$ 480,000**	
Equipment					
Bypass Weir	1	ls	$ 50,000	$ 50,000	
			$ -	$ -	
			$ -	$ -	
Install			30%	$ 15,000	
Subtotal				$ 65,000	
Mechanical			20%	$ 13,000	
Electrical & I&C			20%	$ 13,000	
Total				**$ 91,000**	
Subtotal				**$ 3,123,000**	
Contractor Overhead and Profit			25%	$ 780,800	
Subtotal				$ 3,903,800	
Contingency			50%	$ 1,951,900	
Total Construction Cost				**$ 5,856,000**	
Engineering			25%	$ 1,464,000	
Total Cost				**$ 7,320,000**	

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

Alternative 2 - GBF Primary Clarifiers
2 new clarifiers plus clarifier rehab
OPCC

	Qtny	Units	Rate	Cost	Notes
Demolition					
			$ -	$ -	
Total				**$ -**	
Sitework					
			$ -	$ -	
Total				**$ -**	
Concrete					
Clarifier Rehabilitation	1		$ 1,857,000	$ 1,857,000	From Clarifier Rehabilitation Study prepared by Donohue in 2019
Total				**$ 1,857,000**	
Mechanical (large diameter piping)					
			$ -	$ -	
Total				**$ -**	
Equipment					
90 ft dia x 14-ft deep	667,000	gal	$ 2.75	$ 1,834,250	90 ft dia x 14-ft deep = 0.67 mil gallons
90 ft dia x 14-ft deep	667,000	gal	$ 2.75	$ 1,834,250	90 ft dia x 14-ft deep = 0.67 mil gallons
Clarifier rehab					$/gallon from FdL Master Plan
			$ -	$ -	
Install			30%	$ 1,100,550	
Subtotal				$ 4,769,050	
Mechanical			20%	$ 953,810	
Electrical & I&C			20%	$ 953,810	
Total				**$ 6,676,670**	
Subtotal				**$ 8,533,700**	
Contractor Overhead and Profit			25%	$ 2,133,400	
Subtotal				$ 10,667,100	
Contingency			50%	$ 5,333,600	
Total Construction Cost				**$ 16,001,000**	
Engineering			25%	$ 4,000,300	
Total Cost				**$ 20,001,000**	

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

Alternative 1 - GBF Aeration Basins
Blower and control improvements
OPCC

	Qtny	Units	Rate	Cost	Notes
Demolition					
			$ -	$ -	
Total				**$ -**	
Sitework					
			$ -	$ -	
Total				**$ -**	
Concrete					
			$ -	$ -	
Total				**$ -**	
Mechanical (large diameter piping)					
			$ -	$ -	
Total				**$ -**	
Equipment					
Blower & Control Improvements	1	LS	$ 1,250,000	$ 1,250,000	NEW Water CIP for Blower System Efficiency Upgrade
			$ -	$ -	
Install			30%	$ 375,000	
Subtotal				$ 1,625,000	
Mechanical			20%	$ 325,000	
Electrical & I&C			20%	$ 325,000	
Total				**$ 2,275,000**	
Subtotal				**$ 2,275,000**	
Contractor Overhead and Profit			25%	$ 568,800	
Subtotal				$ 2,843,800	
Contingency			50%	$ 1,421,900	
Total Construction Cost				**$ 4,266,000**	
Engineering			25%	$ 1,066,500	
Total Cost				**$ 5,333,000**	

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

Alternative 2 - GBF Aeration Basins
One new 3MG aeration basin, plus blower and control improvements
OPCC

	Qtny	Units	Rate	Cost	Notes
Demolition					
			$ -	$ -	
Total				**$ -**	
Sitework					
			$ -	$ -	
Total				**$ -**	
Concrete					
			$ -	$ -	
Total				**$ -**	
Mechanical (large diameter piping)					
			$ -	$ -	
Total				**$ -**	
Equipment					
New aeration basin	3,000,000	gal	$ 1.50	$ 4,500,000	Basin $/gal cost calc from Tomahawk WWTP
Blower & Control Improvements	1	LS	$ 1,250,000	$ 1,250,000	NEW Water CIP for Blower System Efficiency Upgrade
Install			30%	$ 1,725,000	
Subtotal				$ 7,475,000	
Mechanical			20%	$ 1,495,000	
Electrical & I&C			20%	$ 1,495,000	
Total				**$ 10,465,000**	
Subtotal				**$ 10,465,000**	
Contractor Overhead and Profit			25%	$ 2,616,300	
Subtotal				$ 13,081,300	
Contingency			50%	$ 6,540,700	
Total Construction Cost				**$ 19,622,000**	
Engineering			25%	$ 4,905,500	
Total Cost				**$ 24,528,000**	

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

Alternative 1 - DPF Aeration Basins
One new 4MG aeration basin
OPCC

	Qtny	Units	Rate	Cost	Notes
Demolition					
			$ -	$ -	
Total				**$ -**	
Sitework					
			$ -	$ -	
Total				**$ -**	
Concrete					
			$ -	$ -	
Total				**$ -**	
Mechanical (large diameter piping)					
			$ -	$ -	
Total				**$ -**	
Equipment					
New Aeration Basin	4,000,000	gal	$ 1.50	$ 6,000,000	Basin $/gal cost calc from Tomahawk WWTP
			$ -	$ -	
Install			30%	$ 1,800,000	
Subtotal				$ 7,800,000	
Mechanical			20%	$ 1,560,000	
Electrical & I&C			20%	$ 1,560,000	
Total				**$ 10,920,000**	
Subtotal				**$ 10,920,000**	
Contractor Overhead and Profit			25%	$ 2,730,000	
Subtotal				$ 13,650,000	
Contingency			50%	$ 6,825,000	
Total Construction Cost				**$ 20,475,000**	
Engineering			25%	$ 5,118,800	
Total Cost				**$ 25,594,000**	

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

Alternative 1 - GBF Final Clarifiers
Rehabilitation Projects
OPCC

	Qtny	Units	Rate	Cost	Notes
Demolition					
			$ -	$ -	
Total				**$ -**	
Sitework					
Clarifier Rehabilitation	1	ls	$ 10,869,000	$ 10,869,000	From Clarifier Rehabilitation Study prepared by Donohue in 2019
Total				**$ 10,869,000**	
Concrete					
			$ -	$ -	
Total				**$ -**	
Mechanical (large diameter piping)					
			$ -	$ -	
Total				**$ -**	
Equipment					
			$ -	$ -	
			$ -	$ -	
Install			30%	$ -	
Subtotal				$ -	
Mechanical			20%	$ -	
Electrical & I&C			20%	$ -	
Total				**$ -**	
Subtotal				**$ 10,869,000**	
Contractor Overhead and Profit			25%	$ 2,717,300	
Subtotal				$ 13,586,300	
Contingency			50%	$ 6,793,200	
Total Construction Cost				**$ 20,380,000**	
Engineering			25%	$ 5,095,000	
Total Cost				**$ 25,475,000**	

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

Alternative 2 - GBF Final Clarifiers
Rehabilitation Projects plus two new sount plant final clarifiers, 130 diameter plus 15 deep
OPCC

	Qtny	Units	Rate	Cost	Notes
Demolition					
			$ -	$ -	
Total				**$ -**	
Sitework					
			$ -	$ -	
Total				**$ -**	
Concrete					
Clarifier Rehabilitation	1	ls	$ 10,869,000	$ 10,869,000	From Clarifier Rehabilitation Study prepared by Donohue in 2019
Total				**$ 10,869,000**	
Mechanical (large diameter piping)					
			$ -	$ -	
Total				**$ -**	
Equipment					
130 ft dia x 15-ft deep	1,490,000	gal	$ 2.75	$ 4,097,500	130 ft dia x 15-ft deep = 1.5 mil gallons
130 ft dia x 15-ft deep	1,490,000	gal	$ 2.75	$ 4,097,500	130 ft dia x 15-ft deep = 1.5 mil gallons
			$ -	$ -	$/gallon from FdL Master Plan
Install			30%	$ 2,458,500	
Subtotal				$ 10,653,500	
Mechanical			20%	$ 2,130,700	
Electrical & I&C			20%	$ 2,130,700	
Total				**$ 14,914,900**	
Subtotal				**$ 25,783,900**	
Contractor Overhead and Profit			25%	$ 6,446,000	
Subtotal				$ 32,229,900	
Contingency			50%	$ 16,115,000	
Total Construction Cost				**$ 48,345,000**	
Engineering			15%	$ 7,251,800	
Total Cost				**$ 55,597,000**	

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

Alternative 1 - DPF Final Clarifiers
Clarifier rehabilitation plus new RAS pumps and piping
OPCC

	Qtny	Units	Rate	Cost	Notes
Demolition					
			$ -	$ -	
Total				**$ -**	
Sitework					
			$ -	$ -	
Total				**$ -**	
Concrete					
Clarifier Rehabilitation	1	ls	$ 3,859,000	$ 3,859,000	From Clarifier Rehabilitation Study prepared by Donohue in 2019
Total				**$ 3,859,000**	
Mechanical (large diameter piping)					
			$ -	$ -	
Total				**$ -**	
Equipment					
			$ -	$ -	
			$ -	$ -	
Install			30%	$ -	
Subtotal				$ -	
Mechanical			20%	$ -	
Electrical & I&C			20%	$ -	
Total				**$ -**	
Subtotal				**$ 3,859,000**	
Contractor Overhead and Profit			25%	$ 964,800	
Subtotal				$ 4,823,800	
Contingency			50%	$ 2,411,900	
Total Construction Cost				**$ 7,236,000**	
Engineering			25%	$ 1,809,000	
Total Cost				**$ 9,045,000**	

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

Alternative 2 - GBF South Effluent Pump Station

Expand to 50 mgd

OPCC

	Qtny	Units	Rate	Cost	Notes
Demolition					
Demolish Existing Pumps	3	ea	$ 20,000	$ 60,000	
Total				**$ 60,000**	
Sitework					
			$ -	$ -	
Total				**$ -**	
Concrete					
			$ -	$ -	
Total				**$ -**	
Mechanical (large diameter piping)					
Piping Modifications	1	ls	$ 100,000	$ 100,000	
Total				**$ 100,000**	
Equipment					
Centrifugal pumps, 25 mgd each	3	ea	$ 200,000	$ 600,000	
			$ -	$ -	
Install			30%	$ 180,000	
Subtotal				$ 780,000	
Mechanical			20%	$ 156,000	
Electrical & I&C			20%	$ 156,000	
Total				**$ 1,092,000**	
Subtotal				**$ 1,252,000**	
Contractor Overhead and Profit			25%	$ 313,000	
Subtotal				$ 1,565,000	
Contingency			50%	$ 782,500	
Total Construction Cost				**$ 2,348,000**	
Engineering			25%	$ 587,000	
Total Cost				**$ 2,935,000**	

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

Alternative 1 - DPF Filtration
Filter rehabilitation
OPCC

	Qtny	Units	Rate	Cost	Notes
Demolition					
			$ -	$ -	
Total				**$ -**	
Sitework					
			$ -	$ -	
Total				**$ -**	
Concrete					
			$ -	$ -	
Total				**$ -**	
Mechanical (large diameter piping)					
			$ -	$ -	
Total				**$ -**	
Equipment					
Tertiary Filter Replacement	1	ls	$ 4,250,000	$ 4,250,000	From NEW Water CIP
			$ -	$ -	
				$ -	
				$ 4,250,000	
				$ -	
				$ -	
Total				**$ 4,250,000**	
Subtotal				**$ 4,250,000**	
Contractor Overhead and Profit			25%	$ 1,062,500	
Subtotal				$ 5,312,500	
Contingency			50%	$ 2,656,300	
Total Construction Cost				**$ 7,969,000**	
Engineering			25%	$ 1,992,300	
Total Cost				**$ 9,961,000**	

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

Alternative 1 - GBF Disinfection
New 140 mgd UV disinfection facility
OPCC

	Qtny	Units	Rate	Cost	Notes
Demolition					
			$ -	$ -	
Total				**$ -**	
Sitework					
			$ -	$ -	
Total				**$ -**	
Concrete					
			$ -	$ -	
Total				**$ -**	
Mechanical (large diameter piping)					
			$ -	$ -	
Total				**$ -**	
Total					
140 MGD UV Facility	1	ls	$ 25,000,000	$ 25,000,000	Includes equipment, concrete,
			$ -	$ -	gates, electrical, mechanical, installation
Total				**$ 25,000,000**	
Subtotal				**$ 25,000,000**	
Contractor Overhead and Profit			25%	$ 6,250,000	
Subtotal				$ 31,250,000	
Contingency			50%	$ 15,625,000	
Total Construction Cost				**$ 46,875,000**	
Engineering			25%	$ 11,718,800	
Total Cost				**$ 58,594,000**	

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

Alternative 2 - GBF Disinfection
New 170 mgd UV disinfection facility
OPCC

	Qtny	Units	Rate	Cost	Notes
Demolition					
			$ -	$ -	
Total				**$ -**	
Sitework					
			$ -	$ -	
Total				**$ -**	
Concrete					
			$ -	$ -	
Total				**$ -**	
Mechanical (large diameter piping)					
			$ -	$ -	
Total				**$ -**	
Equipment					
170 MGD UV Facility	1	ls	$ 30,000,000	$ 30,000,000	Includes equipment, concrete,
			$ -	$ -	gates, electrical, mechanical, installation
Total				**$ 30,000,000**	
Subtotal				**$ 30,000,000**	
Contractor Overhead and Profit			25%	$ 7,500,000	
Subtotal				$ 37,500,000	
Contingency			50%	$ 18,750,000	
Total Construction Cost				**$ 56,250,000**	
Engineering			25%	$ 14,062,500	
Total Cost				**$ 70,313,000**	

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

Alternative 1 - DPF Disinfection
UV disinfection facility expansion
OPCC

	Qtny	Units	Rate	Cost	Notes
Demolition					
			$ -	$ -	
Total				**$ -**	
Sitework					
			$ -	$ -	
Total				**$ -**	
Concrete					
Building Expanson	1,225	sf	$ 250	$ 306,000	
Total				**$ 306,000**	
Mechanical (large diameter piping)					
			$ -	$ -	
Total				**$ -**	
Equipment					
UV Equipment	1	ls	$ 580,000	$ 580,000	
Misc Improvements (Weirs, etc.)	1	ls	$ 100,000	$ 100,000	
Install			30%	$ 204,000	
Subtotal				$ 884,000	
Mechanical			20%	$ 176,800	
Electrical & I&C			20%	$ 176,800	
Total				**$ 1,237,600**	
Subtotal				**$ 1,543,600**	
Contractor Overhead and Profit			25%	$ 385,900	
Subtotal				$ 1,929,500	
Contingency			50%	$ 964,800	
Total Construction Cost				**$ 2,894,000**	
Engineering			25%	$ 723,500	
Total Cost				**$ 3,618,000**	

NEW Water
Green Bay Facility and De Pere Facility
Facility Plan

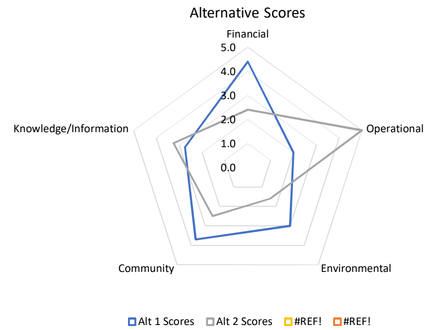
Alternatives 1 and 2 - GBF Thickening
TM 4.2
OPCC

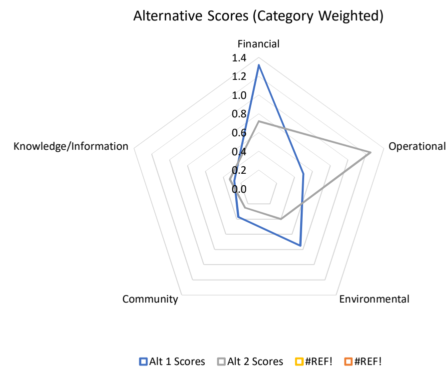
	Qtny	Units	Rate	Cost	Notes
Thickening Improvements	1	ls	$ 5,300,000	$ 5,300,000	
Subtotal				**$ 5,300,000**	Costs from TM 4.2
Contractor Overhead and Profit			25%	$ 1,325,000	
Subtotal				$ 6,625,000	
Contingency			50%	$ 3,312,500	
Total Construction Cost				**$ 9,938,000**	
Engineering			25%	$ 2,484,500	
Total Cost				**$ 12,423,000**	

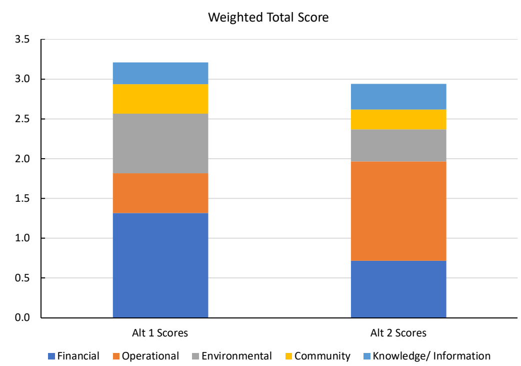
Appendix D

MUA Supporting Details

Category	Category Weights	Criteria	Criteria Weights	Alt 1 Scores	Alt 2 Scores
Financial	30%	Life cycle cost rank (5 - low, 1 - high)	60%	4	2
		Is the cashflow requirement dispersed over time? (5 - phased implementation, 1 - front-end loaded)	40%	5	3
		Criteria weighted sum	100%	4.4	2.4
		Category weighted sum		1.3	0.7
Operational	25%	Human intervention requirements (operation)? (5 - low, 1 - high)	50%	2	5
		Human intervention requirements (maintenance)? (5 - low, 1 - high)	50%	2	5
		Criteria weighted sum	100%	2.0	5.0
		Category weighted sum		0.5	1.3
Environmental	25%	New opportunities for resource recovery (5 - high, 1 - low)	20%	3	3
		Dependency on external resources (chemicals, polymers, additives) (5 - low, 1 - high)	10%	3	3
		Net impact on energy consumption (KWH/yr) (5 - 5 lowest net energy, 1 - highest net energy)	20%	3	1
		Potential impact on nutrient/TSS reduction (pounds/year) (5 - increased removal, 3 - neutral, 1 - increased discharge)	50%	3	1
		Criteria weighted sum	100%	3.0	1.6
		Category weighted sum		0.8	0.4
Community	10%	Relinquished assets (5 - low, 1 - high)	40%	4	1
		Socio-economic community benefits or cost (5 - high community benefit, 1 - high community cost)	30%	3	4
		Socio-economic NEW Water benefits or cost (5 - high NEW Water benefit, 1 - high NEW Water cost)	30%	4	3
		Criteria weighted sum	100%	3.7	2.5
		Category weighted sum		0.4	0.3
Knowledge/ Information	10%	Opportunity for demonstration/pilot testing (5 - high, 1 - low)	25%	4	2
		Opportunity for operational innovation and adaptation (5 - high, 1 - low)	25%	3	3
		Ability to operate in a single single-shift operations paradigm (5 - high, 1 - low)	50%	2	4
		Criteria weighted sum	100%	2.8	3.3
		Category weighted sum		0.3	0.3
Category Sum	**100%**	**Final Score**		**3.2**	**2.9**







Category	Category Weights			Criteria	Criteria Weights	Alt 1 Scores	Alt 2 Scores
	Financial	Baseline	Environmental				
Financial	50%	30%	10%	Life cycle cost rank (5 - low, 1 - high)	60%	4	2
				Is the cashflow requirement dispersed over time? (5 - phased implemei	40%	5	3
				0	0%	0	0
				0	0%	0	0
				0	0%	0	0
				0	0%	0	0
				0	0%	0	0
				Criteria weighted sum	100%	4.4	2.4
				Financial weighted sum		2.2	1.2
				Moderate weighted sum		1.3	0.7
				Environmental weighted sum		0.4	0.2
Operational	30%	25%	20%	Human intervention requirements (operation)? (5 - low, 1 - high)	50%	2	5
				Human intervention requirements (maintenance)? (5 - low, 1 - high)	50%	2	5
				0	0%	0	0
				0	0%	0	0
				0	0%	0	0
				0	0%	0	0
				0	0%	0	0
				Criteria weighted sum	100%	2.0	5.0
				Financial weighted sum		0.6	1.5
				Moderate weighted sum		0.5	1.3
				Environmental weighted sum		0.4	1.0
Environmental	10%	25%	30%	New opportunities for resource recovery (5 - high, 1 - low)	20%	3	3
				Dependency on external resources (chemicals, polymers, additives) (5 -	10%	3	3
				Net impact on energy consumption (KWH/yr) (5 - 5 lowest net energy, :	20%	3	1
				Potential impact on nutrient/TSS reduction (pounds/year) (5 - increase(	50%	3	1
				0	0%	0	0
				Criteria weighted sum	100%	3.0	1.6
				Financial weighted sum		0.3	0.2
				Moderate weighted sum		0.8	0.4
				Environmental weighted sum		0.9	0.5
Community	5%	10%	20%	Relinquished assets (5 - low, 1 - high)	40%	4	1
				Socio-economic community benefits or cost (5 - high community benefi	30%	3	4
				Socio-economic NEW Water benefits or cost (5 - high NEW Water bene	30%	4	3
				0	0	0	0
				0	0	0	0
				0	0	0	0
				0	0	0	0
				Criteria weighted sum	100%	3.7	2.5
				Financial weighted sum		0.2	0.1
				Moderate weighted sum		0.4	0.3
				Environmental weighted sum		0.7	0.5
Knowledge/ Information	5%	10%	20%	Opportunity for demonstration/pilot testing (5 - high, 1 - low)	25%	4	2
				Opportunity for operational innovation and adaptation (5 - high, 1 - lov	25%	3	3
				Ability to operate in a single single-shift operations paradigm (5 - high, :	50%	2	4
				0	0	0	0
				0	0	0	0
				0	0	0	0
				Criteria weighted sum	100%	2.8	3.3
				Financial weighted sum		0.1	0.2
				Moderate weighted sum		0.3	0.3
				Environmental weighted sum		0.6	0.7
Category Sum	**100%**	**100%**	**100%**	**Final Score**		**3.2**	**2.9**
					Low	**-0.2**	**-0.2**
					High	**-0.2**	**-0.1**