Making the Right Choices for Your Utility & Community:

Examples of Multi-Benefit Investment & Community Engagement in Action

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Foreword

Sustainable water infrastructure is vital to every community in the United States. Providing clean and safe water to all people ensures the environmental, social, and economic health of each community. Effective infrastructure planning is essential for water, wastewater, and stormwater systems to manage their operations and to ensure the sustainability of the communities they serve.

Water utilities are faced with the need to make large investments, such as long-term control plans, comprehensive master plans, and major facility upgrades, to promote and support a sustainably managed utility. But how do you plan for this? How do you make the right choices when evaluating large capital projects for your utility, and how do you optimize these choices to benefit the environmental, social, and economic health of your community?

In 2015, the U.S. Environmental Protection Agency (EPA) developed *Making the Right Choices for Your Utility: Using Sustainability Criteria for Water Infrastructure Decision Making,*[1] a planning process called Augmented Alternatives Analysis (AAA). This planning process doesn't replace conventional analysis; the AAA process *augments* it by incorporating the "Triple Bottom Line" approach of environmental, social, and economic criteria. The AAA process can help utilities optimize conventional analysis decision-making in three ways: promoting meaningful community engagement, assisting in quantifying and comparing multi-benefits, and addressing financial constraints of utilities. The AAA process provides utilities with a systematic, transparent process for bringing community stakeholders together and incorporating community goals into utility infrastructure planning and decision-making. These efforts act in support of effective utility management based on the Attributes of Effectively Managed Utilities.[2]

The first pilot project and case example describe the ways in which the Camden County Municipal Utility Authority (CCMUA), together with the U.S. EPA Office of Wastewater Management and representatives from the community-based Camden SMART Initiative, used the AAA approach to help CCMUA identify an optimal and cost-effective mix of green and gray infrastructure to support its Combined Sewer Long-Term Control Plan.

The High Line Canal Conservancy (Conservancy) near Denver, Colorado, works with 11 water jurisdictions and engages them through the Stormwater Transformation and Enhancement Program (STEP) to address stormwater issues and enhance recreational opportunities along the 71-mile-long High Line Canal. The Conservancy's approach is distinct because it is a stakeholder group, using the AAA planning process across 11 different jurisdictions. The Saco, Maine, Water Resource Recovery Department (WRRD) is focusing on long-term planning to improve resilience to extreme weather events, high tides, periods of high precipitation, and storm surges. Saco's WRRD developed a stakeholder group that represents its community and is bringing the stakeholder group through the planning process together.

The lessons learned from these applied experiences are reflected in the newest version of the AAA Guide.[3] Our goal is to provide an actionable set of steps to help utilities engage stakeholders effectively and make investments that capture the full range of potential benefits for their communities.

The AAA process takes commitment and collaboration to consider the full range of benefits of potential infrastructure investments. These case studies demonstrate how organizations in very different contexts applied the AAA process to reach their goals, and we hope you will see how the AAA process can work for you too.

Everybody wins when we all work together.

This product was developed with assistance from Ross Strategic, under contract BPA EP-BPA-18-C-001 with the Office of Wastewater Management at U.S. EPA.

The Augmented Alternatives Analysis case study team was led by Leslie Corcelli, U.S. EPA Office of Wastewater Management, and Michelle Madeley, U.S. EPA Office of Community Revitalization.

Making Future Investment Decisions

All across America, water utilities act as anchor institutions to safeguard public health, protect the environment, and sustain critical water infrastructure investments for their communities. To provide sustainable, cost-effective services, water utilities are regularly faced with the need to make large capital investments to increase levels of treatment, replace aging infrastructure, build major facility upgrades, or transform traditional treatment plants into more cost-effective "water resource recovery facilities" — all while keeping rates affordable for their customers.

These challenges translate into necessary, often costly capital program investments that require public understanding and support. Utilities and water organizations can build public support by effectively engaging their community, understanding community priorities, and demonstrating how those priorities have been incorporated into project decision-making. EPA's Augmented Alternatives Analysis (AAA) capital project decision-making process is a step-by-step, sound, easily explainable, and transparent way to incorporate community values and best meet utility and water organizational needs as they evaluate and select infrastructure investments.

Case Examples

This document describes how two very different organizations applied EPA's AAA process to engage their community, incorporate and evaluate the full range of economic, social, and environmental benefits into their analysis, and identify a cost-effective investment approach that best suited their needs.

The first case example profiles the High Line Canal Conservancy (Conservancy), a non-profit in Colorado that has brought together 11 local jurisdictions to preserve and adapt an existing 71-mile-long canal for enhanced stormwater management in the Denver metropolitan area.

The second case example profiles the Saco Water Resource Recovery Department (WRRD) in Maine, a wastewater utility within a city government organizational structure that is facing the need to make significant investments in infrastructure resilience to address increasingly frequent flooding events.

HIGH LINE CANAL CONSERVANCY

CITY OF Saco friendly by nature

Introduction to the Augmented Alternatives Analysis

How is this process different?

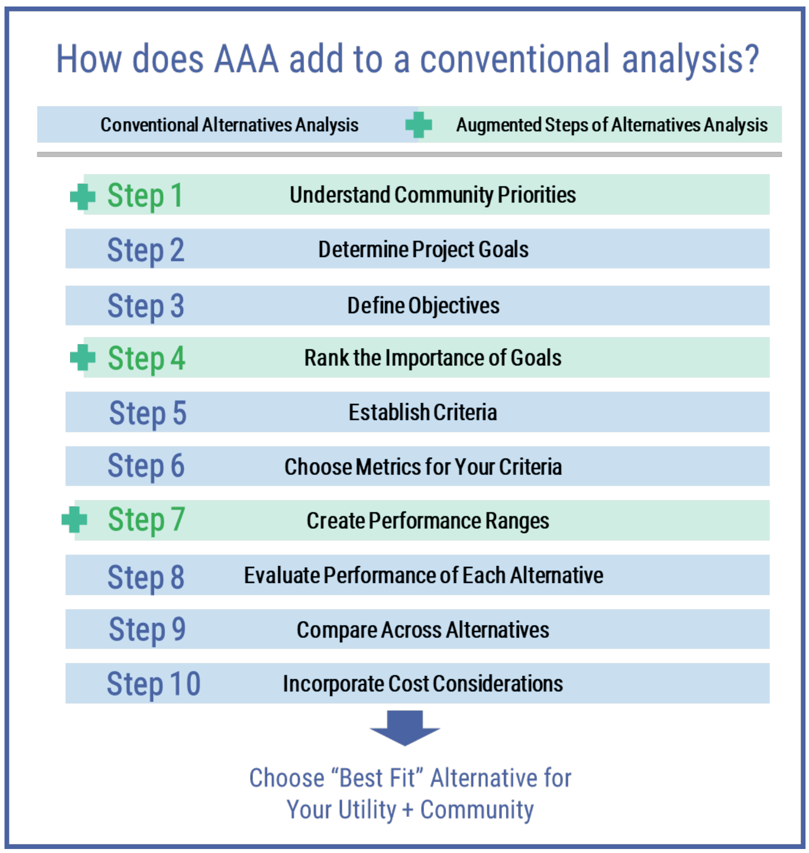
In a conventional alternatives analysis, decision-making criteria are often based on technical performance (e.g., whether the alternative supports meeting a regulatory endpoint such as a technology-based limit or water quality based limit) and the cost of doing so (e.g., the present value of the full life-cycle costs of the alternative), along with other important technical and operational criteria such as reliability, maintainability, and accessibility. In today's challenging and rapidly evolving project decision-making environment, conventional alternatives analyses do not fully encompass the diverse set of challenges facing utilities. There is a growing need for utilities to consider the full range of potential social, environmental, and economic benefits and to meaningfully engage with the community to better understand and reflect its priorities in decision-making.

How does it help you?

EPA's capital project decision-making process, referred to as Augmented Alternatives Analysis (AAA), was originally developed in 2015 to help utilities and their communities address these challenges in modern-day project decision-making, by incorporating community engagement and economic-environmental-social benefits into a "Triple Bottom Line" methodology. As of 2021, the process has been piloted with three organizations and the method has been updated to incorporate lessons learned and address the real needs of decision-makers.

Figure 1 provides an overview of the ways in which this process augments a conventional alternatives analysis and fully describes the ten-step AAA process.

Figure 1: The 10 Steps of the Augmented Alternatives Analysis



The augmented approach benefits your utility by adding to the core tenets of conventional alternatives analysis in three key ways.

Facilitates Meaningful Community Engagement

AAA provides your utility with a structured, effective community engagement process to incorporate input from customers, partners, and other key stakeholders. This engagement helps your utility develop a deeper understanding of the community's long-term priorities and needs that inform future programs and initiatives at your utility. With strategic and consistent engagement, utilities can better align investments with community-identified priorities. The AAA process also helps utilities communicate with members of the public about projects in plain language. **This will result in long-term infrastructure investment decisions that have broad public support.**

Quantifies "Qualitative" Criteria to Compare Multi-Benefits

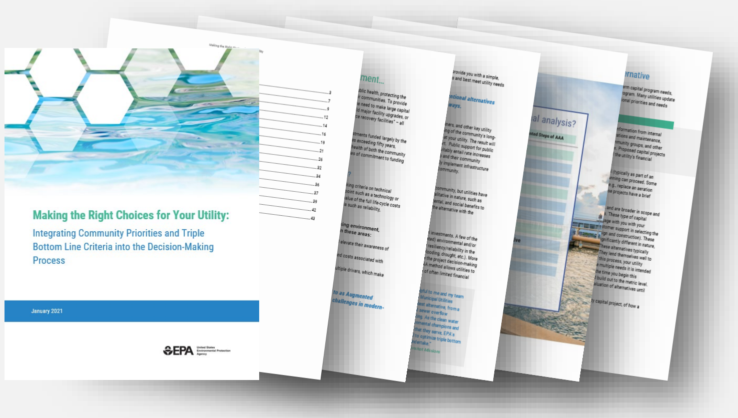
There is growing awareness that investments provide multiple benefits to the community, but utilities may struggle with a process to quantify and incorporate benefits that are more qualitative in nature, such as environmental or social benefits. The AAA process scales economic, environmental, and social benefits to quantify and effectively compare on an "apples to apples" basis. This determines the alternative with the highest benefit to cost ratio. **The AAA process allows for users to compare project alternatives across dissimilar criteria.**

Addresses Financial Constraints of Utilities Through a Staff-Driven, Community-Influenced Prioritization Process

There are many reasons that a utility may need to plan significant capital investments. In other words, these investments often have multiple drivers, which can make project decision-making more complex, with numerous objectives and decision-making criteria. The AAA process allows utilities to prioritize (and weigh) multiple decision-making criteria to ensure the best use of often limited financial resources.

These case studies provide real-world examples of EPA's AAA process. For a more detailed explanation of the process and a step-by-step approach to application of the process, please visit here.[3]

Making the Right Choices for Your Utility: Using Community Priorities and Sustainability Criteria for Water Infrastructure Decision-Making



High Line Canal Conservancy

Denver, CO | 71 Miles of Canal | 11 jurisdictions | 2014: Conservancy was formed

The High Line Canal: A Unique and Valuable Resource

The High Line Canal was completed in 1883 as an agricultural irrigation system to support the growing population of the Denver region. This 71-mile-long canal covers over 850 acres and spans 11 governmental jurisdictions. Though the canal is outliving its original purpose to provide irrigation for the region, it has become a valuable community and ecological resource that provides recreational opportunities for the over 500,000 individuals that use the canal each year. In addition to recreational and environmental benefits, the canal can serve as green stormwater infrastructure, providing stormwater conveyance and treatment. To harness this potential, the multiple government agencies, stormwater managers, and a clean water service provider that span the High Line Canal formed a partnership, collaborating since 2011.Their effort led to the creation of the High Line Canal Conservancy (Conservancy) in 2014. The Conservancy along with its partners developed a collaborative management structure to transition portions of the High Line Canal for stormwater management, called the Stormwater Transformation and Enhancement Program (STEP). STEP's approach is grounded in two seminal studies: the 2014 High Line Canal Feasibility study which found the canal to be technically feasible for stormwater management and the 2018 High Line Canal Stormwater and Operations Master Plan, which recommends stormwater improvements along with an operational model reflective of varied canal conditions.

In 2019, the partners began to implement projects that transformed portions of the High Line Canal into a stormwater management system, conveying stormwater, improving water quality, and supporting flood attenuation in minor storm events. These projects also provide a wide variety of economic, social, and environmental benefits for the region. This transition, however, is challenging because it requires coordinated decision-making, funding, and support across 11 jurisdictions. Each jurisdiction has differing stormwater needs and the current condition of the High Line Canal varies across the region, both in the amount of stormwater currently reaching the canal and in the ecological health of the corridor. The Conservancy searched for an alternatives analysis approach that would incorporate community input and the priorities of the various partners into a decision-making framework that could be applied throughout the High Line Canal as well as locally. This would allow the partners to understand and articulate the multiple benefits of different investment approaches. For these reasons, the Conservancy was excited to work in partnership with EPA to apply the AAA process to evaluate the performance of managing stormwater in the High Line Canal.

The partners began working on the AAA process in May 2020; and over the course of about a year, completed an analysis of their program alternatives, highlighted in detail later in the case study. Through regular meetings and work sessions, the Conservancy solicited and incorporated stakeholder feedback to identify key goals, objectives, criteria, and measurable metrics for comparing the performance of three program alternatives. The partners will use the analysis to guide decision-making and to determine and communicate the benefits of managing stormwater in the High Line Canal with elected officials. These conversations will lead towards a future that more sustainably supports the growing Denver area and its stormwater management needs.

The following provides a description of the Conservancy's and its partners' progression through the AAA steps. More detailed information from this effort is available in Appendices A-D of this document.

STEP 1: Starting the Process: Understanding Community Priorities

Collaboration is at the heart of the Conservancy's leadership approach. Though the Conservancy acts as convenor for transforming the High Line Canal into a stormwater management system, the financing and implementation of the approach is shared with all the partners. As part of STEP, a Technical Leadership Team, composed of representatives from the partners and stormwater experts, meets monthly to advance the High Line Canal's stormwater transformation. This group was involved throughout the AAA process, sharing updates, gathering feedback, adjusting, and gaining consensus. The Conservancy also created a smaller working group from the leadership team to provide dedicated expertise and help refine each step of the analysis.

The Conservancy engages with the community and provides many resources on their website.[4] The Conservancy also provides information on the benefits of the High Line Canal's stormwater transformation as well as helpful resources and informative videos.

Check out the Conservancy's stormwater page here.[5]

The Conservancy actively engages with the communities and key stakeholders from across the region. From 2014-2019, they engaged with more than 5,000 people and hosted over 100 stakeholder meetings during two planning initiatives that led to a comprehensive framework in *The Plan for the High Line Canal.*[6] Before launching EPA's AAA process, the Conservancy wanted to ground any efforts on a foundation of community input. To do this, the Conservancy informed its stakeholder network of its intent to apply the AAA process and evaluate the best investment approach for the Canal. In spring 2020, the Conservancy and EPA hosted a virtual meeting with over 50 community members in attendance in addition to the leadership team. During this meeting, the Conservancy shared an overview of repurposing the Canal for stormwater management and asked attendees for their perspectives on what was most important to prioritize when transforming the Canal. From this discussion, eight community priorities emerged:

- Stormwater Conveyance, Treatment, and Flood Mitigation
- Community Livability
- Increased Public Understanding of Stormwater Management
- Ecological Enhancement
- Advancing One Water[7] Systems
- System Resiliency
- Regulatory Performance
- Stewardship of Public Resources

STEP 2: The Conservancy's Goals for Canal Transformation

After the workshop, the Conservancy surveyed all participants to better understand which community priorities were most important. With this information, the partners incorporated and condensed the list of eight community priorities into four overarching project goals for coordinated investments in the High Line Canal's transition towards green stormwater infrastructure.

The Conservancy's Project Goals for Canal Transformation

Stormwater Management: Conveyance, Treatment, and Flood Mitigation
Reduces the amount of pollutants flowing into natural waterways, provides for alternative conveyance, and mitigates localized flooding through a green infrastructure approach.

Community Livability
Encourages healthy lifestyles and bolsters quality of life.

Public Understanding of Stormwater Management
Raises stakeholder and community awareness of the process and benefits of transforming the Canal for stormwater management.

Ecological Enhancement
Enhances environmental health by building and supporting ecological diversity.

STEP 3: Refining Goals to Objectives

Next, the partners identified "Objectives" for each goal. Objectives consider current resources, conditions, and constraints. Objectives provide greater detail on the specific and measurable outcomes that contribute to achieving the larger goal. For the partners, the goal of "Community Livability" represented a desire to bolster quality of life for nearby residents and users by enhancing the well-loved qualities of this canal. As the partners thought more deeply about what that meant, two types of qualities emerged: immersing users in nature and providing recreational opportunities.

Figure 2: The "Community Livability" goal is further refined to articulate two specific objectives.

Goal: Community Livability

- **Objective:** Enhance recreational use and experience
- **Objective:** Improve environmental conditions

The partners articulated two objectives that spoke to these qualities, as seen in Figure 2, and continued in the same manner to develop objectives for the other three goals.

STEP 4: Ranking the Importance of Goals

Once the partners identified goals and detailed objectives, they had a well-established sense of what the program alternatives would seek to accomplish. Next, the partners worked to balance the sense of importance among the four goals relative to one another. The leadership team ranked the goals taking into consideration the community's input from its public engagement in Step 1 as well as individual partner needs. Through this ranking exercise, the partners determined that "Stormwater Management: Conveyance, Treatment, and Flood Mitigation" was the most important goal and gave it a weight of a 10, on a scale of 1 to 10, with 10 being the highest priority.

The Conservancy and partners then ranked each consecutive goal according to its relative importance to "Stormwater Management: Conveyance, Treatment, and Flood Mitigation." The "Community Livability" goal received a weight of 7, meaning it is 70% as important as "Stormwater Management: Conveyance, Treatment, and Flood Mitigation". The two remaining goals received the same weight of 5. As can often be the case, the partners found there was wide-spread agreement on the first and highest priority goal, while the jurisdictions ranked the other three goals similarly as there was a much smaller difference in the relative importance.

"For me, it was important to perform this analysis to really illustrate the Canal's multiple benefits as green stormwater infrastructure, foster public support for green infrastructure, institutionalize collaboration amongst all partners and communities and enhance the environmental and social conditions along the Canal corridor. Equally important was the opportunity to work with EPA on their innovative analytical tool and see it used and applied by local leaders who are guiding this transformational work."

Cathy McCague, Program Manager at The Conservancy

STEPS 5 & 6: From High-Level Goals to Specific Metrics

The goals established with the partners provided a desired end-state for them to drill down from high-level goals to specific metrics that could be used to measure the performance of each program alternative. To do this, the partners went through an iterative process to present and refine the criteria and metrics.

Below is the full matrix that shows how the partners built out each goal to measurable metrics.

Goals	Objectives	Criteria	Metrics
Goal 1: Stormwater Management: Conveyance, Treatment, and Flood Mitigation Weight: 10	1.1 Improve water quality 1.2 Support flood attenuation 1.3 Provide stormwater conveyance	1.1 Improvement in the post-treatment quality of baseline inflows 1.2 Reduction in peak stormwater flows to natural waterways 1.3 Provides capacity to convey baseline stormwater flows	1.1 Percent increase of volume treated to Mile High Flood District[8] standards 1.2 Change in peak stormwater flows to natural waterways 1.3 Capacity required to convey baseline stormwater inflow
Goal 2: Community Livability Weight: 7	2.1 Enhance recreational use and experience 2.2 Improve environmental conditions	2.1 Increase in use of the Canal corridor 2.2 Improvement in air quality, temperature control and climate resiliency	2.1 Percent change in users over ten years 2.2 Percent change in area of tree canopy cover over ten years
Goal 3: Public Understanding of Stormwater Management Weight: 5	3.1 Advance community understanding of stormwater management 3.2 Promote green infrastructure	3.1 Measurable increase in understanding of stormwater management 3.2 Increase importance of green infrastructure to Canal users	3.1 High, medium, low opportunity to increase awareness and understanding 3.2 Percent increase in prioritization of green infrastructure through annual Canal survey over ten years
Goal 4: Ecological Enhancement Weight: 5	4.1 Maintain/expand connected network of riparian habitat 4.2 Maintain/expand plant diversity 4.3 Support the water cycle	4.1 Preserve/increase riparian habitat 4.2 Preserve/increase native and pollinator plant diversity 4.3 Replenish groundwater	4.1 Percent change in riparian land cover within a 75-feet buffer over 10 years 4.2 Change in number of native and pollinator plant species 4.3 High, medium, low opportunity for groundwater recharge

STEP 7: Building Out Performance Ranges

The Conservancy Goal 2: Community Livability										
Objective 2.2: Improve environmental conditions										
Criteria 2.2: Improvement in air quality, temperature control, and climate resiliency										
Metric 2.2: Percent change in area of tree canopy cover over ten years										
-5	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**
More than 9% decrease in tree canopy cover area over 10 years	7-8% decrease in tree canopy cover area over 10 years	5-6% decrease in tree canopy cover area over 10 years	3-4% decrease in tree canopy cover area over 10 years	1-2% decrease in tree canopy cover area over 10 years	Current canopy coverage in acres	1-2% increase in tree canopy cover area over 10 years	3-4% increase in tree canopy cover area over 10 years	5-6% increase in tree canopy cover area over 10 years	7-8% increase in tree canopy cover area over 10 years	More than 9% increase in tree canopy cover area over 10 years

In a traditional alternatives analysis process, comparing across metrics can be difficult as many metrics will be represented by a different unit of measurement (e.g., stormwater capacity and percent change in tree canopy cover). To holistically evaluate the performance of program alternatives, the partners built out the performance ranges for each metric. These performance ranges created a basis for comparison across metrics and alternative performance by interpreting different units of measurements into a common numerical scale of "-5 to 5." In the example below, the partners created a performance range to measure how each alternative could potentially increase or decrease tree canopy cover along the Canal. First, the partners assigned the current or "baseline" state as a "0" on the scale. This meant that any alternative that had no impact on tree canopy cover would receive zero points. Next, the partners considered the highest or "best case" performance outcome. For the High Line Canal, increasing tree canopy cover by 9% would be the best-case outcome for an alternative. For this reason, any alternative that has the potential to increase tree canopy cover by over 9% would receive a score of "5" in the evaluation. The partners then identified the worst potential performance as equal but opposite to best performance: a decrease in tree canopy cover by 9%. Any alternative that would lead to this negative outcome would receive a score of "-5." Once the upper and lower bounds of the scale were determined, the partners created a range of performance in between and assigned incremental point values. This range provided a basis for evaluating and scoring alternatives created on their potential to increase or decrease a sustainable tree canopy cover along the High Line Canal.

Each metric was built out into a similar performance range to allow comparison across metrics. The full suite of the performance ranges can be found in Appendix A. As the partners developed the performance ranges, they found it helpful to also include proposed measurement methods for each metric to help the partners communicate with a high level of detail on the use and rationale for each metric to decision-makers. These can be found at the end of Appendix A.

STEPS 8-10: The Conservancy's Stormwater Management Alternatives Analysis

After the partners created ranges for each metric, they were ready to evaluate their three program alternatives to determine the performance or "score" of each program alternative against their metrics. There are three program alternatives partners can consider when determining how to manage stormwater inflows reaching the High Line Canal. Based on previous studies, the partners had a general idea of these three potential program alternatives. The AAA process provided a valuable opportunity to detail the specific features, costs, and outcomes of each alternative. This process helped the Conservancy and partners think critically about each alternative's purpose, intent, and functionality across the performance ranges.

Program Alternatives

Alternative 1: Off-Site Treatment (Gray Conveyance, Green Treatment)

- Redirect existing stormwater inflows before they reach the High Line Canal
- Construct conventional gray infrastructure for stormwater conveyance
- Construct off-site green infrastructure for stormwater treatment
- No stormwater project in the High Line Canal

Alternative 2: In-Canal Treatment (Manage Existing Stormwater Inflows)

- Manage stormwater that currently reaches the Canal
- Repurpose the High Line Canal as green infrastructure for stormwater conveyance, treatment, and flood attenuation
- Implement all green stormwater infrastructure recommended in the *High Line Canal Stormwater and Operations Master Plan* [9]

Alternative 3: In-Canal Treatment Plus Landscape Enhancement (Manage Existing Stormwater Inflows while Planting Trees and Shrubs)

- Manage stormwater that currently reaches the High Line Canal
- Repurpose the Canal as green infrastructure for stormwater conveyance, treatment, and flood attenuation
- Implement all green stormwater infrastructure recommended in the High Line Canal Stormwater and Operations Master Plan
- Plant native and/or drought tolerant vegetation including 50 trees per mile and 50 shrubs per mile as directed by *The Plan for the High Line Canal*

Each program alternative represented a different investment approach with relative strengths and weaknesses in their ability to achieve the goals. These strengths and weaknesses of performance were revealed by evaluating each alternative's performance relative to each metric. For example, in Step 8, the partners looked at the "Community Livability" metric related to tree canopy cover and carefully evaluated how each program alternative would score on this scale. If the program alternative provided "More than 9% increase in tree canopy cover area over 10 years," the program alternative would receive a "5" score. If a program alternative provided "More than 9% decrease in tree canopy cover area over 10 years," it would receive a "-5" score.

Alternatives 2 and 3 would result in an increase in a sustainable tree canopy cover area and received higher positive scores.

The partners continued this process for all the metrics. The full suite of unweighted alternative scores can be found in Appendix B.

The Conservancy Goal 2: Community Livability										
Objective 2.2: Improve environmental conditions										
Criteria 2.2: Improvement in air quality, temperature control, and climate resiliency										
Metric 2.2: Percent change in area of tree canopy cover over ten years										
-5	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**
More than 9% decrease in tree canopy cover area over 10 years	7-8% decrease in tree canopy cover area over 10 years	5-6% decrease in tree canopy cover area over 10 years	3-4% decrease in tree canopy cover area over 10 years	1-2% decrease in tree canopy cover area over 10 years	Current canopy coverage in acres	1-2% increase in tree canopy cover area over 10 years	3-4% increase in tree canopy cover area over 10 years	5-6% increase in tree canopy cover area over 10 years	7-8% increase in tree canopy cover area over 10 years	More than 9% increase in tree canopy cover area over 10 years
									Alternative 1	-5
									Alternative 2	3
									Alternative 3	5

After evaluating each metric, the partners had total unweighted scores for each of their program alternatives. That is to say, these scores gave an insight into each alternative's overall performance but did not factor in the sense of relative importance among the goals as determined in Step 4. Alternative 3 had the highest score of 36, then Alternative 2 with a score of 21, and then Alternative 1 with a score of 0. To calculate the weighted score, the partners multiplied each metric by their respective goal weight. After this exercise, Alternative 3 still had the highest score and offered the highest amount of benefits compared to Alternative 2 and 1. The full range of weighted scores can be found in Appendix C.

Next, the partners needed to calculate the annualized costs for each program alternative. They utilized the foundational studies to incorporate the annual project capital, operations, and maintenance costs. All three program alternatives showed similar annualized project capital, operations, and maintenance costs, particularly in Alternatives 1 and 2. While applying costs from the studies, the partners observed that Alternatives 2 and 3 showed early savings. These two alternatives had lower up-front capital costs compared to traditional gray infrastructure which has higher initial costs to convey stormwater away from the High Line Canal and treat it off-site.

However, maintaining green stormwater infrastructure requires increased maintenance compared to off-site facilities. The lower cost of capital improvements compared to the higher cost of ongoing operations and maintenance led to a very similar 50-year life cycle cost between Alternatives 1 and 2. In Alternative 3, the planting of drought-tolerant and/or native vegetation led to an increase of over $4 million in operations and maintenance costs and a higher 50-year life cycle than the other two alternatives.

Once the partners calculated their weighted scores and annualized costs for each program alternative, they were able to calculate the benefit-cost ratio. The benefit-cost ratio represents the cost of each benefit. That is to say, if an alternative provides a high number of benefits, but each benefit costs 3x as much as the next alternative, it will have a low benefit-cost ratio and would not be as desirable. When the benefits of each alternative are factored into the cost evaluation, it is clear that benefit-cost ratio greatly favored Alternatives 2 and 3 and supports the High Line Canal's transformation to green stormwater infrastructure.

	Alt 1 Score	Alt 2 Score	Alt 3 Score
Total Score	**3**	**138**	**225**
Annualized Project Capital and O&M Cost (Millions)	$1.21	$1.18	$1.35
Benefit-Cost Ratio	2.48	117	**167**

Benefits & Take-Away Messages

For the partners, the AAA process provided a transparent, collaborative, and systematic method to evaluate the full range of the High Line Canal's potential benefits as a stormwater management system. The process also encouraged collaboration among all partners and communities to have in-depth conversations about shared goals and the steps to achieve those goals. These conversations allowed for an increase in public understanding and support for green infrastructure.

Throughout the AAA process the partners were able to embed community priorities as the foundation for the decision-making process. They noted their outreach and engagement effort was instrumental to maintain public engagement and better incorporate the community's priorities. This engagement was also important for decision-makers to stay informed of the needs and perspectives within their community. By starting with the end goals in mind, the partners were able to advance a benefits-focused approach instead of a costs-focused approach.

After reflecting on this process, the partners emphasized the importance of ensuring that the metrics measured were the right endpoints. Each metric contributed to the larger story of the High Line Canal as a viable stormwater management system with potential to provide a wide range of benefits to the jurisdictions and their communities. After each leadership team, small group, and internal meeting, the Conservancy found themselves refining their sense of goals, objectives, criteria, and metrics to reflect new information and evolving understandings or incorporating additional perspectives. This iterative process helped the Conservancy ensure that each step in the analysis reflected community needs and would lead to an accurate evaluation of how the potential investments would contribute to the achievement of the goals.

Through consistent participation in the AAA meetings, the partners gained a better understanding of the needs and interests of community members that live, work, and play along the High Line Canal. The partners also recognized the importance of the High Line Canal's existing condition in evaluating its stormwater potential and have prioritized applying this analysis at the jurisdiction-level to reflect the varying conditions of the High Line Canal across the region. This understanding will also keep the partners in tune with the needs, concerns, and priorities of their residents while helping them to identify additional opportunities to collaborate and share information across jurisdictional boundaries to preserve and enhance the High Line Canal.

"The AAA process provided for and required a deeper dive into the goals, comprehensive understanding of the project benefits. This gave the project sponsors a concise message to convey to local jurisdictions and developers looking to use the canal for stormwater benefits."

Alan Leak, Principal at RESPEC Engineering, Member of the Technical Leadership Team and Working Group

Next Steps for the High Line Canal Conservancy

After the partners completed their evaluation and finalized the benefit-cost ratio, they prepared to share these results and the final case study with the broader community in summer 2021. The Conservancy also plans to launch a public outreach campaign comprised of a series of emails, blogs, and social media posts as well as in-person presentations highlighting the AAA process and the multiple benefits of the High Line Canal's transformation to a stormwater management system.

The results of this effort provide the partners with a clear, shared vision of the path forward for the High Line Canal. The partners also have a concrete understanding of the costs and interventions needed to fully capture the numerous benefits and economies of scale possible with a shared regional effort. This shared vision will be used by each jurisdiction to discuss the benefits of the High Line Canal investments unique to their area with decision-makers.

The partners intend to use the evaluation framework created during this process to determine investment decisions on a jurisdiction-by-jurisdiction and reach-by-reach basis across the High Line Canal corridor. These localized analyses will apply the same AAA process but will better reflect the varying conditions of the High Line Canal and needs of local stormwater managers. Given that each reach of the High Line Canal is unique, the AAA framework will create a process to systematically apply these objectives, criteria, and metrics to individual projects and opportunities.

Saco Water Resource Recovery Department

Saco, ME | 4.2 MGD Capacity | Last Major Upgrade in 2010-11 | 46.6” of Rain in 2020

Planning for the Future

Saco Water Resource Recovery Department (WRRD) is a small wastewater utility located on the Saco River in southern Maine and serves almost 12,000 residents and more than 375 businesses. The facility’s riverside location and gravity-dependent wastewater transmission system leave it vulnerable to flooding during high tides, periods of high precipitation, and storm surges. These flooding events cause restricted access to the facility and operational disruptions, threatening WRRD’s ability to operate within regulatory requirements. As these flooding events have become more frequent, WRRD needs to protect their facility’s future. In 2019, WRRD began development of a Long-Term Resiliency Plan (LTRP) to protect the plant from flooding concerns and to establish a plan to address the community’s population growth, the Resource Recovery Facility site constraints, and aging infrastructure. The goal of the LTRP is to ensure that WRRD can provide high quality, reliable sewer services to the City of Saco for the next thirty years.

WRRD has experienced many flooding events and documented the December 2019 flooding event in this video.[10] Howard Carter, WRRD Director, walks through the plant and describes how it impacts normal operations.

The City of Saco has additional[11] videos that highlight WRRD’s importance to the community and its dedicated workforce. Check out Saco’s YouTube site here[12] for more WRRD videos.

Like many other cities and utilities, funding for large infrastructure investments must be balanced with other local funding needs and initiatives. WRRD’s large capital investment would likely be presented to the community at the same time as a significant school funding initiative. Anticipating the communication needs, WRRD leadership recognized that their LTRP provided an excellent opportunity to engage with their community and to ensure they had an accurate understanding of the community’s priorities. This engagement would also elevate the community’s understanding of the role WRRD plays in the economic, environmental, and social health of the community. WRRD hopes this engagement creates broad support for a plan that requires significant financial commitment from the city and its ratepayers. WRRD chose to use the EPA AAA process to gain an accurate understanding of their community’s priorities, and to use it in their “Triple Bottom Line” decision-making process for future infrastructure investments.

WRRD began working on the AAA process in July 2020, and over the course of about a year, completed an analysis of their project alternatives, highlighted in detail later in the case study. Through community stakeholder meetings, WRRD engaged and incorporated community feedback and priorities to identify goals, objectives, criteria, and measurable metrics for comparing the performance of three project alternatives. WRRD plans to present these project alternatives performance and costs to their City Council and anticipates further engagement with their community stakeholders on these results.

The following provides a description of WRRD's progression through the AAA steps. More detailed information from this effort is available in Appendices E-H.

STEP 1: Starting the Process: Understanding Community Priorities

To build community understanding of their investment, WRRD needed an accurate sense of the community's priorities and to directly reflect those priorities in their decision-making process. To achieve this, WRRD and the Saco City Council created a "Coastal Resiliency Committee" (Committee), engaging stakeholders from environmental groups, City Council, commercial and recreational fishing, and consulting firms. All stakeholders are connected to Saco, and many have deep roots in the Saco community, living and working there.

In the fall of 2020, WRRD hosted two virtual meetings with the Committee to share the information about the project as well as to gather the Committee's feedback on community priorities. At the first meeting, WRRD provided an overview of plant operations and flooding challenges they have faced over the past several years. WRRD shared the cost of doing nothing analyzed by the Maine Climate Council as well as the importance of wastewater infrastructure investments to the community's health and long-term growth. Committee members also learned about the AAA process and the way in which it would be used to help quantify such qualitative benefits as "community livability." The second half of this meeting was devoted to a discussion among Committee members about the most pressing priorities for their community. During the second meeting, these community priorities were refined and grouped into priority themes for additional Committee discussion and feedback. From these discussions and feedback, the Committee identified their top five priorities and ranked them from most important to least important:

1. Improve System Resiliency
2. Ensure Financial Sustainability
3. Improve Ecological and Environmental Health
4. Increase Public Awareness and Appreciation of the Value of Water Services
5. Bolster Community Livability

STEP 2: Saco's Long-Term Resiliency Plan Goals

After the Committee meetings, WRRD used the Committee's prioritization, as well as their understanding of the needs at WRRD to build out their project goals. This refinement process incorporated discussions among WRRD and other City staff and included refinements such as the decision to combine "Improve System Resiliency" and "Improve Ecological and Environmental Health" into one goal. From these discussions, WRRD developed four goals that represented the community and utility priorities for the LTRP.

WRRD's Long-Term Resiliency Plan Goals

Improve System Resiliency to Enhance Environmental Health
Ensure water resource recovery facility is resilient to effects of increasing extreme weather events and flooding by planning, maintaining, and operating Saco's water resource recovery infrastructure using sustainable methods that enhance ecological and environmental health.

Ensure Financial Sustainability
Maintain balance of funding needs by making smart investments that consider the long-term health of Saco's water resource recovery infrastructure.

Support Economic and Community Development to Bolster Saco's Livability
Encourage enhanced public access and greenspace use along river frontage near water resource recovery facility and plan for long-term use of the facility to support local community and economic development.

Increase Public Awareness and Appreciation of the Value of Water Services
Communicate the value of Saco's underground assets and water resource recovery facility as it relates to public health, the ecosystem, and community development through collaboration with Saco schools and engagement within the community.

STEP 3: Refining Goals to Objectives

In Step 3, WRRD worked with its technical consultant to define objectives for each goal that were specific and realistic for the utility to achieve. For its "Improve System Resiliency to Enhance Environmental Health" goal, WRRD looked to address three key areas: facility flooding, nitrogen removal requirements, and combined sewer overflows. In Figure 3, WRRD created three objectives that would tackle these key areas and continued developing objectives for the other three goals.

Figure 3: The "Improve System Resiliency to Enhance Environmental Health" goal is separated into three specific objectives

Goal: Improve System Resiliency to Enhance Environmental Health

- **Objective:** Protect facility from the effects of flooding, changing climate, and extreme weather events
- **Objective:** Design and plan for anticipated nitrogen removal requirements
- **Objective:** Reduce combined sewer overflows (CSOs) in system

STEP 4: Ranking the Importance of Goals

Once the goals and objectives were refined, WRRD ranked their four goals using the Committee's priorities as well as staff and consultant rankings. They determined that "Improve System Resiliency to Enhance Environmental Health" was the most important goal for the future of the utility and was given a weight of 10. Each consecutive goal was then ranked according to its relative importance to "Improve System Resiliency to Enhance Environmental Health." So, "Ensure Financial Sustainability" received a weight of 8.8, meaning that goal is 88% as important as "Improve System Resiliency to Enhance Environmental Health." "Support Economic and Community Development to Bolster Saco's Livability" received a weight of 8.6, and "Increase Public Awareness and Appreciation of the Value of Water Services" received a weight of 7. The full list of goals and their weights are listed on the following page.

STEPS 5 & 6: From High-Level Goals to Specific Metrics

After WRRD developed LTRP goals and objectives, they needed a way to test how different project alternatives would compare to one another in relation to their performance toward the goals. Over the course of a few weeks, WRRD advanced their high-level goals to specific metrics that could be used to measure the performance of each project alternative. Developing each metric required WRRD staff to consider the plant's baseline and determine what level of detail would be available to model and measure performance in the analysis.

For "Improve System Resiliency to Enhance Environmental Health," WRRD wanted to protect their facility from the effects of flooding, and one way to measure was examining the elevations of site alternatives. WRRD completed this criteria and metric process for each objective. The full suite of goals, objectives, criterion, and metrics can be found on the following page.

"The AAA evaluation synthesizes goals and objectives in a format that is transparent and easy to understand. The process streamlines communication around investment prioritization, acting as a tool for planning utility decisions."

Emily Cole-Prescott, Industrial Compliance Manager at Saco WRRD

Goals	Objectives	Criteria	Metrics
Goal 1: Improve System Resiliency to Enhance Environmental Health Weight: 10	1.1 Protect facility from the effects of flooding, changing climate and extreme weather events 1.2 Design and plan for anticipated nitrogen removal requirements 1.3 Reduce combined sewer overflows (CSOs) in system	1.1 Reduce potential for future facility flooding and impacts to treatment capacity 1.2 Nitrogen loading of effluent 1.3 Reduction in CSO discharge volume	1.1 Elevations of site alternatives above 100-year flood elevation to be resilient against tidally influenced flooding 1.2 Concentration of nitrogen in effluent of facility 1.3 Percent reduction in average annual CSO volume
Goal 2: Ensure Financial Sustainability Weight: 8.8	2.1 Leverage financing opportunities to ensure efficient and effective water resource recovery facility 2.2 Maximize grant funding opportunities 2.3 Provide design phasing opportunities	2.1 Continue distribution of costs through impact fees, user rates, and capital financing opportunities 2.2 Actively explore and pursue appropriate grant funding opportunities 2.3 Phasing ability of site alternatives	2.1 Retain affordable, annual sewer user rates at 2% or less of median household income 2.2 Percent likelihood of success in obtaining grant and low interest project funding 2.3 Ability to phase upgrade(s) to control financial and scheduling aspects of construction for each site alternative
Goal 3: Support Economic and Community Development to Bolster Saco's Livability Weight: 8.6	3.1 Create an efficient, cost-effective site plan that allows for future growth/additional unit processes 3.2 Design facility to enhance Saco's growth and development opportunities	3.1 Flexible facility land use that accounts for future growth while minimizing adverse impact on existing processes 3.2 Facility can handle additional demands anticipated through 2050	3.1 Percentage of existing site available for expansion to accommodate future growth and regulatory requirements 3.2 Percentage increase in treatment capacity the facility can handle to accommodate growth
Goal 4: Increase Public Awareness and Appreciation of the Value of Water Services Weight: 7.0	4.1 Increase public awareness of the value of water services within community 4.2 Make plant an asset to City and community	4.1 Public outreach through social media, virtual community events, community stakeholder group, and public amenities near the water resource recovery facility that provide educational opportunities about the value of water services 4.2 Incorporate greenspace into final WRRD plan	4.1 Increase in public amenities that offer educational opportunities regarding the value of water services 4.2 Percentage of greenspace acreage around plant, particularly near the Riverwalk

STEP 7: Building Out Performance Ranges

WRRD's suite of metrics provided ways to measure quantitative indicators, such as nitrogen removal, as well as qualitive metrics, such as the likelihood of success in obtaining grant and low interest project funding. Measuring across such dissimilar criteria in a conventional analysis is a challenge, much like trying to compare apples to oranges. However, the AAA process allows for utilities to compare different project alternatives across dissimilar criteria. To holistically evaluate the performance of each project alternative, WRRD built out performance ranges for each metric.

In the example below, WRRD selected "elevations of site alternatives above 100-year flood elevation to be resilient against tidally influenced flooding" as its metric. WRRD selected this metric because flood elevation dictates what infrastructure is at risk of flooding due to a 100-year storm event. If infrastructure is below the 100-year flood elevation, it will be inundated and comprised. Unfortunately, a fair amount of the facility is under the 100-year flood elevation. To improve system resiliency, WRRD is aiming to have all critical structures above this flood elevation to protect critical infrastructure and provide uninterrupted service to its community.

To capture the full range of possibilities, WRRD used a full "-5 to 5" scale. For the "5" score, the ability to protect for an additional five feet above the 100-year flood elevation was the highest performance outcome. WRRD identified that the worst potential performance was the ability to protect zero feet above the 100-year flood elevation and an alternative that did not provide additional elevation would receive a score of "-5." Once the upper and lower bounds of the range were determined, WRRD created a range of performance and assigned one-foot increments. This range provides a basis for evaluation and scoring the project alternatives on their potential to provide additional elevation to be resilient against tidally influenced flooding. The full suite of WRRD's performance ranges can be found in Appendix E.

WRRD Goal 1: Improve System Resiliency to Enhance Environmental Health										
Objective 1.1: Protect facility from the effects of flooding, changing climate and extreme weather events.										
Criteria 1.1: Reduce potential for future facility flooding and impacts to treatment capacity.										
Metric 1.1: Elevations of site alternatives above 100-year flood elevation to be resilient against tidally influenced flooding.										
-5	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**
Ability to protect for 0' above 100-year flood elevation		Ability to protect for 1' above 100-year flood elevation		Ability to protect for 2' above 100-year flood elevation		Ability to protect for additional 3' above 100-year flood elevation		Ability to protect for additional 4' of 100-year flood elevation		Ability to protect for additional 5' of 100-year flood elevation

STEPS 8-10: Long Term Resiliency Plan Alternatives Analysis

Once WRRD created performance ranges for their metrics they were ready to evaluate each of the project alternatives and update the Committee on their current progress. WRRD identified three different potential project alternatives, each with its own strengths and weaknesses. Committee members asked clarifying questions on the alternatives and provided feedback on features they thought were important to include in the alternatives. During the third Committee meeting, WRRD shared their project goals and ranking, overview of the three project alternatives, and provided an early preview of evaluation results.

Project Alternatives

Alternative 1: Wet Weather Resiliency

- Wet weather treatment expanded to 11 million gallons per day (MGD)
- Increase height of access above flood elevations for critical areas
- Relocate critical electrical equipment to protect against flooding
- Install 500,000-gallon CSO tank in former garage location
- Upgrade biosolids equipment

Alternative 2: Wet Weather Resiliency Using Innovative Technology – Aqua NEREDA

- Wet weather treatment expanded to 11 MGD
- Incorporate Aqua NEREDA technology
- Remove older buildings and structures susceptible to flooding and construct newer, more resilient buildings and structures
- Raise the street which provides access to the facility
- Restore land for open green space and potentially accommodate for solar arrays
- Enhance Riverwalk space and public amenities

Alternative 3: Wet Weather Resiliency Using Innovative Technology – Proteus

- Wet weather treatment expanded to 16 MGD
- Incorporate Proteus technology
- Remove older buildings and structures susceptible to flooding and construct newer, more resilient buildings and structures
- Raise the street which provides access to the facility
- Restore land for open green space and potentially accommodate for solar arrays
- Enhance Riverwalk space and public amenities
- Would be first installation of this technology in U.S.

WRRD looked at each project alternative and assigned them a score between "-5 and 5" on how the project alternative would perform against each particular metric. For "Improve System Resiliency to Enhance Environmental Health," each project alternative was evaluated and given a score based on whether the elevation of the site alternative was resilient against tidally influenced flooding. Alternatives 1 and 2 were able to protect an additional three feet above the 100-year flood elevation and both received scores of "1." Alternative 3 would be able to protect an additional five feet above the 100-year flood elevation and received a score of "5." The full evaluation scores can be viewed in Appendix F.

WRRD Goal 1: Improve System Resiliency to Enhance Environmental Health										
Objective 1.1: Protect facility from the effects of flooding, changing climate and extreme weather events.										
Criteria 1.1: Reduce potential for future facility flooding and impacts to treatment capacity.										
Metric 1.1: Elevations of site alternatives above 100-year flood elevation to be resilient against tidally influenced flooding.										
-5	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**
Ability to protect for 0' above 100-year flood elevation		Ability to protect for 1' above 100-year flood elevation		Ability to protect for 2' above 100-year flood elevation		Ability to protect for additional 3' above 100-year flood elevation		Ability to protect for additional 4' of 100-year flood elevation		Ability to protect for additional 5' of 100-year flood elevation
									Alternative 1	1
									Alternative 2	1
									Alternative 3	5

After evaluating each metric, WRRD had a total unweighted score for the three alternatives. Alternative 3 had the highest score of 35, followed by Alternative 2, with a score of 28, then Alternative 1, with a score of 20. While these scores provided insight into the benefits of each alternative, they were unweighted and did not reflect the goal ranking done in Step 4. To calculate the weighted score, WRRD multiplied each metric by their specific goal weight and totaled these new values. Alternative 3 remained at the top with the highest score, followed by Alternatives 2 and 1, respectively. The full range of weighted scores can be viewed in Appendix G.

WRRD examined the three alternatives and calculated the annualized project capital, operation, and maintenance costs. Once WRRD had their weighted scores and annualized costs for each alternative, they were able to calculate the benefit-cost ratio. While Alternatives 1 and 2 had very close ratios, WRRD was drawn toward Alternative 2 because of the treatment flexibility, nutrient removal ability, and the reduced number of processes that would be needed throughout the site. Further research showed that Alternative 2 could also provide land reclamation around the facility.

	Alt 1 Score	Alt 2 Score	Alt 3 Score
Total Score	**184.4**	**251.6**	**309.6**
Annualized Project Capital and O&M Cost (Millions)	2.12	2.87	3.7
Benefit-Cost Ratio	87.0	**87.7**	83.7

After completing the full evaluation and calculating the benefit-cost ratios, WRRD reconvened the Committee to present the full evaluation, answer questions, and describe next steps in spring 2021. WRRD noted that Alternative 2 will be reviewed and further refined for cost savings and innovative treatment research through design development. The Committee appreciated the transparent and engaging process and noted the importance of Alternative 2 for the community's future. They reiterated the need to protect the Saco River, meet future regulatory requirements, and accommodate future smart growth and development.

Benefits & Take-Away Messages

After reflecting on the experience, WRRD noted that the AAA process provided them step-by-step guidance to structure the evaluation within a meaningful, straightforward community-stakeholder framework. Though WRRD staff live in or around Saco and felt aware of community needs, they wanted to ensure decision-making accurately reflected the full range of community priorities. By developing a Committee with a diverse set of stakeholders, WRRD was able to build a broader understanding of the wide range of perspectives and needs within the community. For example, WRRD did not anticipate the support the Committee expressed for alternatives with solar panels. Given this interest, WRRD included solar panels as a type of public amenity evaluated under the "Increase Public Awareness and Appreciation of the Value of Water Services" goal. By ensuring alignment among project goals and community priorities, WRRD created a strong basis to communicate with elected officials and the community on the investments needed to achieve a shared vision. The format of the regular Committee meetings also provided an opportunity to build stronger relationships with community stakeholders.

By starting their process with a conversation of the desired end-state, WRRD and their technical consultants were challenged to create alternatives that provided a wider range of benefits to the community. Often, alternatives analysis processes start with a consideration of the cost and this can limit innovative thinking on potential futures. AAA provided a planning process that properly weighed and considered the needs of multiple groups and community values. WRRD and their technical consultant had dynamic conversations and were able to truly consider each alternative against the "Triple Bottom Line" in a way that did not unfairly weigh economic, social, or environmental benefits over one another. WRRD's internal communication improved through consistent communication and regular coordination meetings. This communication reiterated that it was not one person making the decisions for the facility but a collaborative group effort. The technical consultant noted that these iterative conversations may not have been addressed in other analysis processes.

"The WRRD found this iterative analysis process an asset that allowed them to address issues that may have been overlooked. This leads to an understanding of stakeholder needs, incorporated through a set of performance ranges, that can be fairly and impartially compared across all alternatives to find the optimum solution to fit community needs now and into the future."

Dan Bisson, Vice President at Tighe & Bond, Technical Consultant for Saco WRRD

Next Steps for the Saco Water Resource Recovery Department

Like many utilities across the country, WRRD was faced with the challenge of balancing daily operations alongside the need to consider future facility improvements and large capital investments. These large capital investments represent a substantial financial commitment for a small community. Through the process, WRRD learned about their community's priorities for future utility decisions. With this understanding, the WRRD team was empowered to reflect on how infrastructure investments would achieve those priorities. The community-informed process and regular check-in meetings with the Committee created a shared vision for the future and built trust and communication between the utility and the community.

At the time this case study was written, WRRD anticipates there will be a need to seek approval from the City of Saco for financing appropriation to fund the investments identified in the AAA process. WRRD has also been able to further refine the conceptual plan thereby increasing its community benefit with additional treatment capacity and greenspace. WRRD's investment proposal comes while the City of Saco is considering a significant school funding initiative. For this reason, WRRD wanted to ensure that they truly captured community priorities and communicated the benefits of such a significant investment. WRRD will work with the individuals on the Committee to communicate the benefits of the plan and the rationale for the decisions with elected officials and the public. In addition to the Committee engagement, WRRD plans to further engage the community about the value of wastewater services, through its public outreach video campaign with the City of Saco's Communications Department.

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To date, EPA has worked with three utilities to apply the AAA process. Below is a snapshot of their context:

Camden County Municipal Utility Authority (CCMUA), a large city wastewater entity, worked with the U.S. EPA Office of Wastewater Management (OWM) and representatives from the community-based Camden SMART Initiative, and used AAA to identify an optimal and cost-effective mix of "green" and "grey" infrastructure to supports its Combined Sewer Long-Term Control Plan. Click here[13] to read the full CCMUA case study.

High Line Canal Conservancy worked with OWM and used the AAA process to identify benefits of converting a 71-mile-long canal to a stormwater management system in the Denver metropolitan area. The Conservancy worked with a leadership team of subject matter experts to gain feedback and technical support throughout the AAA process to find a cost-effective solution for its 11 jurisdictions and numerous stakeholders.

Saco Water Resource Recovery Department worked with OWM and members of the Saco Coastal Resiliency Committee to identify an investment package that addressed the technical and operational needs for flood resilience. WRRD incorporated community priorities to determine a cost-effective solution for facility improvement with the greatest utility and community benefit.

Appendix A: The Conservancy's Performance Ranges

The Conservancy Goal 1: Stormwater Management: Conveyance, Treatment, and Flood Mitigation											
Objective 1.1: Improve water quality											
Criteria 1.1: Improvement in the post-treatment quality of baseline inflows											
Metric 1.1: Percent of volume treated to Mile High Flood District (MHFD) standards											
-5	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**	
					No change in volume treated	20% increase of volume treated to MHFD standards	40% increase of volume treated to MHFD standards	60% increase of volume treated to MHFD standards	80% increase of volume treated to MHFD standards	100% increase of volume treated to MHFD standards	
										Alternative 1	5
										Alternative 2	5
										Alternative 3	5

The Conservancy Goal 1: Stormwater Management: Conveyance, Treatment, and Flood Mitigation											
Objective 1.2: Support flood attenuation											
Criteria 1.2: Reduction in peak stormwater flows to natural waterways											
Metric 1.2: Change in peak stormwater flows to natural waterways											
-5	**-4**	**-3**	**-2**	-1	**0**	**1**	**2**	**3**	**4**	**5**	
Substantial increase in peak stormwater flows to natural waterways		Moderate increase in peak stormwater flows to natural waterways		Marginal increase in peak stormwater flows to natural waterways	No change in peak stormwater flows to natural waterways	Marginal decrease in peak stormwater flows to natural waterways		Moderate decrease in peak stormwater flows to natural waterways		Substantial decrease in peak stormwater flows to natural waterways	
										Alternative 1	3
										Alternative 2	1
										Alternative 3	1

The Conservancy Goal 1: Stormwater Management: Conveyance, Treatment, and Flood Mitigation										
Objective 1.3: Provide stormwater conveyance										
Criteria 1.3: Provides capacity to convey baseline stormwater flows										
Metric 1.3: Capacity required to convey baseline stormwater inflow										
-5	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**
High capacity needed to convey baseline inflow		Medium capacity needed to convey baseline inflow		Low capacity needed to convey baseline inflow	Sufficient capacity to convey baseline inflow					
							Alternative 1		-5	
							Alternative 2		-1	
							Alternative 3		-1	

The Conservancy Goal 2: Community Livability										
Objective 2.1: Enhance recreational use and experience										
Criteria 2.1: Increase in use of the Canal corridor										
Metric 2.1: Percent change in users over ten years										
-5	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**
15% decrease change in users over 10 years		10% decrease in number of users over 10 years		5% decrease in number of users over 10 years	Current annual users	5% increase in number of users over 10 years		10% increase in number of users over 10 years		15% increase change in users over 10 years
								Alternative 1		-1
								Alternative 2		1
								Alternative 3		5

The Conservancy Goal 2: Community Livability										
Objective 2.2: Improve environmental conditions										
Criteria 2.2: Improvement in air quality, temperature control, and climate resiliency										
Metric 2.2: Percent change in area of tree canopy cover over ten years										
-5	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**
More than 9% decrease in tree canopy cover area over 10 years	7-8% decrease in tree canopy cover area over 10 years	5-6% decrease in tree canopy cover area over 10 years	3-4% decrease in tree canopy cover area over 10 years	1-2% decrease in tree canopy cover area over 10 years	Current canopy coverage in acres	1-2% increase in tree canopy cover area over 10 years	3-4% increase in tree canopy cover area over 10 years	5-6% increase in tree canopy cover area over 10 years	7-8% increase in tree canopy cover area over 10 years	More than 9% increase in tree canopy cover area over 10 years
									Alternative 1	-5
									Alternative 2	3
									Alternative 3	5

The Conservancy Goal 3: Public Understanding of Stormwater Management

Objective 3.1: Advance community understanding of stormwater management

Criteria 3.1: Measurable increase in understanding of stormwater management

Metric 3.1: High, medium, low opportunity to increase awareness and understanding

-5	-4	-3	-2	-1	0	1	2	3	4	5
					Current awareness and understanding of stormwater management (E.g., educational opportunities, visual amenities)	Low Up to 10% increase in stormwater management awareness and understanding		Medium Up to 15% increase in stormwater management awareness and understanding		High Up to 20% increase in stormwater management awareness and understanding

Alternative 1	1
Alternative 2	5
Alternative 3	5

The Conservancy Goal 3: Public Understanding of Stormwater Management

Objective 3.2: Promote green infrastructure

Criteria 3.2: Increase importance of green infrastructure to Canal users

Metric 3.2: Percent increase in prioritization of green infrastructure through annual Canal survey over ten years

-5	-4	-3	-2	-1	0	1	2	3	4	5
					No change in importance of green infrastructure over 10 years	Up to 4% increase in importance of green infrastructure over 10 years	Up to 8% increase in importance of green infrastructure over 10 years	Up to 12% increase in importance of green infrastructure over 10 years	Up to 16% increase in importance of green infrastructure over 10 years	Up to 20% increase in importance of green infrastructure over 10 years

Alternative 1	5
Alternative 2	3
Alternative 3	5

The Conservancy Goal 4: Ecological Enhancement										
Objective 4.1: Maintain/expand connected network of riparian habitat										
Criteria 4.1: Preserve/increase riparian habitat area										
Metric 4.1: Percent change in riparian habitat within a 75-foot buffer over ten years										
-5	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**
Over 7% decrease in riparian habitat cover area over 10 years		>4-6% decrease in riparian habitat cover area over 10 years		1-4% decrease in riparian habitat cover area over 10 years	No change in riparian habitat cover area	1-4% increase in riparian habitat cover area over 10 years		>4-6% increase in riparian habitat cover area over 10 years		Over 7% increase in riparian habitat cover area over 10 years
									Alternative 1	-3
									Alternative 2	1
									Alternative 3	5

The Conservancy Goal 4: Ecological Enhancement										
Objective 4.2: Maintain/expand plant diversity										
Criteria 4.2: Preserve/increase native and pollinator plant diversity										
Metric 4.2: Change in number of native and pollinator plant species										
-5	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**
High decrease in number of native and pollinator species		Medium decrease in number of native and pollinator species		Low decrease in number of native and pollinator species	No change in number of native and pollinator species	Low increase in number of native and pollinator species		Medium increase in number of native and pollinator species		High increase in number of native and pollinator species
									Alternative 1	-1
									Alternative 2	0
									Alternative 3	3

The Conservancy Goal 4: Ecological Enhancement										
Objective 4.3: Support the water cycle										
Criteria 4.3: Replenish groundwater										
Metric 4.3: High, medium, low opportunity for groundwater recharge										
-5	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**
High opportunity for decrease in groundwater recharge		Medium opportunity for decrease in groundwater recharge		Low opportunity for decrease in groundwater recharge	No change in current opportunity for groundwater recharge	Low opportunity for increase in groundwater recharge		Medium opportunity for increase in groundwater recharge		High opportunity for increase in groundwater recharge
									Alternative 1	1
									Alternative 2	3
									Alternative 3	3

Metric	Proposed Methods
Metric 1.1: Percent of volume treated to Mile High Flood District (MHFD) standards	**Proposed Method:** Include volume from acres drained into the Canal, not whole tributary volume. Water quality improvement occurs with berms installed in the Canal (base assumption).
Metric 1.2: Change in peak stormwater flows to natural waterways	**Proposed Method:** Use best professional judgment to determine if program alternative will increase or decrease in peak stormwater flows to natural waterways. Determine frequency of storm event (e.g., two-year, five-year) to model.
Metric 1.3: Capacity required to convey baseline stormwater inflow	**Proposed Method:** Use best professional judgment to evaluate if additional capacity was required to convey baseline inflows when program alternatives are implemented. Determine frequency of storm event (e.g., 100-year) to model.
Metric 2.1: Percent change in users over ten years	**Proposed Method:** Use Conservancy statistics about current use for baseline, use best professional judgement to estimate change and measure change over time applying both Conservancy and jurisdiction trail count data starting in January 2021.
Metric 2.2: Percent change in area of tree canopy cover over ten years	**Proposed Method:** Use data from tree canopy cover from the “tree canopy” section of the riparian habitat cover data.
Metric 3.1: High, medium, low opportunity to increase awareness and understanding	**Proposed Method:** Use best professional judgment to evaluate if program alternative increases public understanding and considers MS4 permit outreach requirements (visibility/accessibility of infrastructure, quantity and visibility of signage, opportunity for community education)
Metric 3.2: Percent increase in prioritization of green infrastructure through annual Canal survey over ten years	**Proposed Method:** Use best professional judgement to evaluate if program alternative increases prioritization of green infrastructure. Moving forward, the Conservancy’s annual public outreach survey will include questions related to importance of green infrastructure to constituents and its importance relative to other Canal improvements.
Metric 4.1: Percent change in riparian habitat within a 75-foot buffer over ten years	**Proposed Method:** Change in riparian habitat calculated as percent of corridor land cover classified as riparian (prairie grassland, natural groundcover, tree canopy, water), estimated based on best professional judgement and evaluated moving forward. Data will be calculated by reach and then aggregated to develop a Canal-wide number.
Metric 4.2: Change in number of native and pollinator plant species	**Proposed Method:** Select and sample a few key indicator species that can be incorporated into a repeatable methodology for multiple years. Collect native plant/pollinator data from results of the annual BioBlitz canal surveys, estimated based on best professional judgment and evaluated moving forward. DBG soil and vegetation assessments are planned for specific reaches to study plant community response to green stormwater improvements. Data will be calculated by reach and then aggregated to develop a Canal-wide number.
Metric 4.3: High, medium, low opportunity for groundwater recharge	**Proposed Method:** Use best professional judgement to determine if the program alternative will increase or decrease the opportunity for groundwater recharge.

Appendix B: The Conservancy's Unweighted Scores

Unweighted Scores Metric	Alt 1 Score	Alt 2 Score	Alt 3 Score
1.1 Percent increase of volume treated to Mile High Flood District standards	5	5	5
1.2 Change in peak stormwater flows to natural waterways	3	1	1
1.3 Additional capacity required to convey baseline stormwater inflow	-5	-1	-1
2.1 Percent change in annual users over ten years	-1	1	5
2.2 Percent change in area of tree canopy cover over ten years	-5	3	5
3.1 High, medium, low opportunity to increase awareness and understanding	1	5	5
3.2 Percent increase in prioritization of green infrastructure through annual Canal survey	5	3	5
4.1 Percent change in riparian land cover in 75 ft buffer over ten years	-3	1	5
4.2 Percent change in number of native and pollinator plant species	-1	0	3
4.3 High, medium, low opportunity for groundwater recharge	1	3	3
Unweighted Alternative Scores	0	21	36

Appendix C: The Conservancy's Weighted Scores

Weighted Scores Metric	Goal Weight	Alt 1 Score	Alt 2 Score	Alt 3 Score
1.1 Percent increase of volume treated to Mile High Flood District standards	10	50	50	50
1.2 Change in peak stormwater flows to natural waterways	10	30	10	10
1.3 Additional capacity required to convey baseline stormwater inflow	10	-50	-10	-10
2.1 Percent change in annual users over ten years	7	-7	7	35
2.2 Percent change in area of tree canopy cover over ten years	7	-35	21	35
3.1 High, medium, low opportunity to increase awareness and understanding	5	5	25	25
3.2 Percent increase in prioritization of green infrastructure through annual Canal survey	5	25	15	25
4.1 Percent change in riparian land cover in 75 ft buffer over ten years	5	-15	5	25
4.2 Percent change in number of native and pollinator plant species	5	-5	0	15
4.3 High, medium, low opportunity for groundwater recharge	5	5	15	15
Weighted Alternative Scores		3	138	225

Appendix D: The Conservancy's Benefit-Cost Analysis

	Alt 1 Score	Alt 2 Score	Alt 3 Score
Total Score	**3**	**138**	**225**
Annualized Project Capital and O&M Cost (Millions)	$1.21	$1.18	$1.35
Benefit-Cost Ratio	2.48	117	**167**

Appendix E: WRRD's Performance Ranges

WRRD Goal 1: Improve System Resiliency to Enhance Environmental Health										
Objective 1.1: Protect facility from the effects of flooding, changing climate and extreme weather events.										
Criteria 1.1: Reduce potential for future facility flooding and impacts to treatment capacity.										
Metric 1.1: Elevations of site alternatives above 100-year flood elevation to be resilient against tidally influenced flooding.										
-5	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**
Ability to protect for 0' above 100-year flood elevation		Ability to protect for 1' above 100-year flood elevation		Ability to protect for 2' above 100-year flood elevation		Ability to protect for additional 3' above 100-year flood elevation		Ability to protect for additional 4' of 100-year flood elevation		Ability to protect for additional 5' of 100-year flood elevation
									Alternative 1	1
									Alternative 2	1
									Alternative 3	5

WRRD Goal 1: Improve System Resiliency to Enhance Environmental Health										
Objective 1.2: Design and plan for anticipated nitrogen removal requirements.										
Criteria 1.2: Nitrogen loading of effluent.										
Metric 1.2: Concentration of nitrogen in effluent of facility.										
-5	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**
31-35 mg/L of Nitrogen in final effluent		26-30 mg/L of Nitrogen in final effluent		21-25 mg/L of Nitrogen in final effluent	No increase in concentration.	16-20 mg/L of Nitrogen in final effluent.		11-15 mg/L of Nitrogen in final effluent.		10 mg/L and below of Nitrogen in final effluent.
									Alternative 1	3
									Alternative 2	5
									Alternative 3	5

WRRD Goal 1: Improve System Resiliency to Enhance Environmental Health										
Objective 1.3: Reduce combined sewer overflows (CSOs) in system.										
Criteria 1.3: Reduction in CSO discharge volume.										
Metric 1.3: Percent reduction in average annual CSO volume.										
-5	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**
81-100% increase in average annual CSO volume	61-80% increase in average annual CSO volume	41-60% increase in average annual CSO volume	21-40% increase in average annual CSO volume	1-20% increase in average annual CSO volume	No reduction in average annual CSO volume	1-20% reduction in average annual CSO volume	21-40% reduction in average annual CSO volume	41-60% reduction in average annual CSO volume	61-80% reduction in average annual CSO volume	81-100% reduction in average annual CSO volume
									Alternative 1	3
									Alternative 2	5
									Alternative 3	4

WRRD Goal 2: Ensure Financial Sustainability										
Objective 2.1: Leverage financing opportunities to ensure efficient and effective water resource recovery facility.										
Criteria 2.1: Continue distribution of costs through impact fees, user rates, and capital financing opportunities.										
Metric 2.1: Retain affordable, annual sewer user rates at 2% or less of median household income.										
-5	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**
					No likelihood	Low likelihood		Medium likelihood		High likelihood
									Alternative 1	5
									Alternative 2	5
									Alternative 3	3

WRRD Goal 2: Ensure Financial Sustainability										
Objective 2.2: Maximize grant funding opportunities.										
Criteria 2.2: Actively explore and pursue appropriate grant funding opportunities.										
Metric 2.2: Likelihood of success in obtaining grant and low interest project funding.										
-5	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**
					No likelihood	Low likelihood		Medium likelihood		High likelihood
									Alternative 1	3
									Alternative 2	3
									Alternative 3	3

WRRD Goal 2: Ensure Financial Sustainability										
Objective 2.3: Provide design phasing opportunities.										
Criteria 2.3: Phasing ability of site alternatives.										
Metric 2.3: Ability to phase upgrade(s) to control financial and timing aspects of construction for each site alternative.										
-5	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**
					No ability to phase	Low ability to phase		Medium ability to phase		High ability to phase
									Alternative 1	5
									Alternative 2	1
									Alternative 3	1

WRRD Goal 3: Support Economic and Community Development to Bolster Saco's Livability										
Objective 3.1: Create an efficient, cost-effective site plan that allows for future growth/additional unit processes.										
Criteria 3.1: Flexible facility land use that accounts for future growth while minimizing adverse impact on existing processes.										
Metric 3.1: Percentage of existing site available for expansion to accommodate future growth and regulatory requirements.										
-5	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**
11-15% decrease of site availability for future expansion		6-10% decrease of site availability for future expansion		1-5% decrease of site availability for future expansion	No increase in site availability for future expansion.	1-5% increase of site availability for future expansion		6-10% increase of site availability for future expansion		11-15% increase of site availability for future expansion
									Alternative 1	-1
									Alternative 2	1
									Alternative 3	5

WRRD Goal 3: Support Economic and Community Development to Bolster Saco's Livability										
Objective 3.2: Design facility to enhance Saco's growth and development opportunities.										
Criteria 3.2: Facility can handle additional demands anticipated through 2050.										
Metric 3.2: Percentage increase in treatment capacity that the facility can handle to accommodate growth.										
-5	**-4**	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**
					No change to existing treatment capacity	25-40% increase in treatment capacity		40-60% increase in treatment capacity		>60% increase in treatment capacity
									Alternative 1	1
									Alternative 2	3
									Alternative 3	5

WRRD Goal 4: Increase Public Awareness and Appreciation of the Value of Water Services

Objective 4.1: Increase public awareness of the value of water services within community

Criteria 4.1: Public outreach through social media, virtual community events, community stakeholder group, and public amenities near water resource recovery facility that provide educational opportunities about the value of water services

Metric 4.1: Increase in public amenities that offer educational opportunities regarding the value of water services

-5	-4	-3	-2	-1	0	1	2	3	4	5
					No increase in number of amenities	Low increase in number of amenities		Medium increase in number of amenities		High increase in number of amenities

Alternative 1	1
Alternative 2	1
Alternative 3	3

WRRD Goal 4: Increase Public Awareness and Appreciation of the Value of Water Services

Objective 4.2: Make plant an asset to City and community.

Criteria 4.2: Incorporate greenspace into final WRRD plan.

Metric 4.2: Percentage of greenspace acreage around plant, particularly near the Riverwalk.

-5	-4	-3	-2	3	0	1	2	3	4	5
11-15% decrease in greenspace		6-10% decrease in greenspace		1-5% decrease in greenspace	No increase in greenspace	1-5% increase in greenspace		6-10% increase in greenspace		11-15% increase in greenspace

Alternative 1	-1
Alternative 2	3
Alternative 3	3

Appendix F: WRRD's Unweighted Scores

Unweighted Scores Metric	Alt 1 Score	Alt 2 Score	Alt 3 Score
1.1 Elevations of site alternatives above 100-year flood elevation to be resilient against tidally influenced flooding	1	1	3
1.2 Concentration of nitrogen in effluent of facility	3	5	5
1.3 Percent reduction in average annual CSO volume	3	5	4
2.1 Retain affordable, annual sewer rates at 2% or less of median household income	5	5	3
2.2 Percent likelihood of success in obtaining grants and low interest project funding	3	3	3
2.3 Ability to phase upgrade(s) to control financial and timing aspects of construction for each site alternative	5	1	1
3.1 Percentage of existing site available for expansion to accommodate future growth and regulatory requirements	-1	1	5
3.2 Percentage increase in treatment capacity the facility can handle to accommodate growth	1	3	5
4.1 Increase in public amenities that offer educational opportunities regarding the values of water services	1	1	3
4.2 Percentage of greenspace acreage around plant, particularly near the Riverwalk	-1	3	3
Unweighted Alternative Scores	20	28	35

Appendix G: WRRD's Weighted Scores

Weighted Scores Metric	Goal Weight	Alt 1 Score	Alt 2 Score	Alt 3 Score
1.1 Elevations of site alternatives above 100-year flood elevation to be resilient against tidally influenced flooding	10	10	10	30
1.2 Concentration of nitrogen in effluent of facility	10	30	50	50
1.3 Percent reduction in average annual CSO volume	10	30	50	40
2.1 Retain affordable, annual sewer rates at 2% or less of median household income	8.8	44	44	26.4
2.2 Percent likelihood of success in obtaining grants and low interest project funding	8.8	26.4	26.4	26.4
2.3 Ability to phase upgrade(s) to control financial and timing aspects of construction for each site alternative	8.8	44	8.8	8.8
3.1 Percentage of existing site available for expansion to accommodate future growth and regulatory requirements	8.6	-8.6	8.6	43
3.2 Percentage increase in treatment capacity the facility can handle to accommodate growth	8.6	8.6	25.8	43
4.1 Increase in public amenities that offer educational opportunities regarding the values of water services	7.0	7	7	21
4.2 Percentage of greenspace acreage around plant, particularly near the Riverwalk	7.0	-7	21	21
Weighted Alternative Scores		184.4	251.6	309.6

Appendix H: WRRD's Benefit-Cost Analysis

	Alt 1 Score	Alt 2 Score	Alt 3 Score
Total Score	**184.4**	**251.6**	**309.6**
Annualized Project Capital and O&M Cost (Millions)	2.12	2.87	3.7
Benefit-Cost Ratio	87.0	**87.7**	83.7

U.S. Environmental Protection Agency
Office of Wastewater Management
DOC #832R21007
December 2021
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[3] https://www.epa.gov/sustainable-water-infrastructure/making-right-choices-your-utility-using-sustainability-criteria

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