APPENDIX F:

GWLA CIP PRIORITZATION PROJECT SCORING EQUATION TECH MEMO

2023 – 2027

GLWA
Great Lakes Water Authority

1. BACKGROUND

Shortly after its foundation GLWA began to implement a standardized method for prioritizing projects in GLWA's Capital Improvement Plan (CIP). The method was adapted from the City of Los Angeles Sanitation Department (LASan) framework. GLWA evaluated LASan's prioritization method and adjusted the scoring criteria and the weightings to align with GLWA's goals and objectives. This prioritization method was applied to all GLWA CIP Projects, which include water transmission lines, sewer interceptors, storage facilities, pump stations, lift stations, water treatment plants, water resource recovery facilities, and combined sewer overflow facilities.

Eight criteria were chosen to evaluate projects and were assigned weighting factors for the criteria as shown in Table 1-1. Each criterion is scored on a scale of 1-5 based on detailed guidelines established by GLWA for each criterion. A score of 1 indicates minimal value or benefit whereas a score of 5 indicates high value or benefit. See Appendix A for an outline of the guidelines.

Table 1-1 Criteria

No.	Criteria	Description	Weighting	Score
1	Condition	Physical Condition as an indicator of probability of failure	12%	1-5
2	Performance (Service Level/Responsibility)	Ability to meet operational requirements	15%	1-5
3	Regulatory (Environmental/Legal)	Evaluates consequence of non-compliance	18%	1-5
4	Operations and Maintenance	Evaluates impacts to overall O&M	11%	1-5
5	Public Health and Safety	Evaluates impacts to staff safety	17%	1-5
6	Public Benefit	Evaluates benefits to the public of completing the project	8%	1-5
7	Financial	Evaluates financial benefits of implementing the project	10%	1-5
8	Efficiency and Innovation	Evaluates impacts of utilizing existing assets vs constructing new	9%	1-5

Modifier points were included in the framework as a means of evaluating extenuating circumstances surrounding a project. If a project received a score of 5 in any criteria category, the project was eligible for receiving 0 to 50 modifier points. However, GLWA did not adopt this part of the original LASAN framework.

The project score was calculated using the following formula.

$$Calculated\ Score = \sum\left(\frac{Criteria\ Score}{5} * Criteria\ Weight\ Percent * 100\right) + Modifier\ Points$$

Each project was scored by a Project Manager (PM) using the scoring guidelines based on their expertise and understanding of the project. All projects were scored with the exception of programs and program-initiated projects. The projects were also scored by a Water or Wastewater Review Committee

typically comprised of a core group of members from leadership, the business unit associated with the water or wastewater service area, and a member from one of GLWA's customer communities. The Review Committee reviewed the PM scores and re-scored the projects, which generated the final project scores used for prioritization of the CIP.

2. REVIEW

In 2021 an effort to optimize the scoring process and further improve project prioritization was initiated by AECOM at GLWA's request. The goal was to evaluate GLWA's method for prioritizing projects, determine if the intent was being met, and recommend appropriate revisions that would improve the prioritization of projects to better align project scoring with the purpose and need of the projects. AECOM reviewed the methodology, received feedback from GLWA staff, evaluated previous project scores, tested the scoring equation, compared the prioritization method to other utilities, and developed recommendations to address identified limitations.

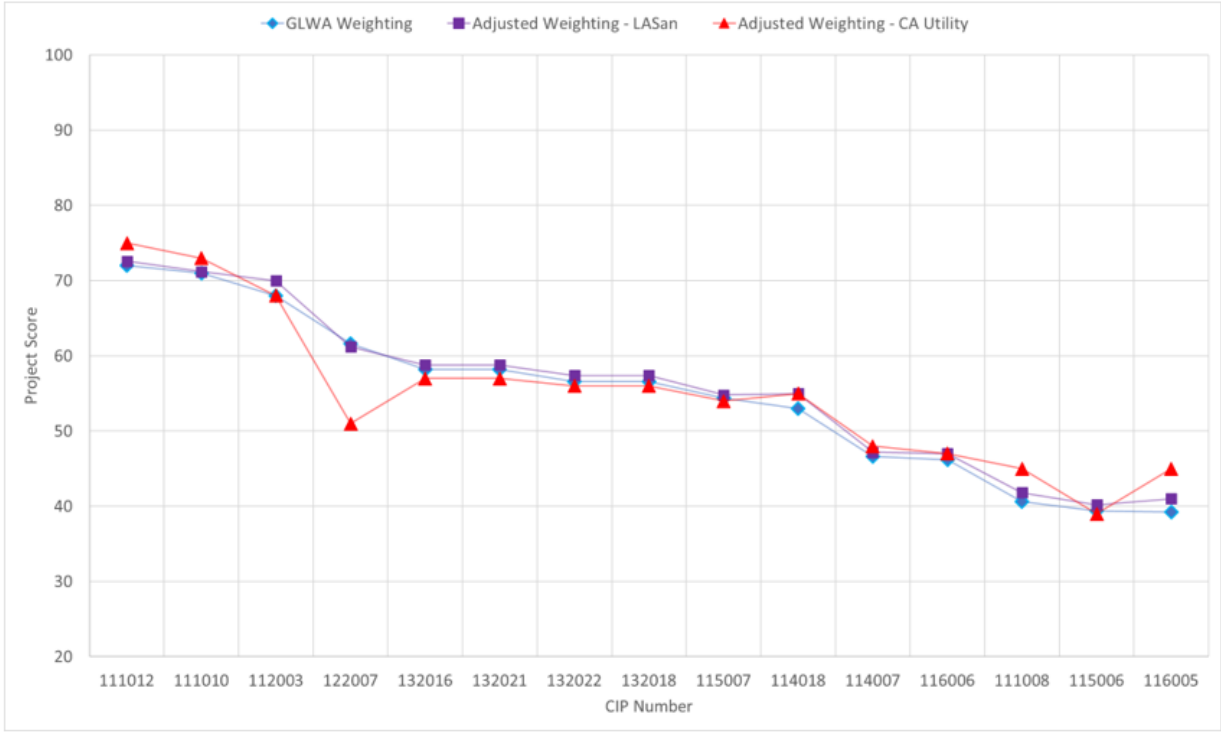
The feedback provided from GLWA regarding the project scoring indicated that there were projects with a significant need as shown with criteria scores of 4 or 5 that would not receive a high overall project score. An example is CIP #111011 shown in Table 2-1. This project has two criteria with scores of 5 and the overall project score is below the median (60 points).

Table 2-1: CIP 111011 Scores

CIP NO.	Condition	Performance (Service Level/ Reliability)	Regulatory (Environmental/ Legal)	O&M	Health & Safety	Public Benefit	Financial	Efficiency & Innovation	Risk Committee Score
111011	5	5	2	1	1	3	1	3	52

To understand if adjusting the criteria weightings would change the overall project scores, 15 projects with a range of scores were selected for testing. The criteria weightings were adjusted to mirror the distribution of weightings of LASan and another California utility. The testing results indicate that the project scores and prioritization results didn't significantly change with adjustments to the weightings as shown in Figure 2-1.

Figure 2-1: Criteria Weighting Comparison



Description	Condition	Performance (Service Level/ Reliability)	Regulatory (Env/ Legal)	O&M	Public Health & Safety	Public Benefit	Financial	Efficiency & Innovation
GLWA Current Weightings	12%	15%	18%	11%	17%	8%	10%	9%
LASan Adjusted Weightings	16%	15%	15%	12%	16%	7%	11%	8%
CA Utility Adjusted Weightings	20%	10%	25%	5%	20%	5%	10%	5%

Thirty-nine GLWA water projects were evaluated to understand how the overall project scores were distributed. As shown in Table 2-2, over half of the projects were below the median. There were only 2 projects with scores greater than 80. Approximately 85% of the projects fall within the 40-point range (40 – 80) around the median.

Table 2-2: GLWA Water Project Scoring Summary

Scoring Range	# of Projects
20 - 40	4
40 - 60	18
60 - 80	15
80 - 100	2

To better understand why the equation produced the observed scoring distribution, hypothetical project scores were developed. Table 2-3 shows that there is an 80-point scoring range of 20 to 100, with the median being 60 points. For a project to get a score in the top 25th percentile, it would need to have most if not all criteria scores be 4s or 5s, which would be rare. To the extent possible, GLWA would be proactive and complete critical projects before they get all 4s or 5s. Most projects would fall within the 40-point range (40 – 80) around the median.

Table 2-3: Example Projects – Range of Scores

Example Project Number	Condition	Performance (Service Level / Reliability)	Regulatory (Environmental / Legal)	O&M	Public Health & Safety	Public Benefit	Financial	Efficiency & Innovation	RC CALC
	12%	15%	18%	11%	17%	8%	10%	9%	
1	5	5	5	5	5	5	5	5	**100**
2	5	4	5	4	5	4	5	4	**91.4**
3	4	4	4	4	4	4	4	4	**80**
4	3	4	3	4	3	4	3	4	**68.6**
5	3	3	3	3	3	3	3	3	**60**
6	2	3	2	3	2	3	2	3	**48.6**
7	2	2	2	2	2	2	2	2	**40**
8	1	2	1	2	1	2	1	2	**28.6**
9	1	1	1	1	1	1	1	1	**20**

Example projects were also generated to understand how projects with a single high criteria score would compare. The example projects are shown in Table 2-4. All of these projects would fall within the bottom 25th percentile, indicating low importance.

Table 2-4: Example Projects – One High Criteria Score

Example Project Number	Condition	Performance (Service Level/ Reliability)	Regulatory (Environmental/ Legal)	O&M	Public Health & Safety	Public Benefit	Financial	Efficiency & Innovation	RC CALC
	12%	15%	18%	11%	17%	8%	10%	9%	
1	5	1	1	1	1	1	1	1	**29.6**
2	1	5	1	1	1	1	1	1	**32**
3	1	1	5	1	1	1	1	1	**34.4**
4	1	1	1	5	1	1	1	1	**28.8**
5	1	1	1	1	5	1	1	1	**33.6**
6	1	1	1	1	1	5	1	1	**26.4**
7	1	1	1	1	1	1	5	1	**28**
8	1	1	1	1	1	1	1	5	**27.2**

Table 2-5 compares Project #3 from Table 2-4 to Project #7 from Table 2-3. Project #3 represents a required project with a regulatory driver. This project would score lower than a project with all 2s, which doesn't have a strong purpose or need. This intuitively indicates that the intent of the CIP prioritization is not being met with the current scoring methodology in certain instances. The methodology could be further improved with more management and oversite to accurately prioritize projects.

Table 2-5: Example Projects – One High Criteria Score

Example Project Number	Condition	Performance (Service Level/ Reliability)	Regulatory (Environmental/ Legal)	O&M	Public Health & Safety	Public Benefit	Financial	Efficiency & Innovation	RC CALC
	12%	15%	18%	11%	17%	8%	10%	9%	
3	1	1	5	1	1	1	1	1	34.4
7	2	2	2	2	2	2	2	2	40

The conclusions from the scoring methodology evaluation indicated that the original equation did not necessarily produce results that were consistent with the values and goals of GLWA. This observation is in alignment with the feedback received from GLWA teams. Changing the criteria weights will not significantly change the prioritization outcomes. AECOM recommended that the equation be modified to better align the project scores with GLWA goals and objectives.

3. DEVELOPMENT OF THE NEW EQUATION

Overall, the GLWA CIP prioritization method including the criteria, weightings, scoring scale, and scoring guidance provides a solid foundation that works well and GLWA CIP delivery teams are familiar with. The recommendation is to make modifications to the current equation while maintaining the current scoring process.

CRITERIA WEIGHTS

Water and wastewater projects will continue to be scored based on the eight criteria shown in Table 3-1. For each project, criteria scores of 1 to 5 have been assigned, with a score of 1 representing minimal value or benefit, and 5 representing high value or benefit based on established definitions and scoring guidelines for each criterion.

Weights for the eight criteria in Table 3-1 have been previously established based on GLWA ranking of the relative importance of each criterion to GLWA's overall priorities. Two of the criteria weightings in Table 3-1 were revised this year to better reflect GLWA's overall priorities. The Health and Safety weighting was increased from 17% to 18% and the Efficiency & Innovation weighting was decreased from 9% to 8%.

Table 3-1: Updated Project Criteria

No.	Weight	Criteria
1	12%	Condition
2	15%	Performance (Service Level/Reliability)
3	18%	Regulatory (Environmental/Legal)
4	11%	O&M
5	18%	Health & Safety
6	8%	Public Benefit
7	10%	Financial
8	8%	Efficiency & Innovation

RELATIVE IMPORTANCE OF PROJECT CRITERIA

The weightings multiplied by the criteria scores identify which factors should be the most important drivers for a Project. Table 3-2 is a heat map showing level of importance of the criteria using the existing GLWA equation. The darker the cells the higher the level of importance. A score of 5 for either Health & Safety or Regulatory criteria represents the greatest purpose and benefit to GLWA based on the established criteria weighting. Considering that these are the most important criteria, it is recommended that any project with a score of 5 in Regulatory or Health & Safety should receive a high overall project score (this does not happen with existing equation as described in Section 2).

Table 3-2: Project Criteria Importance

Score	Regulatory (Environmental/ Legal)	Health & Safety	Performance (Service Level/ Reliability)	Condition	O&M	Financial	Efficiency & Innovation	Public Benefit
	18%	18%	15%	12%	11%	10%	8%	8%
5	18.0	18.0	15.0	12.0	11.0	10.0	8.0	8.0
4	14.4	14.4	12.0	9.6	8.8	8.0	6.4	6.4
3	10.8	10.8	9.0	7.2	6.6	6.0	4.8	4.8
2	7.2	7.2	6.0	4.8	4.4	4.0	3.2	3.2
1	3.6	3.6	3.0	2.4	2.2	2.0	1.6	1.6

Notes:
1. Scores are calculated based on the GLWA equation (criterion score/5*criterion weight*100)

A new equation was developed to automatically factor in the highest purpose and benefit of each project while still considering the overall benefit of each project as follows:

SINGLE HIGHEST PURPOSE AND BENEFIT

The single highest purpose and benefit of each project represents the single criteria that provides the greatest relative importance to GLWA. Based on the results in Table 3-2, a score of 5 for either Health & Safety or Regulatory criteria represents the greatest purpose and benefit to GLWA. This consideration functions as the primary driver of the overall project score and can be expressed as follows:

$$= max\left(\left[\left(\frac{Criterion_1\ Score}{5}\right) * \left(\frac{Criterion_1\ Weight}{18\%}\right)\right], \left[\left(\frac{Criterion_2\ Score}{5}\right) * \left(\frac{Criterion_2\ Weight}{18\%}\right)\right], \dots\right)$$

OVERALL BENEFIT

The overall benefit of each project accounts for all the benefits provided by the project and is represented by current GLWA equation. The overall benefit functions as the secondary driver of the overall project score and can be expressed as follows:

$$= \sum\left(\frac{Criterion\ Score}{5} * Criterion\ Weight\right)$$

SENSITIVITY ANALYSIS

A sensitivity analysis was conducted to determine the importance of the single highest purpose and benefit (Factor 1) compared to the overall benefit (Factor 2). The range of possibilities could include Factor 1 representing some fraction of the Factor 2 importance as a lower bound or Factor 1 could represent an exponential level of importance compared to Factor 2 as an upper bound. Both factors were initially given an equal, 50/50, weighting making them equally important. This equal weighting was then varied over multiple iterations between the lower and upper bound. Hypothetical project criteria scoring was used to calculate project scores using the different iterations of the Factor 1 and Factor 2 relative importance. Resulting project scores from the iterations were then compared against GLWA's goals and objectives.

Based on observation and judgement, a roughly70/30 split of Factor 1/Factor2 produced results that were fairly consistent and aligned with GLWA's values and goals. This split also falls somewhere in the middle of the range of lower and upper bound possibilities on a logarithmic scale considering the exponential nature of the upper bound and appears to provide a reasonable balance between the factors. This approach provides a good balance between the new Factor 1 while retaining value from Factor 2 that has been historically used to inform project scoring and CIP prioritization.

FINAL EQUATION

The final prioritization equation that resulted can be expressed is as follows:

$$= \left\{70 * max\left(\left[\left(\frac{Criterion_1\ Score}{5}\right) * \left(\frac{Criterion_1\ Weight}{18\%}\right)\right], \left[\left(\frac{Criterion_2\ Score}{5}\right) * \left(\frac{Criterion_2\ Weight}{18\%}\right)\right], \ldots\right)\right\} + \left\{30 * \sum\left(\frac{Criterion\ Score}{5} * Criterion\ Weight\right)\right\}$$

4. TESTING OF THE NEW EQUATION

The effectiveness of the new equation was tested by applying the equation to 2021 CIP projects and observing how the project scores and subsequent prioritization changed. The results were also provided to the GLWA team for feedback on the results.

Table 4-1 shows criteria scores, original equation project scores, and new equation project scores for 39 Water CIP projects. The projects in the table are sorted by the new project score from highest to lowest. The criteria scores are color coded with a red to green gradient to visually show the difference in criteria scores. Red represents a criterion score of 5 and dark green represents a criterion score of 1.

The table shows that the new equation prioritizes the projects with criteria scores of 5 as shown with the red cells. The projects with scores of 5 for the highest weighted criteria, Regulatory and/or Health & Safety, are at the top of the prioritization followed by projects with scores of 5 for Performance and/or Condition. This observation shows that the projects are prioritized based on a single highest purpose and benefit.

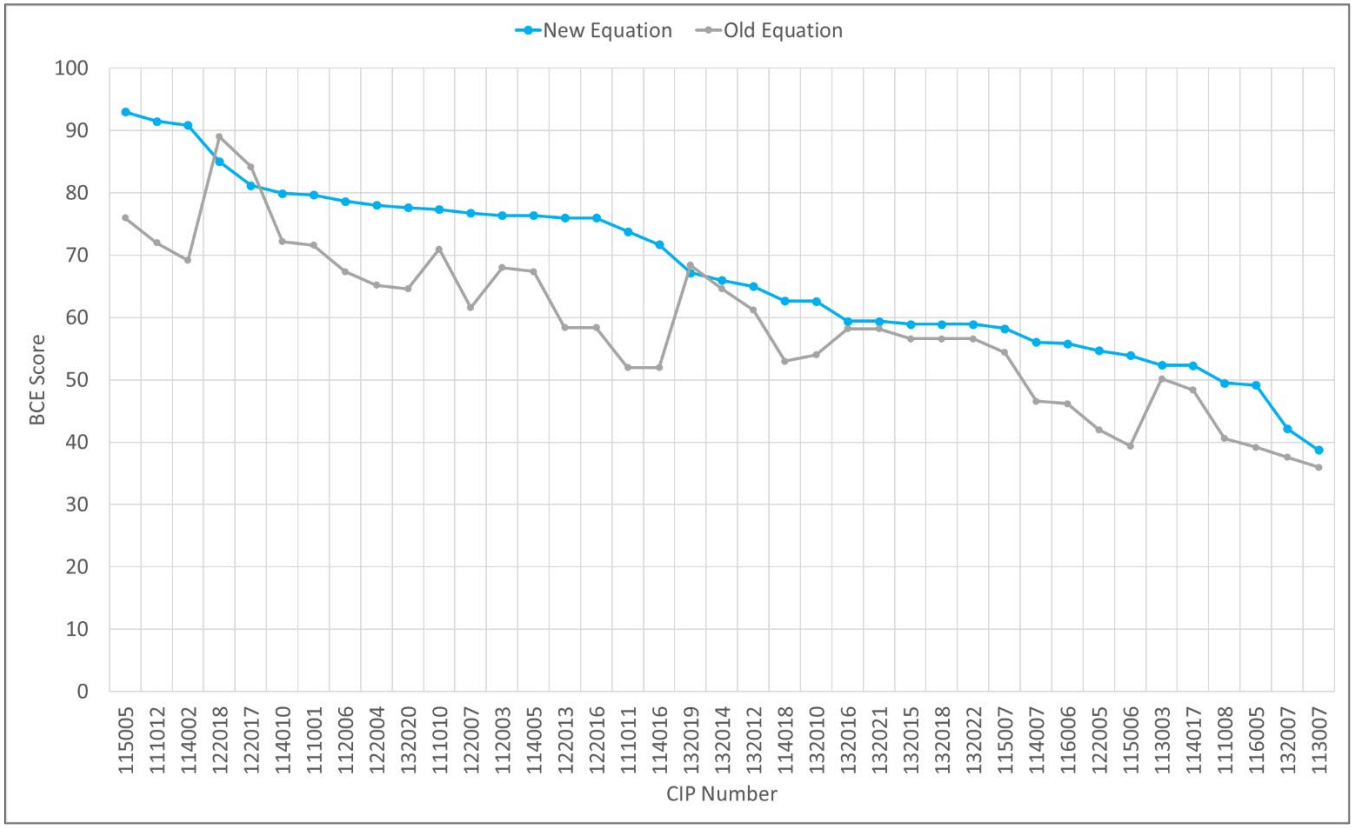
Table 4-1: 2020 Water CIP Comparison of Old and New Equation Scores

CIP NO.	Regulatory (Environmental/ Legal)	Health & Safety	Performance (Service Level/ Reliability)	Condition	O&M	Financial	Efficiency & Innovation	Public Benefit	Old Equation	New Equation
115005	5	5	5	3	2	3	2	3	76.6	93.0
111012	5	2	4	5	4	2	4	2	71.6	91.5
114002	1	5	5	5	5	1	3	2	69.6	90.9
122018	4	4	5	5	4	5	4	5	89.0	85.0
122017	4	4	4	5	4	4	5	4	84.0	81.2
114010	2	3	5	5	3	3	4	5	72.0	79.9
111001	1	2	5	5	5	4	4	5	71.2	79.7
112006	3	3	5	5	4	2	1	3	67.8	78.7
122004	2	4	5	2	5	1	2	5	65.6	78.0
132020	2	3	5	4	3	2	4	3	64.4	77.7
111010	4	4	4	4	4	2	3	2	71.2	77.4
122007	1	3	5	1	4	4	4	4	61.4	76.8
112003	2	4	4	5	4	2	4	2	68.0	76.4
114005	4	4	4	4	4	2	1	2	68.0	76.4
122013	2	4	5	1	3	1	2	5	58.8	76.0
122016	2	4	5	1	3	1	2	5	58.8	76.0
111011	2	1	5	5	1	1	3	3	51.6	73.8
114016	1	4	3	5	3	1	2	1	52.4	71.7
132019	2	3	4	5	4	4	3	3	68.4	67.2
132014	2	3	3	5	3	3	4	4	64.4	66.0
132012	1	3	4	5	4	3	3	2	61.2	65.0
114018	2	3	4	4	3	2	1	1	53.4	62.7
132010	1	1	4	3	4	1	5	5	53.2	62.6
132016	2	3	3	4	3	1	4	4	58.0	59.4
132021	2	3	3	4	3	1	4	4	58.0	59.4
132015	2	3	3	4	3	1	4	3	56.4	58.9
132018	2	3	3	4	3	1	4	3	56.4	58.9
132022	2	3	3	4	3	1	4	3	56.4	58.9
115007	2	3	3	3	2	3	4	2	54.2	58.3
114007	3	2	2	3	4	1	1	2	46.8	56.0
116006	3	1	3	3	3	2	2	1	46.0	55.8
122005	1	3	3	3	3	1	1	1	42.4	54.7
115006	1	3	3	2	2	2	1	1	39.8	53.9
113003	2	2	3	4	4	1	2	2	50.2	52.0
114017	2	2	3	4	3	2	2	2	50.0	52.3
111008	2	2	2	4	1	1	2	2	40.6	49.5
116005	2	2	2	4	1	2	1	1	39.4	49.2
132007	1	1	1	1	3	4	5	1	36.8	42.2
113007	1	1	2	3	3	2	2	1	35.8	39.0

Figure 4-1 shows the difference in project scores with the new and old equation. The prioritization for some projects will change considerably. For example, the project score for project 111011 changes from 51.6 to 73.8.

The range of project scores is similar, however the spread of projects over that range will change with the new equation. For example, with the old equation, there were only 7 projects with scores greater than 70. With the new equation there are 18 projects with scores greater than 70.

Figure 4-1 2020 Water CIP Comparison of Old and New Equation Scores



Comparison of the new and old project scores was provided to GLWA CIP delivery teams and the program management team members to get feedback on whether or not the new project scores better reflected the importance of the projects and if the new prioritization intuitively made sense. The feedback was positive and indicated that the new equation does improve the project prioritization by factoring in the highest benefit and value of each project.

5. CONCLUSIONS AND NEXT STEPS

The development of the new equation is a good evolution of the CIP prioritization method. The new equation factors in the highest purpose and benefit of the project, which creates prioritization results that better align with GLWA's goals and objectives as identified in the criteria weightings. Although this equation improves the prioritization process, there is always opportunity in the future to further review and improve since there isn't a perfect method or equation that will capture all of the nuances of a complex system.

Additional CIP prioritization improvements GLWA is evaluating include the development of tiers based on the project scores, prioritization of projects by project type, and prioritization of related projects (e.g., predecessor, successor) together. The development of tiers could further define the level of importance of the projects and help identify which projects are high priority (required), medium priority (best practice) and a lower priority (recommended but not required). Prioritizing projects by project type would allow GLWA to compare and prioritize projects within each discipline (e.g., comparing water treatment projects to one another). Identifying the predecessor and successor relationships among projects would allow the inter-dependent projects to be prioritized together.

It is recommended that GLWA continues to periodically review its CIP prioritization method and make improvements as needed.