TAYLOR ENGINEERING, INC.

Task 2.1 Technical Memorandum: Develop Mitigation Efficiency Criteria, Mitigation Projects for Modeling, and Project Plan (Revised)

C-8 and C-9 Watersheds Flood Protection Level of Service Adaptation Planning and Mitigation Projects Study

Deliverable 2.1

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Work Order 05

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1 INTRODUCTION

The South Florida Water Management District (SFWMD or District) is conducting a system-wide review of the regional water management infrastructure to determine what mitigation projects would maintain or improve the current flood protection level of service (FPLOS). The FPLOS Phase 1 Study describes the level of protection provided by the water management facilities within a watershed considering sea level rise (SLR), future development, and known water management issues in each watershed.

This memorandum details the development of mitigation efficiency criteria, mitigation projects suitable for modeling, and a draft modeling plan for the adaptation planning and mitigation project study within the SFWMD C8 and C9 basins. Specifically, this memorandum details the criteria used to filter through the project list developed in Task 1 (combination of anticipated impacts and project scale), the list of mitigation projects suitable for modeling, and the preliminary approach proposed to determine what suite of projects the team will apply in the final mitigation scenario models.

Task 1 Summary Memorandum (Desktop Review, Website Project Viewer, and Partner Workshop on the Adaptation Planning and Mitigation Projects) details the complete list of projects identified for flood mitigation in the basins.

2 MITIGATION EFFICIENCY CRITERIA

This project compiled 92 proposed mitigation projects from previous work efforts (Phase 1) and partner communities. These proposed projects ranged from fixing damaged culverts to improving local street drainage to adding forward pump stations and floodwalls at the tidal outfalls. However small or large, each project can, and likely will, have a beneficial impact on the local area it serves in real-world events. However, simulating these projects in the hydrologic and hydraulics model of the C8 and C9 basins, several factors such as model scale and design assumptions (i.e., rainfall distribution) can cause what would realistically be a beneficial project to show an underestimation of benefits, if any. Therefore, to assess such a diverse set of projects and project scales, the team developed a scoring to help generate a better understanding of what the anticipated real-world benefits are likely for each project. The scoring process assigned each project a score of 1 to 5 for each category, with 1 being not likely and 5 being very likely, for each of the following categories:

- *Allows operation flexibility* – flood control managers need operational flexibility to accommodate the dynamic and complex nature of real-world flood events.
- *Prevents "high water" from backflowing in* – a system that can provide mitigation against the influx of tidal surge during a tropical storm event is highly advantageous.
- *Increases discharge ability* – some mitigation activities can promote the ability of a system to increase discharges through canals or hydraulic structures.
- *Can alleviate primary system flooding* – the primary system being major canals such as the C8 or C9.
- *Can alleviate secondary system flooding* – the secondary systems being canals such as the Carol City Canal or Red Road Canal
- *Can alleviate tertiary system flooding* – the tertiary systems being stormwater systems such as Pembroke Pines, the large ponds and drainage areas of Miramar, or Miami Lakes.

In addition to these categories, the team wanted to point out the value of water quality and how well developed the project is. For water quality, a simple scale evaluating a neutral impact or positive impact. And for project development, the team thought capturing some level of how well conceived a project is would help the team know the likelihood of its progress and what to expect for design details. It is important to note that these scores are not used to determine what projects are included in the model simulations. Rather, these scores are just a way to assess anticipated real-world impacts and understand what benefits each project could potentially have. It is important to note that the scoring system was not used to rank projects, chose projects for modeling, or make any other decision; it was simply an exercise used to understand each project better

The team developed, modified, and updated the project list and scoring presented in **Appendix A** many times. This version presents only one set of scoring and draft project lists. The project team found the exercise of scoring the projects quite instructive and helped gain an appreciation of the impact each project may have on the system. It became quite clear that the effort to categorize the projects based on the criteria listed above proved problematic since the majority of the impact a project would have on the system was driven by the exact location of the project.

After discussion of the project list and scoring of the results, the team decided to pivot and create a categorization scheme that would better reflect the scale of the mitigation projects. The team evaluated each project in terms of four categories: (1) regional scale, (2) local scale, (3) micro scale, and (4) other. Regional-scale projects have anticipated impacts on a regional scale, or to a much larger extent than the immediate project area. An example of a regional scale project is improvements to the tidal outfall structure, which has anticipated benefits further upstream such as reduced stages. Local-scale projects have anticipated impacts on a local scale or an area larger than the immediate project area but not to the same extent as a regional scale project. An example of a local scale project is the addition of a gated structure or pump station on the confluence of the primary and secondary canal system, which has anticipated benefits further upstream such as reduced stages or flood duration, but do not necessarily contribute to flood mitigation downstream. Micro scale projects are those that have anticipated impacts on a small (micro) scale, such as only to the immediate project area, or projects that are so local they fall below the scale and resolution of the model. An example of a micro scale project is the drainage improvement to a specific street, which has anticipated impacts only to the immediate drainage area. Projects classified as "other" are those that are outside of the study areas, already constructed, or do not directly affect flooding or flood mitigation in any way. An example of a project classified as "other" is a fire suppression system at a pump station or stormwater system inspections. These projects classified as "other," although important aspects to everyday real-world safety and maintenance, do not relate to the flood model.

For the purposes of this regional Flood Protection Level of Service project, the team will only evaluate regional and local scale projects in the MIKE SHE / MIKE HYDRO models. Micro scale and "other" projects are known to have some level of benefit for the area they serve but are unable to be adequately represented under the current resolution and scale of the model. Therefore, the micro scale and "other" projects are still recommended to be pursued by partner communities.

Appendix A lists the mitigation projects sorted according to regional, local, micro, or other scale. The scoring in this list is based on engineering judgement and with the limited data collected in Task 1. The primary determination is based largely on the location of each project and its scale, as described in the following sections

2.1 Regional Scale Projects

Regional-scale projects are larger magnitude projects that have anticipated impacts on a regional scale, or to a much larger extent than the immediate project area. These projects are often major infrastructure additions or modifications to the primary canal system and are likely considered SFWMD projects. The following list shows the regional scale mitigation projects that are proposed to be evaluated:

- Dredging the C-8 Canal
- Dredging the C-9 Canal
- S-28 Improvements – such as pump station, higher platform and gates, tieback levees/floodwalls
- S-29 Improvements – such as pump station, higher platform and gates, tieback levees/floodwalls
- North Lake Belt Storage Area Improvements- using the western mine pits as storage
- Floodwalls and Storm Surge Barriers downstream of S-28 / S-29
- Raise embankments along S-28 Canal (separate from tieback levee/floodwall)
- Raise embankments along S-29 Canal (separate from tieback levee/floodwall)
- Miami Shores Country Club impoundment

2.2 Local Scale Projects

Local scale projects are smaller magnitude projects that have anticipated impacts on a local scale, or an area larger than the immediate project area but not to the same extent as a regional scale project. These projects are more likely to be smaller infrastructure additions or modifications to the secondary and/or tertiary canal systems. Although SFWMD would lead some of these projects, the local municipalities, partner communities, or local drainage districts would own the majority of local scale projects. This project will evaluate the following list of local scale mitigation projects:

- Pembroke Pines three basin interconnect at Century Village
- Injection Well construction
- SBDD B-1 / B-2 Pump Station upgrades
- SBDD Basin 3 / Basin 7 interconnects at Country Club Ranches
- Add operable structures (gates / pumps) to confluency of primary / secondary canals
- Storage addition to non-pumped drainage areas

2.3 Micro Scale and “Other” Projects

Micro scale projects are small projects that have anticipated impacts on a micro scale, such as only to the immediate project area or projects so local they fall below the scale and resolution of the model. These projects are typically drainage improvements to the tertiary drainage system or beyond. These micro scale projects are anticipated to have some level of benefit for the area they serve but are unable to be adequately represented under the current resolution and scale of the model or model assumptions. Projects classified as “other” are outside of the study areas, already constructed, or do not directly affect flooding or flood mitigation in any way.

3 MITIGATION EFFICIENCY CRITERIA AND MODELING APPROACH

This part of the study, Task 2, involves evaluating and comparing the different mitigation projects proposed in Task 1 to ensure that the current flood control level of service is maintained or improved under future conditions with sea level rise. The project team will evaluate four mitigation strategies across four return interval rainfall events and three sea level rise scenarios, for a total of 48 final model simulations, for use in the flood damage assessment (Task 3 of this project). The four mitigation strategies include (1) Local Mitigation Strategy (M1), (2) Regional Mitigation Strategy for near-term SLR (M2A), (3) Regional Mitigation Strategy for far-term SLR (M2B) and (4) Combination of Mitigation Strategies (MX). Each of the four final mitigation strategies will be simulated using the 5, 10, 25, and 100-year return interval rainfall events with 1, 2, and 3 ft of sea level rise. However, before these 48 final design storm simulations are evaluated, the team will complete a series of iterative model runs to determine what mitigation projects proposed in Task 1 will be included. Or what the specific project details are, such as pump capacity required to achieve a level of service equal to or better than current conditions. Please note that not all projects proposed in Task 1 will be evaluated in the model iterations, specifically the micro scale and "other projects" discussed in **Section 2.3**, rather, just local scale and regional scale projects will be analyzed. Also note that the mitigation efficiency criteria includes PM1 profiles, PM5 flood depths, and PM6 flood durations, as well as qualitative assessment based on the project team's professional judgement. The mitigation efficiency criteria are assessed during the 3-part model iteration process documented in the following subsections and not as part of the 48 final model simulations. The following subsections document the proposed modeling approach that the team will use to select mitigation projects and develop the final four mitigation strategy scenarios' model setup and parameterization.

3.1 Part 1 - Model Setup for M2A and M2B – *Approximating the Tidal Outfall Pump Capacity Required to Achieve a Level of Service Equal to or Greater than Current Conditions for each Return Interval and Sea Level Rise Scenario*

Taylor Engineering proposes to start developing model scenarios by approximating the tidal outfall pump capacity required to achieve a level of service equal to or greater than current conditions for each return interval and sea level rise scenario. To determine if the current level of service provided under current conditions is maintained or improved under future conditions with mitigation, this project will review peak stage profiles. It is important to note that it is possible that regional mitigation strategies alone, specifically the modification of the tidal outfall structure, may not be enough to maintain the current conditions level of service under future sea level rise conditions.

For the Part 1 iteration runs, the team assumed that no other regional or local projects are implemented aside from the pump station and necessary improvements such as raising overtopping elevation of the gate, and conceptually representing tieback levees/floodwalls. This assumption is applied so that the pump station capacity required to achieve a level of service that is equal to or greater than current conditions for each return interval and sea level rise scenario can be determined. At the end of the Part 1 iteration runs, the team can complete the following table for both S-28 and S-29:

Table 3-1: Tidal Outfall Pump Capacity Required to Restore Current Condition (M0) LOS

SLR Condition	Pump Size Required to get Back to M0 Conditions (CFS)			
	5-Year	10-Year	25-Year	100-Year
SLR1				
SLR2				
SLR3				

The following approach is proposed for the Part 1 iteration runs:

1. Start by running the 5-year SLR1 model with the only changes made to SFWMD tidal outfall structure – changes include forward pump, raising gate, and representing a tieback levee/floodwall system.
2. Use an iterative approach to determine approximately what size pump (starting with 500 cfs increments) would be required to reduce 5-year SLR1 peak stage profiles equal to or below the 5-year CSL peak stage profile (M0). This analysis is a PM1 comparison.
3. Repeat step 2 for every rainfall return interval and sea level rise scenario.

This Part 1 iteration runs will provide twelve pump capacities for the S-28 and S-29 structures. The SFWMD will choose two pump capacities from the provided table to be used in the M2 Mitigation Strategies, one pump capacity for M2A and a larger capacity for M2B. The pump size for the M2A scenario will address near-term SLR issues (SLR1 or SLR2) and the pump size for the M2B scenario will address far-term SLR issues (SLR3). Note that the M1 local projects or other M2 regional projects that could increase or decrease the requirement of the District Pumps are not included in this determination of the M2 pump capacity.

3.2 Part 2 - Model Setup for M1 Mitigation Strategy – *Mitigation Efficiency for Local Scale Projects*

This task will evaluate local scale mitigation projects in two separate sets of model iteration scenarios: (A) projects proposed by partner communities that have been categorized as "local scale," and (B) additional projects identified by the consulting team to address local flood vulnerabilities with potential larger regional benefits, not included in the initial list of recommended projects by local partners. Model runs will only apply the 25-yr SLR1 storm event for this part of the study. Subsequent model runs as part of Task 2.2 will apply the full suite of rainfall events and sea level rise scenarios.

The additional projects identified by the consulting team to address local flood vulnerabilities with potential larger regional benefits, grew from a need to take a larger view of the system and propose solutions that address larger scale issues. In Task 1 the team requested mitigation projects from the local communities and partners. However, most of the partner projects are focused on their specific area of interest and do not necessarily contribute to the larger-scale flood protection. The partner projects are still very important to the area they serve and should still be pursued by partner communities and stakeholders. However, for the purposes of this regional-scale model, many of the projects were on such a local scale that they fall below the scale and resolution of the model. Therefore, the team realized the need take a broader view of the area and propose projects that can be explicitly modeled in this regional-scale model and have anticipated benefits that can be quantified through the standard data outputs from the MIKE SHE / MIKE HYDRO model.

The following approach is proposed for the M1 mitigation strategy model setup iteration:

A. Projects Proposed by Partner Communities

1. Start by adding local scale projects proposed by partner communities to the 25-year SLR1 model.
2. Run 25-year SLR1 scenario.
3. Create PM5/PM6 difference maps.
   i. If project has some level of benefit identifiable through model run, it becomes classified as a M1 project to be included in the final M1 model setup.
   ii. If model is unable to show some level of benefit, THEN anticipated real-world impact assessment is used to justify if project is included in final list of recommended projects.

B. Additional Projects Identified by the Consulting Team to Address Local Flood Vulnerabilities

B-1. IF only one proposed option (i.e., only one proposed size culvert for basin interconnect):

1. Start by adding local scale projects identified by the consulting team to the 25-year SLR1 model.
2. Run 25-year SLR1 scenario.
3. Create PM5/PM6 difference maps to determine if/what impact each project has compared to M0.
   i. IF project has some level of benefit identifiable through model run, it becomes classified as a M1 project to be included in the final M1 model setup.
   ii. IF model is unable to show some level of benefit, THEN anticipated real-world impact assessment is used to justify if project is included in final list of recommended projects.

B-2. IF more than one option in the same location (i.e., gate or pump station):

1. Start by adding local scale projects identified by the consulting team to the 25-year SLR1 model.
2. Run 25-year SLR1 scenario for option 1 (i.e., secondary system gate).
3. Create PM5/PM6 difference maps to determine if/what impact each project has compared to M0.
4. Run 25-year SLR1 scenario for option 2 (i.e., secondary system pump)
5. Create PM5/PM6 difference maps to determine if/what impact each project has compared to M0.
6. Create PM5/PM6 difference maps to determine if/what impact each project has compared to proposed Option 1.

Figure 3-1 shows an example of a difference map where two model simulations – with and without mitigation projects – are used to create a difference map. This is an example only and not intended to convey results for this ongoing study.

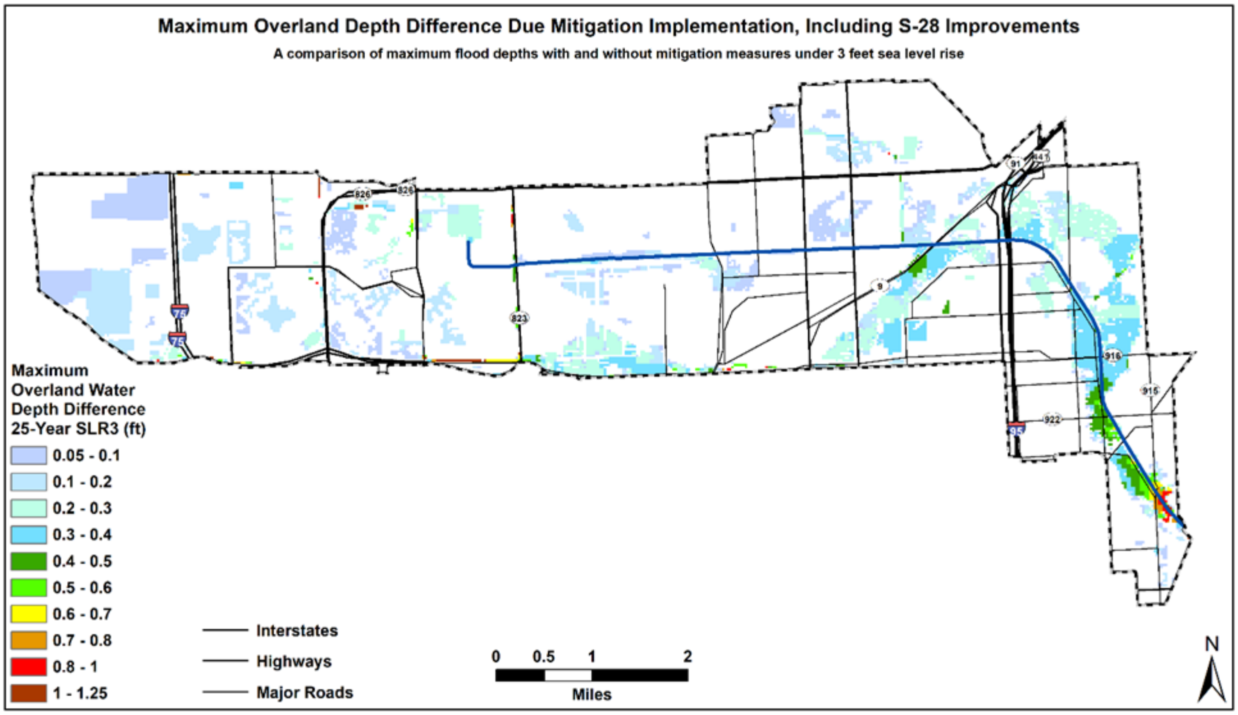

Figure 3-1: Difference Map Showing Example of with and without Mitigation Projects differences.

The team anticipates at least one or two instances of proposing multiple projects in the same general area. The purpose of multiple projects in the same area is that, while pumps may always show a larger benefit, the mitigation projects should not be limited to pumps. This analysis will look at different combinations/placement of gates/pumps and use flood depth/duration difference maps to help the District decide which to include in the final suite of projects to be included in the final M1 model setup.

These iteration runs may show that in the particular area where both a pump station and gated structure are proposed, the pump station has some "X" level of improvement compared to the gated structure. It may be beneficial for the 12 M1 scenarios to use gated structures at these selected secondary system locations instead of pump stations, which would serve as the baseline or minimum level of improvement. Then, as part of the flood damage assessment, a second "back of the envelope" calculation can be performed assuming the same "X" level of improvement to the specific area where the secondary system pump stations were tested, assuming the specific area with some "X" level of benefit could be identified. Essentially, this would allow for an approximation of the cost benefit for a pump instead of just a gated gravity structure in the same location, given there is a set number of final model setups that can be simulated.

3.3 Part 3 - Model Setup for MX Mitigation Strategy – *Approximating Tidal Outfall Capacity Requirements for a Combination of Local and Regional Mitigation Strategies*

Once Parts 1 and 2 are complete, the team will understand what pump capacity is required to maintain or improve the current condition level of flood protection under future conditions assuming no other projects and what local scale projects show a flood mitigation benefit. As M1 local projects or other M2 regional projects could increase or decrease the requirement of the District Pumps, Taylor Engineering proposes to approximate the tidal outfall pump capacity required when these other projects are considered. Therefore, the Part 3 model iteration runs will determine what size tidal outfall pump station the District needs to provide to improve or reestablish a FPLOS comparable to current conditions under future conditions with local and regional mitigation projects in place. For the Part 3 iteration runs the team will analyze PM1, PM5, and PM6 metrics as part of the mitigation efficiency criteria analysis. The following approach is proposed for the Part 3 iteration runs:

1. Start by running 25-year SLR1 model with the final suite of M1 projects and regional projects such as changes to the SFWMD tidal outfall structure – changes include forward pump, raising gate, and representing a tieback levee/floodwall system.
2. Use an iterative approach to determine approximately how much increase in pump capacity (if any) would be required to:
    a. Reduce 25-year SLR1 peak stage profiles equal to or below the 25-year CSL (M0) peak stage profile. This analysis is a PM1 comparison.
    b. Reduce 25-year SLR1 maximum overland flood depths/durations equal to or below the 25-year CSL (M0) maximum overland depths/durations. This analysis is a PM5/PM6 comparison.
    c. Keep S-28/S-29 tidal outfall 12-hour average 25-year SLR1 peak stages and flows at or below the current values for the 25-year CSL (M0). This is a PM3 comparison.

At the end of the Part 3 model runs, the team will have identified a suite of projects and subsequent model parameterization requirements that together meet the flood protection level of service mitigation goals, such as reducing primary canal stages equal to below current conditions, reducing overflood flood depths, and reducing flood duration. Although it is desired that every rainfall storm event and sea level rise scenario modeled will be able to reach a level of service equal to or greater than current conditions, it is likely that this will not be achievable for every scenario. In this event, the final analysis may show that the mitigation can restore or improve the flood protection level of service for some specific storm events while only being able to partially mitigate the effects of sea level rise by some amount for other storm events. It is important to note that a suite of mitigation projects can have a positive cost benefit while not restoring current condition level of service just as a suite of mitigation projects that can restore the current conditions level of service can have a negative cost benefit. As the final suite of projects is determined through the iteration runs, other things besides restoring to current conditions should be considered such as feasibility, as an analysis showing flood reduction back to current conditions that could never feasibly be implemented would not be best use of valuable model runs and analysis.

4 PROJECT PLAN

Section 3 above details the approach used to understand how both local scale and regional scale mitigation projects affect flooding in the C-8 and C-9 Basins, what pumping capacity may be required, and how the model will respond to certain changes. These iteration runs are used to help influence model setup changes including but not limited to what mitigation projects will be implemented, structure operations, and initial conditions. Moving forward, the project plan is to:

- Complete M1 iteration runs to determine final suite of M1 mitigation projects
- Complete MX iteration runs to determine final model setup and parameterization for MX mitigation scenario
- Complete the final M1 Mitigation Strategy modeling (12 events)
    - Postprocess the 12 final model simulations for use in the flood damage assessment
- Complete the final M2A Mitigation Strategy modeling (12 events)
    - Postprocess the 12 final model simulations for use in the flood damage assessment
- Complete the final M2B Mitigation Strategy modeling (12 events)
    - Postprocess the 12 final model simulations for use in the flood damage assessment
- Complete the final MX Mitigation Strategy modeling (12 events)
    - Postprocess the 12 final model simulations for use in the flood damage assessment

Table 4-1 shows the list of 48 final model simulations the team will complete in Task 2.2 to analysis the flood protection level of service under future conditions with mitigation, some of which are required to complete the flood damage assessment. **Table 4-2** shows a breakdown of what data will be generated/postprocessed and provided as part of the project deliverables. It is estimated that it will take 4 to 5 months to fully simulate and postprocess the 48 final model simulations, which cannot start until after the 3-part model iteration process detailed in **Section 3** is completed. In order to make-up time, the project team will provide model results for use in the flood damage assessment in four sets of completed runs instead of waiting until all 48 model scenarios are simulated and postprocessed. Additionally, the project team will enlist additional engineer’s familiar with the postprocessing routine to shorten the amount of time required to complete all postprocessing while ensuring a consistent approach.

Table 4-1: List of Final Model Simulations to be Completed in Task 2.2

Design Storm Frequency	Mitigation Scenario											
	M1			M2A			M2B			MX		
	SLR1	SLR2	SLR3	SLR1	SLR2	SLR3	SLR1	SLR2	SLR3	SLR1	SLR2	SLR3
5-Year	5-Yr SLR1 (M1)	5-Yr SLR2 (M1)	5-Yr SLR3 (M1)	5-Yr SLR1 (M2A)	5-Yr SLR2 (M2A)	5-Yr SLR3 (M2A)	5-Yr SLR1 (M2B)	5-Yr SLR2 (M2B)	5-Yr SLR3 (M2B)	5-Yr SLR1 (MX)	5-Yr SLR2 (MX)	5-Yr SLR3 (MX)
10-Year	10-Yr SLR1 (M1)	10-Yr SLR2 (M1)	10-Yr SLR3 (M1)	10-Yr SLR1 (M2A)	10-Yr SLR2 (M2A)	10-Yr SLR3 (M2A)	10-Yr SLR1 (M2B)	10-Yr SLR2 (M2B)	10-Yr SLR3 (M2B)	10-Yr SLR1 (MX)	10-Yr SLR2 (MX)	10-Yr SLR3 (MX)
25-Year	25-Yr SLR1 (M1)	25-Yr SLR2 (M1)	25-Yr SLR3 (M1)	25-Yr SLR1 (M2A)	25-Yr SLR2 (M2A)	25-Yr SLR3 (M2A)	25-Yr SLR1 (M2B)	25-Yr SLR2 (M2B)	25-Yr SLR3 (M2B)	25-Yr SLR1 (MX)	25-Yr SLR2 (MX)	25-Yr SLR3 (MX)
100-Year	100-Yr SLR1 (M1)	100-Yr SLR2 (M1)	100-Yr SLR3 (M1)	100-Yr SLR1 (M2A)	100-Yr SLR2 (M2A)	100-Yr SLR3 (M2A)	100-Yr SLR1 (M2B)	100-Yr SLR2 (M2B)	100-Yr SLR3 (M2B)	100-Yr SLR1 (MX)	100-Yr SLR2 (MX)	100-Yr SLR3 (MX)

Table 4-2: Data Deliverables for C-8 C-9 Task 2 H&H Modeling

C-8 Basin					C-9 Basin				
	Excel files	Figures	GIS Rasters	Data Tables		Excel files	Figures	GIS Rasters	Data Tables
PM1	48	48			**PM1**	48	48		
PM2	48			1 combined table	**PM2**	48			1 combined table
PM5 Max Flood depth (project area)		48	48	4 combined tables	**PM5 Max Flood depth (project area)**		48	48	4 combined tables
PM5 Max Flood depth (urban area)		48	48		**PM5 Max Flood depth (urban area)**		48	48	
PM5 Max Flood elevation (project area)			48		**PM5 Max Flood elevation (project area)**			48	
PM6 Flood Duration (project area)		48	48	4 combined tables	**PM6 Flood Duration (project area)**		48	48	4 combined tables
PM6 Flood Duration (urban area)		48	48		**PM6 Flood Duration (urban area)**		48	48	
Water Budget for 10-yr event				12	**Water Budget for 10-yr event**				12
Summary of peak discharge, peak head water, and peak tail water (instantaneous and 12-hr moving average)				48	**Summary of peak discharge, peak head water, and peak tail water (instantaneous and 12-hr moving average)**				48

Number of data tables are subject to change depending on how the data is organized (i.e., by mitigation scenario, by design storm frequency, or by sea level rise scenario, or any combination thereof

PM2 for C-9 Basin is just for the overall basin, not east/west of Red Road

PM5/PM6 Figures are just flood depth/duration maps, not difference maps

5 CONCLUSIONS

This technical memorandum has outlined the team's process to categorize the mitigation projects identified in Task 1 and developed a modeling approach to examine the projects' efficacy to meet FPLOS mitigation criteria. After several iterations of scoring, the consulting team and District agreed that the scoring system was not intended to be used to rank projects or chose which projects to model. Rather, the scoring system was used as a way to understand potential benefits or lack thereof. Therefore, the process of categorizing mitigation projects hinged primarily on the location and scale of the project. To that end, the team's final project list and categorization is focused on whether the project affects a primary, secondary, or tertiary system. Therefore, the projects were identified as affecting regional, local, or micro scale systems.

As part of the 3-part model iteration process, a limited number of projects will be evaluated based on the project team's understanding of the MIKE SHE/MIKE HYDRO model and its limitations, which are influenced by the proposed project scale and location. During the Task 1 assessment, the proposed projects were ultimately categorized into four categories: regional scale, local scale, micro scale, and "other." The C-8 C-9 MIKE SHE/MIKE HYDRO model is a regional scale model and there are limitations to what can be modeled with respect to the scale and location of the project. For example, projects like the addition of a control structure on a canal is readily modellable and can be modeled explicitly, whereas projects related to improving roadway drainage for a small section of road is not explicitly modellable as the underground storm drains are not explicitly modeled. During current conditions model development, systems that could not be simulated explicitly were conceptually represented through various runoff and routing parameters based on literature values (assuming a well-maintained system) and were refined during model calibration as needed. This was possible since there was observed data to calibrate to, allowing for a measurable level of adjustment to the conceptual representation based on model response in relation to the observed data. With the proposed mitigation projects, there is no basis for determining an appropriate level of adjustment. Therefore, the project team used their professional judgement and knowledge of the C-8 C-9 MIKE SHE/MIKE HYDRO model to filter through the project list to separate out projects that are not of appropriate scale, have already been completed, or do not directly affect flooding or flood mitigation. The project categorization of regional scale, local scale, and micro scale ultimately line up with primary canal systems, secondary systems, and tertiary/beyond systems.

For the 3-part iteration process, the evaluation of projects on flood mitigation will be primary focused on projects in the primary and secondary canal system, due to the scale issues. However, this is not to say that the micro scale and "other" projects are not important or won't have an impact, they are just not compatible with this resolution and scale of the C-8 C-9 MIKE SHE/MIKE HYDRO model. The micro scale and "other" projects proposed by partner communities and stakeholders are known to have some level of benefit for the area they serve but are simply unable to be adequately represented under the current resolution and scale of the model. These projects are still recommended to be pursued by partner communities.

The three primary aspects of mitigation efficiency are (1) reducing peak canal stages equal to or below current conditions, (2) reducing overland flooding equal to or below current conditions, and (3) reduce flood duration equal to or below current conditions. These three mitigation efficiencies will be evaluated through flood protection level of service performance metrics, specially PM1, PM5, and PM6. If a project does not show any benefits through the traditional model outputs, whether due to project scale or due to underlying model assumptions (such as design rainfall everywhere), the project team's qualitative assessment of the project will determine if it is included in the final list of mitigation projects. These mitigation efficiencies are evaluated during the 3-part model iteration process, which is used to understand how the mitigation projects affect flooding, what pumping capacity may be required, and how the model responds to changes such as structure operations. The 3-part model iteration process is used to evaluate the mitigation efficiencies and influence the final four mitigation strategies model setup and parameterization.

At the end of the 3-part model iteration process, the team will have identified a suite of projects and subsequent model parameterization requirements that together meet the flood protection level of service mitigation goals, such as reducing primary canal stages, reducing overflood flood depths, and reducing flood duration, whether equal to or below current conditions or some other acceptable level that is determined once the project team and the District have a better understanding of what is possible. Once the final model setup is configured for each of the four mitigation strategies, the project team will begin to run the final 48 model simulations. Each of the four final mitigation strategies will be simulated using the 5, 10, 25, and 100-year return interval rainfall events with 1, 2, and 3 ft of sea level rise. After all 12 model runs for a mitigation strategy are completed and the data is post processed, data for the flood damage assessment will be provided before moving on to the next mitigation strategy. At the completion of all 48 final simulations across the four mitigation strategies, several flood protection level of service performance metrics will be completed, and all data required for completing the flood damage assessment will be produced. It is estimated the full simulation, evaluation, and post processing of the 48 final model scenarios will take 4 to 5 months, which cannot start until after the 3-part model iteration process detailed in **Section 3** is completed. The next steps are to complete the Part 2 and Part 3 of the 3-part iteration process, determining which mitigation projects and what pump size will be included in the final model setup.

Appendix A Project Categories and Project Scoring System (Incomplete) Used to Understand Potential Benefits of Proposed Mitigation Projects

Tab 1- Regional Scale: Score 1-5, 1 being not likely and 5 being very likely. Score based on anticipated real-world impacts.

Project Name	Comment		Allows Operation Flexibility	Prevents "high water" from back flowing in	Increases discharge ability	Can alleviate primary system flooding	Can alleviate secondary system flooding	Can alleviate tertiary system flooding	Total Score	Improves Water Quality (neutral impact =3, positive impact =5)	How well developed is the project (conceptual = 1, full design=5)	Notes
Dredging C-8 Canal	Doesn't change operation of anything and doesn't prevent high water from backing in. Has the ability to increase discharge by having larger conveyance capacity, possibly keeping pump operating at max capacity longer. Could reduce head loss / lower stages, which could alleviate some flooding in primary, secondar, and tertiary systems.	Regional	1	1	3	3	3	3	13	3		Restore the design capacity.
S-28 improvements - pump station, higher platform and gates, tieback, levee, and floodwall	Allows operation flexibility and can operate when TW is higher than HW. Prevents storm surge from overtopping or flanking structure. Increases discharge capacity when gravity structure would be forced to close otherwise. Can alleviate flooding in primary, secondary, and tertiary systems.	Regional	5	5	5	5	4	3	22	3		Improvement to the primary system.
S-29 improvements include Oleta River surge barrier, tieback levees, and floodwall	Allows operation flexibility and can operate when TW is higher than HW. Prevents storm surge from overtopping or flanking structure. Increases discharge capacity when gravity structure would be forced to close otherwise. Can alleviate flooding in primary, secondary, and tertiary systems.	Regional	5	5	5	5	4	3	22	3		Improvement to the primary system.
North Lake Belt Storage Area Improvements (western mine pits)		Regional	3	1	1	5	4	3	14	5		Improvement to the primary system by adding additional storage. Need more information.
S-28 downstream of tidal structure - floodwalls and storm surge barriers (USACE Back Bay study)		Regional	3	5	1	5	4	3	18	3		Improvement to the primary system.
S-28 raise levees along canal and add operable structures to secondary system (gates/pumps) (Figure 3 from Phase I mitigation memo)	Allows operation flexibility and can operate when TW is higher than HW. Prevents elevated TW from propagating upstream. Pumps would allow discharge when gravity structure would be forced to close otherwise, gravity structure prevents elevated TW from propagating upstream. Higher levees could prevent elevated canal stage from spilling out. Can alleviate flooding in secondary and tertiary systems.	Regional	5	5	3	5	5	4	22	3		Improvement to the primary system.
S-29 raise levees along canal and add operable structures to secondary system (gates/pumps)	Allows operation flexibility and can operate when TW is higher than HW. Prevents elevated TW from propagating upstream. Pumps would allow discharge when gravity structure would be forced to close otherwise, gravity structure prevents elevated TW from propagating upstream. Higher levees could prevent elevated canal stage from spilling out. Can alleviate flooding in secondary and tertiary systems.	Regional	5	5	3	5	5	4	22	3		Improvement to the primary system.

Tab 2- Local Scale: Score 1-5, 1 being not likely and 5 being very likely. Score based on anticipated real-world impacts.

Project Name	Comment		Allows Operation Flexibility	Prevents "high water" from back flowing in	Increases discharge ability	Can alleviate primary system flooding	Can alleviate secondary system flooding	Can alleviate tertiary system flooding	Total Score	Improves Water Quality (neutral impact =3, positive impact =5)		How well developed is the project (conceptual = 1, full design=5)		Notes
Pembroke Pines Three Basin Interconnect at Century Village Project	This project would allow some operational flexibility of the secondary system as it would allow water to be moved from one basin to the other. It does not prevent high water from backing in (may be gated, but water could not transfer between basins w/o project, so this would just be to allow control of when to transfer water). It is not very likely to alleviate primary system flooding as the water is likely still going to be discharged out, just through a different route. It is likely to alleviate some secondary and tertiary flooding by somewhat increasing discharge ability by moving water to another basin with available storage.	Local	3	1	3	2	3	3	12	3	3			Need length, inverts, diameter, type, etc.
South Broward Drainage District Basin 3 Emergency Sluice Gate into the C-9 Canal	Doesn't allow operation flexibility as it would be used for emergency discharge, *after* existing infrastructure is used or at capacity. Could provide some flexibility as a Failsafe in case pump(s) fail. System already in place to prevent water from backing in, so this project doesn't get points for that. This system does increase discharge capacity by providing emergency relief. Does not alleviate primary system flooding as it is a secondary infrastructure designed to add more water to primary. Very likely to alleviate emergency flooding in secondary/tertiary.	Local	3	1	3	1	3	3	11	3	3			working in conjunction with regional pump station. Kevin Hart from SBDD providing example of an emergency sluice gate. No design available.
South Broward Drainage District Maintenance Dredging of Primary and Secondary Canals	Does not allow operation flexibility nor does it prevent high water from backing in. It cannot increase discharge ability in terms of cfs, but it has the potential to increase duration of max discharge by reducing "down time" of pump stations. Unlikely to alleviate primary system flooding as it is not holding water back, may somewhat increase infiltration. Neutral score for alleviating secondary/tertiary system flooding as system is ultimately controlled by secondary system pump station.	Local	1	1	3	1	3	3	11	3	3			Restore the design capacity.
Enlargement of Silver Lake Control Structure	Existing tertiary system project. This could allow some operation flexibility. It does not prevent high water from backing in as it is already prevented with existing control structure. This could increase discharge ability out of the basin. Could potentially alleviate some local primary system flooding by reducing the total discharge out required by pump station. More likely to alleviate flooding in tertiary system, some in secondary.	Local	5	1	5	1	3	5	15		3			Spoke with Kevin Hart, single 72" RCP. No immediate plans of enlargement by SBDD.
Injection Well Construction	More likely to impact duration of flooding instead of flood depth.	Local	2	1	2	2	2	3	10	5	5			Installing stormwater system, including but not limited, to deep-well injection wells to reduce flooding would benefit approximately 30 percent of the City. This type of project is needed where localized flooding is observed.

Project Name	Comment		Allows Operation Flexibility	Prevents "high water" from back flowing in	Increases discharge ability	Can alleviate primary system flooding	Can alleviate secondary system flooding	Can alleviate tertiary system flooding	Total Score	Improves Water Quality (neutral impact =3, positive impact =5)	How well developed is the project (conceptual = 1, full design=5)	Notes
Basin S-5 Emergency Sluice Gate	Doesn't allow operation flexibility as it would be used for emergency discharge, *after* existing infrastructure is used or at capacity. System already in place to prevent water from backing in, so this project doesn't get points for that. This system does increase discharge capacity by providing emergency relief. Does not alleviate primary system flooding as it is a secondary infrastructure designed to add more water to primary. Very likely to alleviate emergency flooding in secondary/tertiary.	Local	3	1	3	1	3	3	11	3		working in conjunction with regional pump station. Kevin Hart from SBDD providing example of an emergency sluice gate. No design available.
South Broward Drainage District B-1 Pump Station	Upgrade to existing tertiary system pumps.	Local	1	1	5	1	1	5	13	3		working in conjunction with regional pump station. Need pump capacity, operation rule. etc.
South Broward Drainage District B-2 Pump Station	Upgrade to existing tertiary system pumps.	Local	1	1	5	1	1	5	13	3		working in conjunction with regional pump station. Need pump capacity, operation rule. etc.
Rehabilitation of Triple 96" Culverts (CIPP)	Does not allow operation flexibility nor does it prevent high water from backing in. Will increase discharge ability in terms of cfs as it is being restored back to design. Will not alleviate flooding in primary system. May alleviate some flooding in secondary/tertiary system if this culvert was chocking the pump station immediate downstream.	Local	1	1	1	1	1	1	5	3		Restore the design capacity.
South Broward Drainage District Basin 3/Basin 7 Interconnect at County Club Ranches	This project would allow some operational flexibility of the secondary system as it would allow water to be moved from one basin to the other. It does not prevent high water from backing in (may be gated, but water could not transfer between basins w/o project, so this would just be to allow control of when to transfer water). Not likely to alleviate flooding in local primary system, as basin pump would probably still be running at max capacity and the transfer water is likely still going to be discharged out, just through a different route. It is likely to alleviate some secondary and tertiary flooding by increasing discharge ability by moving water to another basin with available storage.	Local	2	1	3	1	3	3	11	3		Kevin Hart from SBDD will provide details
South Broward Drainage District East By-Pass & Sluice Gate at the S-1 Pump Station	Proposed operational gate. Same permitted allowance. Allow them to lessen burden on pump station. Failsafe in case pump(s) fail. Can increase discharge ability with permission from District.	Local	3	1	3	1	3	3	11	3		Kevin Hart from SBDD will provide details

Project Name	Comment		Allows Operation Flexibility	Prevents "high water" from back flowing in	Increases discharge ability	Can alleviate primary system flooding	Can alleviate secondary system flooding	Can alleviate tertiary system flooding	Total Score	Improves Water Quality (neutral impact =3, positive impact =5)		How well developed is the project (conceptual = 1, full design=5)		Notes
Bank stabilization proposed on Marco Canal	Bank stabilization may improve conveyance through canal, increasing discharge ability to some degree, which could potentially reduce flooding in the tertiary system.	Local	**1**	**1**	**2**	**1**	**1**	**3**	**8**					Recommended
C-8 Spur Canal Non-structural Flooding Solutions		Local												Need more details
Add the conveyance between C9 and C11		Local	**3**	**1**	**3**	**2**	**3**	**3**	**12**		3			add inter-basin transfer flexibility.
Outfall Replacement at Pickwick Lake		Local												will help restore the design capacity.
South of airport storage area		Local												
Convert golf courses to stormwater park		Local												

Tab 3- Micro Scale: Score 1-5, 1 being not likely and 5 being very likely. Score based on anticipated real-world impacts.

Project Name	Comment		Allows Operation Flexibility	Prevents "high water" from back flowing in	Increases discharge ability	Can alleviate primary system flooding	Can alleviate secondary system flooding	Can alleviate tertiary system flooding	Total Score	Improves Water Quality (neutral impact =3, positive impact =5)		How well developed is the project (conceptual = 1, full design=5)		Notes
Pembroke Park Carolina Street/Park Road Pump Station	This is a very local scale tertiary system project for draining a street. Doesn't provide operation flexibility or prevent high water from back flowing in. It does increase discharge ability of a very small area. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding.	Micro	3	1	3	1	1	5	11					Nowhere near canal system. Draining to a lake so it would not be dependent on regional pump station.
Pembroke Park SW 30 Avenue Drainage	This is a very local scale tertiary system project for some local street drainage. Doesn't provide operation flexibility or prevent high water from backing in. Will have some increase in local drainage. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding	Micro	1	1	3	1	1	5	11					Need more details
Pembroke Park SW 52nd Avenue Drainage	This is a very local scale tertiary system project for some local street drainage. Doesn't provide operation flexibility or prevent high water from backing in. Will have some increase in local drainage. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding	Micro	1	1	3	1	1	5	11					Need more details
Pembroke Pines Storm Water Project - Lakeside Key Storm Drainage System	This is a very local scale tertiary system project for some local drainage. Doesn't provide operation flexibility or prevent high water from backing in. Will have some increase in local drainage ability. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding	Micro	1	1	3	1	1	5	11					Need more details
Pembroke Pines Storm Water Project - Taft St. and 85th Way Culvert Linings	This is a very local scale tertiary system project for a culvert under a road. Replacing culvert linings could reduce friction or prevent degradation and erosion of pipe. Doesn't provide operation flexibility or prevent high water from backing in. Could somewhat increase discharge ability with reduced friction or restoring back to design capacity. Will not alleviate primary or secondary system flooding.	Micro	1	1	3	1	3	5	14		3			Restore the design capacity and reduce frictions

Project Name	Comment		Allows Operation Flexibility	Prevents "high water" from back flowing in	Increases discharge ability	Can alleviate primary system flooding	Can alleviate secondary system flooding	Can alleviate tertiary system flooding	Total Score	Improves Water Quality (neutral impact =3, positive impact =5)		How well developed is the project (conceptual = 1, full design=5)		Notes
Pembroke Pines Storm Water Project - Taft St. Swale Regrading	This is a very local scale tertiary system project for some local drainage. Doesn't provide operation flexibility or prevent high water from backing in. Could have some increase in local drainage ability. Will not alleviate primary or secondary system flooding. Could have some local scale reduction in flooding. Not modellable.	Micro	1	1	3	1	3	5	14		3			Restore the design capacity and improve conveyance
Drainage Improvements Multiple Sites	Drainage improvement doesn't provide operation flexibility or prevent high water from backing in. Will have some increase in local drainage ability. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding	Micro	1	1	3	1	1	5	11					Need more details (25? 26? 27? Relationship? What kind of improvements?
NW 178 ST and NW 82 AVE	This is a very local scale tertiary system project for some local drainage. Doesn't provide operation flexibility or prevent high water from backing in. Will have some increase in local drainage ability. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding	Micro	1	1	3	1	1	5	11					Need more details
NW 57 PL from NW 194 ST to NW 198 TR	This is a very local scale tertiary system project for some local drainage. Doesn't provide operation flexibility or prevent high water from backing in. Will have some increase in local drainage ability. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding	Micro	1	1	3	1	1	5	11					Need more details
105 Street Drainage Pump Station	This is a very local scale tertiary system project for draining streets. Doesn't provide operation flexibility or prevent high water from back flowing in. It does increase discharge ability of a very small area. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding. Downstream of S-28 pump station	Micro	3	1	3	1	1	5	16		3			Need more details. The neighborhood in the vicinity of 104 Street has been experiencing flooding during times of heavy rain especially during high tide and also sunny day flooding in relation to king tides. The drainage pump system will help against this.

Project Name	Comment		Allows Operation Flexibility	Prevents "high water" from back flowing in	Increases discharge ability	Can alleviate primary system flooding	Can alleviate secondary system flooding	Can alleviate tertiary system flooding	Total Score	Improves Water Quality (neutral impact =3, positive impact =5)		How well developed is the project (conceptual = 1, full design=5)		Notes
20021 to 20081 NW 13 Ave-Stormwater Drainage Improvements Project	This is a very local scale tertiary system project for some local drainage. Doesn't provide operation flexibility or prevent high water from backing in. Will have some increase in local drainage ability. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding	Micro	**1**	**1**	**3**	**1**	**1**	**5**	**11**					Need more details. Stormwater Drainage Project - Flooding Issues in the area.
20601 NW 44 Court-Stormwater Drainage Improvements Project	This is a very local scale tertiary system project for some local drainage. Doesn't provide operation flexibility or prevent high water from backing in. Will have some increase in local drainage ability. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding	Micro	**1**	**1**	**3**	**1**	**1**	**5**	**11**					Need more details. Drainage Project due to flooding.
Biscayne Gardens Community Rating System site mitigation		Micro	**2**	**1**	**1**	**2**	**2**	**2**	**8**					Need more details. Mitigate future losses by buying low lying homes and turning them into water retention areas.
Drainage Improvements NW 170 St west of 22 Ave	This is a very local scale tertiary system project for some local drainage. Doesn't provide operation flexibility or prevent high water from backing in. Will have some increase in local drainage ability. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding	Micro	**1**	**1**	**3**	**1**	**1**	**5**	**11**					Need more details. The following areas have been identified as having severe flooding problems, and the stated improvements will reduce property damage and repetitive losses from future rain events. Two repetitive losses exist in this area. These projects also improve water
Kings Gardens #3		Micro	**1**	**1**	**3**	**1**	**1**	**5**	**11**					Need more details. through time, the roads and drainage have declined due to a lack of maintenance. The decline is to the extent that the situation is a driving and flooding hazard

Project Name	Comment		Allows Operation Flexibility	Prevents "high water" from back flowing in	Increases discharge ability	Can alleviate primary system flooding	Can alleviate secondary system flooding	Can alleviate tertiary system flooding	Total Score	Improves Water Quality (neutral impact =3, positive impact =5)		How well developed is the project (conceptual = 1, full design=5)		Notes
Leslie Estates #4 Road and Drainage Improvements	This is a very local scale tertiary system project for some local drainage. Doesn't provide operation flexibility or prevent high water from backing in. Will have some increase in local drainage ability. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding	Micro	**1**	**1**	**3**	**1**	**1**	**5**	**11**					Need more details. This area was assessed of the conditions for acquiring the ROW in order to do road and drainage improvements since the area has private roads without a Homeowners Association.
NE 105 St Pump Station	This is a very local scale tertiary system project for draining a street. Doesn't provide operation flexibility or prevent high water from back flowing in. It does increase discharge ability of a very small area. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding.	Micro	**3**	**1**	**3**	**1**	**1**	**5**	**16**		**3**			Downstream of S-28. Tidally influenced.
NE 10th Avenue/NE 159th Street and NMB Boulevard	This is a very local scale tertiary system project for some local drainage. Doesn't provide operation flexibility or prevent high water from backing in. Will have some increase in local drainage ability. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding	Micro	**1**	**1**	**3**	**1**	**1**	**5**	**11**					Need more details. This project consists of street and Roadway improvements. This will make significant drainage improvements.
NE 154 Street and NE 5 Court	This is a very local scale tertiary system project. Doesn't provide operation flexibility or prevent high water from backing in. Will have some increase in local drainage ability. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding	Micro	**1**	**1**	**3**	**1**	**1**	**5**	**11**					Have some project plans. Roadway Drainage.
NE 167 Street and NE 14 Avenue	This is a very local scale tertiary system project for some local drainage. Doesn't provide operation flexibility or prevent high water from backing in. Will have some increase in local drainage ability. Will not alleviate primary or secondary system flooding. Will have extremely local scale reduction in flooding. ~700 linear ft area of influence	Micro	**1**	**1**	**3**	**1**	**1**	**5**	**11**					Have project plans. General drainage improvements, mitigation of flood complaints.

Project Name	Comment		Allows Operation Flexibility	Prevents "high water" from back flowing in	Increases discharge ability	Can alleviate primary system flooding	Can alleviate secondary system flooding	Can alleviate tertiary system flooding	Total Score	Improves Water Quality (neutral impact =3, positive impact =5)		How well developed is the project (conceptual = 1, full design=5)		Notes
NE 197 Terrace and NE 17 Avenue Drainage Improvements	This is a very local scale tertiary system project. Doesn't provide operation flexibility or prevent high water from backing in. Will increase local drainage ability Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding.	Micro	1	1	3	1	1	5	11					Have some project plans. Drainage improvements. The recommended solution is the construction of an exfiltration system to fully retain onsite runoff.
NW 146 St and NW 7 Ave (east end of street)	This is a very local scale tertiary system project for some local drainage. Doesn't provide operation flexibility or prevent high water from backing in. Will have some increase in local drainage ability. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding	Micro	1	1	3	1	1	5	11					Need more details. General drainage improvements, mitigation of flood complaints.
NW 159 Street Stormwater Drainage Project	This is a very local scale tertiary system project for some local drainage. Doesn't provide operation flexibility or prevent high water from backing in. Will have some increase in local drainage ability. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding	Micro	1	1	3	1	1	5	11					Need more details. Drainage Improvement Project - Flooding Issues and Vehicles Hydroplaning through the area that can cause an accident.
NW 163 Street Drainage Improvement Project	This is a very local scale tertiary system project for some local drainage. Doesn't provide operation flexibility or prevent high water from backing in. Will have some increase in local drainage ability. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding	Micro	1	1	3	1	1	5	11					Need more details. Increasing underground drainage capacity due to flooding issues and vehicles hydroplaning causing a possible accident to occur.
NW 191 Street-196 Terrace, from NW Sunshine State Parkway East to NW 12 Avenue - Drainage Improvement	This is a very local scale tertiary system project for some local drainage. Doesn't provide operation flexibility or prevent high water from backing in. Will have some increase in local drainage ability. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding	Micro	1	1	3	1	1	5	11					Need more details. The following areas have been identified as having severe flooding problems, and the stated improvements will reduce property damage and repetitive losses from future rain events. These projects also improve water quality of stormwater runoff.
NW 195 Street West of NW 12 Avenue - Drainage Improvements	This is a very local scale tertiary system project for some local drainage. Doesn't provide operation flexibility or prevent high water from backing in. Will have some increase in local drainage ability. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding	Micro	1	1	3	1	1	5	11					Need more details. The following areas have been identified as having severe flooding problems, and the stated improvements will reduce property damage and repetitive losses from future rain events. These projects also improve water quality of stormwater runoff.

Project Name	Comment		Allows Operation Flexibility	Prevents "high water" from back flowing in	Increases discharge ability	Can alleviate primary system flooding	Can alleviate secondary system flooding	Can alleviate tertiary system flooding	Total Score	Improves Water Quality (neutral impact =3, positive impact =5)		How well developed is the project (conceptual = 1, full design=5)		Notes
NW 42 Avenue and NW 167 Terrace	This is a very local scale tertiary system project for some local drainage. Doesn't provide operation flexibility or prevent high water from backing in. Will have some increase in local drainage ability. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding	Micro	1	1	3	1	1	5	11					Need more details. French Drainage Project due to excessive flooding.
Vista Verde Phase #4 - Remaining Phase from Snake Creek Canal to NW 41 Ave Rd Community		Micro	1	1	3	1	1	5	11					Sediment removal and canal stabilization and headwall and culvert repairs.
West Dixie Highway Drainage Improvements	This is a very local scale tertiary system project for some local drainage. Doesn't provide operation flexibility or prevent high water from backing in. Will have some increase in local drainage ability. Will not alleviate primary or secondary system flooding. Will have some local scale reduction in flooding. Was built in 2017... conceptually factored into model already?	Micro												Have some project plans. Underground drainage improvement to eliminate flooding after storm events
Well Field Stormwater System Improvement		Micro												In order to protect public water supply wells #13 and #19 from contamination, the City needs to modify the stormwater system previously constructed in the vicinity of the wells. Approximately 300 ft. of 30-inch French drain needs to be removed and replaced

Tab 4- Other Projects: Score 1-5, 1 being not likely and 5 being very likely. Score based on anticipated real-world impacts.

Project Name	Comment		Allows Operation Flexibility	Prevents "high water" from back flowing in	Increases discharge ability	Can alleviate primary system flooding	Can alleviate secondary system flooding	Can alleviate tertiary system flooding	Total Score	Improves Water Quality (neutral impact =3, positive impact =5)		How well developed is the project (conceptual = 1, full design=5)		Notes
Encantada Sluice Gate	Already constructed	Other	5	5	5	1	1	5	17		3			working in conjunction with regional pump station. Kevin Hart from SBDD providing gate details.
Harbour Lake Estates Sluice Gate	Already constructed	Other	5	5	5	1	1	5	17		3			working in conjunction with regional pump station. Kevin Hart from SBDD providing gate details.
Sunset Lakes Sluice Gate	Already constructed	Other	5	5	5	1	1	5	17		3			working in conjunction with regional pump station. Kevin Hart from SBDD providing gate details.
South Broward Drainage District S.W. 54th Place/S.W. 164th Terrace Culvert Replacement	This project is in the C-11 Basin. Remove	Other												Restore the design capacity. Need length, inverts, diameter, type, etc.
South Broward Drainage District Seepage Management Storm Water Pump Station	This project is in the C-11 Basin. Remove	Other												Need pump capacity, operation rule. etc.
Hollywood Arthur and Cleveland Streets Drainage Improvement	This project is outside of model domain. Remove	Other												Need more details
Hollywood North Lake Pump Station and Outfalls	This project is outside of model domain. Remove	Other									3			working in conjunction with regional pump station.
Hollywood South Lake Pump Station	This project is outside of model domain. Remove	Other									3			working in conjunction with regional pump station. Need pump capacity, operation rule. etc.
Hollywood Sunset Golf Course Pump Station Rehabilitation	This project is outside of model domain. Remove	Other									3			Restore the design capacity. Need pump capacity, operation rule. etc.
Pembroke Pines West Communities Pump Station	This project is outside of model domain. Remove	Other									3			working in conjunction with regional pump station.
SBHD Memorial Healthcare System Joe DiMaggio Vertical Expansion Flood Proofing Project	This project is outside of model domain. Remove	Other									3			Damage prevention? Resilience project?
West Park Stormwater Vaults along 441/SR7	This project is outside of model domain. Remove	Other												Need more details

Project Name	Comment		Allows Operation Flexibility	Prevents "high water" from back flowing in	Increases discharge ability	Can alleviate primary system flooding	Can alleviate secondary system flooding	Can alleviate tertiary system flooding	Total Score	Improves Water Quality (neutral impact =3, positive impact =5)		How well developed is the project (conceptual = 1, full design=5)		Notes
Biscayne Gardens Stormwater Inspection		Other												General inspection and assessment of the stormwater pump stations located at NE 150 Street and N. Spur Drive (Biscayne Gardens)
Correct Water Infiltration at City Hall (EOC) Basement		Other												Need more details
Storm Water Pump Replacement Program		Other												The project consist of the replacement of existing storm water pumps on an as needed basis.
Emergency Discharge Sluice Gate	Delete. 51 & 52 refer to same project.	Other												
South Broward Drainage District S4/S5 Pump Station	Fire suppression system for all pumps and upgraded exhaust	Other												Does not affect discharge or operations in any way. Delete
Basin S-3 Sluice Gate	proposed emergency gate for basin 3, same as basin 5. Duplicate as project #5	Other									3			will help restore the design capacity.
South Broward Drainage District S-1 Pump Station	Fire suppression system for all pumps and upgraded exhaust	Other												Does not affect discharge or operations in any way.
South Broward Drainage District S-2 Pump Station	Fire suppression system for all pumps and upgraded exhaust. concrete roof and control panel upgrades	Other												Does not affect discharge or operations in any way.
South Broward Drainage District S-3 Pump Station	Fire suppression system for all pumps and upgraded exhaust	Other												Does not affect discharge or operations in any way.
South Broward Drainage District S-7 Pump Station	Fire suppression system for all pumps and upgraded exhaust	Other												Does not affect discharge or operations in any way.
South Broward Drainage District S-8 Pump Station	Fire suppression system for all pumps and upgraded exhaust	Other												Does not affect discharge or operations in any way.
C-9 Impoundment: Seepage Management		Other									4			Need more details

Project Name	Comment		Allows Operation Flexibility	Prevents "high water" from back flowing in	Increases discharge ability	Can alleviate primary system flooding	Can alleviate secondary system flooding	Can alleviate tertiary system flooding	Total Score	Improves Water Quality (neutral impact =3, positive impact =5)		How well developed is the project (conceptual = 1, full design=5)		Notes
Drainage Improvements for Eastern Shores		Other												Need more details
Miami Dade County Flood Criteria Map		Other												completed by the County
Retrofit the Control Structure to Block Surge		Other	**1**	**5**	**1**	**5**	**4**	**3**	**18**					Improvement to the primary system.
Stormwater Master Plan		Other												Recommended
Biscayne Bay and Southeastern Everglades Ecosystem Restoration (BBSEER); BBSEER project		Other									**4**			Additional conveyance route.
Add cut-off wall at impoundment to address seepage issues		Other									**3**			Model assumes no leakage- conceptually represents seepage collection
Make sure to consider different perspectives, such as insurance and land use issues		Other												none-structure strategy
Lake Belt Storage project		Other												
Good Neighbor Stormwater Park project, City of North Miami		Other									**5**			Need more details
an ongoing project to alleviate low-lying area flooding along A1A		Other									**4**			need more details
Regarding the C8 Canal & S28 Structure		Other												need clarification
Regarding the C9 Canal & S29 Structure		Other												Improvement to the primary system.
Pickwick Lake outfall replacement project		Other												Improvement to the primary system.
Canal bank improvement and roadway improvement planned in C8 Basin		Other												Improvement to the primary system.