### 5.2.12 STUDY AREA 12 – NORTH RIVERSIDE DRIVE AND NE 14TH STREET CAUSEWAY

This study area is primarily located along North Riverside Drive between NE 14th Street Causeway and NE 8th Street. This neighborhood is a mixture of single family homes, multi-family residential complex and commercial properties. The existing stormwater system within the study area consists of the FDOT system along US A1A and a City system along North Riverside Drive with three existing outfalls discharging directly to the Intracoastal Waterway. The topography of the study area along with the model schematics are displayed on Figure 5-12A after this section. The ground surface elevation along the centerline of North Riverside Drive is as low as 1.3 feet NAVD at some locations. Due to the very low elevation of the study area, the flooding problems within the study area are directly influenced by the tidal fluctuations within the Intracoastal Waterway.

The existing conditions stormwater model was used to simulate the performance of the existing stormwater management system in the study area during a 5-year, 24-hour design storm event with 7.8 inches of rainfall. The study area is defined by the sub-basins CE_041_01, CE_073_01 and CE_075_01 within the stormwater model. Based on topography, these sub-basins receive a significant amount of stormwater runoff from the areas east of US A1A within sub-basins CE_041_02, CE_074_01, and CE_077_01. Based on our analysis with the stormwater model, North Riverside Drive experiences significant flooding of greater than 2 inches throughout the entire length of the study area. Based on the results of the stormwater model, the extent of the estimated flooding within the study area is displayed Figure 5-12B at the end of this section. The system improvement alternatives investigated within this study area include pipe size upgrades and pump stations. Exfiltration trench was not considered as a potential system improvement alternative for this study area due to the very low ground surface elevation which would eliminate the effectiveness of either option.

**Alternative 1: Pipe Size Upgrades**

The stormwater model was used to conduct several simulations of various proposed pipe size upgrades at specific locations within the existing stormwater system. The purpose of this system improvement alternative is to increase conveyance capacity of the stormwater management system to alleviate the existing flooding issues quicker. Alternative 1 included the replacement of the existing City outfall pipes which discharge into the Intracoastal Waterway with a larger diameter pipe. Under Alternative 1, the existing 18-inch pipe will be replaced with a 36-inch pipe at NE 12th Street which includes a total pipe replacement of 200 linear feet. The two existing 15-inch outfall pipes at NE 11th Street will remain in place since it is a private system. The estimated design and construction costs for this pipe size upgrade alternative are approximately $636,000.

Based on the results of our analysis with the stormwater model, the reduction in peak flood stages under Alternative 1 are summarized in Table 5.12.1 below. Alternative 1 results in a maximum reduction of 0.31 feet in peak flood stage within the study area. Within the critical model node (Node IN_3131), the peak flood depth is reduced from 1.58 feet under the existing conditions to 0.25 feet under Alternative 1. For this alternative to be feasible, additional storage should be provided within sub-basin via regarded swales in the public right-of-way.

| Table 5.12.1 – Alternative 1 Peak Flood Stage Summary | | | | | |
|---|---|---|---|---|---|
| | Existing Conditions | | | Alternative 1 | |
| Nodes | Peak Stage (feet) | Ground Elevation (feet, NAVD) | Flood Depth (feet) | Peak Stage (feet) | Peak Reduction (feet) |
| IN_3425 | 4.05 | 2.6 | 1.45 | 4.02 | -0.03 |
| MH_0507 | 3.96 | 5.4 | 0.00 | 3.90 | -0.06 |
| IN_3149 | 3.52 | 1.5 | 2.02 | 3.31 | -0.21 |
| IN_3131 | 3.51 | 2.2 | 1.36 | 3.29 | -0.22 |
| MH_0623 | 3.50 | 2.2 | 1.35 | 3.19 | -0.31 |

Based on the results of our analysis with the stormwater model, the reduction in flooding duration under Alternative 1 is summarized in Table 5.12.2 below. According to the stormwater model, Alternative 1 results in a significant reduction in flooding duration with a maximum reduction of 84%. Within the critical model node (Node IN_3131), the flood duration is reduced from 6.7 hours under the existing conditions to 1.1 hours under Alternative 1.

| Table 5.12.2 – Alternative 1 Flood Duration Summary | | | | |
|---|---|---|---|---|
| Nodes | Reference Roadway Elevation (feet, NAVD) | Flood Duration (hours) | | |
| | | Existing Conditions | Alternative 1 | Reduction (%) |
| IN_3425 | 2.60 | 21.5 | 21.3 | 1 |
| IN_3131 | 2.15 | 6.7 | 1.1 | 84 |
| MH_0623 | 2.15 | 8.8 | 7.6 | 14 |

**Alternative 2: Pump Station**

The stormwater model was used to conduct several simulations of various proposed pump stations within the study area. The purpose of this system improvement alternative is to increase conveyance capacity of the stormwater management system to alleviate the existing flooding issues quicker. The proposed construction under Alternative 2 includes the installation of one pump station near the existing outfall from North Riverside Drive at model Node: IN_3131. The estimated design and construction costs for this pump station alternative are approximately $1,532,000. The components associated to the pump station are listed below.

* Install a new 18-inch discharge pipe from pump station to outfall into Intracoastal Waterway.
* Install new flap gates at existing outfalls for backflow prevention.
* Wet well with a total footprint of about 150 square feet and depth of 8 feet.
* Maximum pump capacity of 30 CFS, which is equivalent to the peak discharge of the existing drainage system during low tide conditions.

Based on the results of our analysis with the stormwater model, the reduction in peak flood stages under Alternative 2 are summarized in Table 5.12.3 below. According to the stormwater model, Alternative 2 results in minimal reductions in the peak flood stage throughout the study area. Within the critical model node (Node IN_3131), the peak flood depth is reduced from 1.36 feet under the existing conditions to 1.30 feet under Alternative 2.

| Table 5.12.3 – Alternative 2 Peak Flood Stage Summary | | | | | |
|---|---|---|---|---|---|
| | Existing Conditions | | | Alternative 2 | |
| Nodes | Peak Stage (feet) | Ground Elevation (feet, NAVD) | Flood Depth (feet) | Peak Stage (feet) | Peak Reduction (feet) |
| IN_3425 | 4.05 | 2.6 | 1.45 | 4.05 | 0.00 |
| MH_0507 | 3.96 | 5.4 | 0.00 | 3.95 | -0.01 |
| IN_3149 | 3.52 | 1.5 | 2.02 | 3.46 | -0.06 |
| IN_3131 | 3.51 | 2.2 | 1.36 | 3.45 | -0.06 |
| MH_0623 | 3.50 | 2.2 | 1.35 | 3.44 | -0.06 |

Based on the results of our analysis with the stormwater model, the reduction in flooding duration under Alternative 2 is summarized in Table 5.12.4 below. According to the stormwater model, the estimated reduction in flooding duration within the study area is relatively limited under Alternative 2. Within the critical model node (Node IN_3131), the flood duration is reduced from 6.7 hours under the existing conditions to 4.8 hours under Alternative 2.

| Table 5.12.4 – Alternative 2 Flood Duration Summary | | | | |
|---|---|---|---|---|
| Nodes | Reference Roadway Elevation (feet, NAVD) | Flood Duration (hours) | | |
| | | Existing Conditions | Alternative 2 | Reduction (%) |
| IN_3425 | 2.60 | 21.5 | 21.5 | 0 |
| IN_3131 | 2.15 | 6.7 | 4.8 | 28 |
| MH_0623 | 2.15 | 8.8 | 8.0 | 9 |

**Alternative 3: Pumped Drainage Well**

The stormwater model was used to conduct several simulations of various proposed pump stations within the study area. The purpose of this system improvement alternative is to increase conveyance capacity of the stormwater management system to alleviate the existing flooding issues quicker. The proposed construction under Alternative 3 includes the installation of one pumped drainage well near the existing outfall from North Riverside Drive at model Node: IN_3131. The estimated design and construction costs for this pump station alternative are approximately $813,000. The components associated to the pumped drainage well are listed below.

* Install a new 18-inch discharge pipe from pump station to outfall into Intracoastal Waterway.
* Install new flap gates at existing outfalls for backflow prevention.
* Install new pumped drainage well, maximum pump capacity of 9 CFS, which is equivalent to the peak discharge of the existing drainage system during low tide conditions.

Based on the results of our analysis with the stormwater model, the reduction in peak flood stages under Alternative 3 are summarized in Table 5.12.5 below. According to the stormwater model, Alternative 3 results in minimal reductions in the peak flood stage throughout the study area. Within the critical model node (Node IN_3131), the peak flood depth is reduced from 1.36 feet under the existing conditions to 1.31 feet under Alternative 3.

| Table 5.12.5 – Alternative 3 Peak Flood Stage Summary | | | | | |
|---|---|---|---|---|---|
| | Existing Conditions | | | Alternative 3 | |
| Nodes | Peak Stage (feet) | Ground Elevation (feet, NAVD) | Flood Depth (feet) | Peak Stage (feet) | Peak Reduction (feet) |
| IN_3425 | 4.05 | 2.6 | 1.45 | 4.05 | 0.00 |
| MH_0507 | 3.96 | 5.4 | 0.00 | 3.95 | -0.01 |
| IN_3149 | 3.52 | 1.5 | 2.02 | 3.47 | -0.05 |
| IN_3131 | 3.51 | 2.2 | 1.36 | 3.46 | -0.05 |
| MH_0623 | 3.50 | 2.2 | 1.35 | 3.45 | -0.05 |

Based on the results of our analysis with the stormwater model, the reduction in flooding duration under Alternative 3 is summarized in Table 5.12.6 below. According to the stormwater model, the estimated reduction in flooding duration within the study area is relatively limited under Alternative 2. Within the critical model node (Node IN_3131), the flood duration is reduced from 6.7 hours under the existing conditions to 4.5 hours under Alternative 2.

| Table 5.12.6 – Alternative 3 Flood Duration Summary | | | | |
|---|---|---|---|---|
| Nodes | Reference Roadway Elevation (feet, NAVD) | Flood Duration (hours) | | |
| | | Existing Conditions | Alternative 3 | Reduction (%) |
| IN_3425 | 2.60 | 21.5 | 21.5 | 0 |
| IN_3131 | 2.15 | 6.7 | 4.5 | 32 |
| MH_0623 | 2.15 | 8.8 | 7.7 | 13 |

**Alternative 4: Pumped Drainage Well and Pipe Size Upgrades**

The stormwater model was used to conduct several simulations of various proposed pump stations within the study area. The purpose of this system improvement alternative is to increase conveyance capacity of the stormwater management system to alleviate the existing flooding issues quicker. The proposed construction under Alternative 4 includes the installation of one pumped drainage well with the same characteristics from Alternative 3 and the installation of pipe size upgrades with the same characteristics as noted in Alternative 1. The estimated design and construction costs for this alternative are approximately $979,000.

Based on the results of our analysis with the stormwater model, the reduction in peak flood stages under Alternative 4 are summarized in Table 5.12.7 below. According to the stormwater model, Alternative 4 results in minimal reductions in the peak flood stage throughout the study area. Within the critical model node (Node IN_3131), the peak flood depth is reduced from 1.36 feet under the existing conditions to 1.04 feet under Alternative 4.

| Table 5.12.7 – Alternative 4 Peak Flood Stage Summary | | | | | |
|---|---|---|---|---|---|
| | Existing Conditions | | | Alternative 4 | |
| Nodes | Peak Stage (feet) | Ground Elevation (feet, NAVD) | Flood Depth (feet) | Peak Stage (feet) | Peak Reduction (feet) |
| IN_3425 | 4.05 | 2.6 | 1.45 | 4.01 | -0.04 |
| MH_0507 | 3.96 | 5.4 | 0.00 | 3.89 | -0.07 |
| IN_3149 | 3.52 | 1.5 | 2.02 | 3.20 | -0.32 |
| IN_3131 | 3.51 | 2.2 | 1.36 | 3.19 | -0.32 |
| MH_0623 | 3.50 | 2.2 | 1.35 | 3.12 | -0.38 |

Based on the results of our analysis with the stormwater model, the reduction in flooding duration under Alternative 4 is summarized in Table 5.12.8 below. According to the stormwater model, the estimated reduction in flooding duration within the study area under Alternative 4 is much greater than the previous alternatives listed. Within the critical model node (Node IN_3131), the flood duration is reduced from 6.7 hours under the existing conditions to 1.0 hours under Alternative4.

| Table 5.12.8 – Alternative 4 Percent Flood Duration Reduction | | | | |
|---|---|---|---|---|
| Nodes | Reference Roadway Elevation (feet, NAVD) | Flood Duration (hours) | | |
| | | Existing Conditions | Alternative 4 | Reduction (%) |
| IN_3425 | 2.60 | 21.5 | 21.3 | 1 |
| IN_3131 | 2.15 | 6.7 | 1.0 | 85 |
| MH_0623 | 2.15 | 8.8 | 7.6 | 14 |

**Alternative Comparison**

Refer to Table 5.12.9 below for a comparison of the various system improvement alternatives for this study area. Please note the peak flood stage and flood reduction results within Table 5.12.9 refer to the critical problem area of the study area, which corresponds to Node IN_3131 within the stormwater model. Based on our analysis with the stormwater model, Alternative 4 provides significantly better flood control benefits to the study area in regards to the reduction of both peak flood stages and expected flood duration than all other alternatives. Alternative 4 should be implemented for this study area since it provides better flood control benefits. Although Alternative 4 does not provide enough additional flood protection to meet the level of service criteria for all public roadways within the study area, Alternative 4 does provide significant benefits which alleviate the flooding problems within the study area.

| Table 5.12.9 – Alternative Comparison | | | |
|---|---|---|---|
| Alternative | Peak Flood Stage Reduction (feet) | Flood Duration Reduction (hours) | Implementation Costs ($) |
| Alternative 1 | 0.22 | 5.6 | $636,000 |
| Alternative 2 | 0.06 | 1.9 | $1,532,000 |
| Alternative 3 | 0.05 | 2.2 | $813,000 |
| Alternative 4 | 0.32 | 5.7 | $976,000 |

The recommended stormwater improvements for this study area include the installation of a new pumped drainage well and the replacement of one existing outfall pipe with 36-inch diameter pipe. The proposed

upsized outfall pipe is intended to reduce flooding within North Riverside Drive during low tide periods within the Intracoastal Waterway. Due to the extremely low ground surface elevations along North Riverside Drive, the proposed upsized outfall pipe will not assist with the gravity discharge during high tide periods within the Intracoastal Waterway. The installation of the pumped drainage well is intended to reduce flooding within North Riverside Drive during high tide periods within the Intracoastal Waterway. Due to the negative impacts of high tide on the performance of the stormwater system in this study area, the proposed improvements also include the installation of backflow prevention devices at this outfall from North Riverside Drive. The swale areas should also be regraded throughout the study area to provide additional storage volume for stormwater runoff. For the recommended stormwater improvements for this study area, CMA has prepared a conceptual layout, which is enclosed within Appendix A-1 and a preliminary cost estimate, which is enclosed within Appendix A-2. During the detailed design phase, Alternative 4 will encounter various constructability concerns related to the replacement of outfall pipe within utility easements on private property and regulatory limitations on the peak discharge via the upsized outfall pipes.

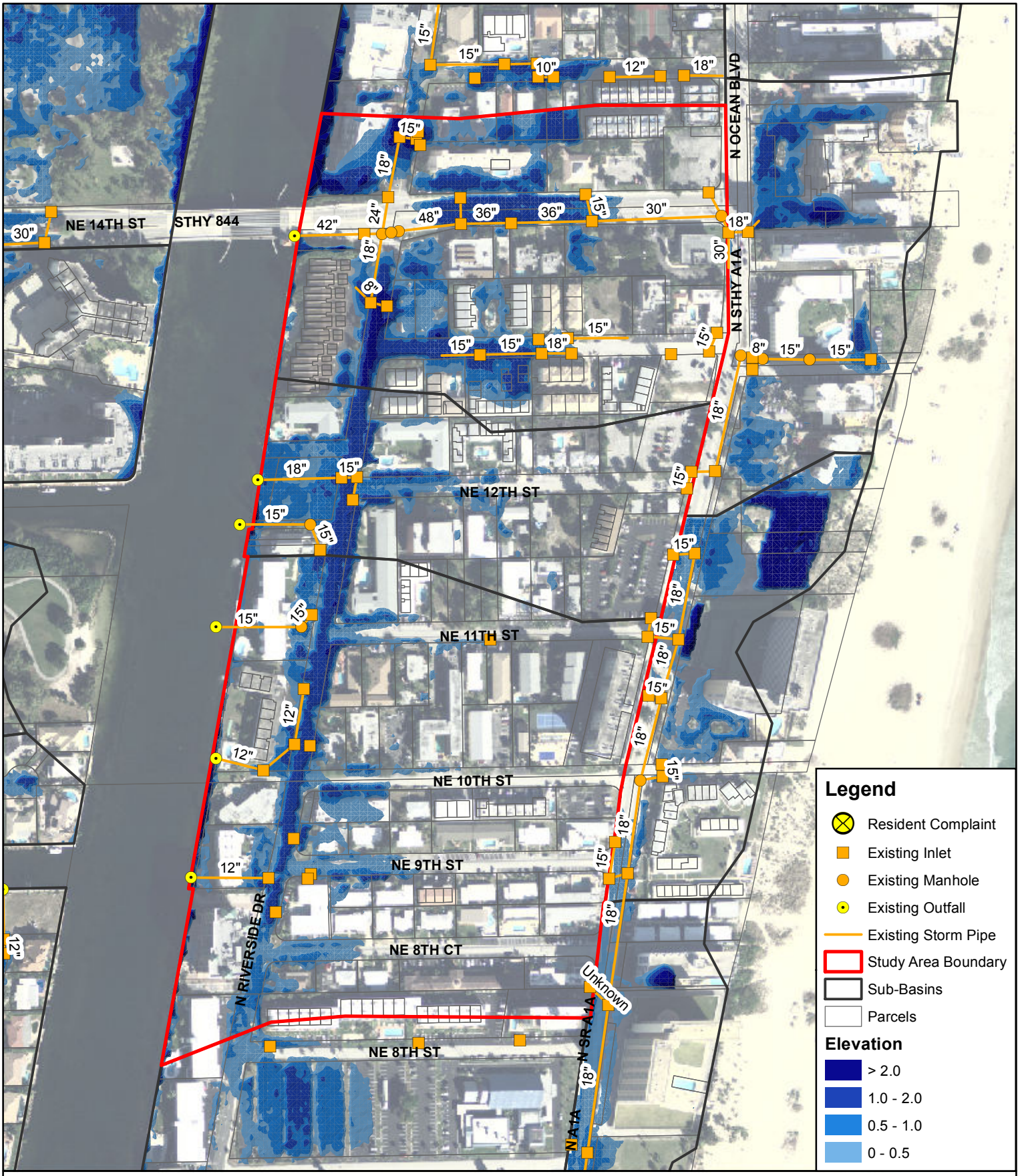

pompano beach
Florida's Warmest Welcome

CHEN·MOORE
&ASSOCIATES

**Figure 5-12A**
**N Riverside Drive & NE 14th Street Causeway**
**Existing Topography & Model Schematics**

N
W E
S

0 200 400
Feet




pompano beach
Florida's Warmest Welcome

CHEN·MOORE &ASSOCIATES

**Figure 5-12B**
**N Riverside Drive & NE 14th Street Causeway**
**Potential Flooding Depth**

N
W E
S

0 200 400
Feet