CITY OF PORT ST. JOE CENTRAL CHANNEL STORMWATER MASTER PLAN

PORT ST. JOE, FLORIDA

OCTOBER 31, 2024

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1. Executive Summary

The City of Port St. Joe Central Channel Stormwater Master Plan project was completed to create an existing conditions model of the City project area, assess alternative solutions to improve the City's stormwater system, and provide a model that can be used in the future for any potential projects or assessments. Multiple baseline simulations were completed to model resulting flood elevations in the City for different events. These results were used to assess alternative solutions such as channel modifications, wetlands creation, pipe upgrades, and tidal gates. A level of service analysis was also completed for the closed stormwater network in the project area. Multiple options presented in this report present opportunities to improve circulation in the system, upgrade infrastructure, and improve flood elevations throughout the project area. The following sections summarize the model set up, solutions models, and future recommendations.

2. Background

Dewberry developed a Stormwater Master Plan (SWMP) for the City of Port St. Joe, FL in January 2021, funded by the Northwest Florida Water Management District (NWFWMD) and Florida Trustee Implementation Group. The purpose of this project was to map the existing stormwater system, identify areas for improvement, and provide a plan of action for addressing flooding and water quality entering St. Joseph Bay.

The purpose of this City of Port St. Joe Central Channel SWMP project was to expand on the 2021 SWMP by modeling the Central Channel, Chicken House Branch, and Depot Creek in the City as well as surrounding closed stormwater networks. Utilizing the previous Master Plan stormwater network inventory and basin delineation, this study utilized ICPR 2D modeling software to build upon the results of the previous study and use model results to guide assessment of alternatives. The alternatives assessed in this project address flooding and infrastructure issues in the City and provide options for future design and construction projects. The existing and proposed ICPR 2D models from this master plan can be used to further develop design projects and model potential future projects, allowing the model to be refined, expanded and updated for any future stormwater needs for the City.

The main objectives of this project are to:

- Explain the existing stormwater network and connectivity
- Provide a buildable, comprehensive existing conditions model
- Provide alternative options for potential grant opportunities and design projects
- Provide a level of service analysis for the stormwater system
- Allow for the model to be built upon and expanded in future projects

3. Survey

Dewberry collected detailed survey for 23 cross sections, 23 structural crossings, and approximately 490 pipe sections throughout the scoped area shown in **Appendix A**. A full survey report can be viewed in **Appendix A** including photos, sketches, and detailed survey data. All survey data was incorporated into the 2D model, and any data included outside of the survey scope was supplemented with data from the 2021 SWMP inventory.

4. ICPR 2D Model Setup

ICPR 2D was selected for this project in order to accurately model the flat, coastal topography of the project area and the open channel and closed stormwater networks. ICPR 2D is a hydrologic and hydraulic modeling engine that uses a 2D computational framework and integrated 1D and 2D surface flow. Results including flood extents, velocity vectors, and water surface profiles can be rendered using these methodologies. ICPR also has diverse groundwater capabilities that could be further explored and added to this model in the future. **Appendix B** outlines the various parameters, inputs, and components of this model in detail and explains how the results and alternatives in the report were computed and evaluated.

Figure 1 below shows the model extents for this project. The 2D mesh was expanded to the south to capture more area than the survey scope in order to incorporate this area for future use. The extended area was modeled at a coarse resolution that can be refined for future work. The results maps for the scenarios shown in this report are shown for the area of more refined resolution in order to optimize run times, but the models contain results for the entire area.

Figure 1: ICPR Model Extents

The model was calibrated using data from hurricanes as well as monitoring data at four project site locations. Details on the model calibration data and results can be viewed in **Appendix C**. The overall stormwater network and survey project area can be viewed in the Reference Maps in **Appendix D**. The maps provided in this appendix detail the extents of the pluvial models and indicate flow direction for the closed and open systems.

5. Baseline Model and Simulations

5.1 Storm Surge Considerations

Two storm surge boundary conditions were considered in order to assess surge propagation through the system. Surge Condition A modeled Hurricane Michael (October 2018) as the surge event. Hurricane Michael is the largest storm surge in recent years and has surge data available from the LSU CERA ADCIRC model to accurately model the surge hydrograph. This consideration was also used as a calibration event, as photographic and anecdotal evidence of water surface elevations were compared to model results. The model validation from this event is further discussed in **Appendix C**. Surge Condition B modeled the 25-year storm surge event. The surge hydrograph was determined by finding a representative storm from the JPM-OS storm suite and using the 25-year storm surge elevation Hurricane Helene was also modeled as an additional surge event (with rainfall) to further analyze the surge conditions modeling and compare results to actual flooding from the event.. **Figure 2** below shows a comparison of Surge Conditions A and B, and the maps at the end of this section show the model results and flood extents of the various surge events. These figures highlight the areas of high impact from surge conditions and were used for the alternative options discussed later in this report. These storm surge results can be used to anticipate future impacts from storm surges and build resilient infrastructure in vulnerable areas.

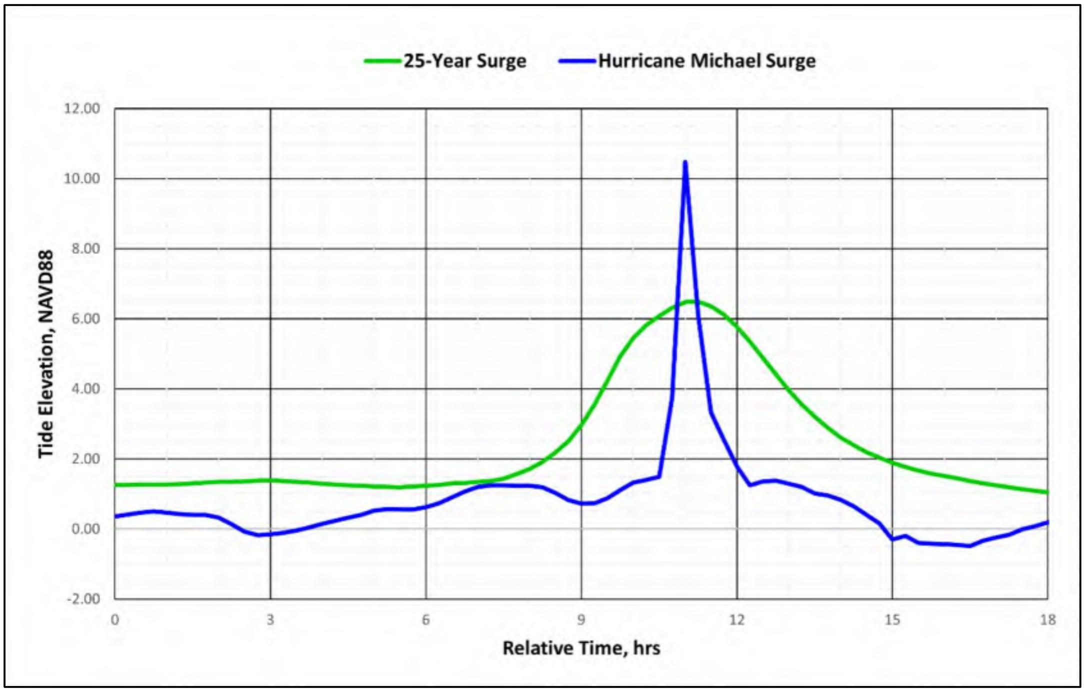


Figure 2: 25-Year and Hurricane Michael Storm Surge Elevations

5.2 Pluvial Flooding Considerations

The 10-, 25-, and 100-year precipitation events were modeled in ICPR using the rain-on-grid approach. Each scenario was run using tidal boundary conditions, and a small and large tidal range (1ft and 2ft, respectively) was evaluated for each. Results maps for each pluvial event can be viewed at the end of this section. The maps display the pluvial flood conditions throughout the project site and show the flooding extents for each event. The maps were used to identify areas of concern and were used to inform the alternatives assessed and level of service analysis discussed later in the report.

5.3 Water Quality Considerations

In order to assess circulation of the system and water quality, a continuous 1-month simulation with tidal boundaries was run. The ICPR Overland Flow Region was extended into St. Joseph Bay, and a Boundary Condition Line in ICPR was used to set the tide elevation boundary conditions and to allow water to flow in and out of the Overland Flow Region.

The tidal boundary condition was developed using NOAA tidal prediction data. **Figure 3** shows the NOAA tidal prediction data for June 2024, which was used for the ICPR coastal boundary condition. This month was selected because the tidal predictions during this month progress through two full cycles of high and low amplitude.

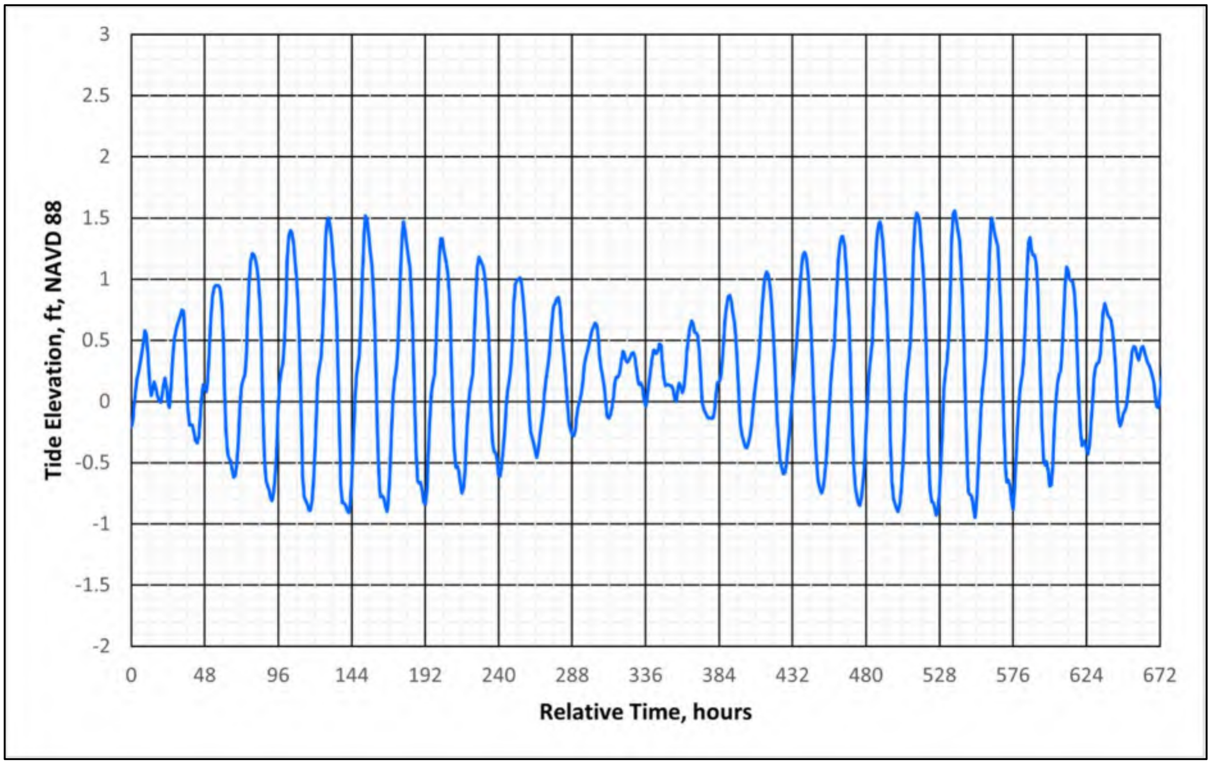


Figure 3: 1-Month Continuous Water Quality Simulation Tidal Boundary Condition

The model results showed water was circulating well through the system with various choke points at culvert crossings. The alternatives discussed below, including the channel modifications, took the results from this analysis into consideration and modeled ways to improve circulation in the system.

5.4 Baseline Simulation Maps

The following section displays results maps from the storm surge and pluvial flooding baseline simulations.

Legend

Model Extents

Model Results - Hurricane Michael

Depth, ft

- < 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- > 5

Port St. Joe Hydrologic Study

Hurricane Michael Surge Condition Model Results

Legend

Model Extents

Model Results - Hurricane Helene

Depth, ft

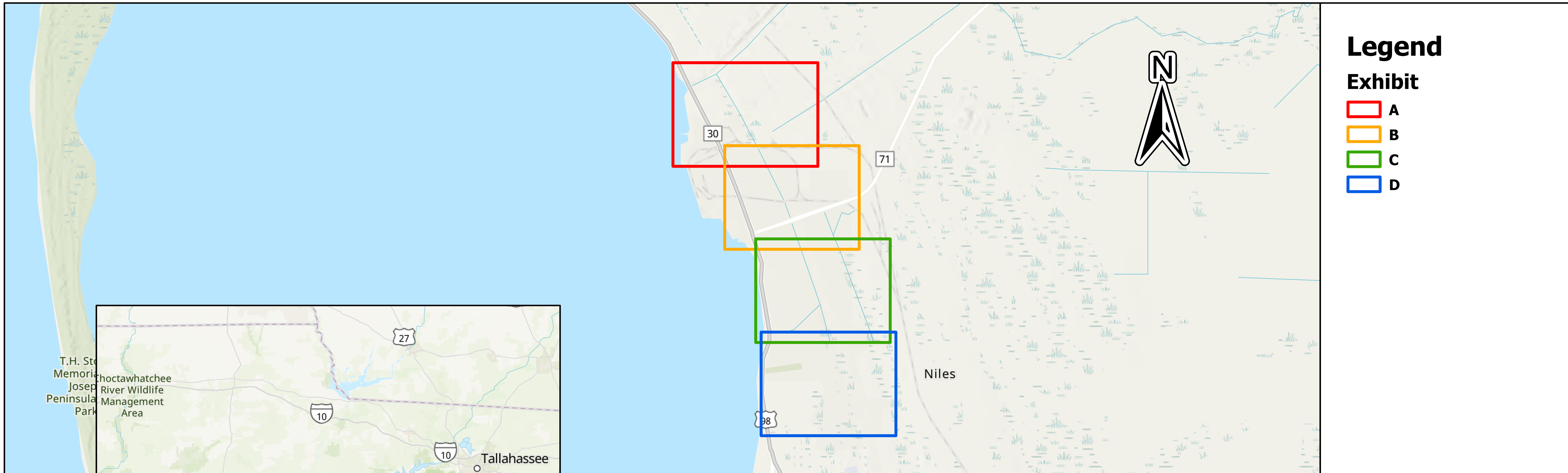
- < 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- > 5

Port St. Joe Hydrologic Study

Hurricane Helene Surge and Rainfall Condition Model Results

Port St. Joe Hydrologic Study

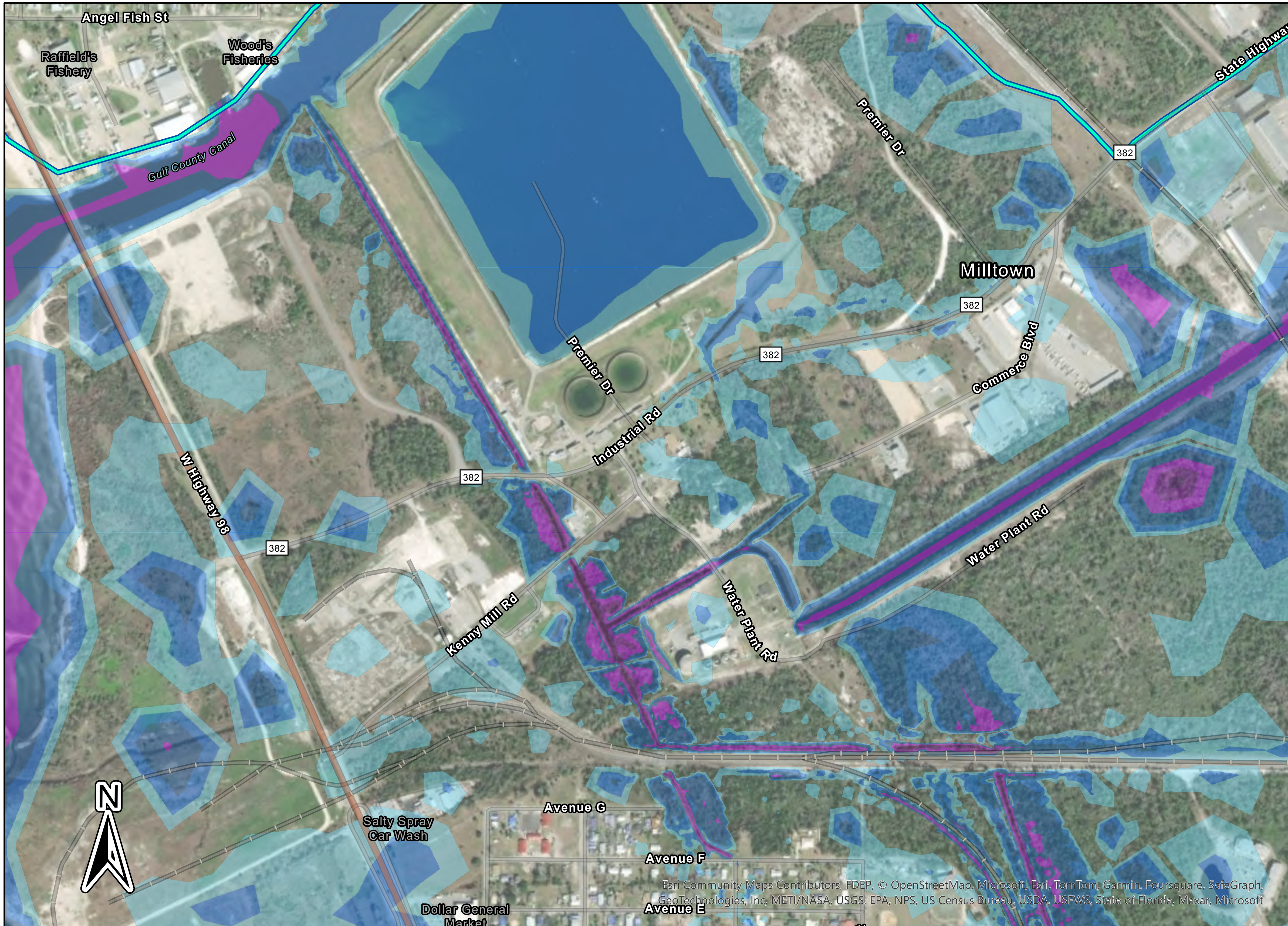
25-Year Surge Condition Model Results



Port St. Joe Hydrologic Study

Existing Conditions Model Results

Reference Map



Legend

Model Extents

Model Results - 10-year, 24-hour Storm Event

Depth, ft

- < 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- > 5

Port St. Joe Hydrologic Study

Existing Conditions Model Results

10-yr, 24-hr Rainfall Event

Exhibit A

Legend

Model Extents

Model Results - 10-year, 24-hour Storm Event

Depth, ft

- < 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- > 5

Port St. Joe Hydrologic Study

Existing Conditions Model Results

10-yr, 24-hr Rainfall Event

Exhibit B

Legend

Model Extents

Model Results - 10-year, 24-hour Storm Event

Depth, ft

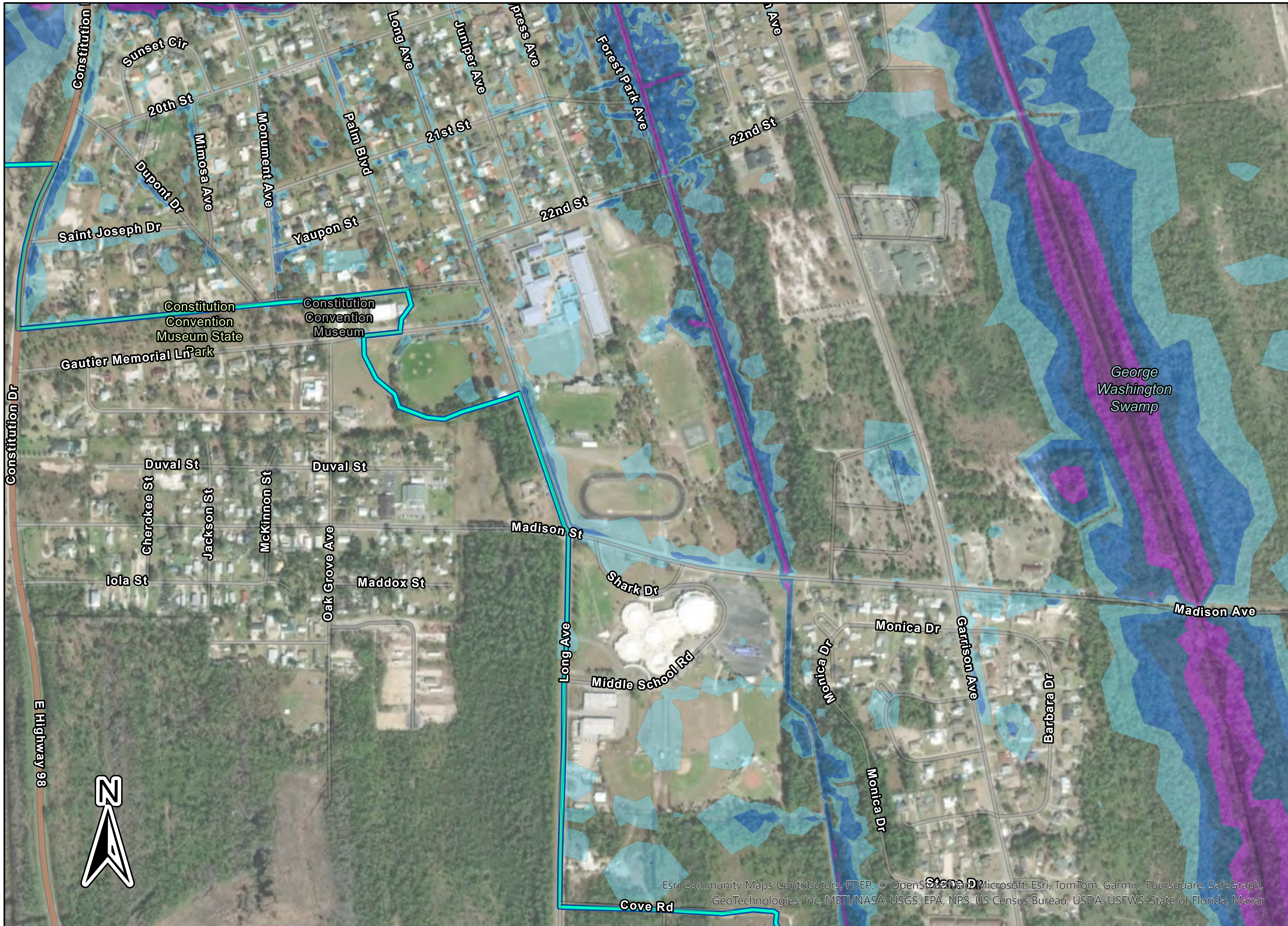
- < 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- > 5

Port St. Joe Hydrologic Study

Existing Conditions Model Results

10-yr, 24-hr Rainfall Event

Exhibit C



Legend

Model Extents

Model Results - 10-year, 24-hour Storm Event

Depth, ft

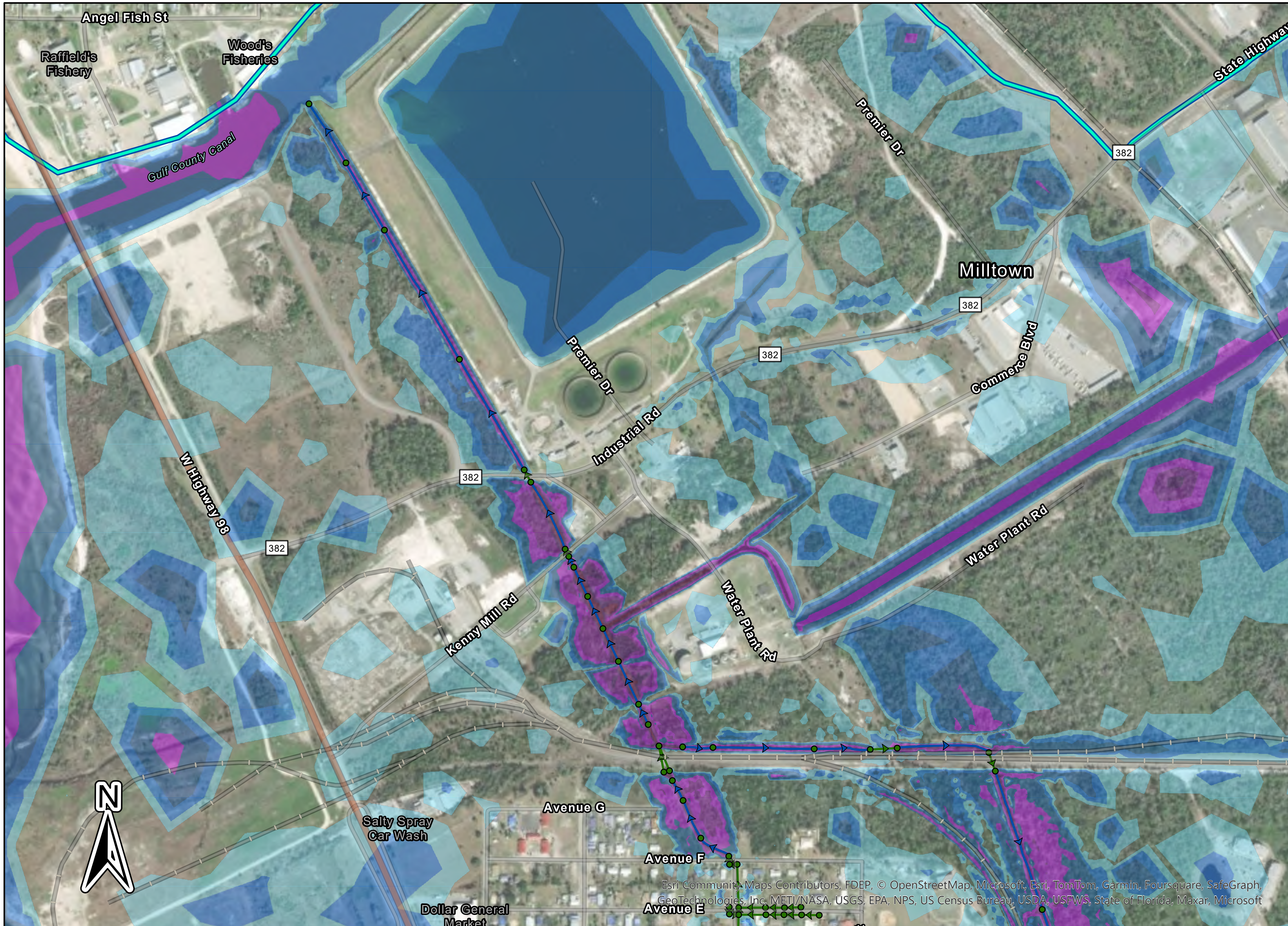
- < 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- > 5

Port St. Joe Hydrologic Study

Existing Conditions Model Results

10-yr, 24-hr Rainfall Event

Exhibit D

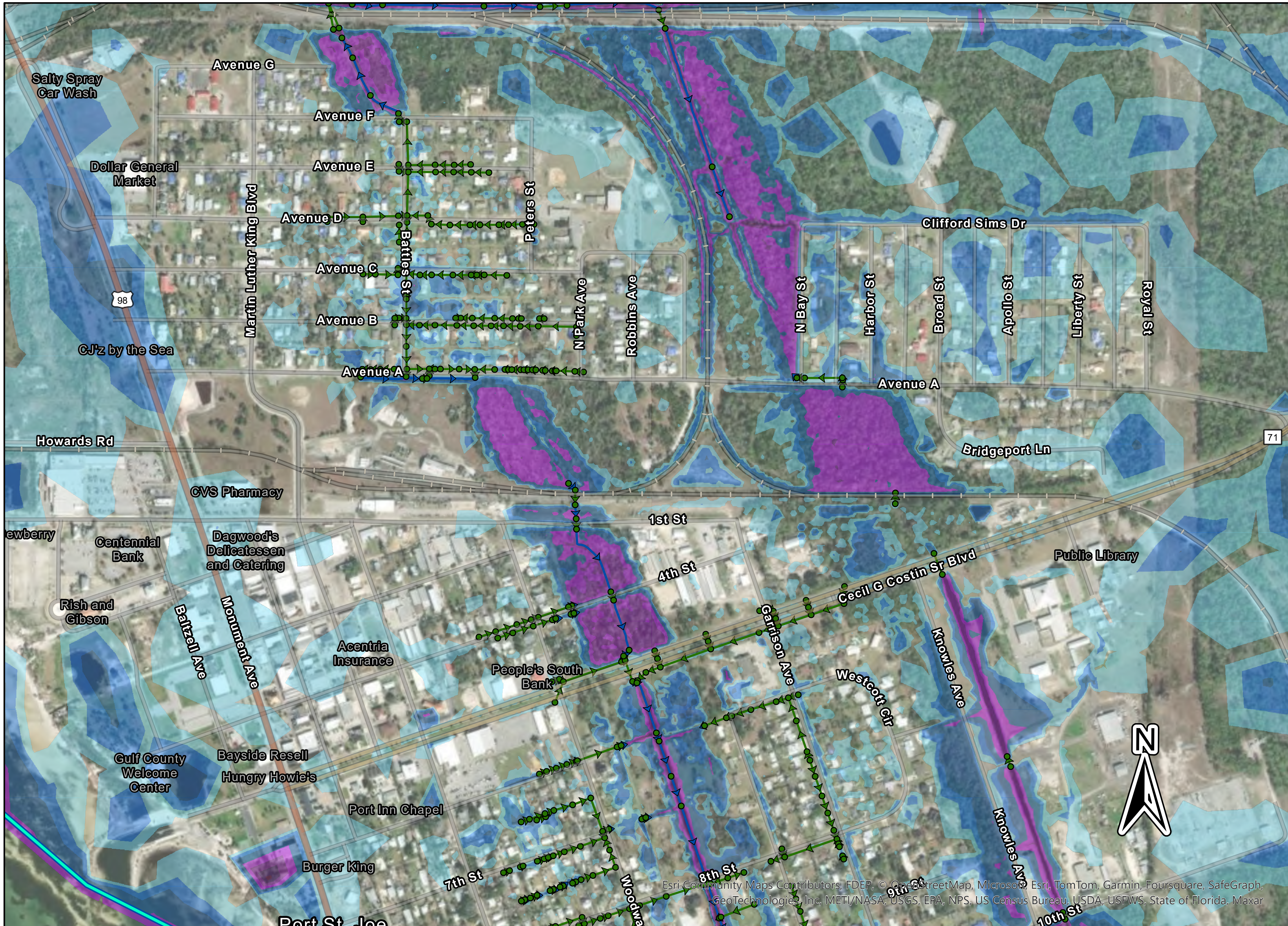


Port St. Joe Hydrologic Study

Existing Conditions Model Results

25-yr, 24-hr Rainfall Event

Exhibit A



Legend

- Model Nodes
- Pipes
- Channels

Model Results - 25-year, 24-hour Storm Event

Depth, ft

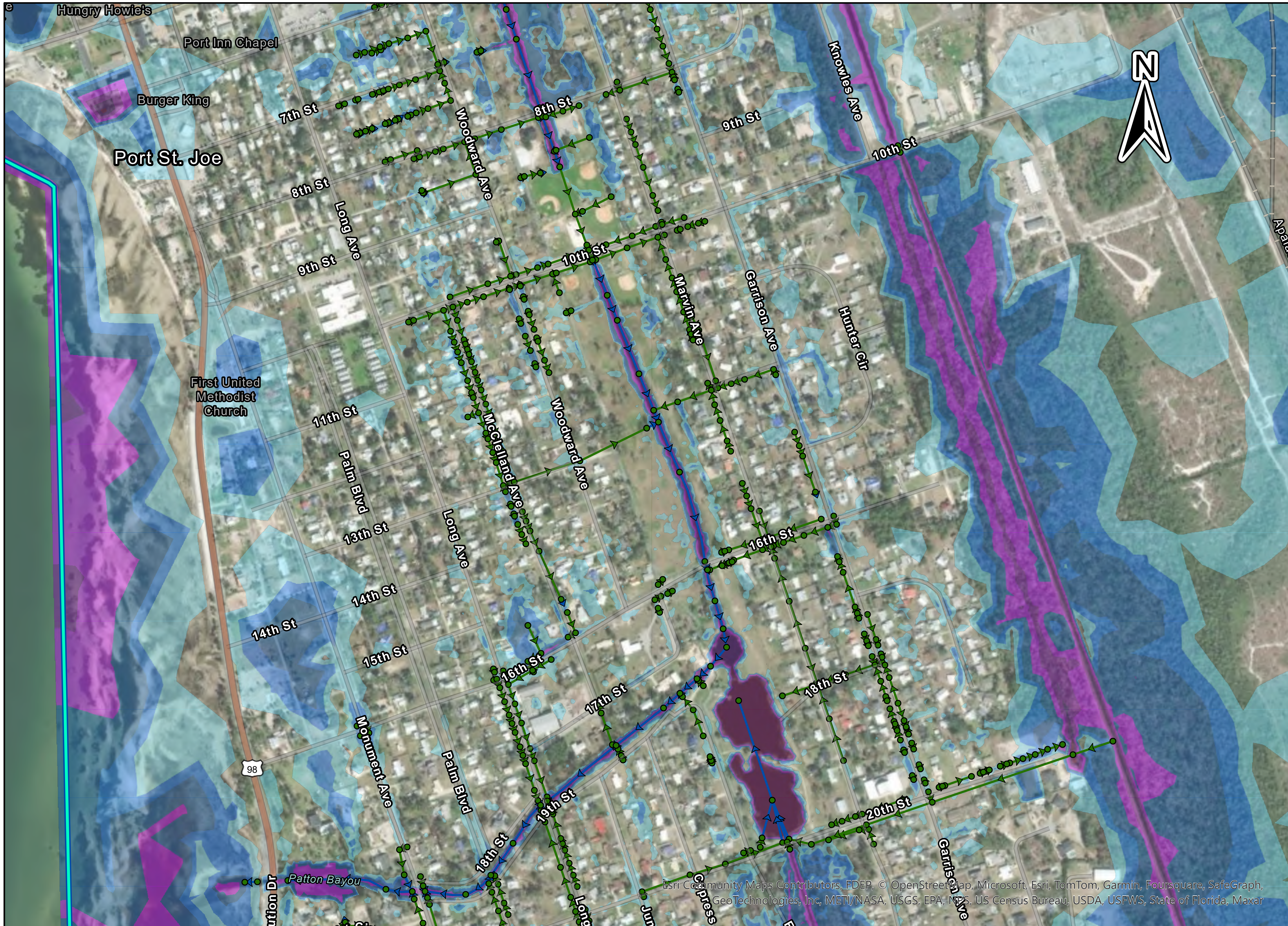
- < 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- > 5
- Model Extents

Port St. Joe Hydrologic Study

Existing Conditions Model Results

25-yr, 24-hr Rainfall Event

Exhibit B



Legend

- Model Nodes
- Pipes
- Channels

Model Results - 25-year, 24-hour Storm Event

Depth, ft

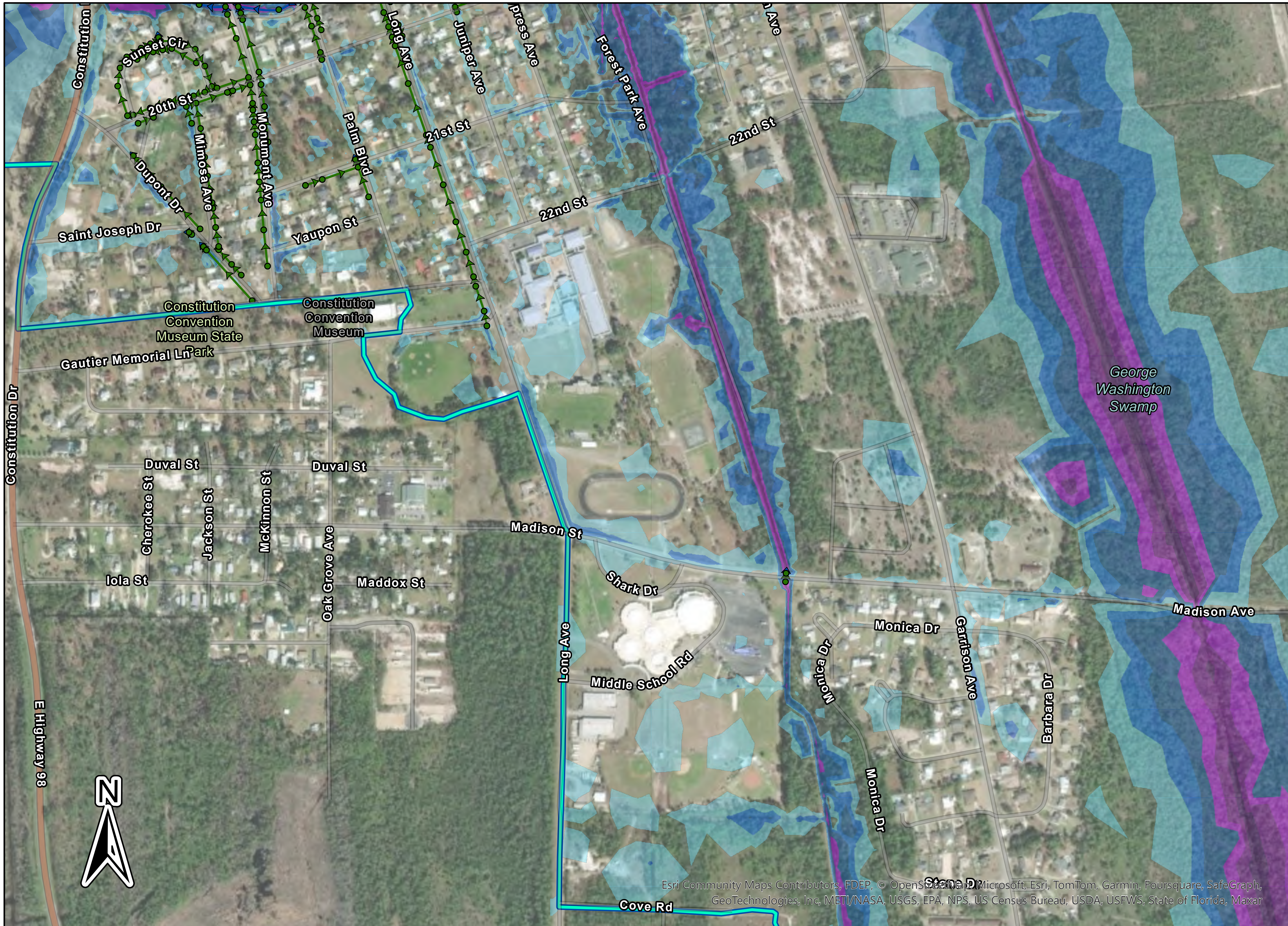
- < 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- > 5
- Model Extents

Port St. Joe Hydrologic Study

Existing Conditions Model Results

25-yr, 24-hr Rainfall Event

Exhibit C

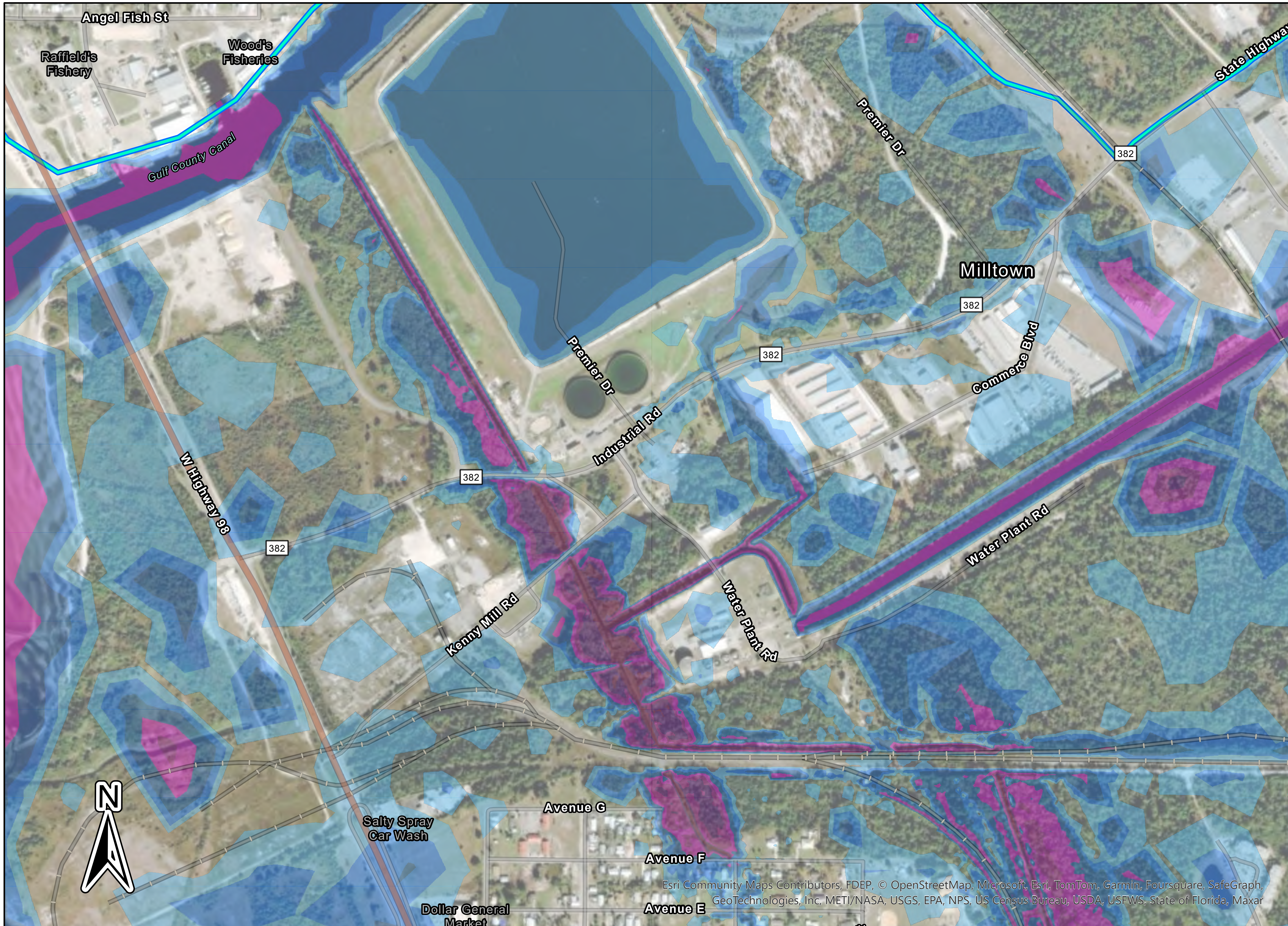


Port St. Joe Hydrologic Study

Existing Conditions Model Results

25-yr, 24-hr Rainfall Event

Exhibit D



Legend

Model Extents

Model Results - 100-year, 24-hour Storm Event

Depth, ft

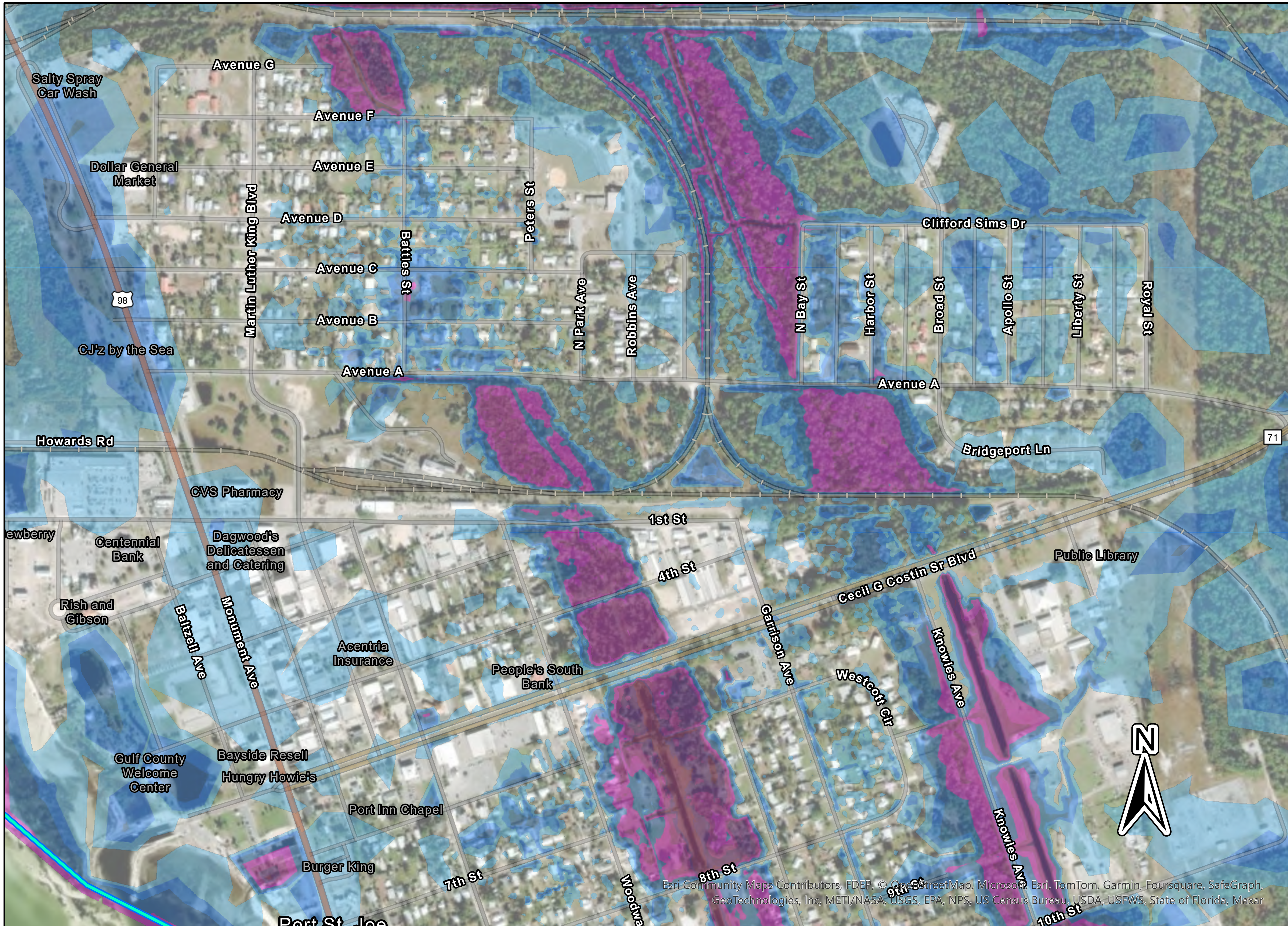
- < 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- > 5

Port St. Joe Hydrologic Study

Existing Conditions Model Results

100-yr, 24-hr Rainfall Event

Exhibit A



Legend

Model Extents

Model Results - 100-year, 24-hour Storm Event

Depth, ft

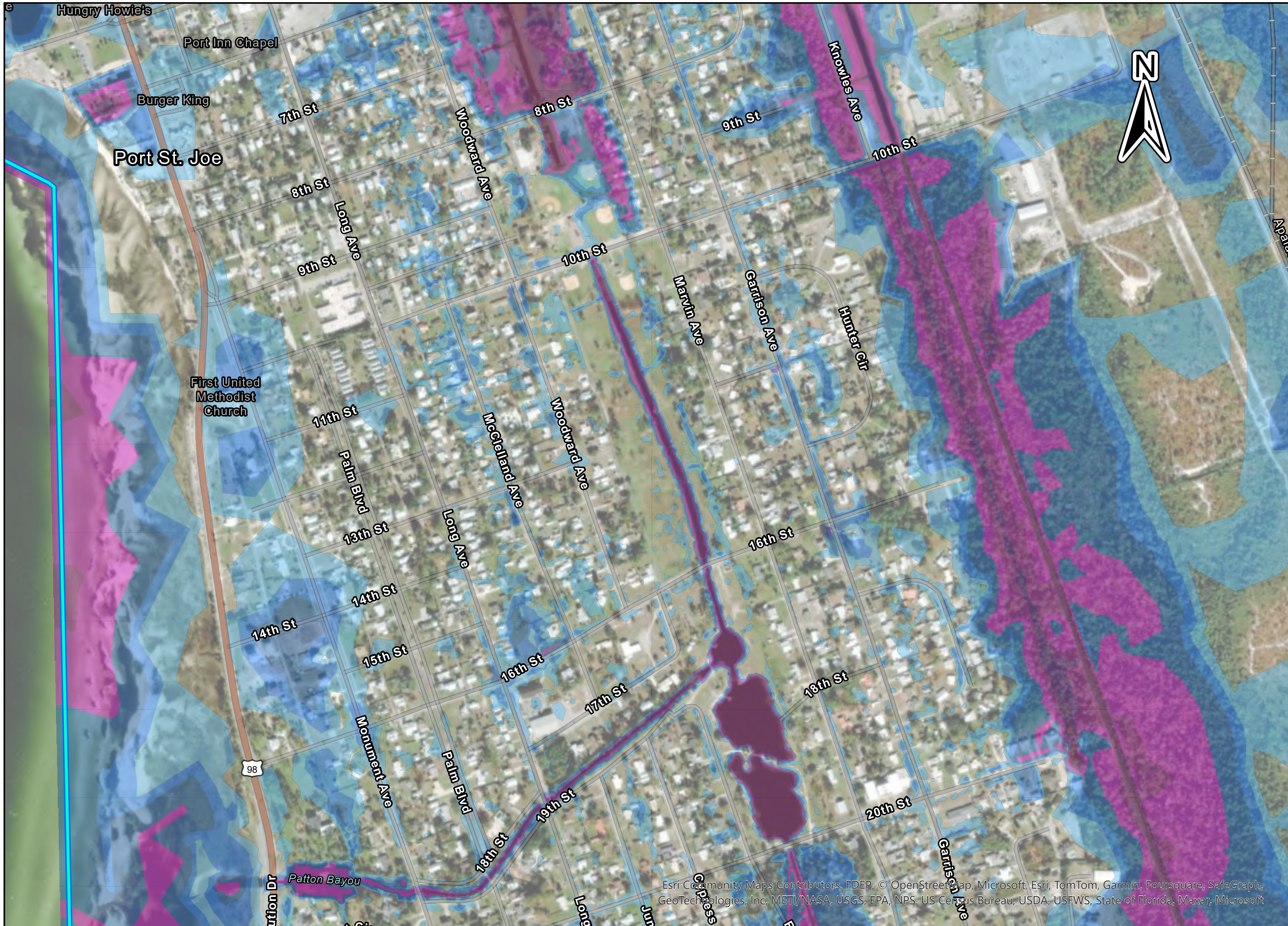
- < 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- > 5

Port St. Joe Hydrologic Study

Existing Conditions Model Results

100-yr, 24-hr Rainfall Event

Exhibit B



Legend

Model Extents

Model Results - 100-year, 24-hour Storm Event

Depth, ft

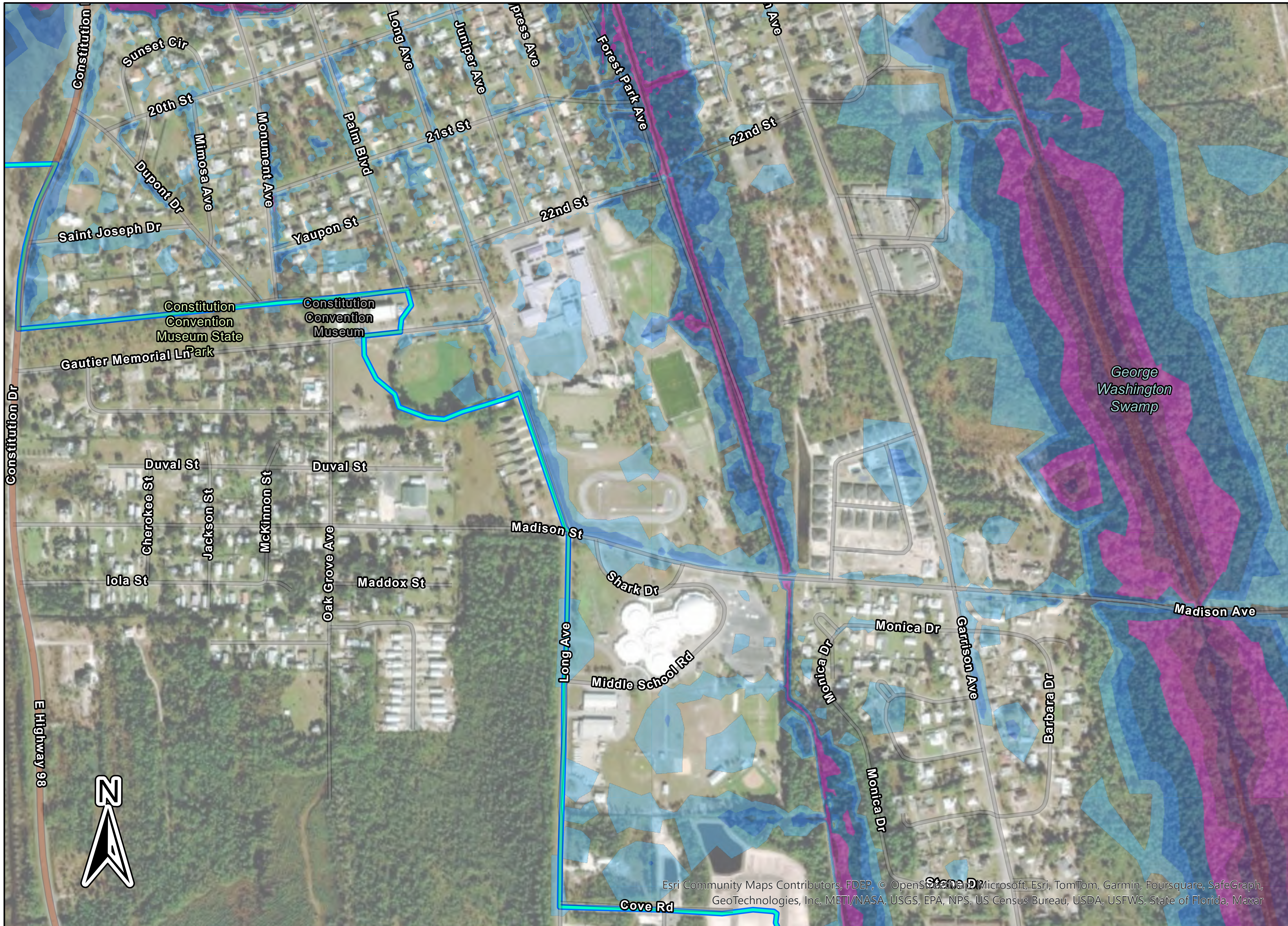
- < 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- > 5

Port St. Joe Hydrologic Study

Existing Conditions Model Results

100-yr, 24-hr Rainfall Event

Exhibit C



Legend

Model Extents

Model Results - 100-year, 24-hour Storm Event

Depth, ft

- < 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- > 5

Port St. Joe Hydrologic Study

Existing Conditions Model Results

100-yr, 24-hr Rainfall Event

Exhibit D

6. Assessment of Alternatives

Multiple major project improvements were assessed as alternative options to improve flood elevations and stormwater circulation in the project area. Each alternative option is outlined below including the Culvert Rehabilitation between 8th and 10th Street, Wetlands Creation, 20th Street Connection Improvements, Channel Modifications, Tidal Gates on Patton Bayou, Battle Street Daylighting, and Improvements to the Channel Between Ave F and the Railroad. A few scoped options have been combined into one section in this report based on model results and benefits to the overall system.

6.1 Culvert Replacement Between 8th and 10th Street

During the timeline of this project, the culvert between 8th and 10th Street has continued to cause issues and sink holes, and the analysis was shifted to determine the culvert size needed to replace the 48-in existing metal pipe. It was determined that the pipe condition was too poor for rehabilitation, so replacement options were assessed to optimize pipe size while not increasing flows.

The Existing Conditions baseline simulations indicate that this culvert is a bottleneck for pluvial flood waters exiting the system through the Central Channel. **Figure 4** below shows the maximum water surface elevation model results from the 10-year, 24-hour baseline simulation and show the pipe flowing full.

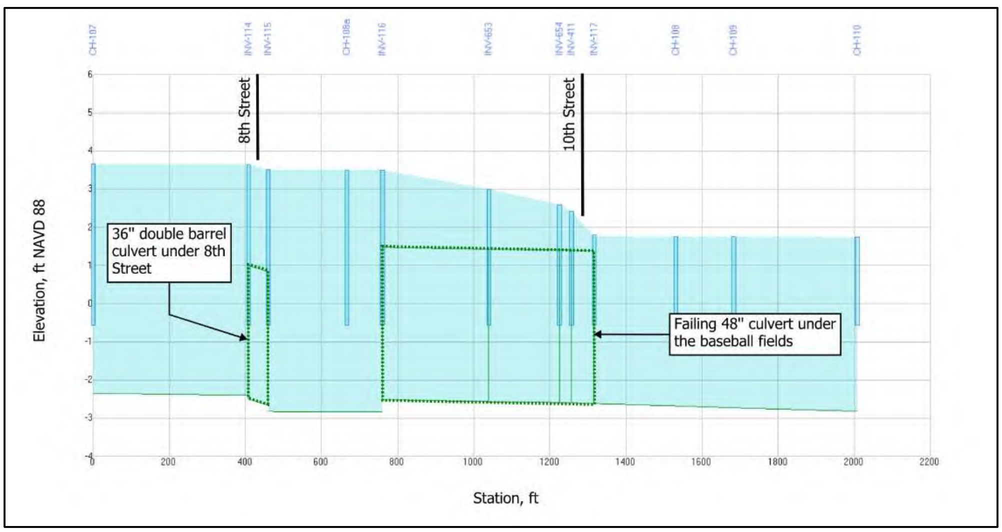


Figure 4: Pipe & Channel Profile Between 10th and 8th Street Showing the Water Level for the 10-Year, 24-Hour Baseline Simulation

It was determined that a 60-in pipe replacement was the maximum feasible pipe size due to site constraints and cover. **Figure 5** shows a profile of the proposed pipe and channel system between 8th and 10th Street, with results from the 10-year, 24-hour design storm. The increased pipe size reduces the upstream water surface elevation by approximately 1-ft due to additional storage capacity in the pipe. The pipe size increases did not increase flows significantly downstream due to the water surface elevation being controlled by the downstream system. See **Figure 6** for elevation and flow data. This project is currently under construction as an emergency repair.

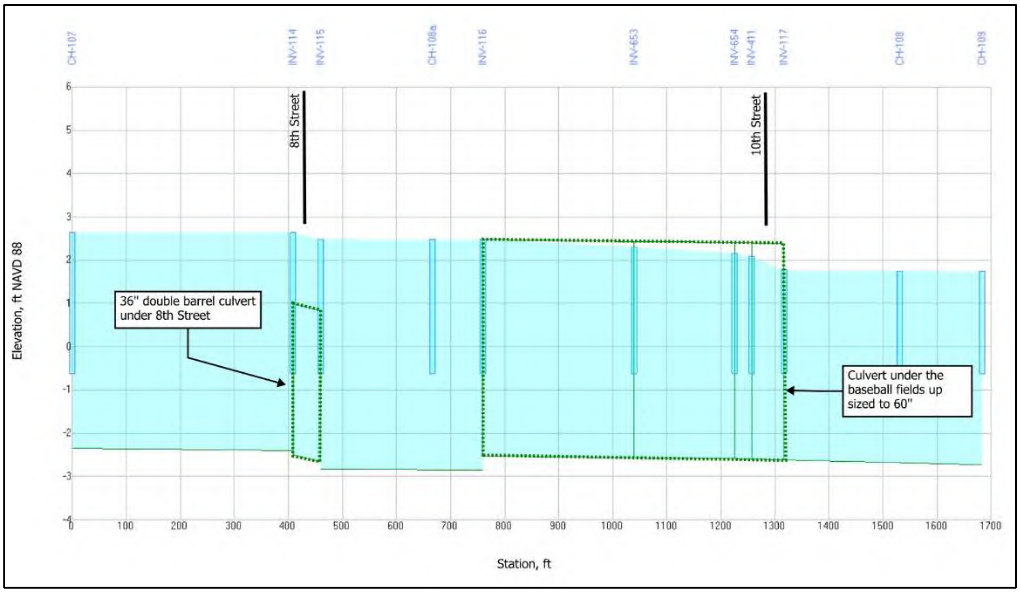


Figure 5: Pipe & Channel Profile Between 10th and 8th Street Showing the Water Level for the 10-Year, 24-Hour Simulation with the Proposed Pipe Up Size Under the Baseball Fields

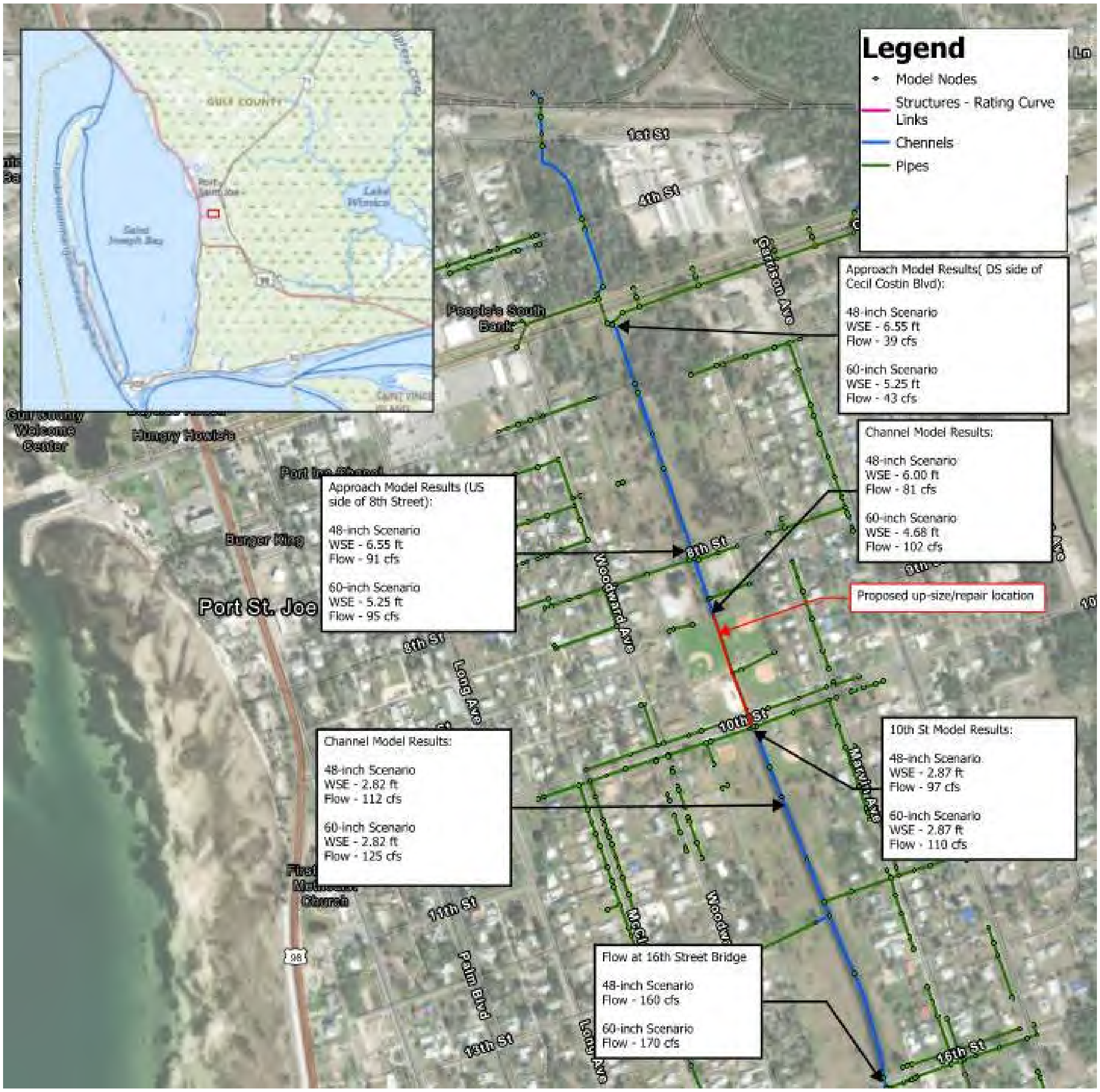


Figure 6: WSE and Flow Comparisons for Pipe Upgrade Between 10th and 8th Street

6.2 Wetlands Creation

Multiple areas were considered for wetlands creation in order to relieve flooding along the channels and improve water quality. Two areas south of Avenue A, one area south of Cecil G Costin Blvd, and one area off 20th Street along Depot Creek were considered based on existing channel capacity and construction feasibility. See **Figure 7** below for locations. Assumptions were made about local groundwater tables to model the wetlands, and only flood storage was considered as part of this project. The modeling scenarios focused on determining the effects that the additional storage volume would have on the stormwater system during the 10-year and 25-year, 24-hour design storms and assume no infiltration losses. Pumping was also modeled to remove water from the wetlands more efficiently in each scenario.

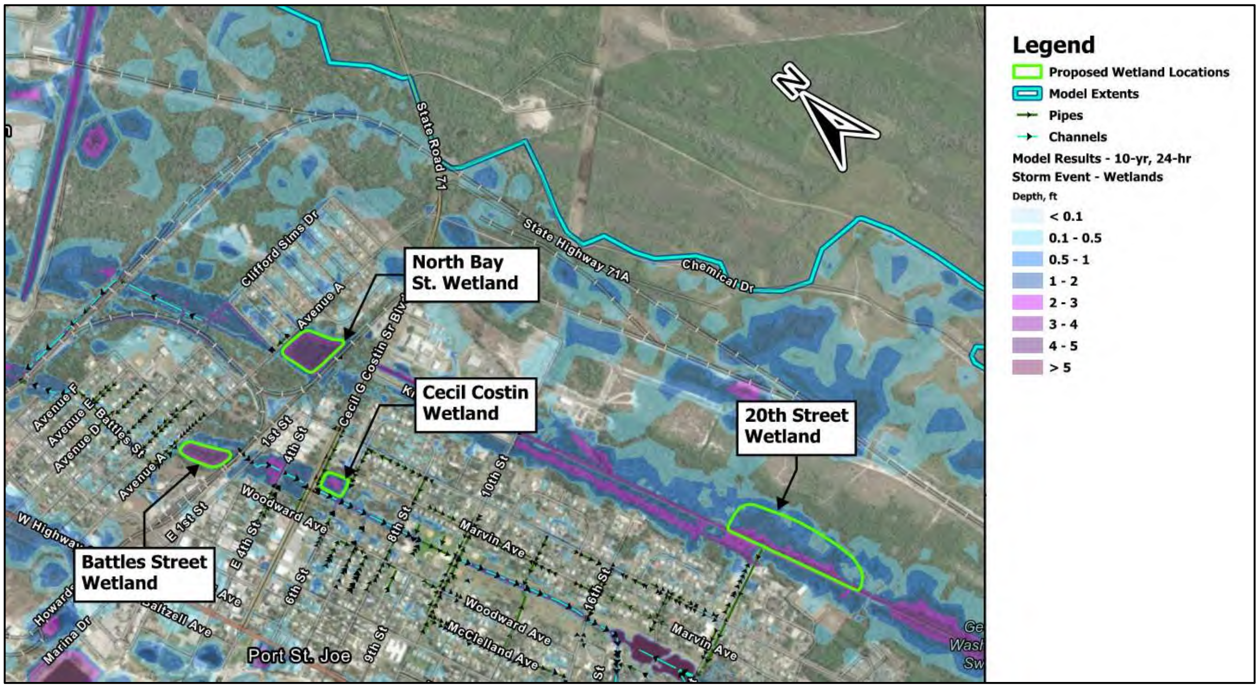


Figure 7: Proposed Wetland Locations

Appendix E highlights hydrographs at locations downstream of the proposed wetlands to compare existing and proposed channel flows. **Table 1** below shows the potential storage volume that could be achieved at each wetland location.

In general, the flood reduction from wetlands creation in the project area is minimal, and this is largely due to site constraints and the assumed groundwater elevation. Pairing wetlands creation with pumping does reduce the outflow at project sites. Wetlands creation would improve water quality, and there are no negative impacts to flow or water surface elevation as a result.

Based on modeling results, the proposed wetlands at Battles Street and 20th Street have the most potential to provide some amount of flood reduction, particularly with the addition of pumps which reduce downstream flows in the Central Channel and relieve stress on the downstream stormwater system as it is draining. The proposed wetland designs and modeling results for these locations are discussed further in the next section.

Table 1: Proposed Wetlands Potential Storage Volume

Wetland Location	Storage Volume, ac-ft*
Battles Street	8
20th Street	7.5**
North Bay St.	14
Cecil Costin	5

*The achievable storage volume for each wetland is highly dependent on the local water table elevation. The storage calculations in this table assume the water table is 2 feet below the ground surface at each wetland location.
**this value represents the storage volume added in the model. The actual storage volume associated with this wetland is not well-defined due to the large drainage area.

6.2.1 Battles Street Wetland

The proposed Battles Street wetland utilized the existing terrain to create a wetland space with minimal excavation requirements. Most of the storage volume for this wetland design was achieved by creating a weir/embankment structure upstream of the pipe running under the railroad north of 1st Street, and additional storage was added to the design by lowering the terrain data to represent approximately 2 feet of excavation, as shown in **Figure 8**. Approximately 5 ac-ft of storage volume could be achieved with the addition of only the weir/embankment structure.

An additional 3 ac-ft of storage capacity could potentially be achieved through approximately 2 feet of excavation, shown in **Figure 8**. Low resolution data from the Surficial Aquifer System (SAS) Florida Aquifer Vulnerability Assessment (FAVA) indicates the depth to the water table is approximately 7 feet below ground level; however, the vertical accuracy of the dataset is ±6 feet, so the full 3 ac-ft of storage capacity may not be achievable through excavation. Additionally, seasonal variations in water table depth and infiltration capacity in this area are also factors that could affect what amount of storage the proposed wetland design could provide at any given time.

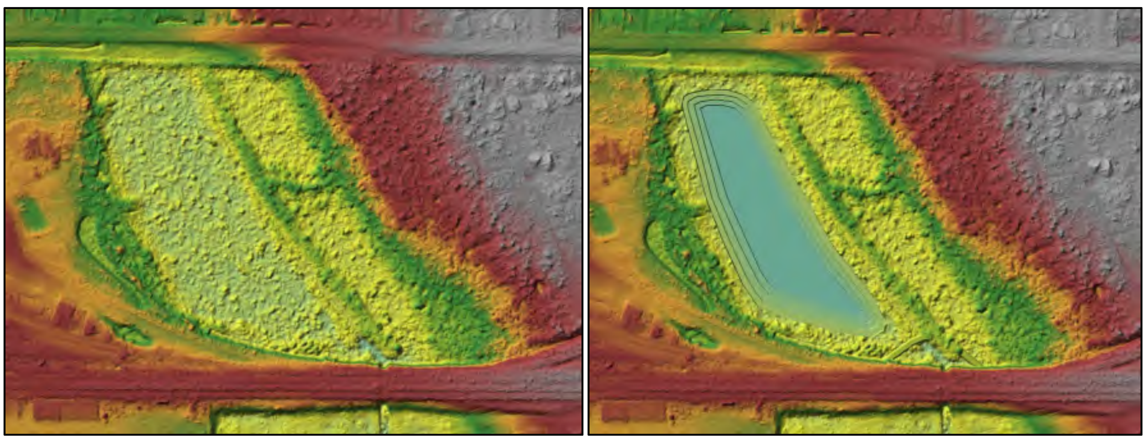


Figure 8: Battles Street Wetland Terrain Modifications (Left: Existing Grade; Right: Proposed Grade)

A more detailed design for the Battles Street wetland would include a standpipe or some other type of dewatering structure to allow the wetland to drain and control the water level. However, the flow through such a dewatering structure would be small and have little impact during a significant rain event. The proposed wetland scenario assumes the wetland is fully drained at the start of the simulation, utilizing the full 8 ac-ft storage capacity, and assumes no flow through the weir until it is overtopped.

The proposed wetland design, with or without pumps, had minimal effect on the extent of flooded areas compared to the existing conditions scenario for both the 10-year and 25-year, 24-hour design storms. This is likely due to the relatively small drainage area captured by the wetland; however, the downstream hydrograph shows that pumping has the potential to relieve stress in the downstream system during significant rain events. While maximum flood depths were not significantly affected, reduced flows in the downstream channel could allow other areas to drain more quickly after a rain event.

6.2.2 20th Street Wetland

The proposed design for the 20th Street Wetland achieves additional storage capacity through a combination of an outflow control structure and ICPR pond control volume. Rather than adjusting terrain data, which could result in inaccurate flooding results in the model at this location, an ICPR pond control volume was used to represent additional storage. Flow from the ICPR 2D Overland Flow Region can enter and exit the control volume at the control volume boundary, and the control volume was connected to the 20th Street pipe connection with an outlet control structure as shown in **Figure 9**. 7.5 ac-ft of additional storage capacity was manually added to the ICPR control volume. The model assumed no specific method to achieve the additional storage capacity, as the wetland space could be created in several ways including excavation, re-grading, or diversion.

Similar to the Battles Street wetland, the 20th Street wetland was assumed fully drained at the start of the ICPR simulation. The outlet control structure was modeled as a drop structure where flow begins to pass over a weir when the wetland water surface elevation exceeds 6.5 feet.

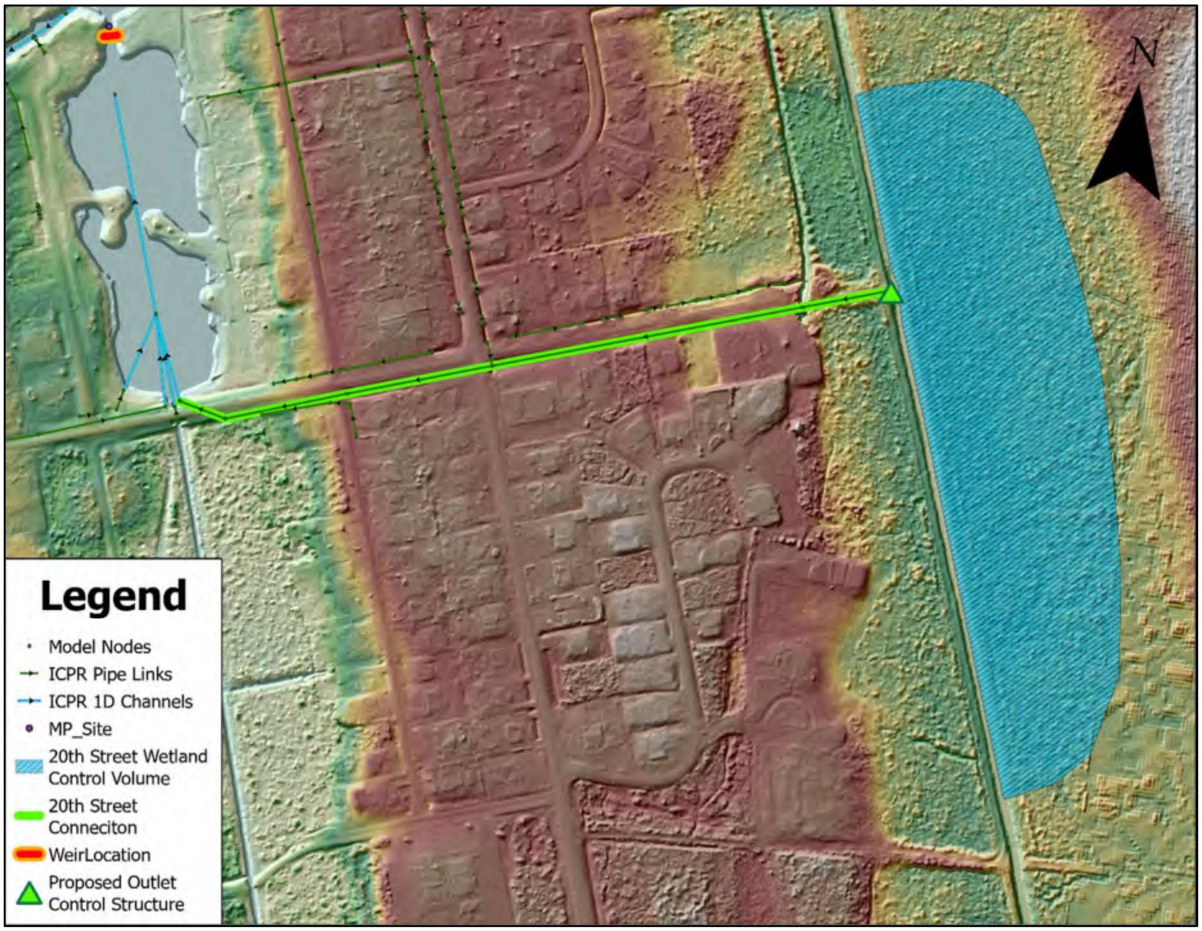


Figure 9: 20th Street Pipe Connection and Proposed Wetland Location.

Pumping was also tested at this location but was not included in the final model scenario. While some reduction in downstream flows may be achievable with pumping stormwater out of the wetland to St Joseph Bay, the drainage area for the proposed wetland is so large that pumping is likely not a feasible option.

Model results showed that the proposed 20th Street wetland design had a negligible effect on flooding extents or peak downstream flows, but the model results do show a small amount of flow attenuation in the 20th Street pipe connection. This flow attenuation could provide some benefit to areas along 20th Street that drain through the 20th Street connection during more frequent storm events.

The potential for this wetland to provide any flooding relief to the surrounding area is limited due to the weir at Buck Griffin Lake. The upstream and downstream invert of the existing 20th Street connection are approximately 3.9 and -0.7 feet, respectively, while the overtopping elevation of the weir is 2.0 feet. For any large storm event, the water surface elevation of the Central Channel would likely exceed the weir elevation and prevent the 20th Street Wetland from draining through the 20th Street pipe connection, through the ponds, and over the weir. Additionally, model results show the elevation of the ponds exceeding 3.5 feet during the 10-year, 24-hour event, which would prevent any significant flow in the 20th Street pipe connection.

6.2.3 N Bay Street Wetland and Cecil G. Costin Wetland

The two other wetland locations that were assessed but are less impactful are the N Bay Street and Cecil G. Costin Wetlands. These proposed wetlands had a negligible impact on flows or flooding extents in the model and provide less of a benefit to the surrounding community. These wetlands do not, however, cause any negative impacts and have the potential to provide water quality benefits to the stormwater system.

6.3 20th Street Connection Improvements

The 20th Street connection, shown in **Figure 9** in the previous section, was upgraded in the model to determine if any flooding reduction could be achieved. The Existing 20th Street connection consist of two parallel 24-in pipes that transition to 48-in under 20th Street. A model scenario considering two 48-in pipes extended to Depot Creek was developed and compared to the Existing Conditions model scenario.

As discussed previously, the elevation of the weir connecting the two ponds north of 20th Street is over 2 feet higher than the downstream invert of the 20th Street Connection, so the primary benefit of upsizing the 20th Street connection is increasing storage in the pipe system.

Figure 10 below compares the existing and proposed conditions at 20th Street. While the flood elevation at Depot Creek is slightly lowered, there are downstream impacts from this alternative due to increased flows and the weir between the ponds overtopping (due to raised water surface elevation) during large rain events and more flow entering the Central Channel from Depot Creek. Further analysis can be done to assess how these impacts could be addressed. An option was also modeled to install a valve on the Depot Creek side of the pipe to cut off flow during high flow events, but this option caused more flooding on the east side and inundated residential areas.

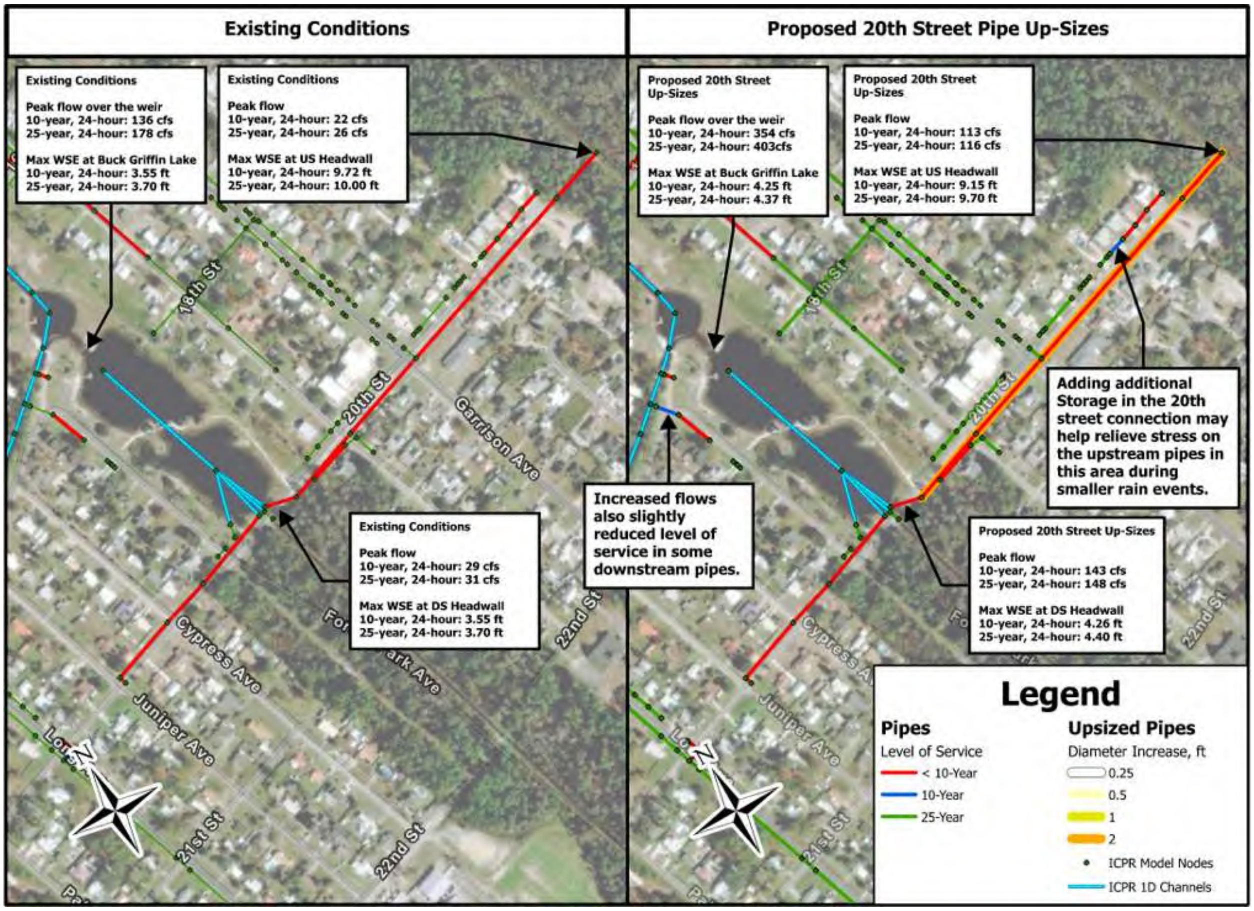


Figure 10: 20th Street Existing vs Proposed Conditions

6.4 Channel Modifications

Channel widening and excavation was modeled with the goal of improving water circulation throughout the Central Channel. The ground surface DEM was modified with the proposed channel modifications in HEC-RAS and then imported into ICPR, where the new DEM was used to update the 1D channel cross section data in the ICPR model.

Channel modifications focused on utilizing the available space and minimizing the required excavation volume and impact on the surrounding areas. **Figure 11** shows the proposed excavation depth for the overall extents of channel modifications that were analyzed, with some areas showing zero change.

Figure 11: Channel Widening Between 16th and 10th Street

In order to assess circulation improvements, a 15-day simulation, which encompassed a full tide cycle, was run and compared to the first 15 days of the base 1-month water quality simulation. For each day of the simulation, the total volume of water that circulated through the Central Channel was calculated by subtracting the minimum and maximum stored water volume, as shown in **Table 2.** This table quantifies the increase in MG total volume circulated per day with the combined channel modifications. Individual areas or portions of channel modifications could be done as standalone or phases projects, thus increasing the volume circulated in the system.

Table 2: Channel Modifications Volume Circulation Calculations, Million Gallons (MG)

Day	Existing Conditions Max Stored Volume (S)	Existing Conditions Min Stored Volume (S)	Existing Conditions ΔS	Channel Modifications Max Stored Volume (S)	Channel Modifications Min Stored Volume (S)	Channel Modifications ΔS	Difference in Circulated Volume
1	60.0	18.3	41.6	235.4	72.1	163.3	121.6
2	70.1	13.8	56.3	273.5	49.5	224.0	167.8
3	82.6	1.9	80.7	319.9	6.1	313.9	233.2
4	98.3	-4.6	102.9	381.5	-16.4	397.9	295.0
5	110.3	-6.5	116.8	428.6	-25.1	453.7	336.9
6	117.7	-5.5	123.2	453.9	-27.5	481.4	358.2
7	120.1	-3.9	124.0	457.9	-27.1	484.9	360.9
8	118.7	-0.3	119.0	444.5	-22.0	466.5	347.5
9	112.8	0.7	112.1	409.0	-19.4	428.4	316.3
10	105.9	6.0	99.9	370.7	-12.3	383.0	283.1
11	98.5	13.6	84.9	330.5	3.2	327.3	242.4
12	90.7	22.2	68.5	293.4	24.7	268.7	200.2
13	79.7	31.9	47.8	245.8	56.2	189.7	141.8
14	67.9	39.6	28.3	194.9	83.6	111.3	83.0
15	71.8	45.8	26.0	207.7	104.2	103.5	77.5
Total:			1232.0			4797.4	3565.4
Average:			82.1			319.8	237.7

Flows were also compared between the Existing Conditions and Proposed Channel Modifications Scenarios at 8th Street, 16th Street, and Patton Bayou. **Figure 12** shows the ICPR channel flow for the channel just upstream of each location during the 1-month simulation. The dashed lines show the flows during the Existing Conditions simulation and the solid lines show flows during the Channel Modifications simulation. Peak flows for each day increased at each of the three locations by approximately 50%, while velocity remained relatively unchanged, which indicates that the proposed channel modifications will not cause additional erosion or wash-out. Water surface elevations were also compared at multiple locations. **Figure 13** shows the existing and proposed water surface elevations and how channel expansion and/or excavation minimally improves flood elevation due to the improved circulation and increase in total flow. The increase in flood elevations at 8th Street is due to the undersized culvert at the baseball fields causing backup with the proposed channel modifications. The 60-in pipe replacement would help to improve this flood elevation.

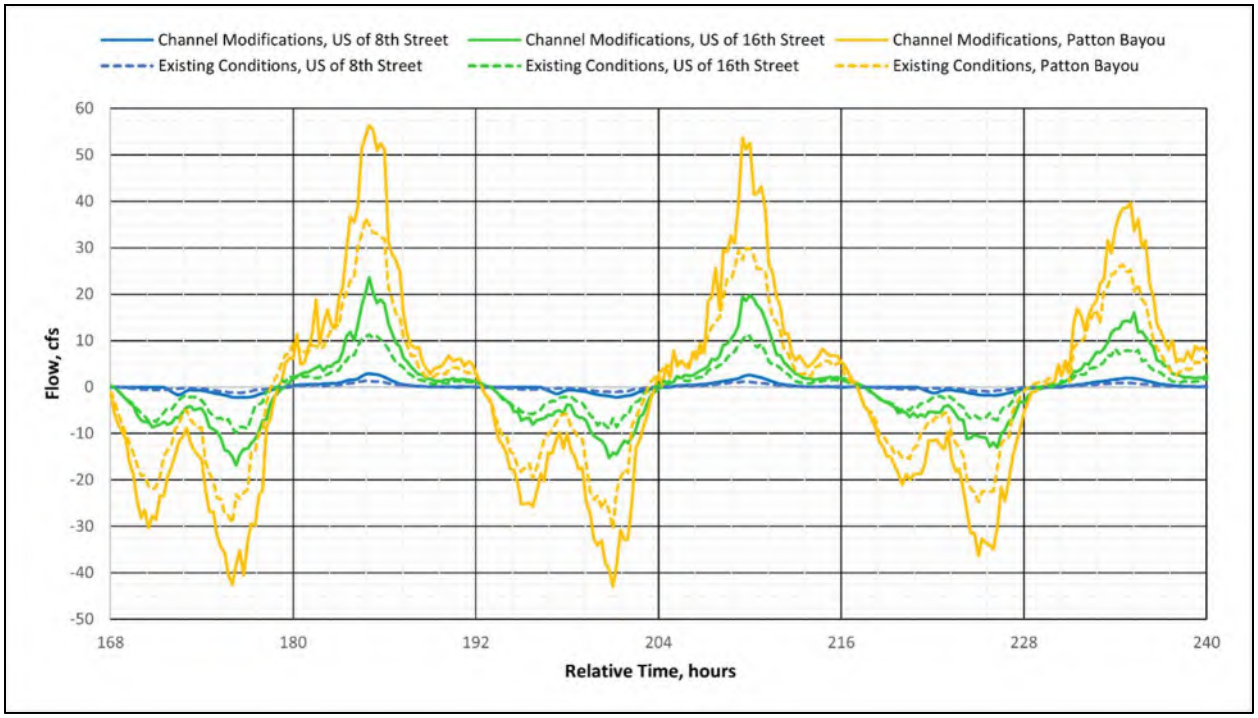


Figure 12: Existing Conditions vs. Channel Modifications Flow Comparison at 8th Street, 16th Street, and Patton Bayou. (Positive Flow Direction Towards the Bay)

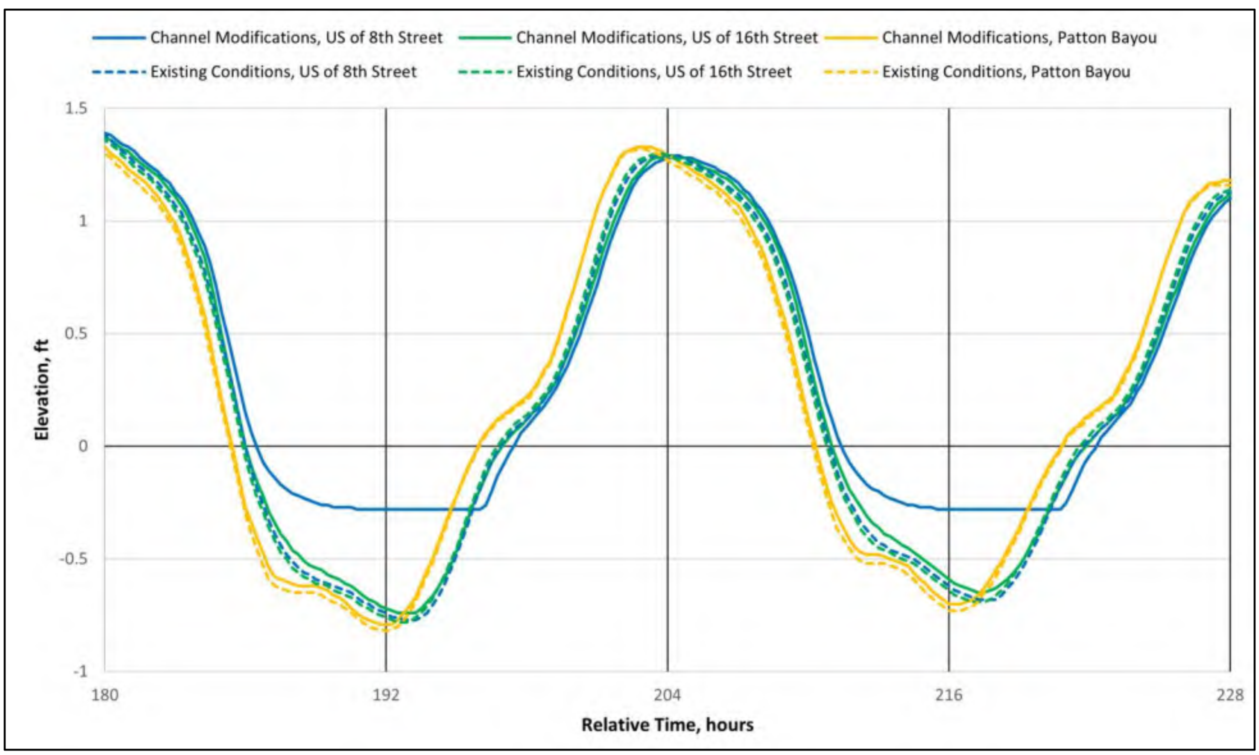


Figure 13: Existing Conditions vs. Channel Modifications WSE Comparison at 8th Street, 16th Street, and Patton Bayou. (Positive Flow Direction Towards the Bay)

6.5 Tidal Gates on Patton Bayou

A tidal gate on Patton Bayou was modeled to assess how this could improve impacts from tidal surge. A tidal gate on Patton Bayou has the potential to prevent storm surges form inundating areas along the Central Channel. The main barrier for storm surge waters entering Port St. Joe is Constitution Drive, which acts as a levee during storm surges. The overtopping elevation of Constitution Drive is approximately 5 feet, and tide waters below that elevation flow in and out of the Central Channel via a channel under the bridge adjacent to Patton Bayou.

Aerial imagery and elevational data was reviewed to identify probable culvert locations along Constitution Drive, which are shown in **Figure 13**. These culverts were not included in the ICPR model, as they were outside of the scoped survey area and are not expected to significantly affect flooding results along the Central Channel. The ICPR tidal gate simulations assume no flow is passing under Constitution Drive at these locations; however, tidal gates or backflow prevention devices at these locations have the potential to mitigate localized flooding as a result of storm surges less than 5 feet. **Figure 14** below compared the proposed tidal gate elevation relative to the road profile.

Figure 13: Monument Avenue and Constitution Drive Map

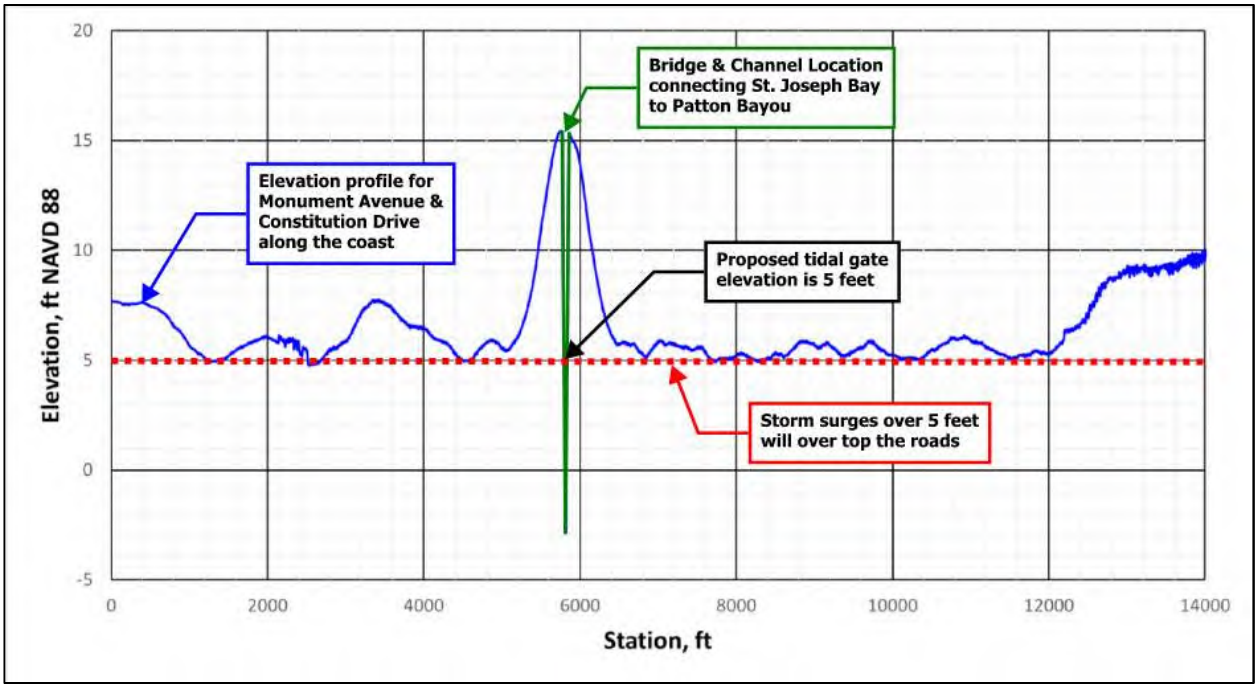


Figure 14: Monument Avenue and Constitution Drive Elevation Profile

A tidal gate was tested in the ICPR model by adjusting the rating curve link which runs under Constitution Drive, where Patton Bayou flows into St. Joseph Bay. The location of the Rating Curve Link is shown in **Figure 13**. The rating curve for the bridge connecting Patton Bayou to St. Joseph Bay, developed in HEC-RAS, was given elevation controls so that no flow can occur until the tide elevation reaches 5 feet. A second link representing three 5-foot by 5-foot box culverts with self-regulating tidal gates was added to the model to allow the Central Channel to drain as the tide recedes. The ICPR link representing the tidal gates was given a flow direction control so that flow can only occur from Patton Bayou to St Joseph Bay.

The Hurricane Michael surge was tested with the tidal gate. No rainfall was modeled during this simulation to help isolate the effect the tidal gate would have on flooding extents as a result of a storm surge. The tidal gate showed no significant effect for the Hurricane Michael storm surge, as that storm surge exceeded 5 feet for approximately two hours with a peak of over 10 feet. As expected, the tidal gate prevented drainage of the Central Channel as the tide receded during the simulation leading to areas staying flooded for a longer period after the height of the storm surge.

The tidal gate modeled in this project may not be a feasible option for the City due to site constraints and constructability at this location. Further discussion is needed to determine what type of tidal gate structure would be feasible at this height and how it would be opened to allow drainage of the channel, as this could cause potential flooding issues during high surge events.

6.6 Battle St. Daylighting and Improvements to Channel Between Ave F and Railroad

An alternative was evaluated to daylight the closed stormwater system along Battle Street between Avenue A and Avenue F. This option would allow for additional storage capacity in the residential area. Initial modeling results showed that improvements to the channel between Avenue F and the railroad would work best in conjunction with the Battles Street daylighting. Site constraints including limited ground cover for culverts along the daylighted channel, flat topography, and existing lateral connection inverts made it necessary to lower the channel between avenue F and the railroad so that a positive slope could be achieved in the daylighted channel. These two options have been combined in this section as a result.

The most optimal location for the daylighted channel is on the west side of Battles Street. Daylighting the channel on the west side of the street allows for the existing culverts under Avenue F and Avenue A to be utilized, and results in less conflict with existing building footprints. **Figure 15** shows the proposed channel location, the existing pipes, and the proposed pipes. **Figure 16** shows the existing versus proposed profile of the system. The daylighting of the system increases flow through the system and slightly raises 25-year water surface elevations on the north end, but it improves 10-year water surface elevations on the south side of the system. The channel grading improves the drainage of the system and makes it perform more efficiently. Backflow prevention is recommended to prevent the daylighted channel from backing up into these areas during large storm events, as the existing system currently flows full. It is noted in the image that the daylighting of the system in this area does encroach on residential buildings due to the sloping of the channel.

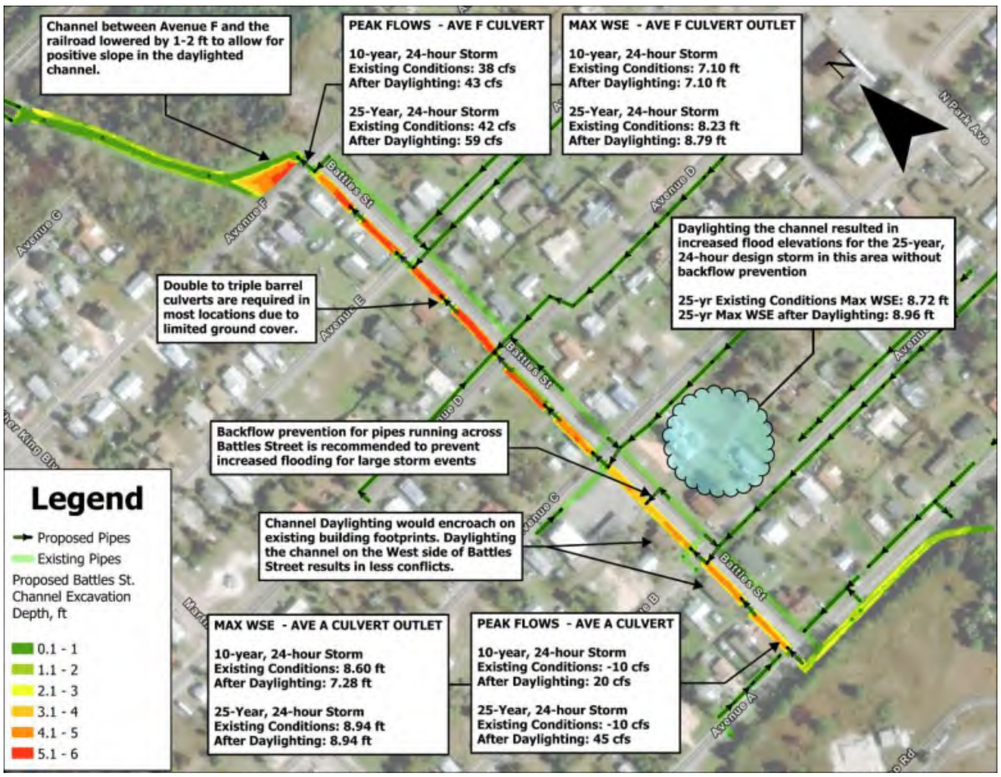


Figure 15: Battles Street Daylighting and Channel Improvements Between Avenue F and The Railroad

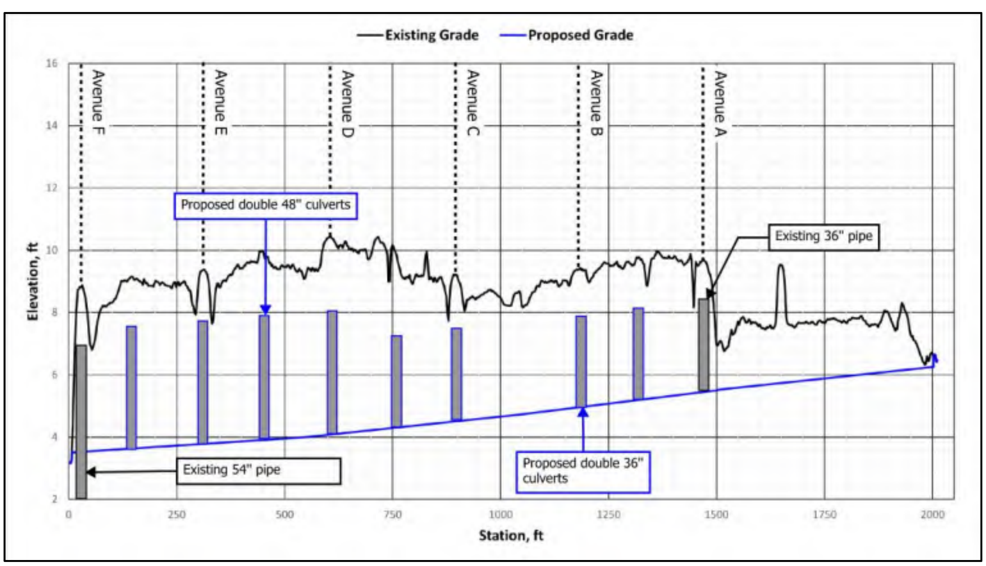


Figure 16: Proposed Battles Street Channel Profile

7. Minor System Improvements/Level of Service Assessment

The baseline model simulations were analyzed to determine the level of service of every pipe in the scoped stormwater system and assess minor improvement projects. The 10-year event was selected as the desired LOS for pipes in the study area, so pipes were ranked based on not meeting, meeting, or exceeding this desired LOS based on the 2-, 5-, 10-, 25- and 100-year simulations. 33 pipe sections were selected to upgrade and/or rehabilitate to increase their level of service as part of this project based on the model results. In order to select these pipes, other considerations taken into account were pipe condition (based on anecdotal or survey information), location (near homes, road crossings, etc.), and feasibility of design.

Three areas were selected for pipe upgrades to meet the desired level of service: McClelland Avenue area, Sunset Avenue area, and the Battle Street area. These areas are highlighted and summarized on the images on the following pages. The McClelland Ave pipes were selected due to their location at a road crossing, and their proximity to the Central Channel made this option feasible to upsize the pipes and alleviate flooding along the residential driveways. Upgrading the pipes increased the LOS to 25-year, and the flooding at the residential driveways was reduced. The Sunset Ave pipes were selected due to the proximity to residential homes and quantity of pipes flooding in the 10-year event. Upgrading pipes in this area increased the LOS to 25-year and reduced flooding along Monument Avenue. The Battle Street pipes were selected due to the known poor condition of the main line pipes, and the main line and some lateral pipes were upsized to see if this would increase the lateral system's LOS. The main line mostly meets a 25-year LOS. The impacts to the pipes along Battle Street were minimal as the main line already has capacity, but improvements to the system did increase the lateral systems LOS to 10- and 25-year in some areas. Additional survey is needed in this area due to the pipes having standing water to do a full analysis on the system. See **Figure 17**, **Figure 18**, and **Figure 19** below. A full level of service map for the project area can be viewed in **Appendix F**.

The system along N Bay Street north of Avenue A was also modeled for a level of service assessment, as this area is known to have flooding issues in more frequent storm events. The model results showed that the flood elevation to the west of N Bay Street controls the flood elevations, so any piped system would further back up into the neighborhood. Modifications to the west of N Bay Street could be assessed in the future to determine how drainage could be improved to lower the flood elevation.

Figure 17: McClelland Avenue Level of Service Improvements

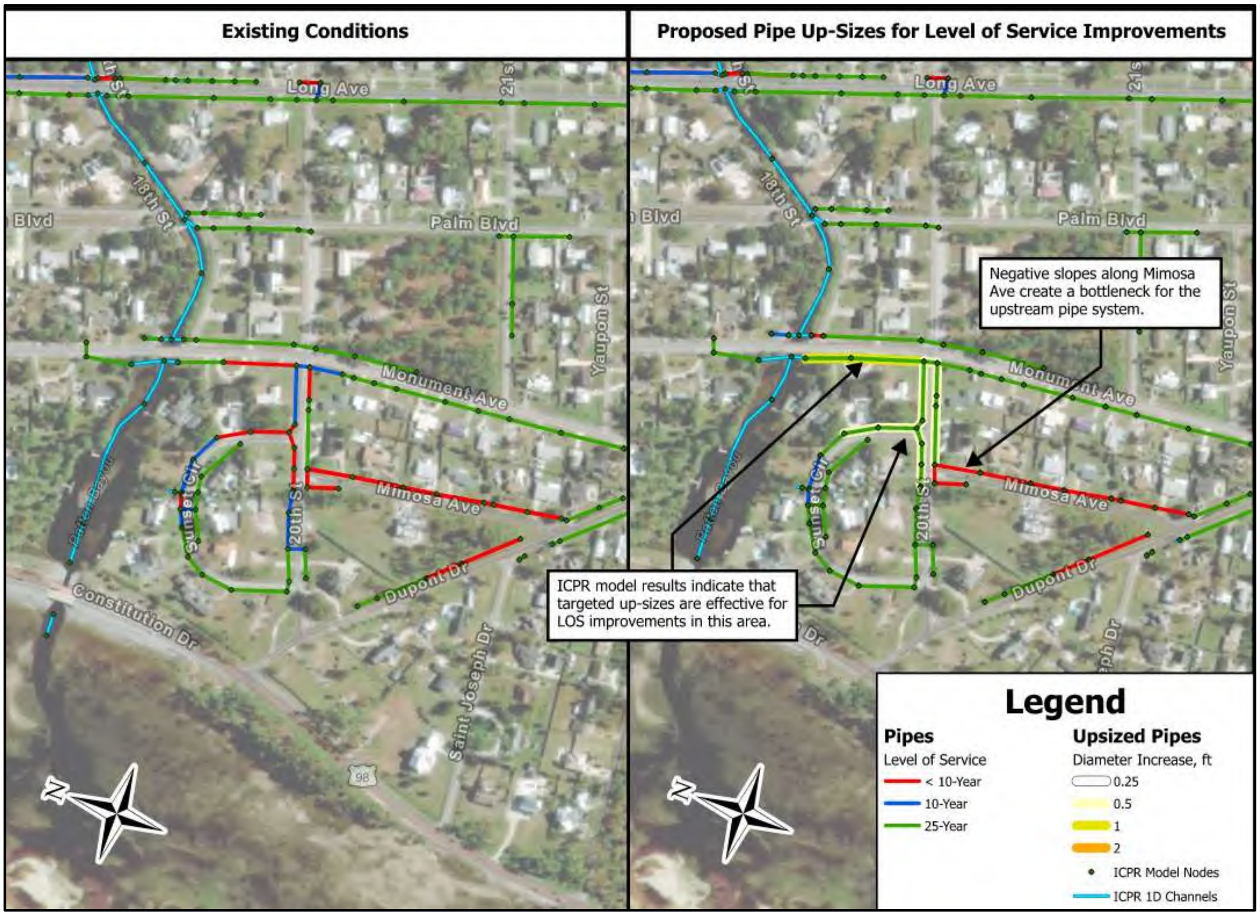


Figure 18: Sunset Blvd Level of Service Improvements

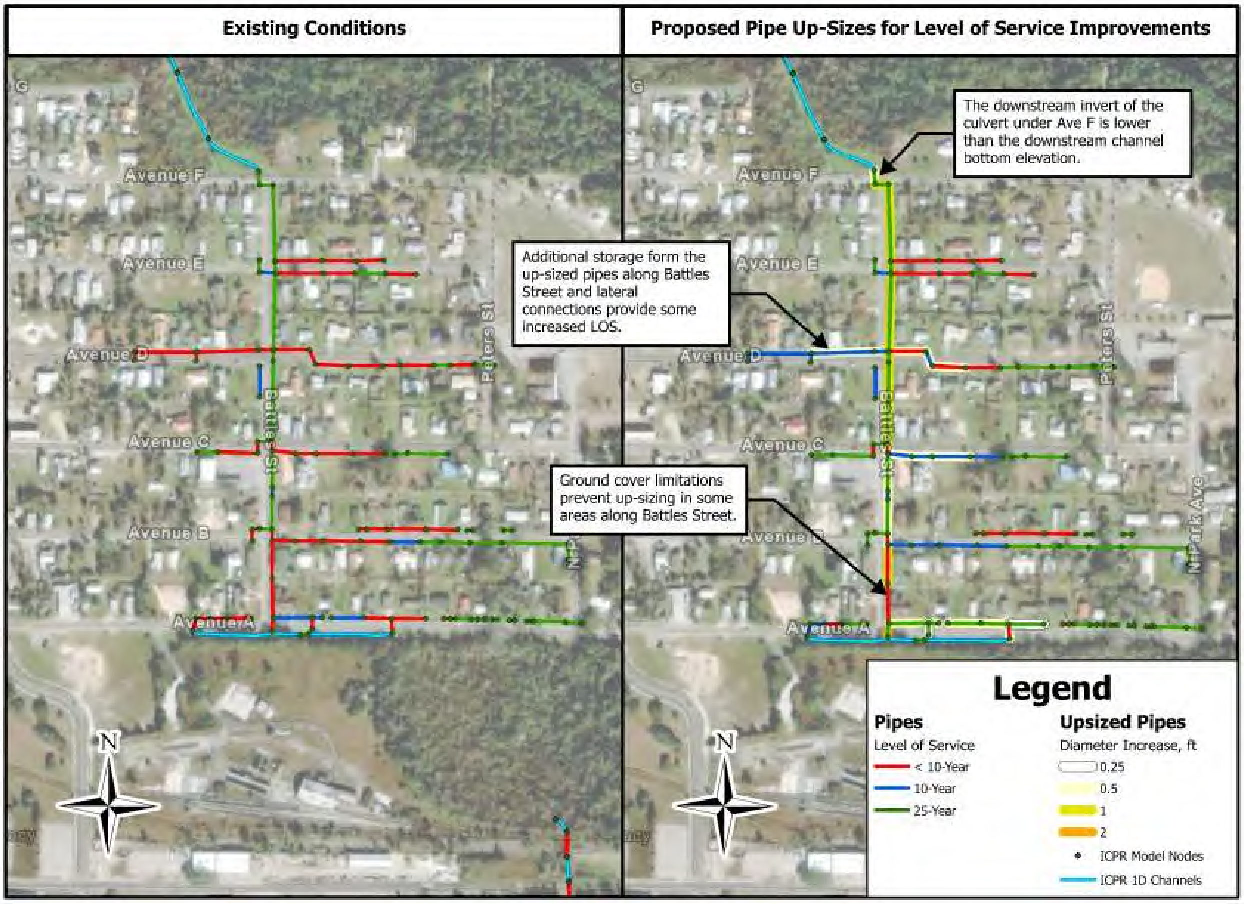


Figure 19: Battles Street Level of Service Improvements

8. Potential Grant Opportunities

Multiple grant opportunities have been discussed throughout this project to fund potential construction projects. The Natural Resource Damage Assessment (NRDA) grant has particularly been discussed to fund a wetlands project in the project area. These potential projects would address water quality needs, and discussion is ongoing about which wetlands location would best serve the community and ecosystem to direct these funds.

The NOAA Coastal Habitat Restoration and Resilience Grant for Underserved Communities is also a potential grant opportunity in the project area. The grant support community-driven habitat restoration and could be used for the wetlands projects summarized in this report as well as the Battle Street Daylighting project as a stream restoration. Resources are available to identify wildlife species that could be benefited by these projects and help to secure funding from these grants for the projects.

The Resilient Florida Grant is another opportunity for funding for projects that address impacts of flooding and sea level rise. The channel modification projects and tidal gates are both potential project options to provide additional flood storage and/or flood protection to create a more resilient stormwater system.

9. Recommendations

Due to the flat coastal topography of the project area and tidal influences, increasing storage capacity in the system is the most effective way to reduce flooding from pluvial and surge events. The wetlands, pipe upgrades, and channel modification projects provide the most benefits to the system in this regard without negative impacts on other areas of the system. Ecological impacts to these modifications, such as the channel modifications, have not been assessed as part of this project and would need to be considered as part of future work. The tidal gate is also a feasible option that could protect from storm surge impacts up to a certain elevation. A General Permit for Stormwater Retrofit Activates would likely be required for the alternatives in this report, with additional permit requirements for the wetlands and excavation projects.

The level of service analysis modeled in this project can be used for any future stormwater infrastructure improvement projects. The pipes selected in the project provide an example, but any pipe in the system can be modeled as upsized or rehabilitated, and surrounding impacts can be assessed and evaluated. This is a valuable tool to be able to assess the impacts of any infrastructure project quickly by running the existing model. In the future, the model can also be updated to incorporate any changes to the stormwater system, thus creating a “best available” model that is kept up to date and represents the existing system. Overall, this stormwater model can be used for any future efforts in the City to assess systems and evaluate alternatives.

Appendix A

Survey Data

TOPOGRAPHIC SURVEY REPORT

PORT ST. JOE CENTRAL CHANNEL PROJECT

For: The Nature Conservancy

Dewberry Project #: 50146276

May 7, 2024

SUBMITTED BY:
Dewberry Engineers Inc.
203 Aberdeen Parkway
Panama City, FL 32405-6457
850.522.0644 O

POINTS OF CONTACT:
Jonathan H. Gibson, PSM
Associate, Business Unit Manager
850.571.1194 D

Frederick C. Rankin, PSM
Associate, Senior Project Manager
850.571.1194 D

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1. Project Summary

The objective of this project was to acquire location, dimension, and elevation data for structures, inlets, pipes, and cross sections throughout the City of Port St. Joe, Florida, within the project area. The scope of this survey includes point data, sketches, and photos for each site surveyed. Dewberry's survey team provided all the equipment and resources necessary to collect field data, process the data collected, and prepare a Survey Report of the results.

1.1 Project Area

Approximate limits of survey shown below:

Figure 1.1 Overall project limits.

2. Project Details

2.1 Scope

Dewberry's survey team collected survey data which included point data (location and elevations), photos, and sketches for the Port St. Joe Central Channel Survey. Point data was used to create sketches of each site, which show the location, size, dimensions, and elevations of each inlet, pipe, structure, and cross section.

Cross section surveys were spaced throughout the project site. Surveys include photos looking upstream and downstream. Point data collected includes elevations of the top of banks, bottom of banks, and low point of channels.

Structure sites include bridges and culvert crossings. Surveys include photos looking upstream, downstream, a view over the top of the structure, the upstream face of the structure, and the downstream face of the structure. Point data collected includes piers, abutments, decks, rails, culverts, headwalls, etc.

2.2 Ground Survey Procedures

The ground survey was performed January 12, 2024 through May 2, 2024. Published Department of Natural Resources control point "X 294" was recovered and observed prior to the start of the survey, and at the beginning of each day, for the purpose of verifying the accuracy of the GPS equipment used. Control point "X 294" is published, and was obtained from the Florida Department of Environmental Protection, Division of State Lands, Bureau of Survey and Mapping, Land Boundary Information System website (www.labins.org). Secondary control points were established throughout the project site, and used periodically to confirm the accuracy of the GPS. Site control points are shown on sheet 1 of the Topographic Survey Maps.

Once control was established, field survey of each site began. Field crews recorded notes of their daily progress, collected point data, and took photos at each site. Conditions, obstructions, or other deficiencies that prevented crews from collecting the required data were also recorded and/or documented. Digital photos are shown in appendices 6.2 through 6.3.

2.3 Data Processing Procedures

GPS observation data was downloaded into the AUTOCAD Civil 3D software. Point files are loaded into the program (AutoCAD Civil 3D) to make a visual check of the point data (Point Numbers, Coordinates, Elevations and Descriptions). The data was then used to create sketches of each site surveyed. Sketches of each site are shown on the Topographic Survey Maps in appendix 6.1.

2.4 Coordinate Refence System

HORIZONTAL DATUM	PROJECTION	VERTICAL DATUM	GEOID MODEL	UNITS
NAD83/2011	UTM Zone 16 North	NAVD 1988	GEOID18	Feet

2.5 Equipment and Software

- Spectra Precision SP85 GNSS RTK GPS system
- 2-meter fixed height carbon fiber GPS pole
- Trimble TSC5 Data Collector
- Trimble Access (Version 2022.11)

- AutoCAD Civil 3D – 2022 Imperial
- Microsoft Office (Word / Excel)
- Google Earth Pro (7.3.3.7786 – 64 bit)
- Trimble Business Center (Version 5.70)

All equipment was inspected and checked at the beginning of each workday for deficiencies to include: GNSS receivers have the latest firmware updates from the manufacturer installed; GNSS receivers have sufficient memory to insure the storage of project data; GPS poles checked for plumbness; elevation mask of 10 degrees set within data collector; observation sampling rate set to 1 second within the data collector.

3. Personnel

- Frederick C. Rankin, PSM
  Professional Surveyor & Mapper
- Ryan Daniel, LSIT
  Land Surveyor-in-Training
- Joe Marlow
  Crew Leader II
- Chris Cumbie
  Crew Leader II

4. Deliverables (Sent via Electronic Transfer)

4.1 Topographic Survey Maps (AUTOCAD Civil 3D and Adobe PDF)

4.2 DXF File

4.3 Digital Photos – Structures

4.4 Digital Photos – Cross Sections

4.5 Digital Photos – Inlets

4.6 Digital Photos – Pipes

5. Surveyor's Certification

I hereby certify this survey report meets the applicable "Standards of Practice" as set forth by the Florida Board of Professional Surveyors and Mappers in rule 5J17.050-052, Florida Administrative Code. The electronic signature hereon is in compliance with Florida Administrative Code (FAC) 5J-17.062(3). The seal appearing on this document was authorized by Frederick C. Rankin, PSM, LS #6585, on May 7, 2024 per FACE 5J-17.062(2).

Frederick C. Rankin, PSM
Florida Licensed Surveyor and Mapper No. 6851
Certificate of Authorization No. L.B. 8011

6. Appendices

6.1 Topographic Survey Map:

SURVEYOR'S NOTES:

1. THIS SURVEY IS REFERENCED TO FLORIDA STATE PLANE COORDINATES, NORTH ZONE, NAD 1983/2011, U.S. SURVEY FEET, PER N.G.S. CONTROL POINT "X 294".
2. VERTICAL DATUM SHOWN HEREON IS REFERENCED TO NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), PER N.G.S. CONTROL POINT "X 294".
3. THIS SURVEY, MAP, AND REPORT IS NOT VALID WITHOUT THE SIGNATURE AND ORIGINAL SEAL OF A FLORIDA LICENSED SURVEYOR AND MAPPER. ADDITIONS OR DELETIONS TO SURVEY MAPS OR REPORTS BY OTHER THAN THE SIGNING PARTY OR PARTIES IS PROHIBITED WITHOUT WRITTEN CONSENT OF THE SIGNING PARTY OR PARTIES.
4. DATE OF FIELD SURVEY: JANUARY 12, 2024, THROUGH MAY 2, 2024.

SYMBOLS & ABBREVIATIONS:

INV. = INVERT
CMP = CORRUGATED METAL PIPE
RCP = REINFORCED CONCRETE PIPE
× ELEV = SPOT ELEVATION AT "X"
= EXISTING ASPHALT PAVEMENT
= EXISTING DIRT/GRAVEL

0 750 1,500
1 INCH = 1,500 FEET

SOURCE CONTROL POINTS:

	DESCRIPTION	NORTHING	EASTING	ELEV. (NAVD 1988)
S1	FOUND N.G.S. MONUMENT "X 294"	295952.74'	1713354.96'	4.89' (PUBLISHED)

TEMPORARY SITE CONTROL POINTS:

	DESCRIPTION	NORTHING	EASTING	ELEV. (NAVD 1988)
T6	FOUND 5/8" CAPPED IRON ROD L.B. 8011	297015.41'	1716407.57'	12.67'
T5001	SET 5/8" CAPPED IRON ROD L.B. 8011	299850.61'	1714333.20'	8.22'
T5005	SET 5/8" CAPPED IRON ROD L.B. 8011	299881.66'	1714419.57'	8.70'
T5007	SET 5/8" CAPPED IRON ROD L.B. 8011	302048.11'	1713258.12'	7.35
T5009	SET 5/8" CAPPED IRON ROD L.B. 8011	302016.22'	1713138.59'	7.16'

FREDERICK C. RANKIN, P.S.M. DATE SIGNED
PROFESSIONAL SURVEYOR & MAPPER No. LS6585

Dewberry®
DEWBERRY ENGINEERS INC.
203 ABERDEEN PARKWAY
PANAMA CITY, FLORIDA 32405
PHONE: 850.522.0644 FAX: 850.522.1011
WWW.DEWBERRY.COM
CERTIFICATE OF AUTHORIZATION NO. L.B. 8011

FB/PG:	344/15-44
FIELD DATE:	JAN 12 - MAY 2, 2024
DRAWN BY:	FCR
DWG DATE:	05/06/2024
SHEET SCALE:	1" = 1,500'
APPROVED BY:	JG

TOPOGRAPHIC SURVEY
2024 POST ST. JOE COASTAL STRUCTURES
CITY OF PORT ST. JOE
GULF COUNTY, FLORIDA.

PROJECT NO. 50146276
SHEET NO. 1 OF 54

Drawing name: C:\Survey Projects (temporary)\50146276_PSJ_PSJ Central Channel\Survey dwg\50146276-TS.dwg S(1) May 06, 2024 11:42am by: erankin

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369A - SHEET 54

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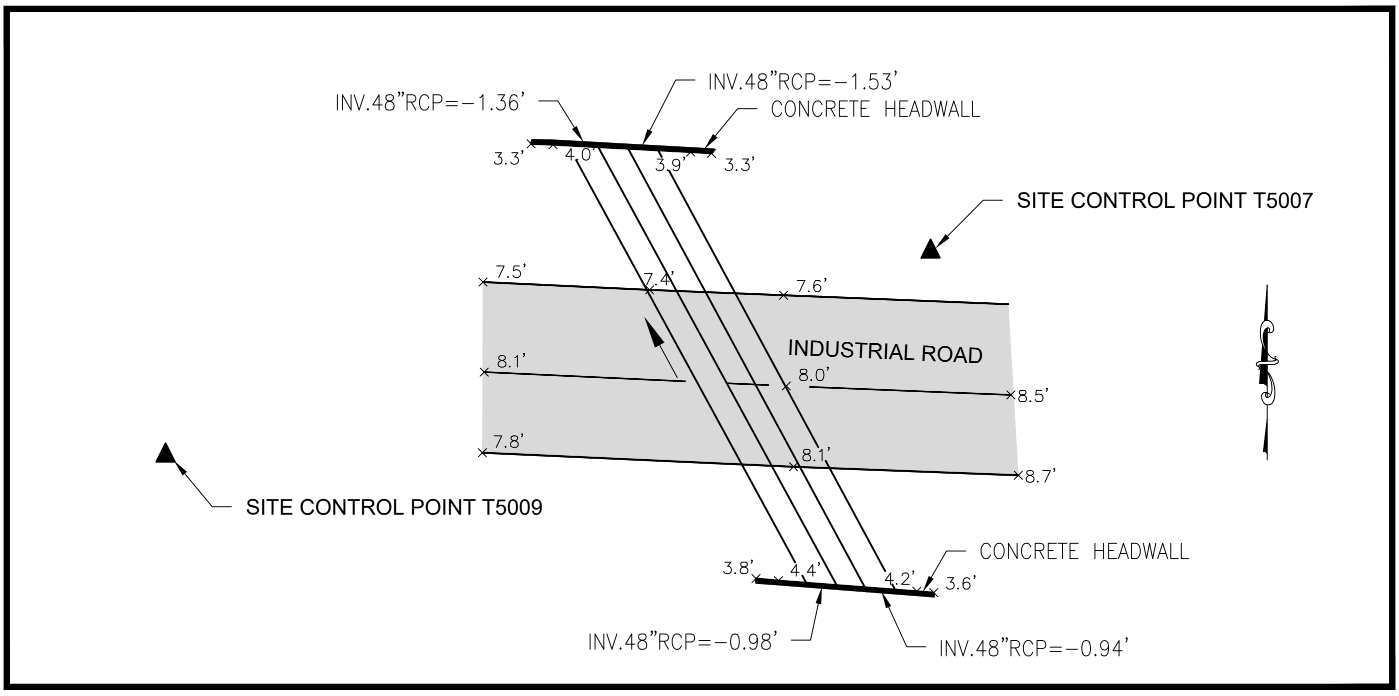
SHEET SCALE:	N.A.
APPROVED BY:	JG

TOPOGRAPHIC SURVEY
2024 POST ST. JOE COASTAL STRUCTURES
CITY OF PORT ST. JOE
GULF COUNTY, FLORIDA.

PROJECT NO. 50146276
SHEET NO.

STRUCTURE 1



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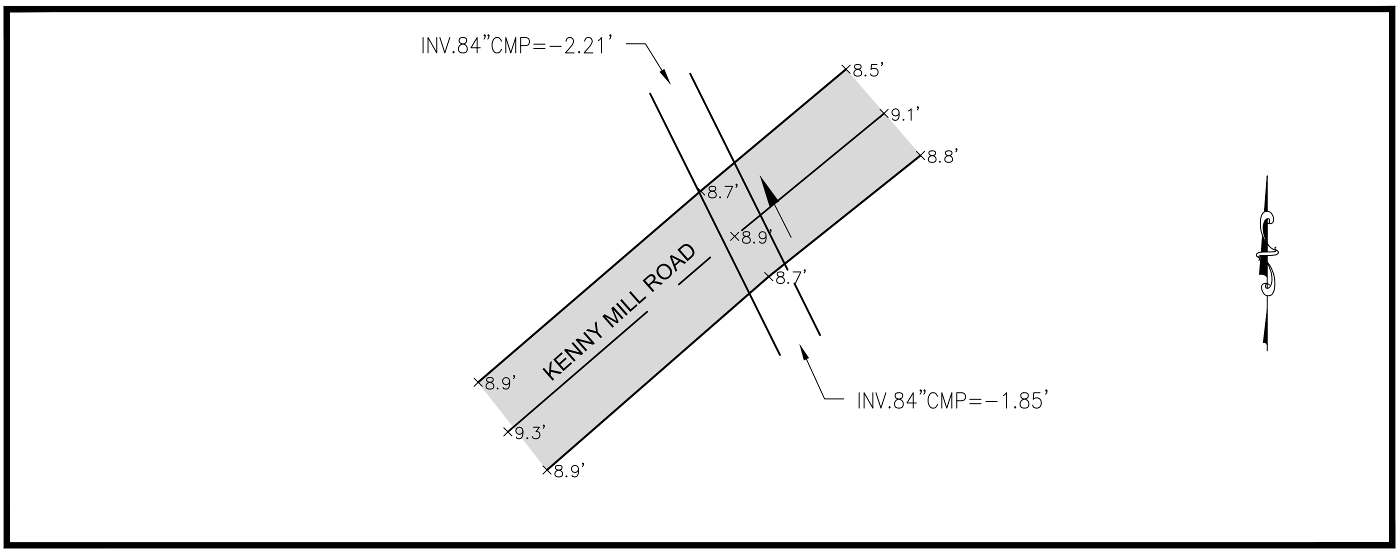

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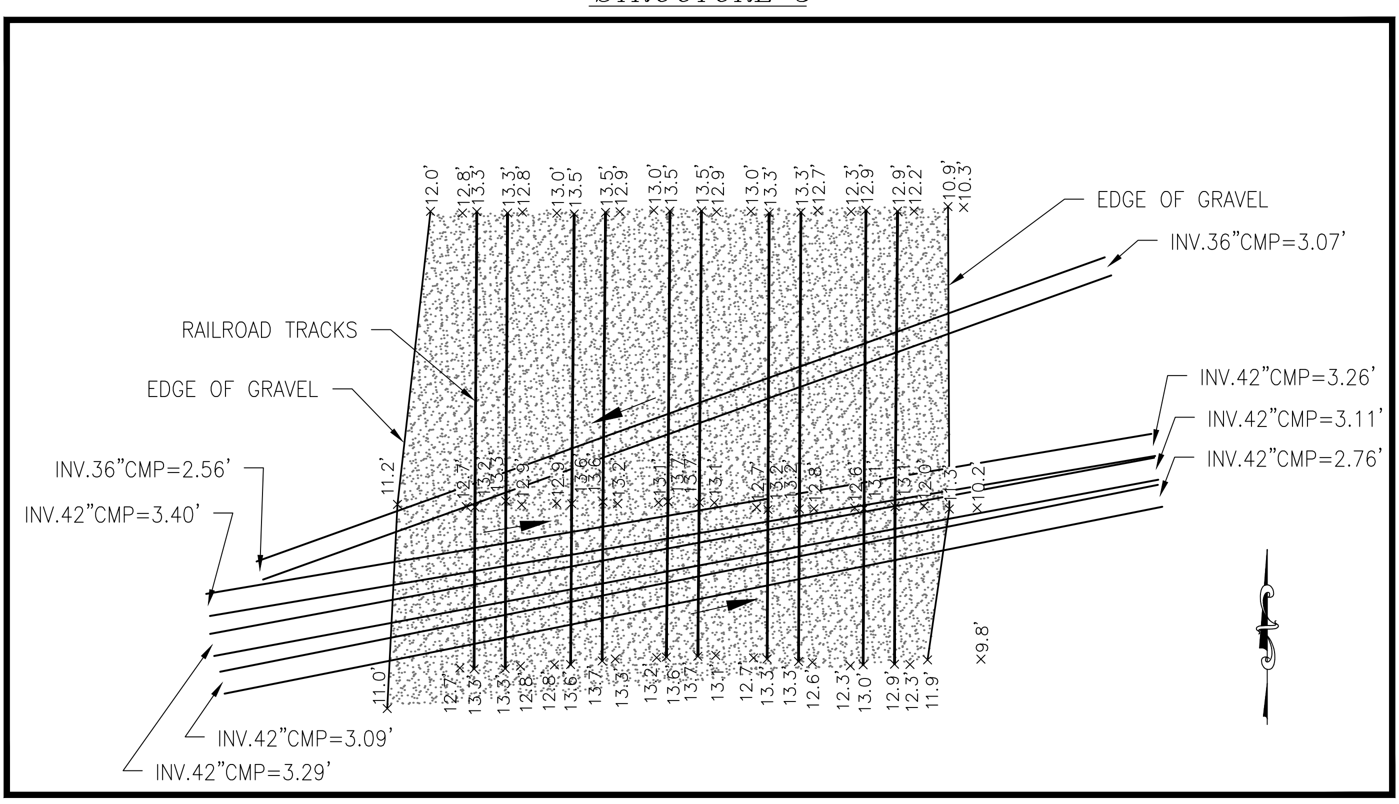

0 15 30

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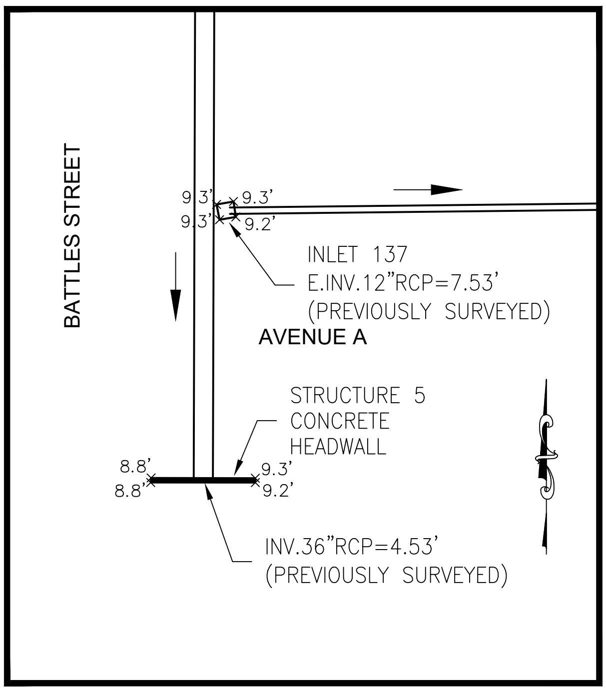
TOPOGRAPHIC SURVEY
2024 POST ST. JOE COASTAL STRUCTURES
CITY OF PORT ST. JOE
GULF COUNTY, FLORIDA.

PROJECT NO. 50146276

SHEET NO. 3 OF 54

Drawing name: C:\Survey Projects (temporary)\50146276_PSJ_PSJ Central Channel\Survey dwg\50146276-TS.dwg S(3) May 06, 2024 11:40am by: erankin

STRUCTURE 5 – INLET 137



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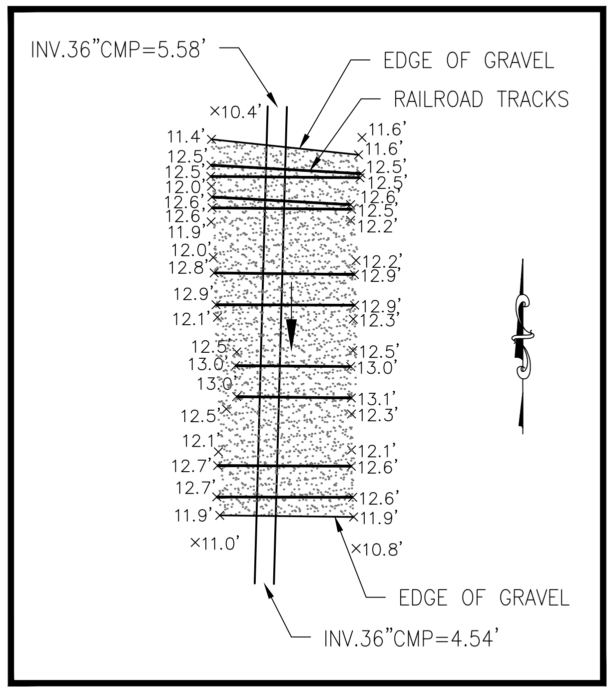

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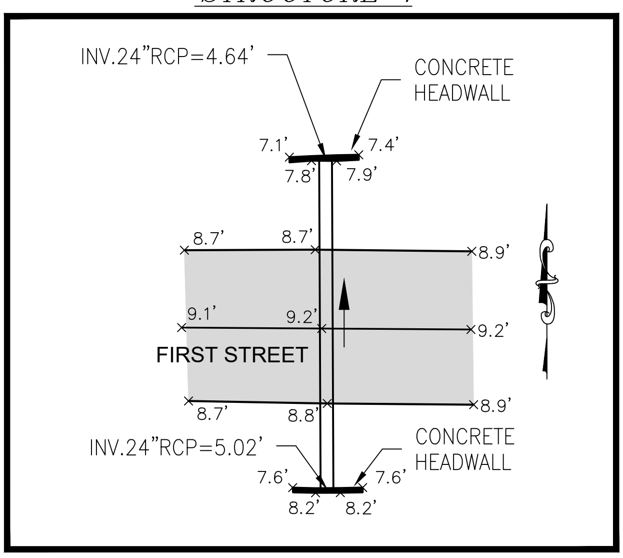
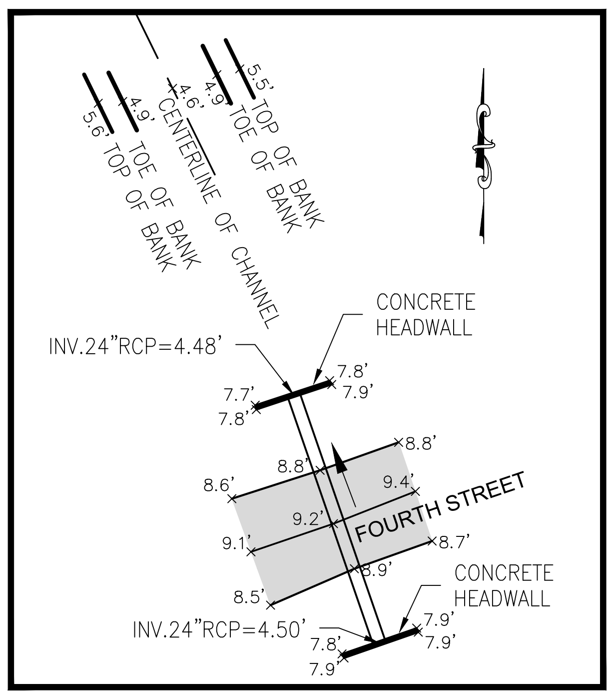
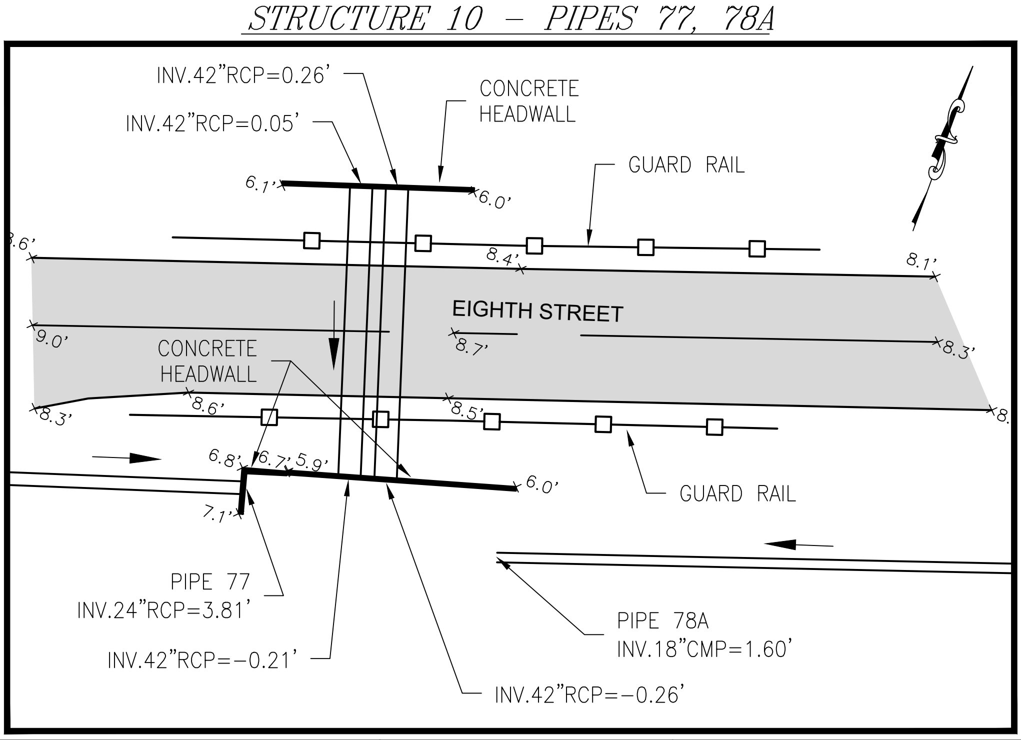
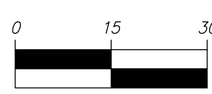


STRUCTURE 8 – CROSS SECTION 10



STRUCTURE 10 – PIPES 77, 78A





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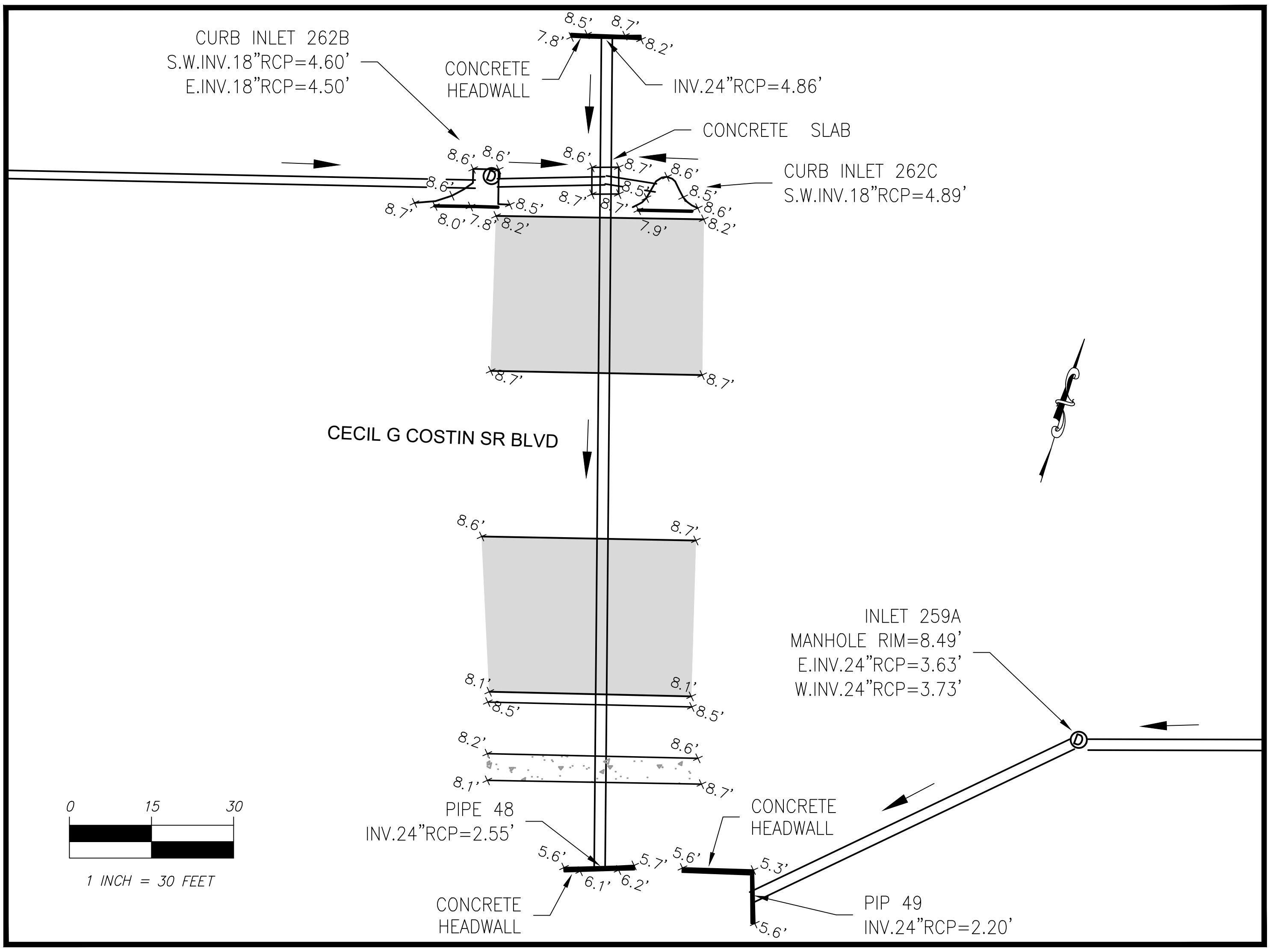
TOPOGRAPHIC SURVEY
2024 POST ST. JOE COASTAL STRUCTURES
CITY OF PORT ST. JOE
GULF COUNTY, FLORIDA.

PROJECT NO. 50146276
SHEET NO. 4 OF 54

STRUCTURE 9 – INLETS 262B, 262C, 259A – PIPES 48, 49



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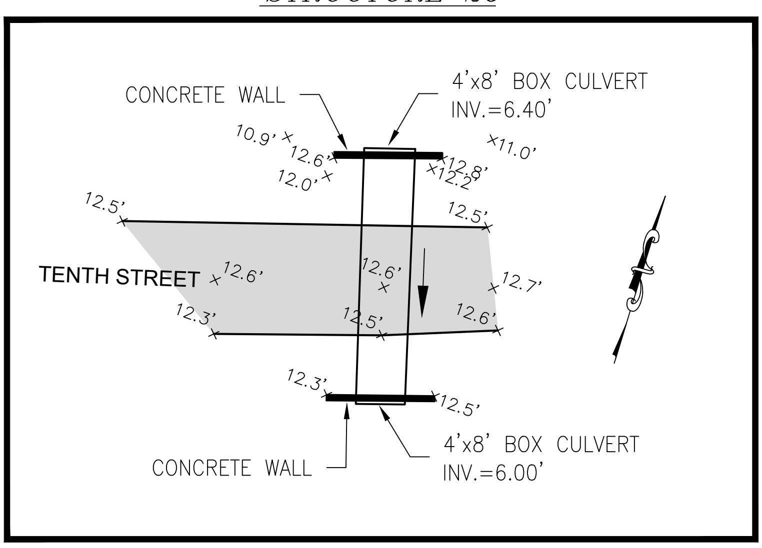

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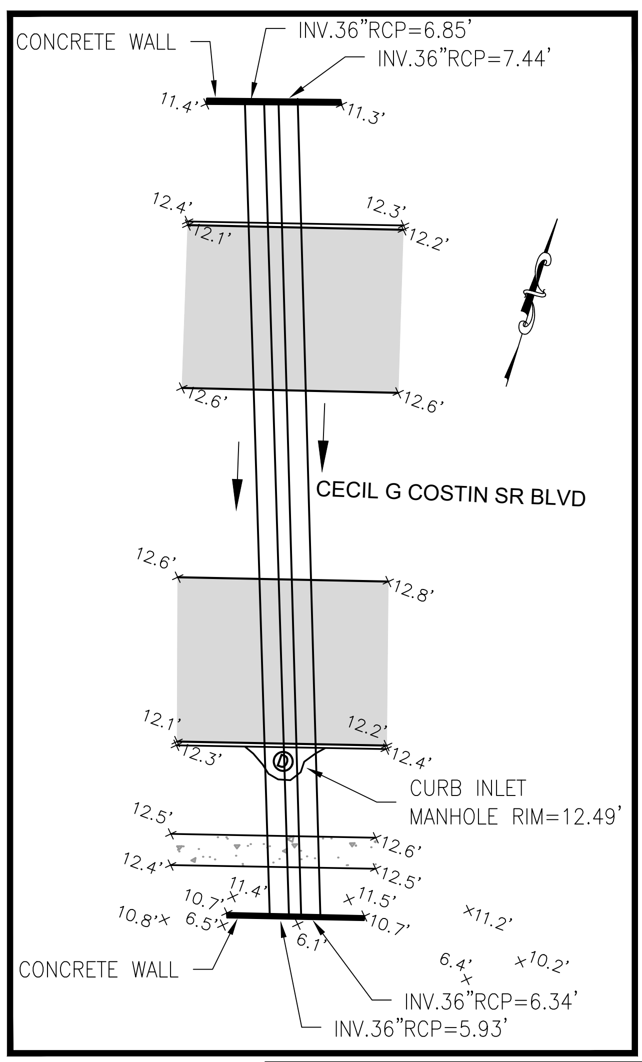
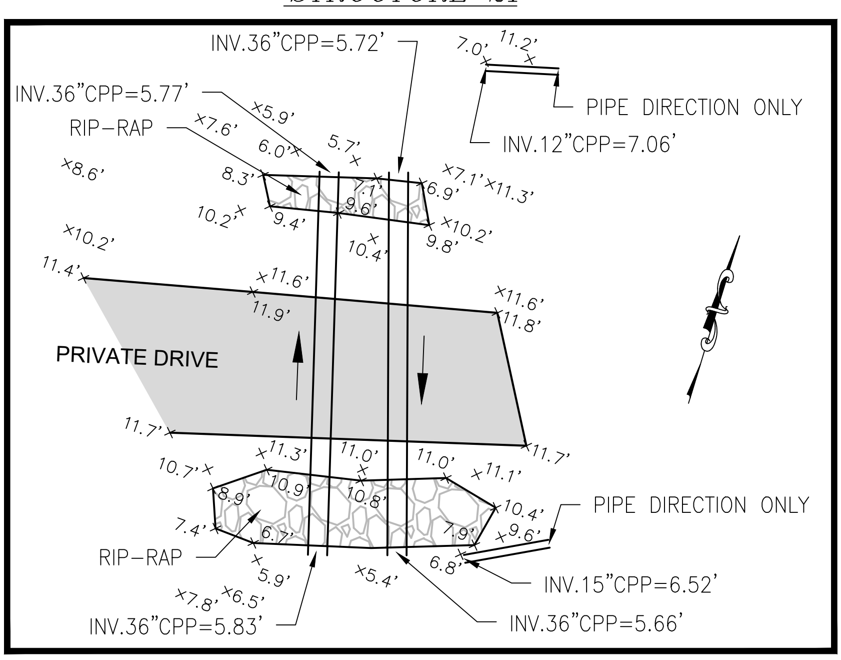


STRUCTURE 21



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SHEET SCALE:	1" = 30'
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CITY OF PORT ST. JOE
GULF COUNTY, FLORIDA.

PROJECT NO. 50146276
SHEET NO.
5 OF 54

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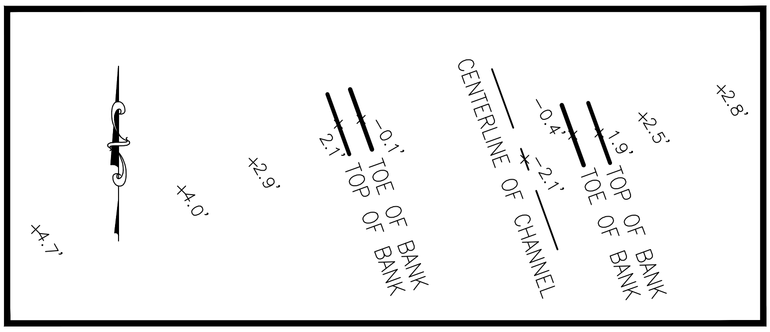
CROSS SECTION 9



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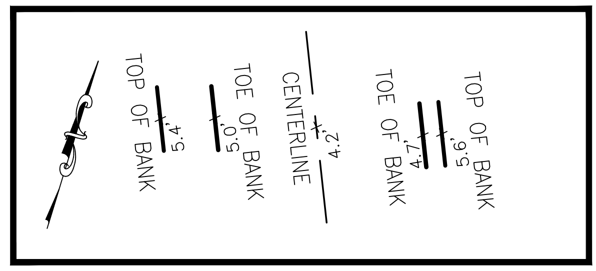
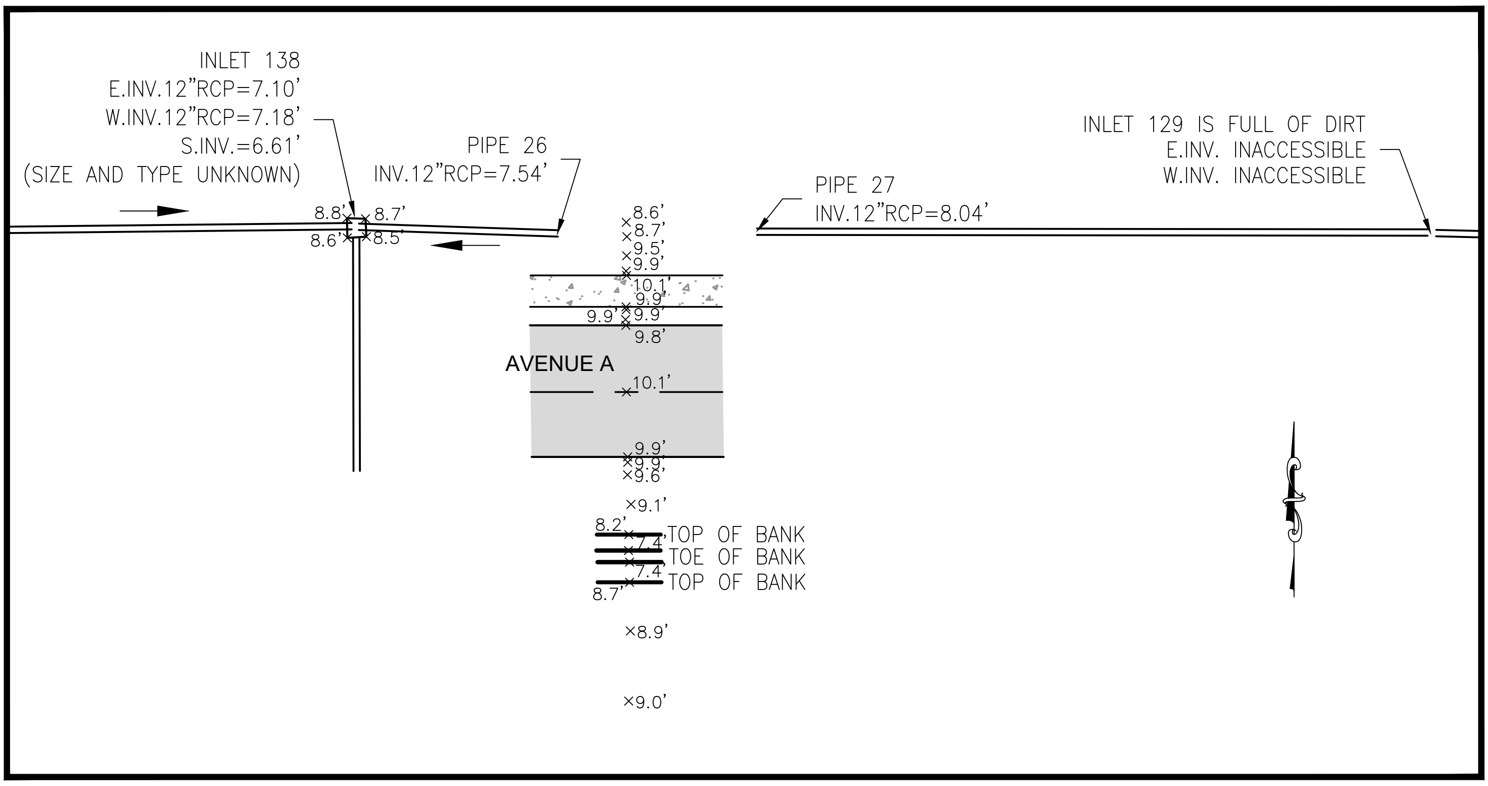


CROSS SECTION 12 – INLETS 129, 138 – PIPES 26, 27



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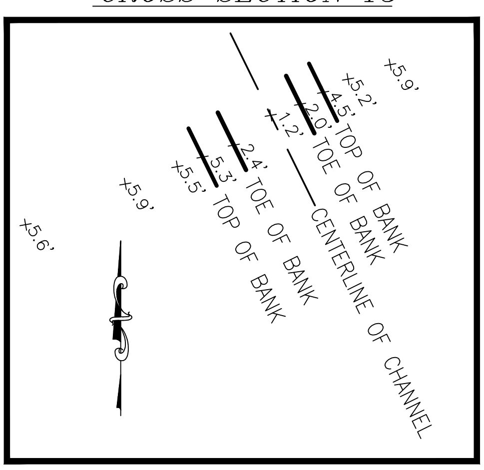

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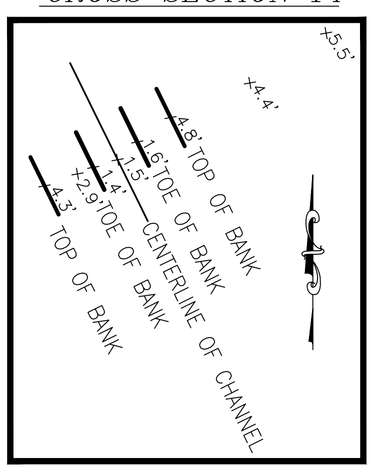

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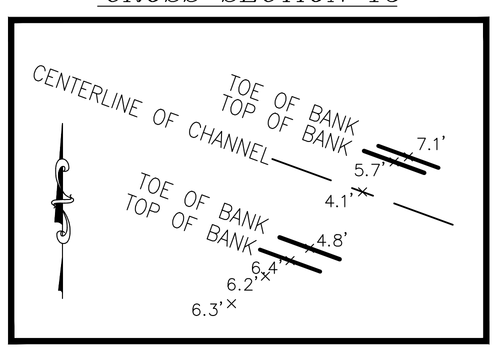

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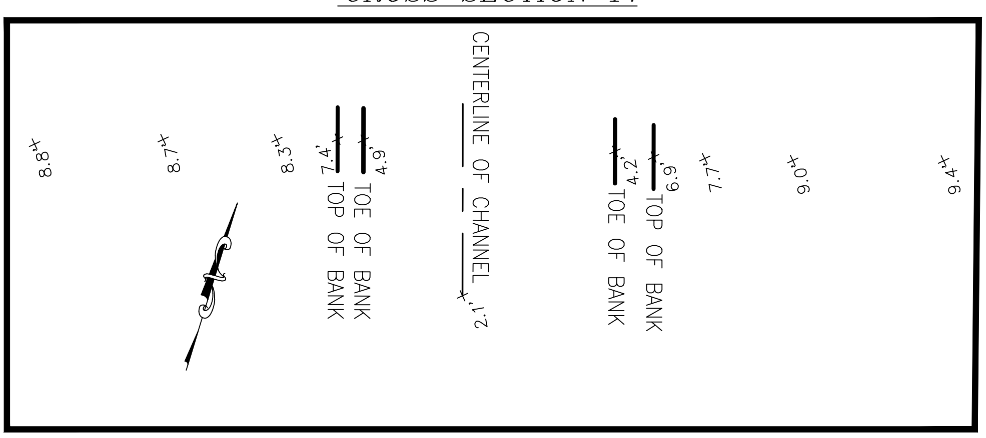

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APPROVED BY:	JG

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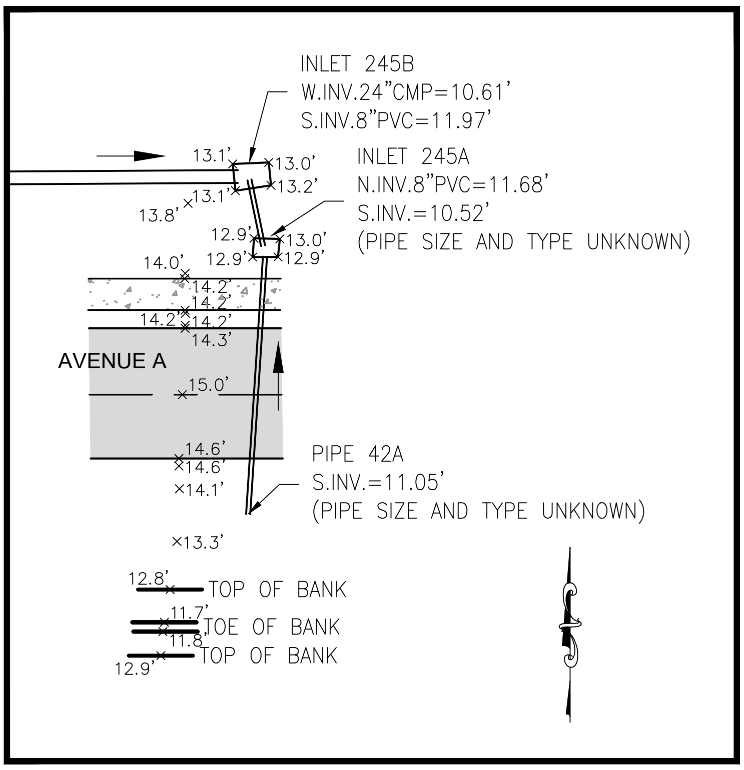
CITY OF PORT ST. JOE
GULF COUNTY, FLORIDA.

PROJECT NO. 50146276

SHEET NO. 6 OF 54

CROSS SECTION 19 – INLETS 245A,245B–PIPE 42A



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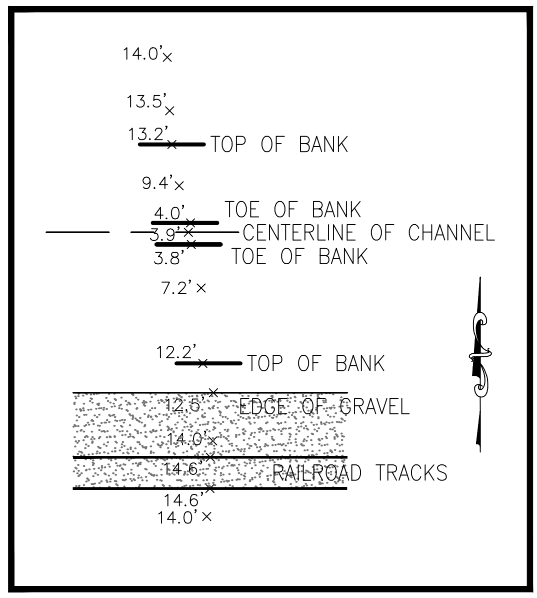

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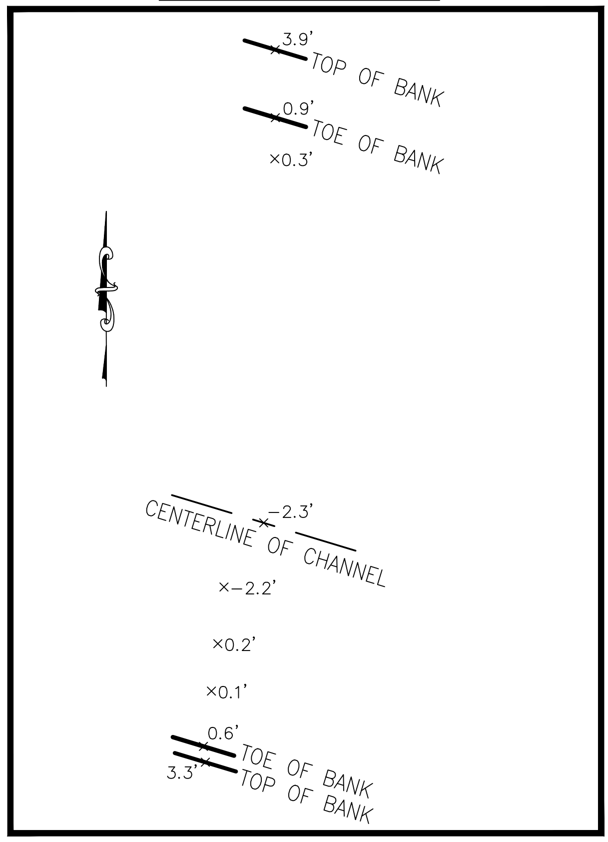
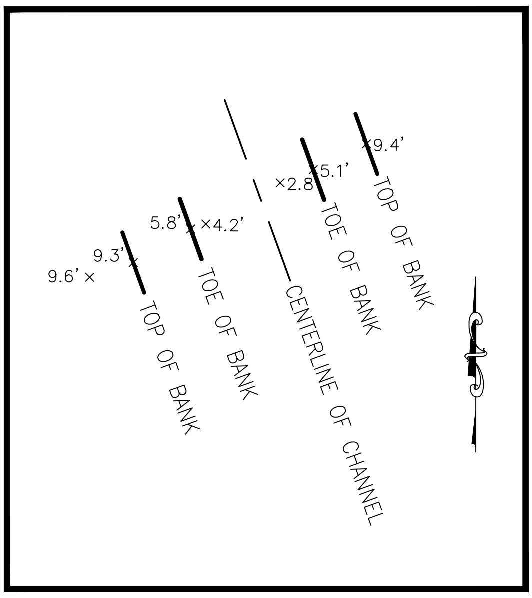
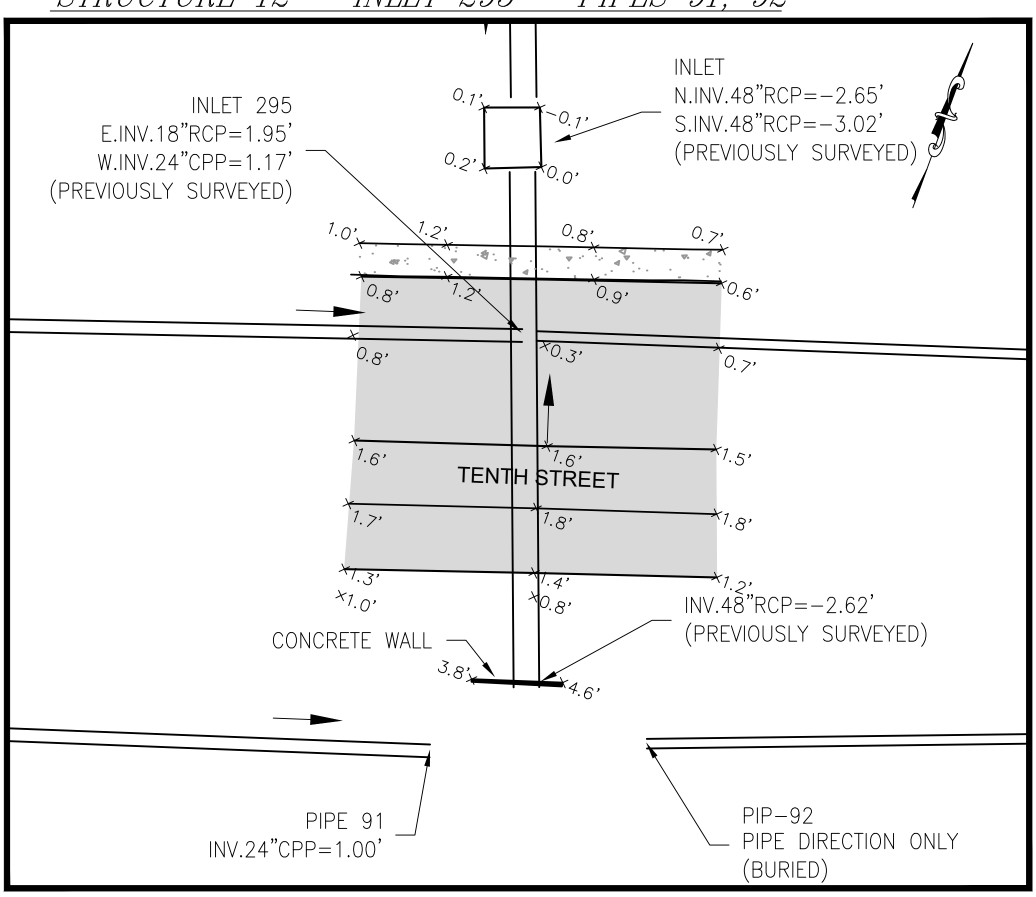


CROSS SECTION 18



STRUCTURE 12 – INLET 295 – PIPES 91, 92



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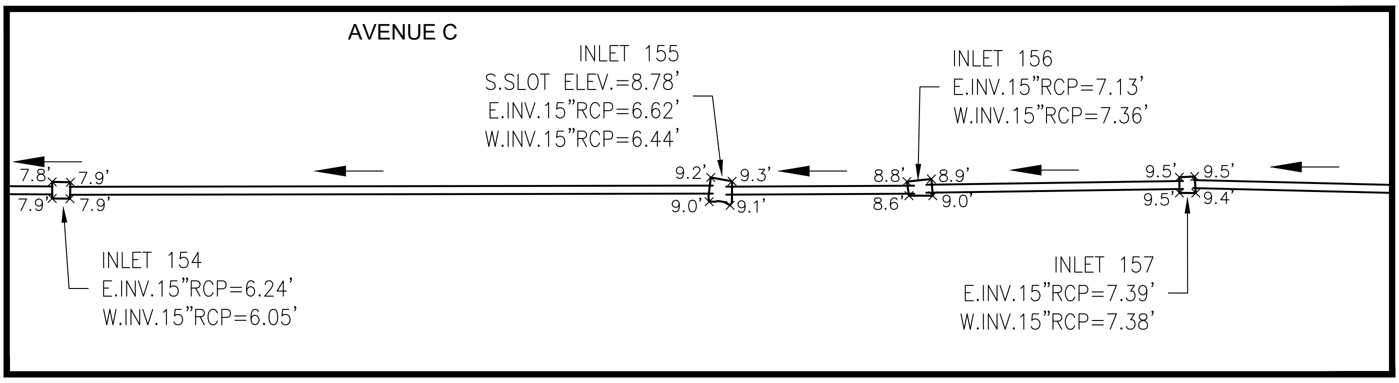
TOPOGRAPHIC SURVEY
2024 POST ST. JOE COASTAL STRUCTURES
CITY OF PORT ST. JOE
GULF COUNTY, FLORIDA.

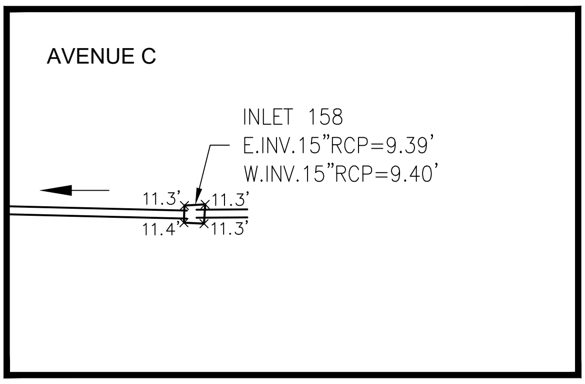
PROJECT NO. 50146276

SHEET NO. 7 OF 54

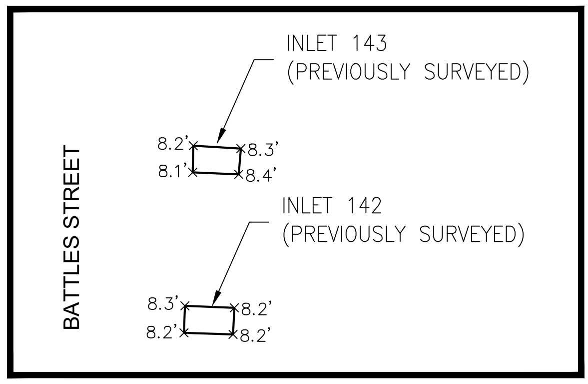
INLETS 154, 155, 156, 157



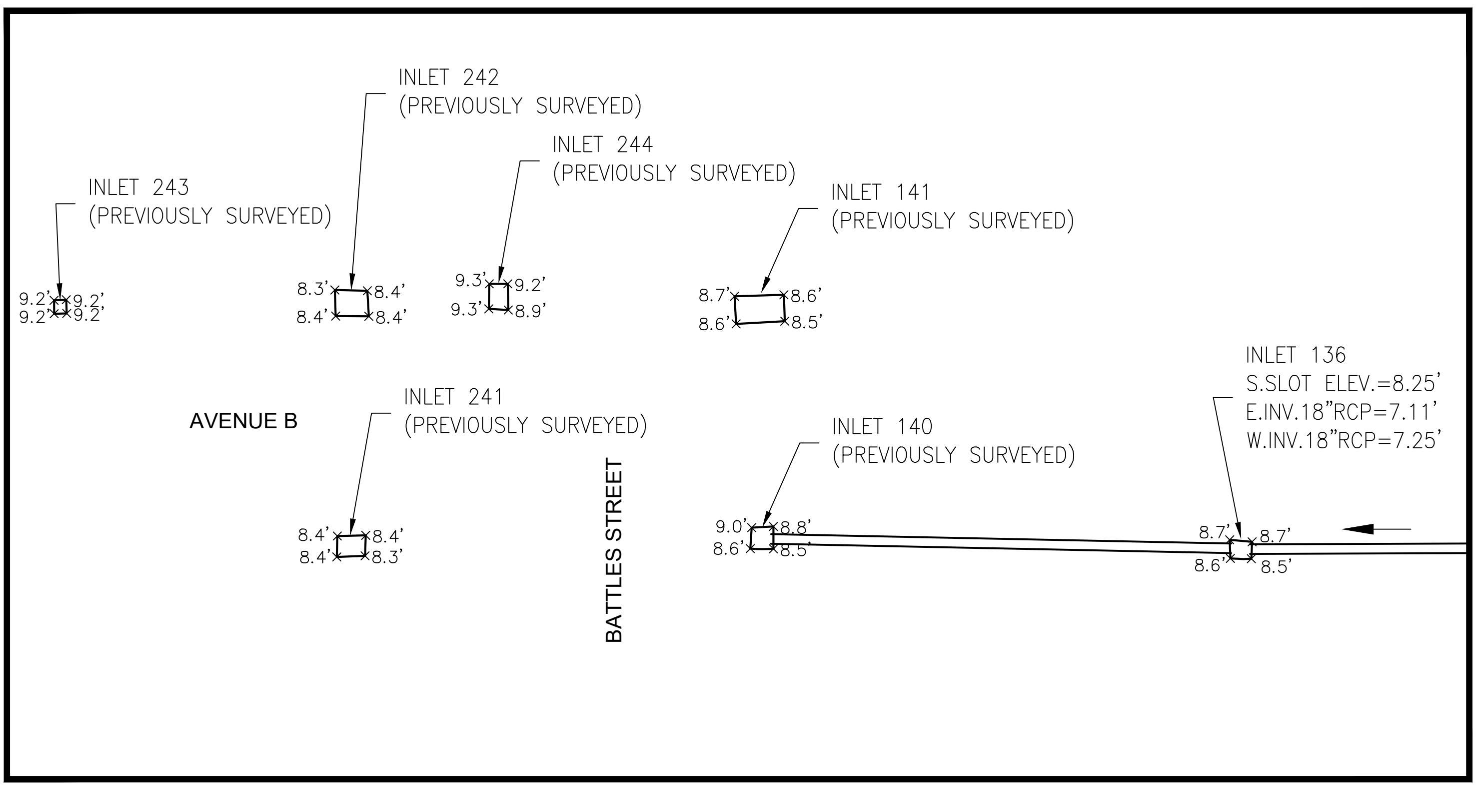
INLET 158



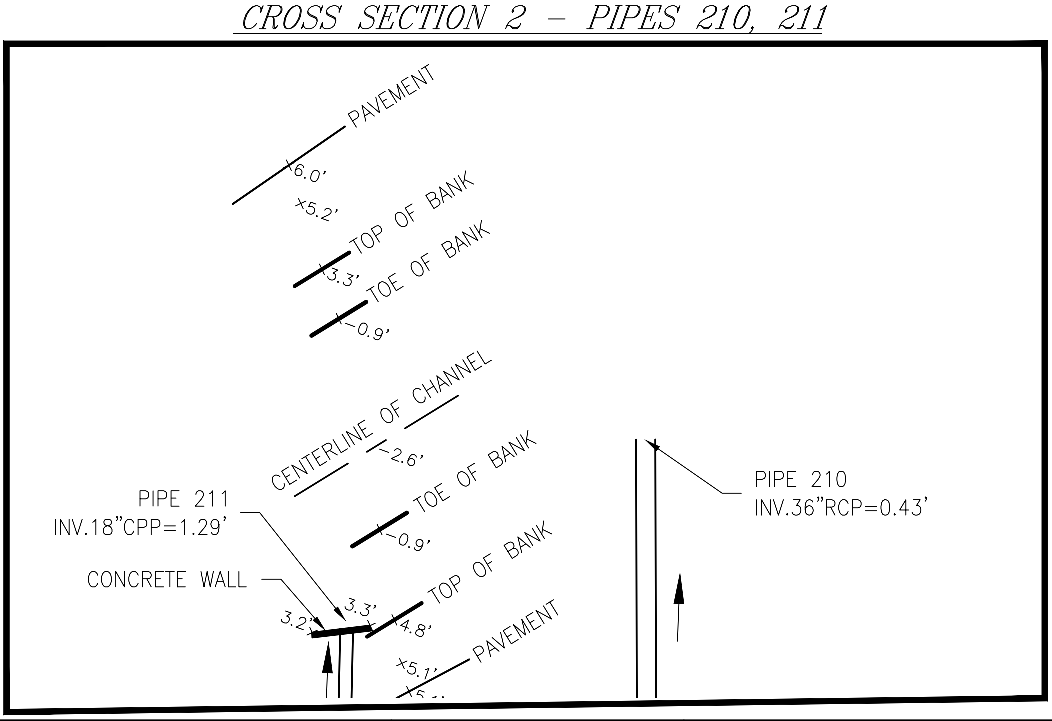
INLETS 142, 143

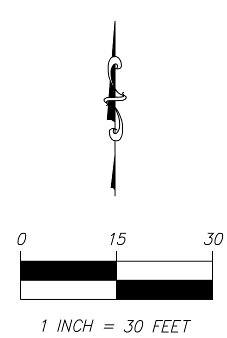


INLETS 136, 140, 141, 241, 242, 243, 244



CROSS SECTION 2 - PIPES 210, 211





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TOPOGRAPHIC SURVEY
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PROJECT NO. 50146276
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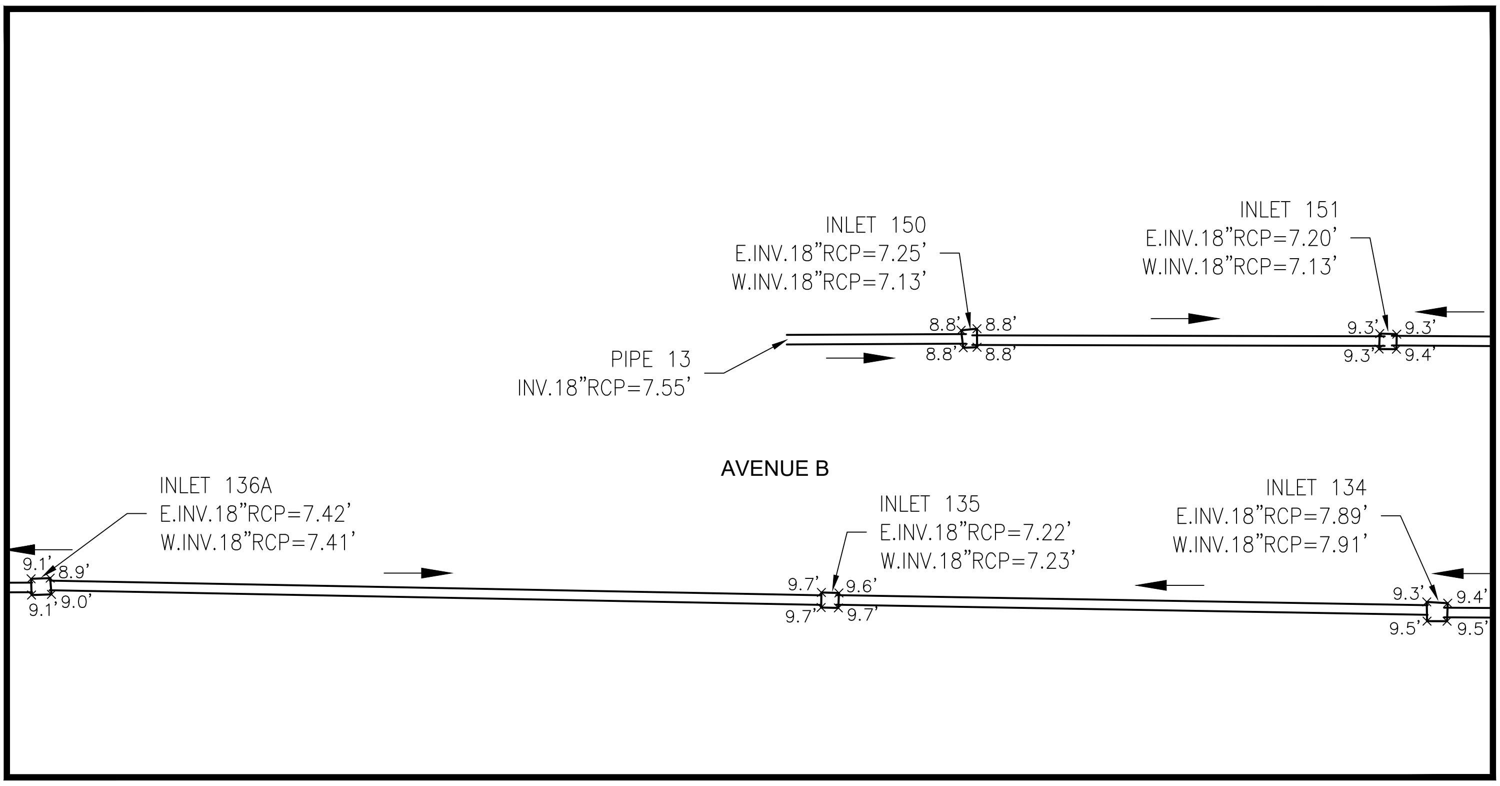
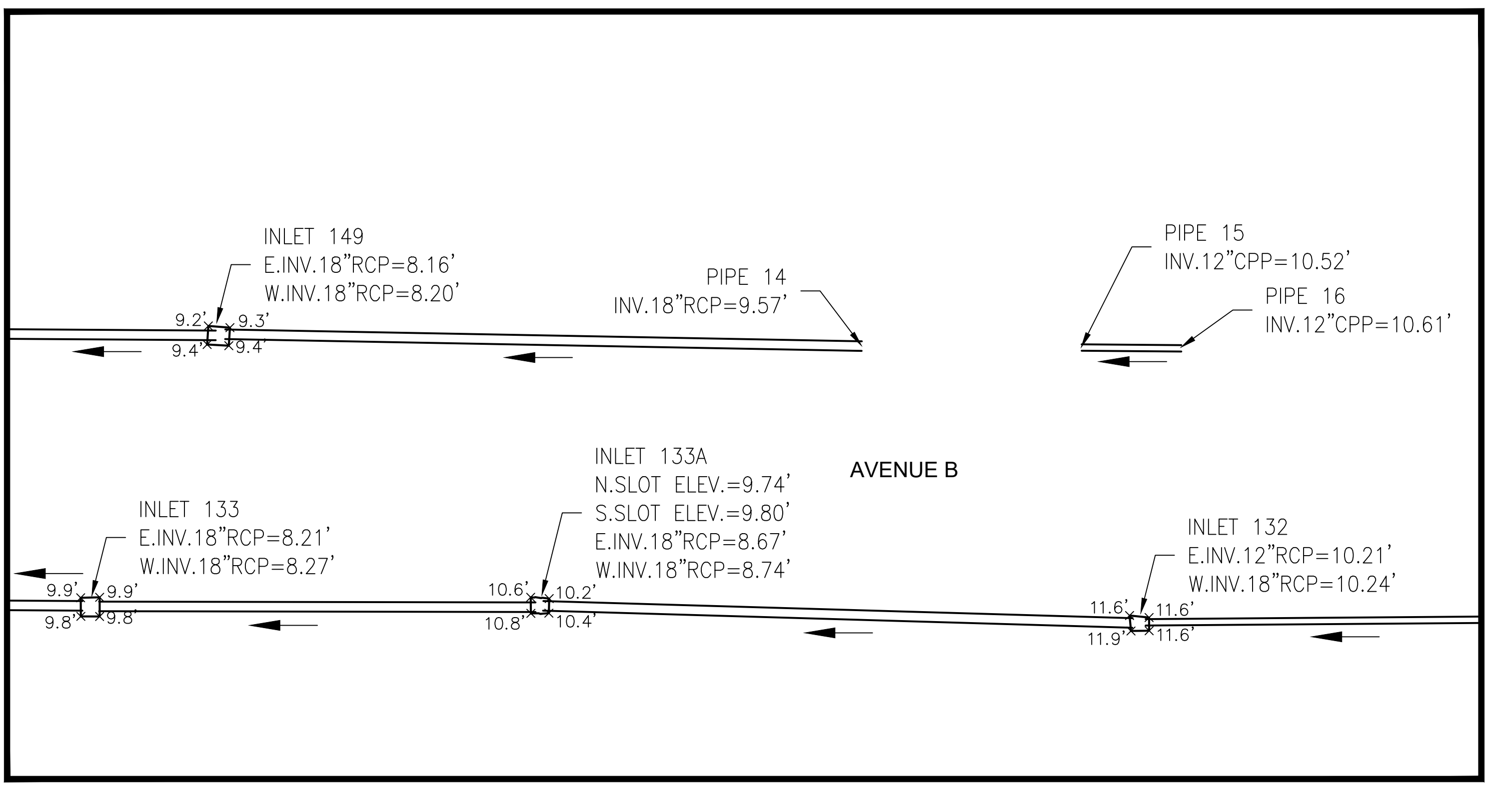
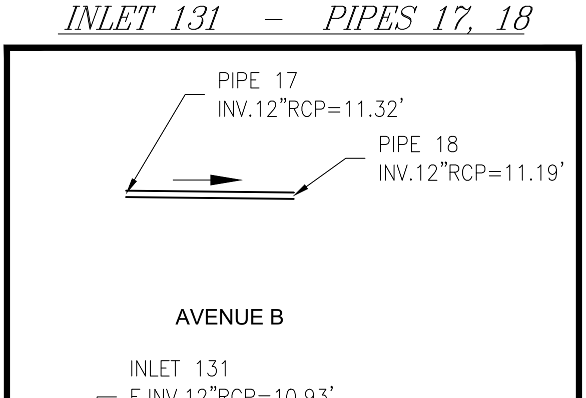
INLETS 134, 135, 136A, 150, 151 – PIPE 13



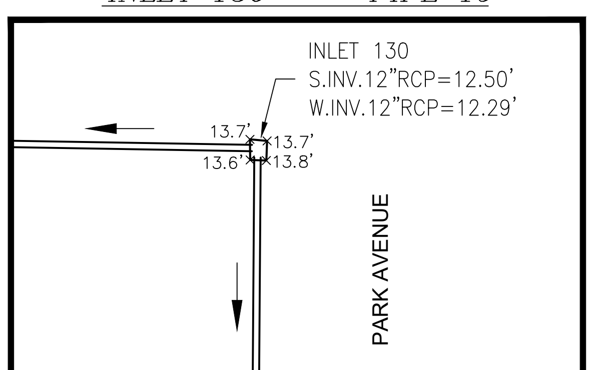
INLETS 132, 133A, 133, 149 – PIPES 14, 15, 16

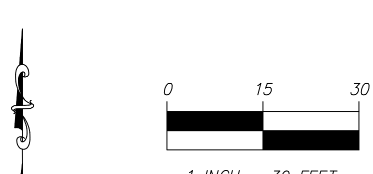


INLET 131 – PIPES 17, 18



INLET 130 – PIPE 19





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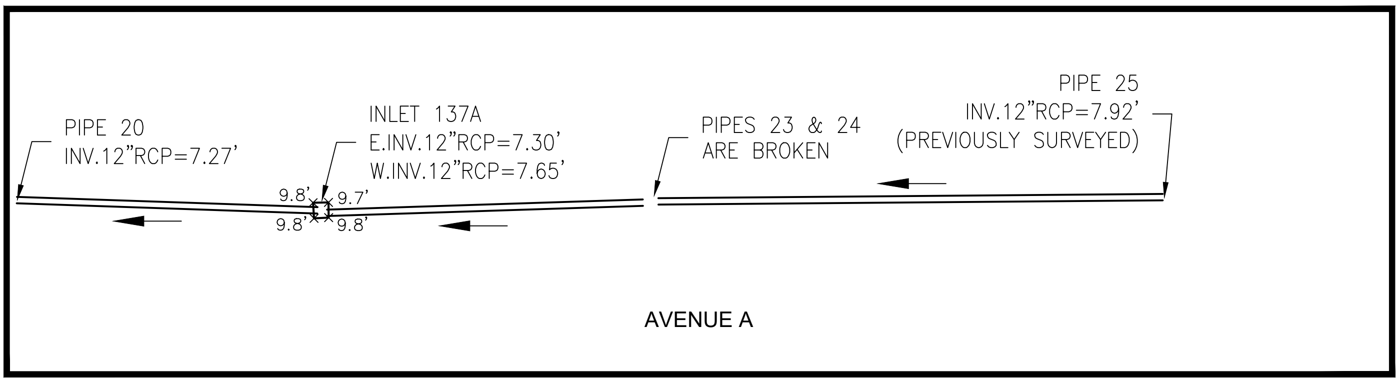
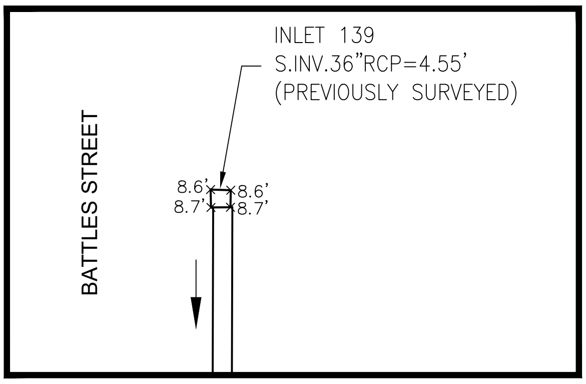
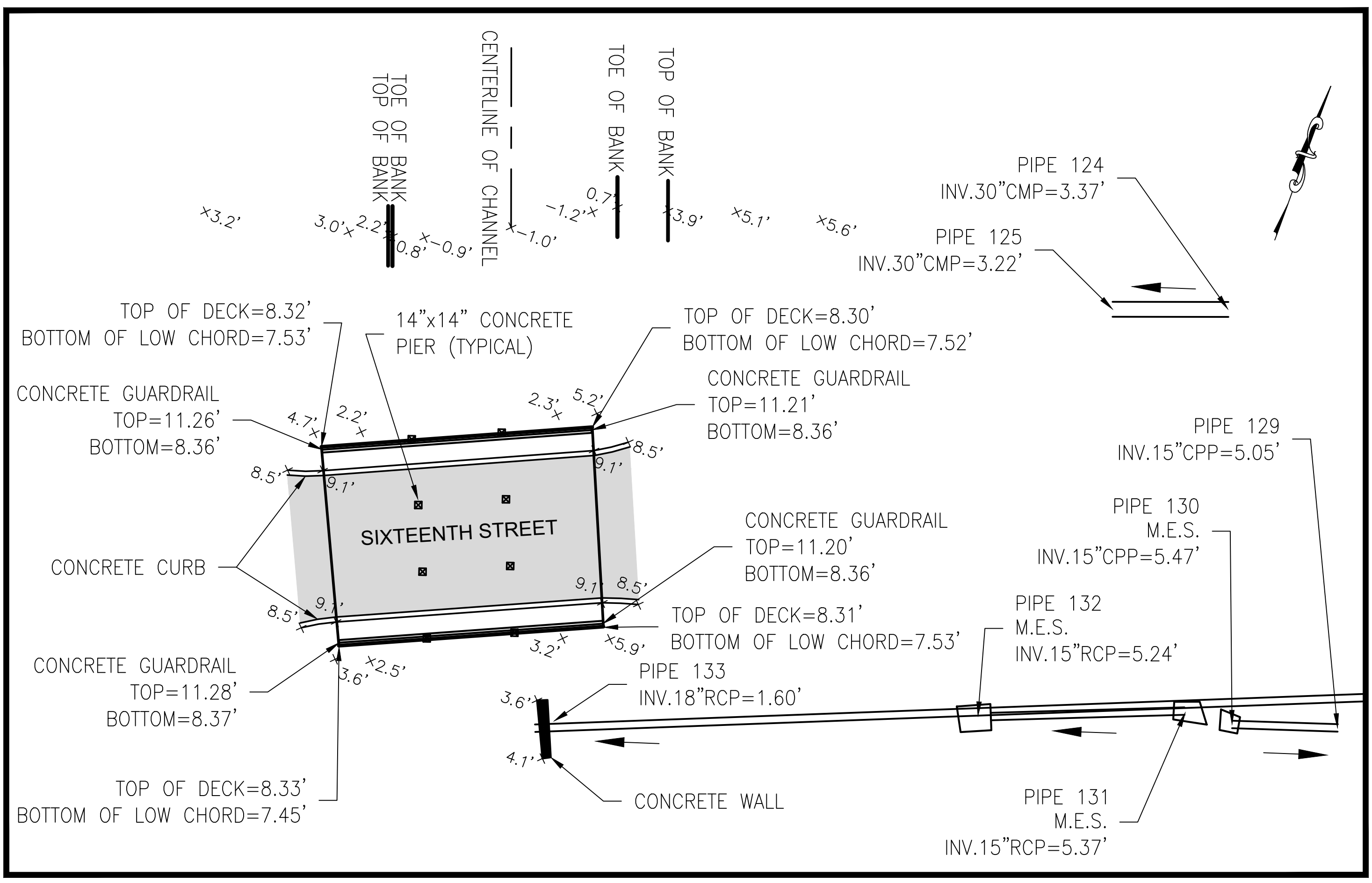
INLET 137A – PIPES 20, 23, 24, 25



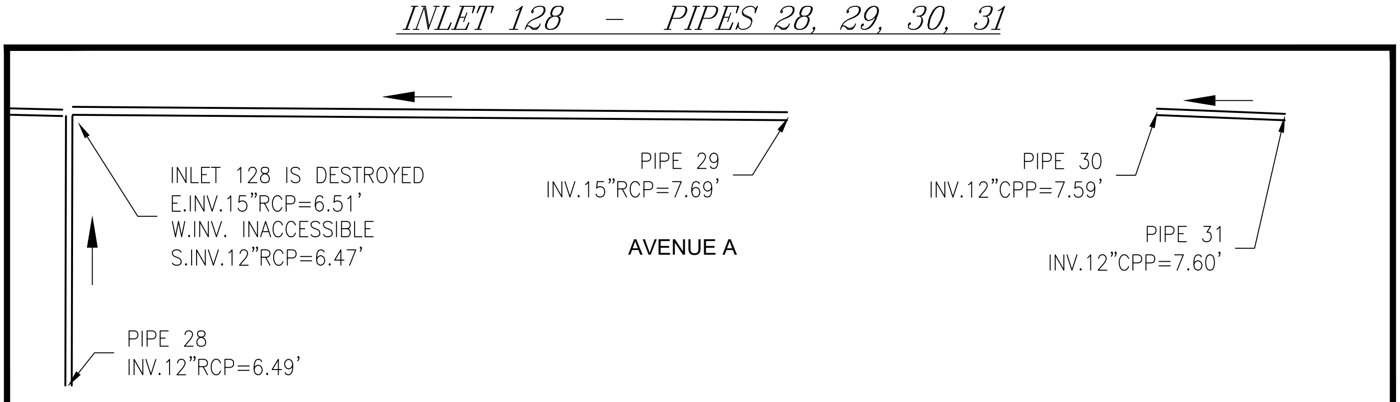
INLET 139



STRUCTURE 13 – CROSS SECTION 10
PIPES 124, 125, 129, 130, 131, 132, 133



INLET 128 – PIPES 28, 29, 30, 31



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2024 POST ST. JOE COASTAL STRUCTURES
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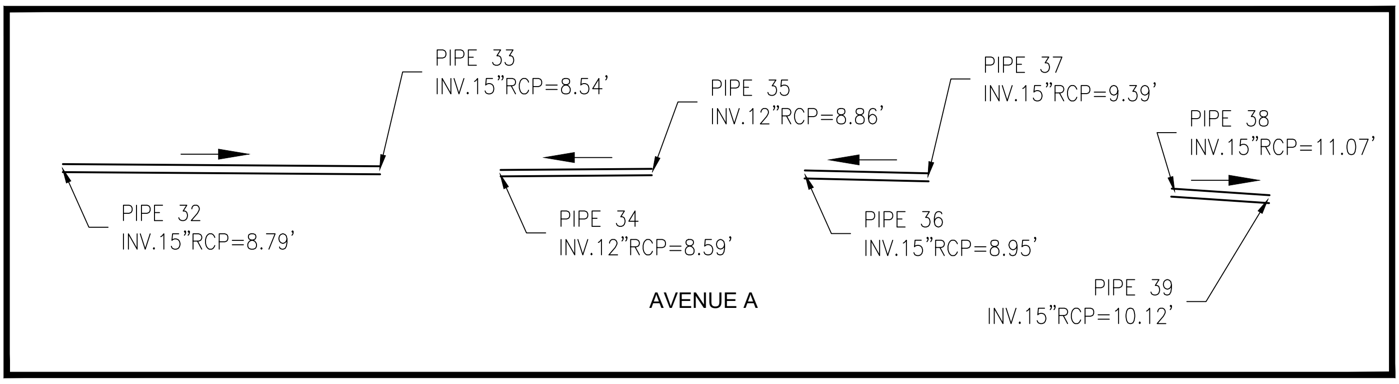
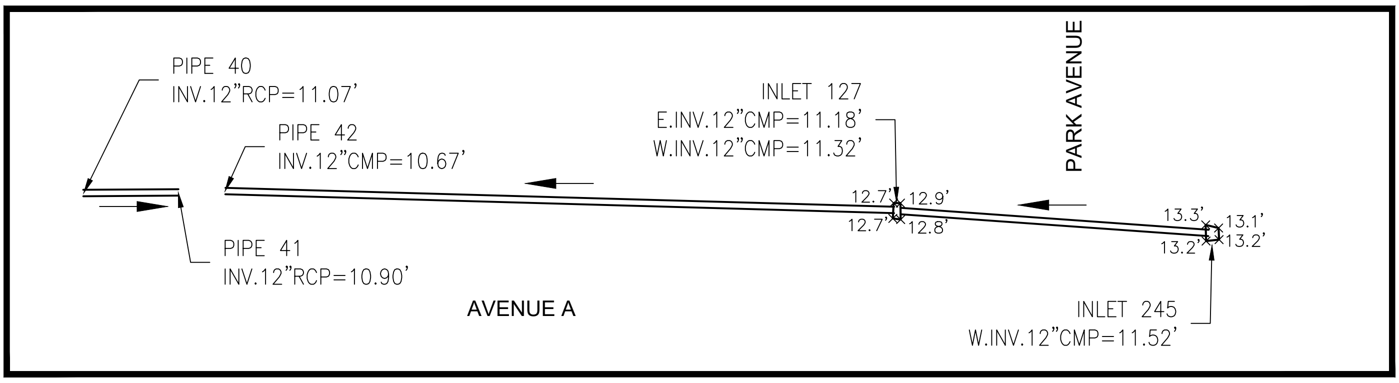
PROJECT NO. 50146276
SHEET NO.
9 OF 54

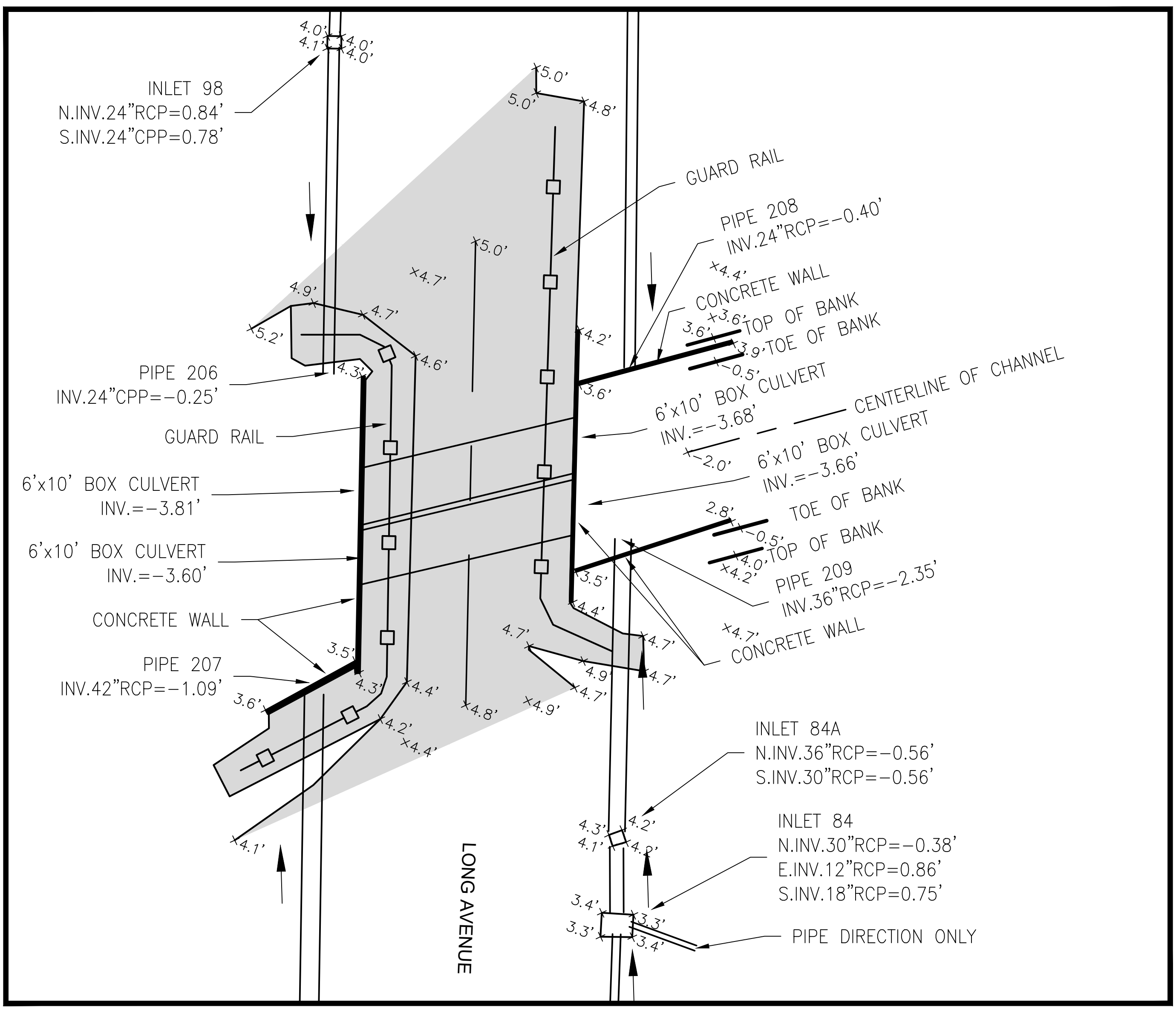
PIPES 32, 33, 34, 35, 36, 37, 38, 39



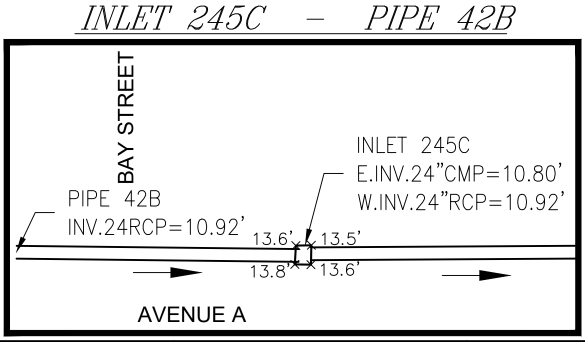
INLETS 127, 245 – PIPES 40, 41, 42



STRUCTURE 15 – CROSS SECTION 16 – INLETS 84, 84A, 98, PIPES 206, 207, 208, 209



INLET 245C – PIPE 42B



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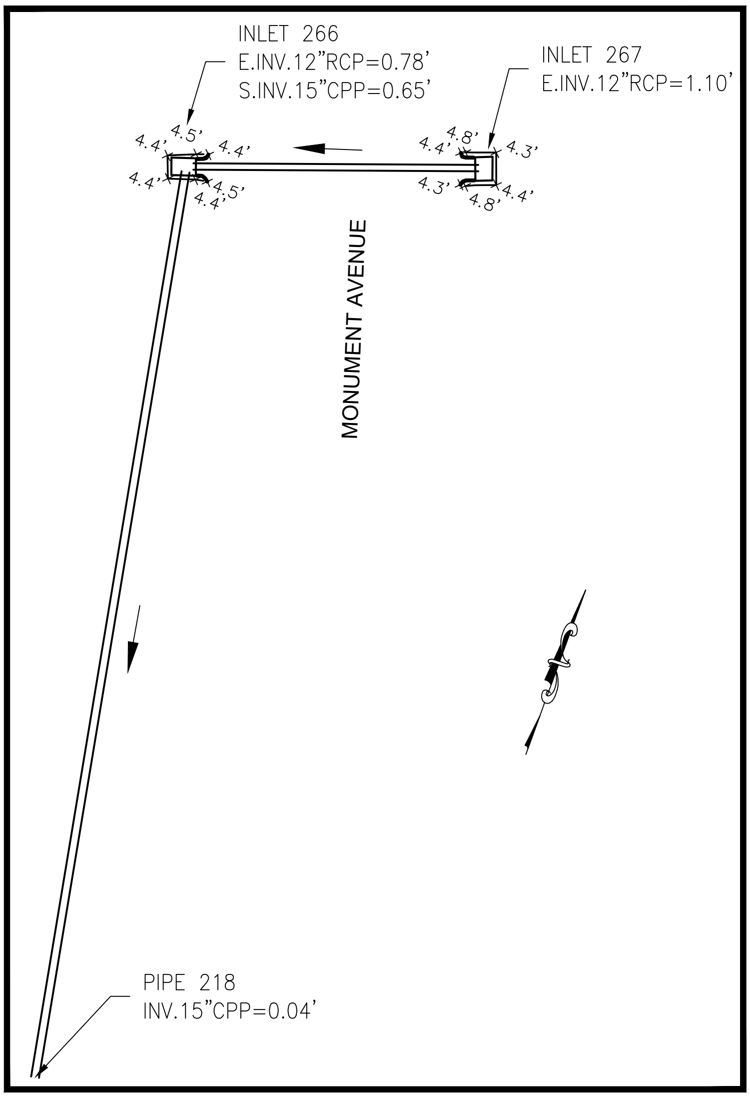
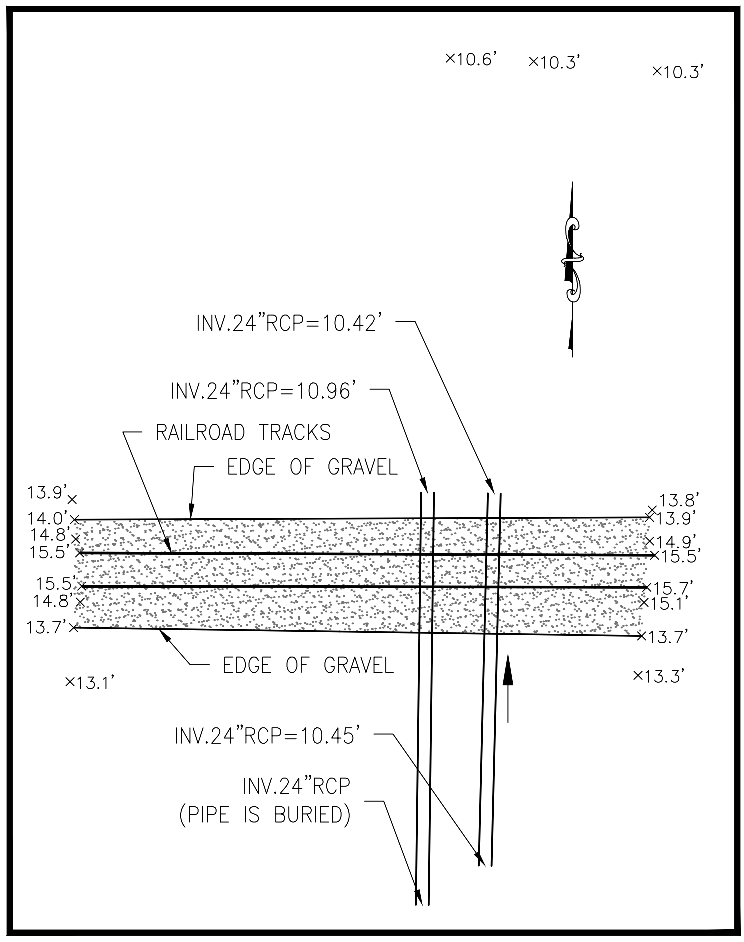
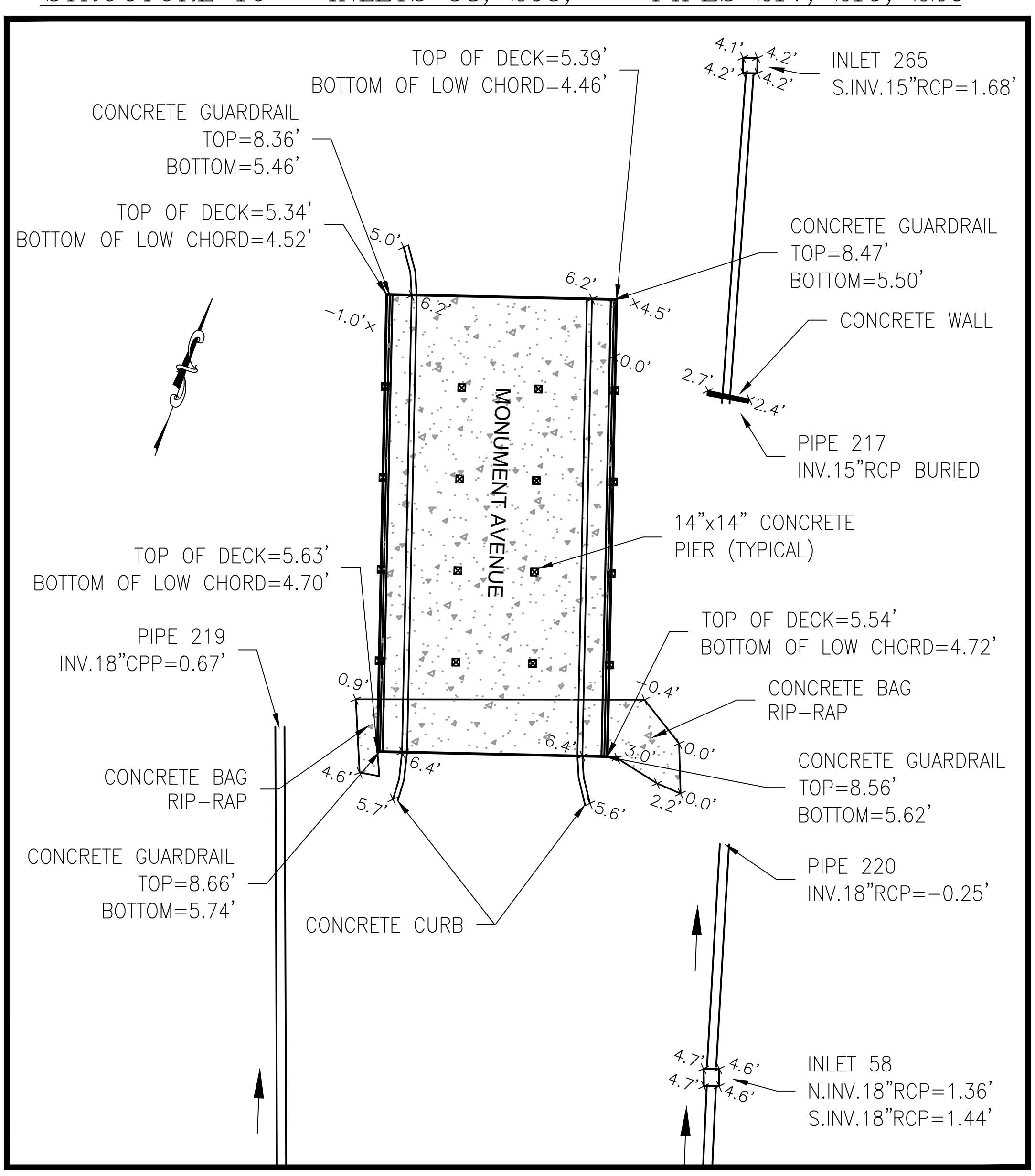
INLETS 266, 267 – PIPE 218

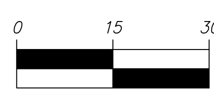


STRUCTURE 23 – CROSS SECTION 21



STRUCTURE 16 – INLETS 58, 265, – PIPES 217, 219, 220





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PROJECT NO. 50146276
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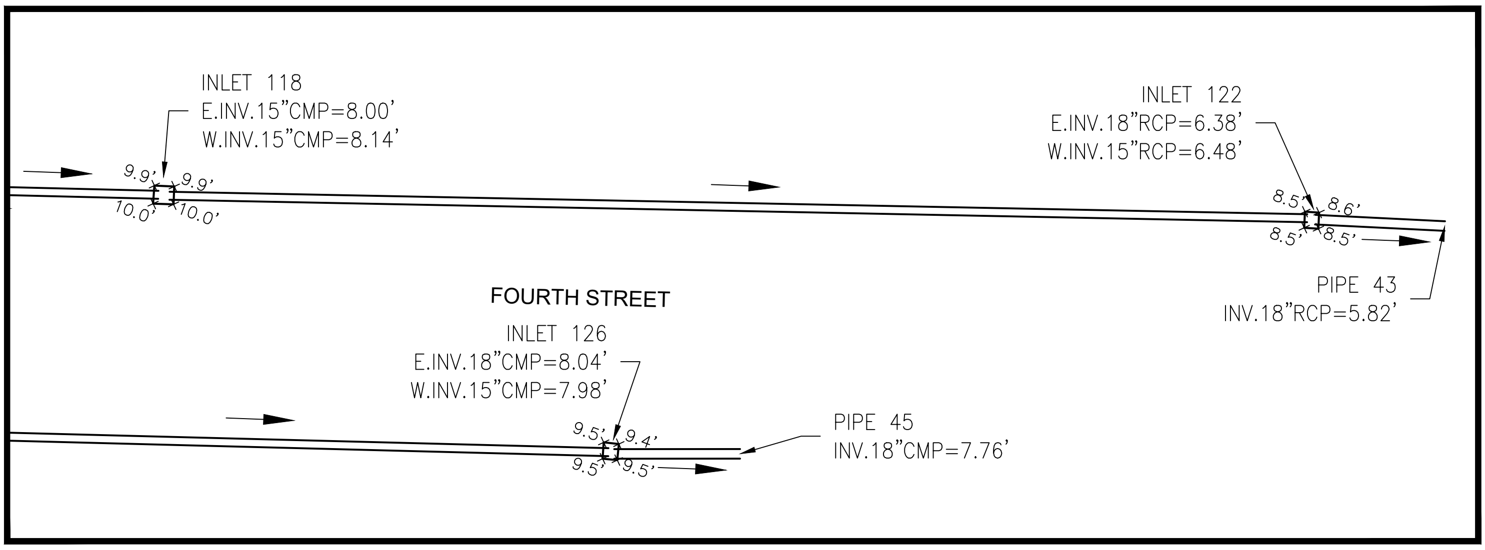
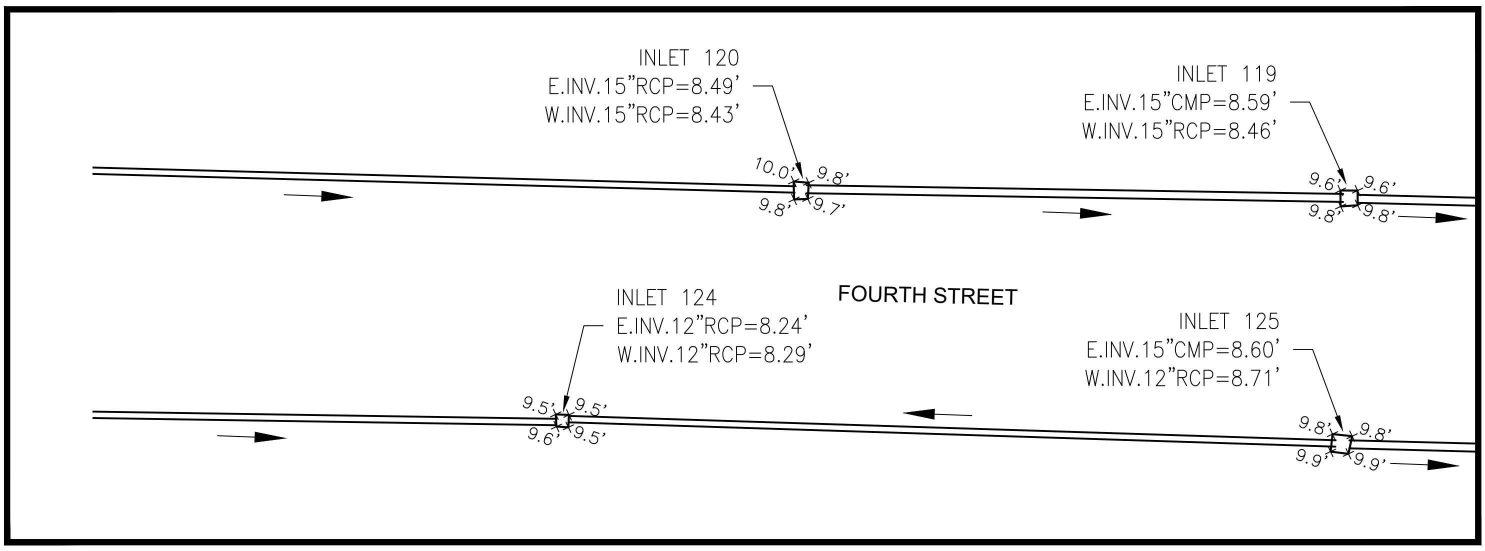
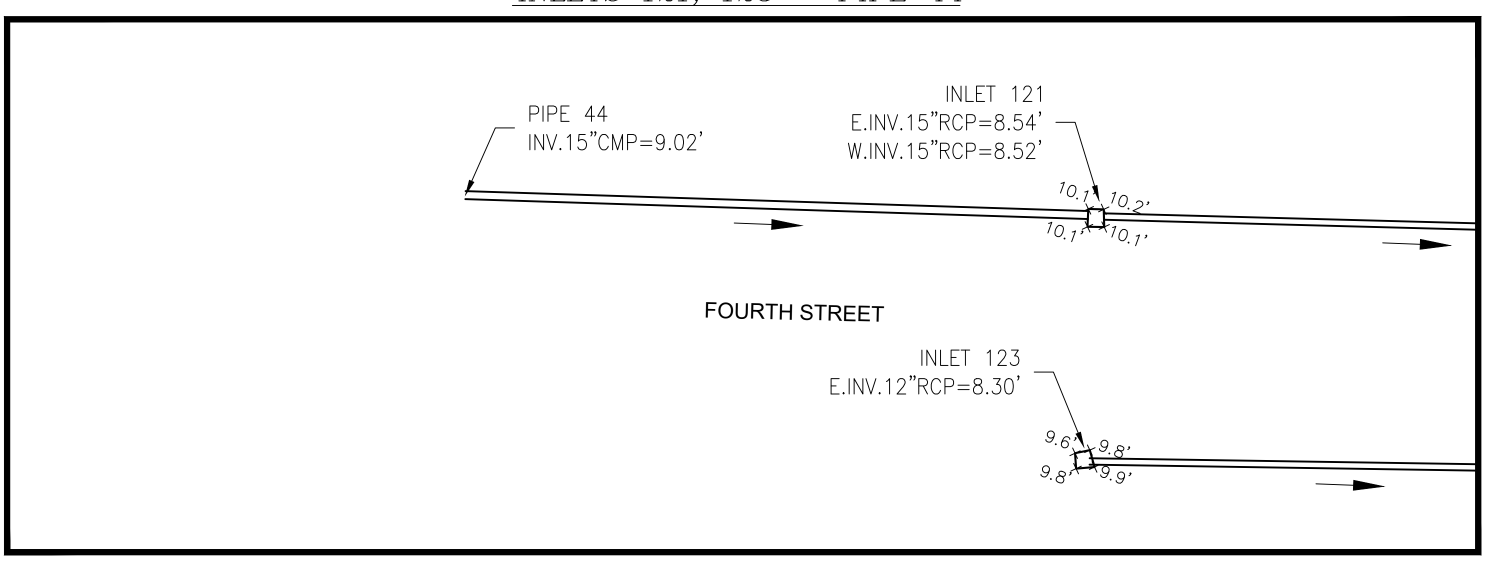
INLETS 118, 122, 126 – PIPES 43, 45



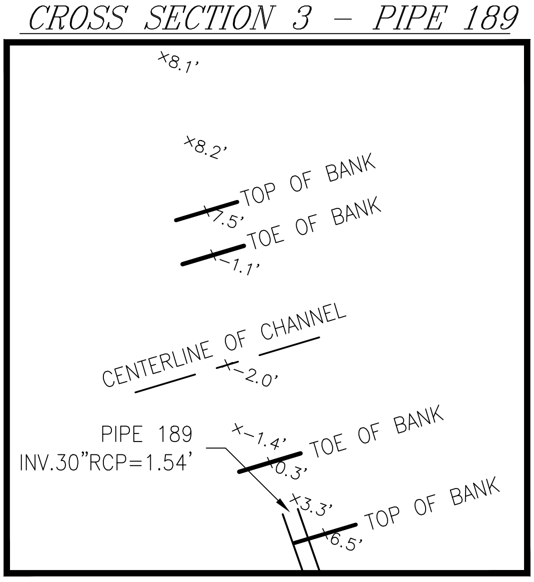
INLETS 119, 120, 124, 125



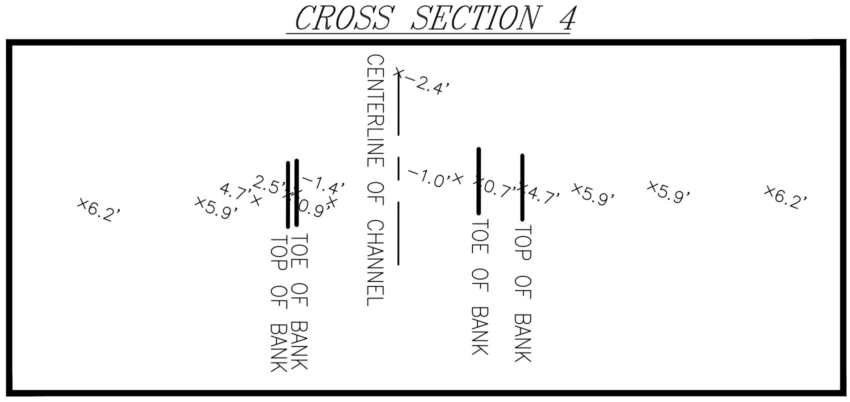
INLETS 121, 123 – PIPE 44



CROSS SECTION 3 – PIPE 189



CROSS SECTION 4



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CITY OF PORT ST. JOE
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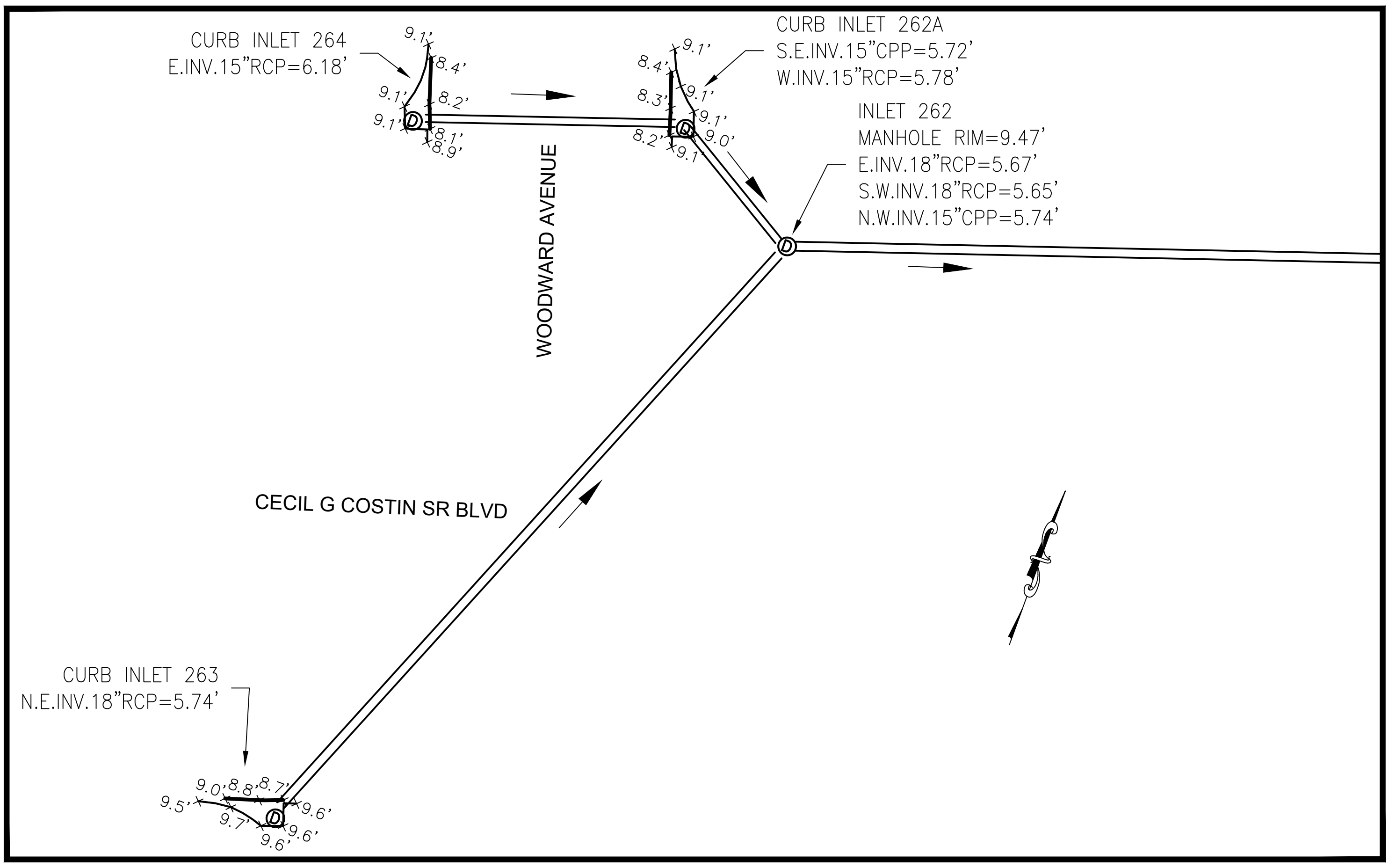
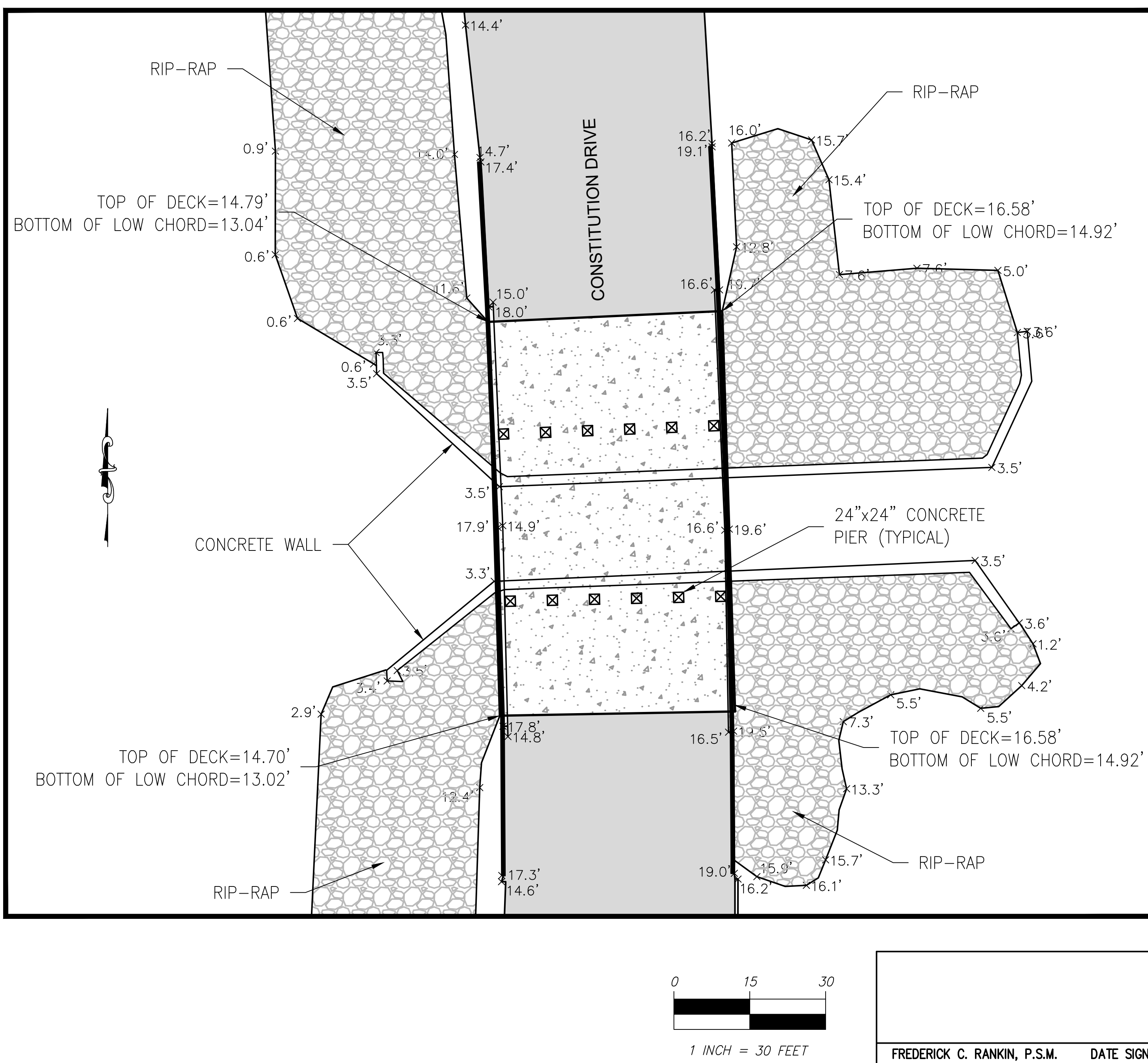
INLETS 262, 262A, 263, 264



STRUCTURE 17



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PROJECT NO. 50146276

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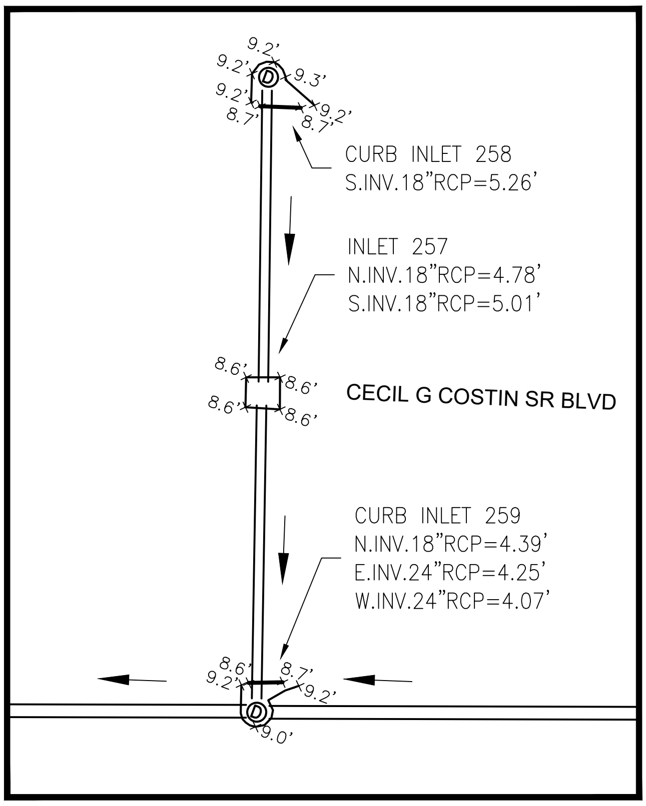
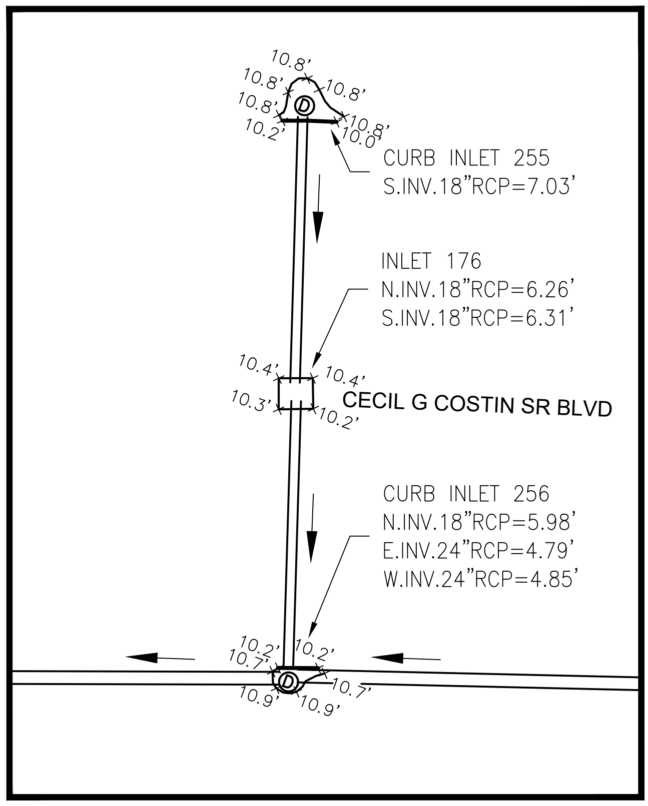
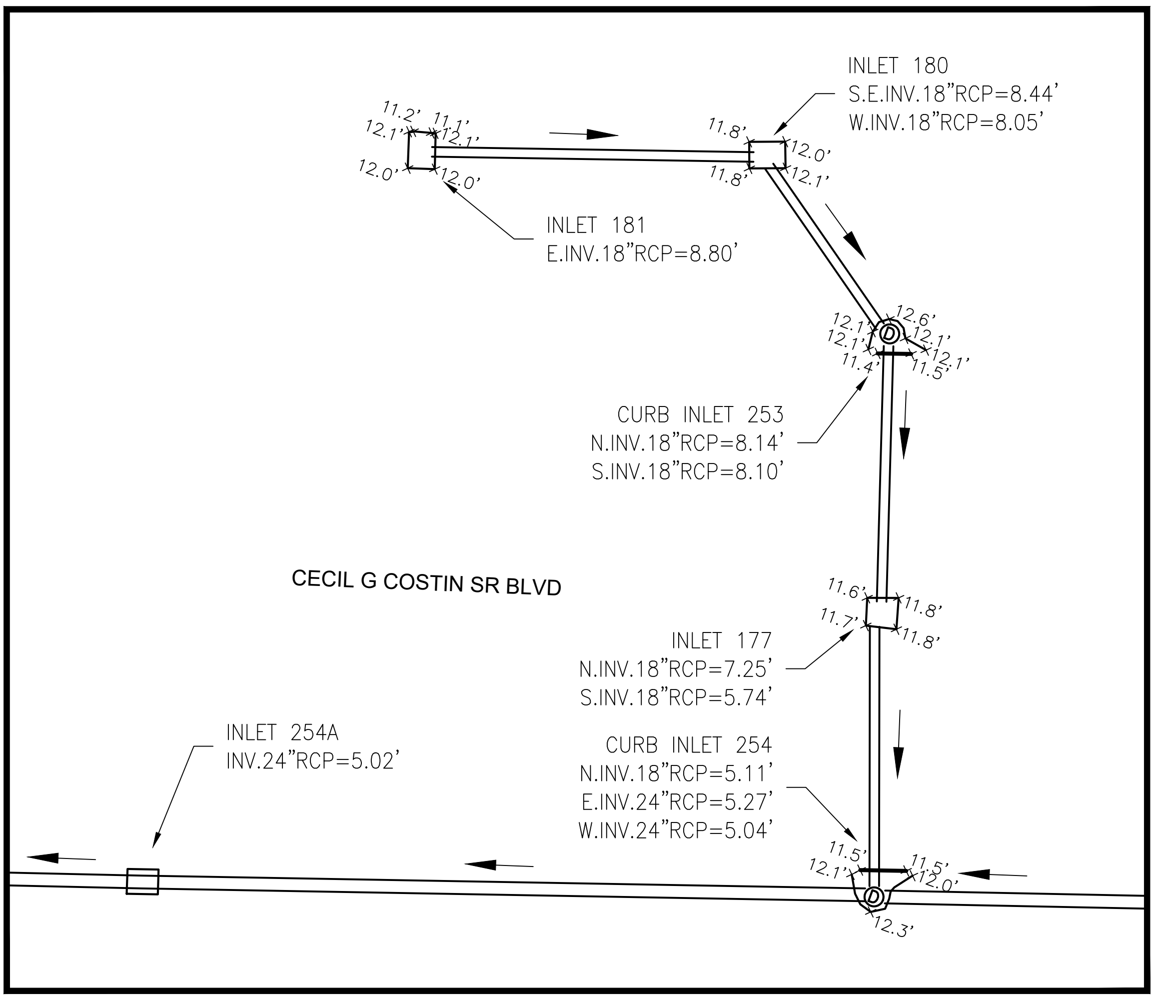
INLETS 257, 258, 259



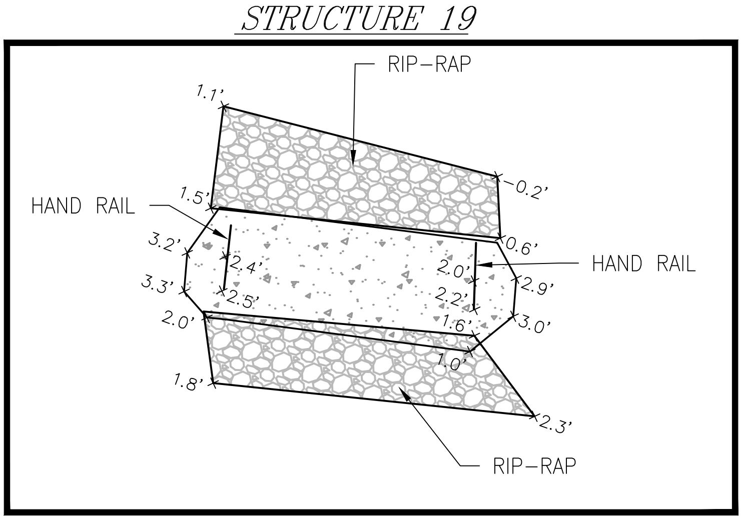
INLETS 176, 255, 256



INLETS 177, 180, 181, 253, 254, 254A



STRUCTURE 19



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CITY OF PORT ST. JOE
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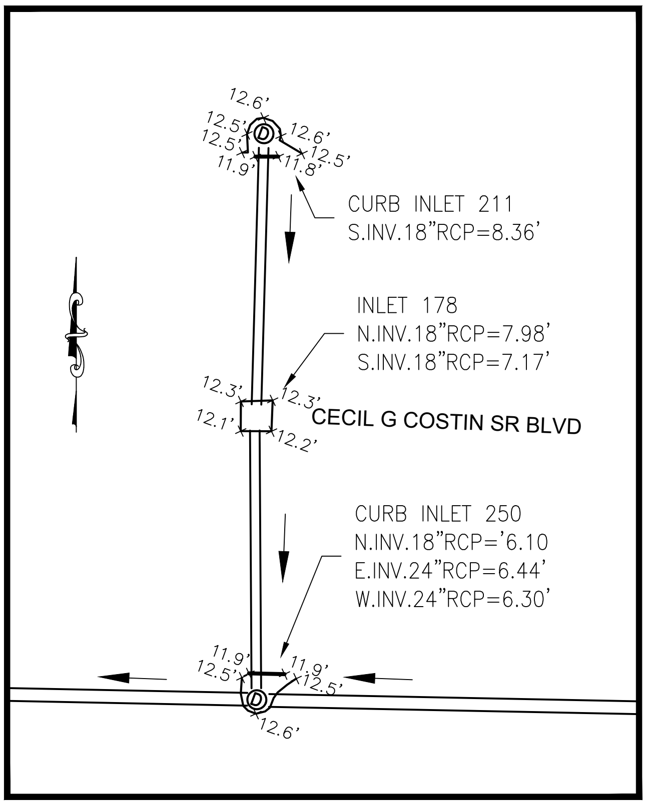
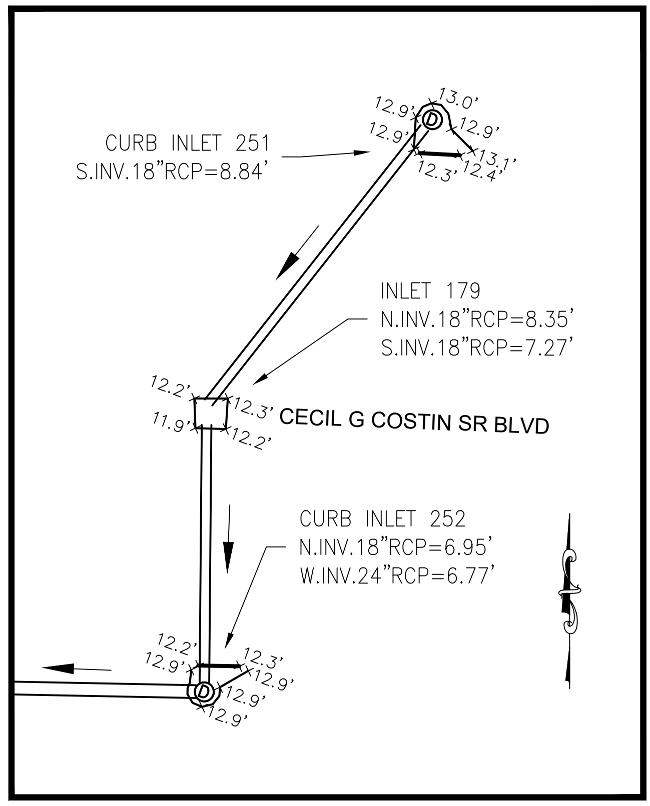
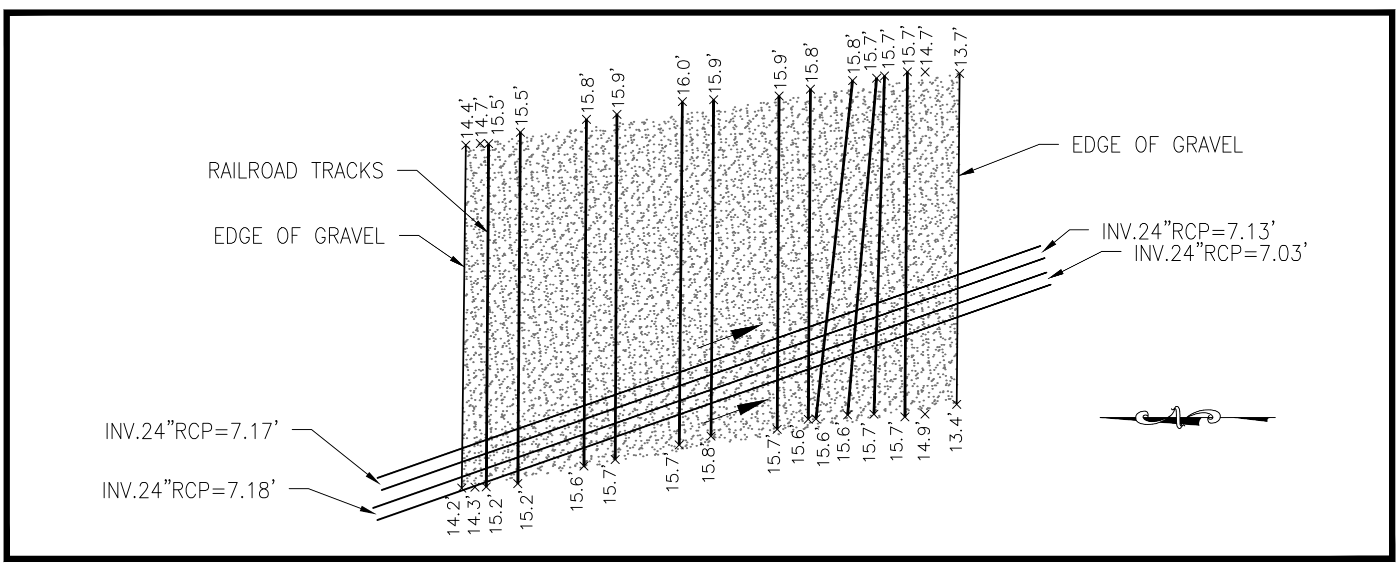
INLETS 178, 211, 250



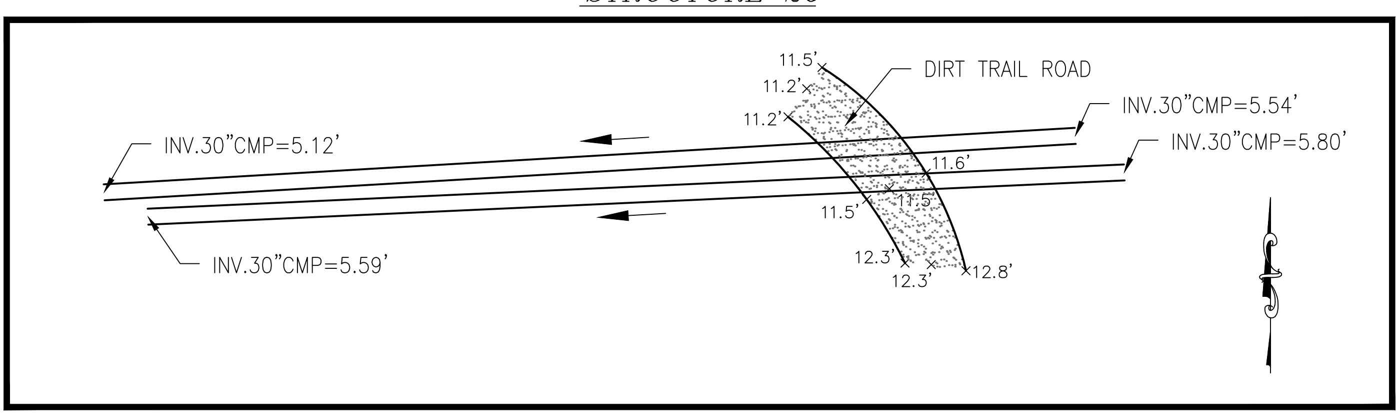
INLETS 179, 251, 252



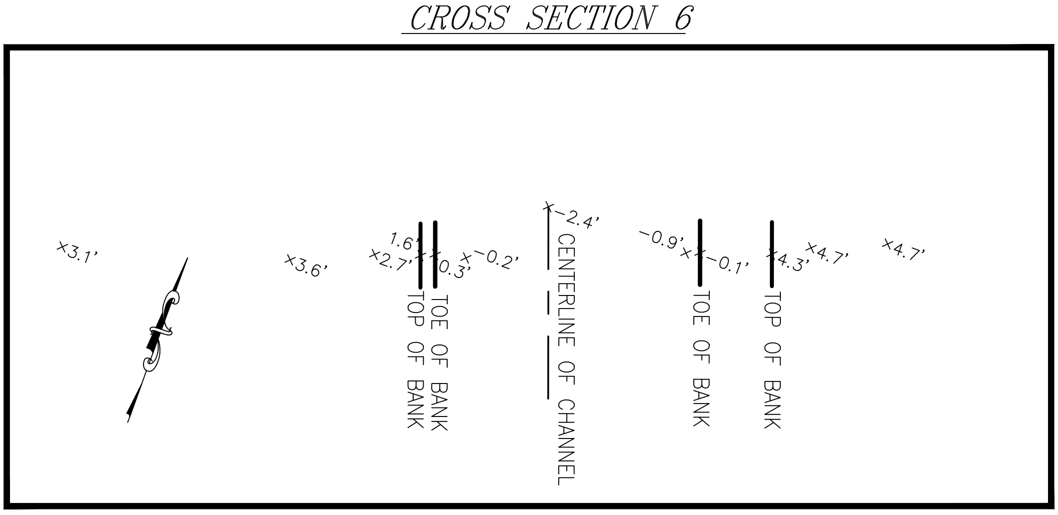
STRUCTURE 25

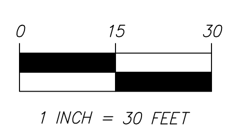


STRUCTURE 26



CROSS SECTION 6





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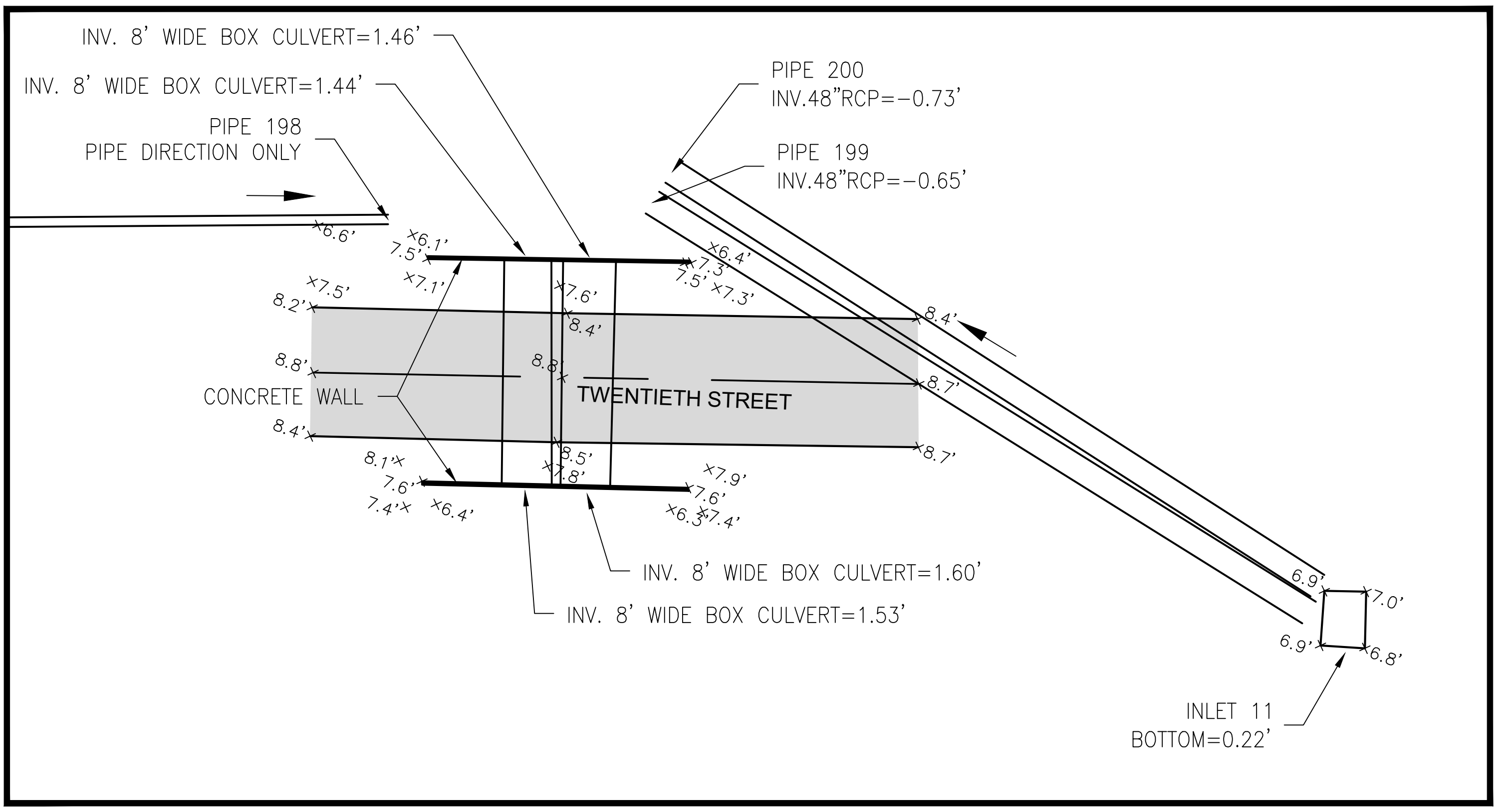
STRUCTURE 28 - INLET 11 - PIPES 198, 199, 200



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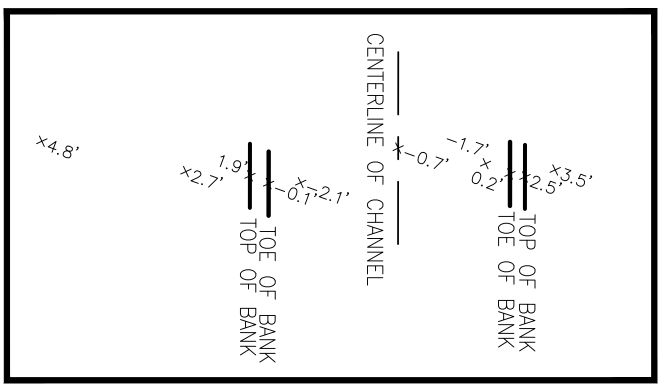
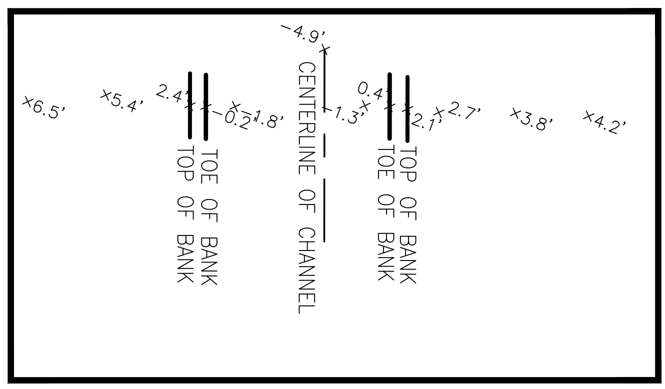
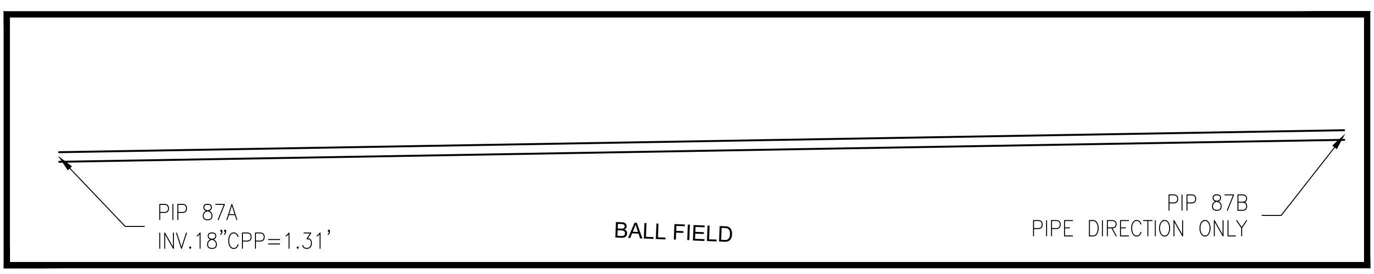


CROSS SECTION 8



PIPES 87A, 87B



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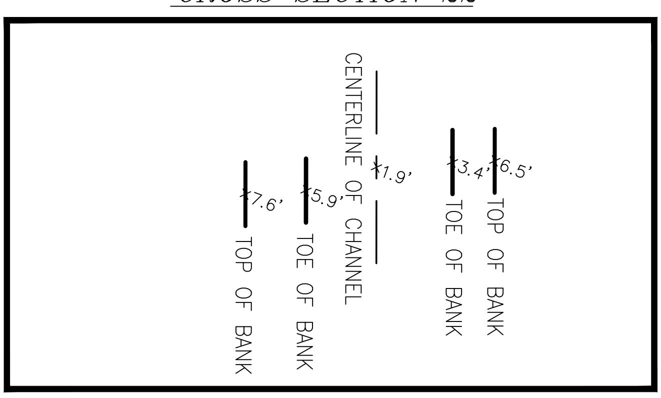
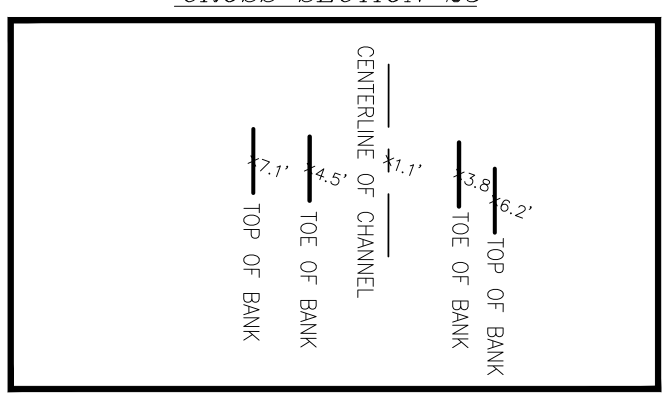
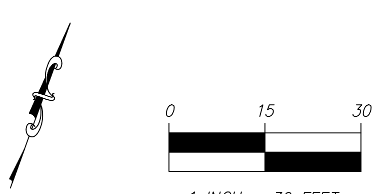


CROSS SECTION 23





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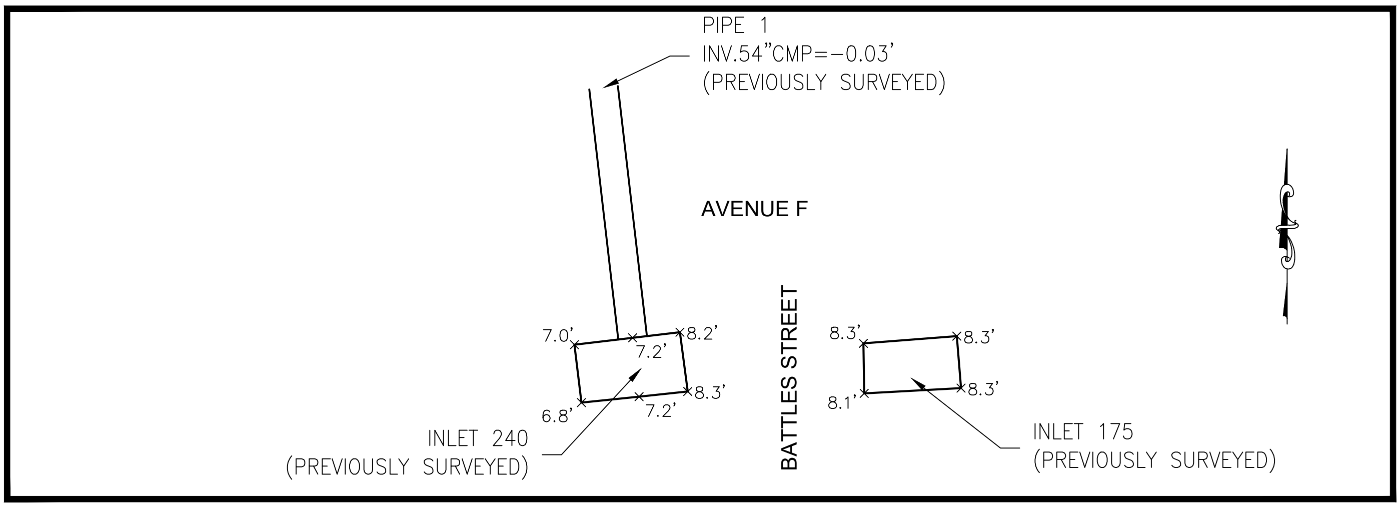
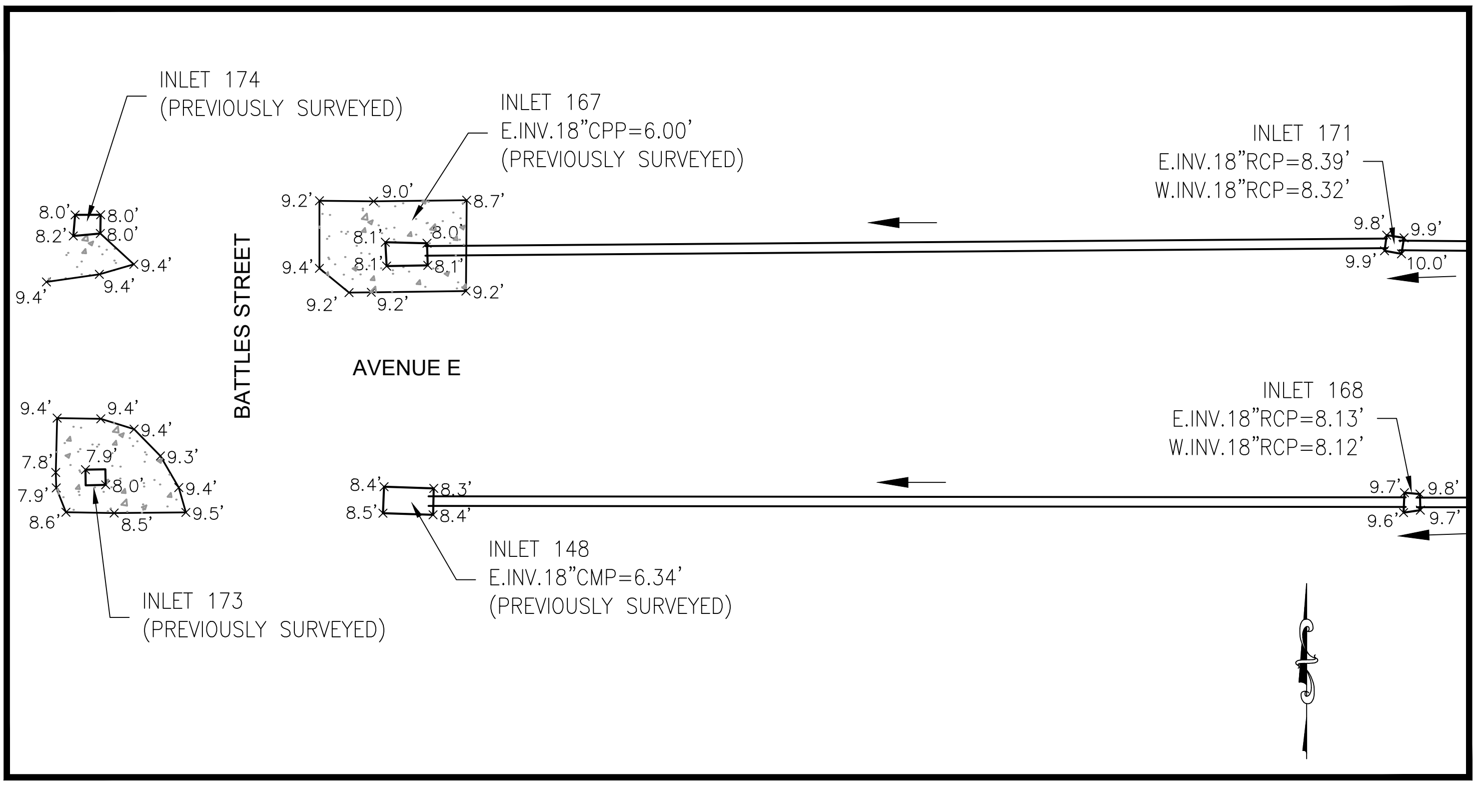
2024 POST ST. JOE COASTAL STRUCTURES
CITY OF PORT ST. JOE
GULF COUNTY, FLORIDA.

PROJECT NO. 50146276
SHEET NO. 17 OF 54

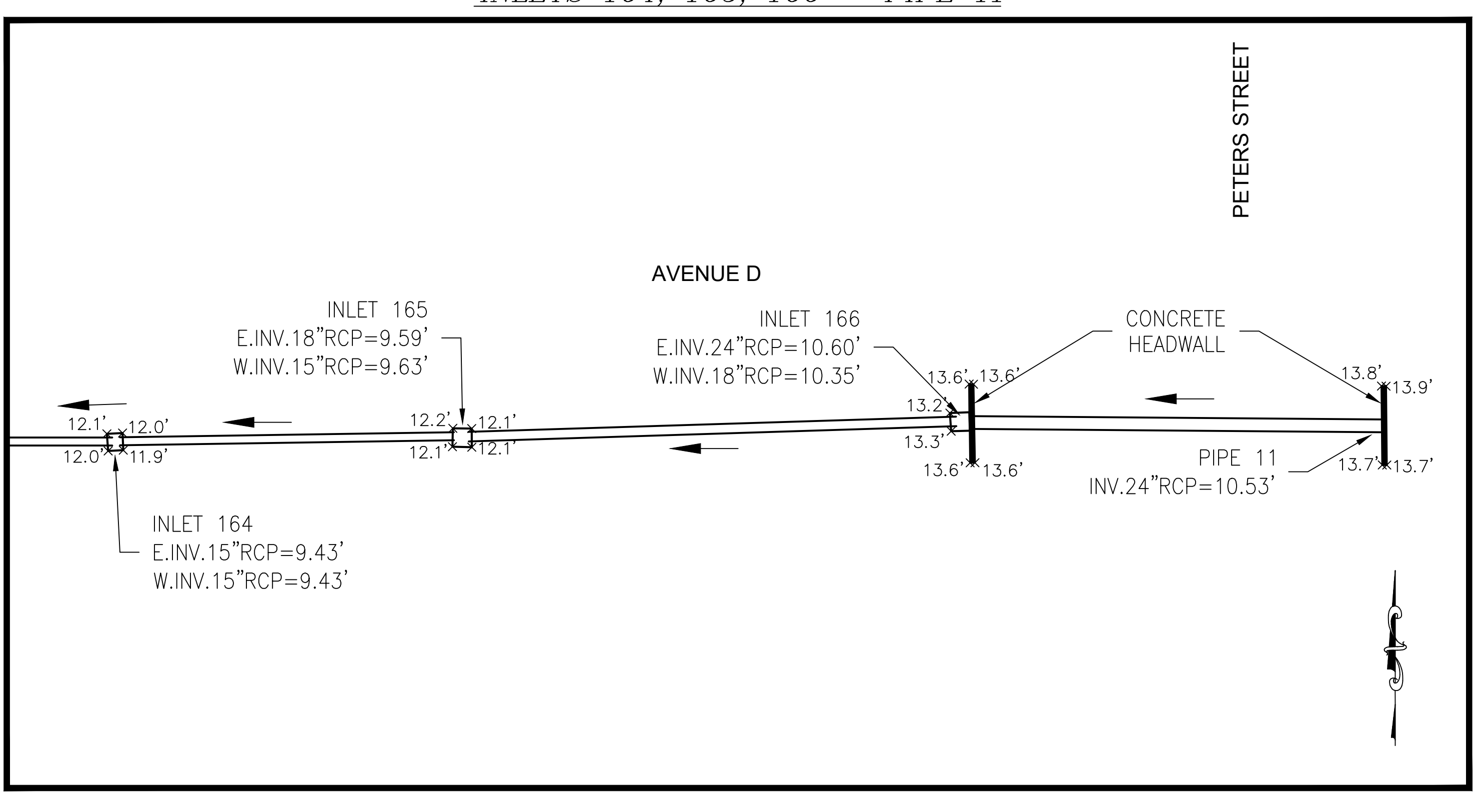
INLETS 240, 175 – PIPE 1



INLETS 148, 167, 168, 171, 173, 174



INLETS 164, 165, 166 – PIPE 11



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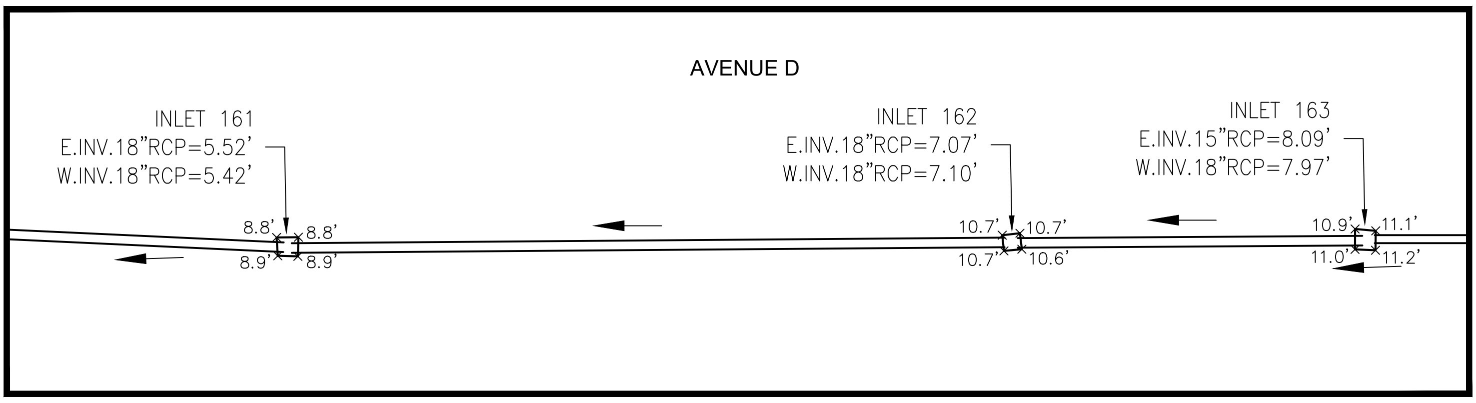
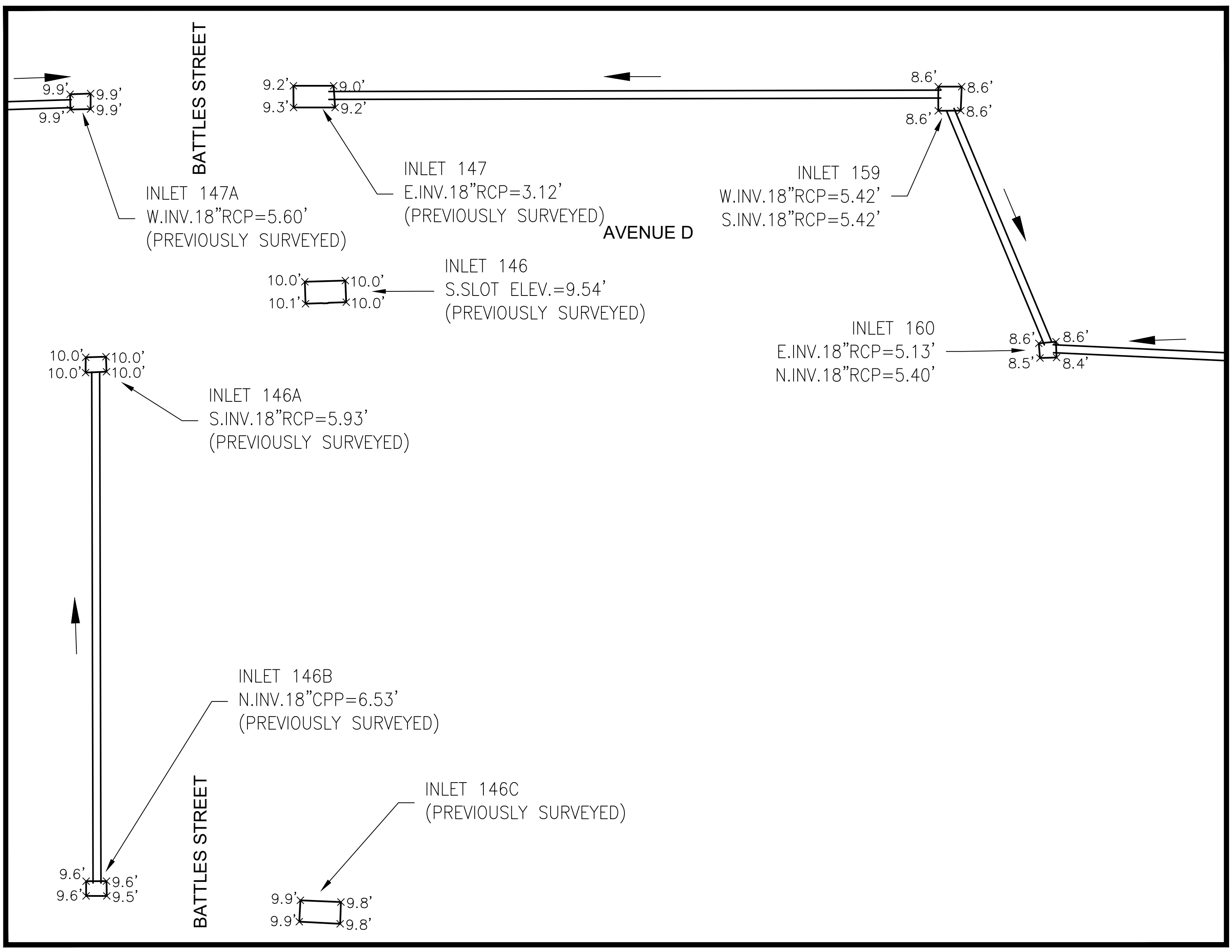
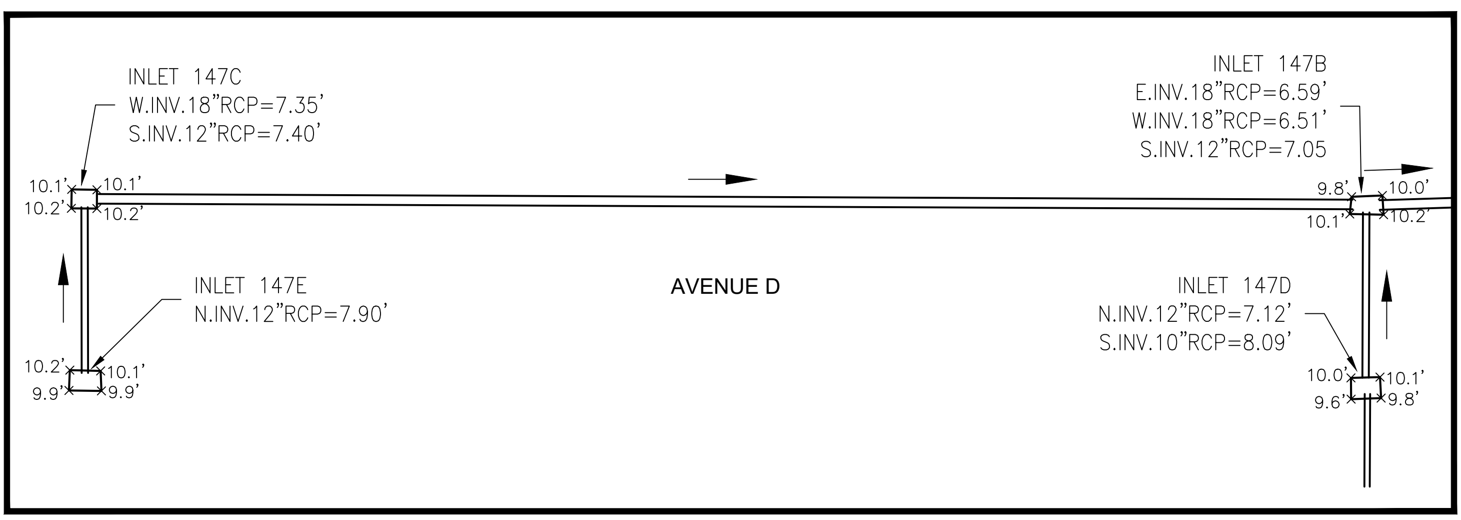
INLETS 161, 162, 163



INLETS 146, 146A, 146B, 146C, 147, 147A, 159, 160



INLETS 147B, 147C, 147D, 147E



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GULF COUNTY, FLORIDA.

PROJECT NO. 50146276
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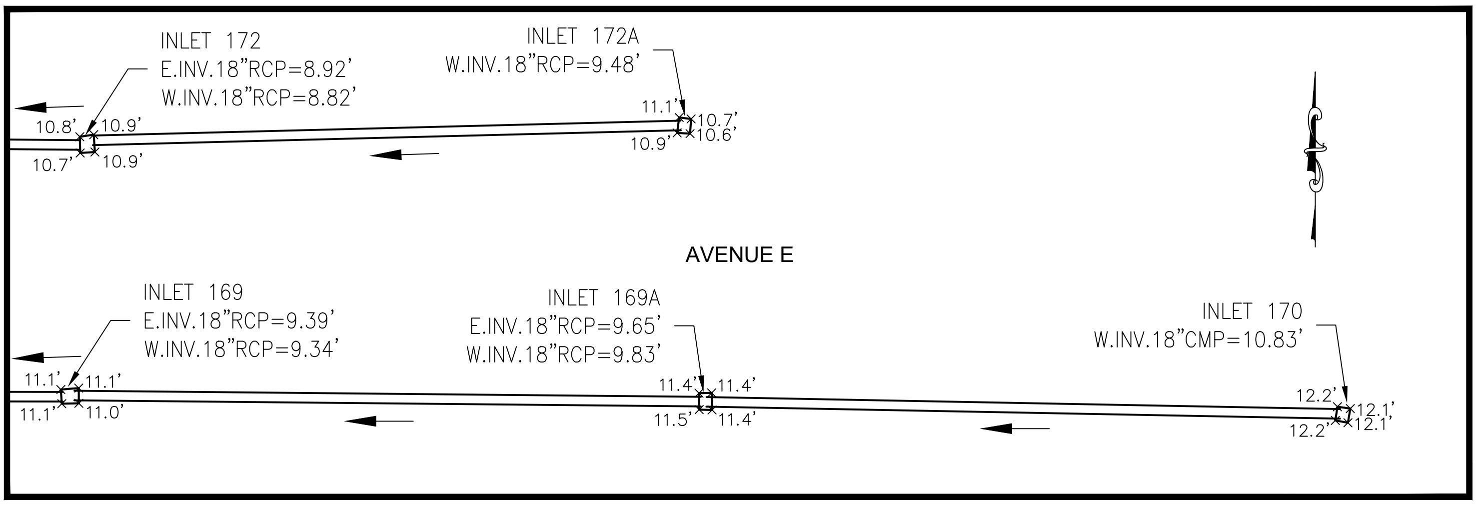
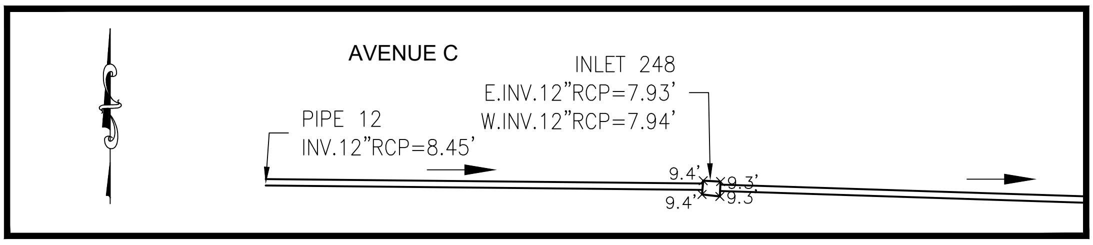
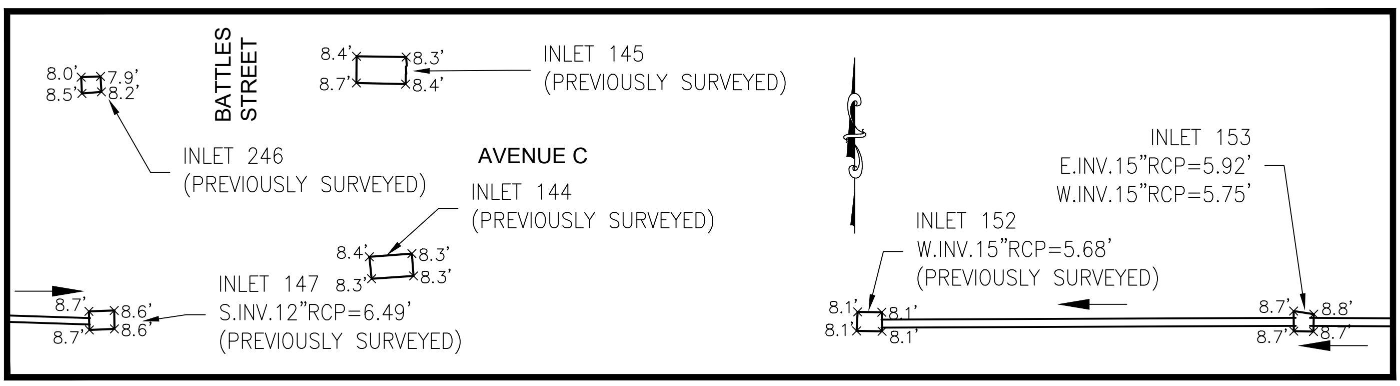
INLETS 169, 169A, 170, 172, 172A



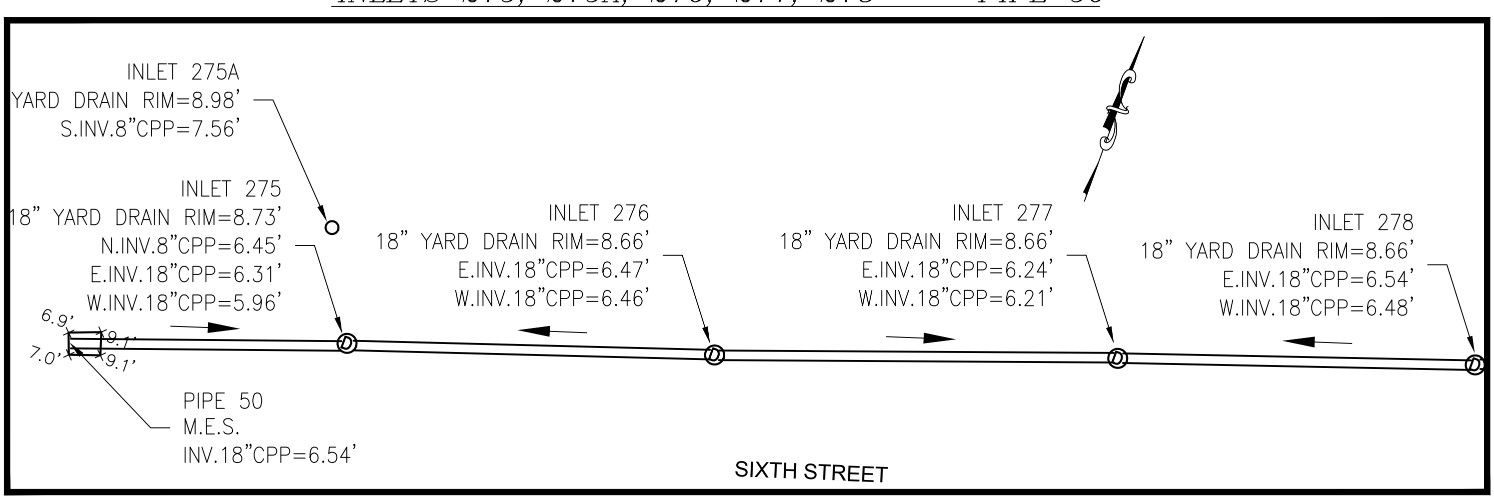
INLET 248 – PIPE 12



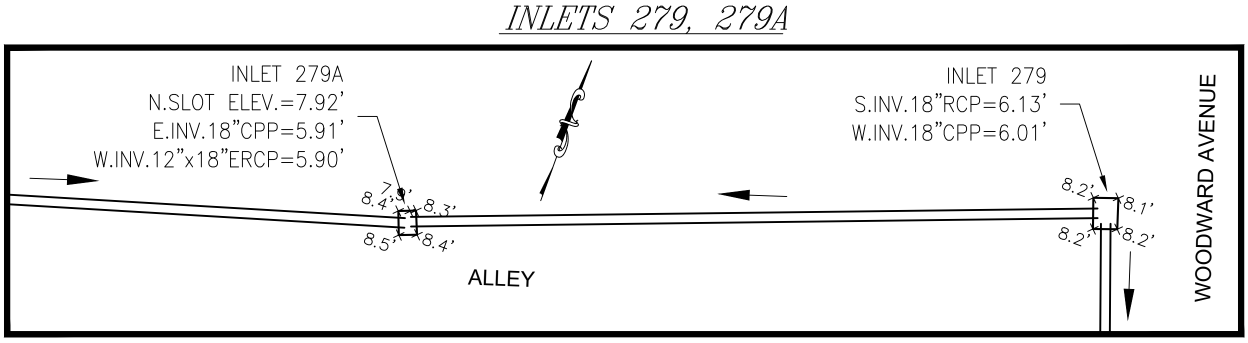
INLETS 144, 145, 152, 153, 246, 247



INLETS 275, 275A, 276, 277, 278 – PIPE 50



INLETS 279, 279A



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CITY OF PORT ST. JOE
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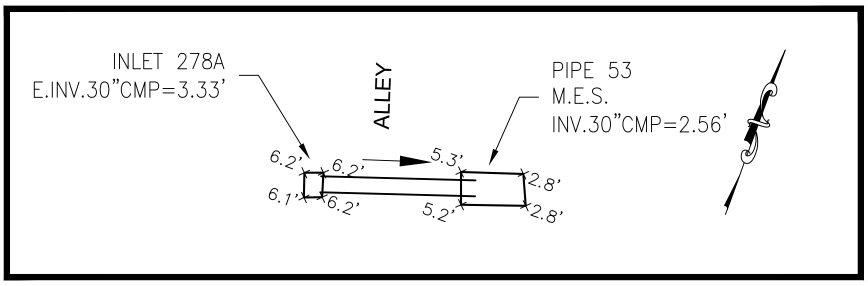
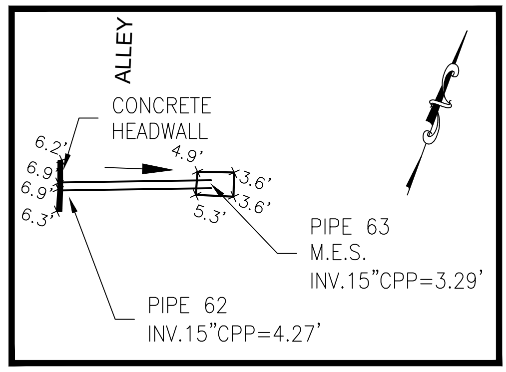
PROJECT NO.	50146276
SHEET NO.	20 OF 54

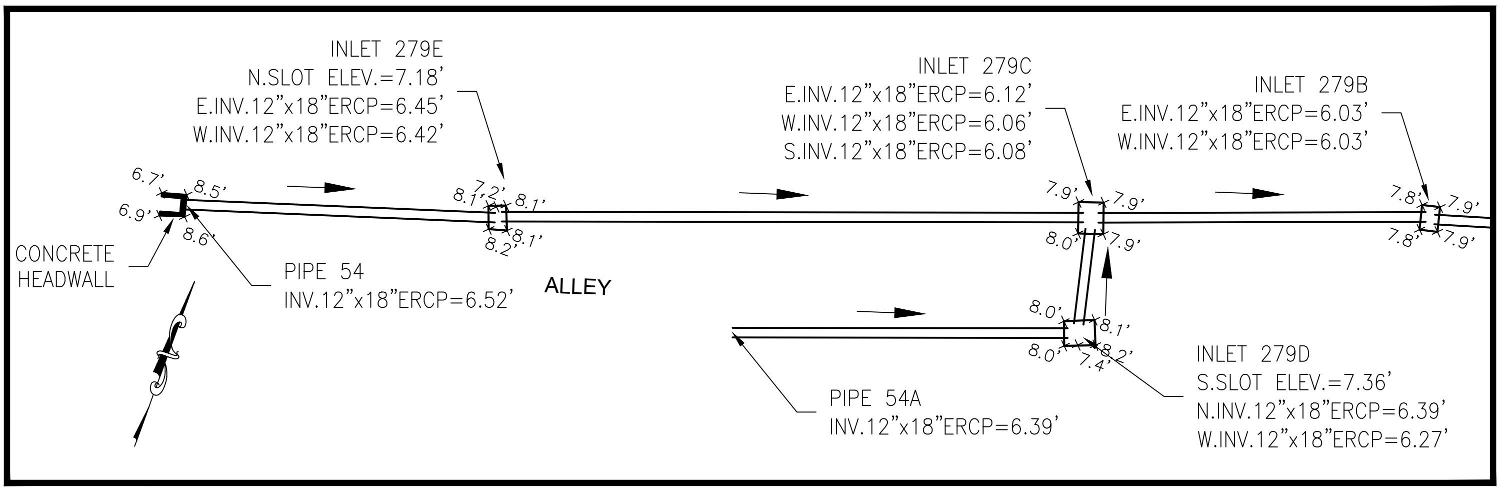
INLET 278A – PIPE 53



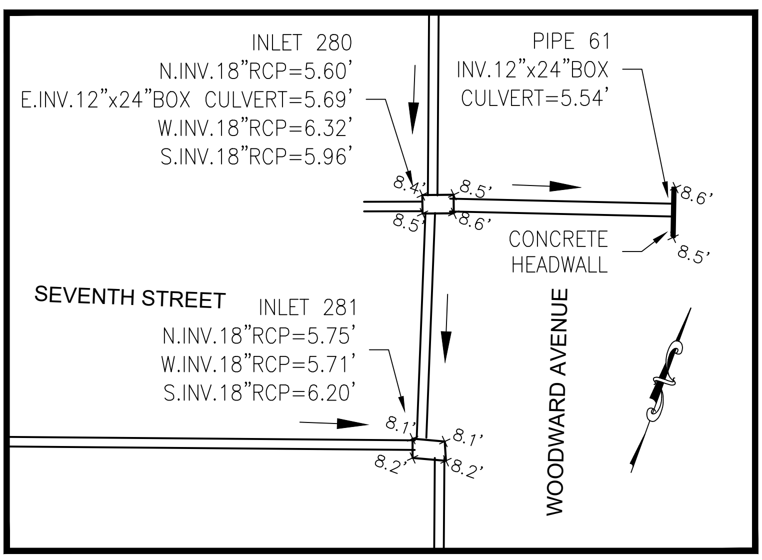
PIPES 63, 63



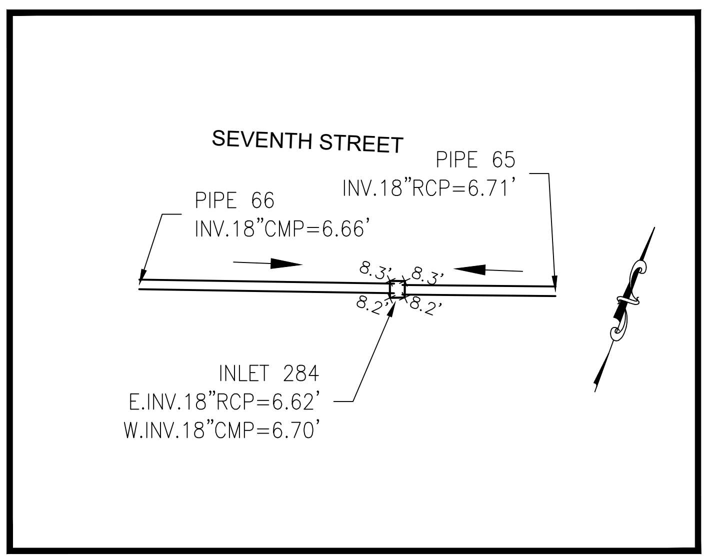
INLETS 279B, 279C, 279D, 279E – PIPES 54, 54A



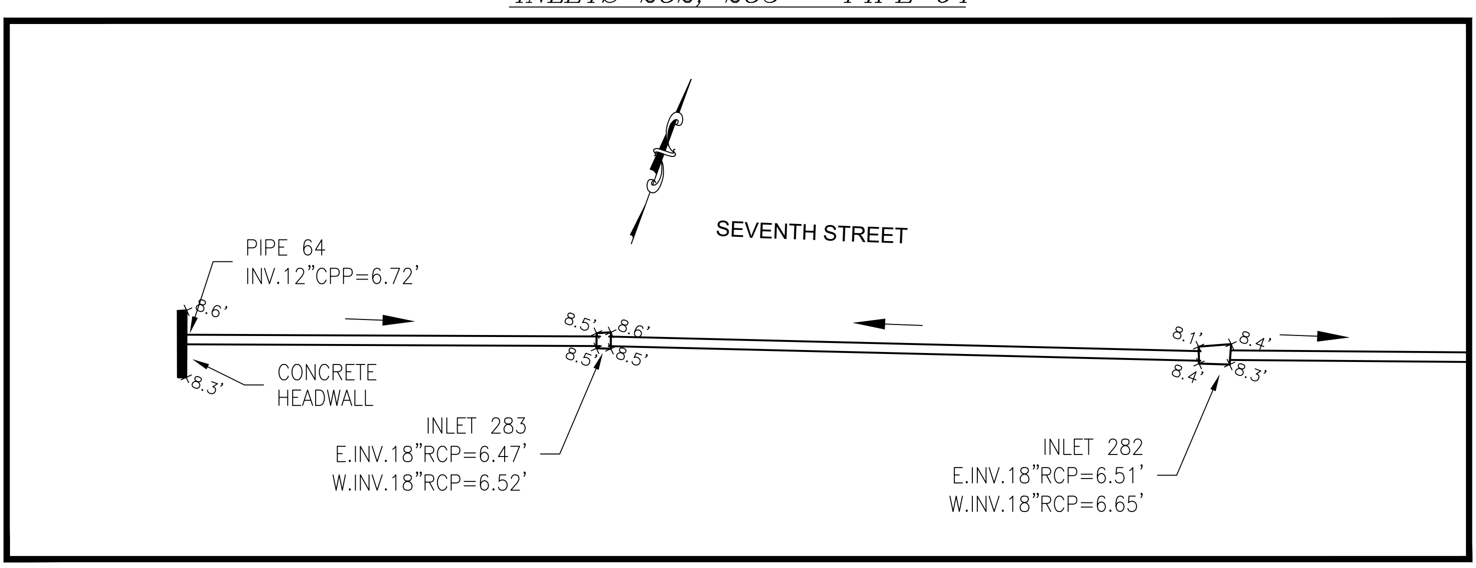
INLETS 280, 281 – PIPE 61



INLET 284 – PIPES 65, 66



INLETS 282, 283 – PIPE 64



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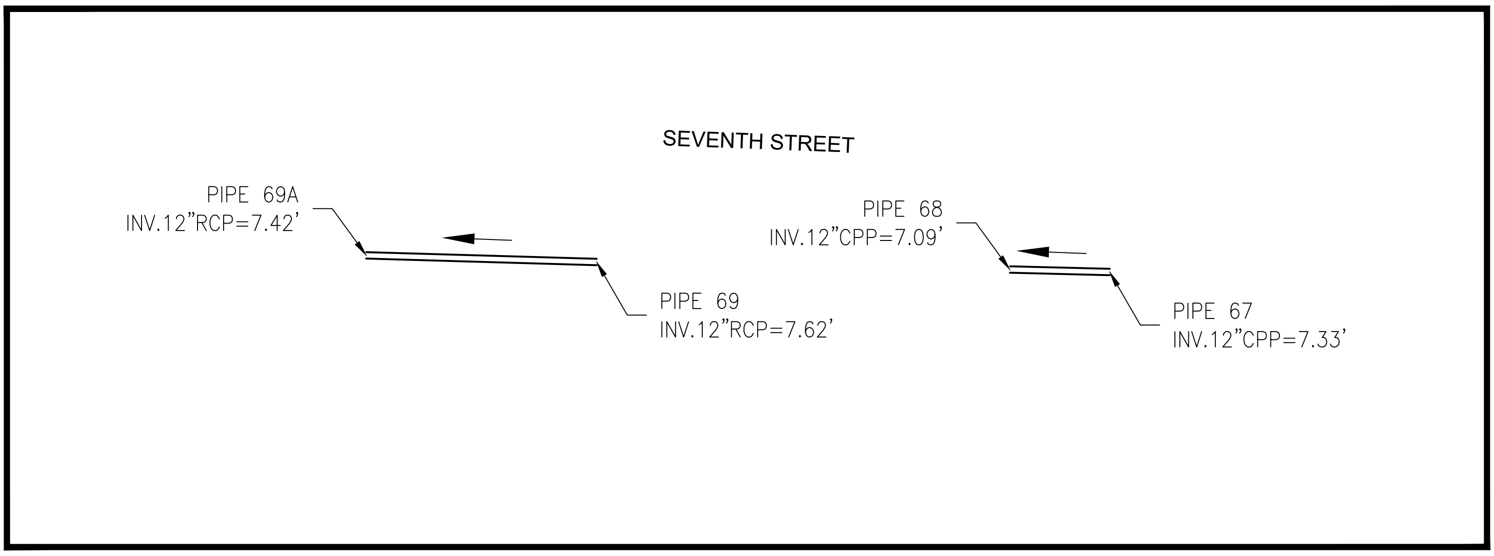
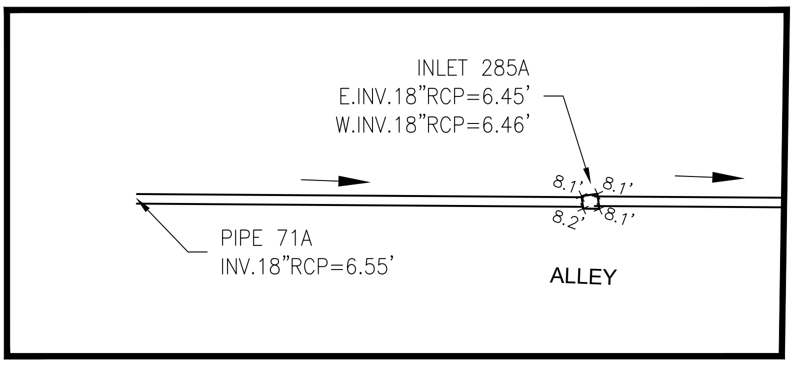
PROJECT NO. 50146276

SHEET NO.

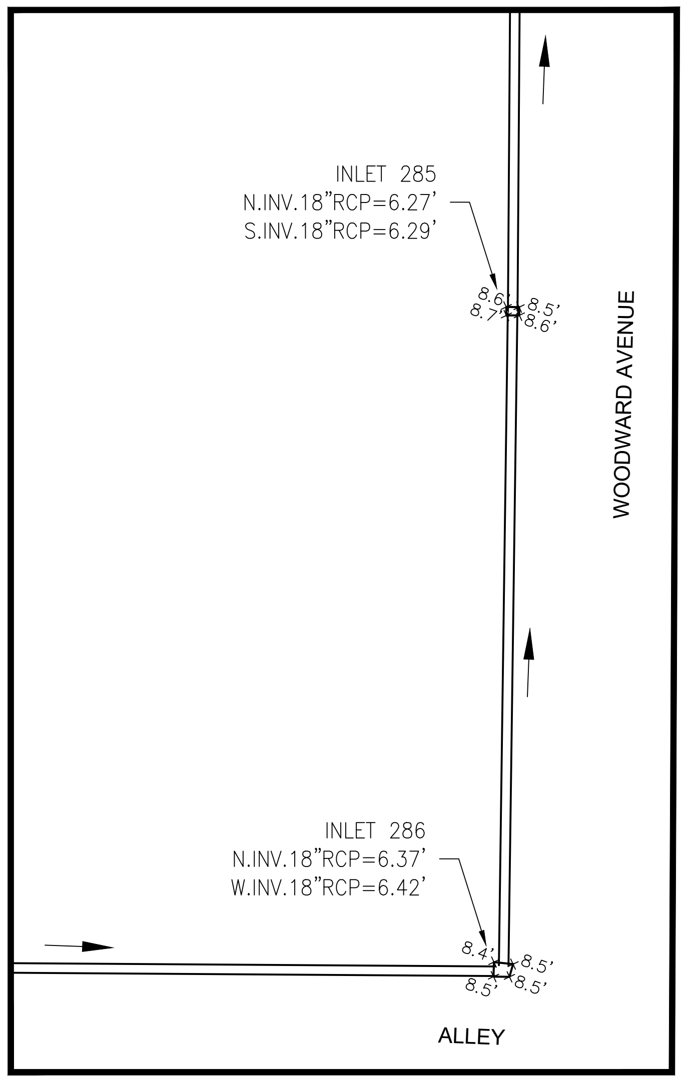
PIPES 67, 68, 69, 69A



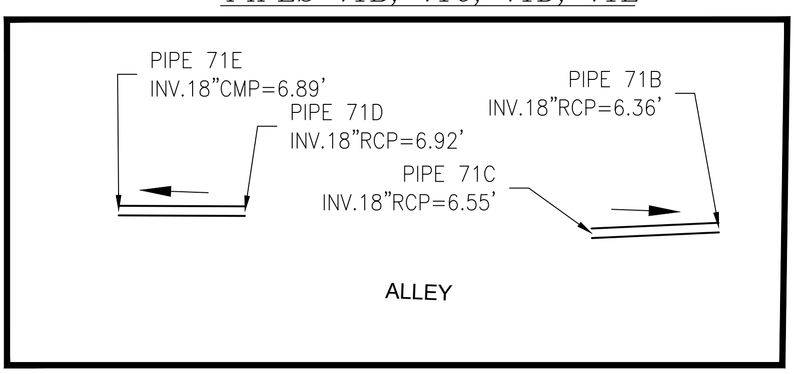
INLETS 285A – PIPE 71A



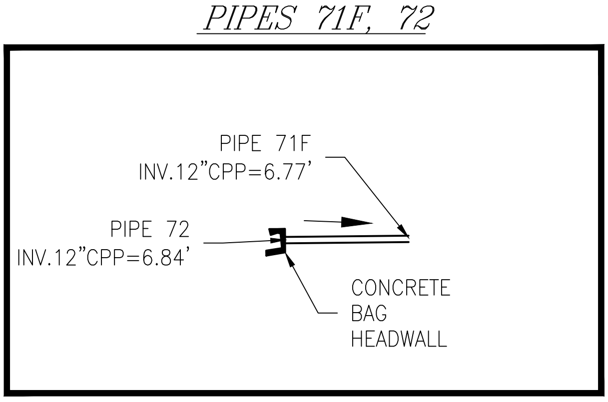
INLETS 285, 286



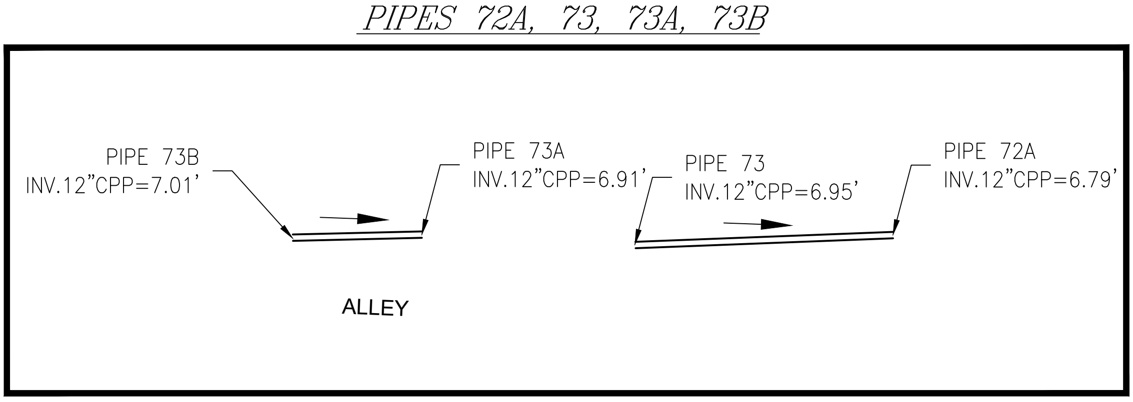
PIPES 71B, 71C, 71D, 71E



PIPES 71F, 72



PIPES 72A, 73, 73A, 73B



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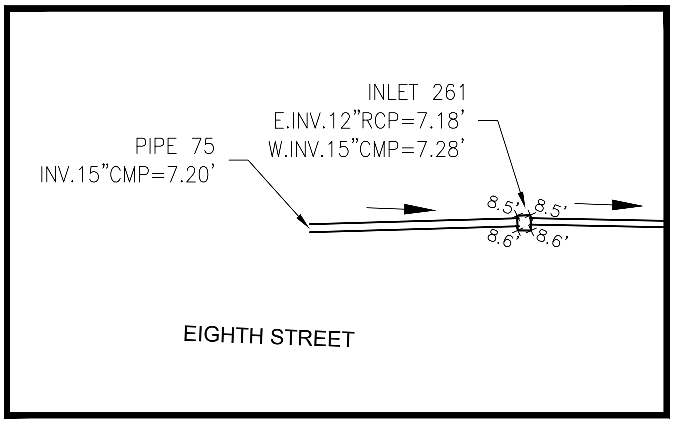
CITY OF PORT ST. JOE
GULF COUNTY, FLORIDA.

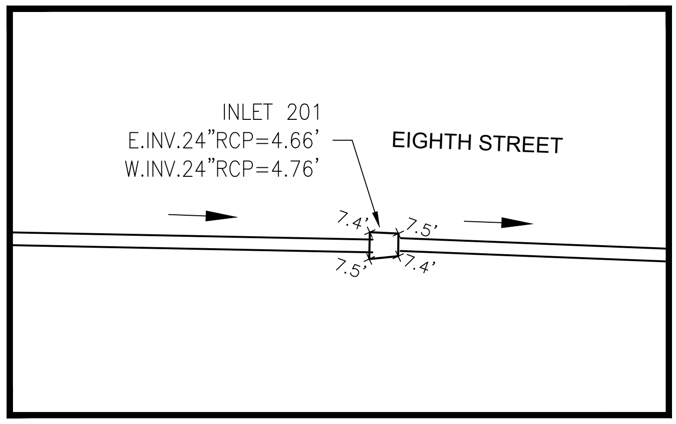
PROJECT NO. 50146276

SHEET NO.
22 OF 54

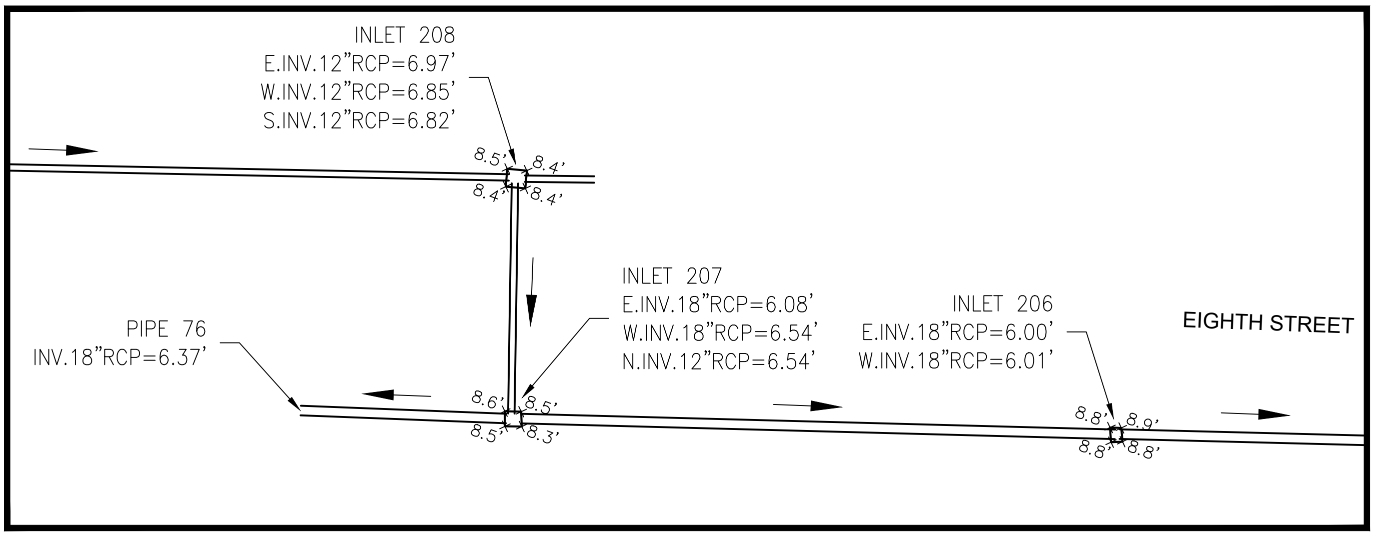
INLET 261 – PIPE 75



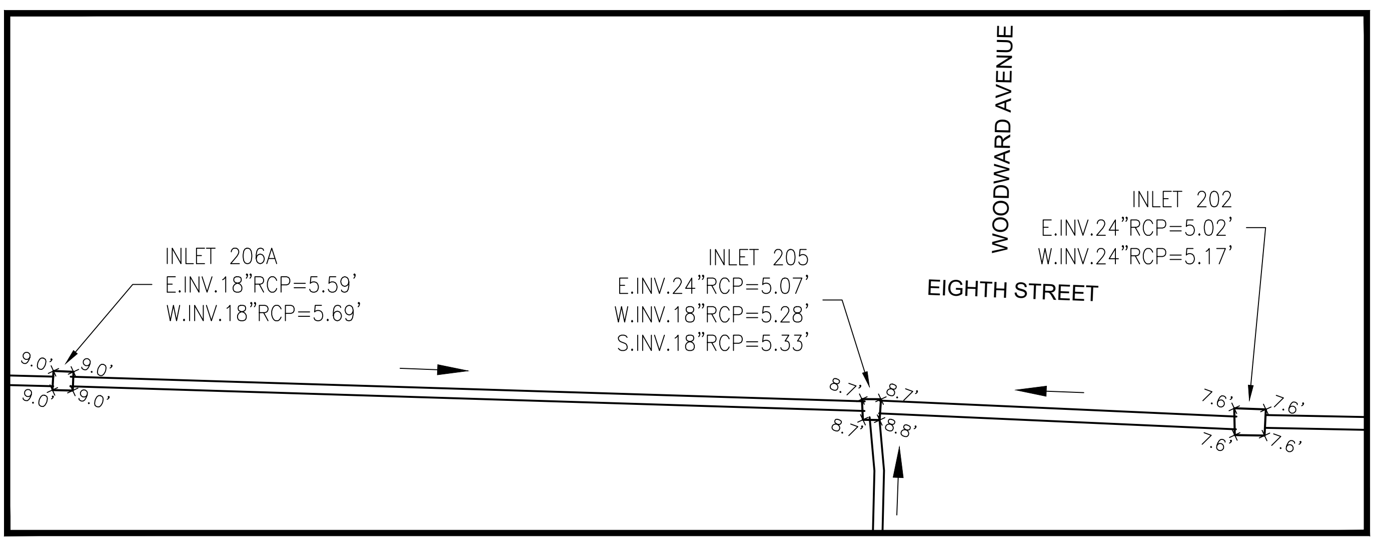
INLET 201



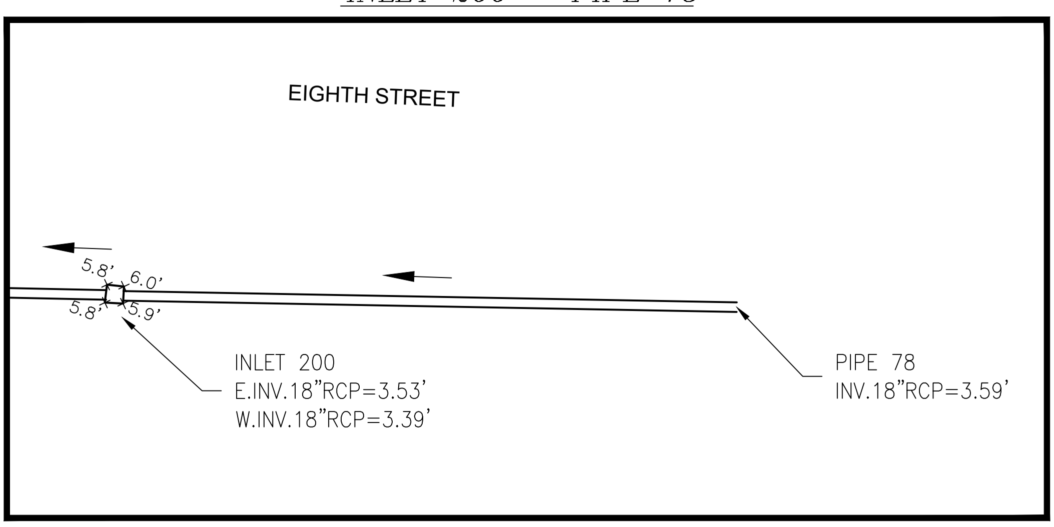
INLETS 206, 207, 208 – PIPE 76



INLETS 202, 205, 206A



INLET 200 – PIPE 78



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CITY OF PORT ST. JOE
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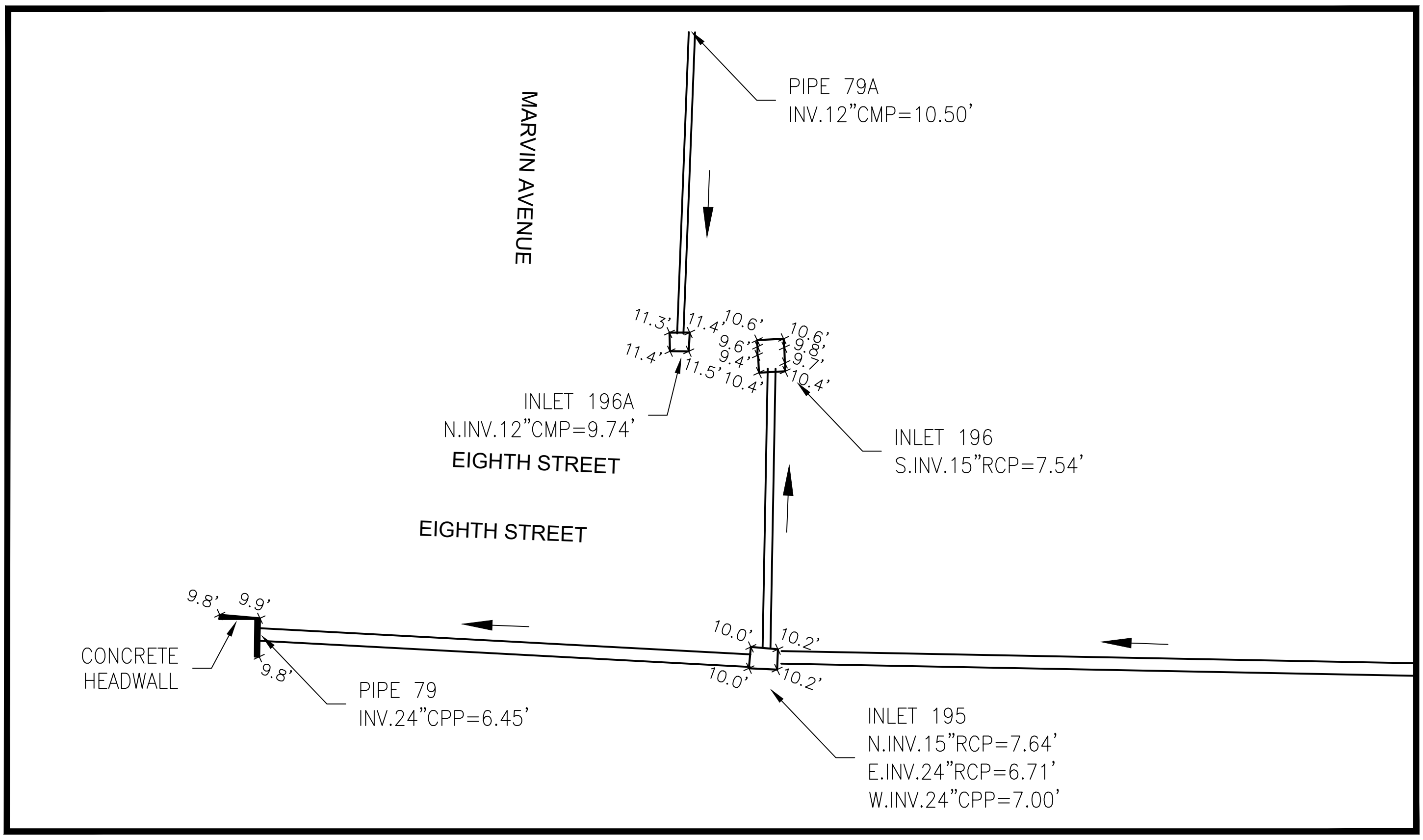
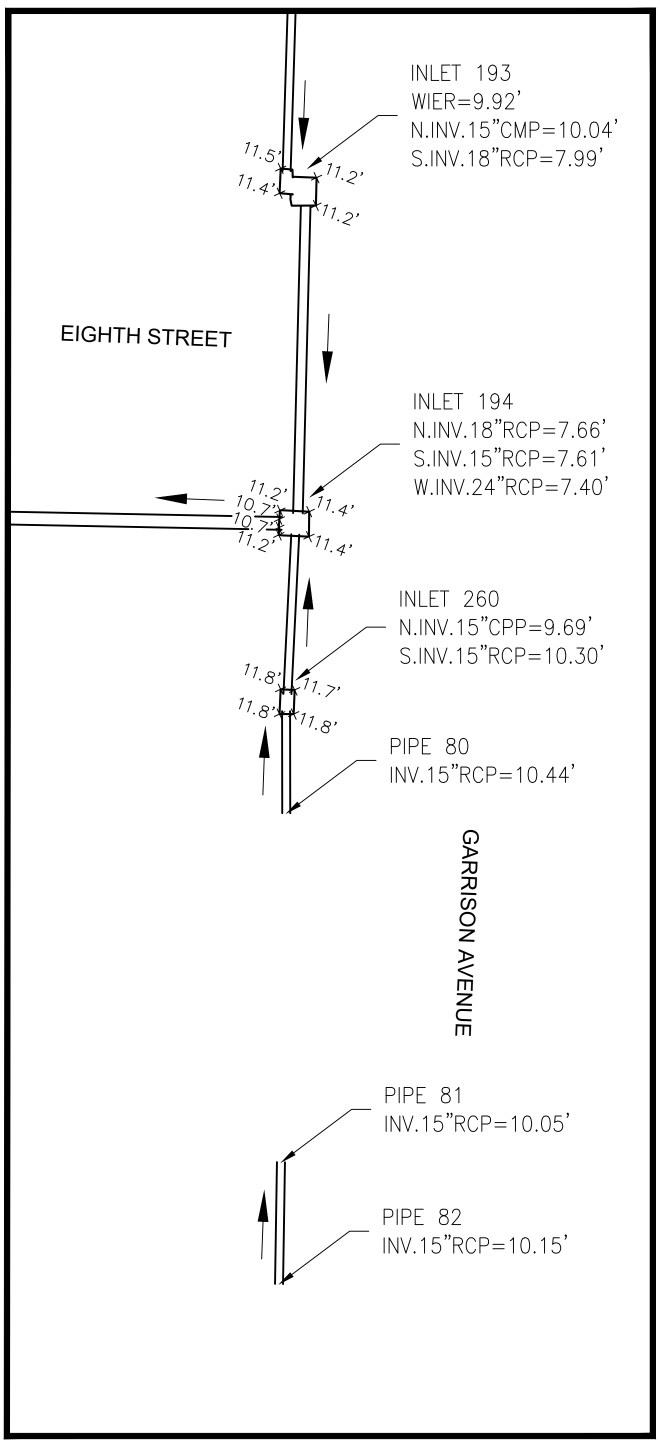
PROJECT NO. 50146276
SHEET NO. 23 OF 54

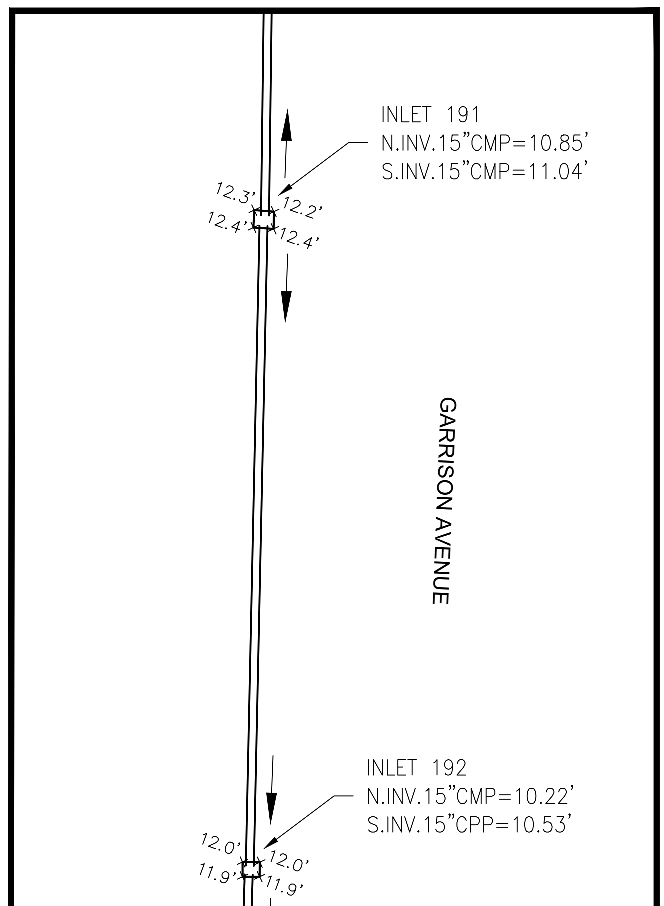
INLETS 195, 196, 196A – PIPES 79, 79A

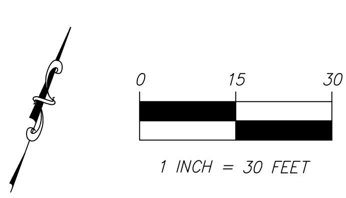


INLETS 193, 194, 260 – PIPES 80, 81, 82



INLETS 191, 192





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CITY OF PORT ST. JOE
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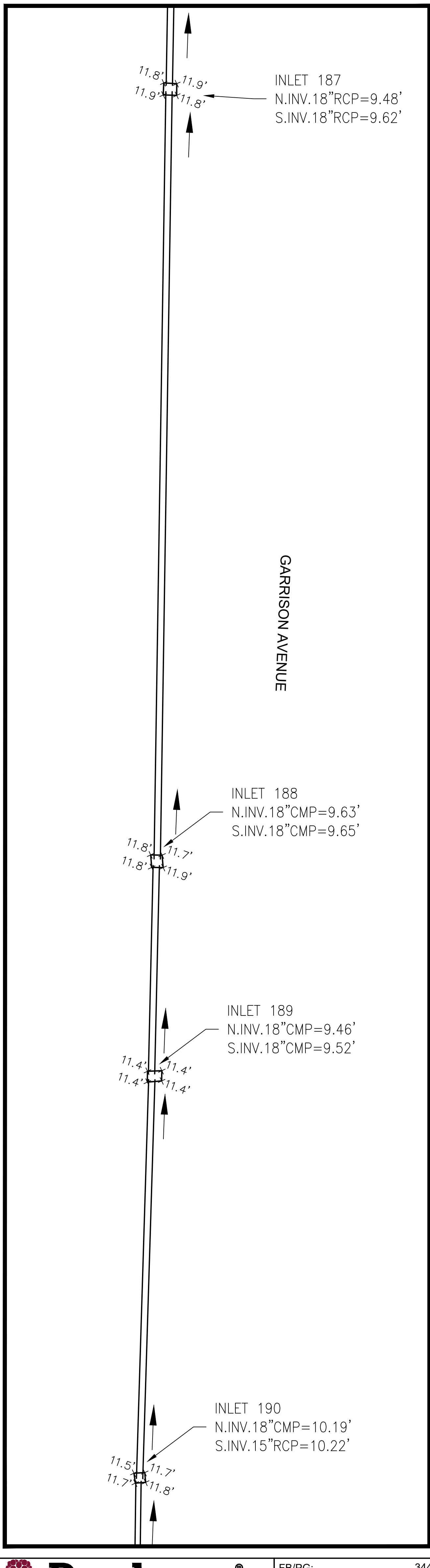
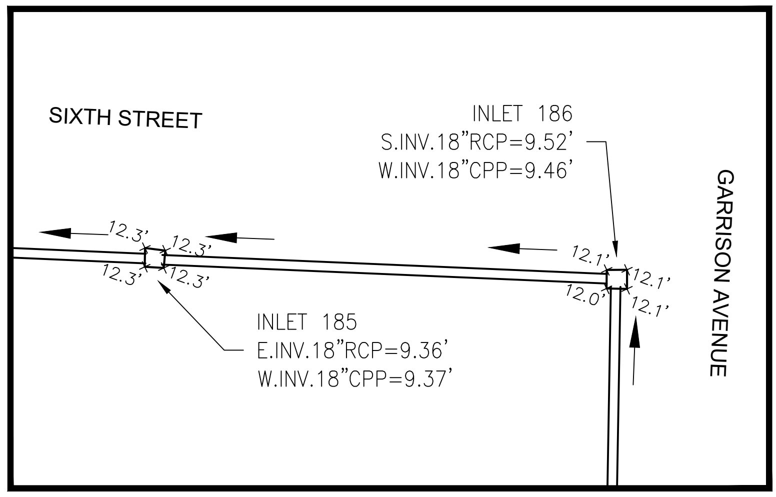
PROJECT NO. 50146276
SHEET NO.
24 OF 54

INLETS 187, 188, 189, 190



INLETS 185, 186



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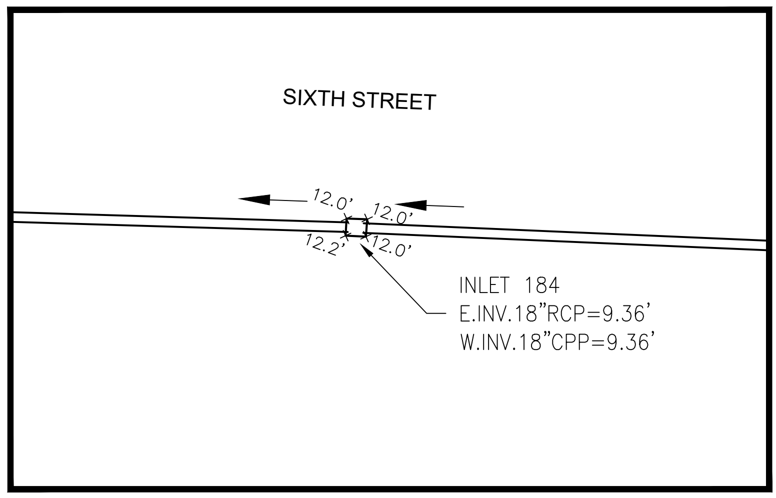
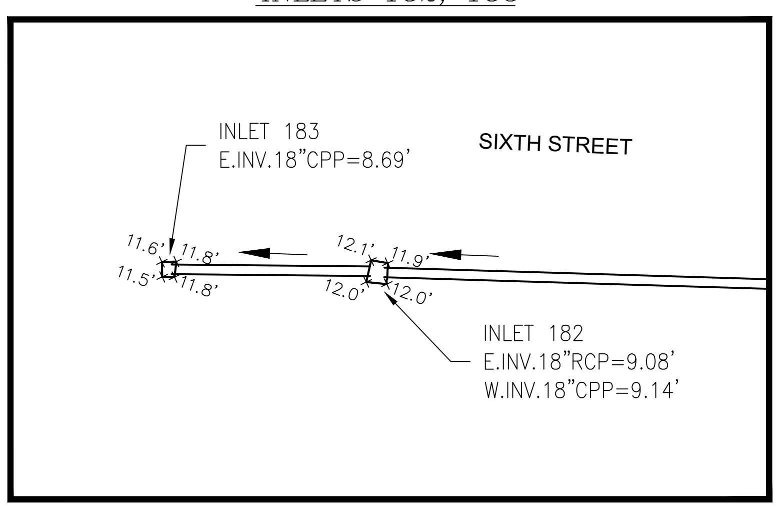
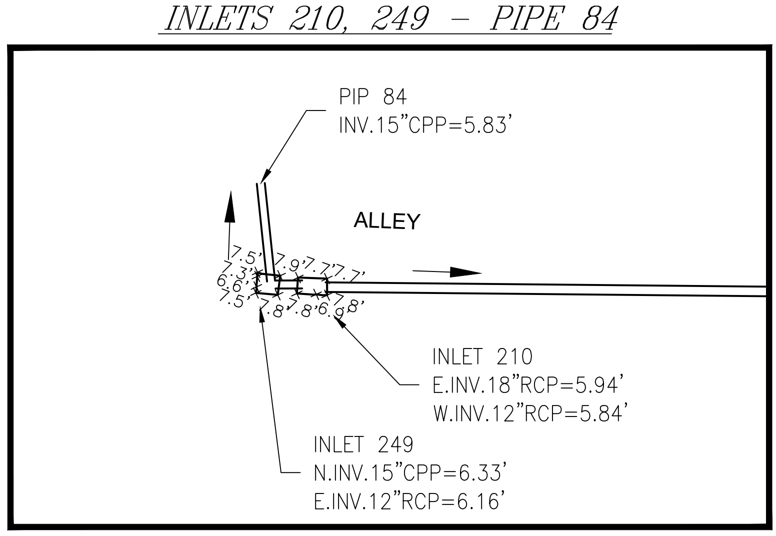
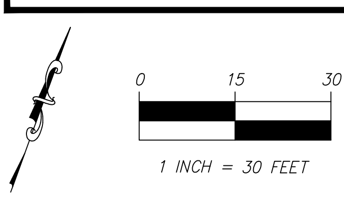


INLETS 182, 183



INLETS 210, 249 – PIPE 84





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PROJECT NO. 50146276
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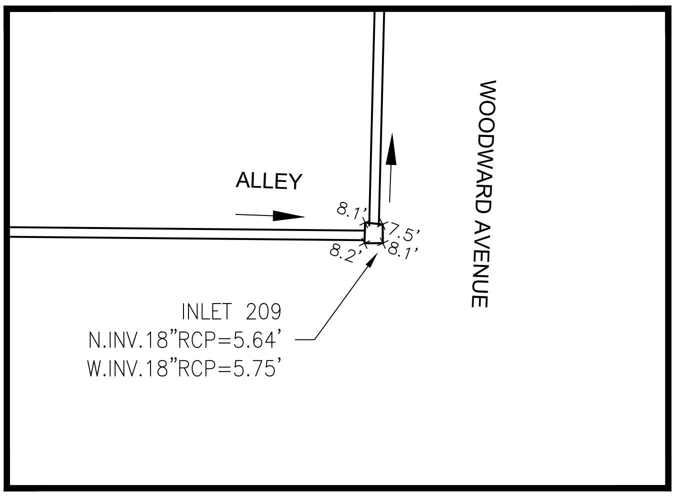
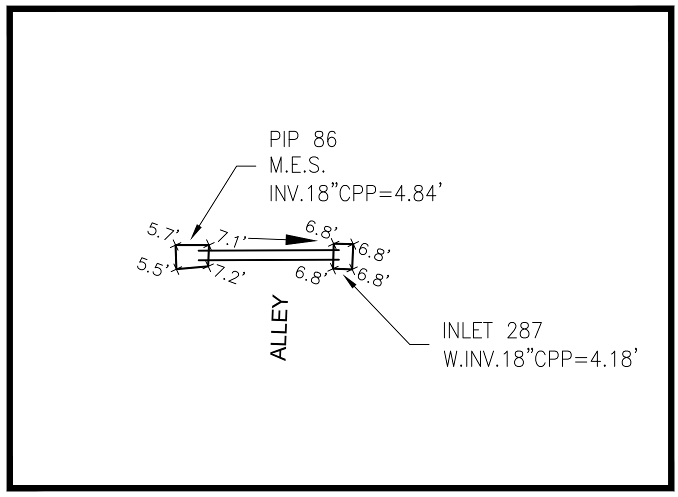
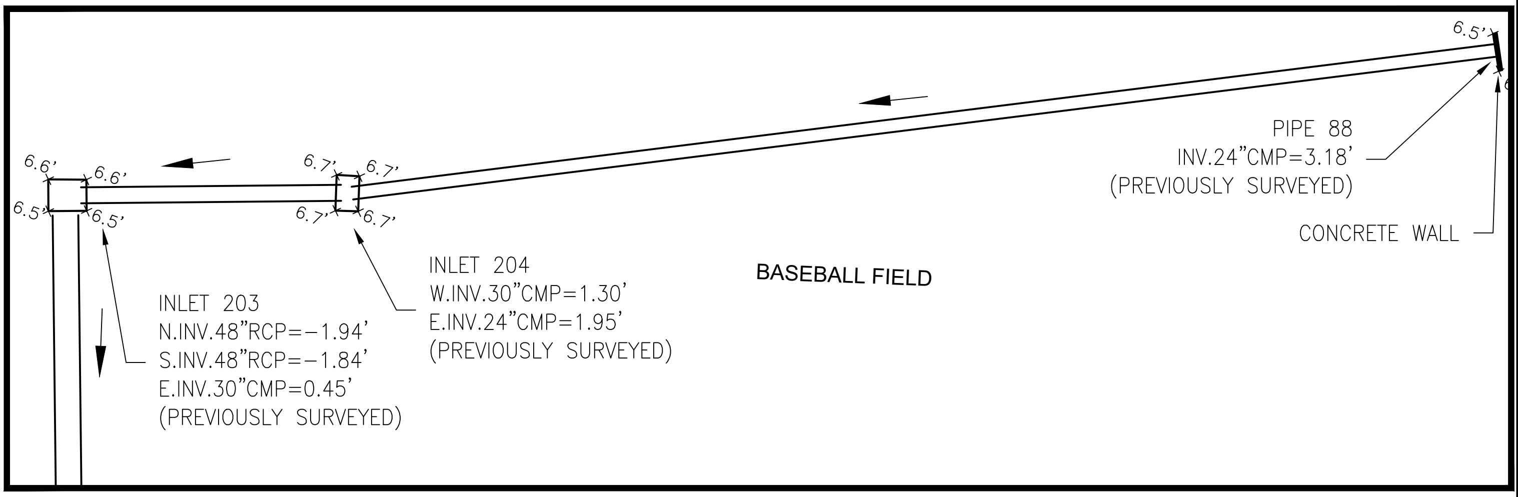
INLET 209



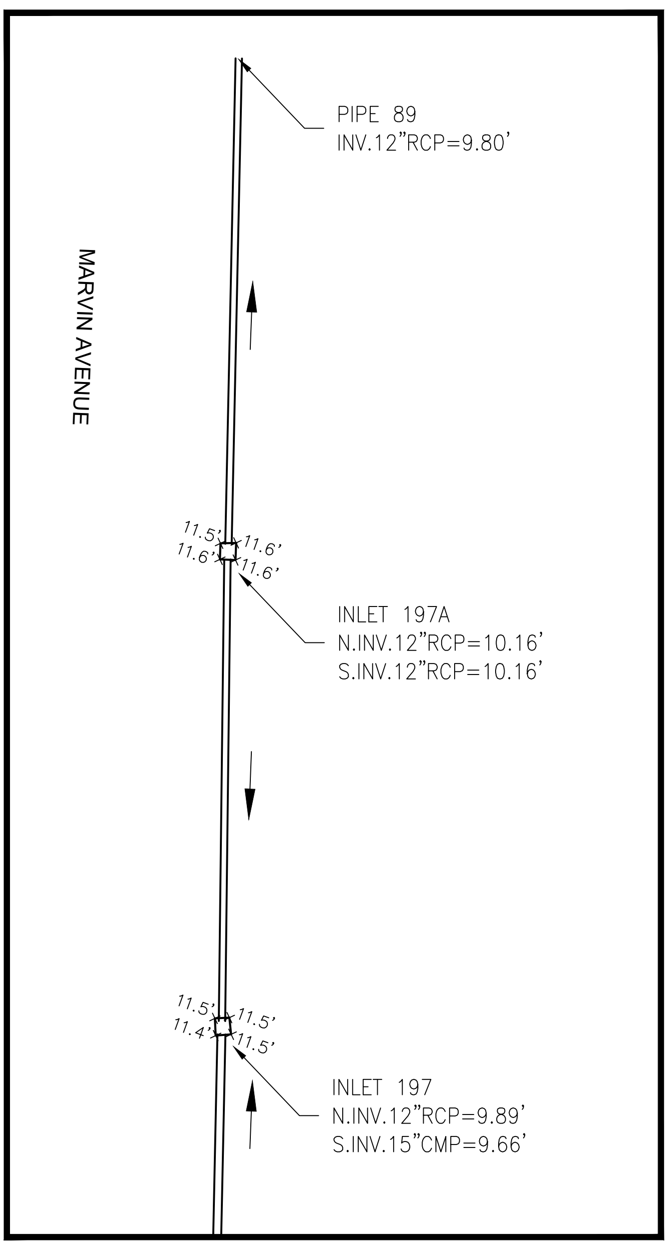
INLET 287 – PIPE 86



INLETS 203, 204 – PIPE 88



INLETS 197, 197A – PIPE 89



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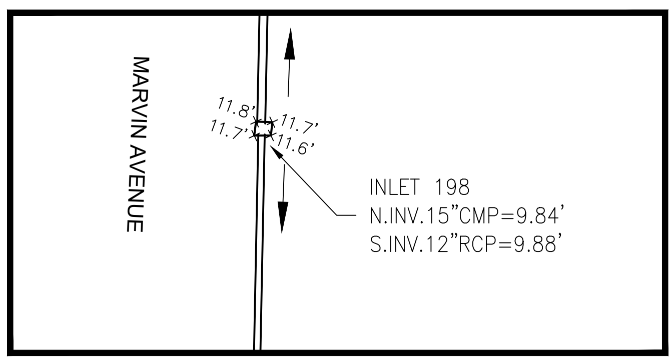
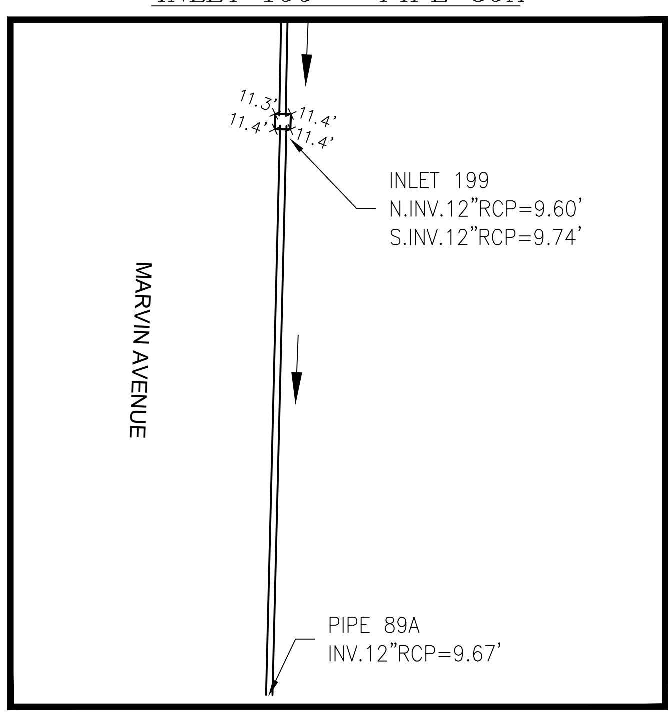
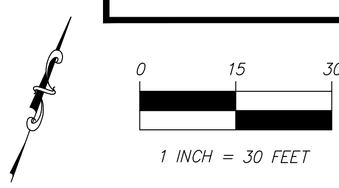


INLET 199 – PIPE 89A





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CITY OF PORT ST. JOE
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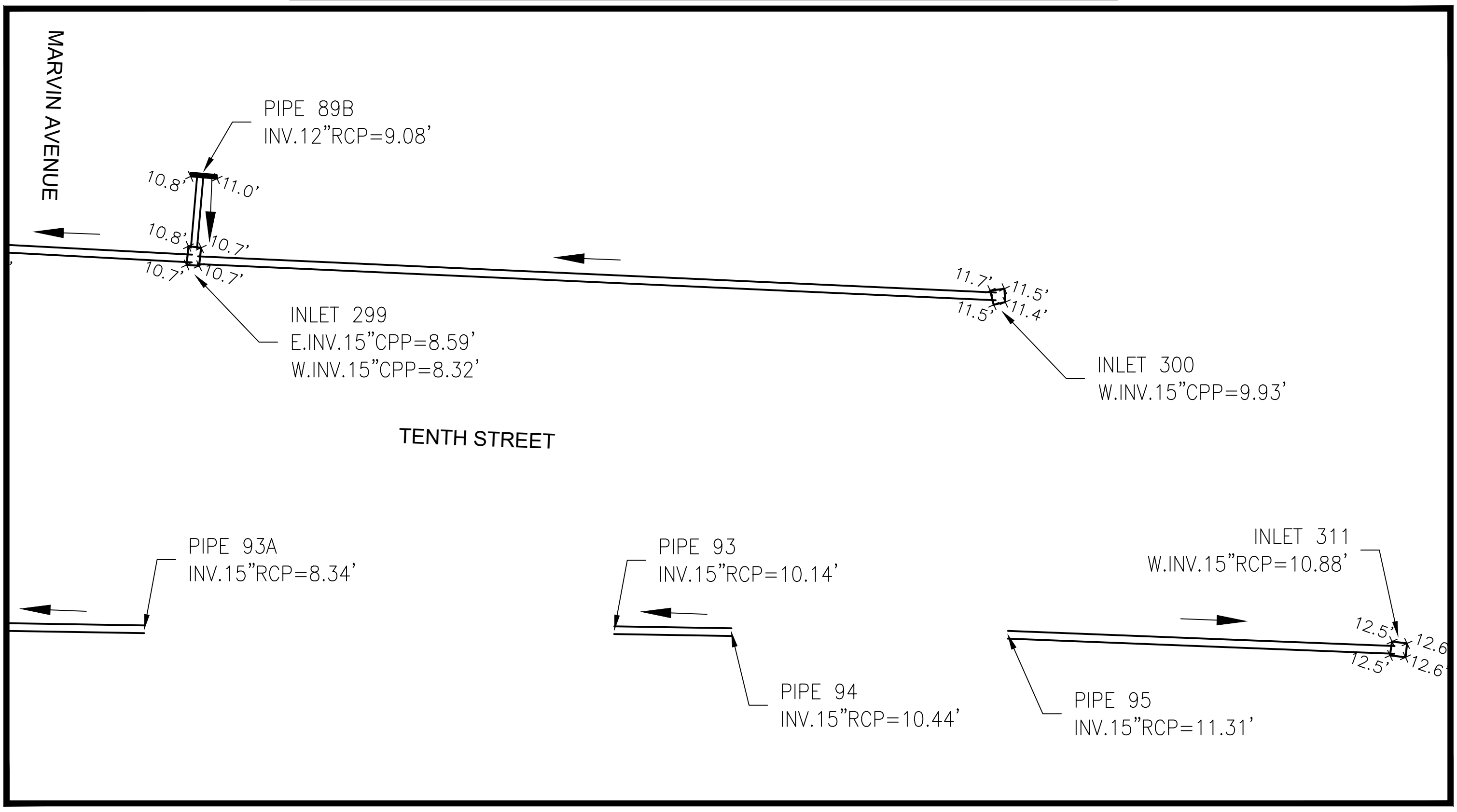
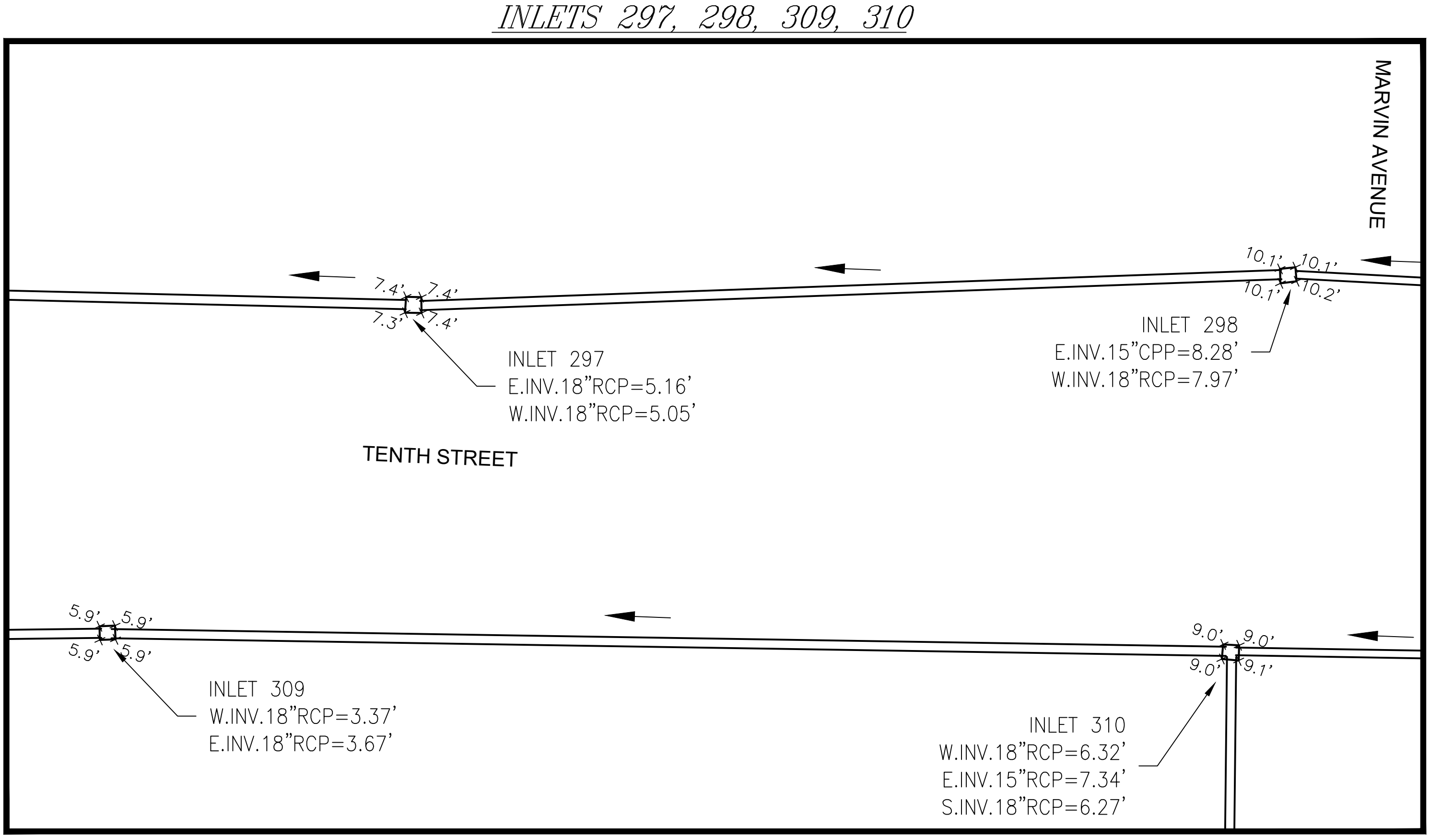
PROJECT NO. 50146276
SHEET NO.
26 OF 54

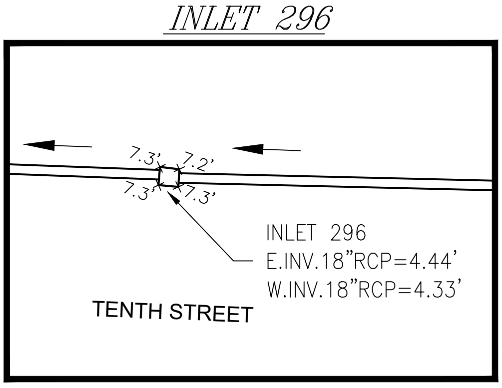
INLETS 299, 300, 311 – PIPES 89B, 93, 93A, 94, 95



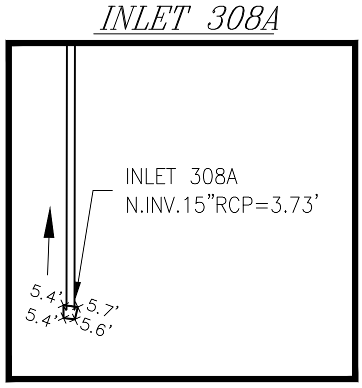
INLETS 297, 298, 309, 310



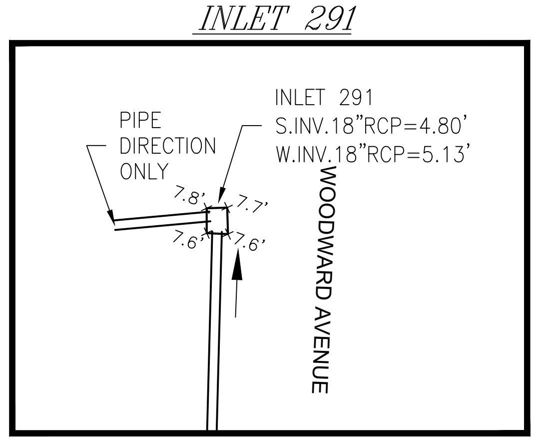
INLET 296

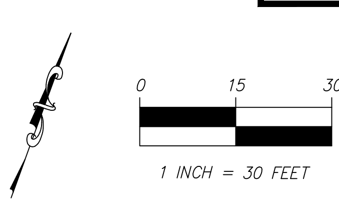


INLET 308A



INLET 291





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2024 POST ST. JOE COASTAL STRUCTURES
CITY OF PORT ST. JOE
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PROJECT NO. 50146276
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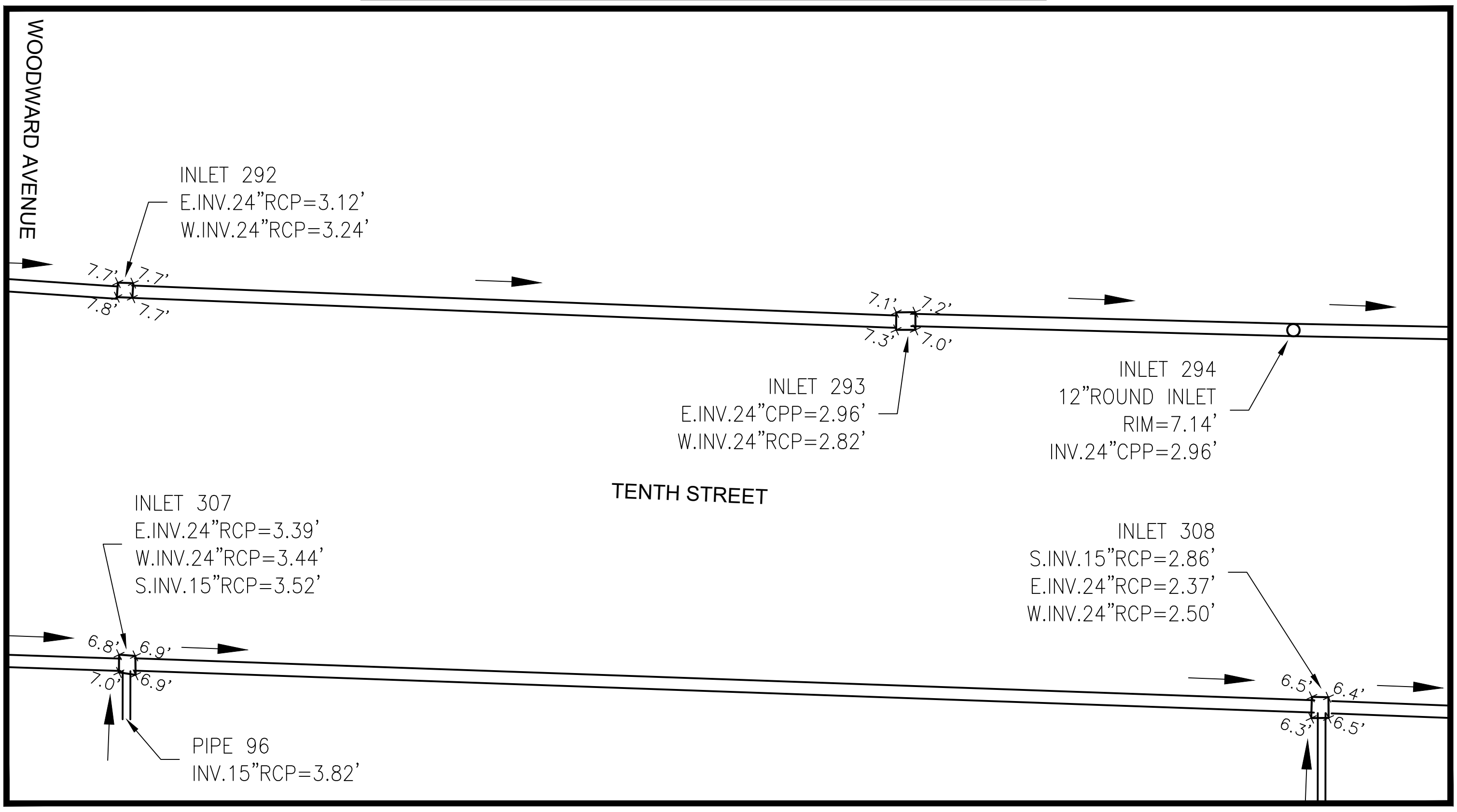
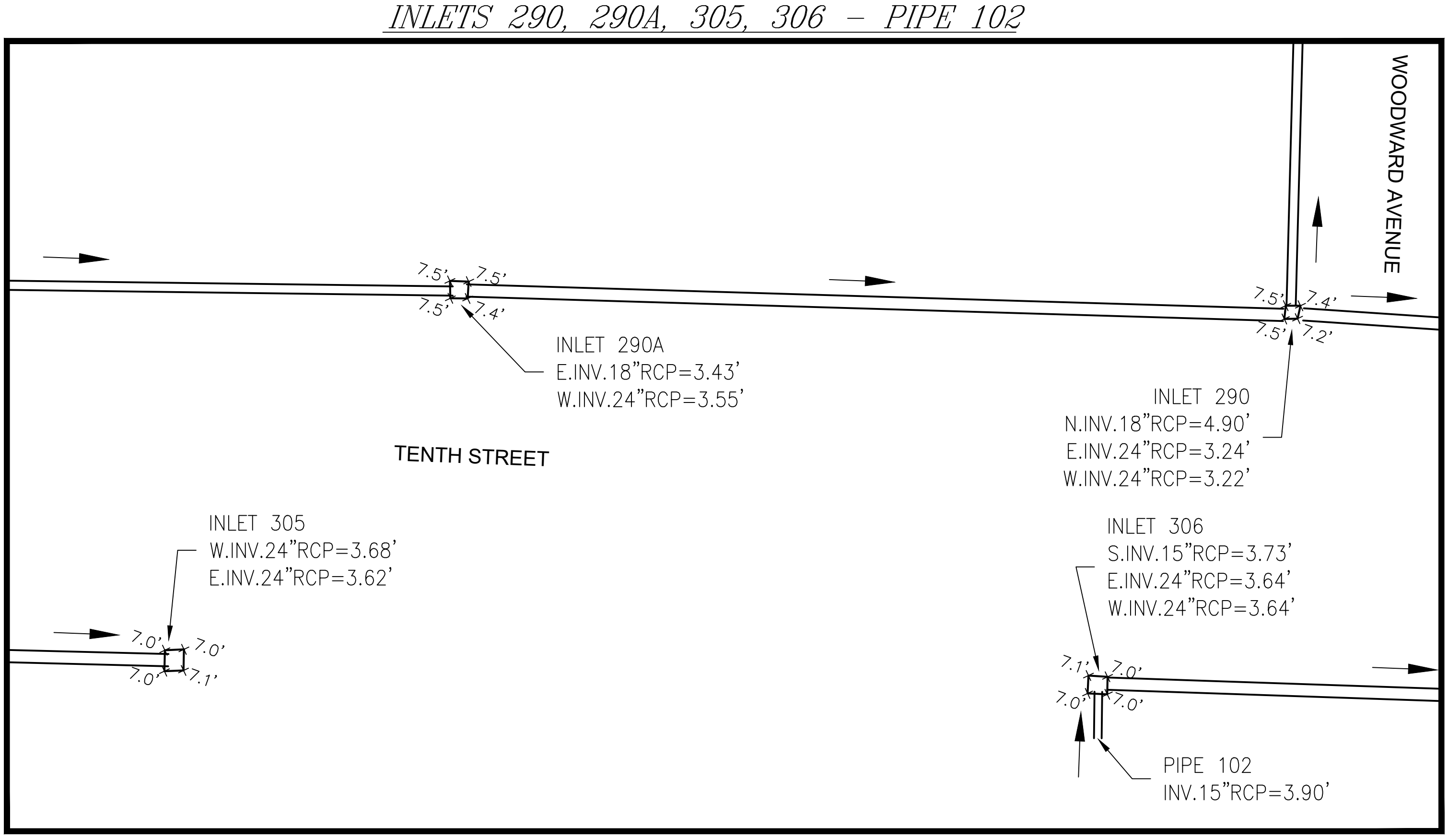
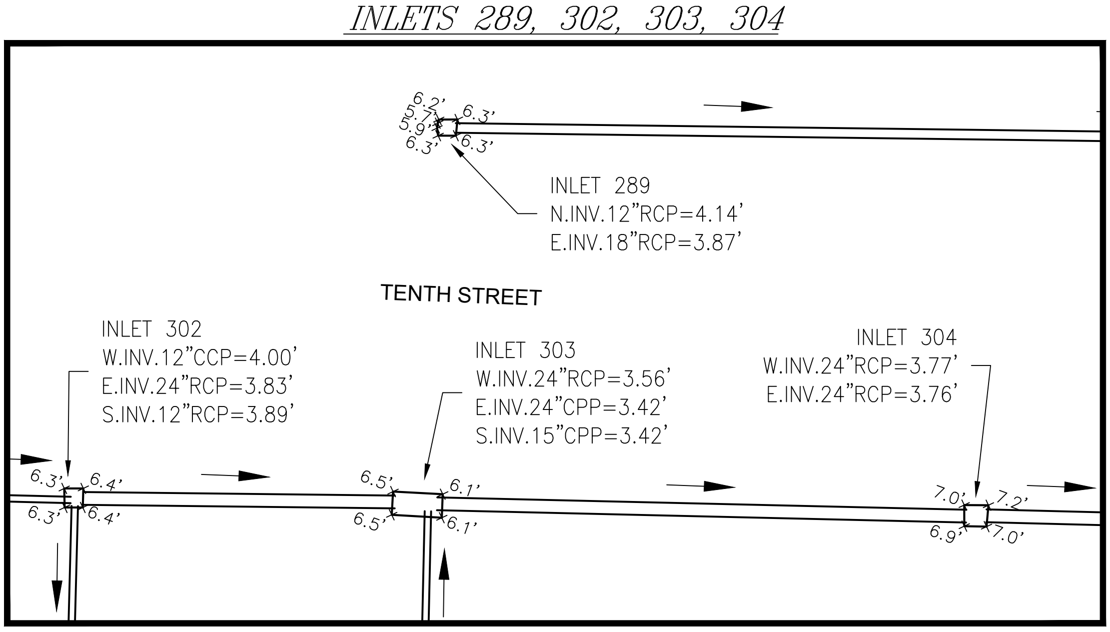
INLETS 292, 293, 294, 307, 308 – PIPE 96

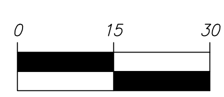


INLETS 290, 290A, 305, 306 – PIPE 102



INLETS 289, 302, 303, 304





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PROJECT NO. 50146276
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28 OF 54

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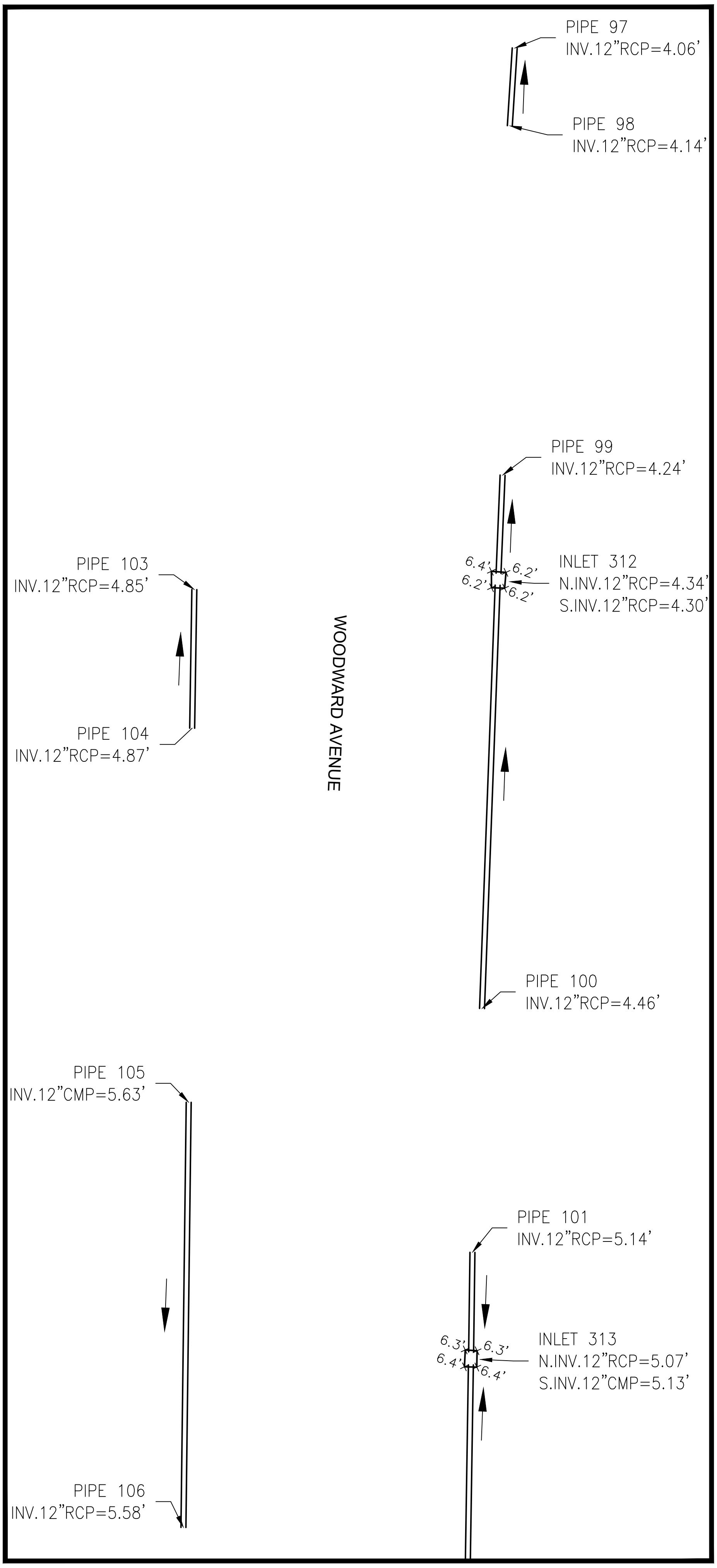
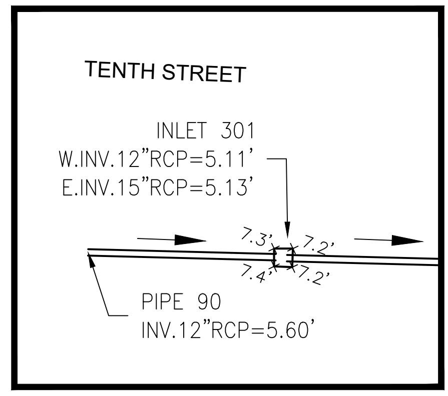
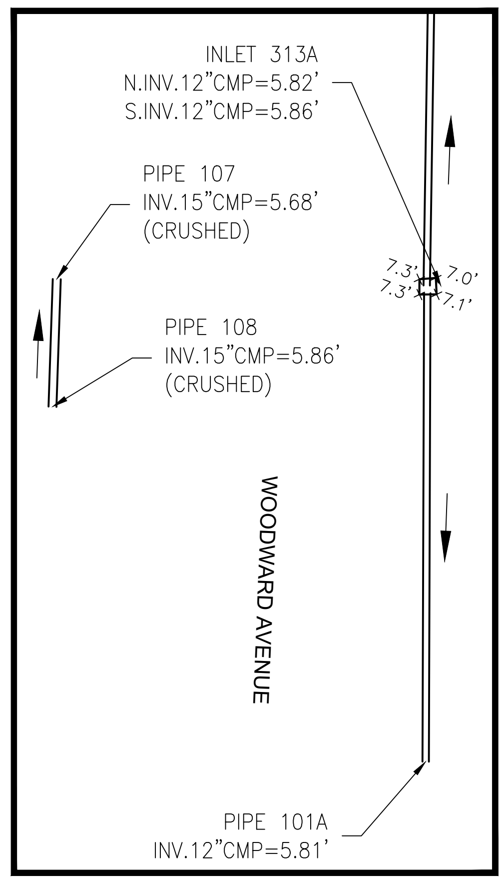
INLETS 312, 313 – PIPES 97,98,99,100,101,103,104,105,106



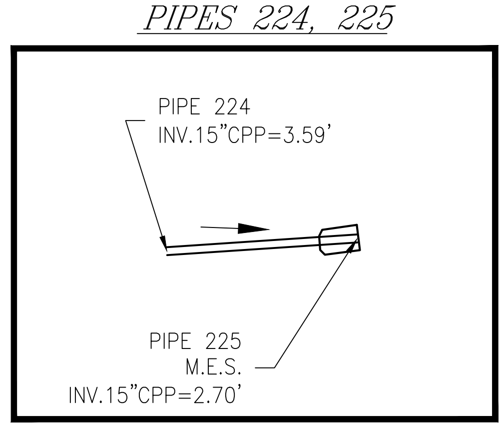
INLET 301 – PIPE 90

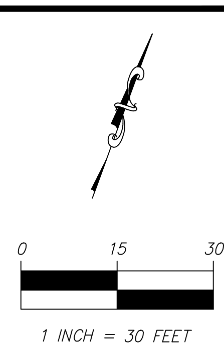


INLET 313A – PIPES 101A,107,108

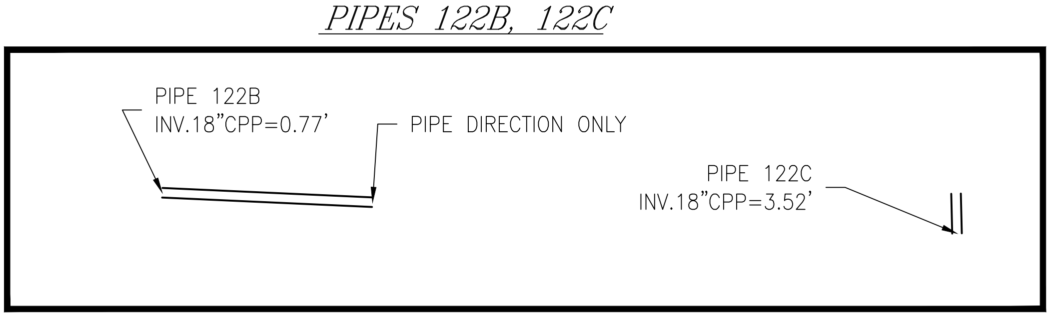


PIPES 224, 225





PIPES 122B, 122C



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CITY OF PORT ST. JOE
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PROJECT NO. 50146276
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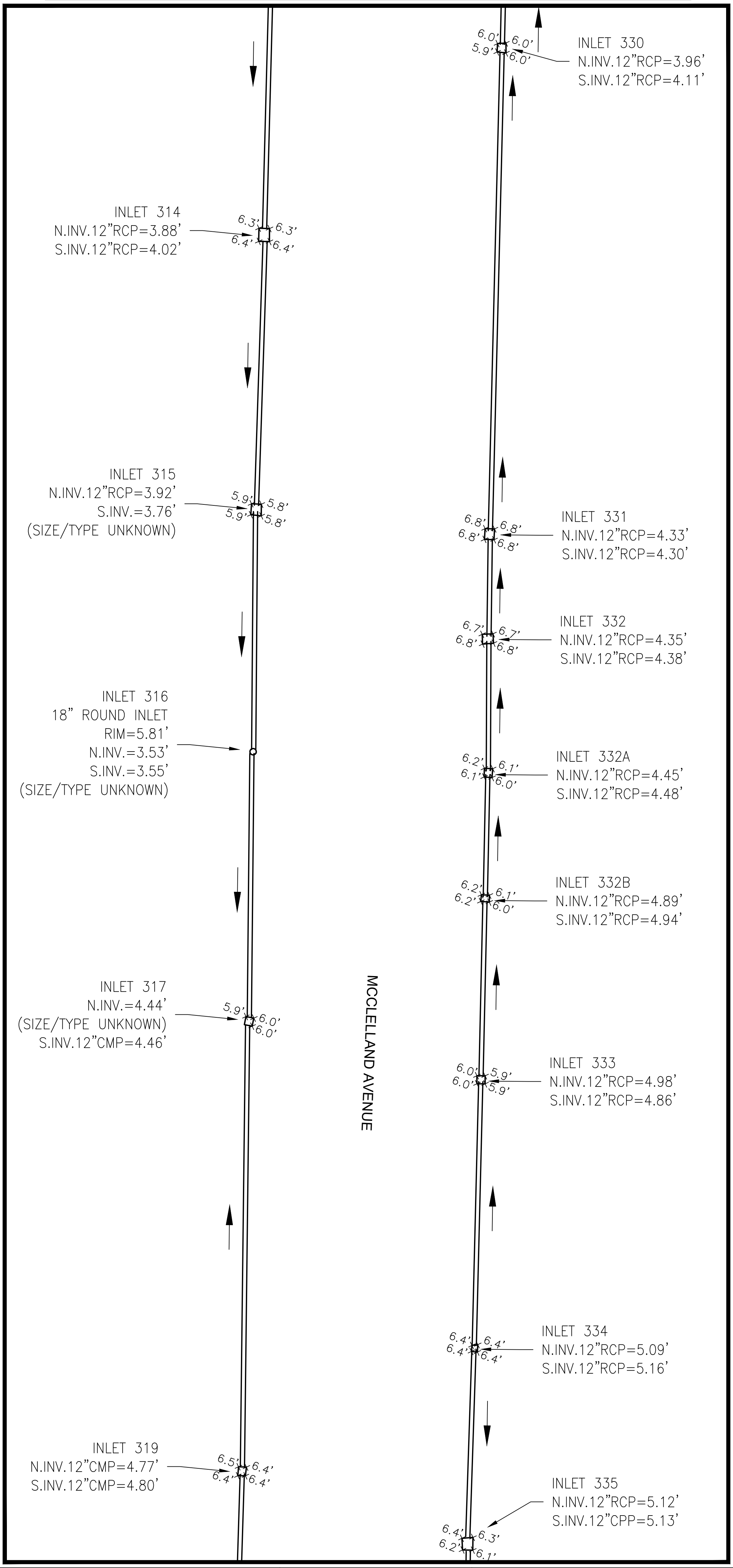
INLETS 314,315,316,317,319,330,331,332,332A,332B,333,334,335



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SHEET NO.
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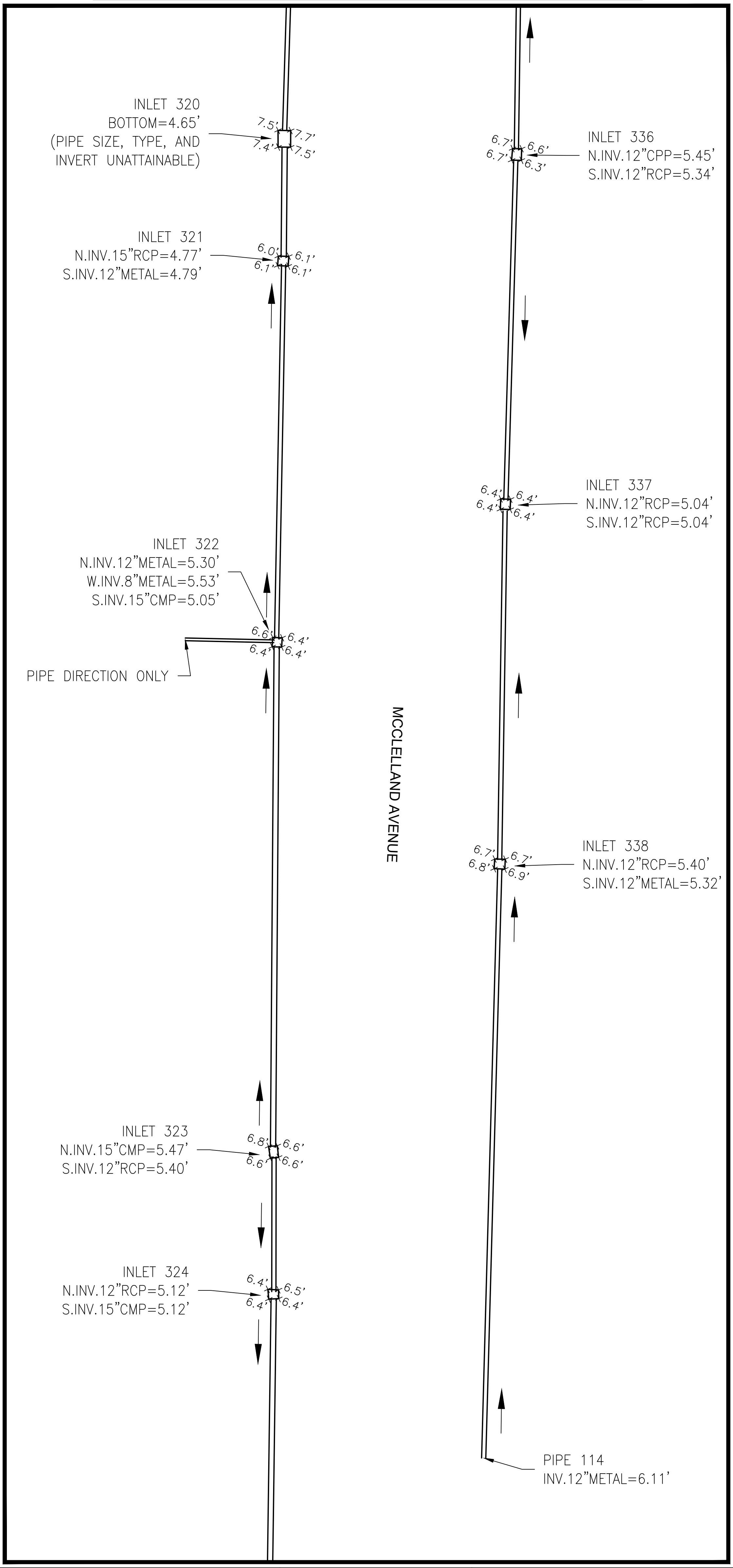
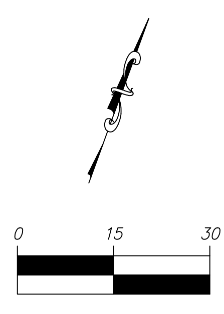
INLETS 320,321,322,323,324,336,337,338 – PIPE 114





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2024 POST ST. JOE COASTAL STRUCTURES
CITY OF PORT ST. JOE
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PROJECT NO. 50146276
SHEET NO.
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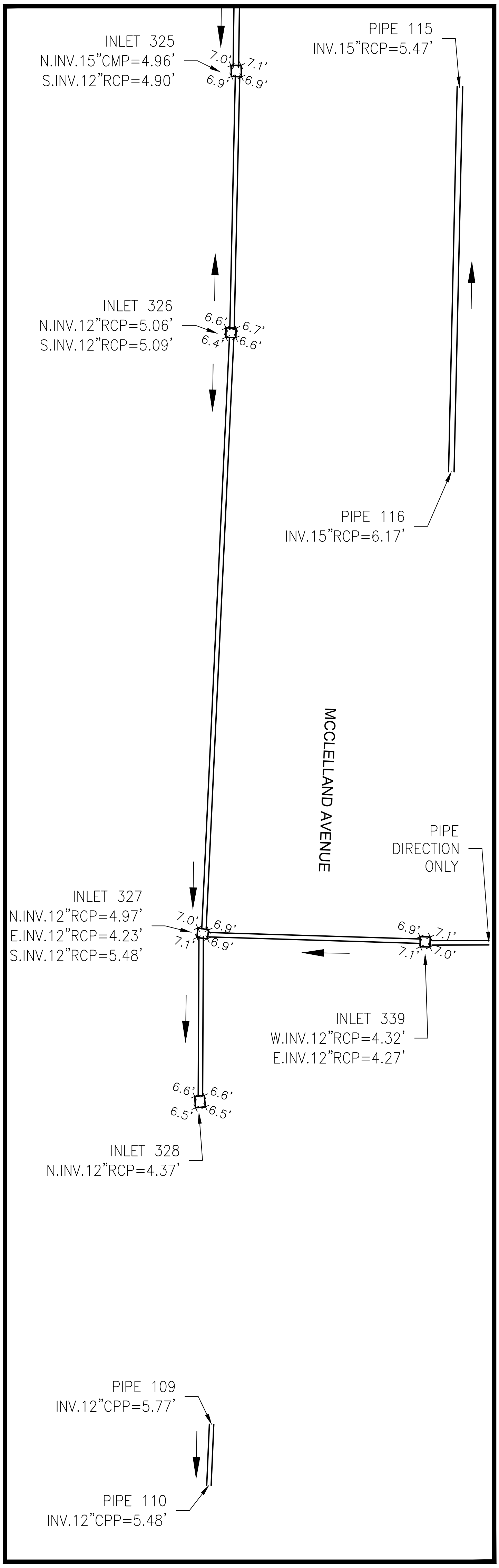
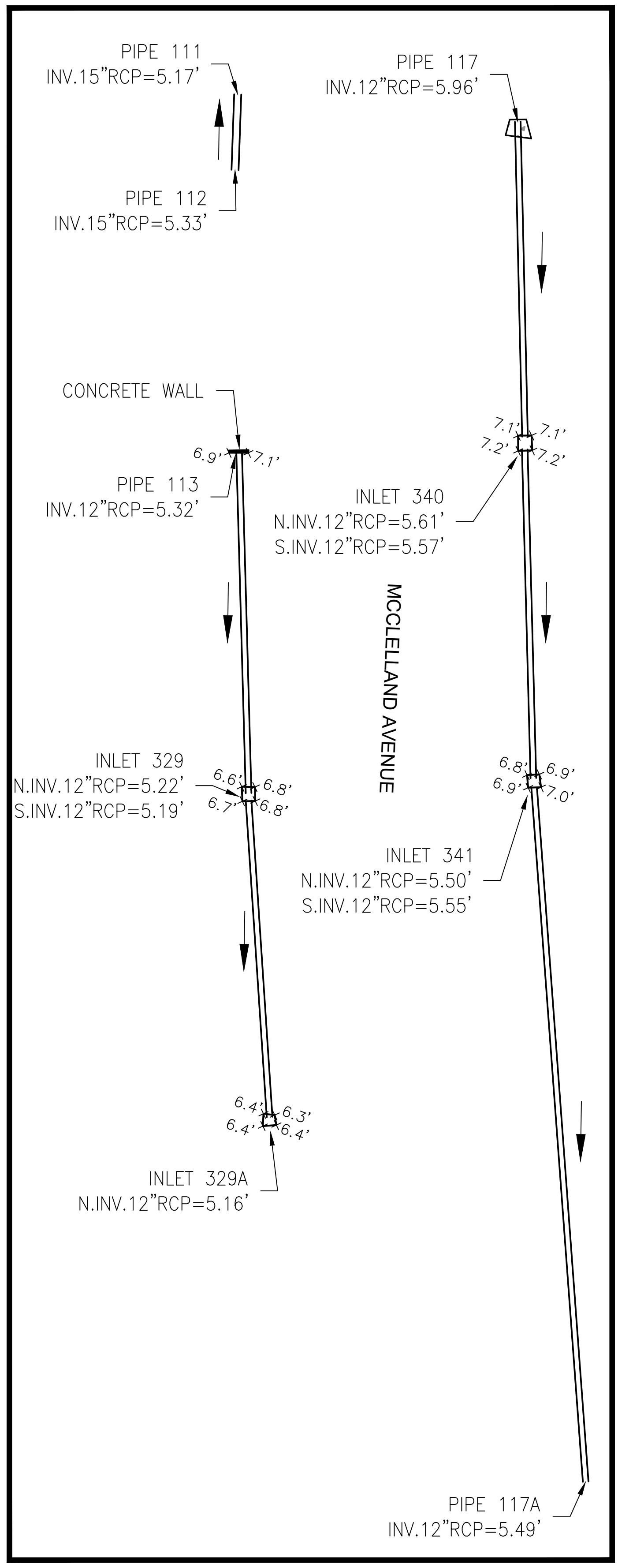
INLETS 325, 326, 327, 328, 339
PIPES 109, 110, 115, 116



INLETS 329, 329A, 340, 341
PIPES 111, 112, 113, 117, 117A



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PROJECT NO. 50146276

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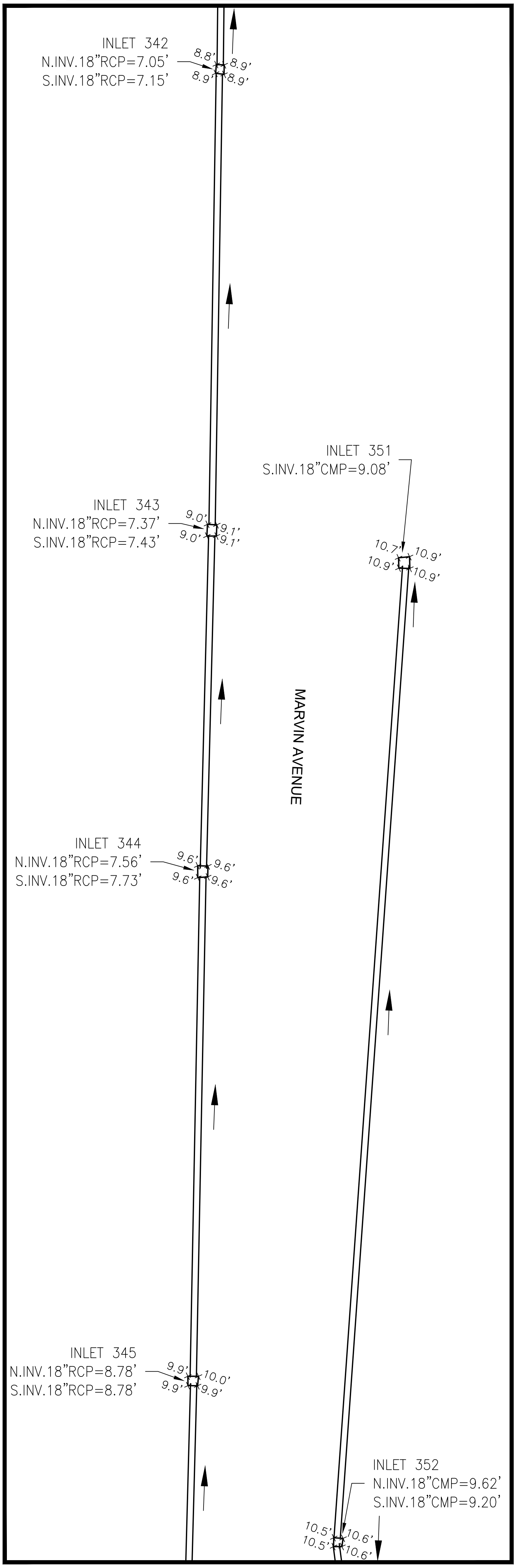
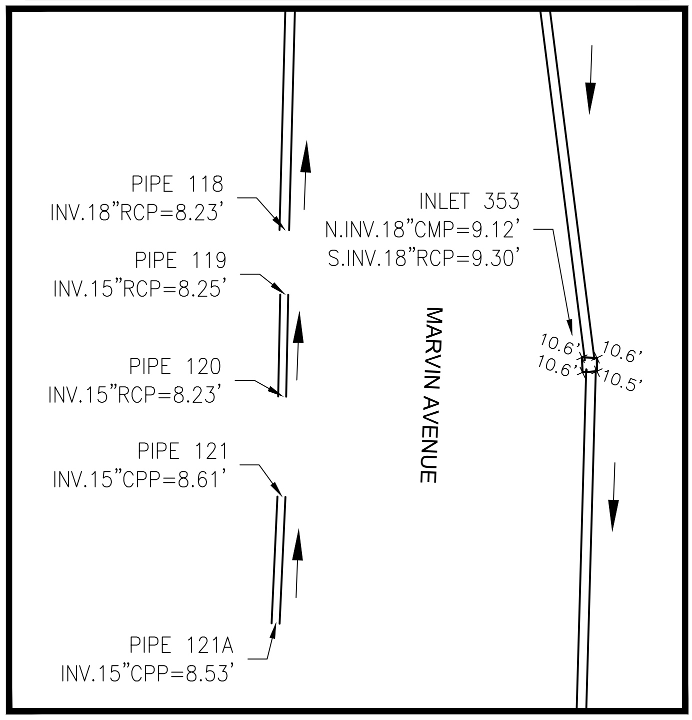
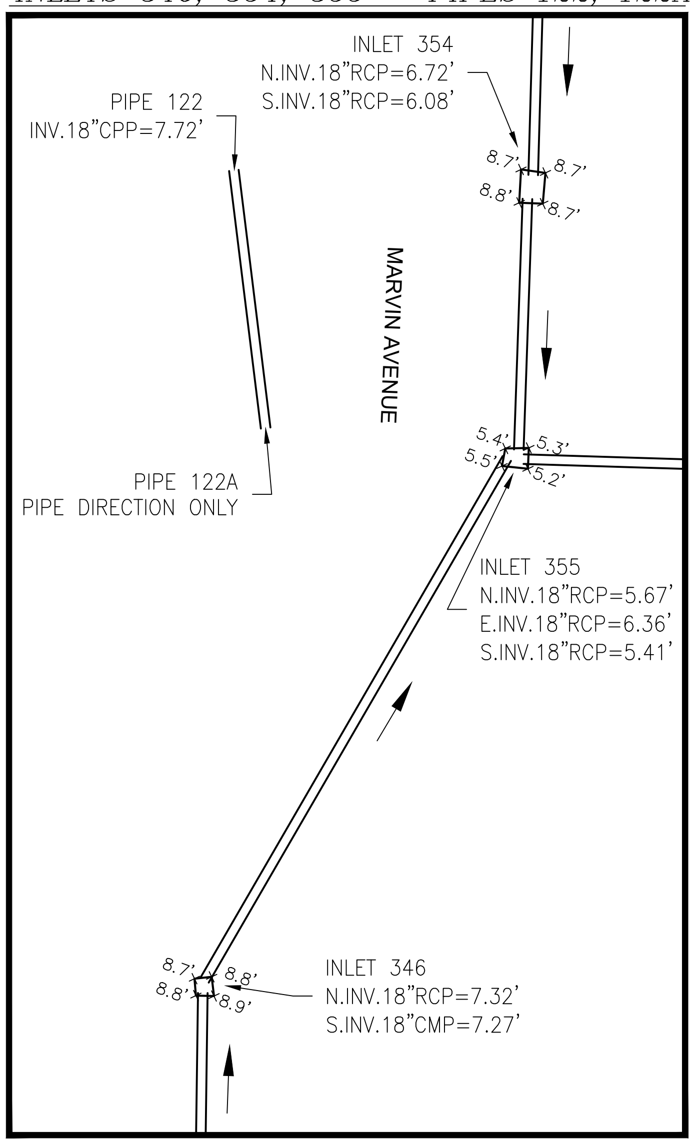
INLETS 342, 343, 344, 345, 351, 352

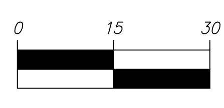


INLET 353 – PIPES 118,119,120,121,121A



INLETS 346, 354, 355 – PIPES 122, 122A





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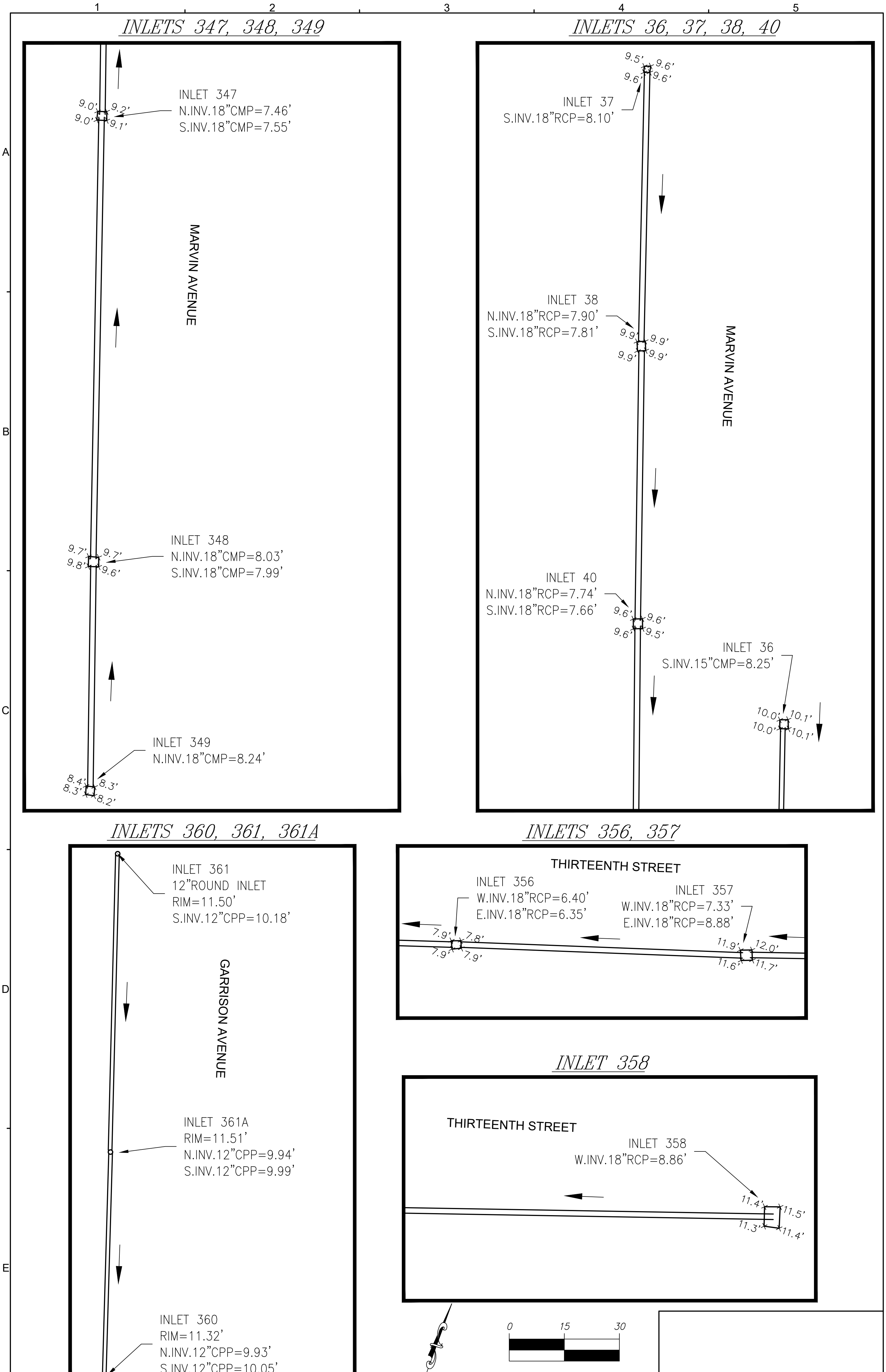
CITY OF PORT ST. JOE
GULF COUNTY, FLORIDA.

PROJECT NO. 50146276
SHEET NO. 33 OF 54



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CITY OF PORT ST. JOE
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SHEET NO.
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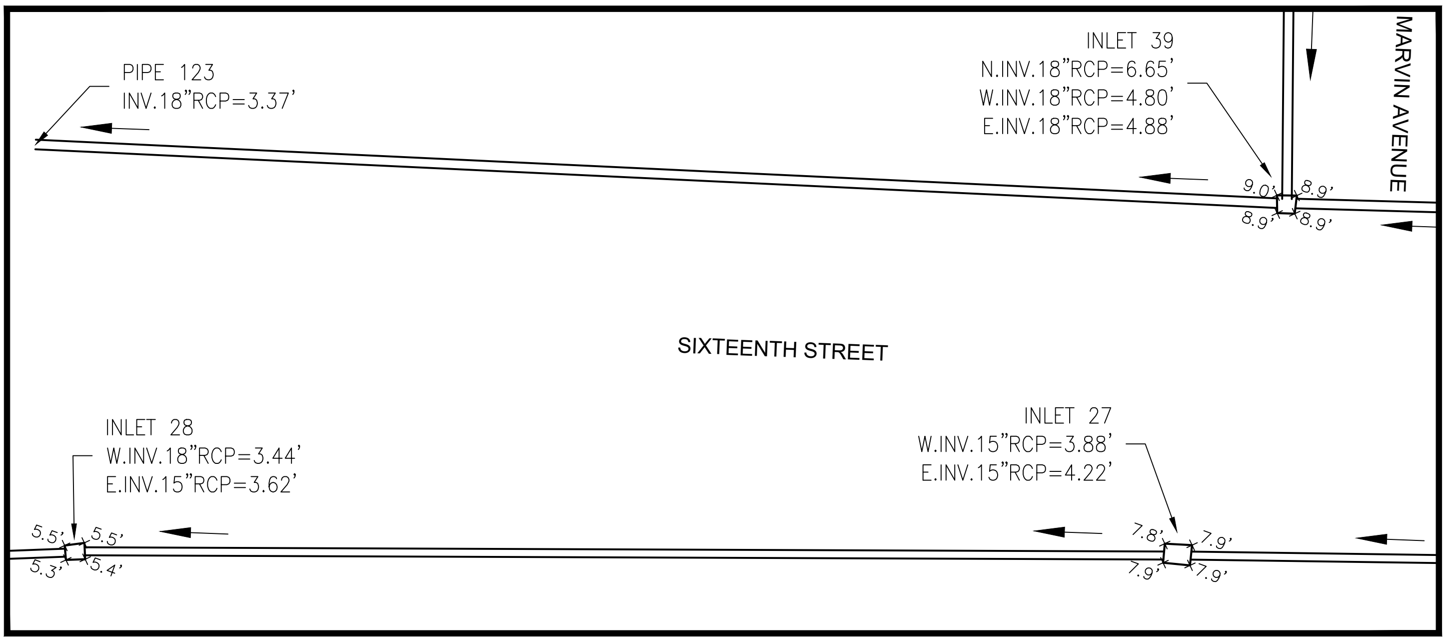
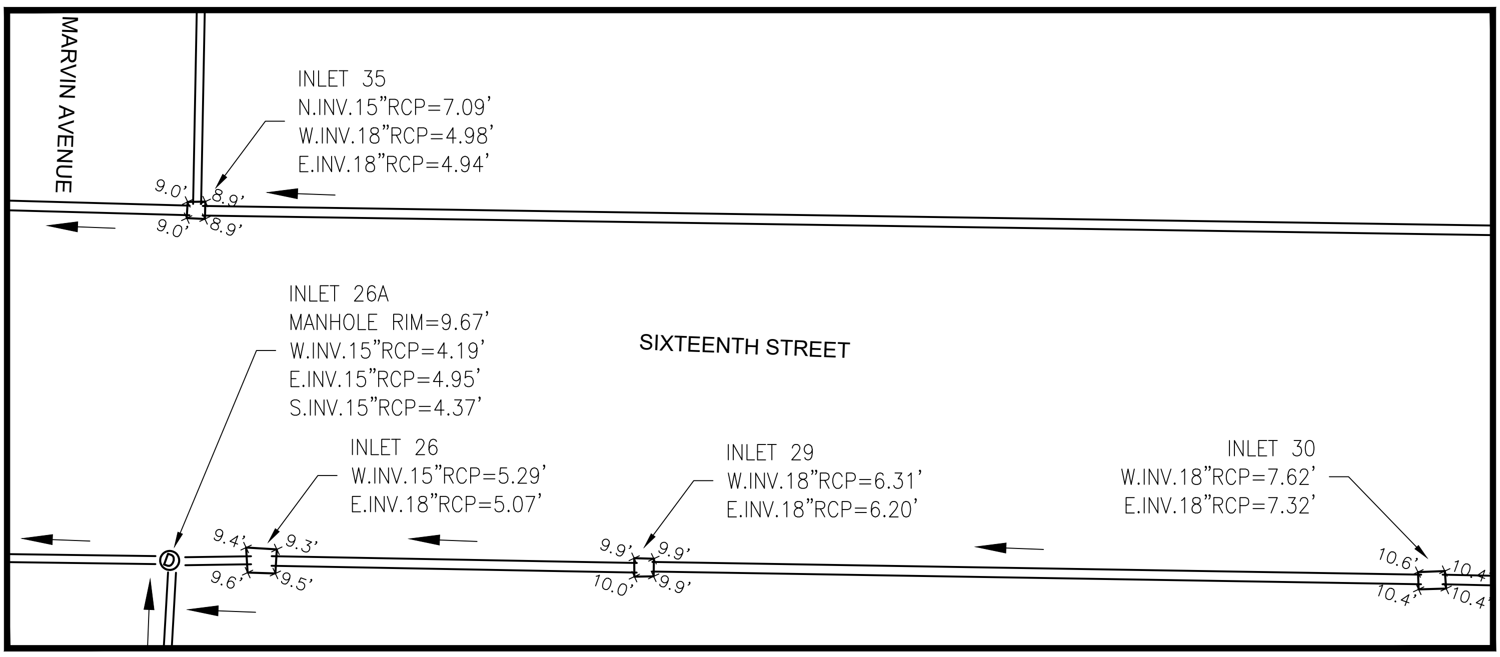
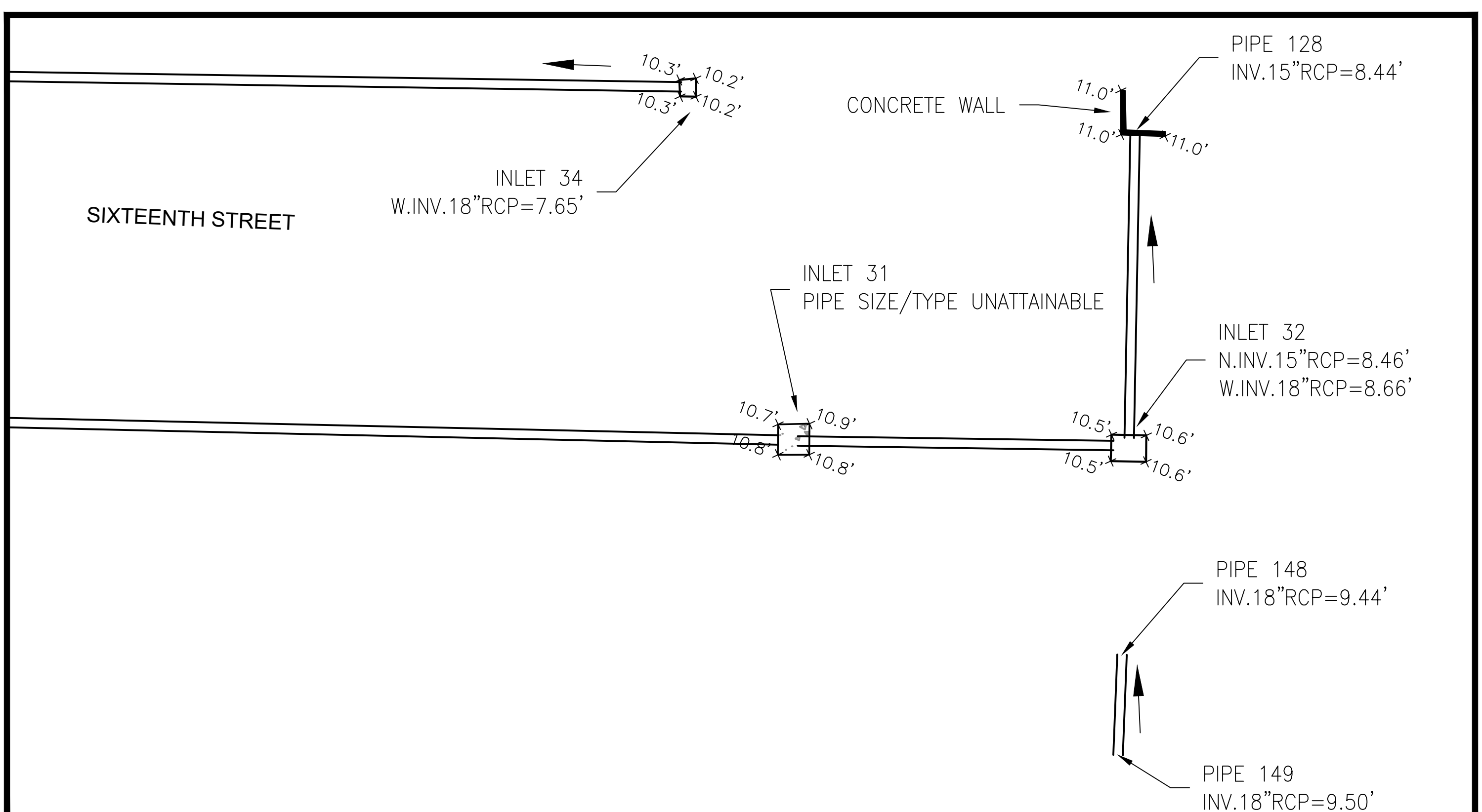
INLETS 27, 28, 39 – PIPE 123

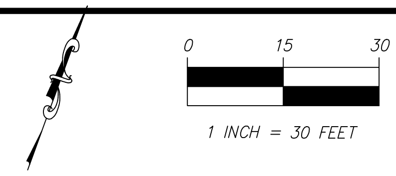


INLETS 26, 26A, 29, 30, 35



INLETS 31, 32, 34 – PIPES 128, 148, 149





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35 OF 54

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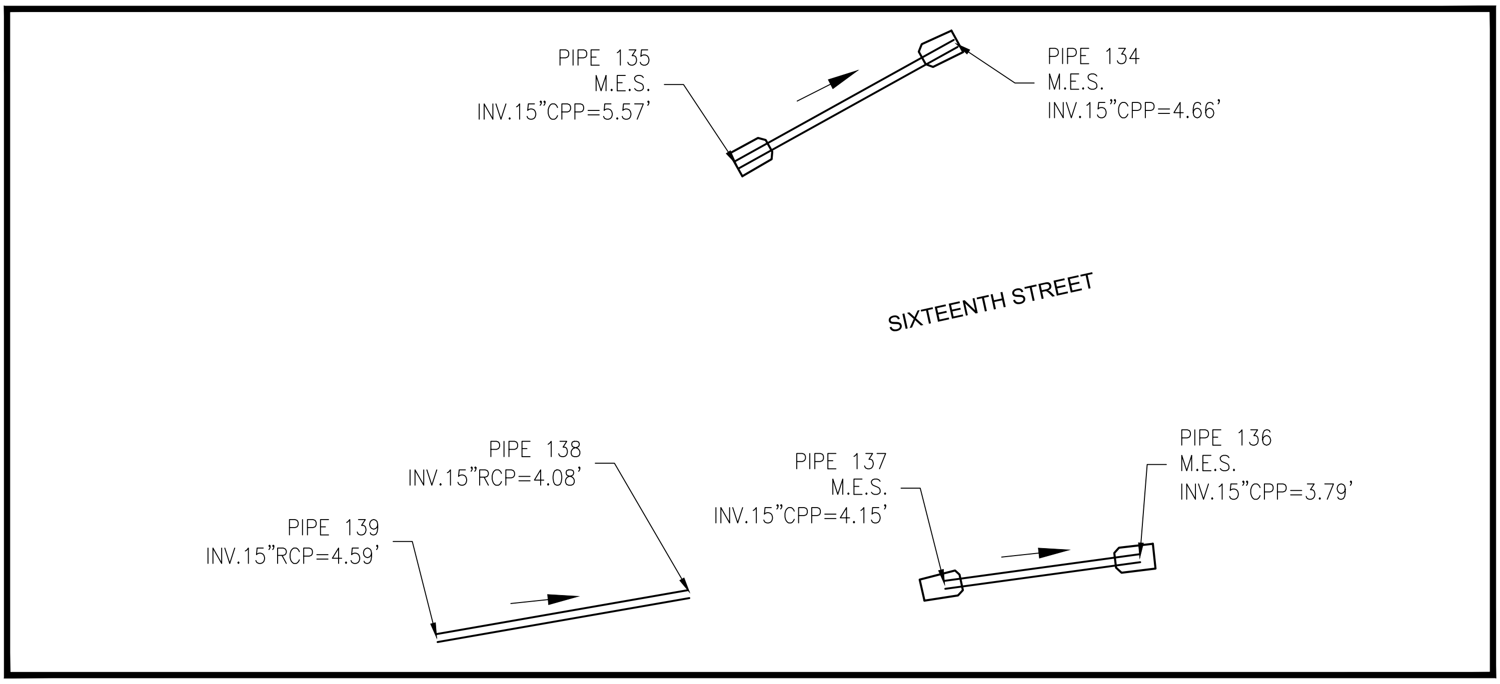
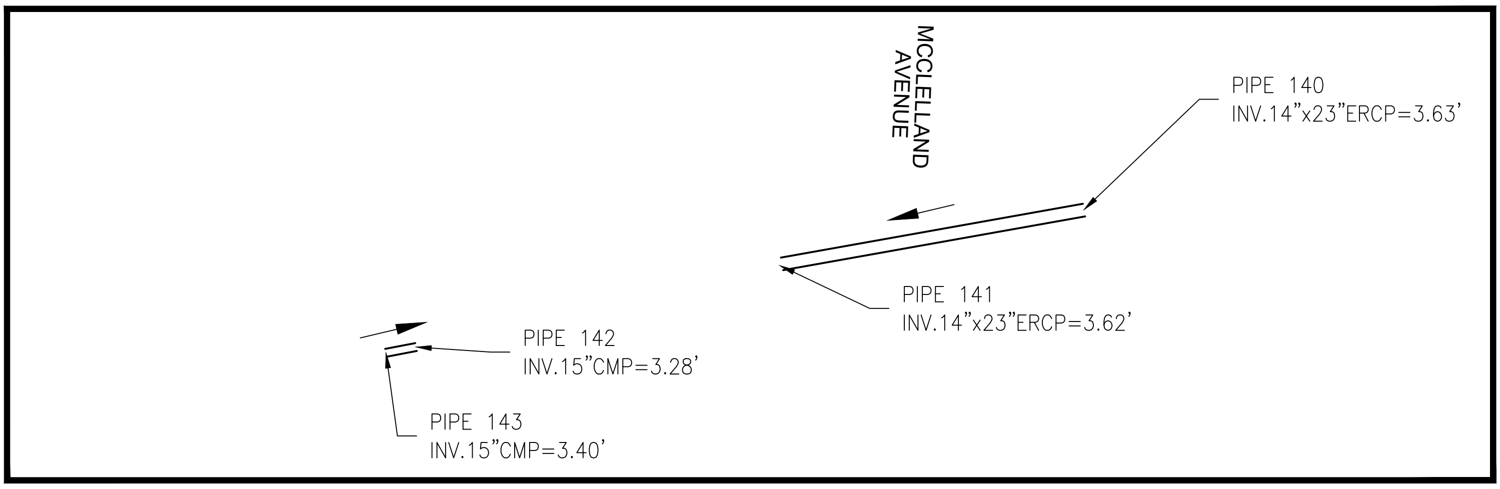
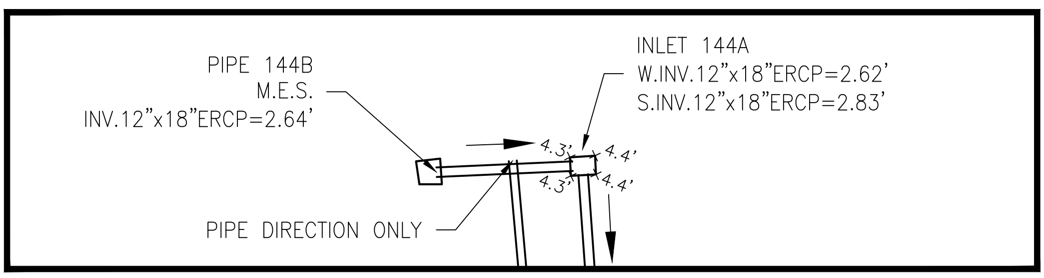
PIPES 134, 135, 136, 137, 138, 139



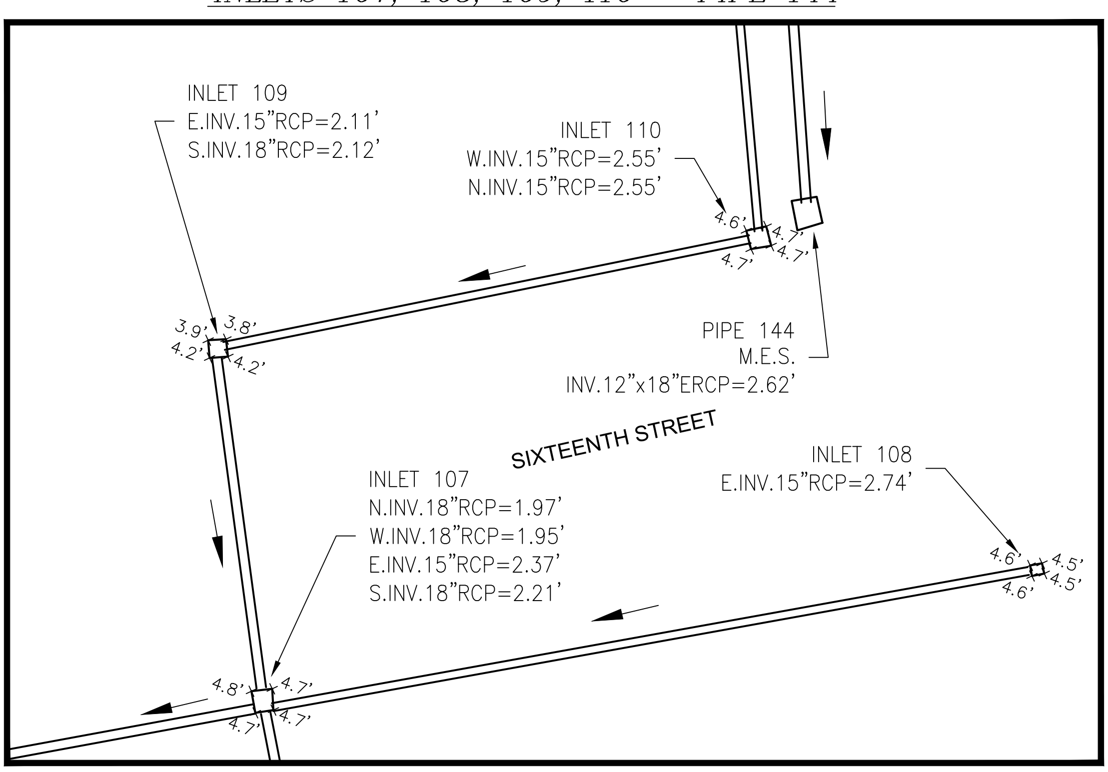
PIPES 140, 141, 142, 143

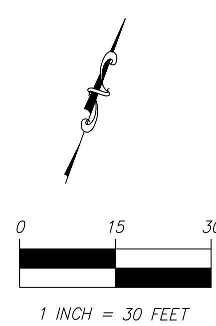


INLET 144A – PIPE 144B



INLETS 107, 108, 109, 110 – PIPE 144





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2024 POST ST. JOE COASTAL STRUCTURES
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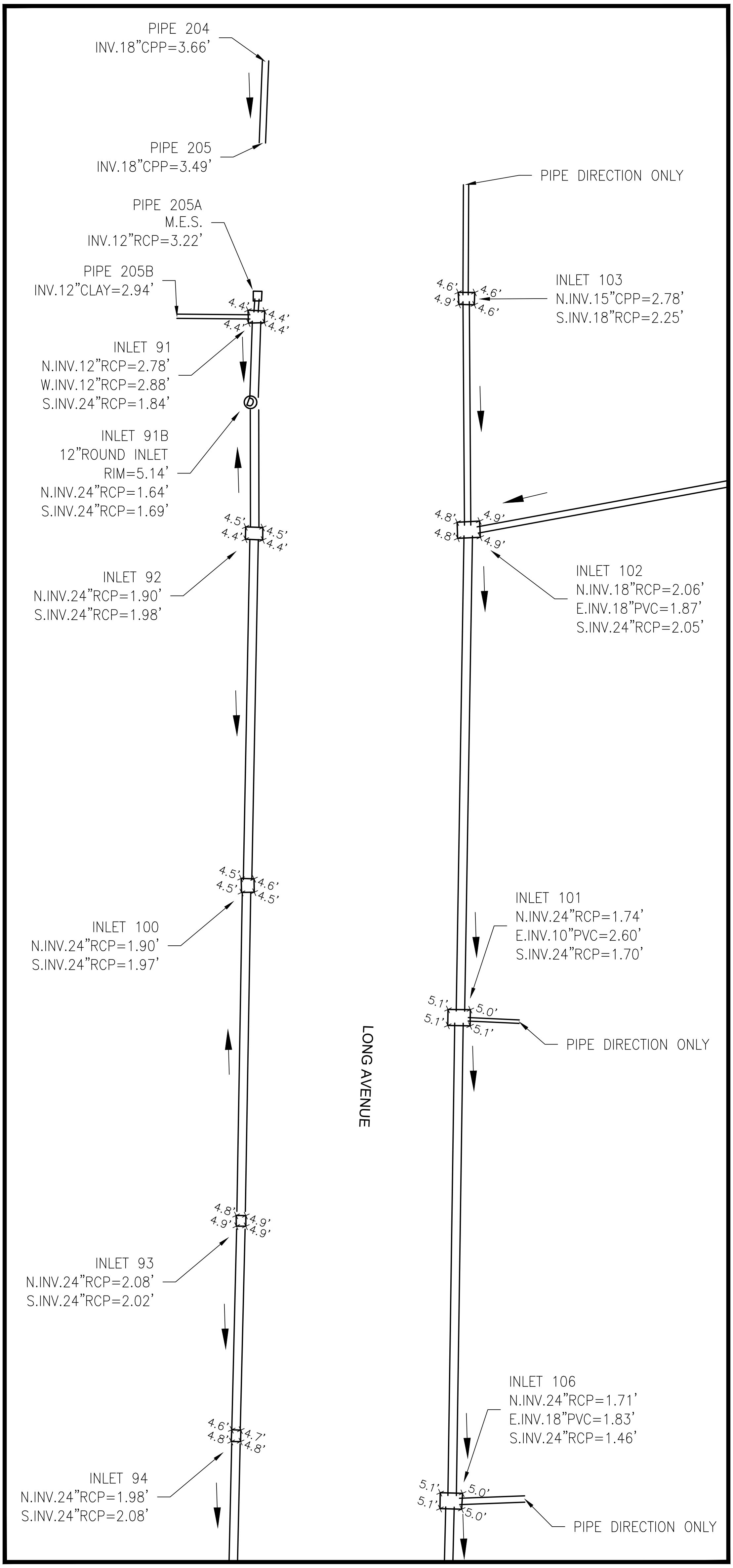
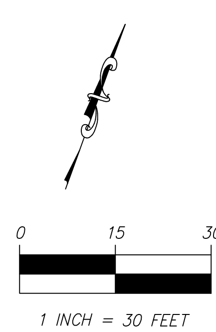
INLETS 91,91B,92,93,94,100,101,102,103,106 – PIPES 204,205,205A,205B





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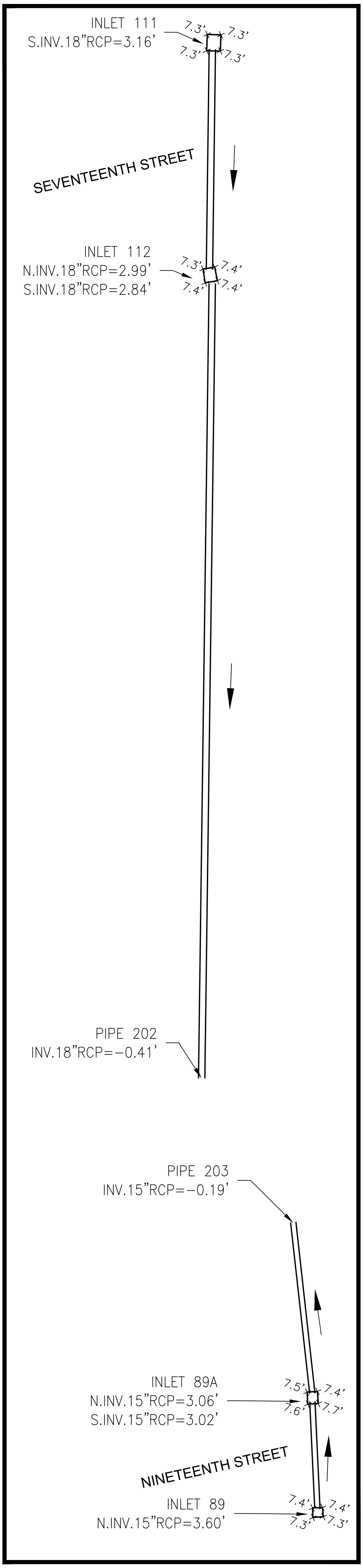
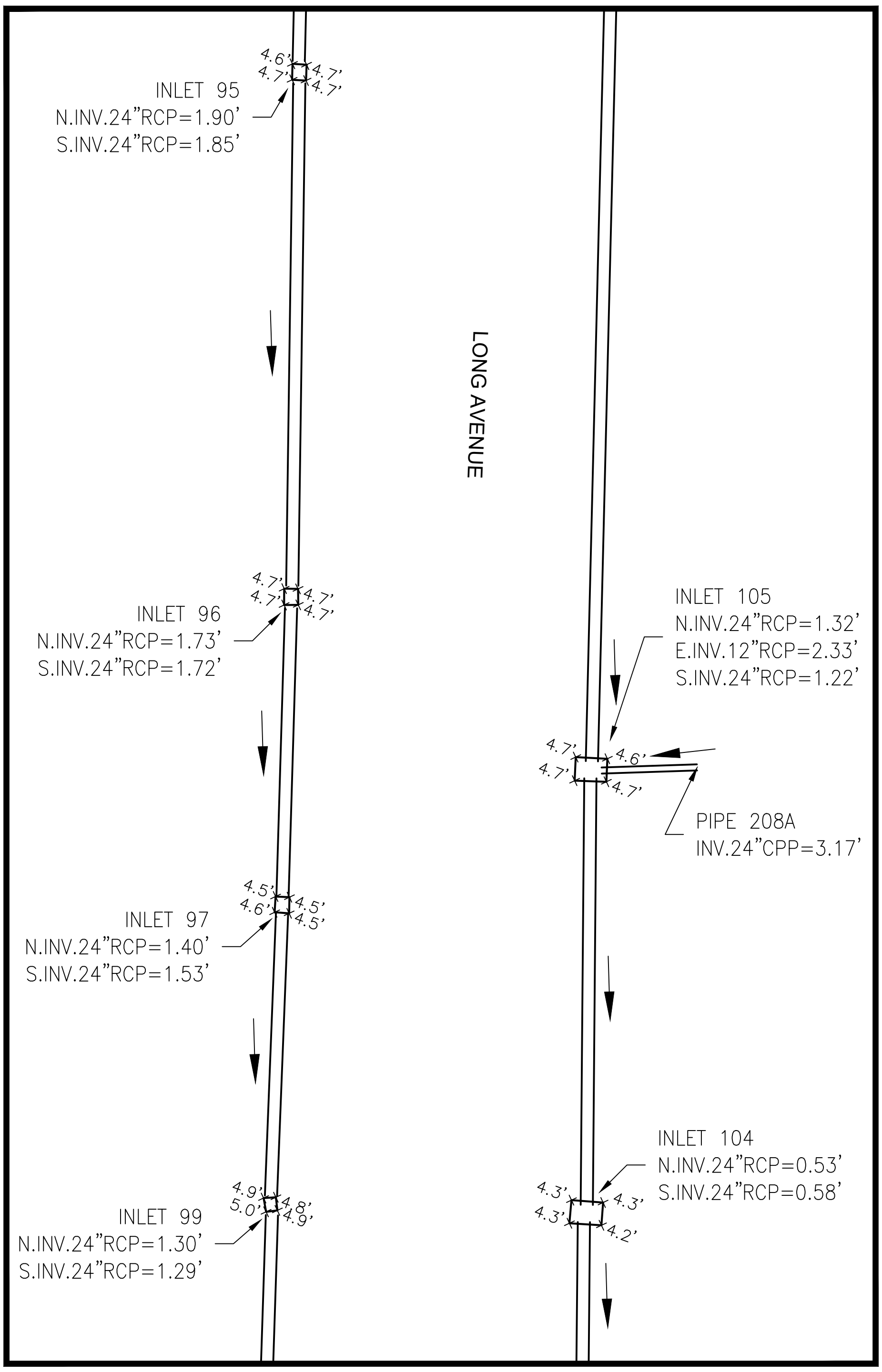
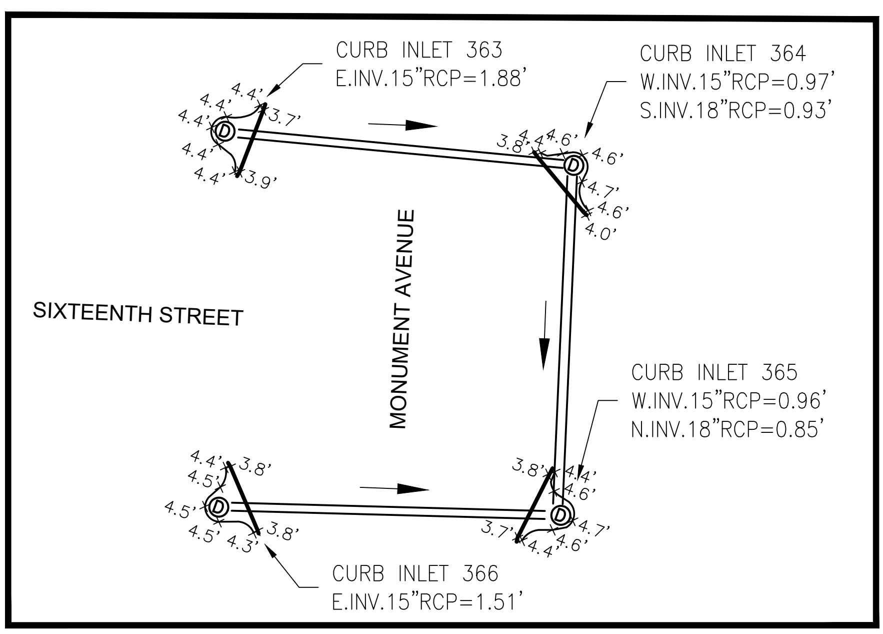
INLET 89,89A,111,112, – PIPE 202,203,



INLETS 95, 96, 97, 99, 104, 105 – PIPE 208A



INLETS 363, 364, 365, 366



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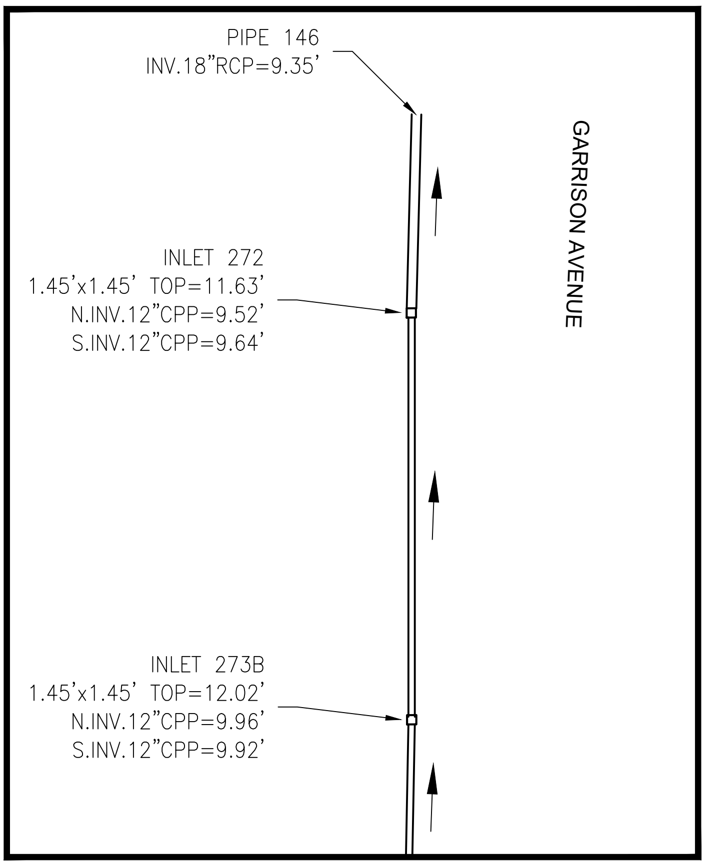
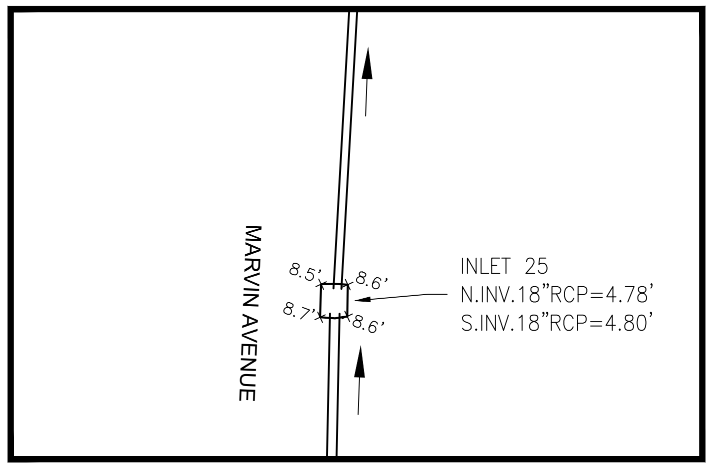
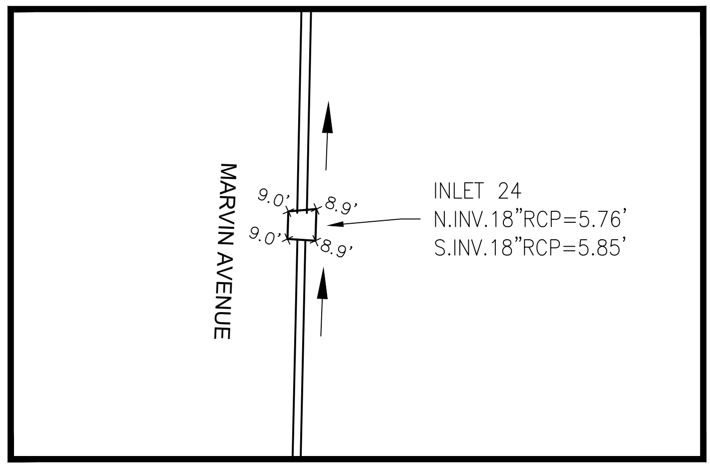
INLETS 272, 273B – PIPE 146



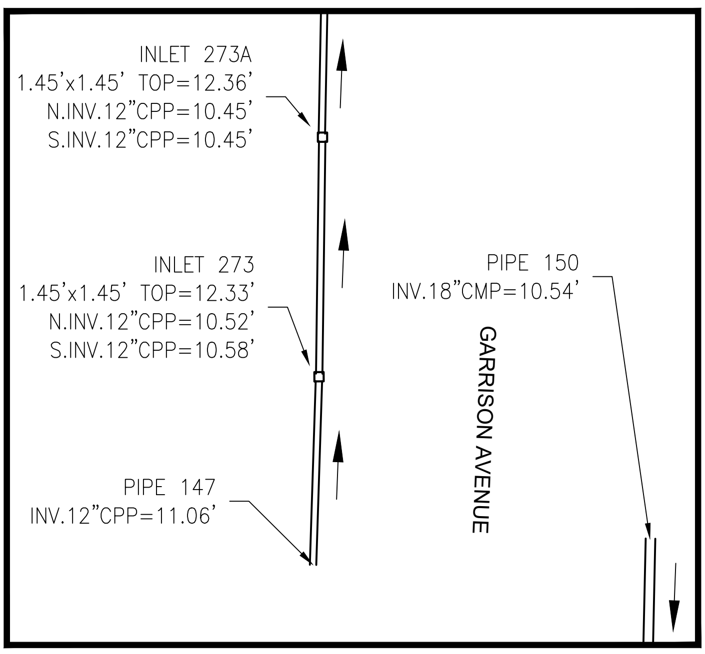
INLET 25



INLET 24



INLETS 273, 273A – PIPES 147, 150



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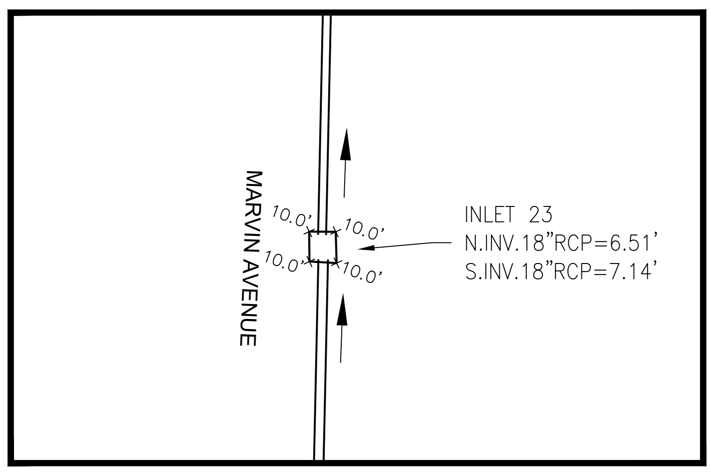
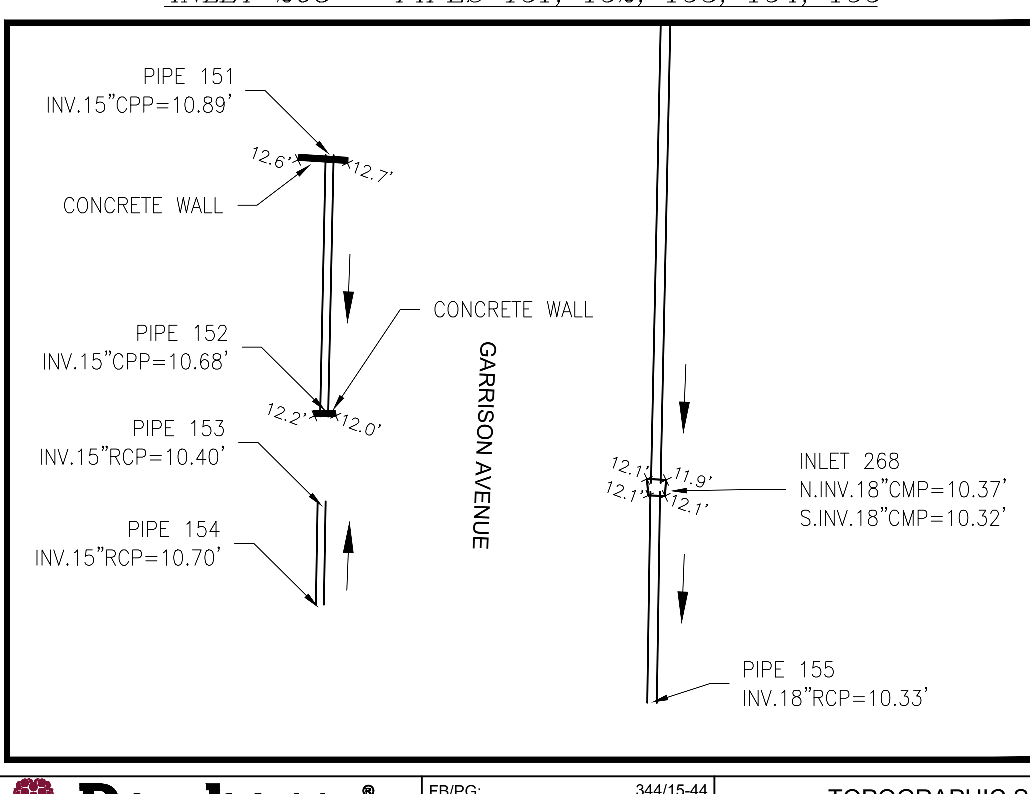
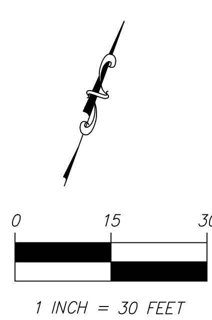


INLET 268 – PIPES 151, 152, 153, 154, 155





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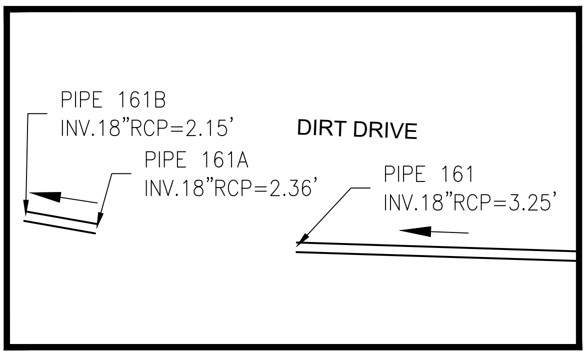
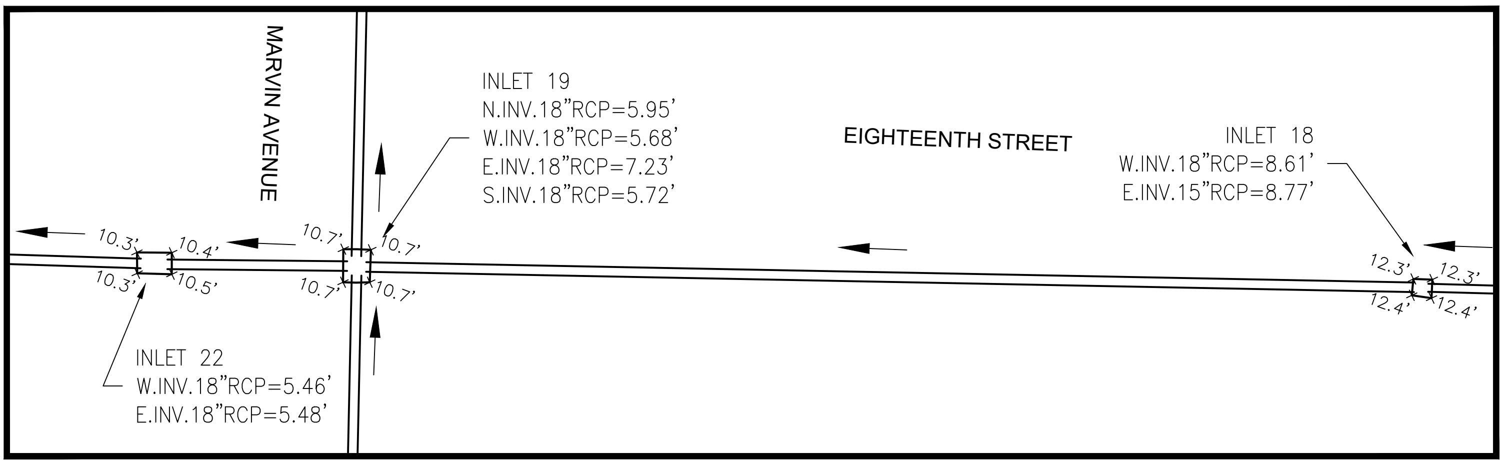
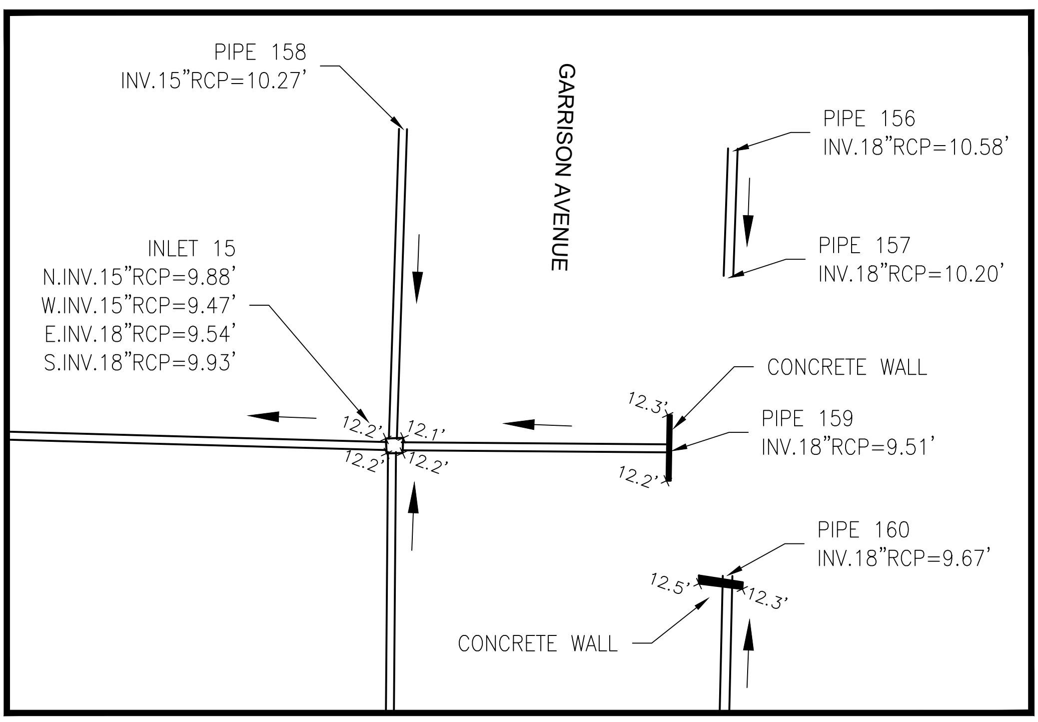
PIPES 161, 161A, 161B



INLETS 18, 19, 22



INLET 15 – PIPES 156, 157, 158, 159, 160



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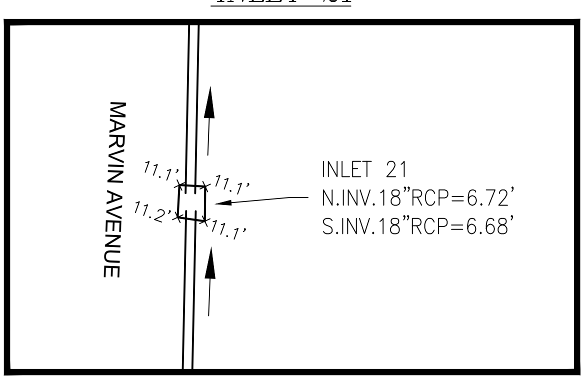
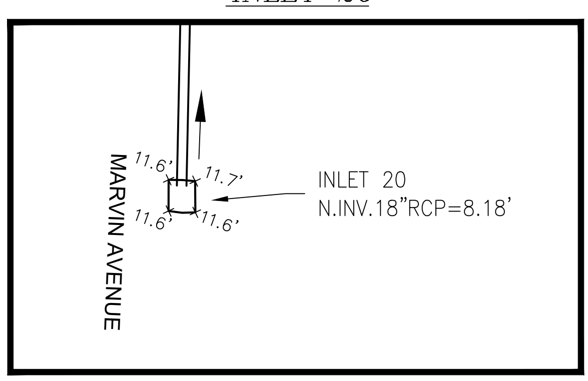
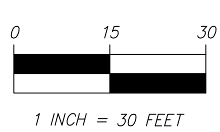


INLET 20





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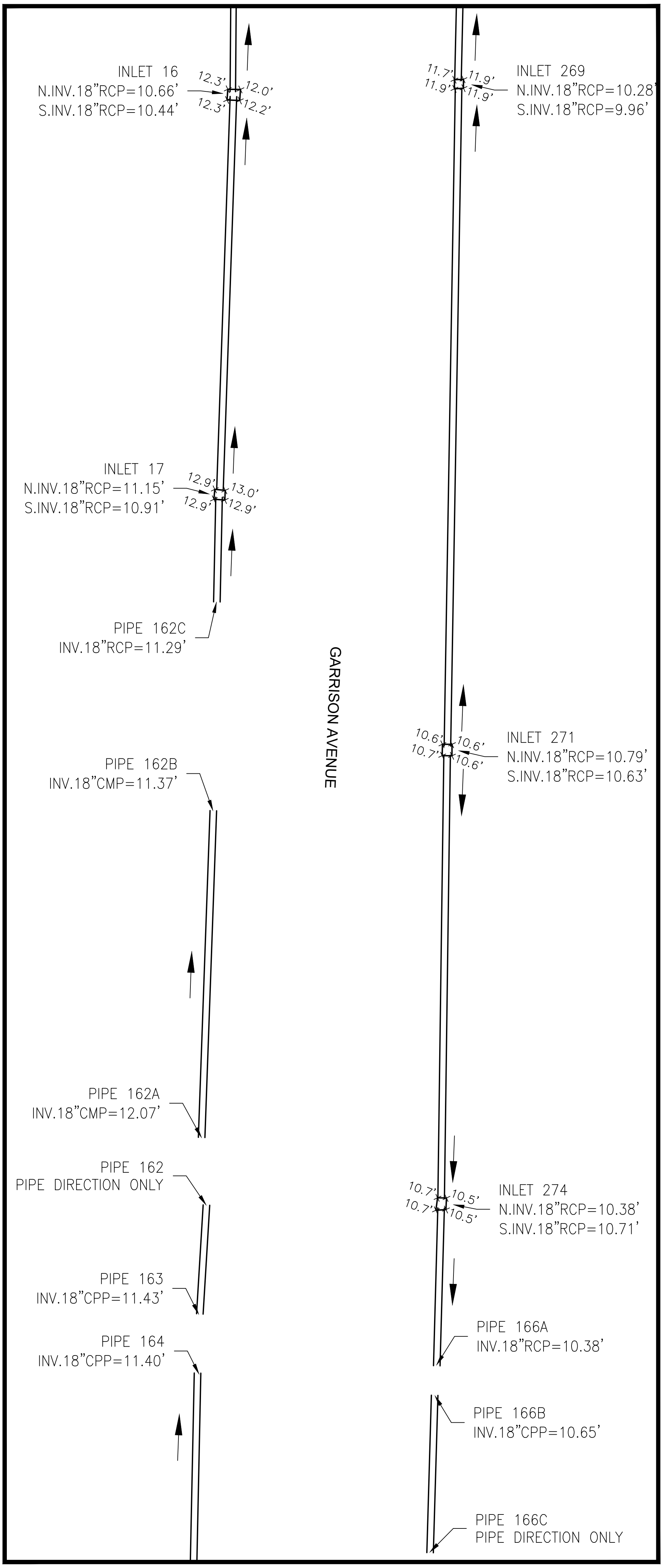
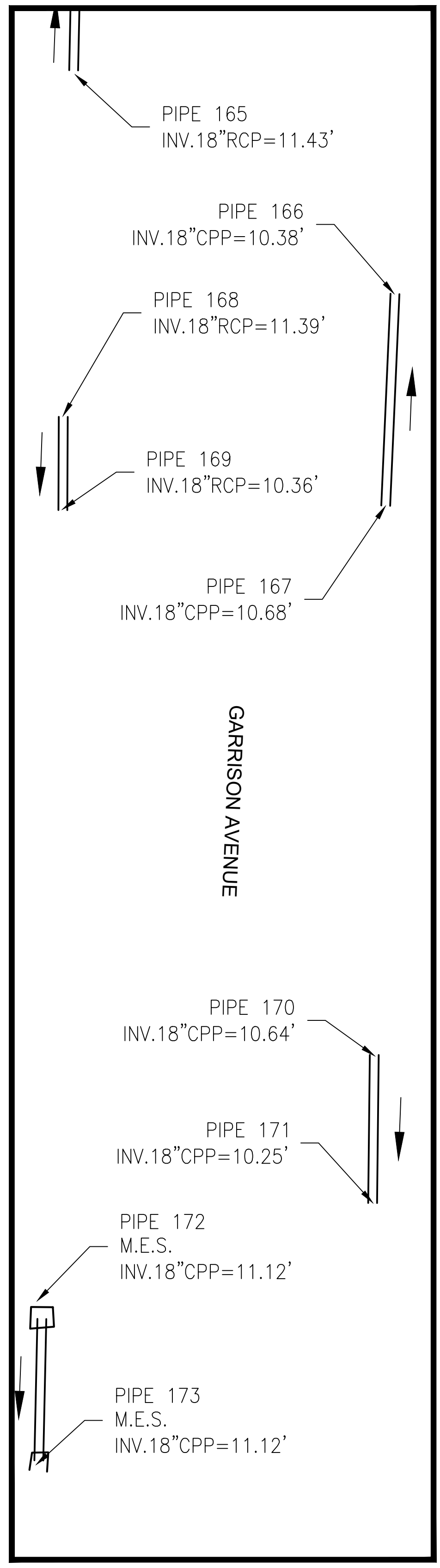
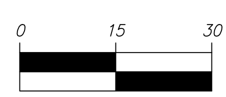
1 2 3 4 5

INLETS 16, 17, 269, 271, 274
PIPES – 162, 162A, 162B, 162C, 163, 164, 166A, 166B, 166C



PIPES – 165,166,167,168, 169,170,171,172,173





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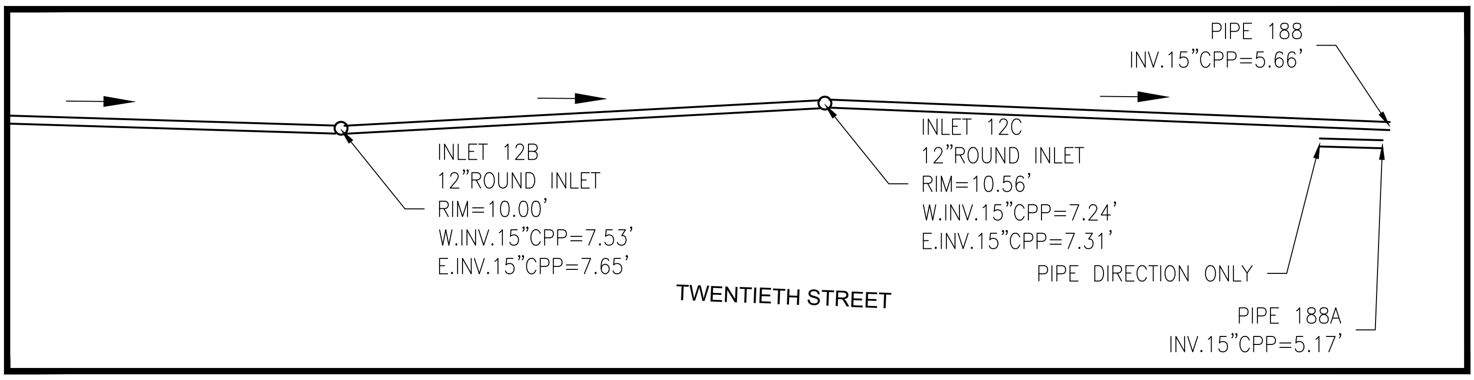
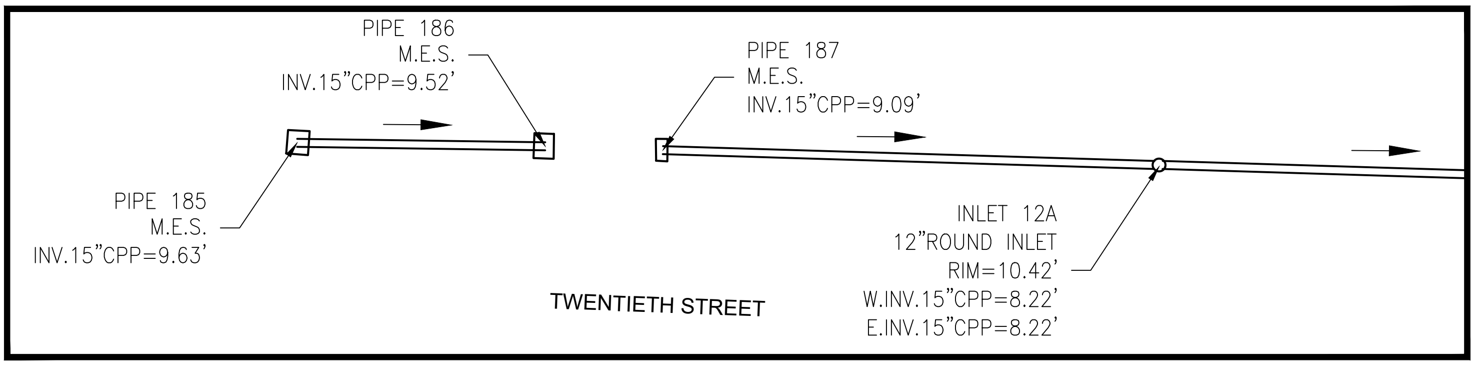
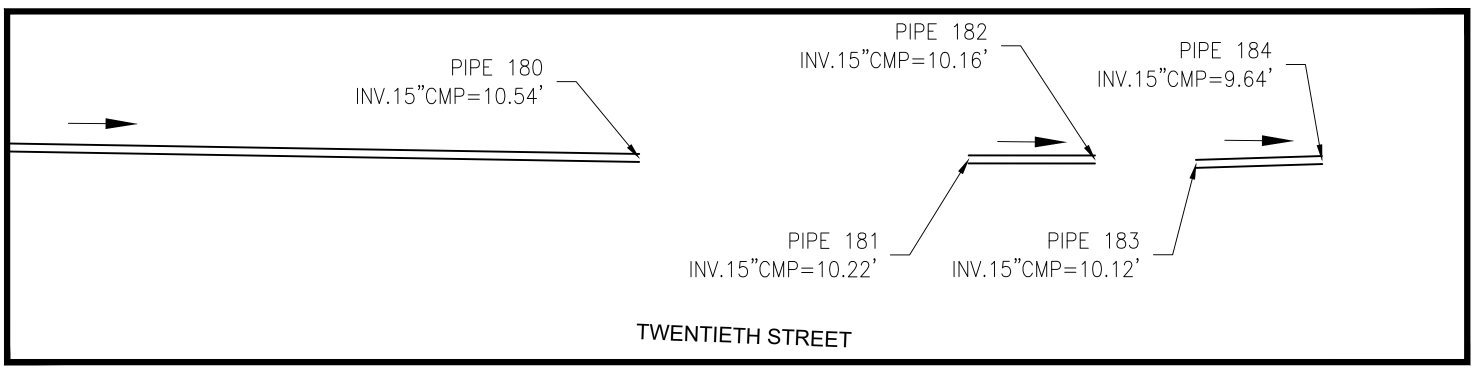
INLETS 12B, 12C – PIPES 188, 188A



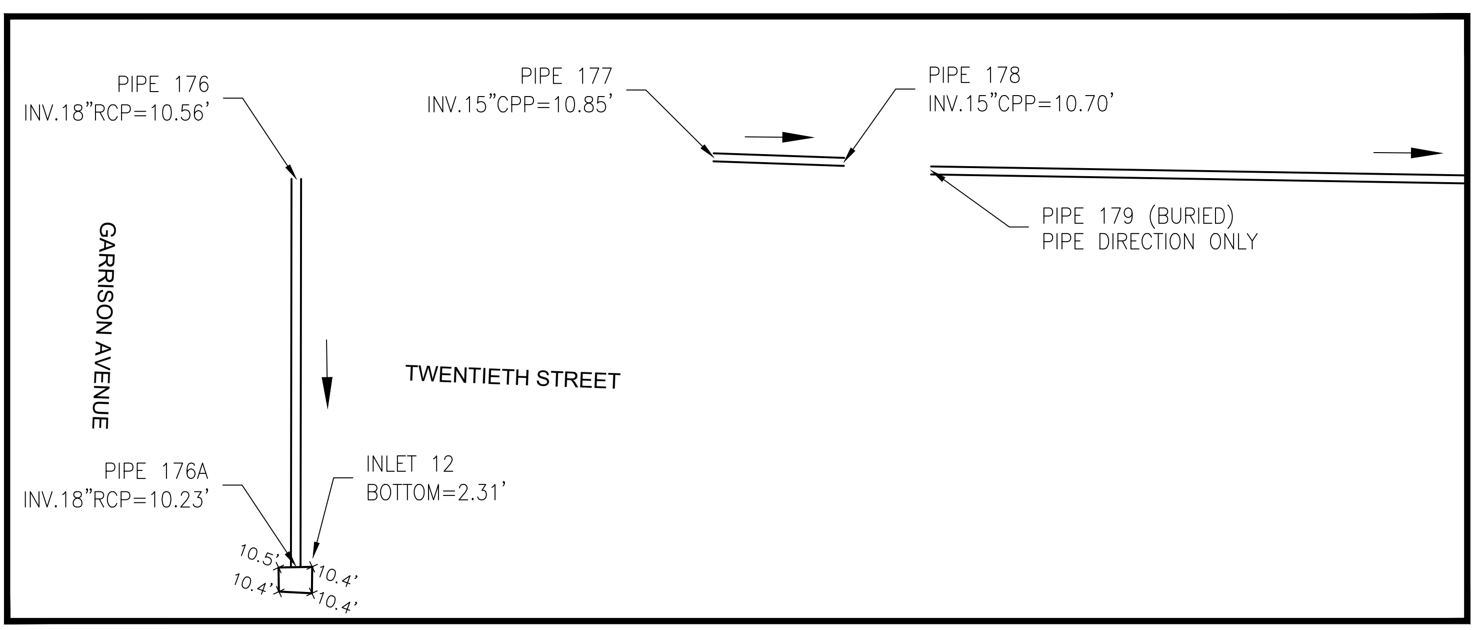
INLET 12A – PIPES 185, 186, 187



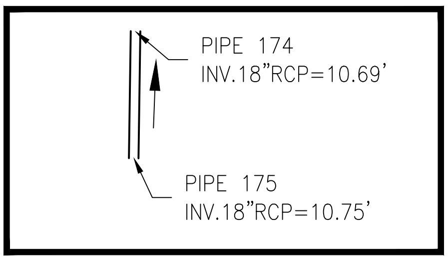
PIPES – 180, 181, 182, 183, 184



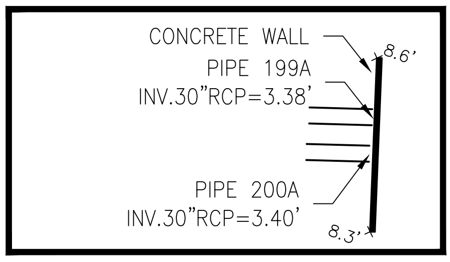
INLET 12 – PIPES 176, 176A, 177, 178, 179

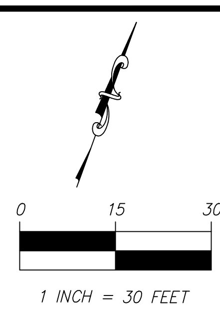


PIPES 174, 175



PIPES 199A, 200A





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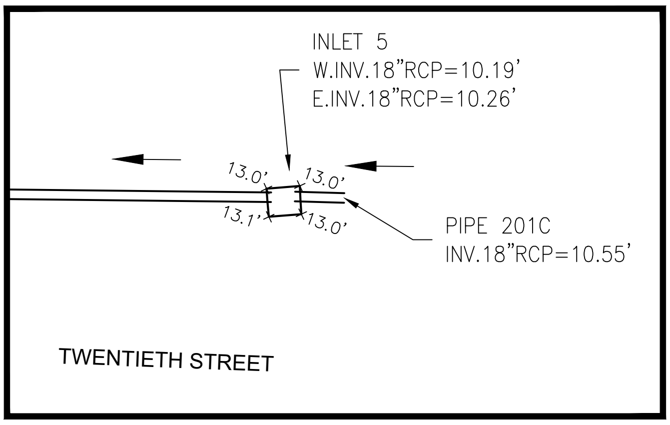
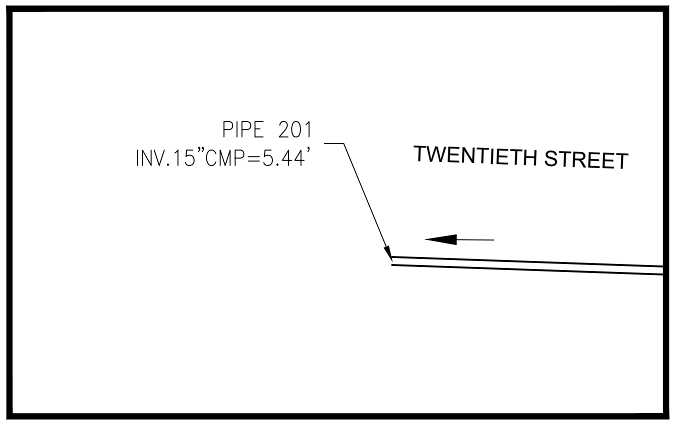
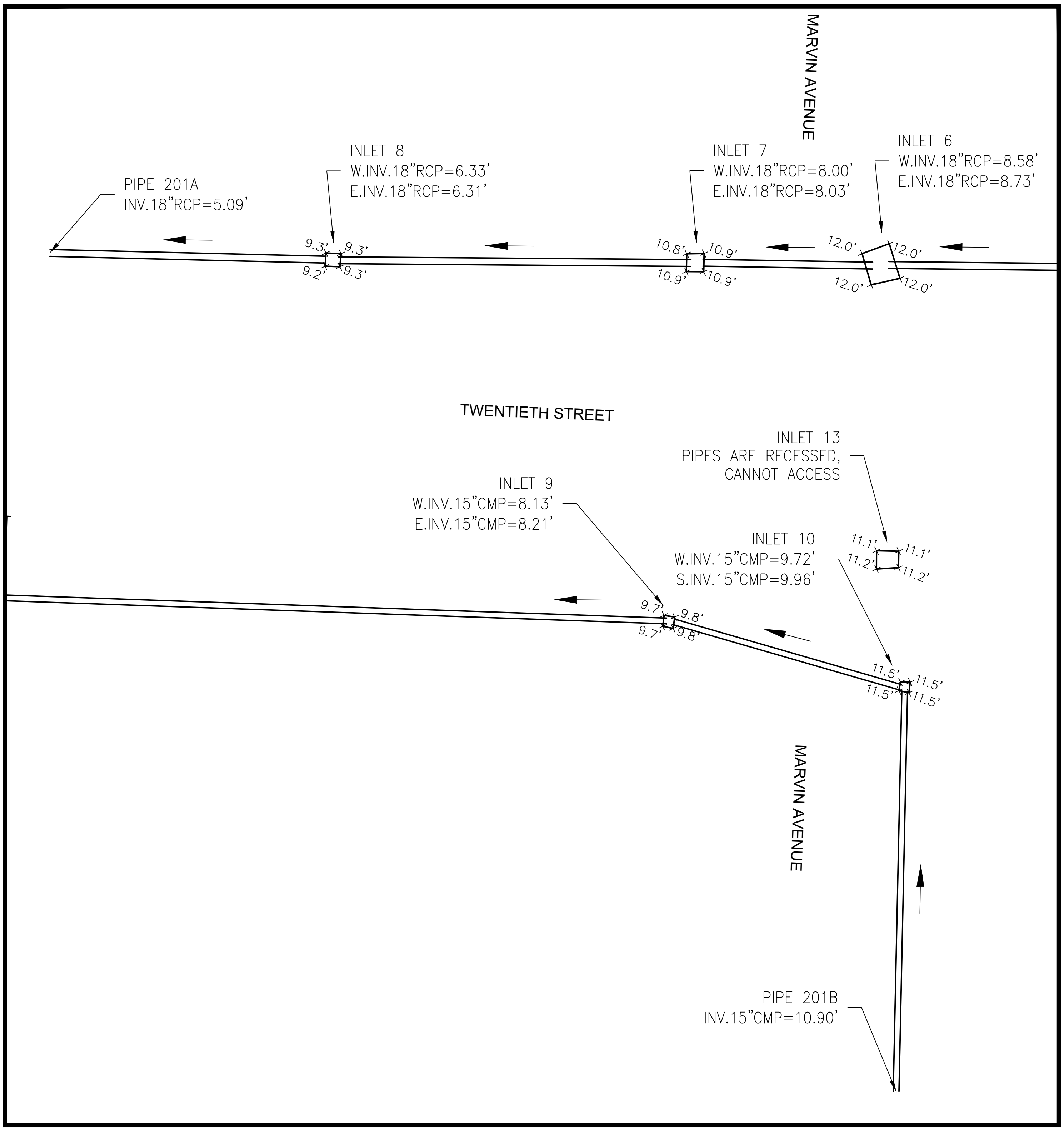
INLET 5 – PIPE 201C

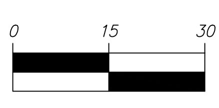


PIPE 201



INLETS 6, 7, 8, 9, 10, 13 – PIPES 201A, 201B





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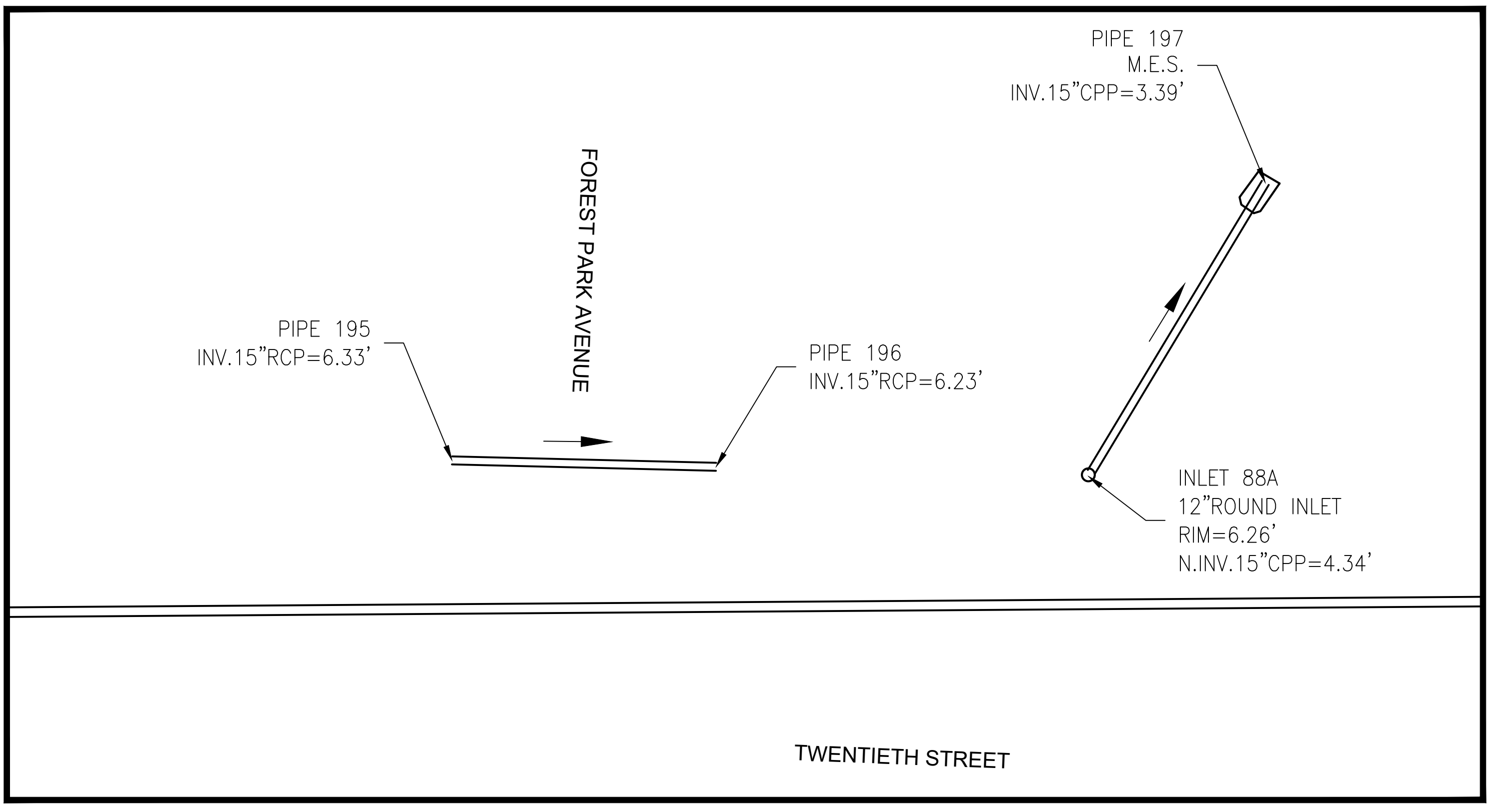
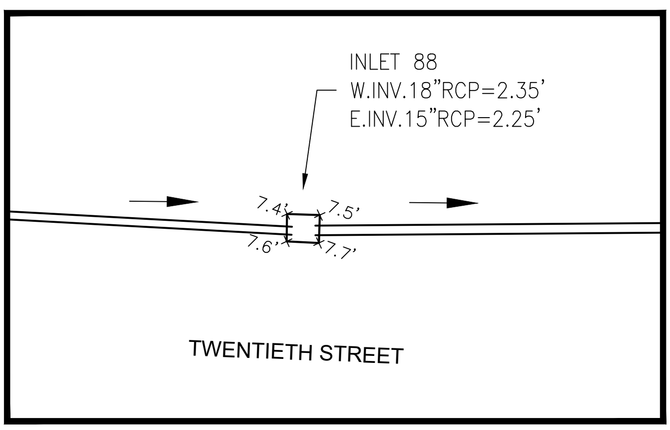
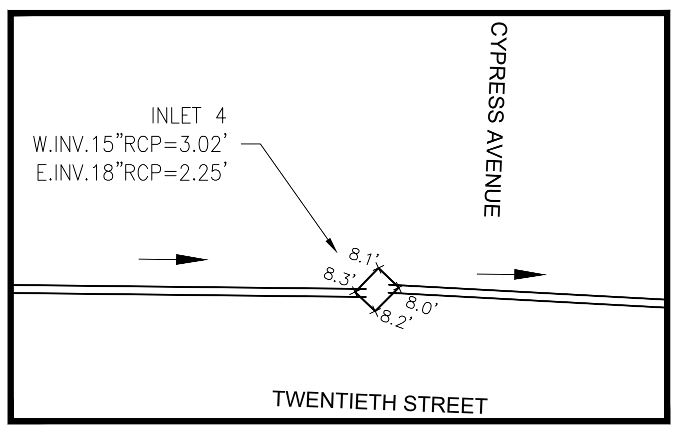
INLET 88A – PIPES 195, 196, 197



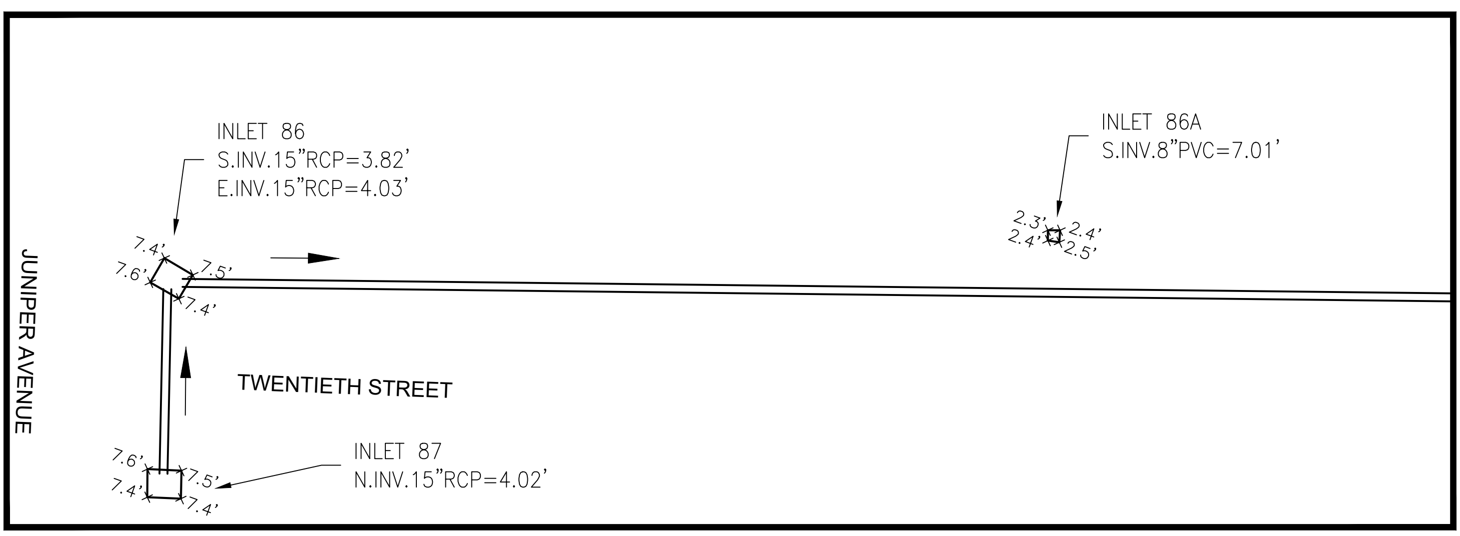
INLET 88

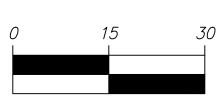


INLET 4



INLETS 86, 86A, 87





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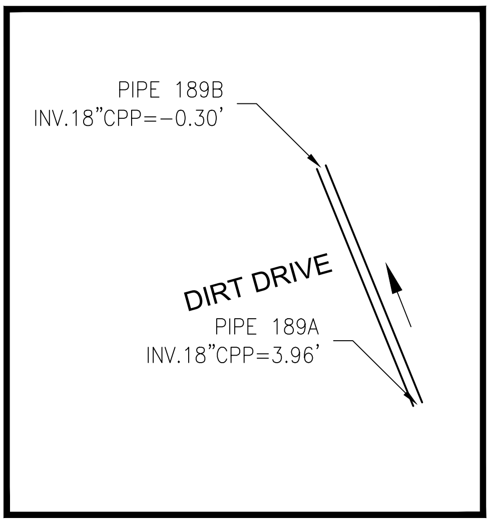
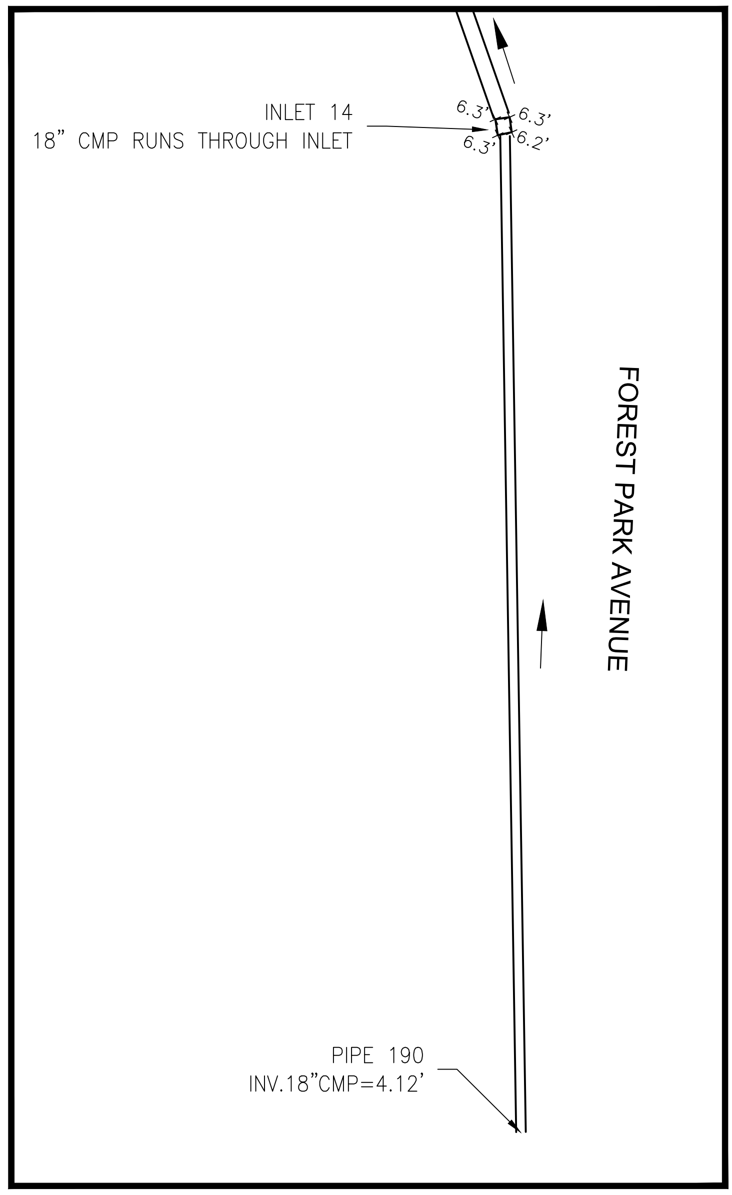
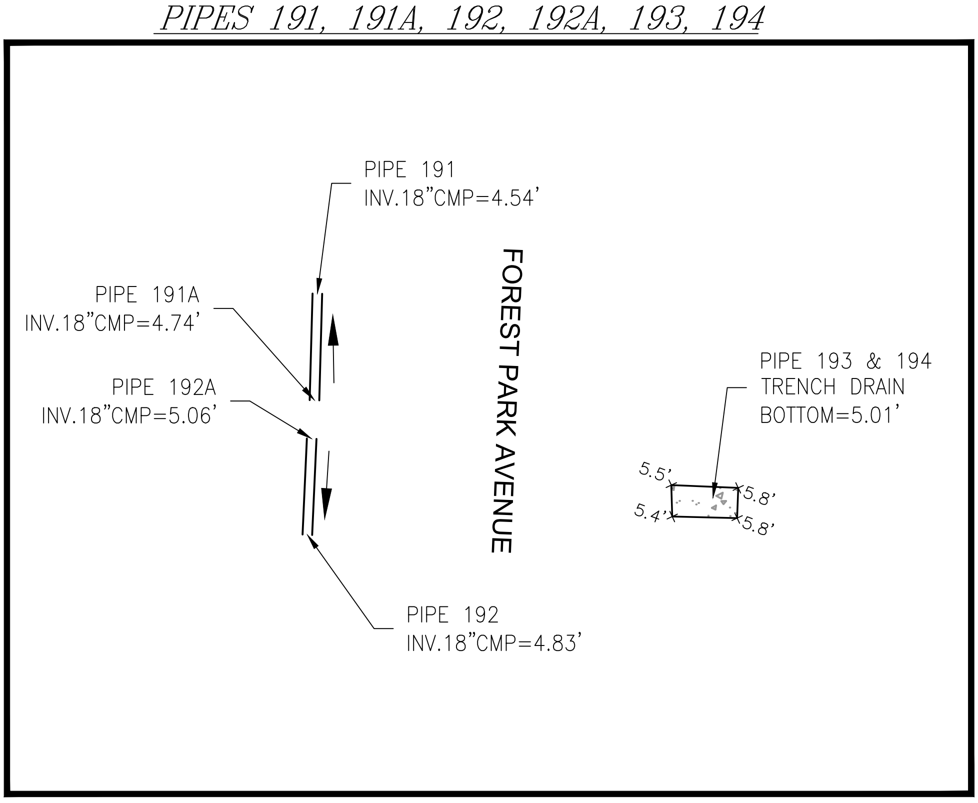
PIPES 189A, 189B

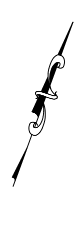


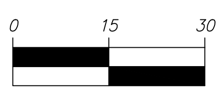
INLET 14 – PIPE 190



PIPES 191, 191A, 192, 192A, 193, 194







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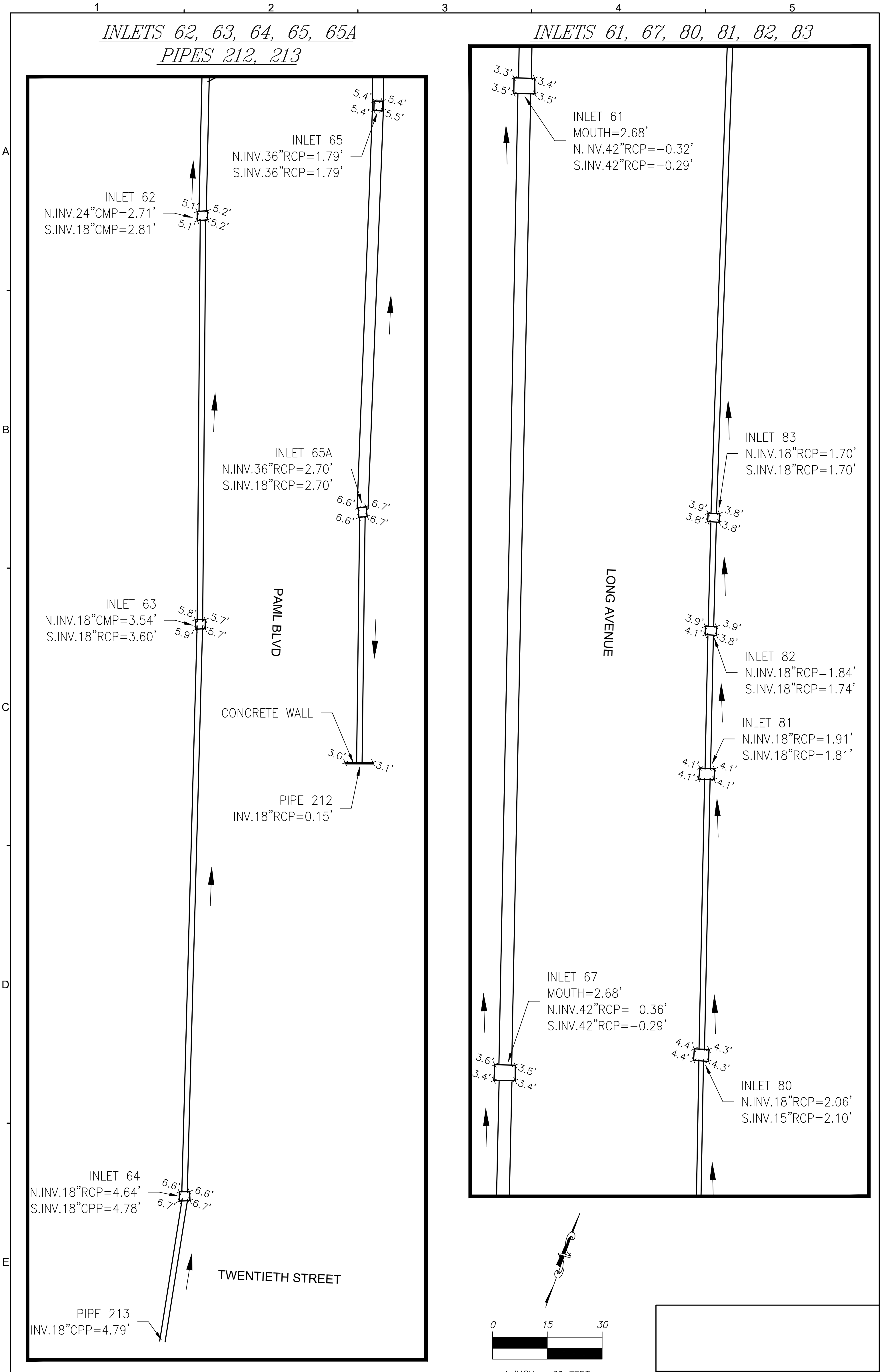

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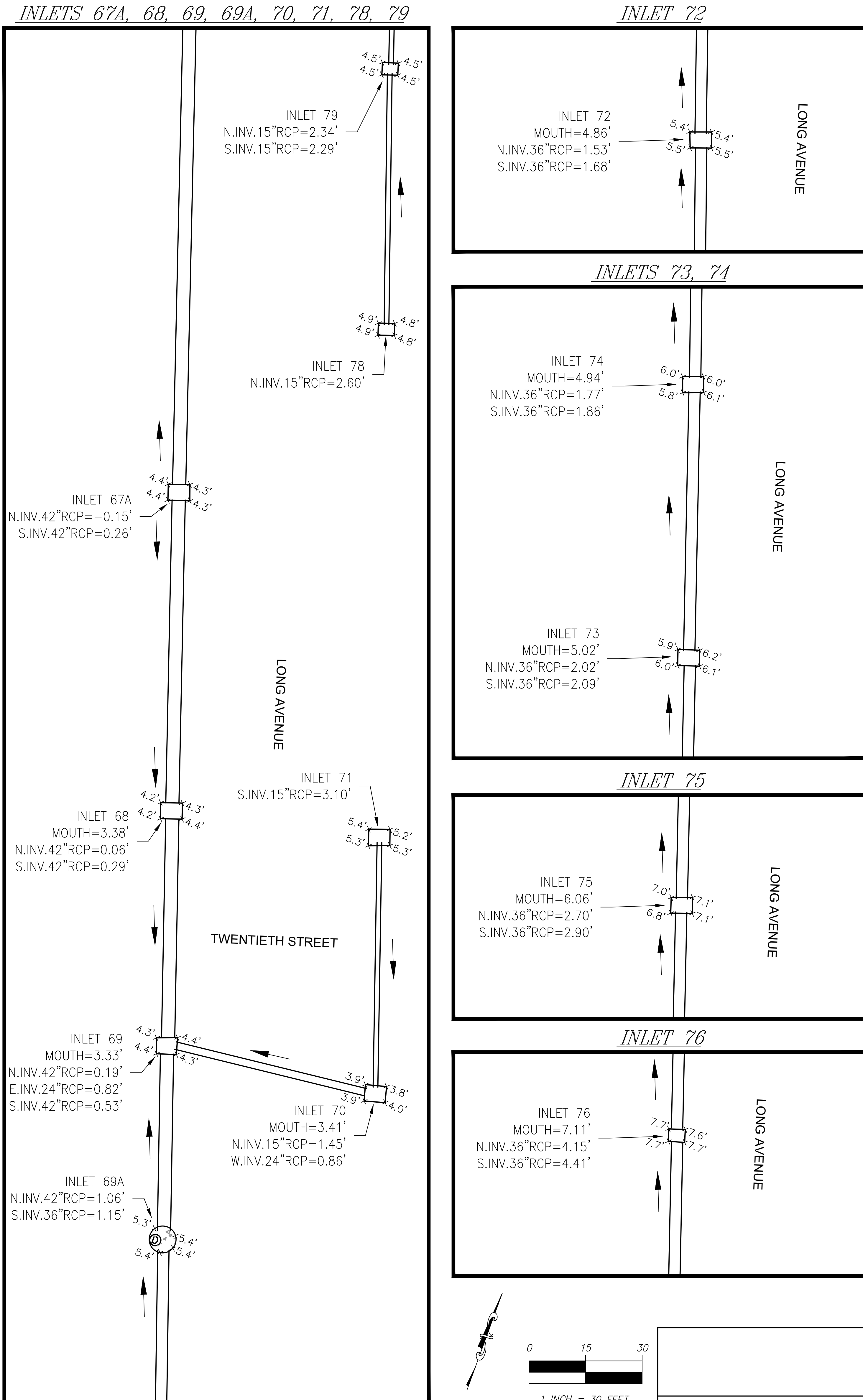

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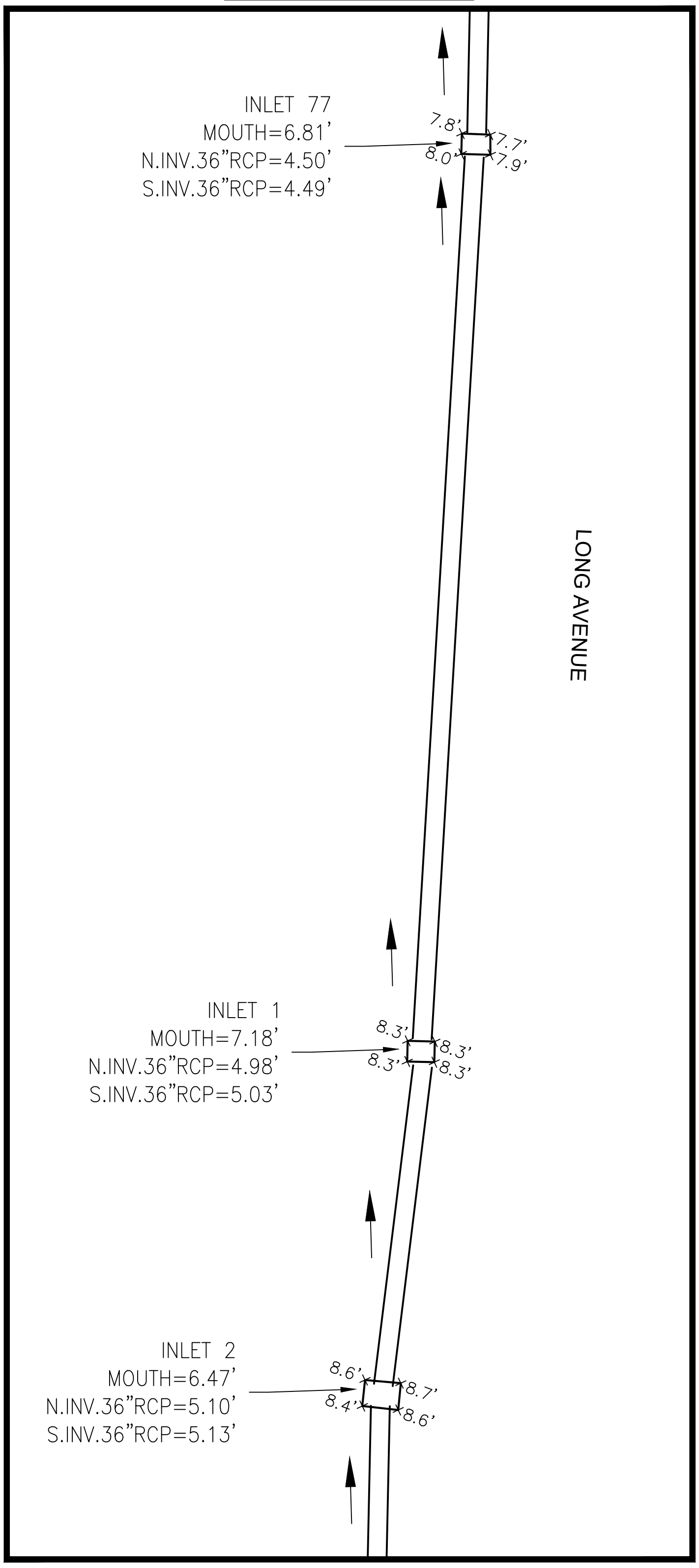
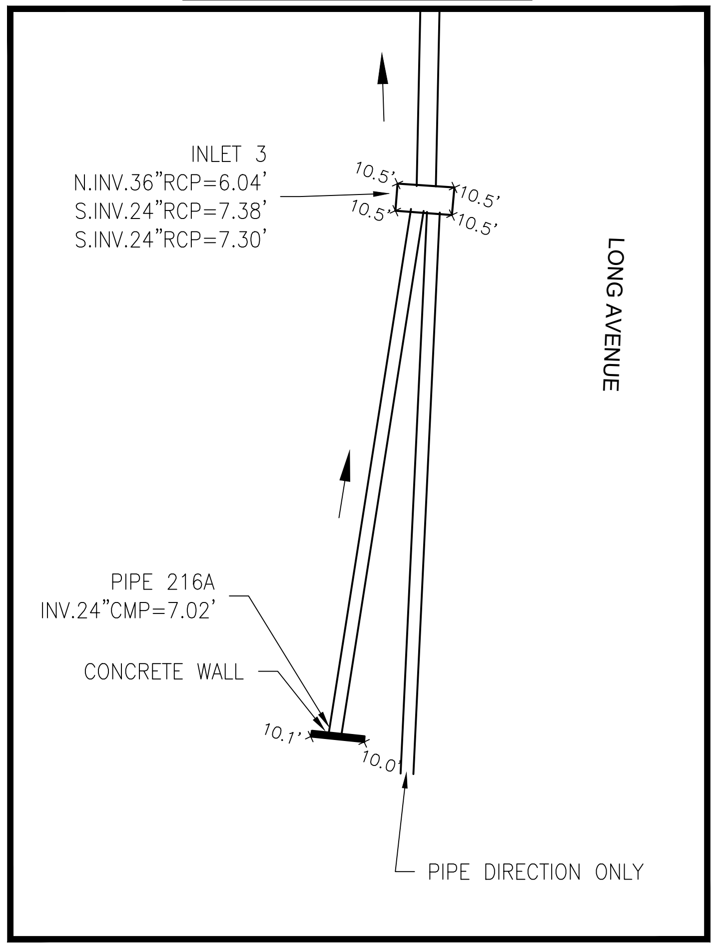
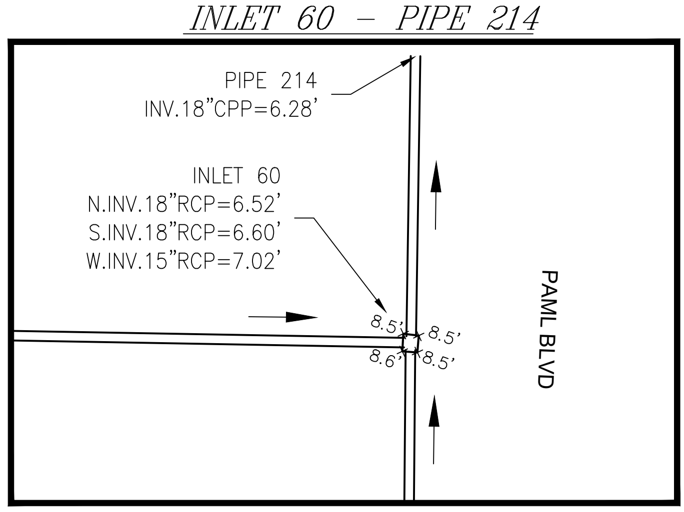
INLETS 1, 2, 77



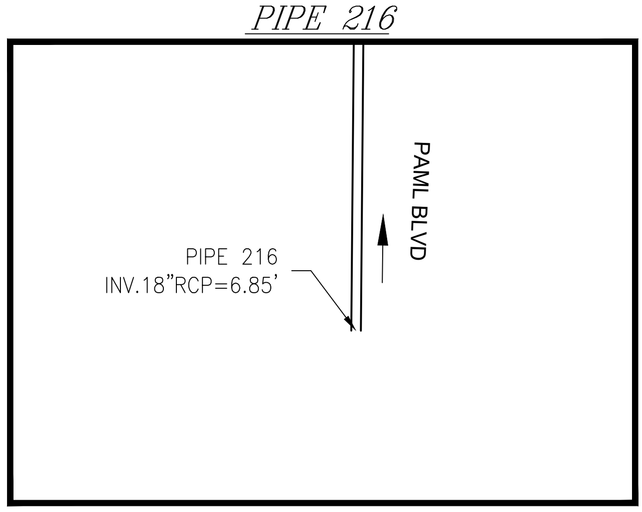
INLET 3 - PIPE 216A



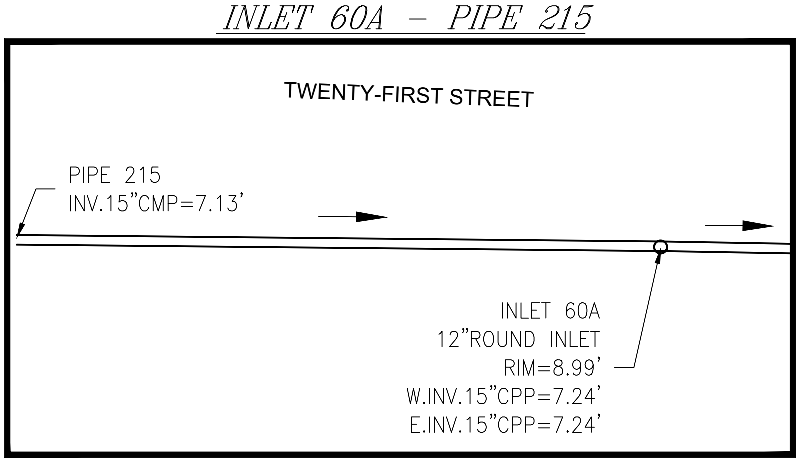
INLET 60 - PIPE 214



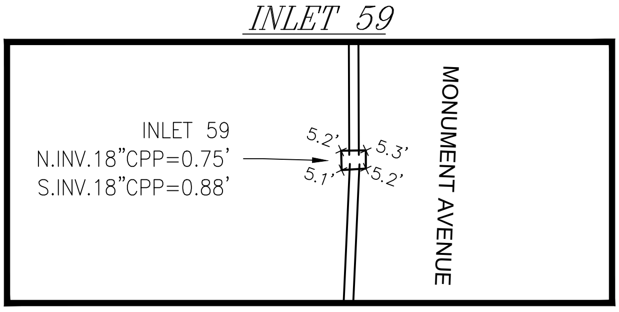
PIPE 216

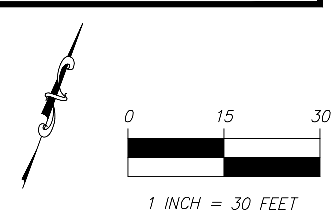


INLET 60A - PIPE 215



INLET 59





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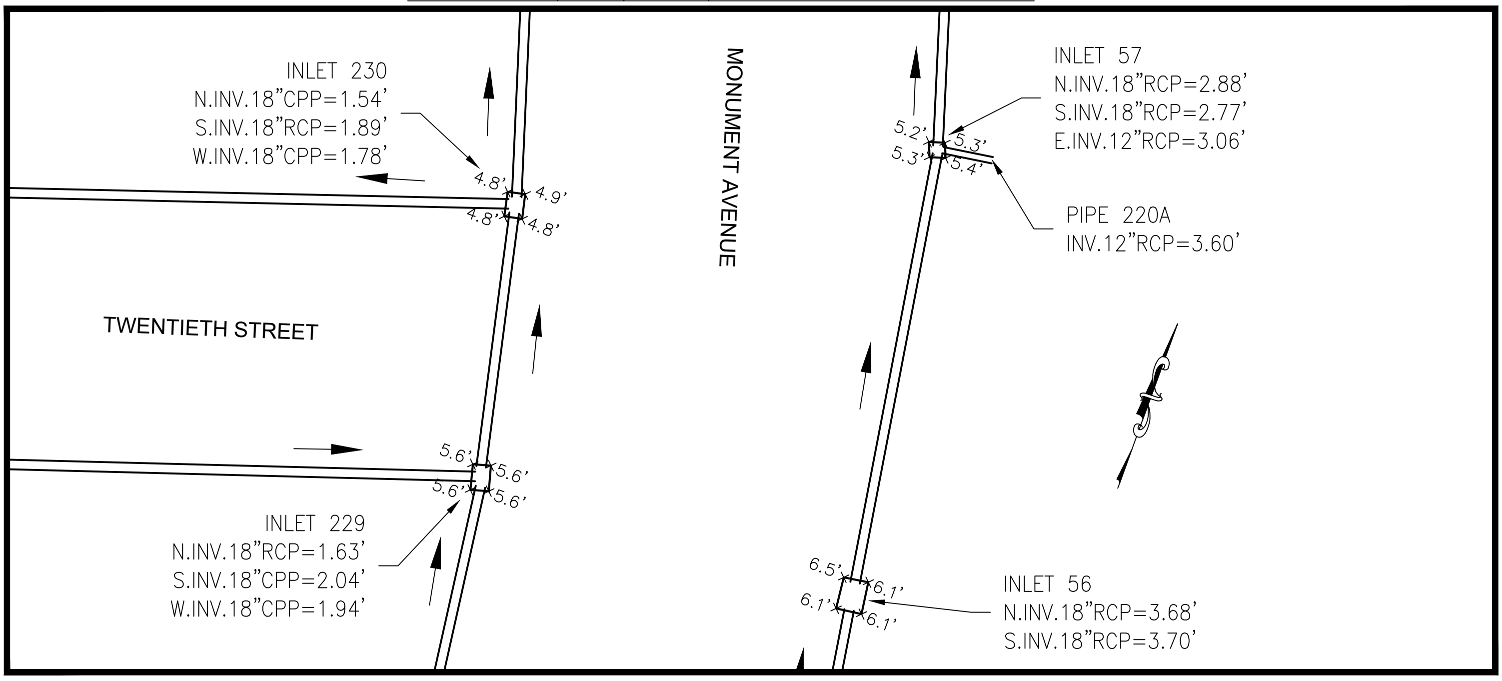
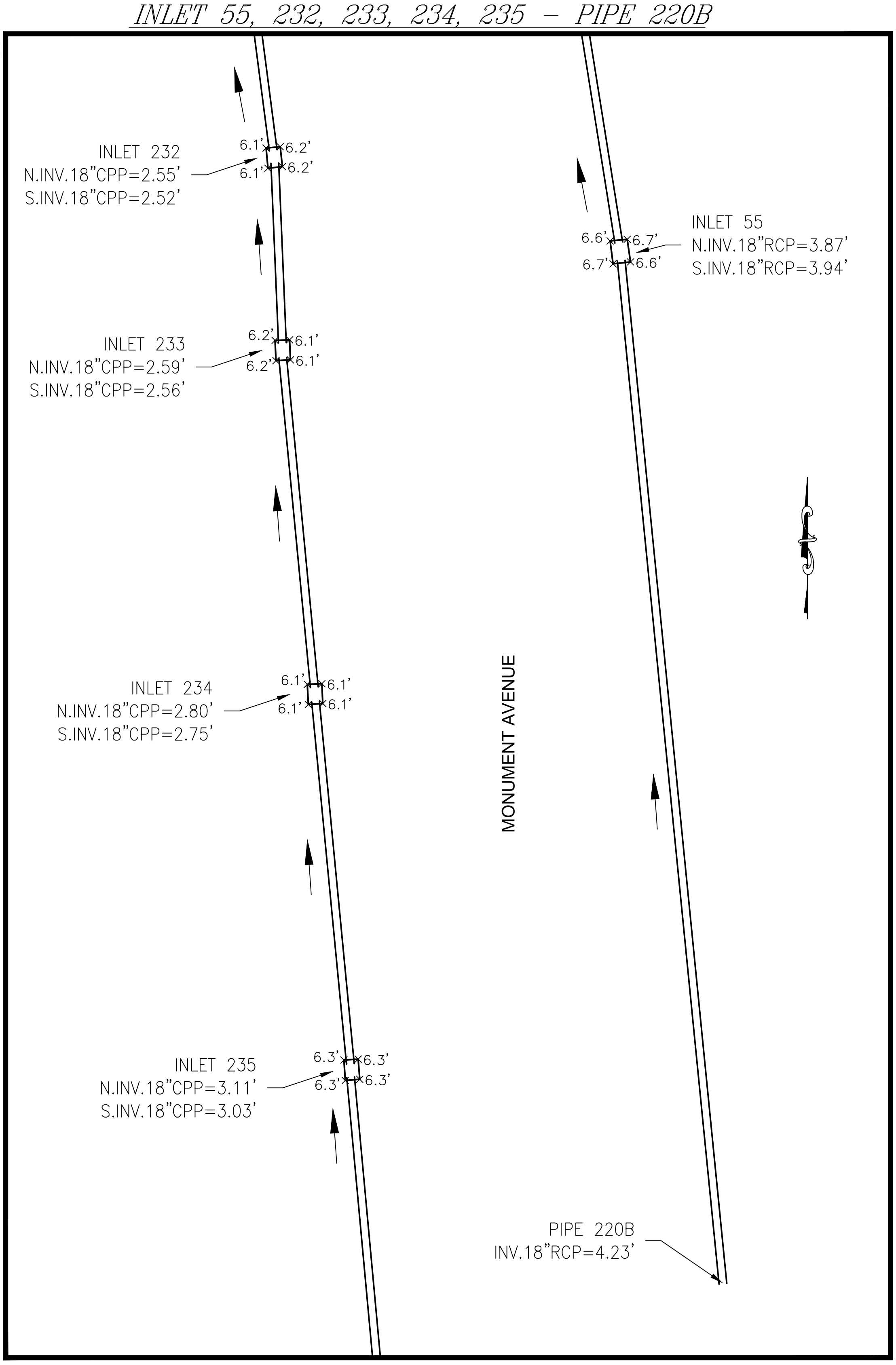
INLET 56, 57, 229, 230 – PIPE 220A



INLET 55, 232, 233, 234, 235 – PIPE 220B



0 15 30

1 INCH = 30 FEET

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WWW.DEWBERRY.COM
CERTIFICATE OF AUTHORIZATION NO. L.B. 8011

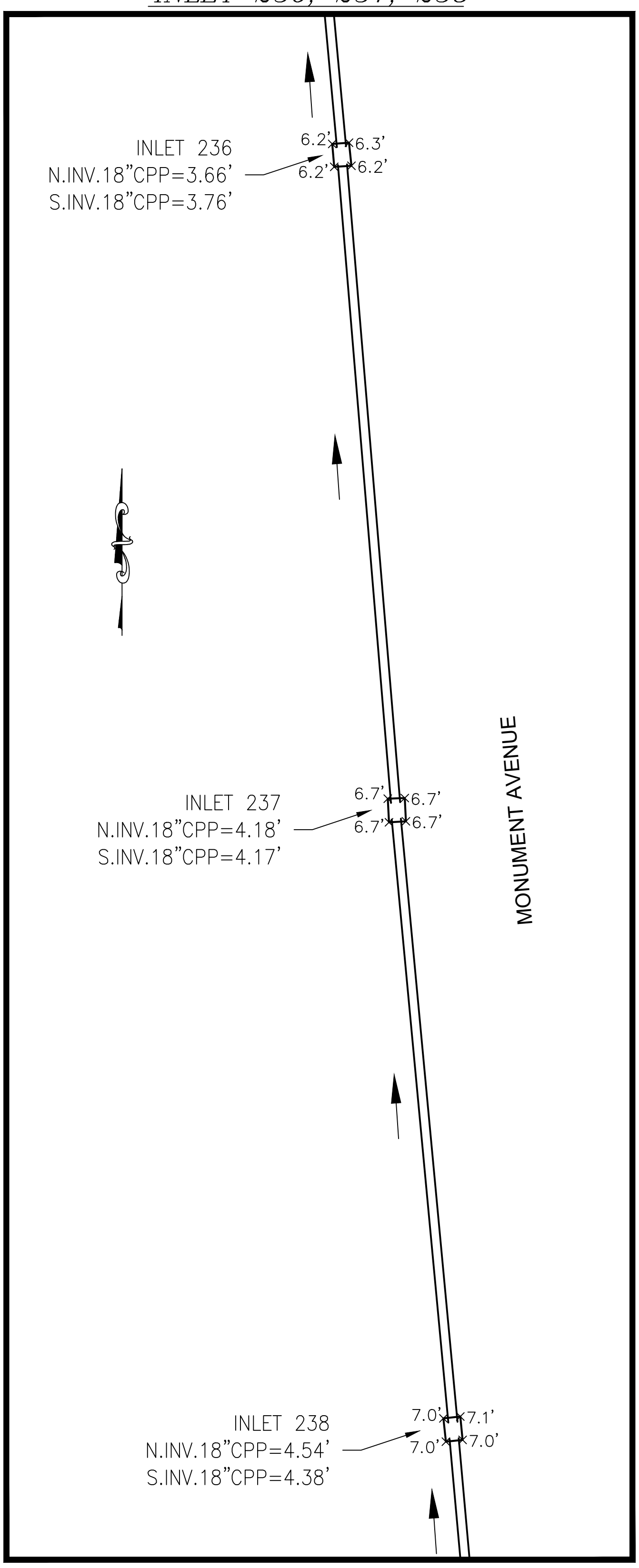
FB/PG:	344/15-44
FIELD DATE:	JAN 12 - MAY 2, 2024
DRAWN BY:	FCR
DWG DATE:	05/06/2024
SHEET SCALE:	1" = 30'
APPROVED BY:	JG

TOPOGRAPHIC SURVEY
2024 POST ST. JOE COASTAL STRUCTURES
CITY OF PORT ST. JOE
GULF COUNTY, FLORIDA.

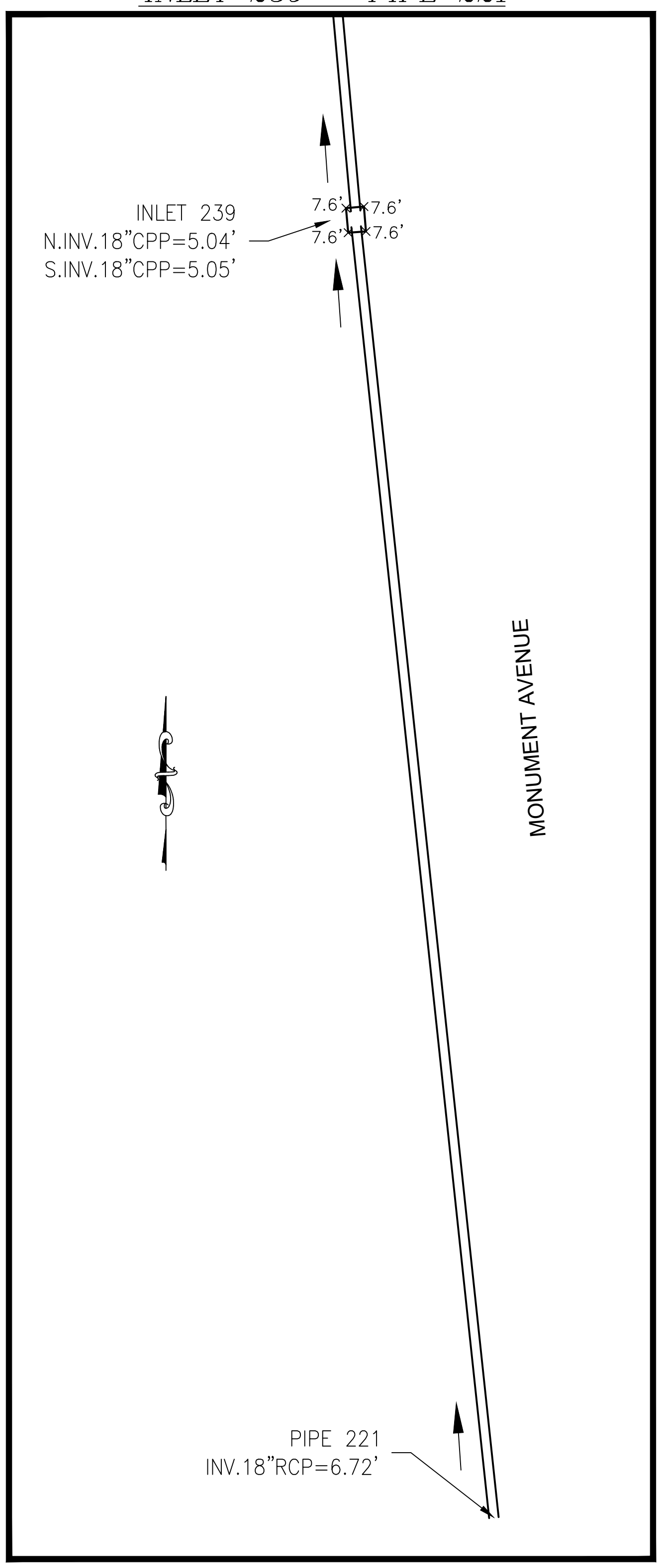
PROJECT NO. 50146276

SHEET NO.
49 OF 54

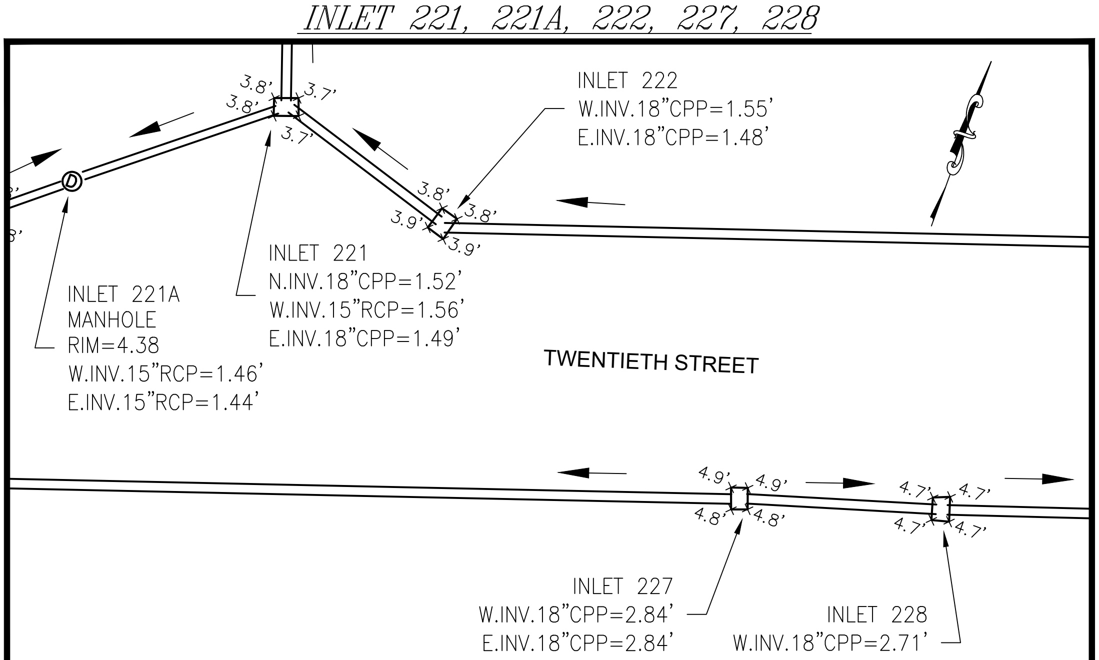
INLET 236, 237, 238



INLET 239 – PIPE 221



INLET 221, 221A, 222, 227, 228



0 15 30

1 INCH = 30 FEET

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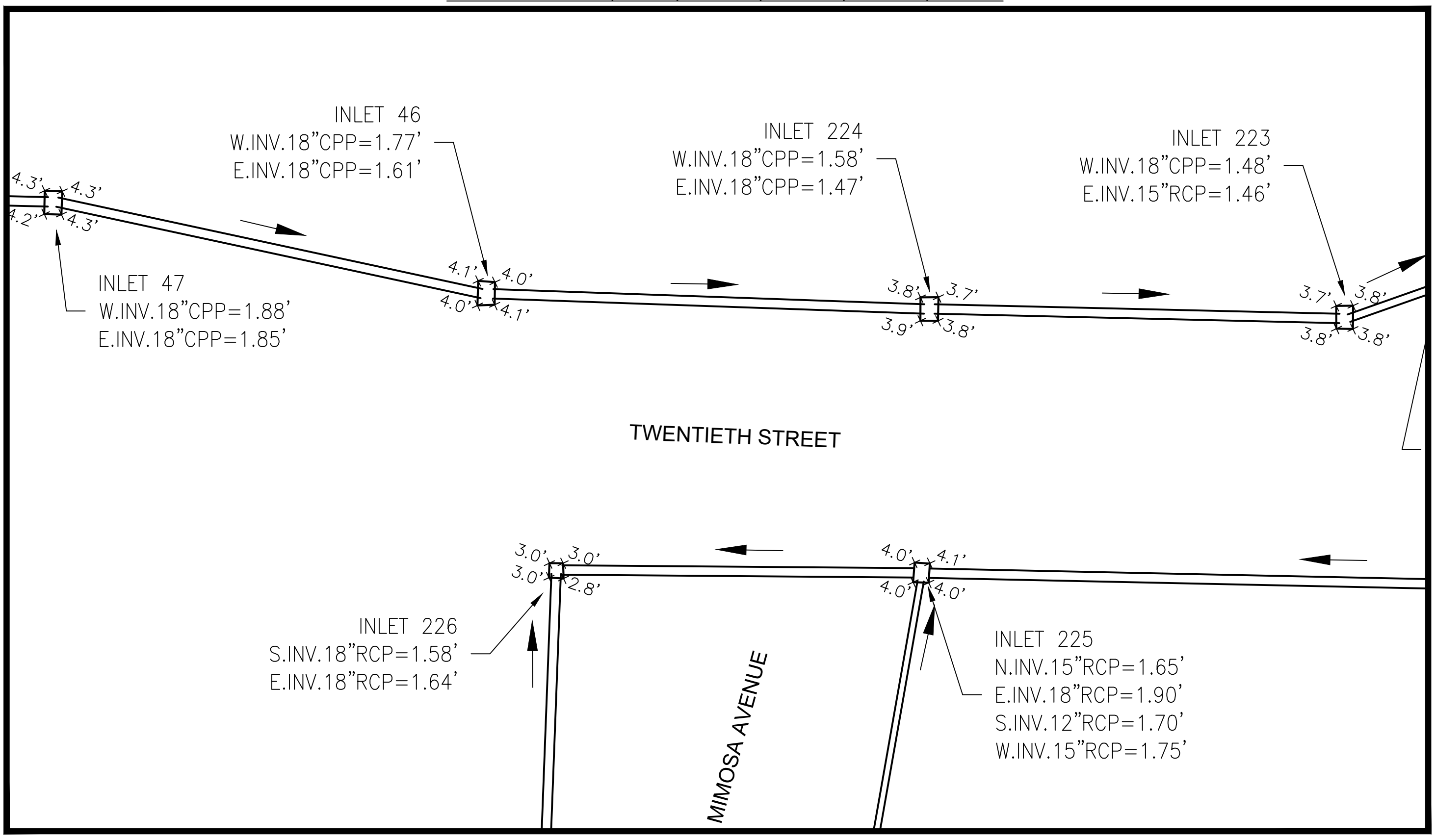
2024 POST ST. JOE COASTAL STRUCTURES
CITY OF PORT ST. JOE
GULF COUNTY, FLORIDA.

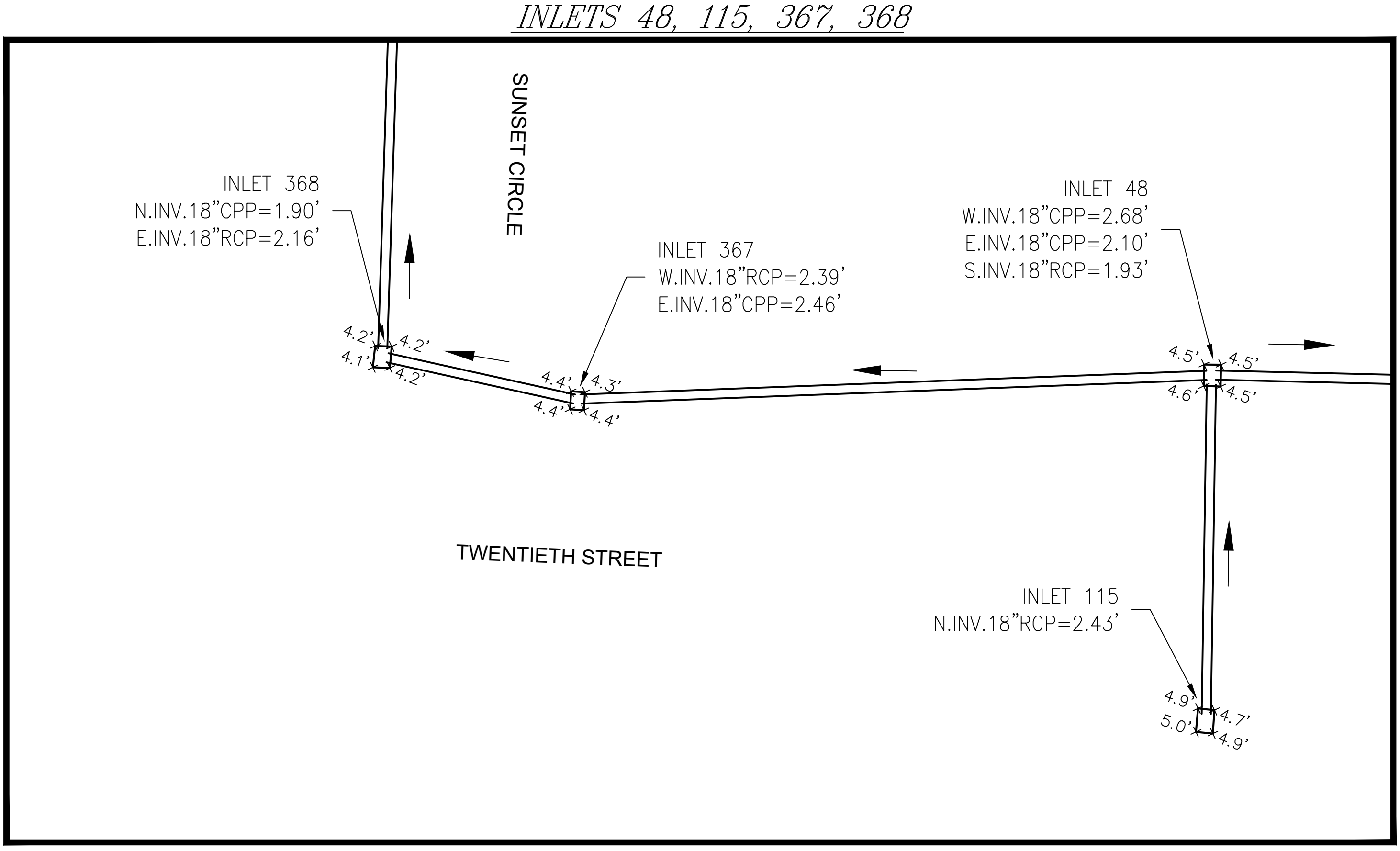
PROJECT NO. 50146276

SHEET NO.

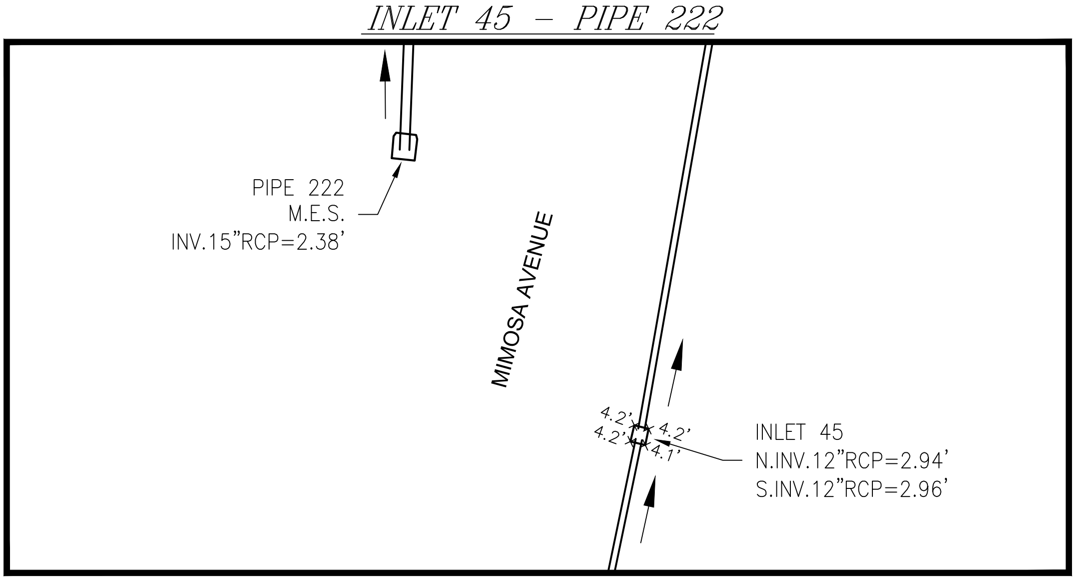
INLETS 46, 47, 223, 224, 225, 226

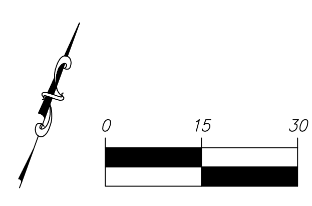


INLETS 48, 115, 367, 368



INLET 45 – PIPE 222





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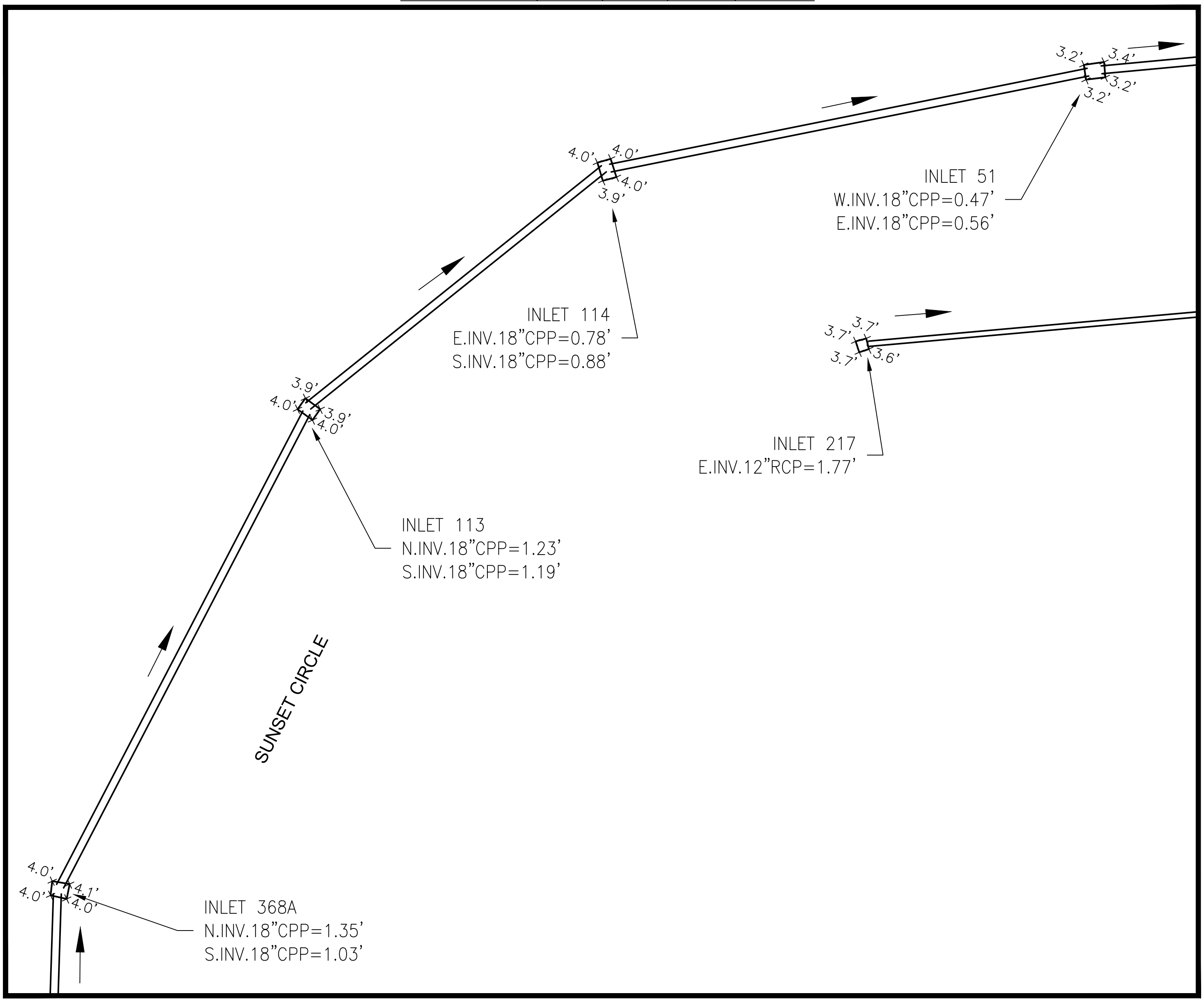
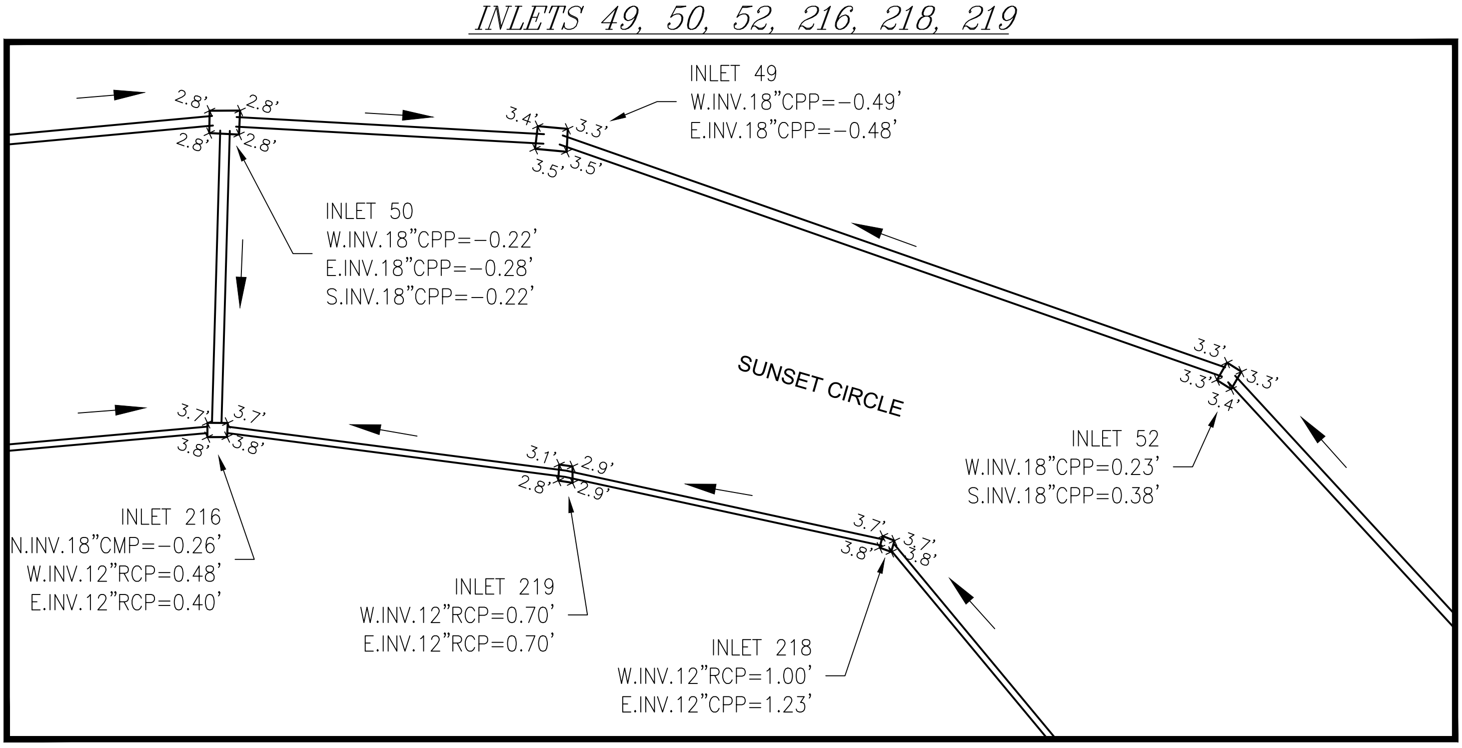
2024 POST ST. JOE COASTAL STRUCTURES
CITY OF PORT ST. JOE
GULF COUNTY, FLORIDA.

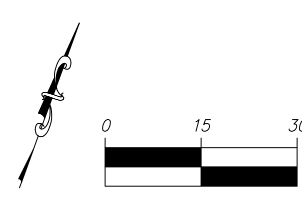
PROJECT NO. 50146276
SHEET NO.
51 OF 54

INLETS 51, 113, 114, 217, 368A



INLETS 49, 50, 52, 216, 218, 219





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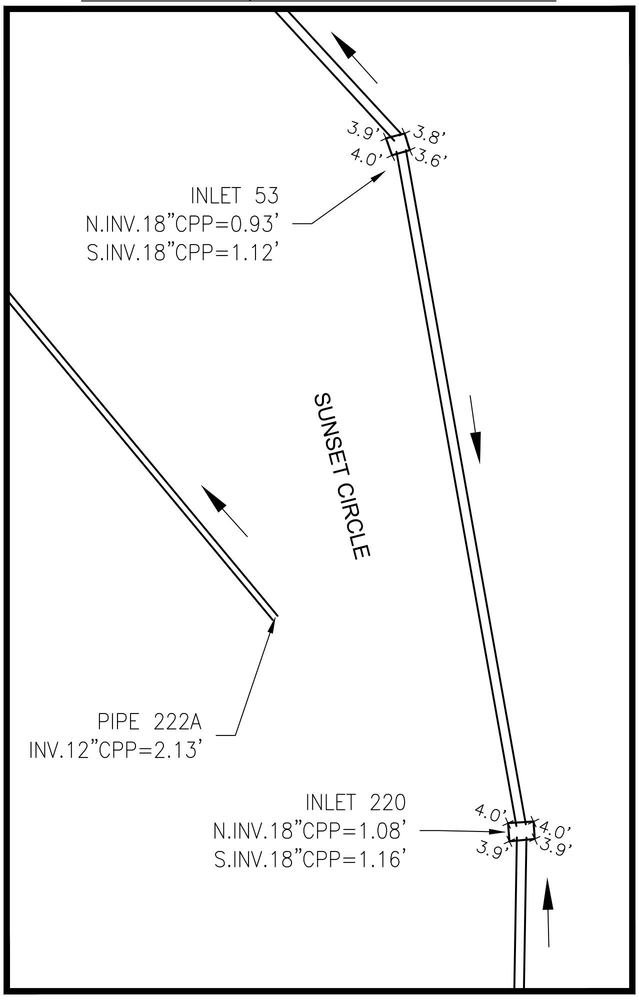
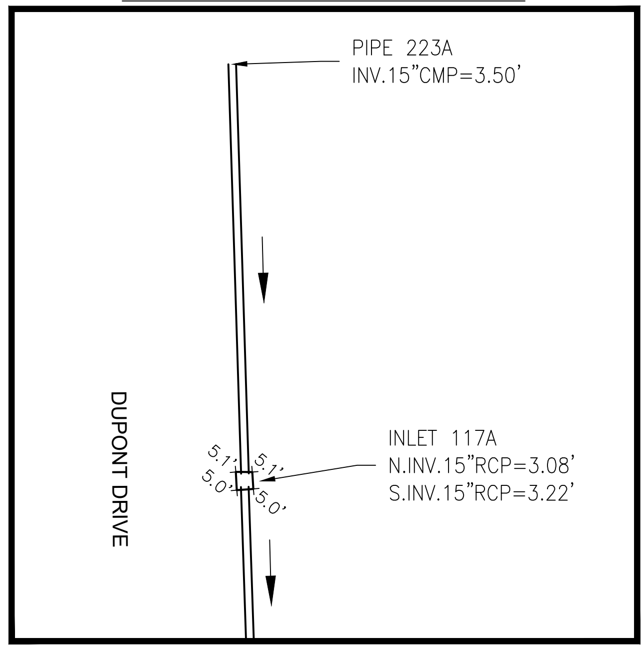
TOPOGRAPHIC SURVEY
2024 POST ST. JOE COASTAL STRUCTURES
CITY OF PORT ST. JOE
GULF COUNTY, FLORIDA.

PROJECT NO. 50146276
SHEET NO.
52 OF 54

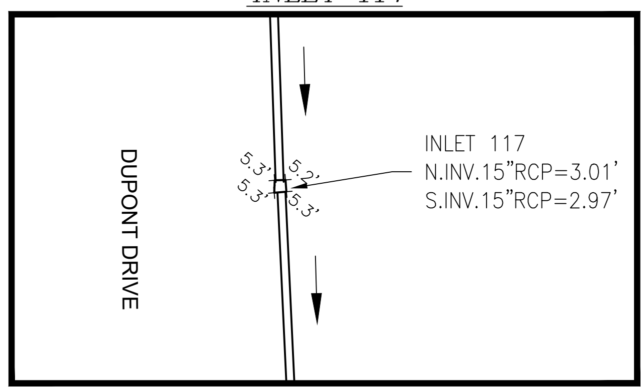
INLETS 53, 220 – PIPE 222A



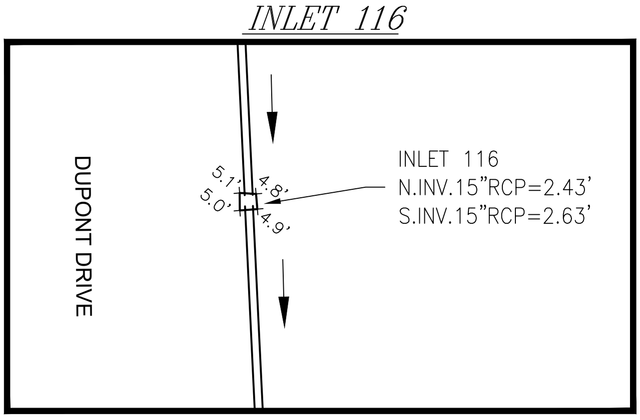
INLET 117A – PIPE 223A



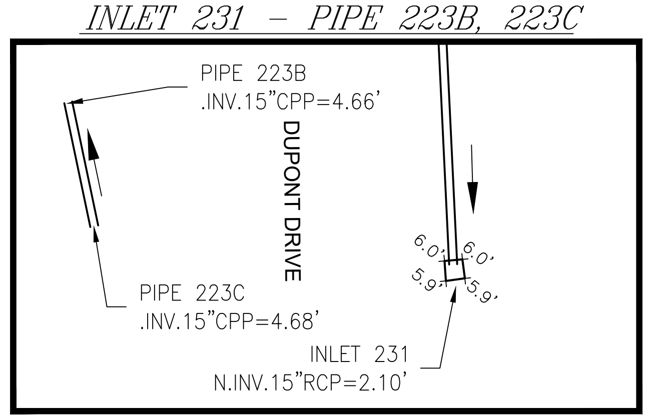
INLET 117



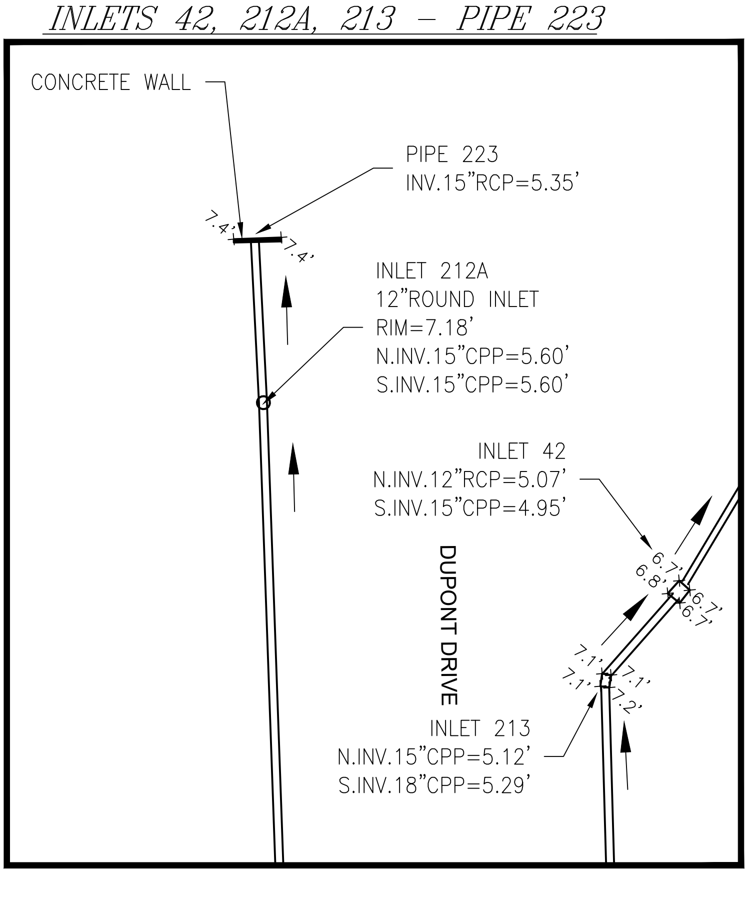
INLET 116



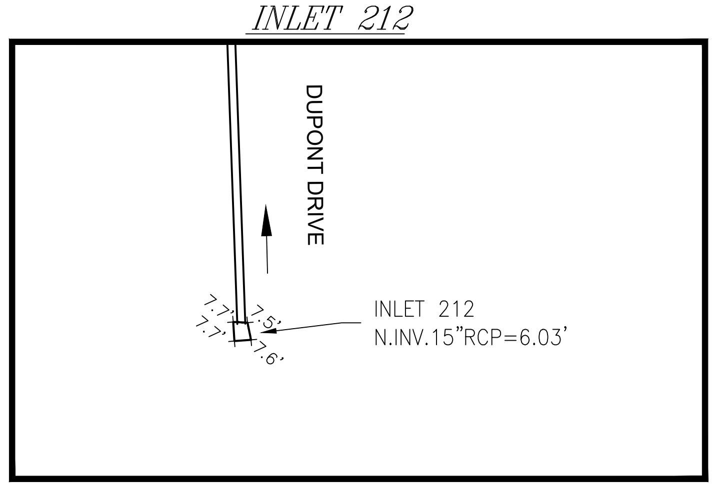
INLET 231 – PIPE 223B, 223C

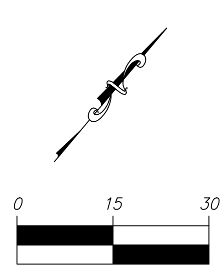


INLETS 42, 212A, 213 – PIPE 223



INLET 212





1 INCH = 30 FEET

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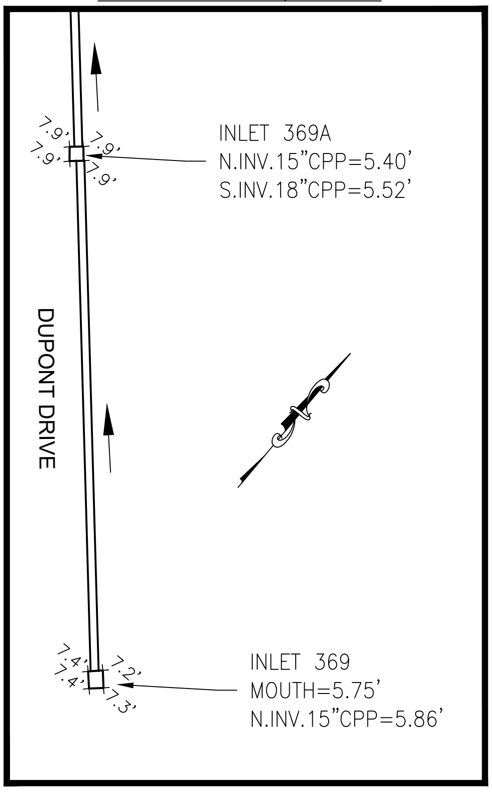
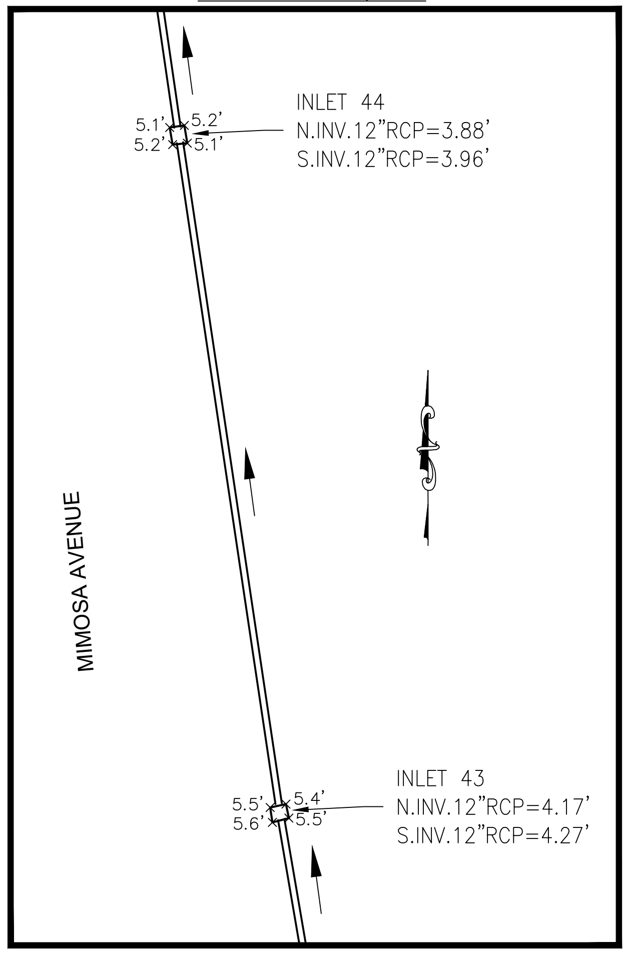
TOPOGRAPHIC SURVEY
2024 POST ST. JOE COASTAL STRUCTURES
CITY OF PORT ST. JOE
GULF COUNTY, FLORIDA.

PROJECT NO. 50146276
SHEET NO.

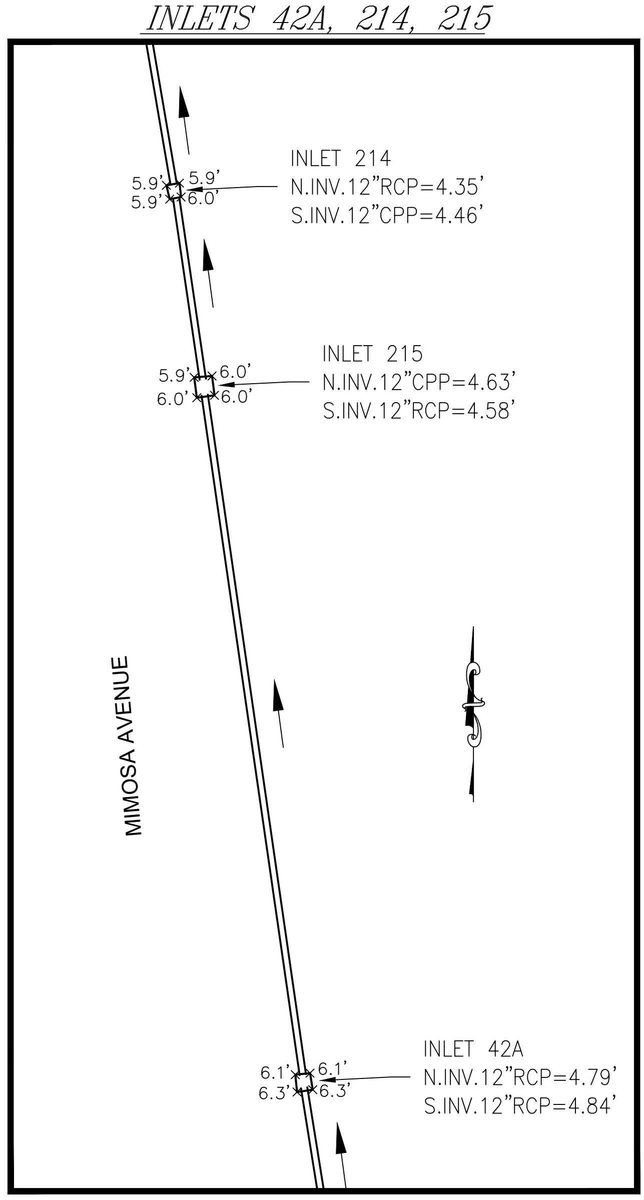
INLETS 369, 369A



INLETS 43, 44



INLETS 42A, 214, 215



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TOPOGRAPHIC SURVEY
2024 POST ST. JOE COASTAL STRUCTURES
CITY OF PORT ST. JOE
GULF COUNTY, FLORIDA.

PROJECT NO. 50146276

SHEET NO.

6.2 Digital Photos - Structures

2024 PORT ST. JOE CENTRAL CHANNEL SURVEYS
STRUCTURE 1

Downstream Channel

Overtopping

Upstream Channel

Downstream Face of Structure

Upstream Face of Structure

Dewberry

STRUCTURE 2

Downstream Channel

Overtopping

Upstream Channel

Downstream Face of Structure

Upstream Face of Structure

Downstream Channel

Overtopping

Upstream Channel

Downstream Face of Structure

Upstream Face of Structure

2024 PORT ST. JOE CENTRAL CHANNEL SURVEYS

STRUCTURE 5

Downstream Channel

Overtopping

Upstream Channel

Downstream Face of Structure

Upstream Face of Structure

Dewberry

STRUCTURE 6

Downstream Channel

Overtopping

Upstream Channel

Downstream Face of Structure

Upstream Face of Structure

Dewberry

Downstream Channel

Overtopping

Upstream Channel

Downstream Face of Structure

Upstream Face of Structure

STRUCTURE 8

Downstream Channel **Overtopping** **Upstream Channel**

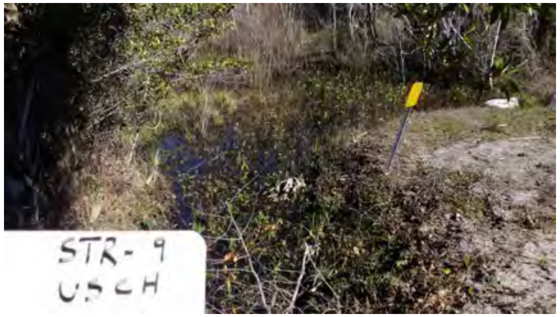
Downstream Face of Structure

Upstream Face of Structure

STRUCTURE 9

Downstream Channel

Overtopping



Upstream Channel

Downstream Face of Structure

Upstream Face of Structure

STRUCTURE 10

Downstream Channel

Overtopping

Upstream Channel

Downstream Face of Structure

Upstream Face of Structure

Dewberry

Downstream Channel

Overtopping

Upstream Channel

Downstream Face of Structure

Upstream Face of Structure

Downstream Channel

Overtopping

Upstream Channel

Downstream Face of Structure

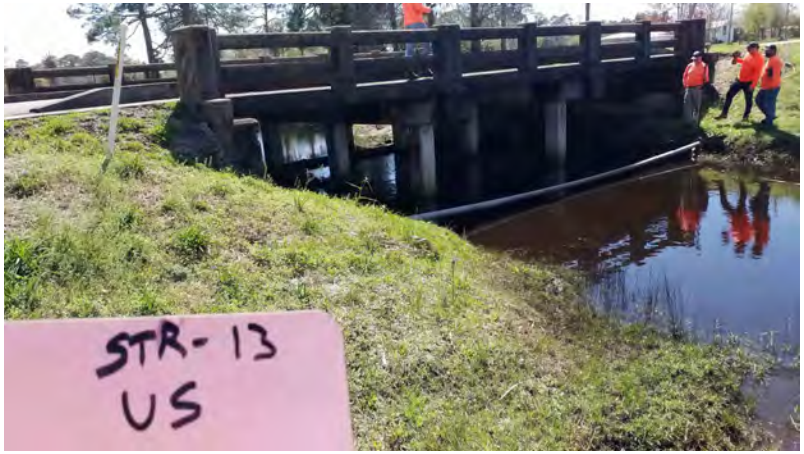
Upstream Face of Structure

Dewberry

Downstream Channel

Overtopping

Upstream Channel



Downstream Face of Structure

Upstream Face of Structure

Dewberry

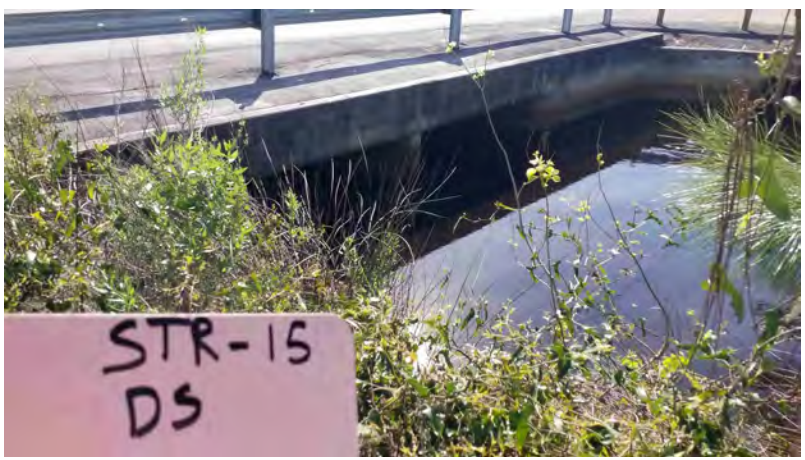
2024 PORT ST. JOE CENTRAL CHANNEL SURVEYS

STRUCTURE 15

Downstream Channel

Overtopping

Upstream Channel



Downstream Face of Structure

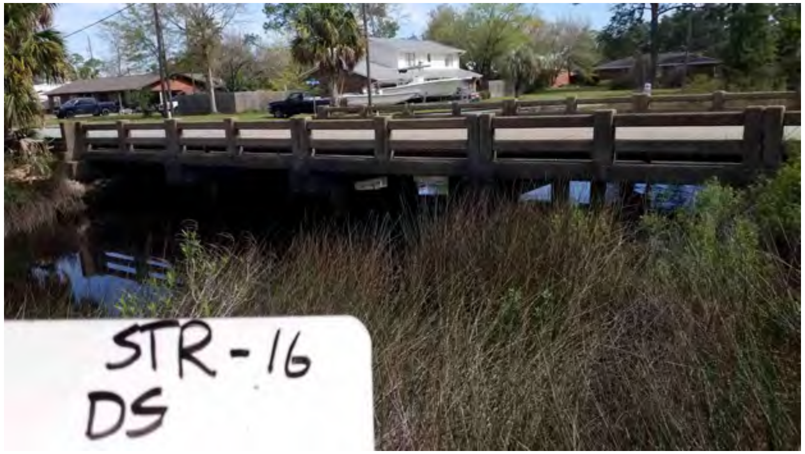
Upstream Face of Structure

2024 PORT ST. JOE CENTRAL CHANNEL SURVEYS
STRUCTURE 16

Downstream Channel

Overtopping

Upstream Channel



Downstream Face of Structure

Upstream Face of Structure

Downstream Channel

Overtopping

Upstream Channel

Downstream Face of Structure

Upstream Face of Structure

STRUCTURE 19

Overtopping

Downstream Channel

Upstream Channel

Downstream Channel

Overtopping

Upstream Channel

Downstream Face of Structure

Upstream Face of Structure

Dewberry

Downstream Channel

Overtopping

Upstream Channel

Downstream Face of Structure

Upstream Face of Structure

Downstream Channel

Overtopping

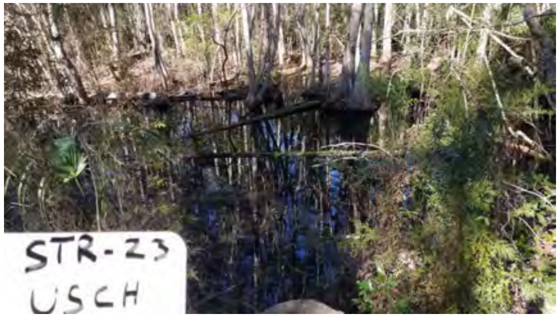
Upstream Channel

Downstream Face of Structure

Upstream Face of Structure

Downstream Channel

Overtopping



Upstream Channel

Downstream Face of Structure

Upstream Face of Structure

Downstream Channel

Overtopping

Upstream Channel

Downstream Face of Structure

Upstream Face of Structure

Downstream Channel

Overtopping

Upstream Channel

Downstream Face of Structure

Upstream Face of Structure

Downstream Channel

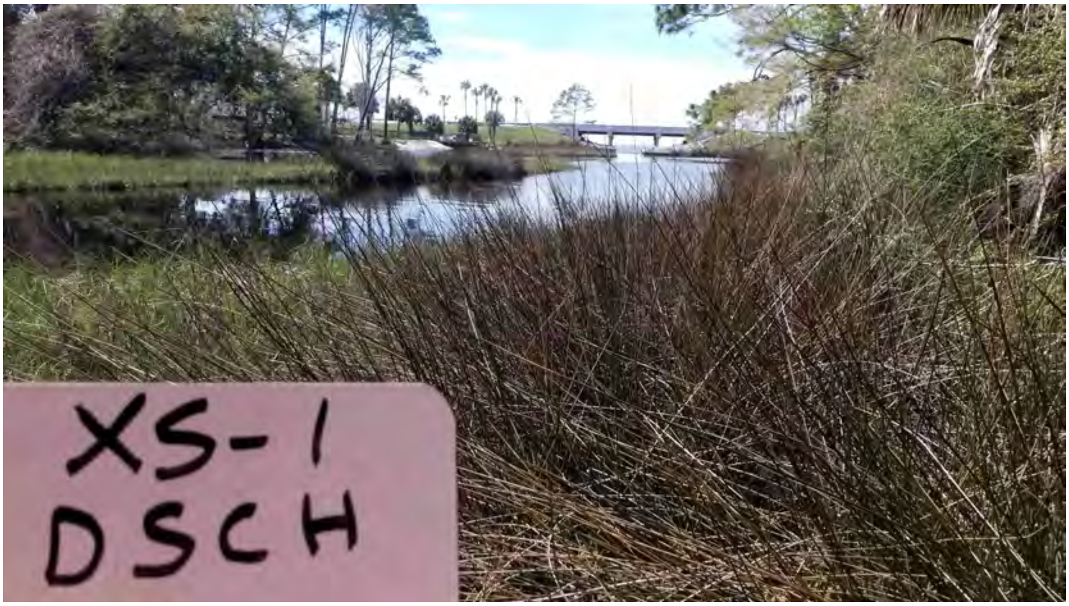
Overtopping

Upstream Channel

Downstream Face of Structure

Upstream Face of Structure

6.3 Digital Photos – Cross Sections



Downstream Channel

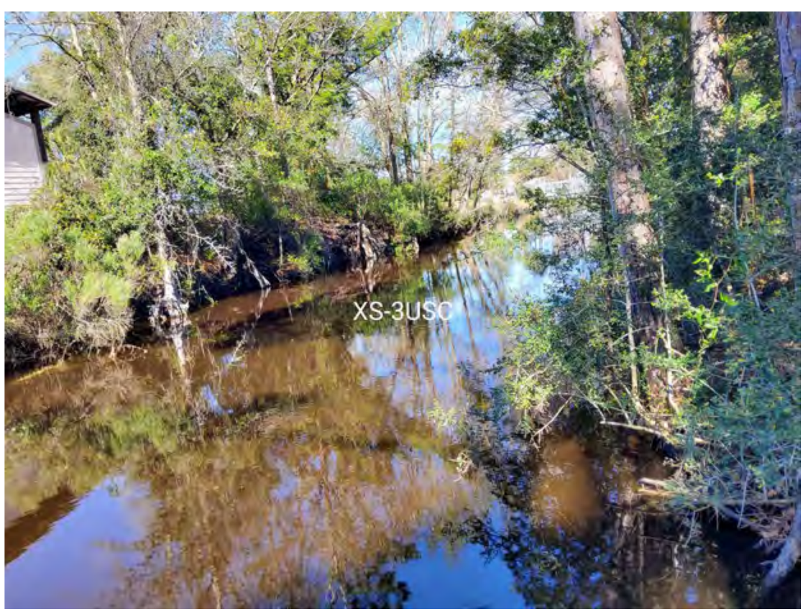
Upstream Channel

Downstream Channel

Upstream Channel

Dewberry

Downstream Channel



Upstream Channel

Downstream Channel

Upstream Channel

Downstream Channel

Upstream Channel

Downstream Channel

Upstream Channel

Dewberry

Downstream Channel

Upstream Channel

Downstream Channel

Upstream Channel

Downstream Channel

Upstream Channel

Downstream Channel

Upstream Channel

Downstream Channel

Upstream Channel

Downstream Channel

Upstream Channel

Downstream Channel

Upstream Channel

Downstream Channel

Upstream Channel

Dewberry

Downstream Channel

Upstream Channel

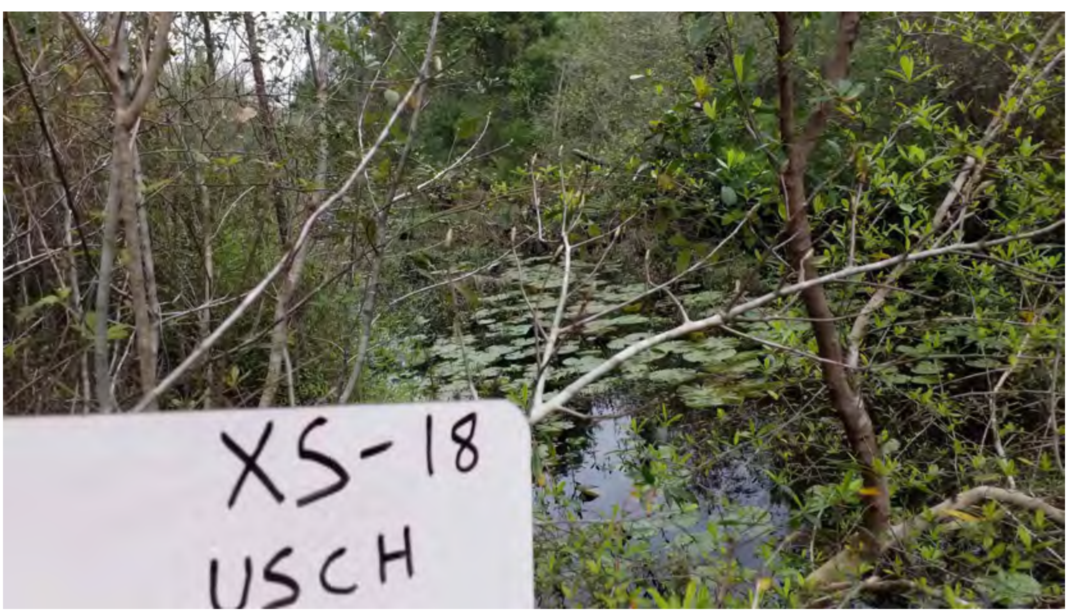
Downstream Channel

Upstream Channel

Downstream Channel

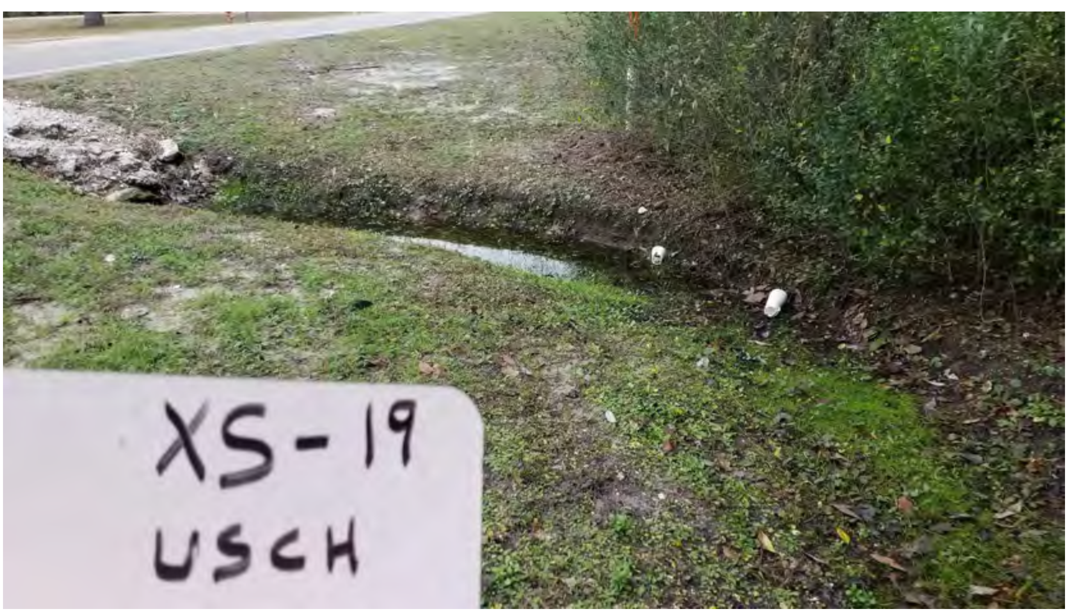
Upstream Channel

Downstream Channel



Upstream Channel

Downstream Channel



Upstream Channel

Downstream Channel

Upstream Channel

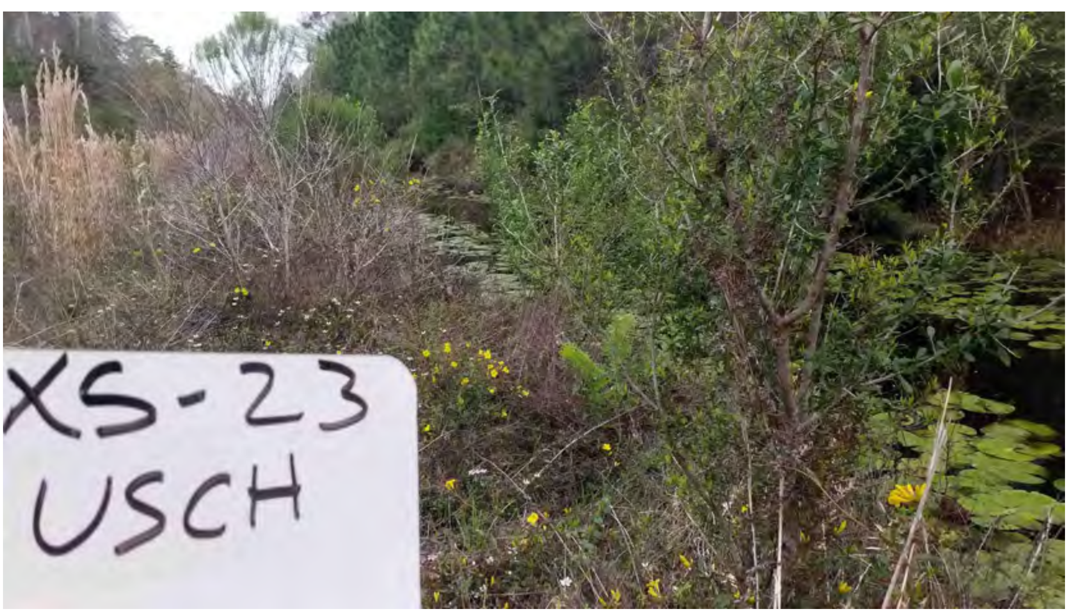
Downstream Channel

Upstream Channel

Downstream Channel

Upstream Channel

Downstream Channel



Upstream Channel

6.4 Digital Photos – Inlets

Inlet 1

Inlet 1

Inlet 2

Inlet 2

Dewberry

Inlet 3

Inlet 3

Inlet 4

Inlet 5

Dewberry

Inlet 6

Inlet 7

Inlet 8

Inlet 9

Inlet 10

Inlet 11

Inlet 12

Inlet 12A

Dewberry

Inlet 12B

Inlet 12C

Inlet 13

Inlet 14

Dewberry

Inlet 15

Inlet 16

Inlet 17

Inlet 18

2024 PORT ST. JOE CENTRAL CHANNEL SURVEYS
INLETS 19, 20, 21, 22

Inlet 19

Inlet 20

Inlet 21

Inlet 22

Dewberry

Inlet 23

Inlet 24

Inlet 25

Inlet 26

Inlet 26A

Inlet 26A

Inlet 27

Inlet 28

Inlet 29

Inlet 30

Inlet 30

Inlet 31

2024 PORT ST. JOE CENTRAL CHANNEL SURVEYS
INLETS 32, 34, 35, 36

Inlet 32

Inlet 34

Inlet 35

Inlet 36

INLETS 37, 38, 39, 40

Inlet 37

Inlet 38

Inlet 39

Inlet 40

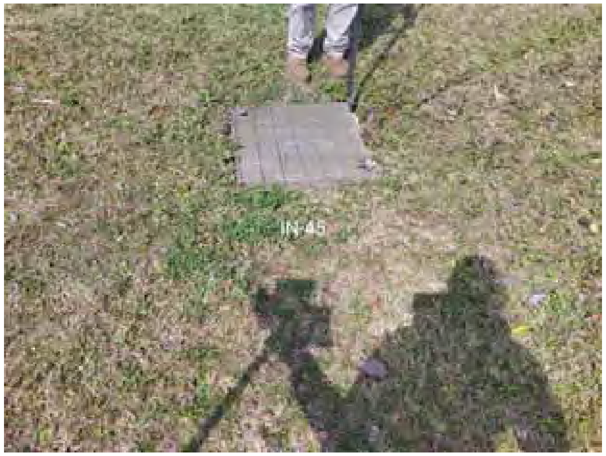
Inlet 42

Inlet 42A

Inlet 43

Inlet 44

Inlet 45



Inlet 46

Inlet 47

Inlet 48

Inlet 49

Inlet 50

Inlet 51

Inlet 52

Inlet 53

Inlet 55

Inlet 56

Inlet 57

Inlet 58

Inlet 59

Inlet 60

Inlet 60A

Inlet 61

Inlet 62

Inlet 63

Inlet 64

Inlet 65

Inlet 65A

Inlet 67

Inlet 67A

Dewberry

Inlet 68

Inlet 69

Inlet 69A

Inlet 70

Inlet 71

Inlet 72

Inlet 73

Inlet 74

Inlet 75

Inlet 76

Inlet 77

Inlet 78

INLETS 79, 80, 81, 82

Inlet 79

Inlet 80

Inlet 81

Inlet 82

Inlet 83

Inlet 84

Inlet 84A

Inlet 86

Inlet 86A

Inlet 87

Inlet 88

Inlet 88A

Inlet 89

Inlet 89A

Inlet 91

Inlet 91B

Inlet 92

Inlet 93

Inlet 94

Inlet 95

Inlet 96

Inlet 97

Inlet 98

Inlet 99

Inlet 100

Inlet 101

Inlet 102

Inlet 103

Dewberry

Inlet 104

Inlet 105

Inlet 106

Inlet 107

Inlet 108

Inlet 109

Inlet 110

Inlet 111

Inlet 112

Inlet 113

Inlet 114

Inlet 115

2024 PORT ST. JOE CENTRAL CHANNEL SURVEYS
INLETS 116, 117, 117A, 118

Inlet 116

Inlet 117

Inlet 117A

Inlet 118

Inlet 119

Inlet 120

Inlet 121

Inlet 122

Inlet 123

Inlet 124

Inlet 125

Inlet 126

Inlet 127

Inlet 128

Inlet 129

Inlet 130

Inlet 131

Inlet 132

Inlet 133

Inlet 133

Inlet 133A

Inlet 134

Inlet 135

INLETS 136, 136A

Inlet 136

Inlet 136

Inlet 136A

Inlet 136A

2024 PORT ST. JOE CENTRAL CHANNEL SURVEYS

INLETS 137, 137A

Inlet 137

Inlet 137

Inlet 137A

Inlet 138

Inlet 138

Inlet 139

Inlet 139

Inlet 140

Inlet 140

Inlet 141

Inlet 141

Inlet 142

Inlet 142

Inlet 143

Inlet 143

Inlet 144

Inlet 144

Inlet 144A

Inlet 145

Inlet 145

Inlet 146

Inlet 146

Inlet 146A

Inlet 146A

Inlet 146B

Inlet 146B

Inlet 146C

Inlet 146C

Inlet 147

Inlet 147

Inlet 147A

Inlet 147A

Inlet 147B

INLETS 147C, 147D

Inlet 147C

Inlet 147C

Inlet 147D

Inlet 147D

Inlet 147E

Inlet 148

Inlet 148

Inlet 149

Inlet 149

Inlet 150

Inlet 150

Dewberry

Inlet 151

Inlet 152

Inlet 152

Inlet 153

Inlet 154

Inlet 154

Inlet 155

Inlet 155

Inlet 156

Inlet 157

Inlet 158

Inlet 158

Inlet 159

Inlet 159

Inlet 160

Inlet 160

INLETS 161, 162

Inlet 161

Inlet 161

Inlet 162

Inlet 162

Inlet 163

Inlet 163

Inlet 164

Inlet 164

Inlet 165

Inlet 165

Inlet 166

Inlet 166

Inlet 167

Inlet 167

Inlet 168

Inlet 168

Inlet 169

Inlet 169

Inlet 169A

Inlet 169A

Dewberry

Inlet 170

Inlet 171

Inlet 171

Inlet 172

Inlet 172

Inlet 172A

Inlet 172A

Inlet 173

Inlet 173

Inlet 174

Inlet 174

Inlet 175

Inlet 175

Inlet 176

Inlet 177

Inlet 178

Inlet 179

Inlet 180

Inlet 181

INLETS 182, 183, 184, 185

Inlet 182

Inlet 183

Inlet 184

Inlet 185

Inlet 186

Inlet 187

Inlet 188

Inlet 189

Inlet 190

Inlet 191

Inlet 192

Inlet 193

Inlet 194

Inlet 195

Inlet 196

Inlet 196A

Inlet 197

Inlet 197A

Inlet 198

Inlet 199

Dewberry

Inlet 200

Inlet 200

Inlet 201

Inlet 201

Inlet 202

Inlet 203

Inlet 204

Inlet 205

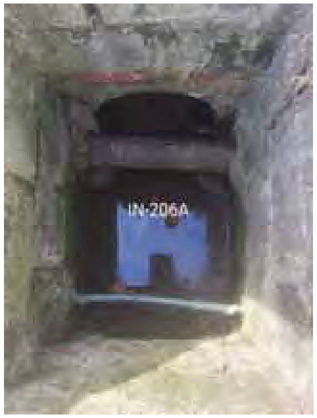
Inlet 205

Inlet 206

Inlet 206

Inlet 206A

Inlet 206A



Inlet 207

Inlet 207

Dewberry

Inlet 208

Inlet 208

Inlet 209

Inlet 209

Inlet 210

Inlet 211

Inlet 211

Inlet 212

Inlet 212A

Inlet 213

Inlet 214

Inlet 215

Inlet 216

Inlet 217

Inlet 218

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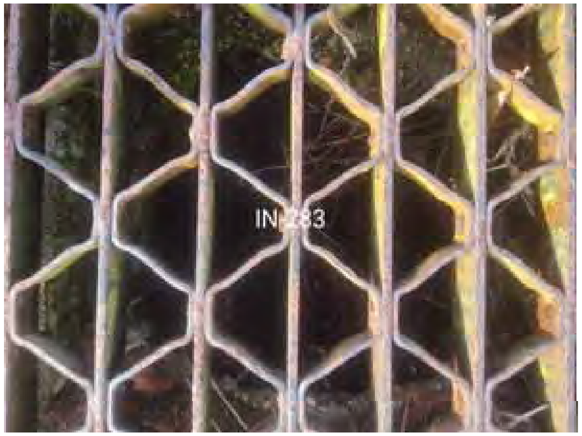

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6.5 Digital Photos - Pipes

2024 PORT ST. JOE CENTRAL CHANNEL SURVEYS

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Pipe 12

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Pipe 61

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Pipe 63

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Pipe 67

Pipe 68

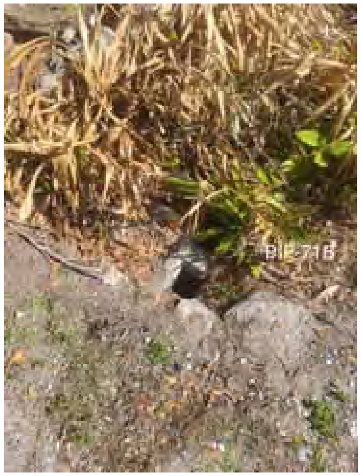
Pipe 69

Pipe 69A

Pipe 71A

Pipe 71A

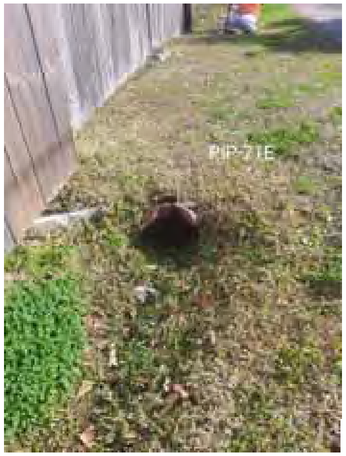
Pipe 71B



Pipe 71C

Pipe 71D

Pipe 71E



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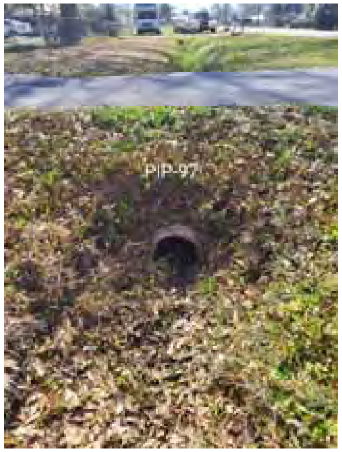

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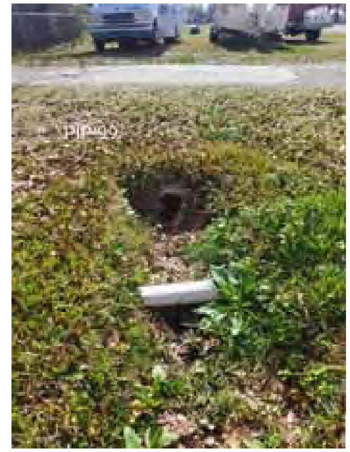

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Pipe 111

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Pipe 169D

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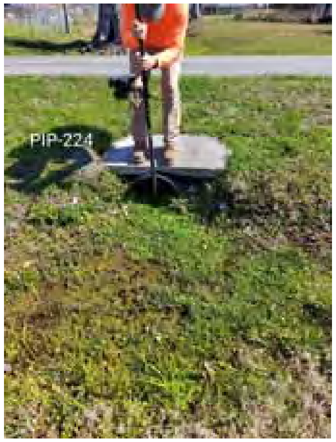
Pipe 224



Pipe 225

Dewberry

Appendix B

ICPR 2D Model Setup

B.1 Overland Flow Region

An ICPR 2D Overland Flow Region (OFR) was used to model rainfall infiltration and overland flow for all scenarios in this project. The OFR is a triangular computational 'mesh' that consist of a network of links and nodes. For each node, elevational data is sampled to determine elevation and storage volume, and links transfer flow from node to node. Rainfall is applied directly to the OFR using a rain-on-grid, and excess rainfall is routed through the OFR based on drainage direction defined by the elevational data.

The rain-on-grid approach was chosen for this area to help inform drainage direction, which is not well defined in some areas due to the flat coastal topography. The rain-on-grid methodology allows the OFR to determine flow routing rather than using manual hydrology with subbasin delineation. This approach generally results in a more accurate representation of what areas are contributing flow to specific inlets or channels.

B.1.1 2D Overland Flow Region Computational Framework

ICPR uses a triangular mesh as the basis for overland flow 2D computations. The vertices of the triangles in the mesh are treated as nodes, and the edges of the triangles as links. A honeycomb layer is generated as control volumes around the triangle vertices, and a diamond layer is generated along the triangle edges as shown in **Figure B1**.

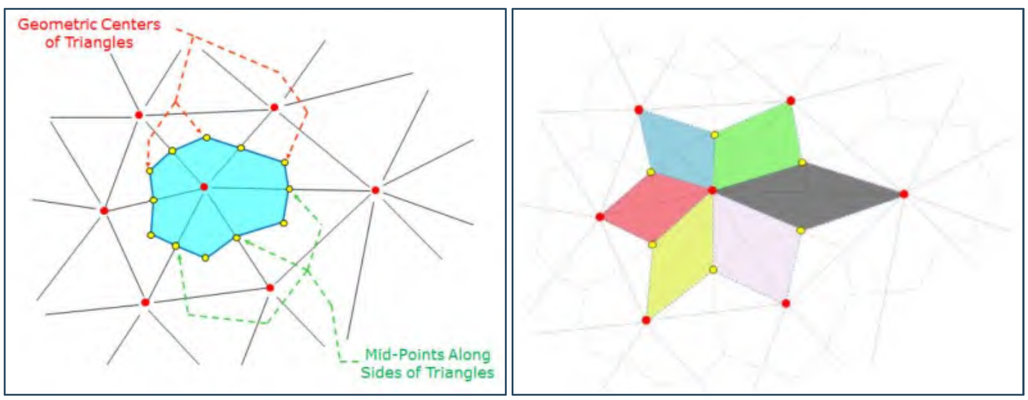


Figure B1: Triangular mesh - Honeycomb (Left) and Diamond (Right) Layers

The honeycomb layer is used for hydrology and storage calculations, and the diamond layer is used to calculate the flow between each node along each triangle edge. This is considered a finite volume approach, where the mass balance equations are lumped at the honeycomb control volumes and the momentum, energy, or diffusion wave equations are lumped along triangle edges. The diamond layer is used to calculate flow from honeycomb to honeycomb. The diamonds are converted to equivalent rectangles for the flow calculations, with average ground slopes determined by sampling the elevational data at the nodes, or triangle vertices.

B.1.2 1D Network Computational Framework

The 1D network consist of 1D Links and Nodes. Links include pipes, channels, weirs, and rating curve links. For this study all nodes are stage-area nodes and represent storm structures, ponds, or simply a connection between two 1D links. Stage-area tables were used to calculate storage at nodes.

B.1.3 1D & 2D Interactions

There are multiple ways to connect the 1D network to the 2D mesh in ICPR 2D. These include 1D interface nodes, channel control volumes, and pond control volumes – which were all utilized in this modeling effort.

1D interface nodes allow 1D links to connect to the 2D mesh. 2D surface flow can then enter the 1D system via the 1D interface node, flow through the connection link, and into the manhole stage-area node where it then progresses through the 1D network. Conversely, if the stage at the manhole in this example reaches above the invert elevation of the connection link, flow can move from the 1D network to the 2D mesh.

Channel control volumes are polygons associated with a 1D node that is connecting two channel links. The channel control volume typically follows the top of the channel bank and extends halfway upstream and downstream of the channel links connected to the associated 1D node. Each vertex of the channel control volume behaves like a 1D interface node, where flow can be transferred between the OFR and channel node. The triangular mesh is extended into the channel control volume so that the honeycomb layer can be generated, however 2D flow computations are excluded within the control volume. This allows for a 1D approach to channel hydraulics without excluding the rainfall in the channel area from the 2D hydrology computations. See **Figure B2** for an example.

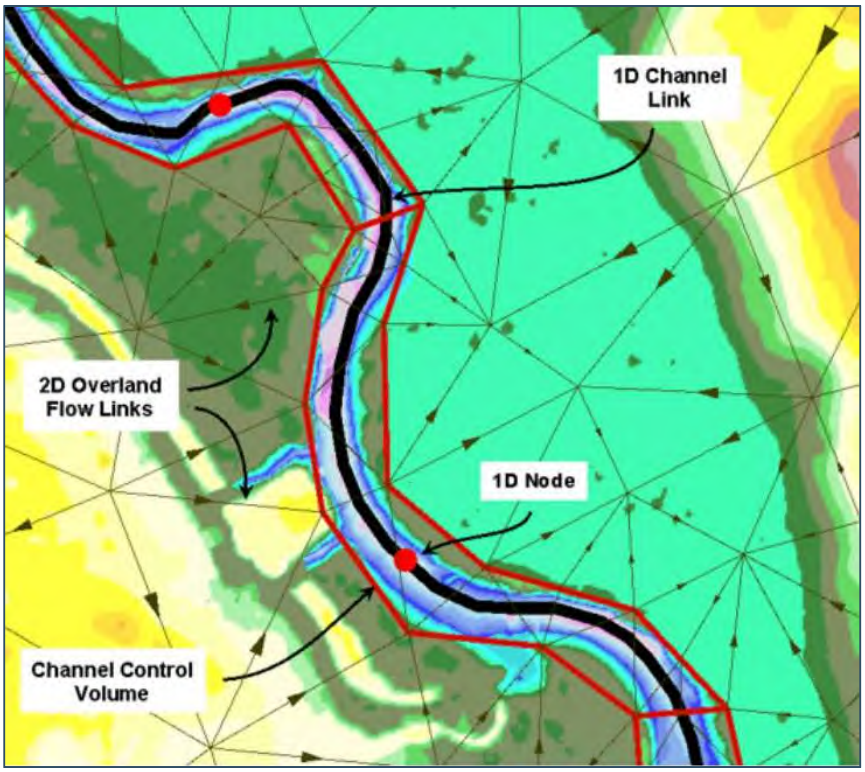


Figure B2: Channel Control Volumes

Pond control volumes are essentially identical to channel control volumes, except the water surface elevations shown in the 2D results maps is level with the stage of the pond, whereas the water surface elevation shown within channel control volumes is interpolated based on the stage of adjacent channel control volumes vertices and OFR nodes.

B.2 Hydrology

B.2.1 Validation Watershed Delineation

Watersheds for the central channel drainage area were manually delineated to check flows against the Florida regression equations in SIR 2011-5034, Magnitude and Frequency of Floods for Rural Streams in Florida. Florida does not have any current Scientific Investigation Reports for urban watersheds.

B.2.2 Land Cover & Soil Data

The 2019 National Land Cover Dataset (NLCD) and GSSURGO soil database were used to assign infiltration and roughness parameters to the OFR. These data were used to parameterize the OFR based on different roughness and infiltration characteristics associated with different land uses and soil types. The roughness characteristics are applied to the OFR Diamond Layer to establish flow conditions from node to node, and infiltration characteristics are applied to the OFR Honeycomb Layer to vary what amount of rainfall does not infiltrate into the ground (rainfall excess) and flows to the next node.

B.2.3 Infiltration & Rainfall Excess

The OFR uses the honeycomb layer to model infiltration & rainfall excess. Each honeycomb is intersected with the land cover & soil layers to form sub-polygons with unique infiltration parameters. Rainfall excess is aggregated for each honeycomb and transferred to the corresponding 2D node.

The Curve Number (CN) methodology was used to model infiltration in this study. The curve number method estimates precipitation excess as a function of precipitation depth, soil cover, land cover, and antecedent soil moisture. The method was developed empirically by the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service (SCS). Precipitation excess is calculated using the following equation:

$$P_e = \frac{(P - I_a)^2}{P - I_a + S}$$

Where:

$$P_e = Excess\ Precipitation$$

$$P = Accumulated\ Precipitation\ Depth$$

$$Ia = Initial\ Abstraction = rS$$

$$r = Abstraction\ Ratio = 0.2$$

$$S = Maximum\ Potential\ Soil\ Retention = \frac{1000}{CN} - 10$$

ICPR uses an abstraction ratio of 0.2 and recommends using curve numbers from the NRCS TR-55 publication. Curve numbers were assigned based on the ICPR recommendations and prior knowledge of typical curve numbers for the study area. **Table** shows the curve numbers used for this study.

Table B1 - Curve Numbers used in the ICPR model

Land Cover Description	Hydrologic Soil Group			
	None/Open Water	A	A/D	B/D
Barren Land	100	73	92	92
Channel	100	98	98	98
Deciduous Forest	100	40	48	48
Developed, High Intensity	100	89	95	95
Developed, Low Intensity	100	65	89	89
Developed, Medium Intensity	100	76	92	92
Developed, Open Space	100	46	82	82
Emergent Herbaceous Wetlands	100	80	80	80
Evergreen Forest	100	40	71	71
Grassland/Herbaceous	100	40	85	85
Open Water	100	100	100	100
Shrub/Scrub	100	40	40	40
Woody Wetlands	100	86	86	86

B.2.4 Manning's Roughness

Manning's roughness coefficients were used to define roughness and were assigned to the overland flow region in ICPR using the 2019 NLCD dataset. A channel polygon was 'cut' into the NLCD data to better define channel roughness values. ICPR assigns manning's roughness values to the OFR links using a roughness table that relates the land cover designation defined by the NLCD dataset to a manning's n value. The roughness table specifies shallow and deep manning's n values for each land cover designation. The Manning's N Values are shown below in **Table B2**.

Table B2: Manning's N Values

Land Cover Description	Manning's N
Barren Land	0.023
Channel	0.038 - 0.05
Deciduous Forest	0.15
Developed, High Intensity	0.075
Developed, Low Intensity	0.038
Developed, Medium Intensity	0.056
Developed, Open Space	0.026
Emergent Herbaceous Wetlands	0.075
Evergreen Forest	0.15
Grassland/Herbaceous	0.023
Open Water	0.023
Shrub/Scrub	0.038
Woody Wetlands	0.075

Manning's roughness coefficients for the OFR were decreased by 20% to improve model stability and improve drainage efficiency to the 1D pipe and channel networks. Additionally, the same 20% reduction was used for channel cross sections. These changes were based on prior knowledge and validation of other 2D overland flow models and comparisons to the Florida Regression equations and flooding extents observed during Hurricane Michael discussed in **Appendix C**.

B.3 Coastal Boundary Conditions

The OFR was extended into St. Joseph Bay, and a boundary stage line was used to control the stage at the boundary of the OFR along the coast. See **Table B3** below.

Table B3: Boundary Conditions

==Boundary Condition	Data Source	Simulations
Hurricane Helene	Gulf of Mexico Tide Gage at Apalachicola & NOAA Tide Predictions	Hurricane Helene
Hurricane Michael	LSU CERA ADCIRC	Hurricane Michael, Proposed Tidal Gates Scenario.
25-yr Storm Surge	JPM- OS Storm Suite	25-yr Surge, Proposed Tidal Gates Scenario
1-ft and 2-ft Generic Tide Ranges	Sin Wave Calculation	10, 25, and 100-yr Baseline Simulations & Critical Duration Analysis
MLLW	NOAA Online Vertical Datum Transformation	LOS Analysis, Proposed Pipe Upgrades Scenario
1-Month Continuous Tide	NOAA Tide Predictions at Station 8728912, Port St. Joe, FL	1-Continuous Water Quality Simulations for Existing Conditions and Proposed Channel Modifications

Mean Lower Low Water (MLLW) was used as a boundary condition for the Level of Service Analysis and the proposed pipe upgrade scenarios.

Tidal signals predicted by NOAA were used for analysis of existing pluvial flooding conditions so that the impact of varying tidal ranges on the storm drainage system could be considered in conjunction with varying rainfall conditions. 2-ft and 1-ft tide ranges were developed with a sin wave calculation using the equation below. The sin wave parameters for the Principal Lunar Semidiurnal Constituent (M2) of the NOAA tide predictions for the Port St. Joe Tidal Station were used to develop generic 1 and 2-ft tide ranges, as this constituent appeared to be the best visual match to the typical tidal patterns shown in the tidal records found on the NOAA webpage for the tidal gage.

$$y(t) = A * SIN(\omega t + \theta)$$

Where:

- y(t) = Tide Elevaiton
- A = Amplitude
- ω = angular frequency = $2\pi f$
- f = 1/T
- T = period, hrs
- θ = Phase of the Sin wave in radians

The MLLW level was used as the low-tide value for the 2-ft range, and the 1-ft tide range was centered to the 2-ft tide range. The tide ranges resulting from the sin wave calculation are shown in **Figure B3**.

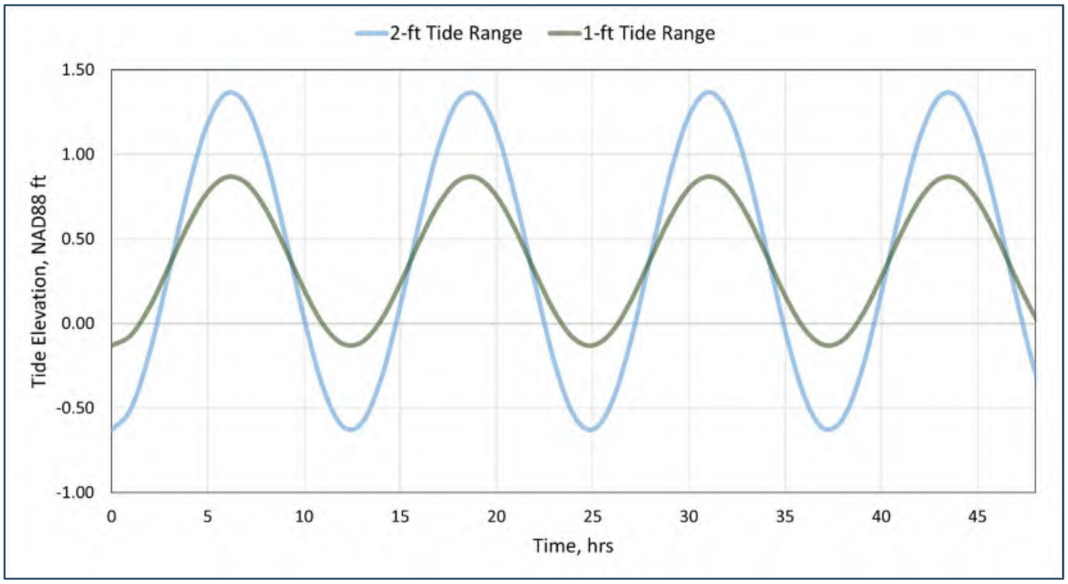


Figure B3: 1-ft and 2-ft Tide Ranges

Flow monitoring data collected along the Central Channel in November of 2023 was used for model validation runs. Tidal signals from the flow monitoring data at the Central Channel outfall to St. Joseph Bay near Patton Bayou were used as a boundary condition, and model results along the Central Channel were compared to the flow monitoring data at three additional monitoring locations.

B.4 Rainfall

Several built-in rainfall distributions are available in ICPR, including the FDOT rainfall distributions, which are shown in **Error! Reference source not found.**. The FDOT 72hr, 24hr, 8hr, 4hr, and 2hr rainfall distributions were used to conduct a critical duration analysis, where each storm duration was simulated with the same Average Exceedance Probability (AEP) rainfall amount to determine which duration is most stressful to the storm system. The 24hr FDOT rainfall distribution caused the most stormwater inlets to surcharge, and therefore was selected as the critical duration and used for all scenarios which consider rainfall. The critical duration analysis is discussed further in the following section. The rainfall data, sources, and simulations are summarized in **Table B4** below.

Table B3: Rainfall Data

Rainfall Data	Data Source	Simulations
Hurricane Helene	Distance-Weighted Rainfall Calculations Utilizing Weather Underground Rainfall Data	Hurricane Helene
FDOT Rainfall Distributions	ICPR FDOT Non-Dimensional Rainfall Distributions, NOAA Atlas 14	10, 25, and 100-yr Baseline Simulations, Critical Duration Analysis, LOS Analysis, Proposed Pipe Upgrades Scenario
No Rainfall	N/A	Hurricane Michael, 25-yr Surge, Proposed Tidal Gates Scenario

For pluvial flooding considerations, the 10, 25, and 100-year AEP precipitation events were simulated using the critical duration FDOT rainfall distribution, with both large and small tidal ranges.

The rainfall amount for each AEP precipitation event was determined using NOAA Depth-Duration-Frequency (DDF) curves. Archived FDOT Intensity-Duration-Frequency (IDF) curves were also considered, however the current FDOT Drainage Design Guide, 2024 recommends use of the NOAA curves. **Figure B4** shows the NOAA DDF obtained from the NOAA Atlas 14 website.

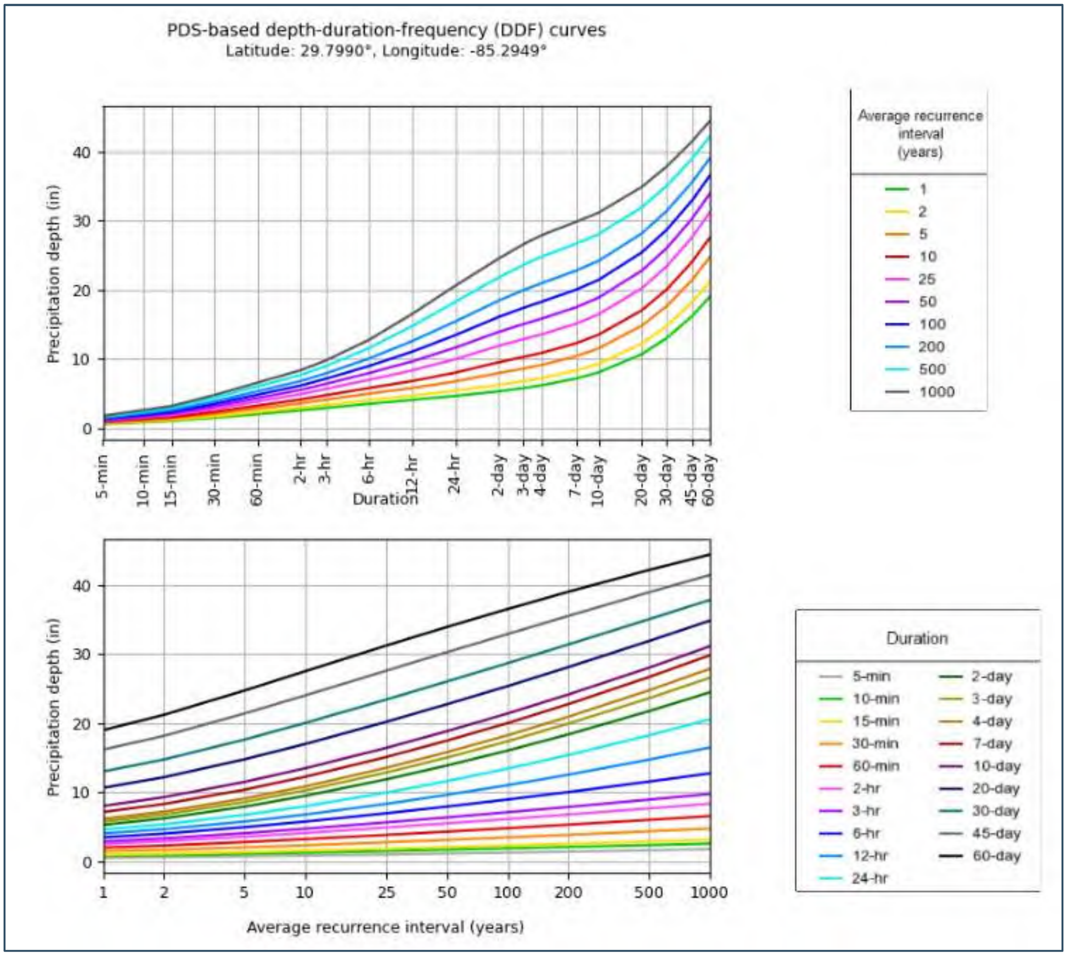


Figure B4: NOAA DDF Curves for Port St. Joe, FL

B4 shows the cumulative precipitation values used in the ICPR model for each recurrence interval considered.

Table B4: NOAA Precipitation Frequency Estimates

Average Recurrence Interval (years)	Precipitation Estimate (inches)
10	8.02
25	9.97
100	13.2

B.5 Hydraulics

B.5.1 1D Pipe Network

The pipe survey data was digitized into a GIS database and imported to ICPR. Assumptions were made for pipe locations and elevations that were outside of the survey scope but were necessary to complete the network connectivity. The energy equations were used for flow computations in the pipe network. Manning's n values were assigned to the pipes based on observed pipe material form the survey data. See **Table B5** below.

Table B5: Pipe Manning's Values

Pipe Material	Manning's N Value
RCP	0.013
CMP	0.02 – 0.024
VCP	0.011

Culverts along the Central channel were given an FHWA culvert code. ICPR automatically assigns entrance and exit losses based on the FHWA culvert code.

Preliminary simulations indicated that reduced exit and entrance loss coefficients for small pipes, including small driveway culverts and buried pipe drainage networks, resulted in more realistic results. Entrance and exit loss coefficients of 0.3 and 0.1, respectively, were used for these pipes based on recommendations provided in the ICPR documentation. See **Figure B5** and **Table B6** below.

Table C.2. Entrance Loss Coefficients.

Outlet Control, Full or Partly Full Entrance Head Loss

$$H_e = K_e\left[\frac{V^2}{2g}\right]$$

Type of Structure and Design of Entrance	Coefficient K_e
• Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end	0.2
Square-edge	0.5
Rounded (radius = D/12	0.2
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side- or slope-tapered inlet	0.2
• Pipe. or Pipe-Arch. Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side- or slope-tapered inlet	0.2
• Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of D/12 or B/12 or beveled edges on 3 sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of D/12 or beveled top edge	0.2
Wingwall at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side- or slope-tapered inlet	0.2

*Note: "End Sections conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be designed using the information given for the beveled inlet.

Figure B5:ICPR Entrance Loss Coefficient Recommendations

Table B6: ICPR Exit Loss Coefficient Recommendations

$(V_{pipe} / V_{downstream})$ or $(A_{downstream} / A_{pipe})$	C_{ext}
1.00	0.000
1.10	0.174
1.25	0.450
1.50	0.556
1.75	0.673
2.00	0.750
3.00	0.889
4.00	0.938
8.00	0.984
infinity	1.000

B.5.2 1D Central Channel

The Central Channel was modeled with a 1-D approach. The 1-D approach allows better incorporation of surveyed cross sections and improves accessibility of results hydrographs in ICPR. However, depth results maps may be less accurate within the channel control volumes compared to a fully 2-D channel modeling approach.

Bathymetry data were incorporated to the ICPR channel cross sections based on the surveyed cross sections. Cross section data was automatically generated in ICPR based on the topographic data. Channel bottom width, bank station width, and channel bottom elevations from the survey data were then used to modify the cross sections generated in ICPR. Constant slopes were assumed between known elevations, such as cross sections or pipe inverts along the channel.

The survey data was incorporated to the ICPR cross sections in different ways on a case-by-case basis to ensure a reasonable cross section profile based on the topographic data, survey elevation data, and available photos of the channel.

B.5.3 2D Triangular Mesh Refinement

The ICPR triangular mesh only samples elevational data at the triangle vertices, or nodes, so vertices must be placed at locations that approximate the actual topography as closely as possible for an accurate representation of overland flow. Breaklines & Breakpoints were used to refine the mesh in this way. Breaklines and Breakpoints work in a similar way, where triangular mesh vertices are placed at the breaklines vertices and breakpoints directly define triangular mesh vertex locations. A triangle edge is guaranteed along a breaklines.

Breaklines were placed on embankments and in channels. The general strategy for placing the breaklines was to define all flow paths or obstructions for each inlet node, and to define significant features such as roads or large embankments for more accurate flood mapping. A grid of breakpoints was used to force more detail (smaller triangles and thus more elevation sampling points) in areas along the Central Channel.

B.6 Critical Duration Analysis

Several preliminary simulations were run to determine the storm duration that surcharges the most inlet nodes in the system. The 2, 4, 8, 24, and 72-hour FDOT Rainfall Distributions were used with a 100-year rainfall amount. Other Boundary conditions were also tested with the 8, 24, and 72-hour durations after the initial simulations to determine what effect varying tidal boundary conditions had on the number of surcharged inlet nodes in the system. These included a static tide elevation equal to the MLLW level and the same 2-ft tide range with varying phase values for the sin wave used to calculate the changing tide levels.

Varying the phase of the sin wave calculation results in high or low tide occurring at different times in relation to the FDOT rainfall distributions. The varying boundary conditions did not have a significant effect on the number of surcharged nodes, with the 24-hour duration surcharging the most inlet nodes for each simulation. As a result, this was selected as the critical duration for the model. See **Figure B6** and **Table B7** below.

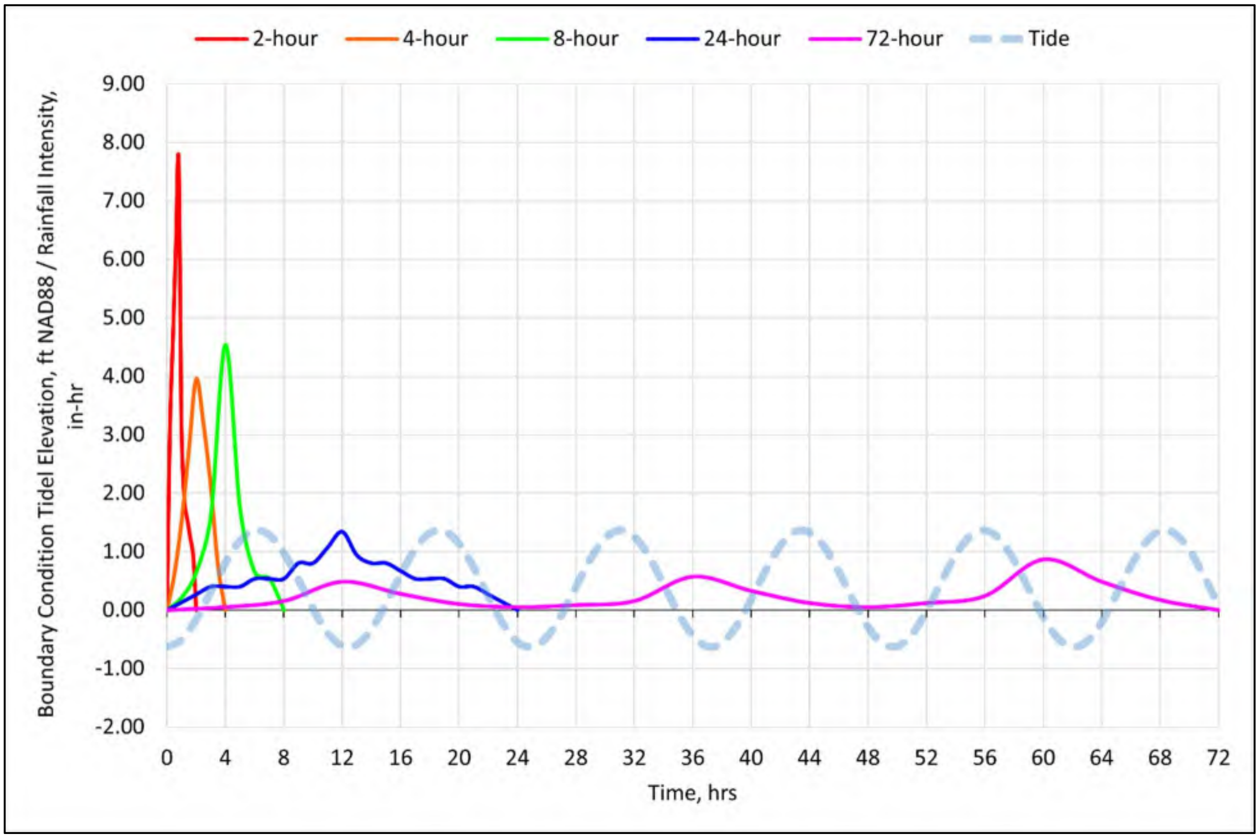


Figure B6: Coastal Boundary Condition and FDOT 100-year Rainfall Distributions

Table B7: Boundary Conditions

Rainfall Duration	2-hour	4-hour	8-hour	24-hour	72-hour
Number of Surcharged Inlet Nodes	83	89	131	140	122

Appendix C

Model Validation

C.1 Hurricane Michael

The storm surge for Hurricane Michael was used during model development to validate that the model produced reasonable results compared to available pictures of flooding caused by Hurricane Michael. See **Figure C1** below for the model and photographic comparison from the event. Based on photographic evidence, the model was estimated to be within approximately half a foot of the flood elevation. The flood extents aligned with the model outputs, and inundated homes and buildings results also aligned with anecdotal evidence of flooding during the hurricane.

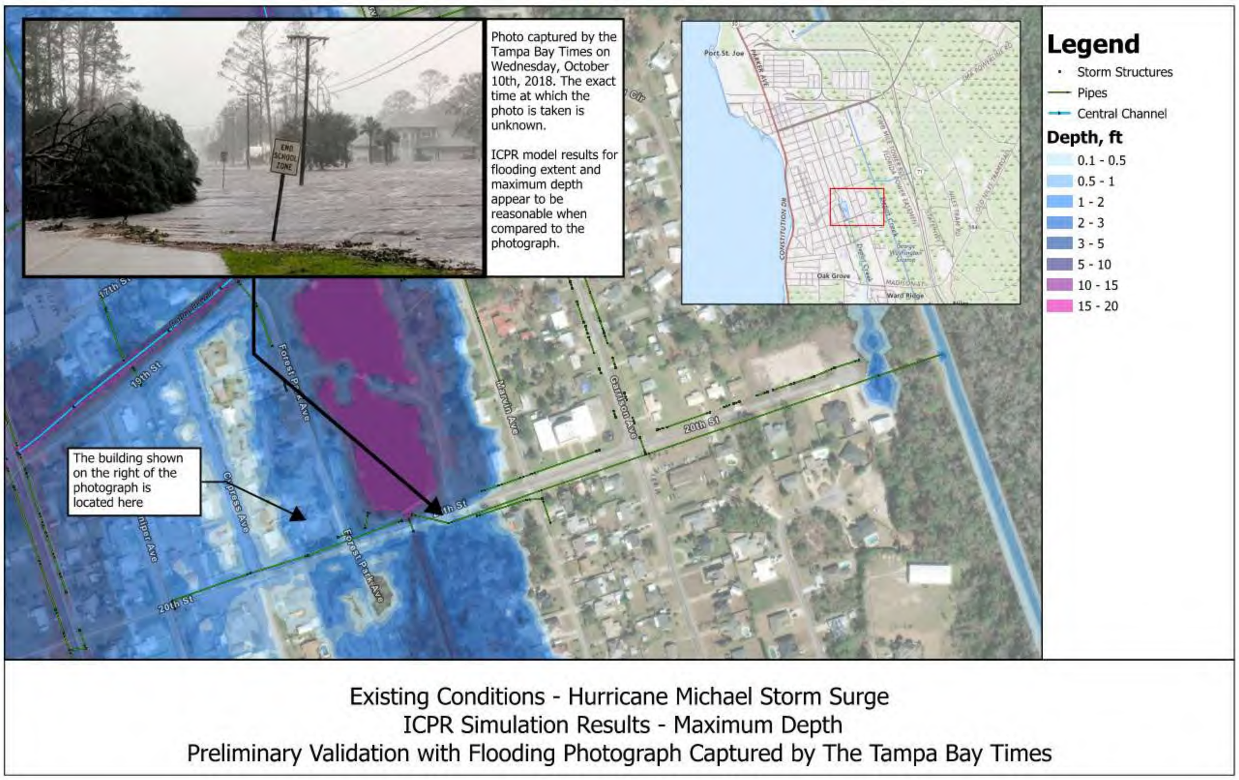


Figure C1: Boundary Conditions

C.2 Flow Monitoring Data

Flow monitoring data was collected at four site locations for this project in order to provide calibration data for the existing conditions model. Monitoring data collected water surface elevations and culvert depths on November 14th, 2023. The data was used to compare model results during a similar tidal boundary condition at each of the monitoring sites. **Figure C2** shows the locations of sites 2, 3, and 4. Site 1 is located on Chicken House Branch near Kenny Mill Road. Site 1 was not used for model validation since a second flow monitoring site was not available to develop a boundary condition at the confluence of Chicken House Branch and Gulf County Canal. Significant flows or changes in WSE were not recorded at Site 3.

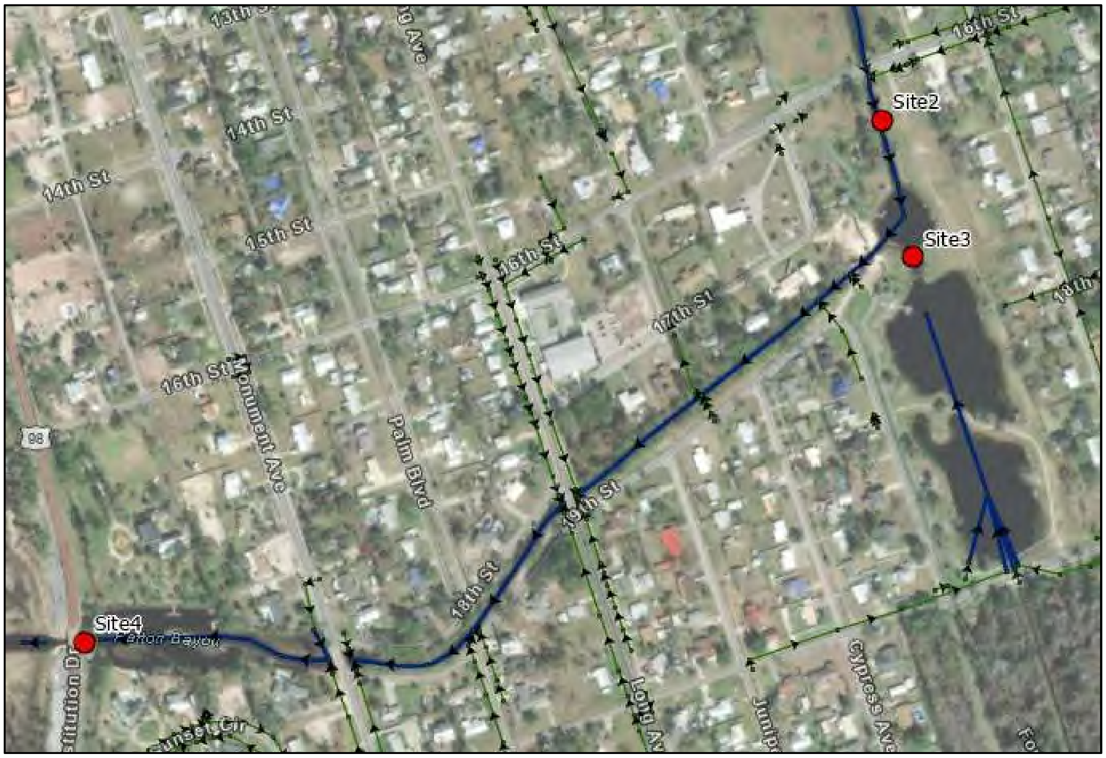


Figure C2: Flow Monitoring Site Locations

The tidal boundary condition was developed by adjusting the NOAA tide predictions for November 14th, 2023 to match the flow monitoring data during the data collection period. The NOAA tide predictions were used to extend the duration of the tidal boundary condition for 12 hours before and after the flow monitoring data collection period. **Figure C3** shows the NOAA tide predictions, flow monitoring data, and ICPR model input for the coastal boundary condition. This boundary condition was applied to the entire coastal boundary condition line.

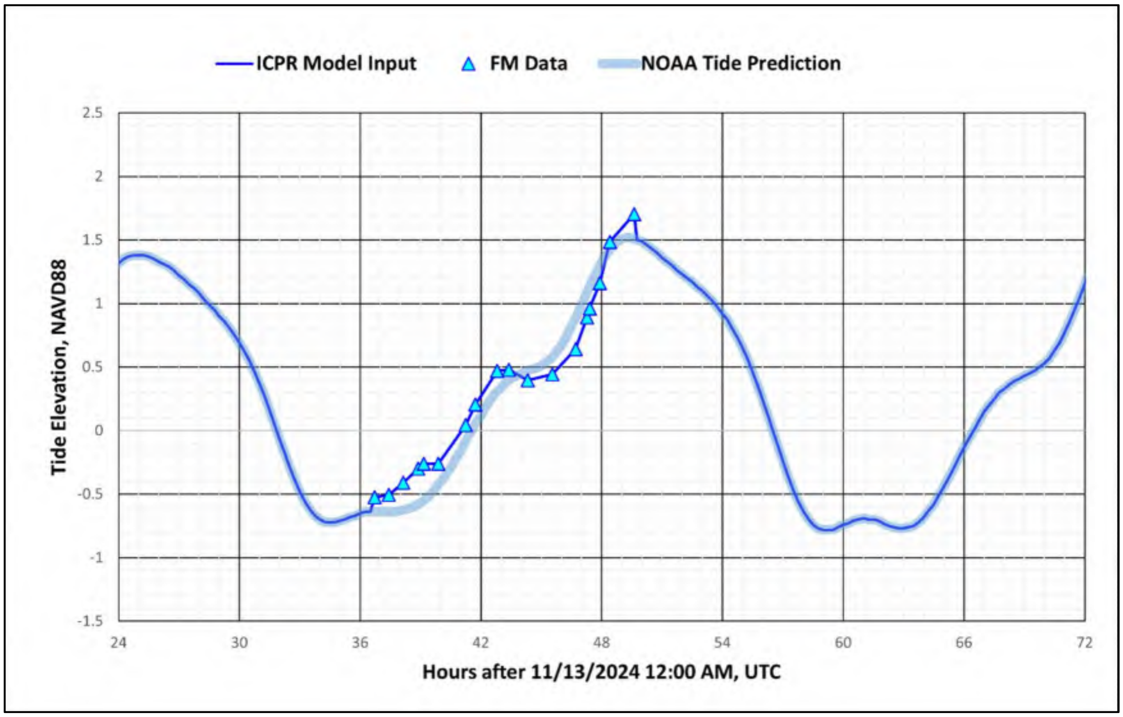


Figure C3: Validation Coastal Boundary Condition

The model was run for a 36-hour period beginning on November 14th, 2024. Flows and WSE from the Flow monitoring data at Site 2 were compared to model results, and several adjustments were made to calibrate the model including adjustments to Manning's N values down by 20%, adjustments to cross section data interpolated between survey locations to smooth the elevation changes, and adjustments to structure rating curves. **Figure C4** and **belowFigure C5** show the final calibration results at Site 2 for WSE and Flow, respectively.

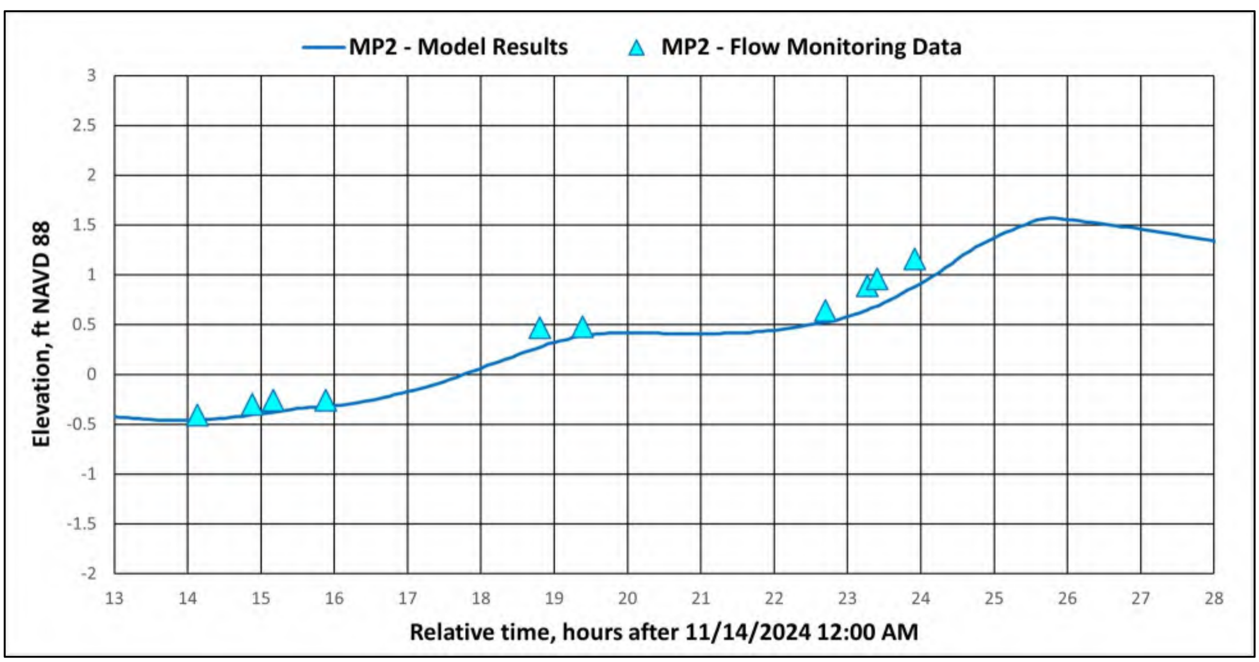


Figure C4: Site 2 Calibration Results - Water Surface Elevation

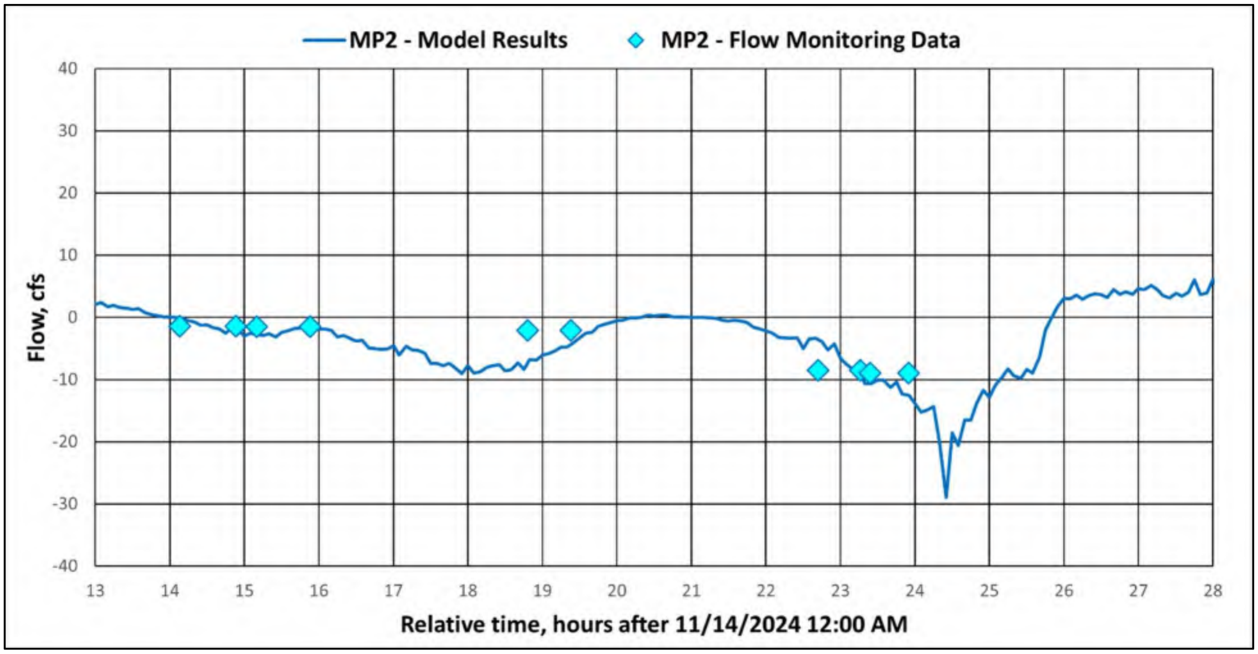


Figure C5: Site 2 Calibration Results - Flow

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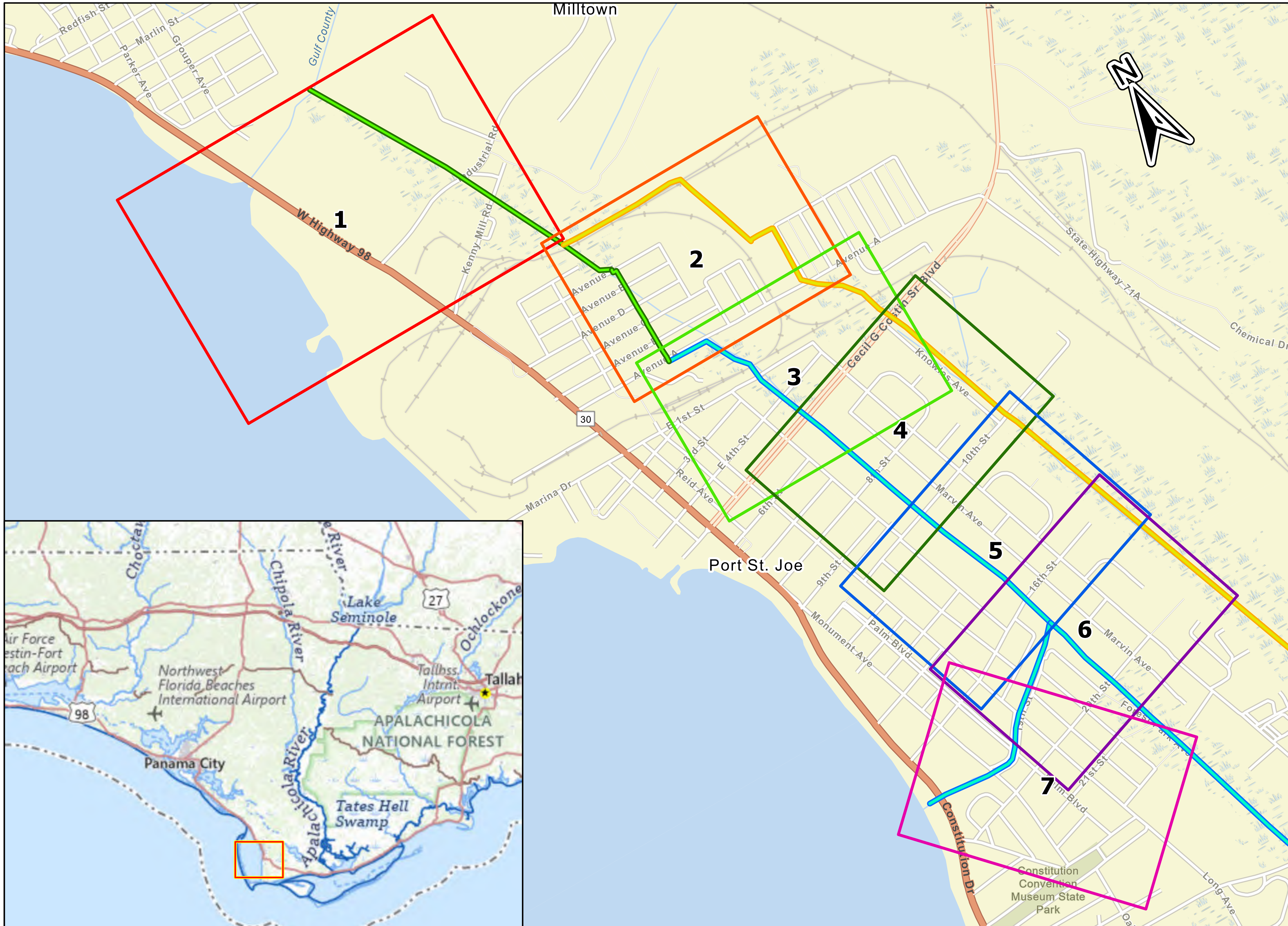
Appendix D

Reference Maps



Legend

Page

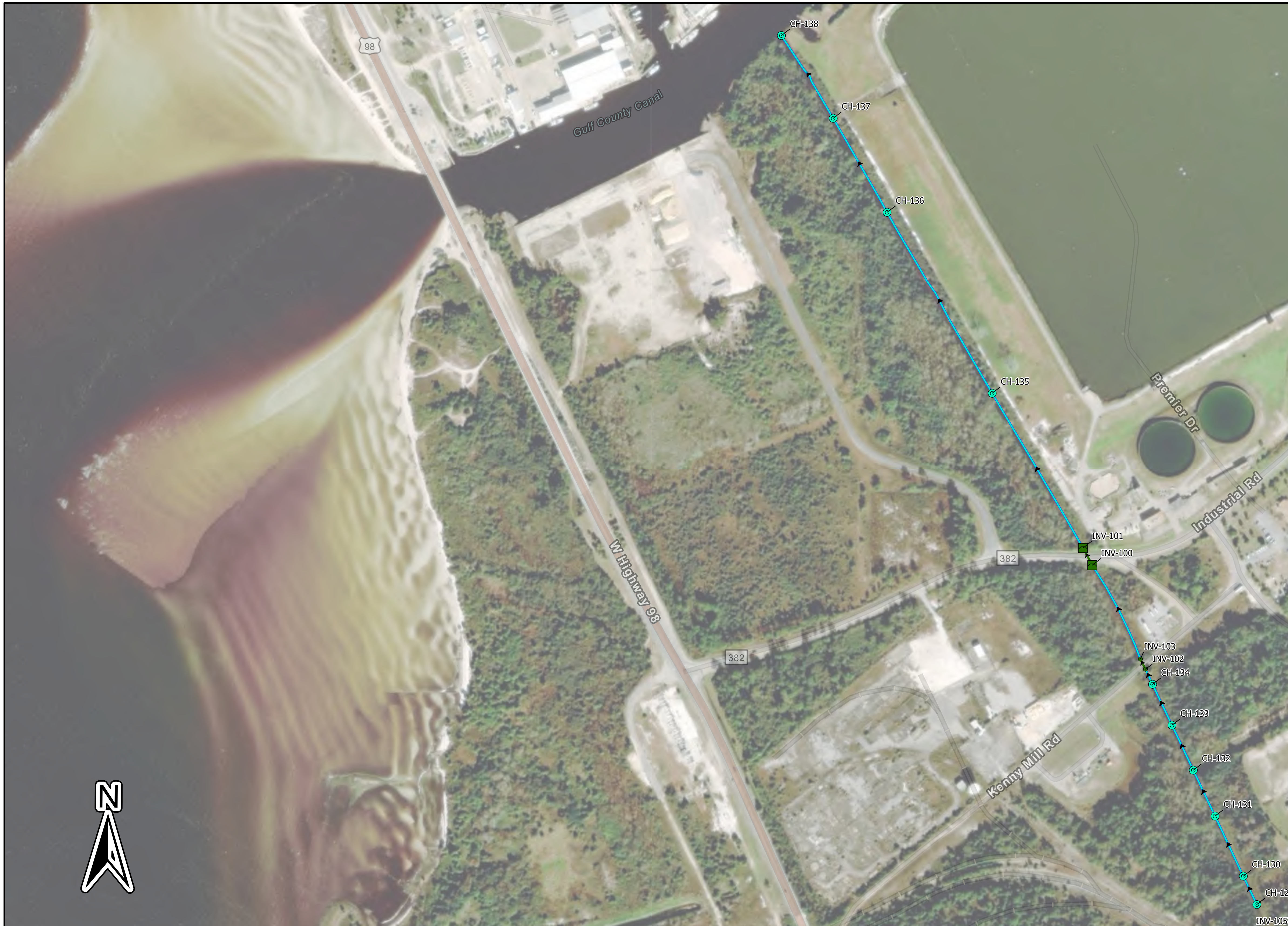
- 1
- 2
- 3
- 4
- 5
- 6
- 7

Channels

- Central Channel
- Chicken House Branch
- Depot Creek

City of Port St. Joe Central Channel Stormwater Master Plan Port St. Joe Hydrologic Study

Reference Maps



Legend

- ICPR Pipe Links
- ICPR 1D Channels

ICPR Node Type

- Curb Inlet
- Drop Grate Inlet
- Headwall
- Manhole
- Pipe Opening
- UNK
- Channel Node

City of Port St. Joe Central Channel Stormwater Master Plan

Reference Map

Page 1

Legend

- ICPR Pipe Links
- ICPR 1D Channels

ICPR Node Type

- Curb Inlet
- Drop Grate Inlet
- Headwall
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- Channel Node

City of Port St. Joe Central Channel Stormwater Master Plan

Reference Map

Page 2

Legend

- ICPR Pipe Links
- ICPR 1D Channels

ICPR Node Type

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City of Port St. Joe Central Channel Stormwater Master Plan

Reference Map

Page 3

Legend

- ICPR Pipe Links
- ICPR 1D Channels

ICPR Node Type

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- Channel Node

City of Port St. Joe Central Channel Stormwater Master Plan

Reference Map

Legend

- ICPR Pipe Links
- ICPR 1D Channels

ICPR Node Type

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- Drop Grate Inlet
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City of Port St. Joe Central Channel Stormwater Master Plan

Reference Map

Legend

- ICPR Pipe Links
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City of Port St. Joe Central Channel Stormwater Master Plan

Reference Map

Legend

- ICPR Pipe Links
- ICPR 1D Channels

ICPR Node Type

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- Headwall
- Manhole
- Pipe Opening
- UNK
- Channel Node

City of Port St. Joe Central Channel Stormwater Master Plan

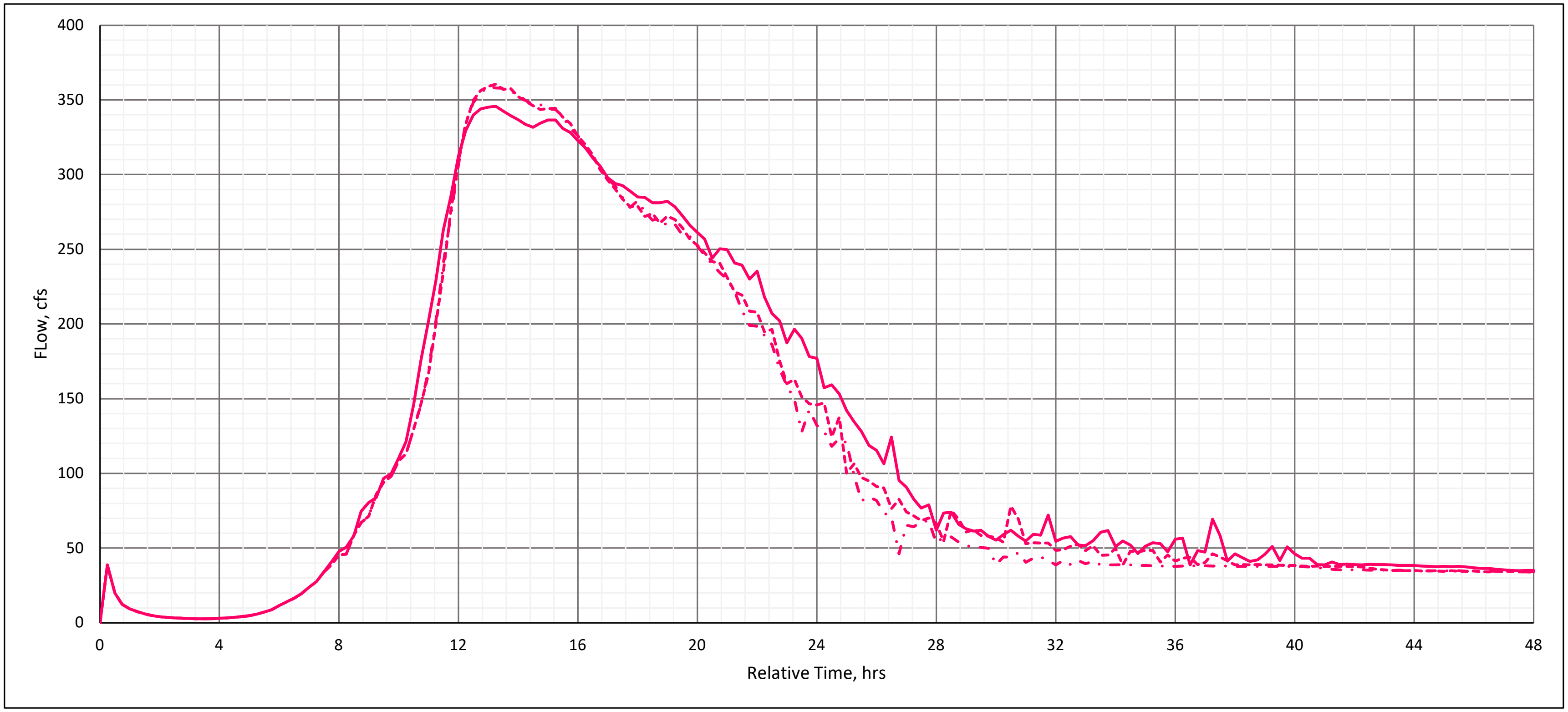
Reference Map

Appendix E

Wetlands Hydrographs

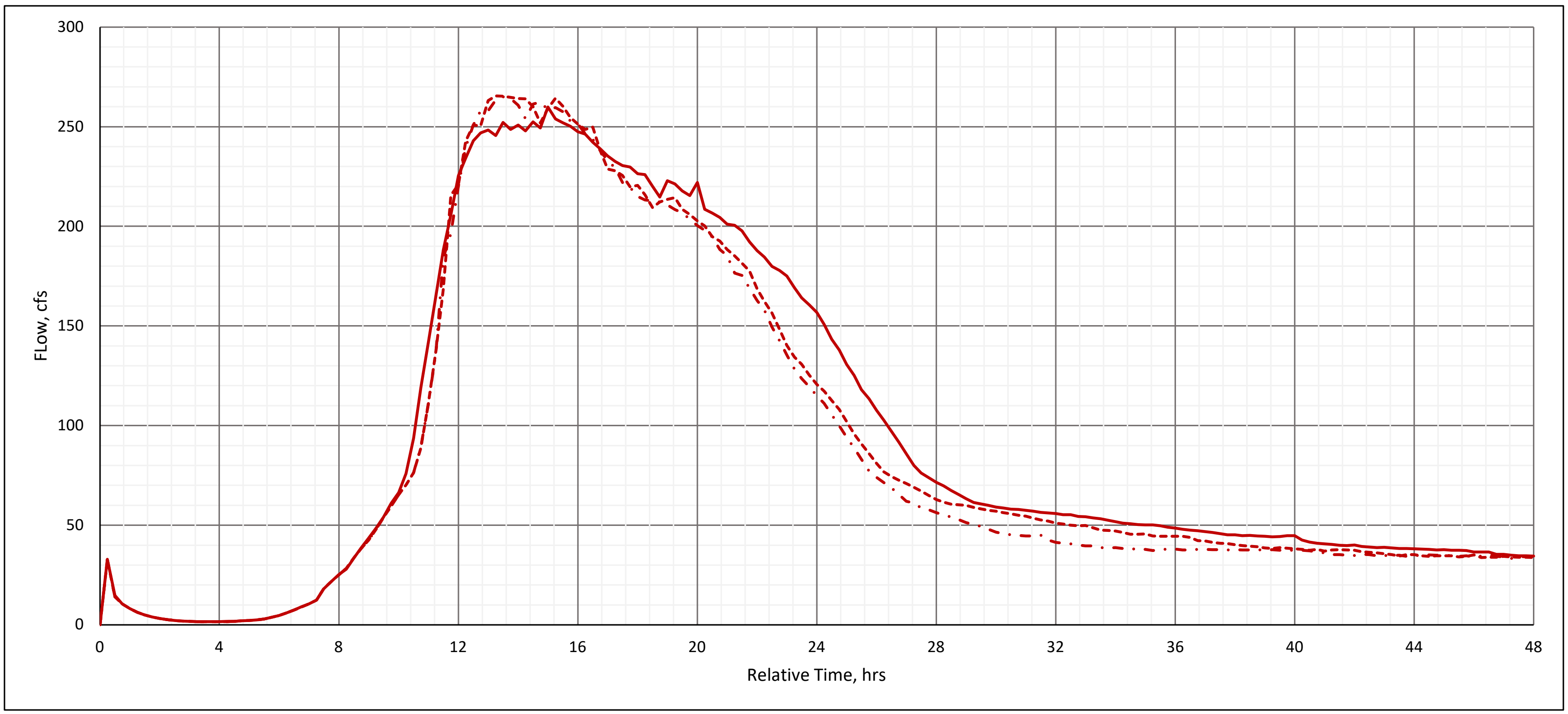
10-Year, 24-Hour Rainfall Event

LEGEND	
Line Colors	
	Central Channel outfall flowing under Constitution Drive
	Central Channel flowing under Long Avenue
	Double 24'' pipe running along the south side of 20th Street
	48'' pipe under 10th Street
	24'' pipe under Cecil Costin
Dash Type	
Solid Line	Existing Conditions
Dashed Line	Proposed Wetlands
Dash-Dot Line	Proposed Wetlands with Pumps



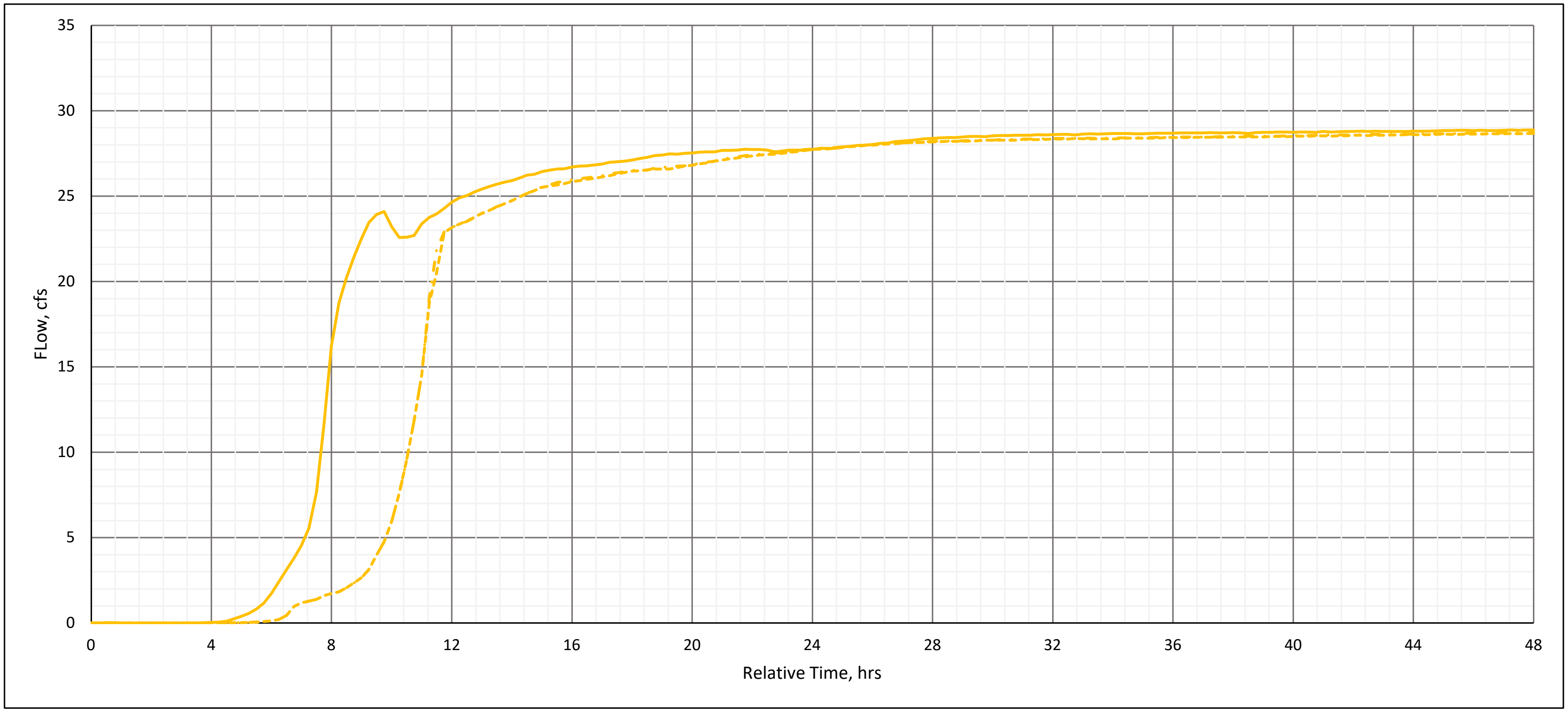
10-Year, 24-Hour Rainfall Event

LEGEND	
Line Colors	
(pink)	Central Channel outfall flowing under Constitution Drive
(dark red)	Central Channel flowing under Long Avenue
(yellow)	Double 24'' pipe running along the south side of 20th Street
(green)	48'' pipe under 10th Street
(blue)	24'' pipe under Cecil Costin
Dash Type	
Solid Line	Existing Conditions
Dashed Line	Proposed Wetlands
Dash-Dot Line	Proposed Wetlands with Pumps



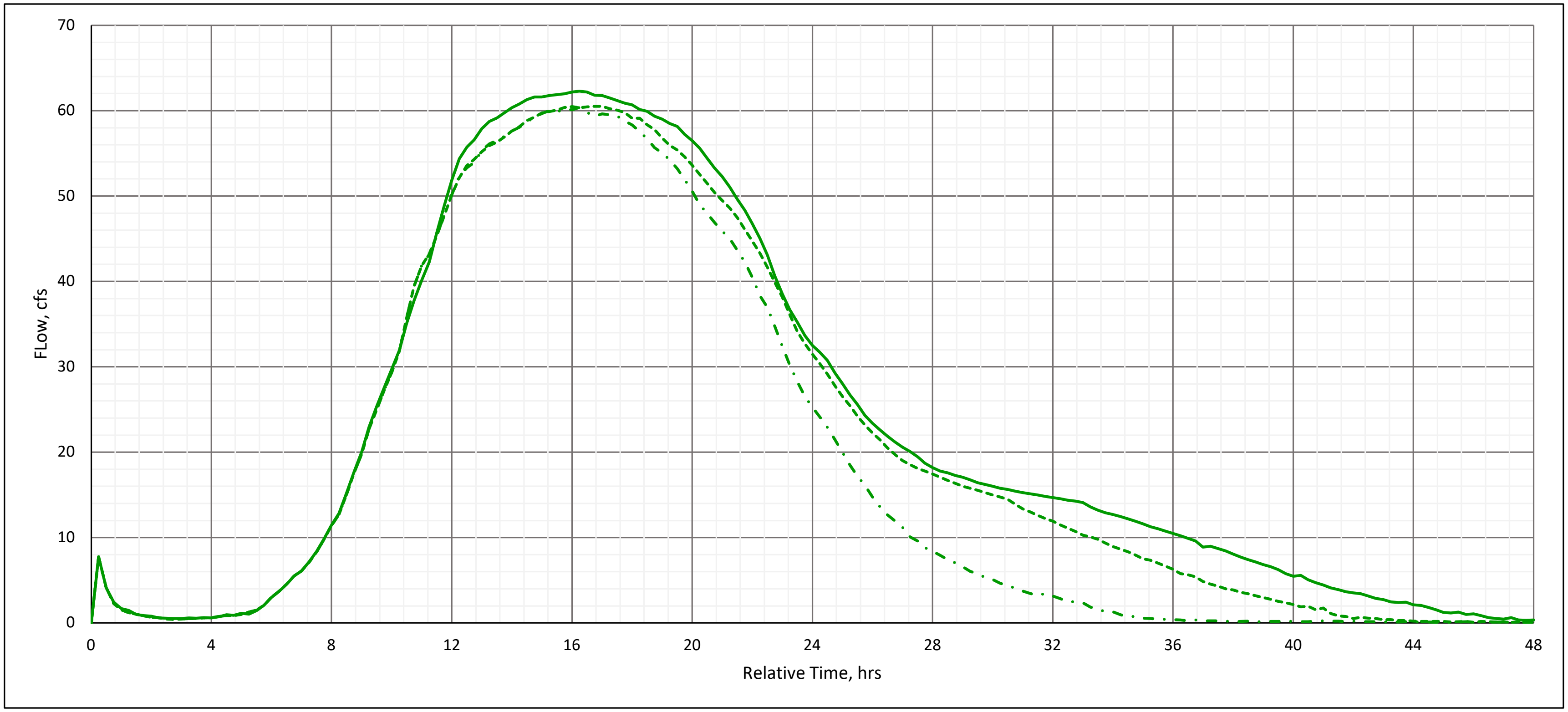
10-Year, 24-Hour Rainfall Event

LEGEND	
Line Colors	
	Central Channel outfall flowing under Constitution Drive
	Central Channel flowing under Long Avenue
	Double 24'' pipe running along the south side of 20th Street
	48'' pipe under 10th Street
	24'' pipe under Cecil Costin
Dash Type	
Solid Line	Existing Conditions
Dashed Line	Proposed Wetlands
Dash-Dot Line	Proposed Wetlands with Pumps



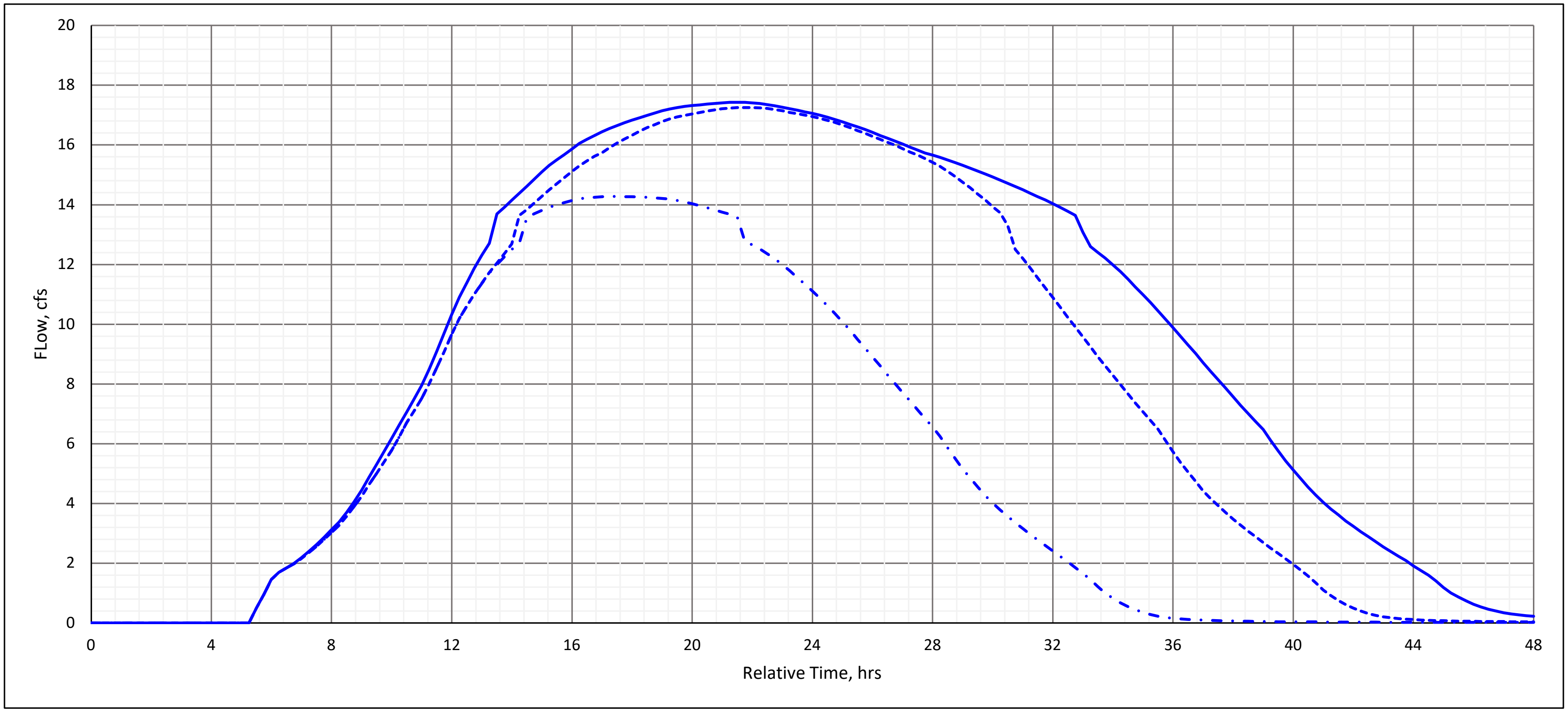
10-Year, 24-Hour Rainfall Event

LEGEND	
Line Colors	
	Central Channel outfall flowing under Constitution Drive
	Central Channel flowing under Long Avenue
	Double 24'' pipe running along the south side of 20th Street
	48'' pipe under 10th Street
	24'' pipe under Cecil Costin
Dash Type	
Solid Line	Existing Conditions
Dashed Line	Proposed Wetlands
Dash-Dot Line	Proposed Wetlands with Pumps



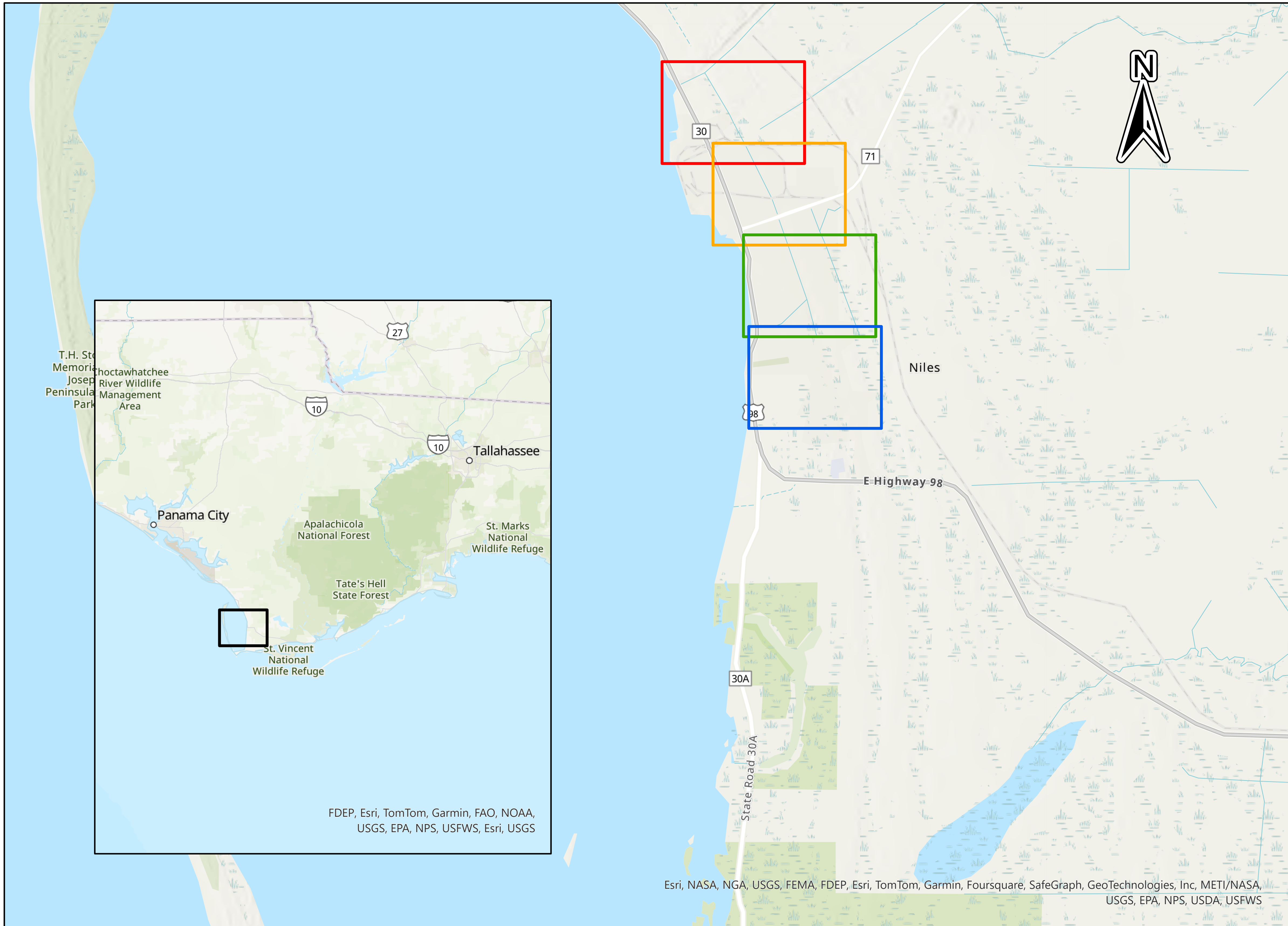
10-Year, 24-Hour Rainfall Event

LEGEND	
Line Colors	
(pink)	Central Channel outfall flowing under Constitution Drive
(dark red)	Central Channel flowing under Long Avenue
(yellow)	Double 24'' pipe running along the south side of 20th Street
(green)	48'' pipe under 10th Street
(blue)	24'' pipe under Cecil Costin
Dash Type	
Solid Line	Existing Conditions
Dashed Line	Proposed Wetlands
Dash-Dot Line	Proposed Wetlands with Pumps



Appendix F

Level of Service Maps



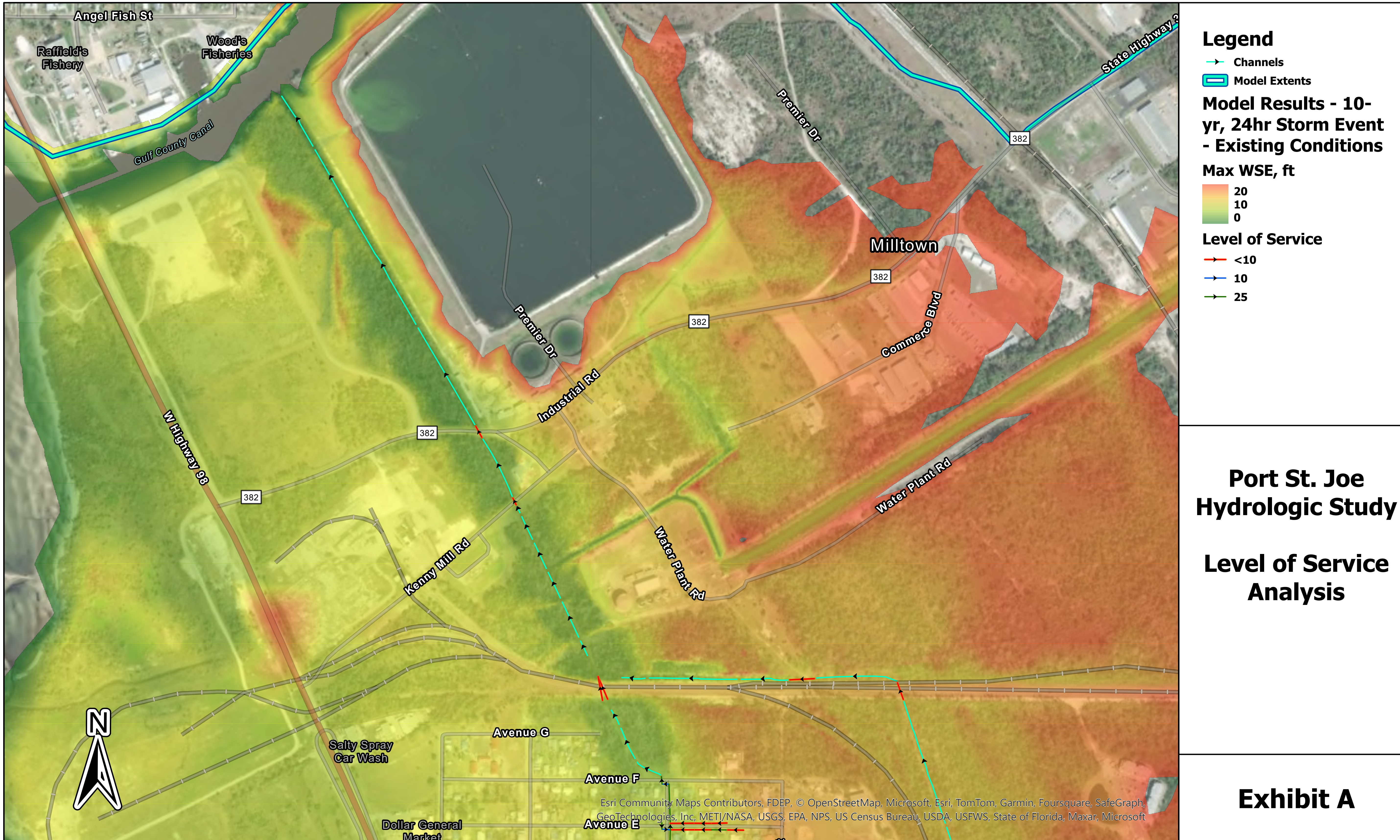
Legend

Exhibit

- A
- B
- C
- D

Port St. Joe Hydrologic Study

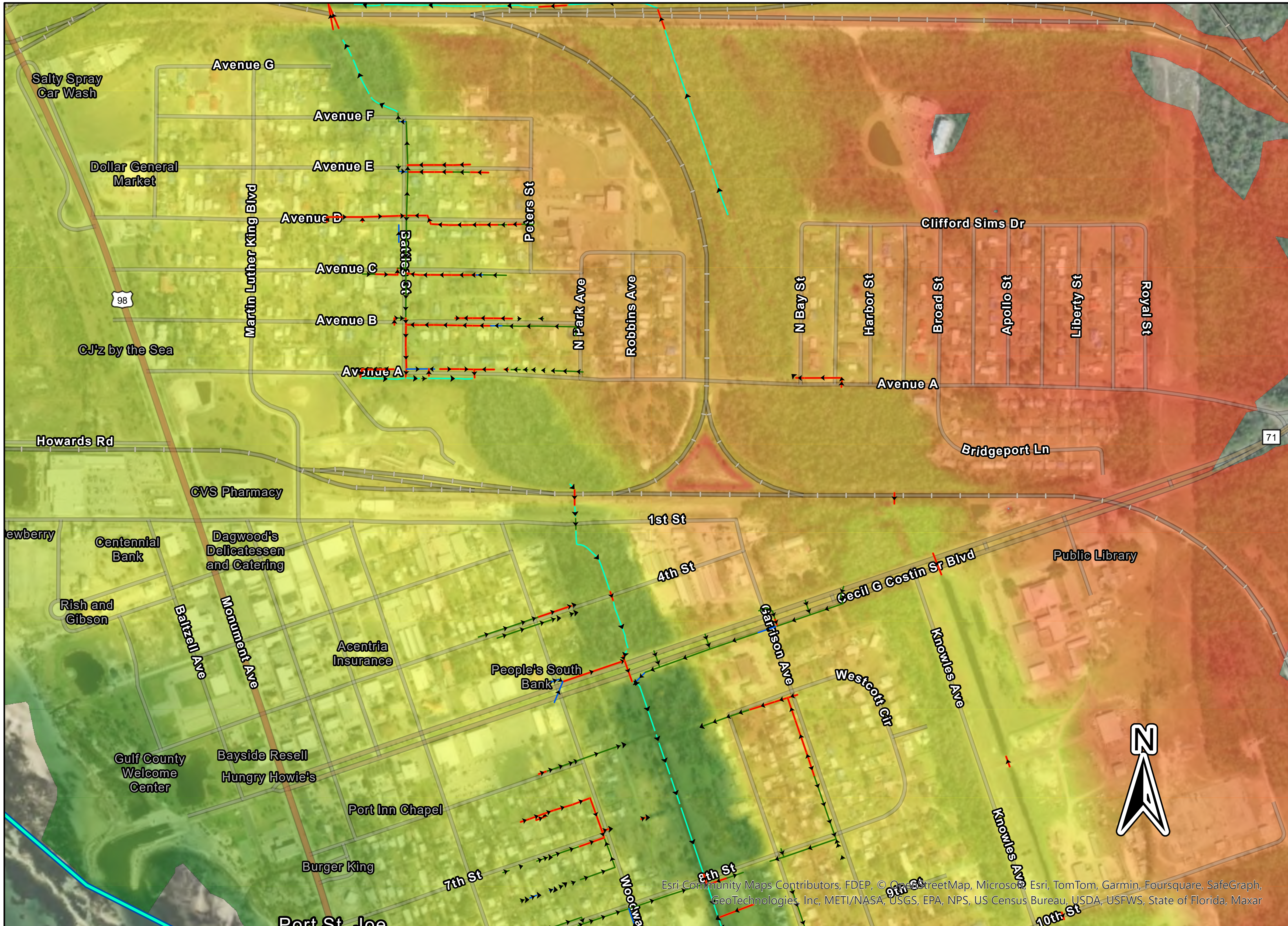
Reference Map



Port St. Joe Hydrologic Study

Level of Service Analysis

Exhibit A



Legend

Channels

Model Extents

Model Results - 10-yr, 24hr Storm Event - Existing Conditions

Max WSE, ft

20
10
0

Level of Service

<10
10
25

Port St. Joe Hydrologic Study

Level of Service Analysis

Exhibit B

Legend

Channels

Model Extents

Model Results - 10-yr, 24hr Storm Event - Existing Conditions

Max WSE, ft

20
10
0

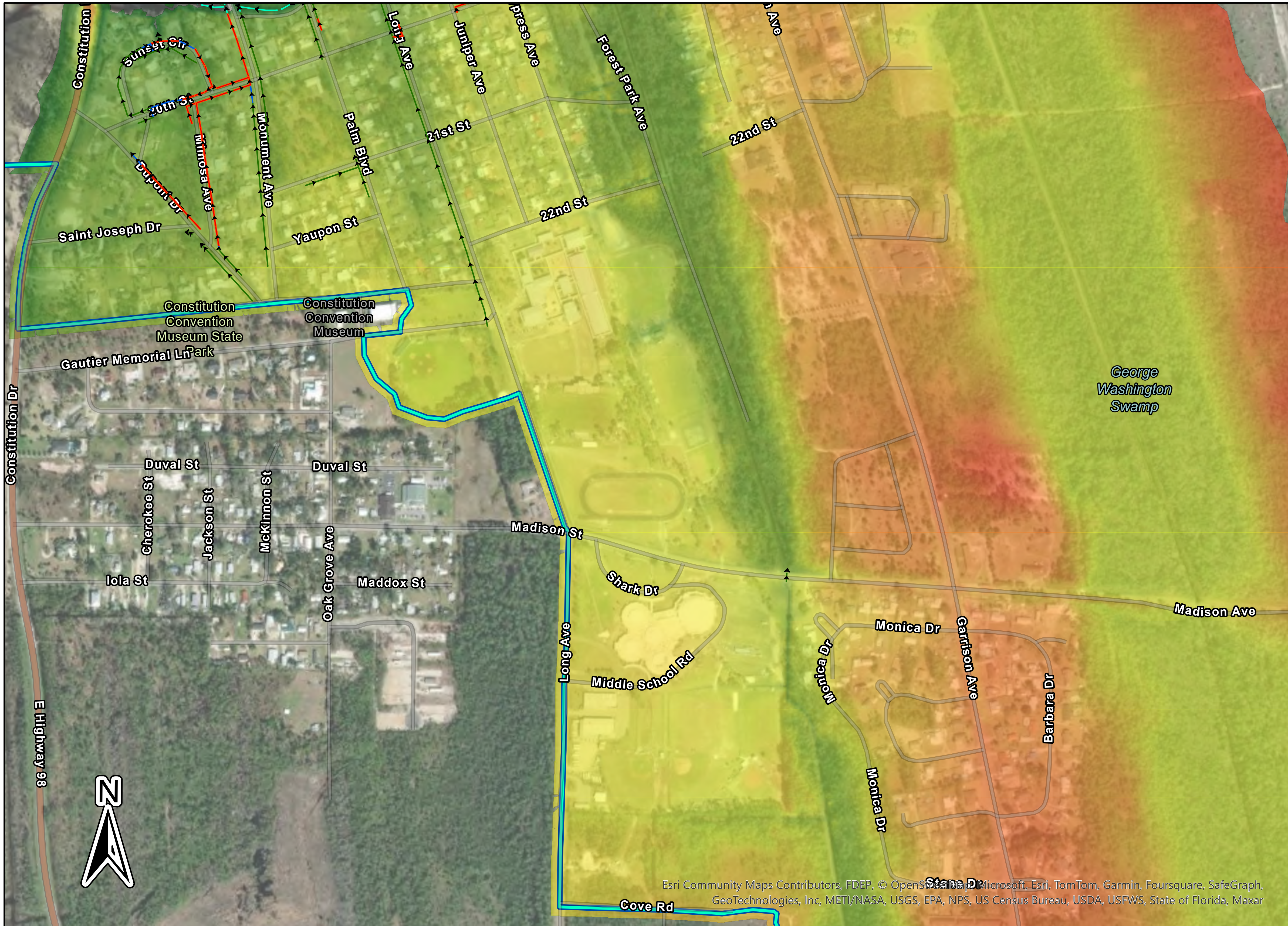
Level of Service

<10
10
25

Port St. Joe Hydrologic Study

Level of Service Analysis

Exhibit C



Legend

Channels

Model Extents

Model Results - 10-yr, 24hr Storm Event - Existing Conditions

Max WSE, ft

20
10
0

Level of Service

<10
10
25

Port St. Joe Hydrologic Study

Level of Service Analysis

Exhibit D