



# Missouri River Ice Jam and Open Water Flood Response and Action Plan (Updated 2015)

City of Bismarck, North Dakota





# Certification

## Missouri River | Ice Jam and Open Water Flood Response and Action Plan (Updated 2015)

City of Bismarck

Apex Project Number 12.118.0059

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of North Dakota.



A handwritten signature in blue ink that reads "Scott M. Schneider".

Scott M. Schneider, PE, CFM

A handwritten date in blue ink that reads "4-7-15".

Date

March 2015

Apex Engineering Group, Inc.  
600 South 2<sup>nd</sup> Street – Suite 145  
Bismarck, ND 58504

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# Missouri River

## Ice Jam and Open Water Flood Response and Action Plan

### (Updated 2015)

#### **Purpose of the Action Plan**

This action plan will outline the specific temporary flood protective works including equipment and materials that will be mobilized to fight various flood scenarios within the City of Bismarck, should they occur in the spring of 2015 or future years. This study is an amendment to the 2014 Missouri River Flood Response and Action Plan. It includes any changes to temporary or semi-permanent flood protection measures that were implemented in 2012, 2013 and 2014, including any revised levee elevations, road grade raises and closure structures. This plan amendment identifies one ice jam scenario and two open water flood scenarios. It then identifies the trigger points for the protective measures including equipment and materials that will be mobilized to fight the ice jam or flood should they occur in the future.

#### **Background**

Two recent Missouri River flood events resulted in significant physical damage and economic harm to private citizens and local government entities. On March 24, 2009, an ice jam on the Missouri River threatened much of South Bismarck. In the summer of 2011, South Bismarck experienced a major Missouri River open water flood caused by unprecedented precipitation and runoff from above normal basin snowpack. In 2011, a series of publicly constructed levees were built to protect much of the City; however exclusively private efforts protected much of the Southport area from overland flooding.

As a result of its experiences in the 2009 and 2011 flood events, the City has conducted appropriate planning for a potential future ice jam or flood event. The Ice Jam and Flood Response and Action Plan is intended to provide clear direction for both City staff and private volunteers to execute a coordinated flood fighting response, in advance of an ice jam or open water flood.

Ground water migration and impacts will not be addressed in this report.



## Data Collection

Data for the Missouri River Ice Jam and Flood Response and Action Plans and previous versions came from two general sources: public input and technical data from public agencies. The data from the original public input meetings can be found in the 2012 Flood Response and Action Plan.

The Southport Protection Planning Project was completed in 2013. The project planning included the development of a permanent bay closure structure and a permanent levee around Southport extending from Riverwood Drive to Mills Avenue. A project progress meeting was held with the five Presidents of the Southport Homeowner's Associations and the maintenance association to present the concepts and preliminary opinion of costs. Due to the costs of the project and blocking of the view between the homes and the river, the Homeowner's Associations were not in favor of pursuing the permanent structures.

## Data from Public Agencies

Both flood events generated a wealth of technical data from local, state and federal agencies. Public Agency data that was collected came from the following sources:

- [US Geological Survey \(USGS\) Missouri River Bismarck Gage Data](#)
- ND State Water Commission
  - FEMA Flood Insurance Study – Burleigh County
- ND Department of Emergency Services
  - 2011 Flood Photo
  - Post 2011 Flood Photo
  - Various inundation mapping
  - Levee alignments/locations
  - FEMA DFIRM Database – Burleigh County
- City of Bismarck Engineering and Public Works Departments
  - 2011 stormwater pumping locations and pump sizes
  - GIS Dataset
  - 2011 levee elevations
  - Various 2011 high water survey elevations
  - 2011 levee construction costs and temporary pumping costs
- Burleigh County
  - Flood Annex Plan

### **2011 Protective Measures**

The 2011 temporary protective measures included approximately 4.6 miles of earthen levee and Hesco Barriers to protect much of South Bismarck from the floodwaters of the Missouri River. After the flood receded, many of the structures were left in place for potential flood events in 2012 and 2013. All 2011 temporary protective measures were removed in 2013.

Additional levees were installed by Burleigh County along England Street and 48<sup>th</sup> Avenue South. These levees also protected South Bismarck and were completely removed.

### **Existing Protective Measures – See Figure 1**

Additional ice jam protection measures were installed in 2012 by Burleigh County. The grade of Tavis Road has been raised to a flood stage of 20-feet and a flood control gate has been installed. The gate actuator has electrical power and is fully operational.

In 2014, Burleigh County and the City of Bismarck completed the construction of the Tavis Road flood control pumping station. The pumping plant is equipped with three, 20 cubic feet per second (cfs) submersible pumps. This gives the plant a total capacity of 60 cfs or 27,000 gallons per minute (gpm), which is 120 acre-feet per day. This plant will be used to pump storm water runoff from the South Bismarck watershed during flood events when the Tavis Road flood gate is closed.

The flood control gate on South Washington Street (on the storm water channel) was rehabilitated by the City in 2014. This gate acts as a backup for the Tavis Road flood control gate and is identified on FEMA's Flood Insurance Rate Map (FIRM).

A control gate was also installed on Whisper Drive to prevent flood waters from within Whispering Bay from flooding east into the Traynor Drive area south of Mills Avenue.

An additional river gaging station was installed by the USGS to collect river elevation data for both open water and ice covered periods on the Missouri River. The USGS installed the stage gage near Fort Lincoln on the west side of the river ([USGS 06349070, Missouri River below Mandan, ND](#)). This gage will provide timely river stage information for South Bismarck.

In 2013, the City of Bismarck began the construction of the Riverwood Drive and Mills Ave reconstruction projects. These projects included grade raises of the existing roadways to a flood stage of 20-feet. The Riverwood Drive and Mills Avenue grade raises, paving, gate well and gates installation were completed in 2014. The project included several control structures with sluice gates located on the storm water outfalls and a control structure on the Mills Avenue causeway. A berm was constructed on the west side of Riverwood Drive between the north and south ends of Southport Loop to a stage of 17-feet.

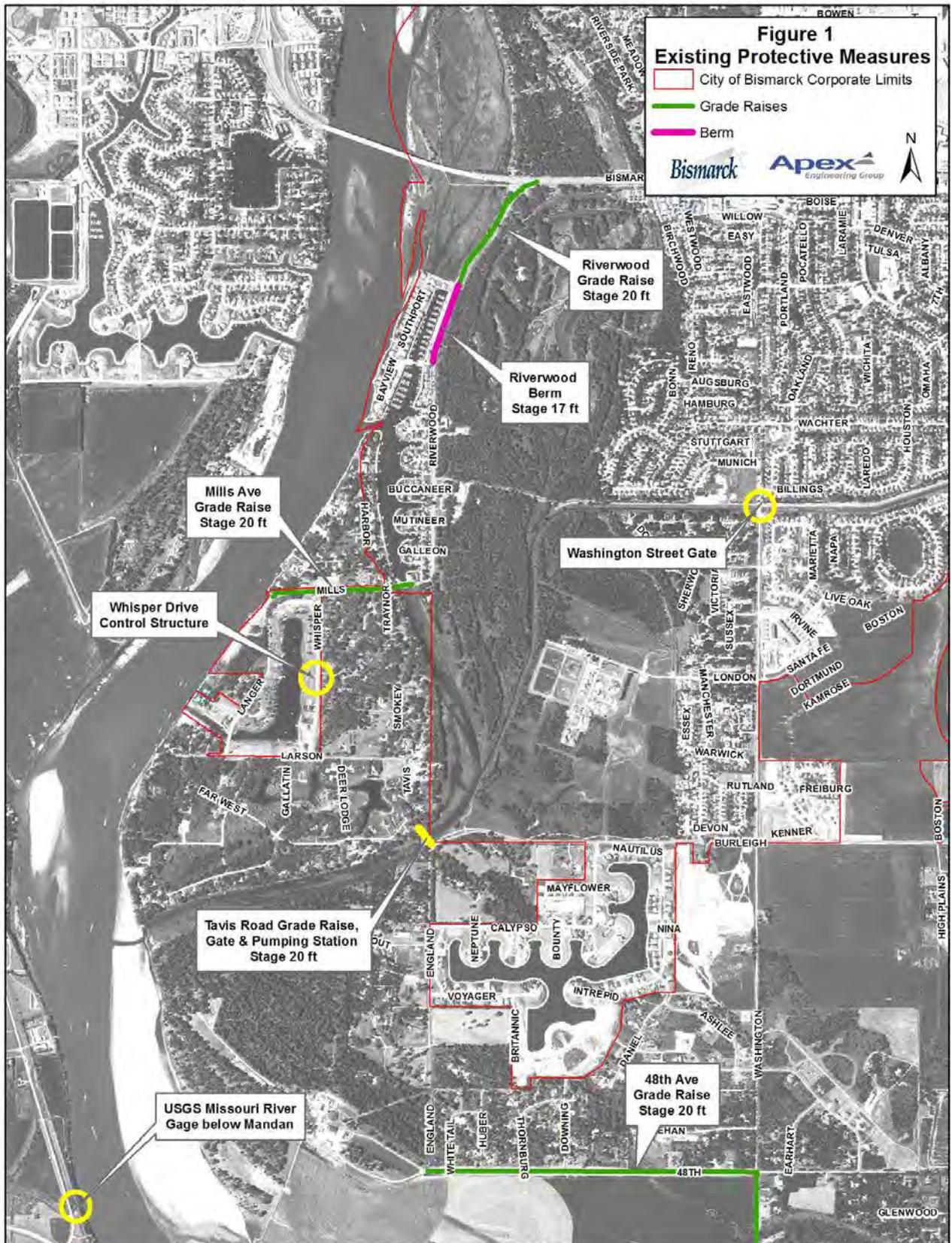




In 2013, the City of Bismarck completed the installation of flood control gates on four storm water outfalls from Bismarck Expressway, north through the Sertoma Park area. Closing these gates will prevent flood waters from backing up through the storm sewer system and flooding low lying areas.

In 2014, Burleigh County completed a grade raise on 48<sup>th</sup> Ave, west of Washington St, to a stage of 20-feet.





## Action Plan

The technical data and public perceptions collected during the 2012 study phase were used to prepare the 2012 Flood Response and Action Plan. The technical data has been updated in this amendment for City officials and the public to use as a guide for the execution of a coordinated flood fight, should it become necessary to do so in the future.

## Plan Development

The location of temporary protective measures was determined based on the observed 2009 ice jam event and 2011 open water flood event as well as the recent construction of several protection projects. Burleigh County's flood protective measures were taken into account in the development of this plan. Opinion of costs were developed for the various action plans based on the 2011 levee construction and removal costs and the 2011 internal drainage pumping costs. The opinion of costs were updated to reflect cost increases since 2011.

Critical elements of the action plan include:

- Observation and monitoring of Missouri River conditions that may indicate an impending flood. The continued monitoring of ice conditions on the Missouri River, Knife River, and the Heart River is a critical element of the plan.
- Review of flood forecasts.
- Snow and rainfall data in the Missouri River basin upstream of Bismarck.
  - US Army Corps of Engineers
    - [Missouri River Basin Water Management Division – Forecast Information](#)
  - National Oceanic and Atmospheric Administration
    - [Regional Snow Analyses](#)
- Trigger Points that initiate specific flood responses and actions.
  - Ice jam alerts.
  - River stage readings.
  - Garrison Dam release schedules.

**The Recommended Action Plans for the Three Designated Flood Scenarios are found on the following pages.**



## Ice Jam Flood

The temporary protective measures for an ice jam are more difficult to implement than those of a standard open water flood. This is primarily due to the limited response time to implement protective measures. For instance, during the 2009 ice jam, the stage on the Missouri River developed in 24-hours and began dropping within 36-hours after the formation of the jam. The unpredictability of an ice jam in terms of the location, timing and stage of the river upstream of the jam make it very difficult to plan the temporary protective measures. The 2009 ice jam stages were used as the baseline for determining temporary protective measures for the City of Bismarck; however the 2011 flood caused major scouring of the main channel and large amounts of sand deposition within the main channel overbanks, which makes predicting an ice jam similar to 2009 very difficult. The new river channel system will have to be monitored closely during a future ice jam to determine the temporary protective measures that should be implemented.

The completion of the Tavis Road flood control gate structure and the 60 cfs pumping station in conjunction with the completion of the Riverwood-Mills grade raise project will greatly enhance the City's ability to react to rapidly developing ice jams.

Four primary trigger points have been identified in terms of a potential ice jam:

- Forecast – temperature and precipitation.
- Monitoring of the river conditions – the stage of the river needs to be closely monitored at various locations throughout Bismarck and Burleigh County.
- Tributary ice pack monitoring – the Knife River and Heart River ice pack and ice melt should be closely monitored as snow melt or ice out precipitation events occur.
- Water surface elevations in South Bismarck are higher than expected in relation to the USGS Bismarck Gage reading.
- Monitoring of the USGS Mandan Gage elevations.

### ***Ice Jam Temporary Protective Measures (see Figure 2)***

#### Trigger:

- River Stage 12.0 ft. (1631.6 NAVD 88) at the Bismarck Gage *or* a corresponding water surface elevation of 1631.0 NAVD 88 in South Bismarck (*stage increase happens unusually fast followed by a continuing rise at both the Bismarck and Mandan gages*)

#### Actions:

- Activate Emergency Operations Center (EOC).
- Ice Jam Alert: Issue a public announcement for potential flooding and prepare a call for sandbagging volunteers.
- Closure of Stormwater Structures
  - Coordinate with Burleigh County on the closure of the Whisper Drive and Tavis Road gate structures.



- Closure of the four gates in three structures on Mills Avenue (Gates to be operated by City). See appendix.
- Closure of the one gate on Riverwood Drive and two gate valves on the east side of the parking lot between the Southport Loop entrances (Gate to be operated by City). See appendix.
- Ensure the Tavis Road pumping plant is fully operational.
- Ensure that the Washington Street gate is operational and could be closed in an emergency.
- Additional pumps and plugs will be called for to provide additional pumping capacity as needed to control internal drainage.

Trigger:

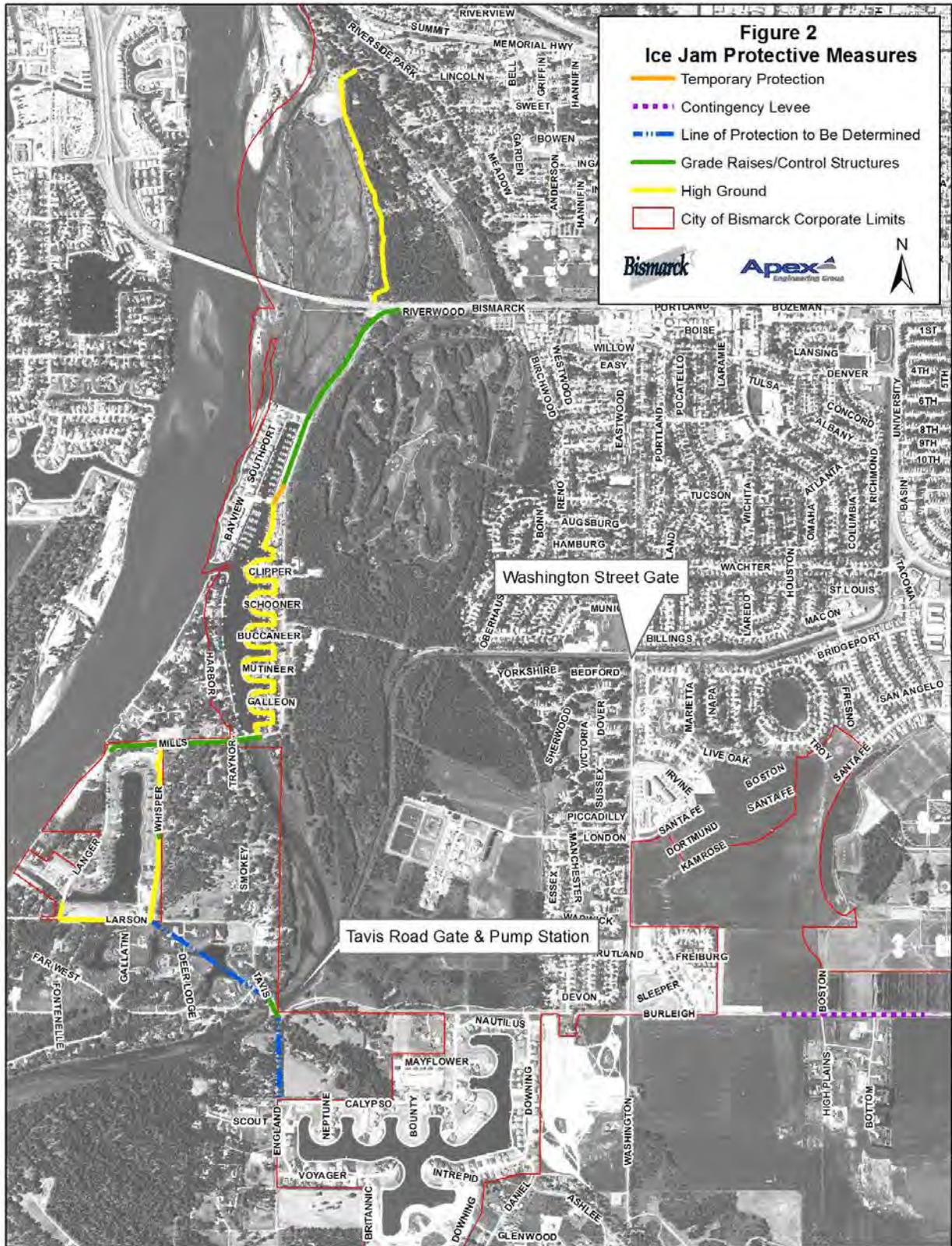
- River Stage 14.0 ft. (1633.6 NAVD 88) at the Bismarck Gage or a corresponding water surface elevation of 1633.0 NAVD 88 in Southport Bay.

Actions:

- Riverwood Drive
  - To prevent overtopping of Riverwood Drive at the Southport Loop South intersection, a small earthen levee or sandbag levee will be constructed between the existing berm and the high ground. Approximately 10,000 sandbags will be necessary for a levee with a width of six feet and an average height of 3 feet. This protection could also be constructed with a temporary flood barrier such as AquaFence.
  - The north driveway into the Pier parking lot is approximately 0.7-feet lower than the berm, but is above the 2009 ice jam stage; however this driveway shall be monitored during the event.
  - Plug the three storm water outfalls on Riverwood Drive in the Southport area. See appendix.
- Tavis Road/England Street
  - Coordinate with Burleigh County to monitor Tavis Road and England Street and possibly mobilize sandbagging to prevent overtopping.
- Close the four storm water outfall gates from Expressway Avenue north. See Figure 5.
- Install effluent pumping from the Wastewater Treatment Facility into the Tavis Road backwater area.
- Mobilize volunteers to fill sandbags at EOC designated locations.
- Depending on the location of the ice jam, it may be necessary to construct a contingency levee on Burleigh Avenue shown in Figure 2.

The **total estimated costs** of installation and removal of the identified temporary protective measures for the **Ice Jam Temporary Protective Measures is \$125,000.**





### **Open Water Floods**

The planning and implementation of temporary protective measures is normally more achievable during the standard open water flood due to the advanced warnings and the published release schedules from Garrison Dam. The buffer of Garrison Dam, or delay of above normal releases from Garrison Dam, allows time for the protective measures to be planned and constructed. For this report, it is assumed that sufficient time is available to construct temporary protective measures for the open water flood event.

In the 2011 event, flood protection measures were initiated immediately after high releases from Garrison Dam were announced by the US Army Corps of Engineers. In this instance, the announcement of higher releases allowed time for the construction of temporary measures; however, this may not be the case in all open water flood situations. The situation can exist that the reservoir is full, and the Corps does not anticipate increasing/releasing flows that would cause flood stages through Bismarck. In this situation, preliminary planning and implementation of the action plan may still be prudent as a full reservoir and a major precipitation event immediately upstream or downstream of the Garrison Dam could cause a flood event without sufficient time to construct temporary protective measures.

#### Missouri River Stages

The 2011 temporary flood protection measures were constructed to a certain flood stage (elevation) and adjusted accordingly along the river to match the anticipated river profile developed for the 2005 FEMA Flood Insurance Study (FIS). At the time of implementing the 2011 temporary measures, the FEMA FIS was the best available data. The 2011 observed river profile stages did not match the FEMA FIS profile; therefore the observed river profile stages will be used for planning temporary protective measures.

Temporary protective measures were investigated for flood stages of 16-feet and 20-feet. The actual observed 2011 river flood event profile was used as the baseline profile. The 2011 flood event resulted in a peak stage of 19.3-feet at the Bismarck Gage; therefore the 16-foot and 20-foot profiles were adjusted -3.3 and +0.7-feet respectively.



### Burleigh County Flood Protection

Burleigh County installed a gate well control structure and grade raise at Tavis Road in 2012. This flood protection was identified as Project Number 22 and was constructed to the 20-foot flood stage. The flood control gate was installed in 2012 and is functional for an open water flood. This flood control structure will be utilized in future flood fights and has been included in this Ice Jam and Flood Response Plan for open water floods.

Burleigh County and the City of Bismarck have completed the 60 cfs (27,000 gpm) pump station at Tavis Road. The permanent pump station is designed to pump surface water runoff from the South Bismarck watershed. When the Tavis Road and Mills Avenue gates are closed, a temporary flood control (pumping) reservoir is created in the wetland area upstream of Tavis Road.

Burleigh County has completed construction of the 48<sup>th</sup> Avenue grade raise which was identified in their Flood Annex Plan as the line of protection. Burleigh County is also identifying various permanent flood protection measures from Tavis Road to Whisper Drive and from Tavis Road to 48<sup>th</sup> Avenue. The exact location of these temporary protective measures will be identified immediately if an open water flood is predicted.

### City of Bismarck Flood Protection

Bismarck has completed the grade raises on Riverwood Drive and Mills Avenue and the installation of flood control gates on the major Missouri River outfalls. The Washington Street flood gate was rehabilitated in 2014 and is fully functional. The Washington Street gate is a backup measure for the Tavis Road flood control measures. The earthen berm between the north and south ends of Southport Loop was completed in 2014 to a stage of 17-feet.

## **Open Water Flood – 16 ft. Stage**

Properties within Southport or Whispering Bay do not experience overland flooding at a stage of 16-feet; therefore, the closures of the Southport and Whispering Bay Missouri River inlets are not required to prevent overland flooding from a 16-ft stage open water flood. However, preventing overtopping of Riverwood Drive is *essential* to maintain access to Southport and Fox Island.

### Trigger:

- The flood response and action plan is initiated immediately after the announcement of high releases from Garrison Dam that are forecast to produce a flood stage of 16 ft. in Bismarck.

### Actions: (see Figure 3)

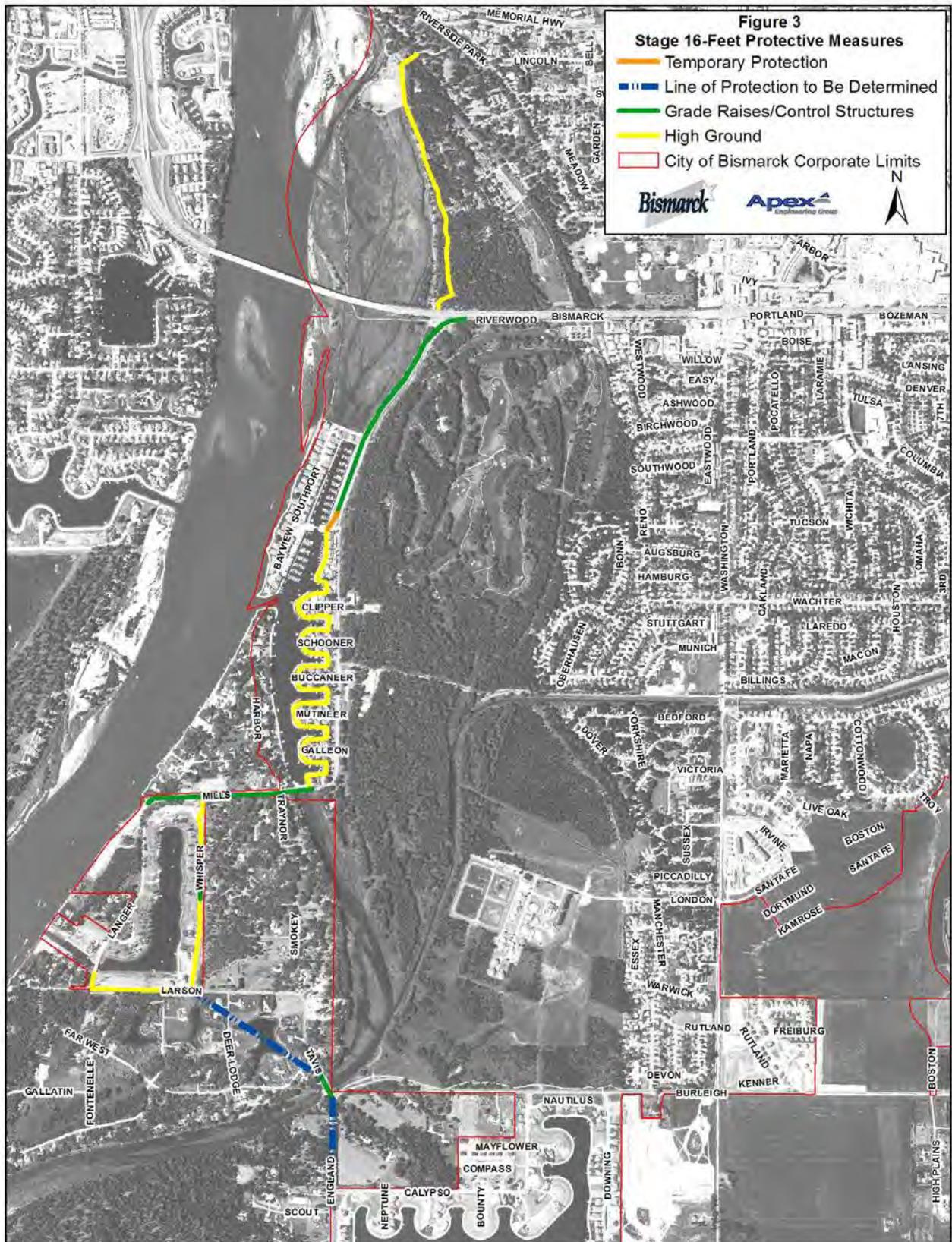
- Alert City Officials when river stage reaches 12.0 ft. concurrently with a forecast of future stage increases.
- Activate Emergency Operations Center.
- Mobilize volunteers to fill sand bags at EOC designated locations.



- Area north of Expressway Avenue
  - The existing ground through this area is higher than stage 16, but shall be monitored closely during such event.
  - Close four storm water outfall gates from Expressway Avenue north. See Figure 5.
- Riverwood Drive
  - To prevent overtopping of Riverwood Drive at the Southport Loop South intersection, a small earthen levee or sandbag levee will be constructed between the existing berm and the high ground. Approximately 10,000 sandbags will be needed for a levee with a width of six feet and an average height of three feet. This protection could also be constructed with a temporary flood barrier such as AquaFence.
  - The north driveway into the Pier parking lot is approximately 0.7-feet lower than the berm, but is above the 16-stage; however this driveway shall be monitored during the event.
  - Plug three storm water outfalls on Riverwood Drive in the Southport area. See appendix.
  - Closure of the one gate on Riverwood Drive and two gate valves on the east side of the parking lot between the Southport Loop entrances (Gates to be operated by City). See appendix.
- Closure of the four gates in three structures on Mills Avenue (Gates to be operated by City). See appendix.
- Coordinate with Burleigh County on the closure of the Whisper Drive and Tavis Road gate structures.
- Ensure the permanent pump station at Tavis Road is fully functioning and that the emergency generator is available.
- Ensure the backup flood control gate at Washington Street is fully functioning.
- Internal Drainage
  - See Pages 18-19 for the Internal Drainage plan common to both the 16-foot and 20-foot open water stages. The Internal Drainage plan includes the gate closures.
- Sandbags will be provided for any properties outside of the protected area. Sandbags will be provided in cooperation with Burleigh County.
- During the flood.
  - Provide dike patrols.
  - 24 hour alert for changing conditions.
  - Deliver sandbags to local problem points

The **total estimated costs** of installation and removal of the identified temporary protective measures for the **16 ft. Stage Open Water Flood is \$924,000.**





## Open Water Flood – 20 ft. Stage

### Trigger:

- The flood response and action plan is initiated immediately after the announcement of high releases from Garrison Dam that are forecast to produce a flood stage of 20 ft. in Bismarck.

### Actions: (see Figure 4)

- Alert City Officials when river stage reaches 12.0 ft. concurrently with a forecast of future stage increases.
- Activate Emergency Operations Center.
- Mobilize volunteers to fill sand bags at EOC designated locations. These bags will be used for specific protection points identified by this response plan.
- Area north of Expressway Ave
  - This area was identified as Segment A in the 2011 open water flood event. Only a small portion of the temporarily constructed protective measures had water against the levee at the peak river stage of 19.3-feet. A small earthen levee or HESCOE barriers will be constructed in this reach along the 2011 alignment.
- Riverwood Drive
  - This area was identified as Segment B in the 2011 open water flood event. The newly constructed grade raise allows for the installation of HESCOE barriers on the west side of the roadway while maintaining access on Riverwood Drive.
- Southport Levee and Closure of Southport Inlet
  - An earthen barrier or HESCO barrier or sandbag levee will be constructed along the north side of Southport Loop to the river side of Southport and extended south to the bay inlet. Approximately 175,000 sandbags will be needed for a levee with a width of eight feet and an average height of four feet.
  - The culvert through the north leg of Southport Loop that provides freshening water to Southport Bay will be plugged for the duration of the flood.
  - The property located on the northwest corner of Southport will receive sandbags for flood protection due to the close proximity to the bank on the north side of the structure.
  - The Southport inlet will be closed with a sheet piling plug. Approximately 7,000 square feet of sheet piling will be needed.
  - An earthen, HESCO, or sandbag barrier will be constructed along the westerly perimeter of Southport along the northern portion of Harbor Drive immediately south of the Southport Bay inlet. Approximately 12,000 sandbags will be needed for a levee with a width of four feet and an average height of two feet. Burleigh County has identified construction of protective measures on Harbor Drive south to Mills Avenue, in their Flood Annex Plan.
- Whispering Bay Development
  - An earthen barrier or HESCO barrier or sandbag levee will be constructed along the west side of Langer Lane with the final location being coordinated with Burleigh County.



- The Whispering Bay inlet will be closed with an earthen plug. Approximately 7,500 CY of material will be needed.
- Coordinate with Burleigh County on the closure of the Whisper Drive and Tavis Road gate structures and the operation of the Tavis Road pumping station.
- Internal Drainage
  - See Pages 18-19 for the Internal Drainage plan common to both the 16-foot and 20-foot stage open water flood events. The Internal Drainage plan includes the gate closures.
  - Operate the Tavis Road Pump Station for the duration of the flood event to control internal drainage.
  - Ensure the backup flood control gate at Washington Street is fully functioning.
- Bismarck property not protected
  - Sandbags will be provided for any properties outside of the protected area in coordination with Burleigh County.
- During the flood.
  - Provide dike patrols.
  - 24 hour alert for changing conditions.
  - Deliver sandbags to local problem points

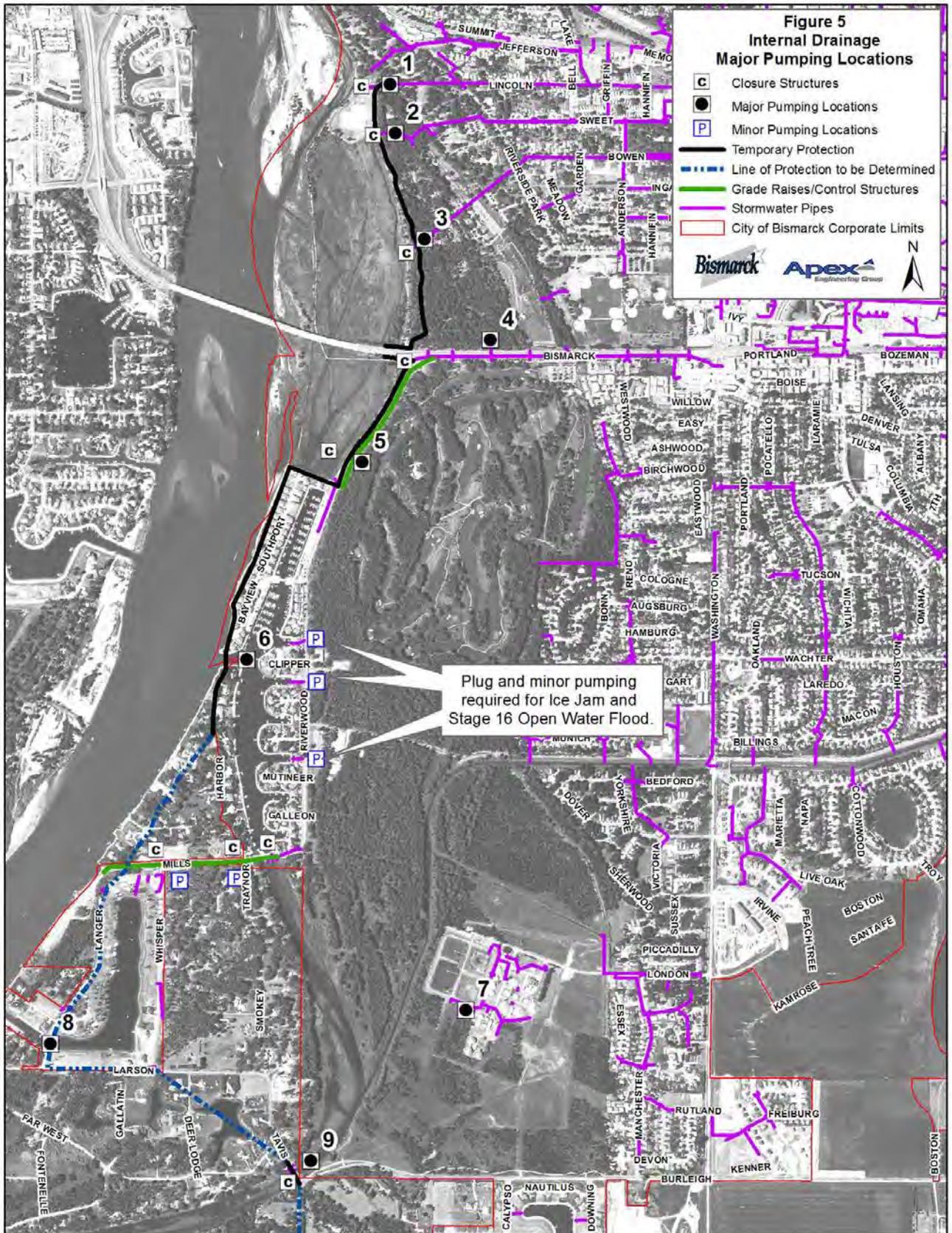
The **total estimated costs** of installation and removal of the identified temporary protective measures for the **20 Ft. Stage Open Water Flood** is **\$5,900,000**.



**Open Water Flood Events – Internal Drainage** (see Figure 5)

Figure 5 identifies the major storm water plugging and pumping locations and the minor pumping locations as well as the major flood control gates. Site Number 9 is the location of the fully functioning permanent Tavis Road pumping station which has a capacity of 60 cfs. The Tavis Road plant will be operated by the County. All other internal drainage must be pumped utilizing temporary portable pumps. The gates located in Riverwood Drive and Mills Avenue are to be operated by the City. The recommended pump sizes are based on discussions with City staff about the 2011 pumping. The opinion of costs for the 16-ft and 20-ft stage open water floods includes the temporary plugging, pumping, and operation and maintenance for three months.

| Site | Temporary Pumps               |
|------|-------------------------------|
| 1    | 2-8" Pumps                    |
| 2    | 2-8" Pumps                    |
| 3    | 1-6" Pump & 1-8" Pump         |
| 4    | 2-3" Pumps                    |
| 5    | 1-6" Pump                     |
| 6    | 1-10" Pump                    |
| 7    | WW Treatment Plant 2-6" Pumps |
| 8    | 1-10" Pump                    |



## Communication Plan

During all flood scenarios identified in the report, internal communication, plus timely and accurate reports to the public is imperative. We recommend that the City of Bismarck EOC Emergency Public Information Group as adopted December 6, 2010 be activated and implemented as soon as a flood threat is identified.

## Coordination with Burleigh County

The various components of the three flood scenarios outlined in this plan, are contingent on the actions taken by Burleigh County in the Fox Island area and south of Burleigh Avenue. Burleigh County has adopted a temporary protection plan. Because the first lines of flood defense are west and south of the City boundaries on Fox Island, the various components of the three flood scenarios outlined in this plan, are contingent on the actions taken by Burleigh County. A City/County coordinated plan in this area will avoid duplication of flood fighting efforts and eliminate unnecessary sandbagging behind the levee system.

## Evacuation Plan

In the event of a major flood that requires the evacuation of a large portion of South Bismarck, a plan should be in place that coordinates the orderly evacuation of residents. The plan would be under the direction and control of the Bismarck Police Department, who would execute road closures and temporary one-way travel on key arterials during the evacuation process.

A second element of the evacuation plan would involve the shut-down of critical water and sewer services in the evacuated areas to preserve the integrity of underground infrastructure.



# Appendix

| NAME                                      |                     |                            |                            |
|---|---------------------|----------------------------|----------------------------|
| Clear Zone Distance: 14'                  | Design Speed: 25/35 |                            |                            |
| Minimum Sight Dist. for Stopping: 250'    | Bridges: N/A        |                            |                            |
| Minimum Sight Dist. for Safe Passing: N/A |                     |                            |                            |
| Sight Dist. for No Passing Zone: N/A      |                     |                            |                            |
| Pavement Design Life 20 (years)           |                     |                            |                            |
| DESIGN DATA (ADT)                         |                     |                            |                            |
| Traffic                                   | Mills Ave           | Riverwood Dr (N/S portion) | Riverwood Dr (E/W portion) |
| Current 2009                              | Total: 1465         | Total: 2565                | Total: 3800                |
| Forecast 2029                             | Total: 1975         | Total: 3455                | Total: 5120                |

# JOB # 37

## CITY OF BISMARCK

### MILLS AVENUE & RIVERWOOD DRIVE

AC-CER-1-981(099)109

DDIR No. 981-1

Event No. 11-2A  
FHWA Limited Involvement

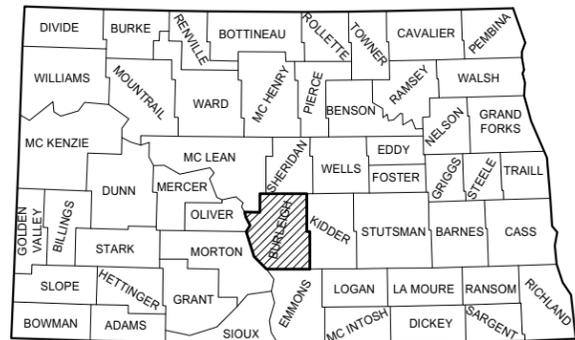
Mills Avenue - Fox Island Boat Ramp to Riverwood Drive  
Riverwood Drive - Mills Avenue to Washington Street  
Bismarck, Burleigh County, North Dakota

Grading, Salvaged Base Course, Hot Bituminous Pavement, Curb  
& Gutter, Storm Sewer, Outlet Structures, Lighting, Signing,  
Marking & Incidentals

GOVERNING SPECIFICATIONS:  
Standard Specifications adopted by the North Dakota  
Department of Transportation October 2008; Standard Drawings  
currently in effect; and other Contract Provisions submitted herein.

| PROJECT NUMBER \ DESCRIPTION | NET MILES  | GROSS MILES |
|------------------------------|------------|-------------|
| AC-CER-1-981(099)109         | 2.49 Miles | 2.49 Miles  |

| STATE | PROJECT NO.          | PCN   | SECTION NO. | SHEET NO. |
|-------|----------------------|-------|-------------|-----------|
| ND    | AC-CER-1-981(099)109 | 19992 | 1           | 1         |



STATE COUNTY MAP



Flood Response and Action  
Plan Comments  
Added 3-23-2015

All coordinates are Burleigh County ground coordinates.  
They are derived from the "North Dakota Coordinate System of 1983",  
NAD83(CORS) North Zone Combination Factor (cf) = 0.9998515  
NAVD-88

| DESIGNERS                 |
|---------------------------|
| Jason P. Gullicks, PE     |
| Scott Schneider, PE, CFM  |
| Jennifer Malloy, PE, LSIT |
| Sarah Mohl                |



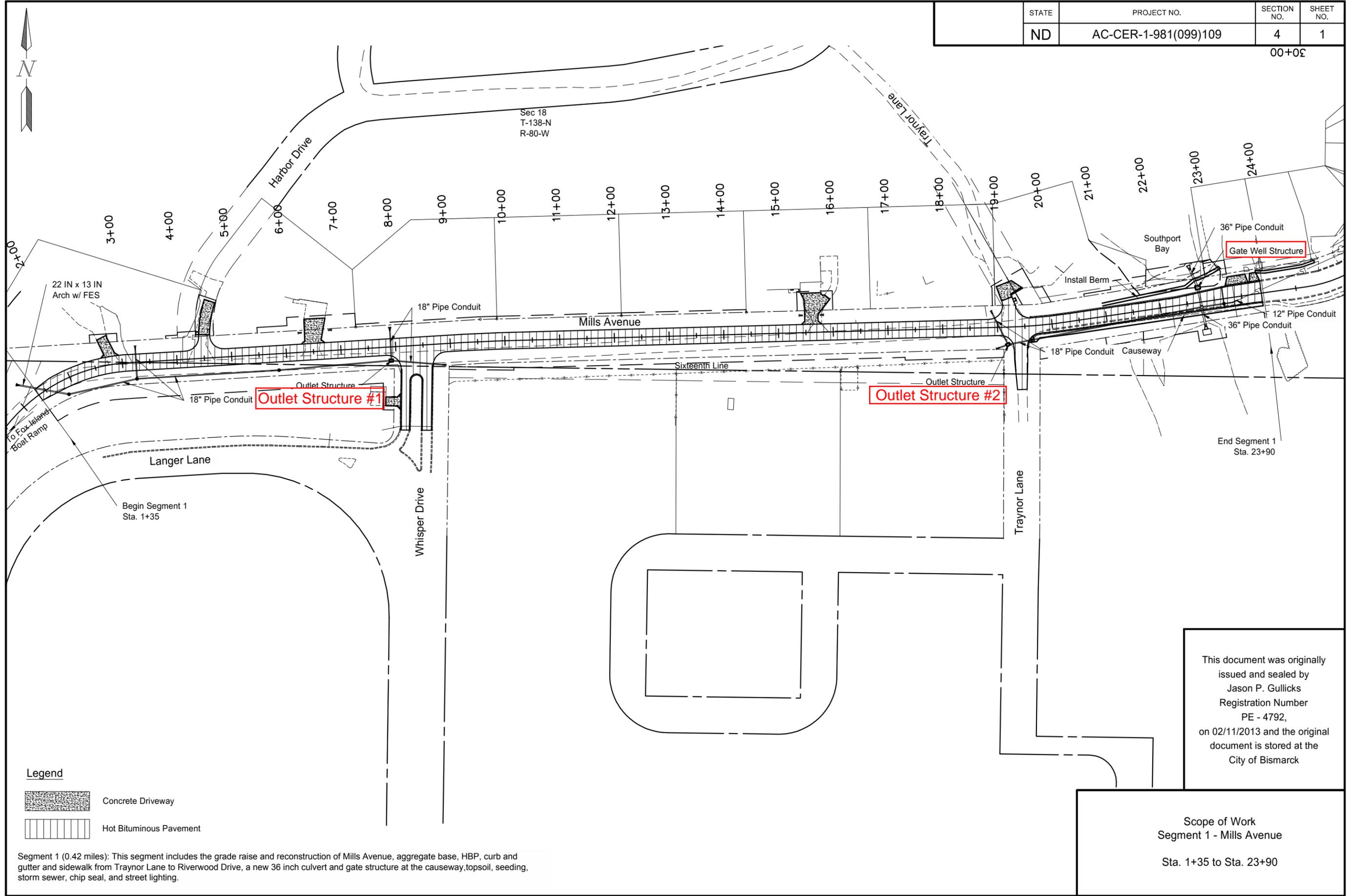
| APPROVAL OF CITY ENGINEER   |
|---|
| I, Melvin J. Bullinger, P.E., City Engineer, for the City of Bismarck, North Dakota, hereby approve these plans for Mills Avenue & Riverwood Drive, Project Number AC-CER-1-981(099)109 as shown on the accompanying plans. |
| APPROVED DATE 02/11/2013  |
| Melvin J. Bullinger /s/   |
| Melvin J. Bullinger, PE<br>City Engineer<br>Bismarck, North Dakota  |

|   |
|---|
| This document was originally issued and sealed by<br>Melvin J. Bullinger<br>Registration Number<br>PE - 2204,<br>on 02/11/2013 and the original document is stored at the<br>City of Bismarck |
|---|

|  |
|--|
| I hereby certify that the attached plans were prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the state of ND. |
| APPROVED DATE 02/11/2013   |
| Jason P. Gullicks /s/  |
| Jason P. Gullicks, PE<br>Apex Engineering Group  |

|   |
|---|
| This document was originally issued and sealed by<br>Jason P. Gullicks<br>Registration Number<br>PE - 4792,<br>on 02/11/2013 and the original document is stored at the<br>City of Bismarck |
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|       |                      |             |           |
|-------|----------------------|-------------|-----------|
| STATE | PROJECT NO.          | SECTION NO. | SHEET NO. |
| ND    | AC-CER-1-981(099)109 | 4           | 1         |

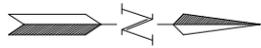


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Scope of Work  
 Segment 1 - Mills Avenue  
 Sta. 1+35 to Sta. 23+90

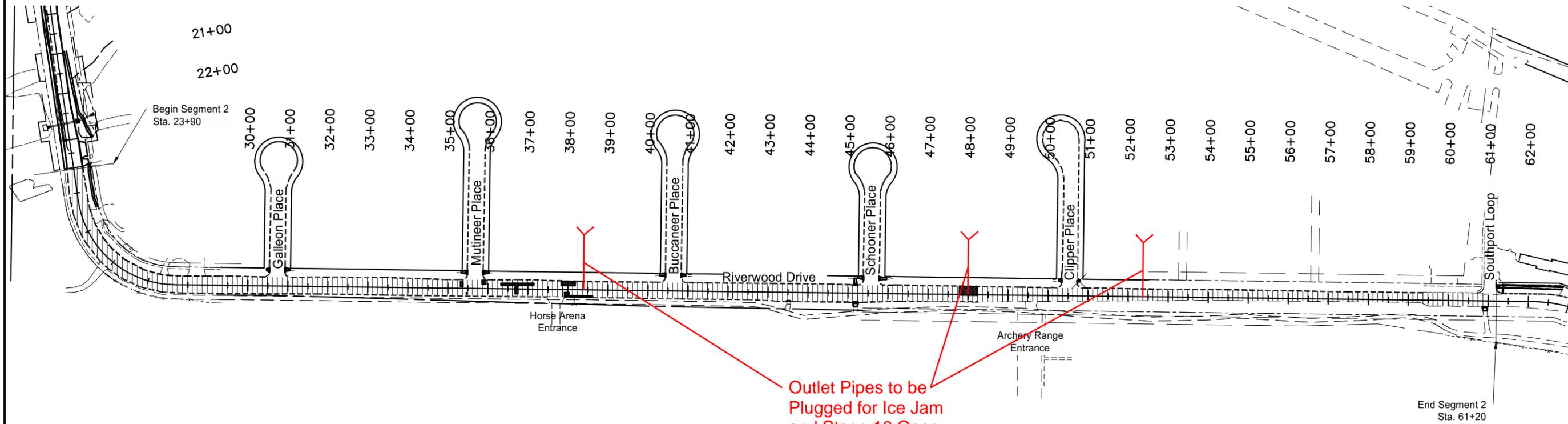
- Legend**
-  Concrete Driveway
  -  Hot Bituminous Pavement

Segment 1 (0.42 miles): This segment includes the grade raise and reconstruction of Mills Avenue, aggregate base, HBP, curb and gutter and sidewalk from Traynor Lane to Riverwood Drive, a new 36 inch culvert and gate structure at the causeway, topsoil, seeding, storm sewer, chip seal, and street lighting.



|       |                      |             |           |
|-------|----------------------|-------------|-----------|
| STATE | PROJECT NO.          | SECTION NO. | SHEET NO. |
| ND    | AC-CER-1-981(099)109 | 4           | 2         |

Sec 18  
T-138-N  
R-80-W



Outlet Pipes to be  
Plugged for Ice Jam  
and Stage 16 Open  
Water Flood

**Legend**

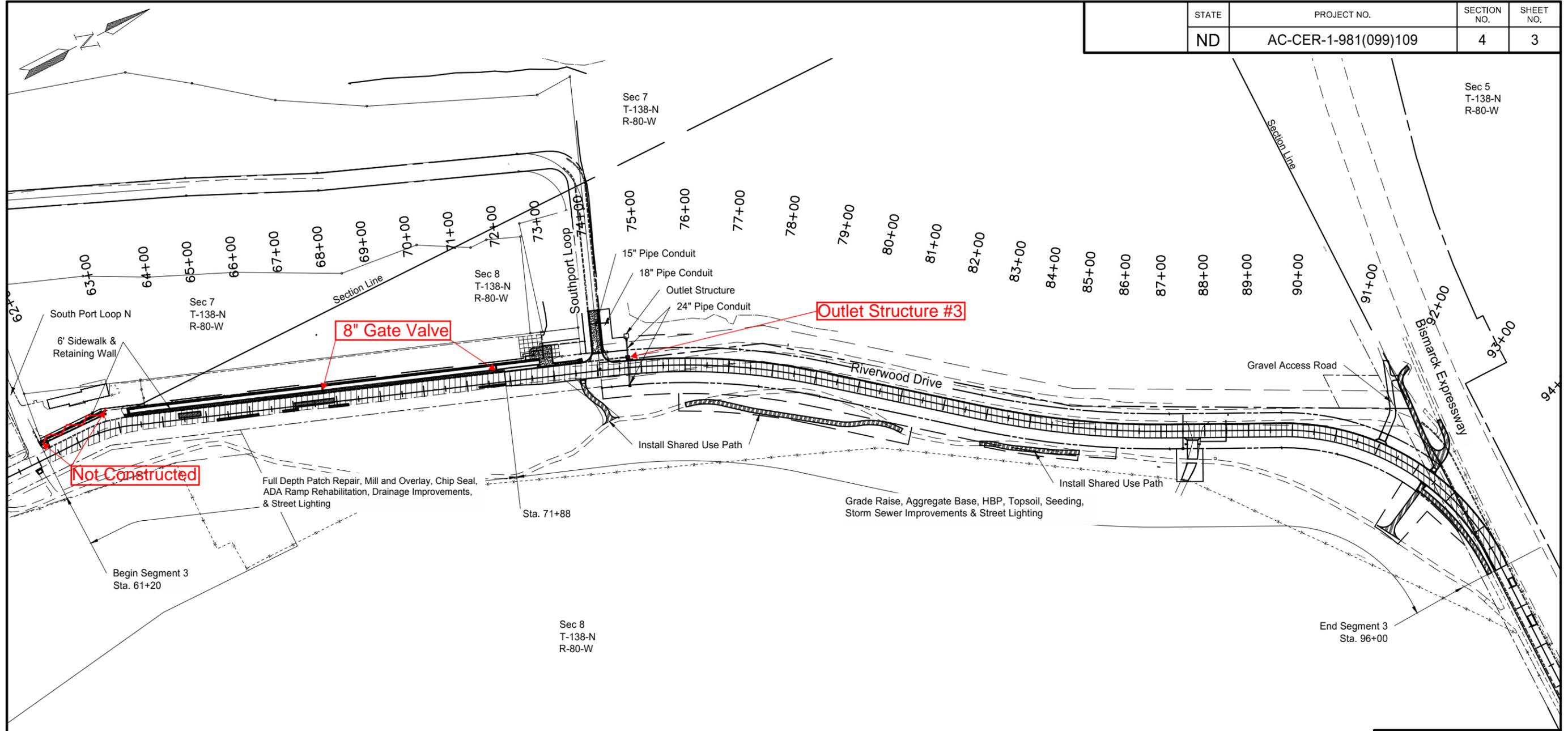
-  Full Depth Patch Repair Locations
-  Milling & Hot Bituminous Pavement Overlay

Segment 2 (0.71 miles): This segment is located on Riverwood Drive between Mills Avenue and Southport Loop (south entrance) and includes full depth patch repair, mill and overlay, chip seal, ADA ramp rehabilitation, drainage improvements, full depth patch repair of a portion of the shared use path, and street lighting.

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Scope of Work  
Segment 2 - Riverwood Drive  
Sta. 23+90 to Sta. 61+20

|       |                      |             |           |
|-------|----------------------|-------------|-----------|
| STATE | PROJECT NO.          | SECTION NO. | SHEET NO. |
| ND    | AC-CER-1-981(099)109 | 4           | 3         |



**Not Constructed**

**8" Gate Valve**

**Outlet Structure #3**

**Legend**

-  Concrete Driveway
-  Shared Use Path
-  Full Depth Patch Repair
-  Hot Bituminous Pavement

Segment 3 (0.67 miles): This segment is located on Riverwood Drive between Southport Loop (south entrance) to the east - west portion of Riverwood Drive and includes mill and overlay, grade raise with roadway reconstruction, chip seal, culvert and outlet structure, shared use path reconstruction, temporary levee removal, and street lighting.

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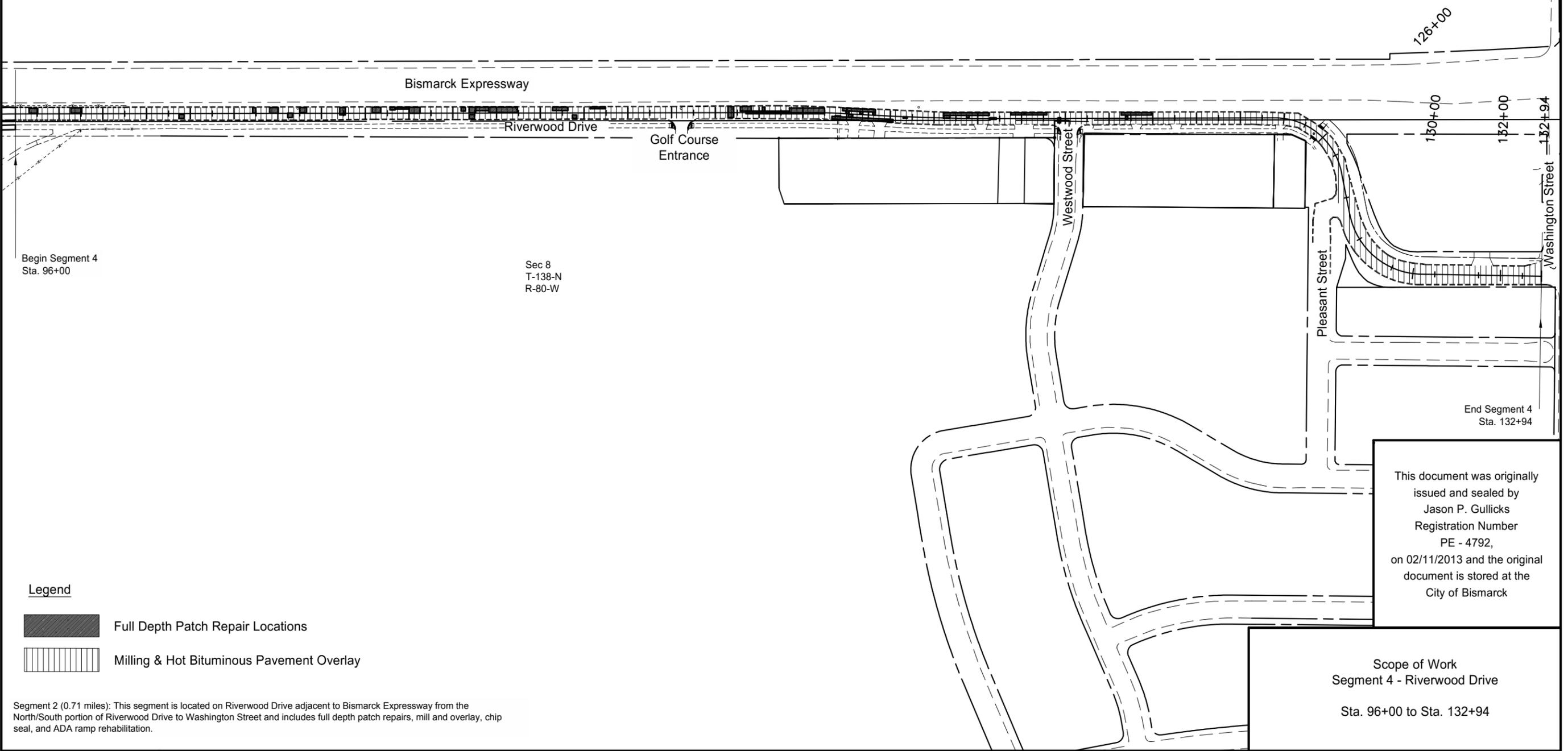
**Scope of Work**  
**Segment 3 - Riverwood Drive**  
 Sta. 61+20 to Sta. 96+00



|       |                      |             |           |
|-------|----------------------|-------------|-----------|
| STATE | PROJECT NO.          | SECTION NO. | SHEET NO. |
| ND    | AC-CER-1-981(099)109 | 4           | 4         |

Sec 5  
T-138-N  
R-80-W

96+00 97+00 98+00 99+00 100+00 101+00 102+00 103+00 104+00 105+00 106+00 107+00 108+00 109+00 110+00 111+00 112+00 113+00 114+00 115+00 116+00 117+00 118+00 119+00 120+00 121+00 122+00 123+00 124+00 125+00



Begin Segment 4  
Sta. 96+00

Sec 8  
T-138-N  
R-80-W

End Segment 4  
Sta. 132+94

**Legend**

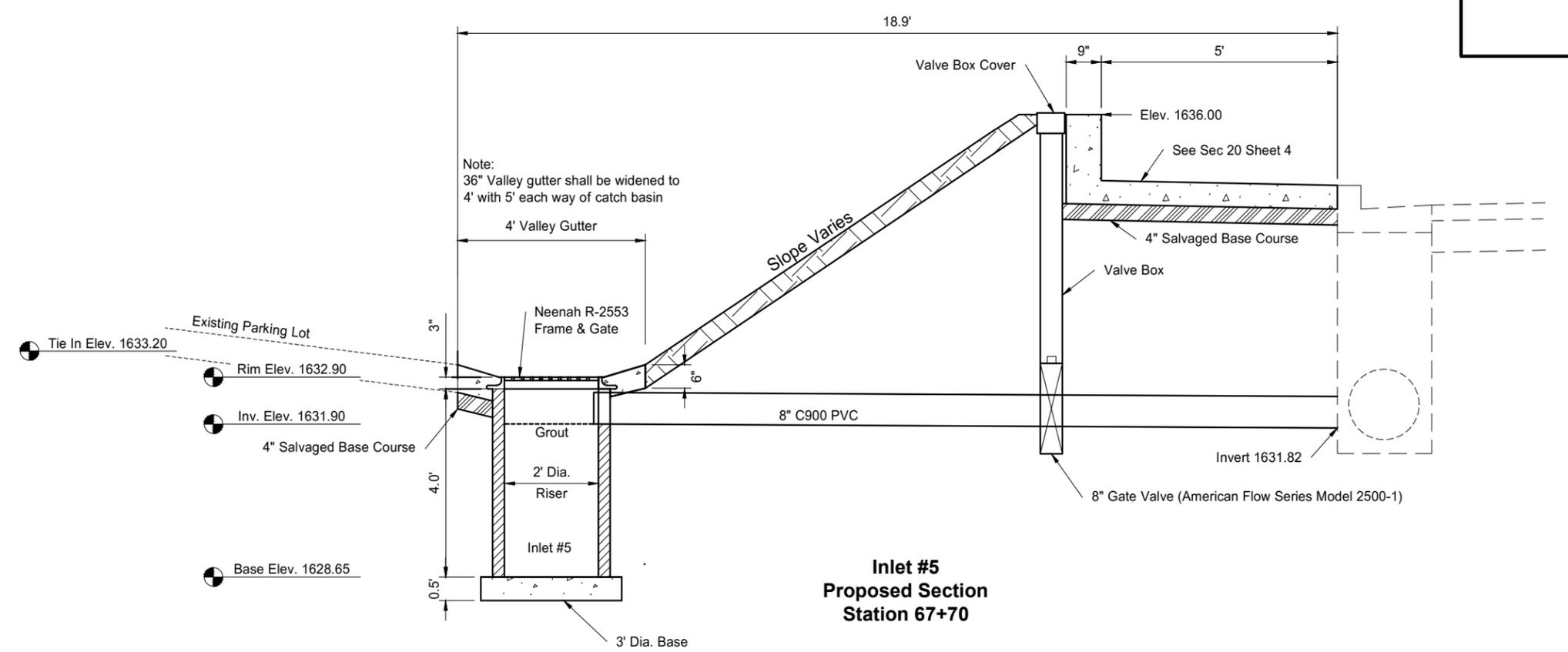
-  Full Depth Patch Repair Locations
-  Milling & Hot Bituminous Pavement Overlay

Segment 2 (0.71 miles): This segment is located on Riverwood Drive adjacent to Bismarck Expressway from the North/South portion of Riverwood Drive to Washington Street and includes full depth patch repairs, mill and overlay, chip seal, and ADA ramp rehabilitation.

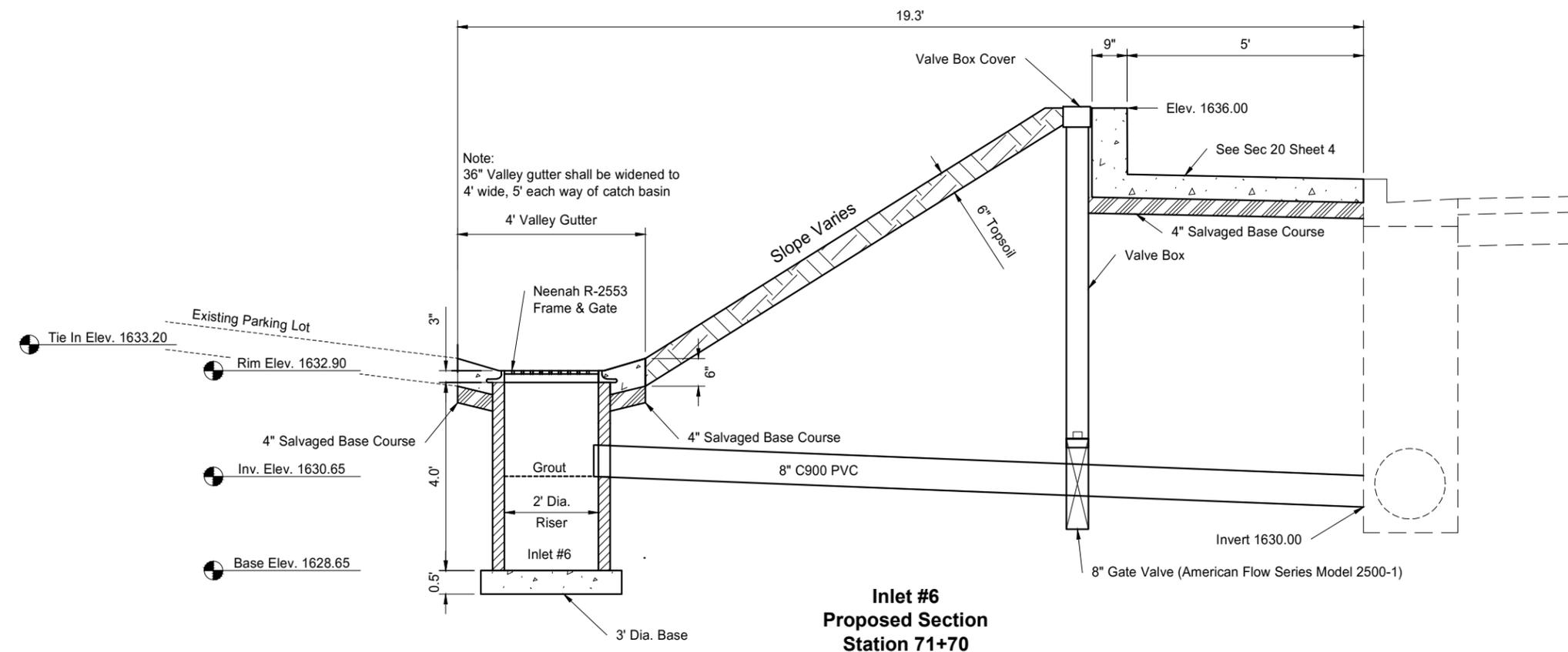
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Scope of Work  
Segment 4 - Riverwood Drive  
Sta. 96+00 to Sta. 132+94

|       |                      |             |           |
|-------|----------------------|-------------|-----------|
| STATE | PROJECT NO.          | SECTION NO. | SHEET NO. |
| ND    | AC-CER-1-981(099)109 | 20          | 1         |



**Inlet #5  
Proposed Section  
Station 67+70**

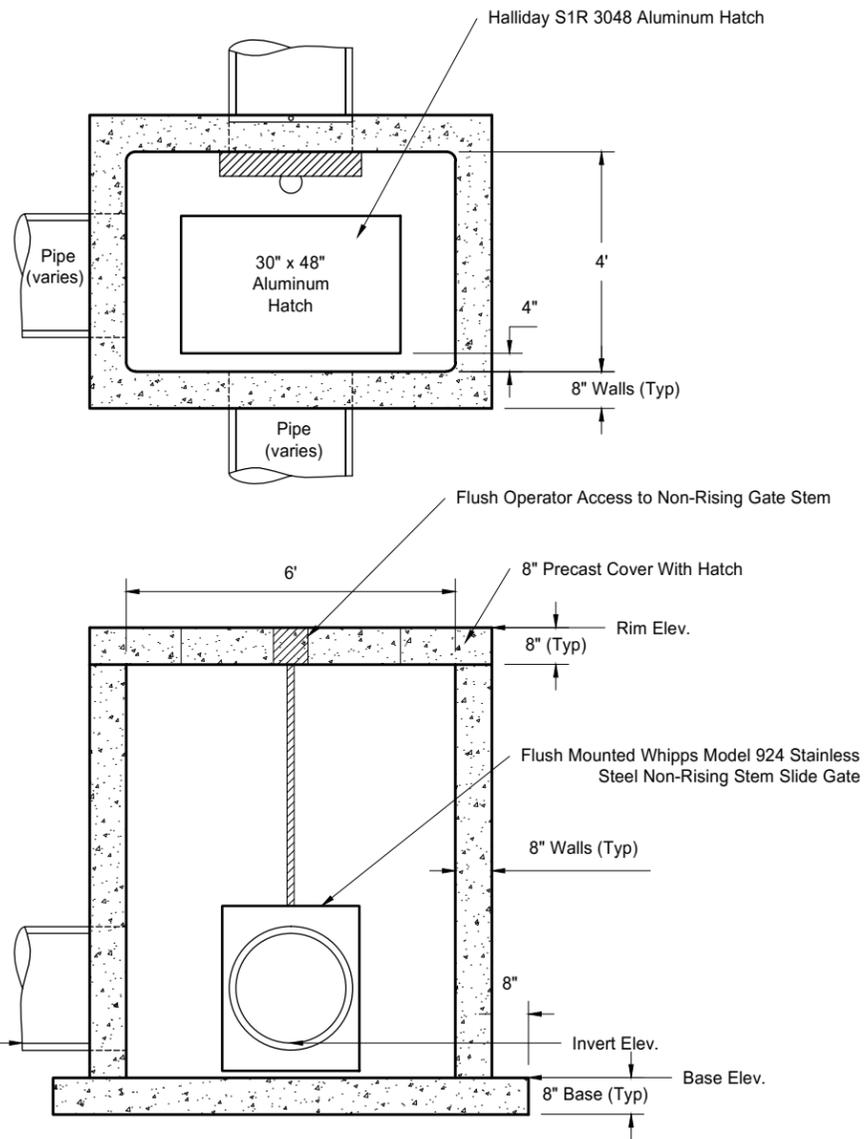


**Inlet #6  
Proposed Section  
Station 71+70**

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Pier Parking Lot Drainage Details

| Outlet Structure # | Centerline Station | Offset    | Rim Elev. | Base Elev. | Dir | Pipe Size | Gate Loc | Width of Gate Opening | Pipe Invert |
|--------------------|--------------------|-----------|-----------|------------|-----|-----------|----------|-----------------------|-------------|
| 1                  | 7+91.87            | 25.02 Rt. | 1637.5    | 1629.98    | N   | 18"       | Gate     | 25"                   | 1630.65     |
|                    |                    |           |           |            | E   | 18"       | Gate     | 25"                   | 1630.65     |
|                    |                    |           |           |            | S   |           |          |                       |             |
|                    |                    |           |           |            | W   | 18"       |          |                       | 1630.65     |
| 2                  | 19+21.64           | 29.91 Rt. | 1637.5    | 1630.48    | N   | 18"       | Gate     | 25"                   | 1631.15     |
|                    |                    |           |           |            | E   | 18"       |          |                       | 1631.15     |
|                    |                    |           |           |            | S   |           |          |                       |             |
|                    |                    |           |           |            | W   | 18"       |          |                       | 1631.25     |
| 4                  | 74+70.93           | 23.64 Lt. | 1638.39   | 1627.78    | NE  |           |          |                       |             |
|                    |                    |           |           |            | SE  | 24"       |          |                       | 1628.55     |
|                    |                    |           |           |            | SW  | 18"       |          |                       | 1628.55     |
|                    |                    |           |           |            | W   | 24"       | Gate     | 32"                   | 1628.45     |



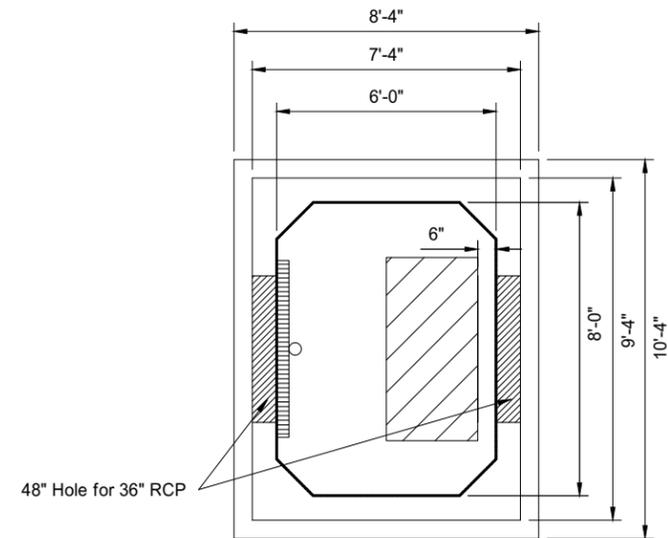
Outlet Structure (Typical)  
6'x4' Precast Manhole

Notes:  
 1. Wall openings for pipes requiring gates shall have a maximum diameter equal to the "Width of Gate Opening".  
 2. Where gates are to be installed Reinforced Concrete Pipes shall be sawed flush with the interior wall of the structure

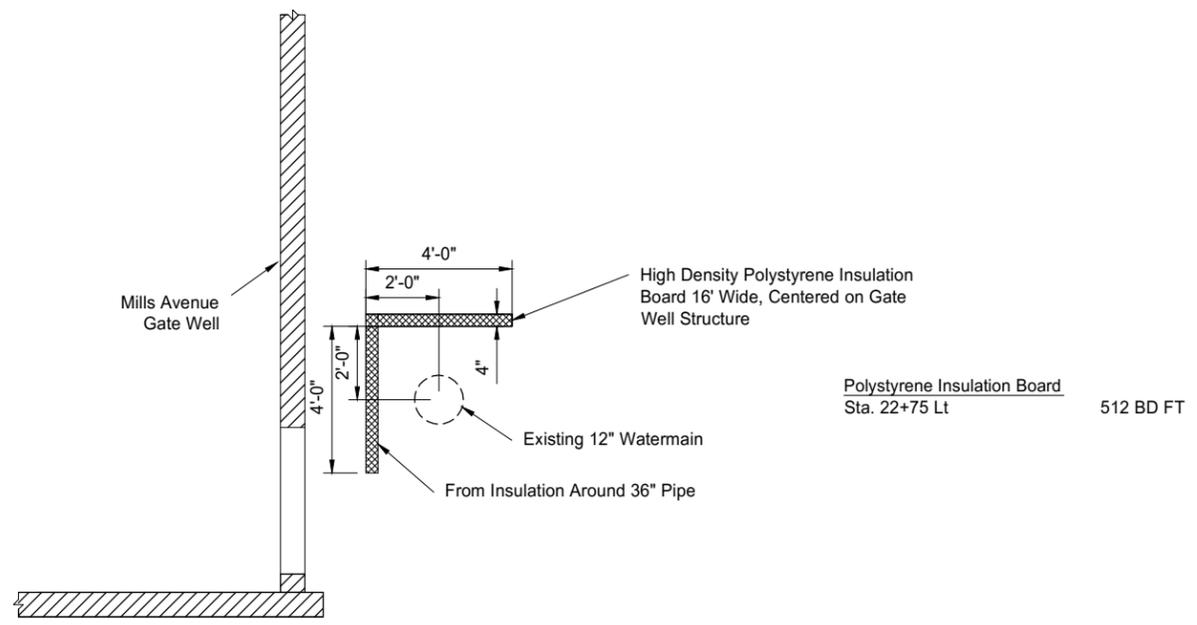
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Outlet Structure  
 Riverwood Drive & Mills Avenue  
 General Details

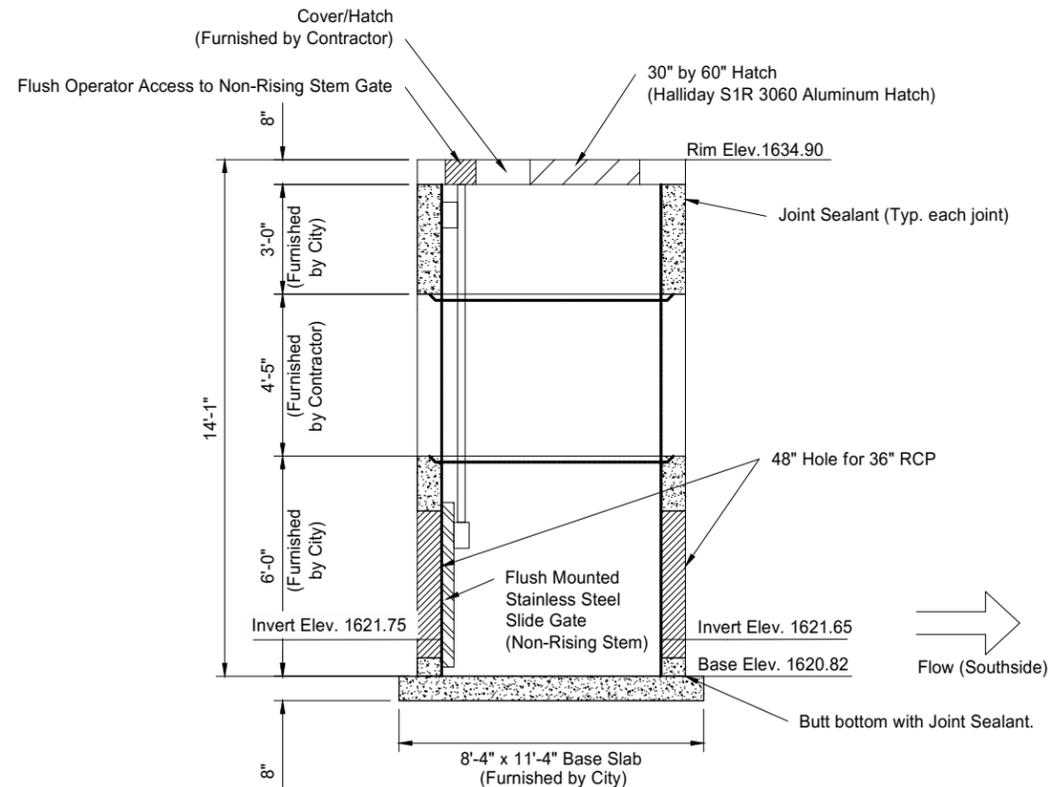
|       |                      |             |           |
|-------|----------------------|-------------|-----------|
| STATE | PROJECT NO.          | SECTION NO. | SHEET NO. |
| ND    | AC-CER-1-981(099)109 | 20          | 3         |



Mills Avenue Gate Well - Plan View



Existing Water Line Insulation Board Detail  
Sta. 22+75 Lt.

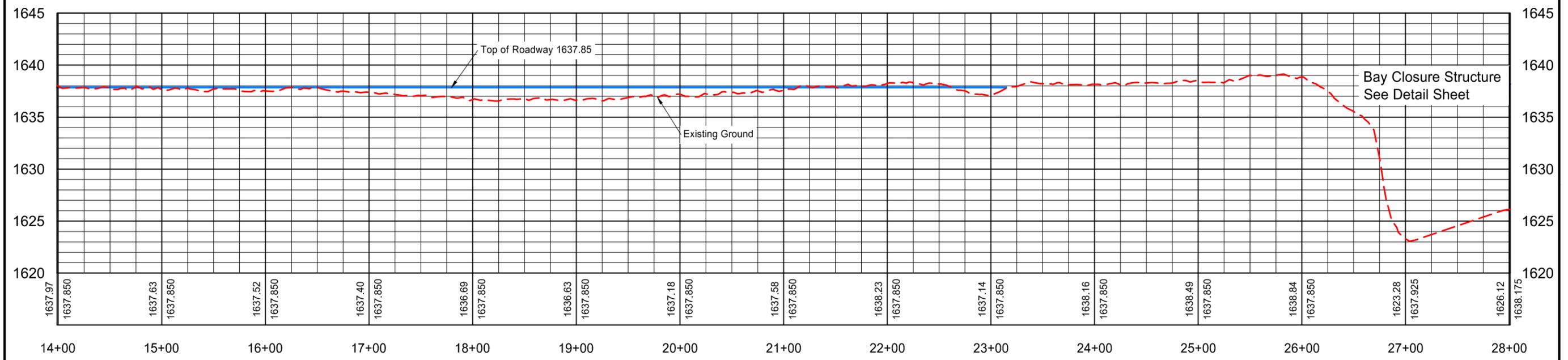
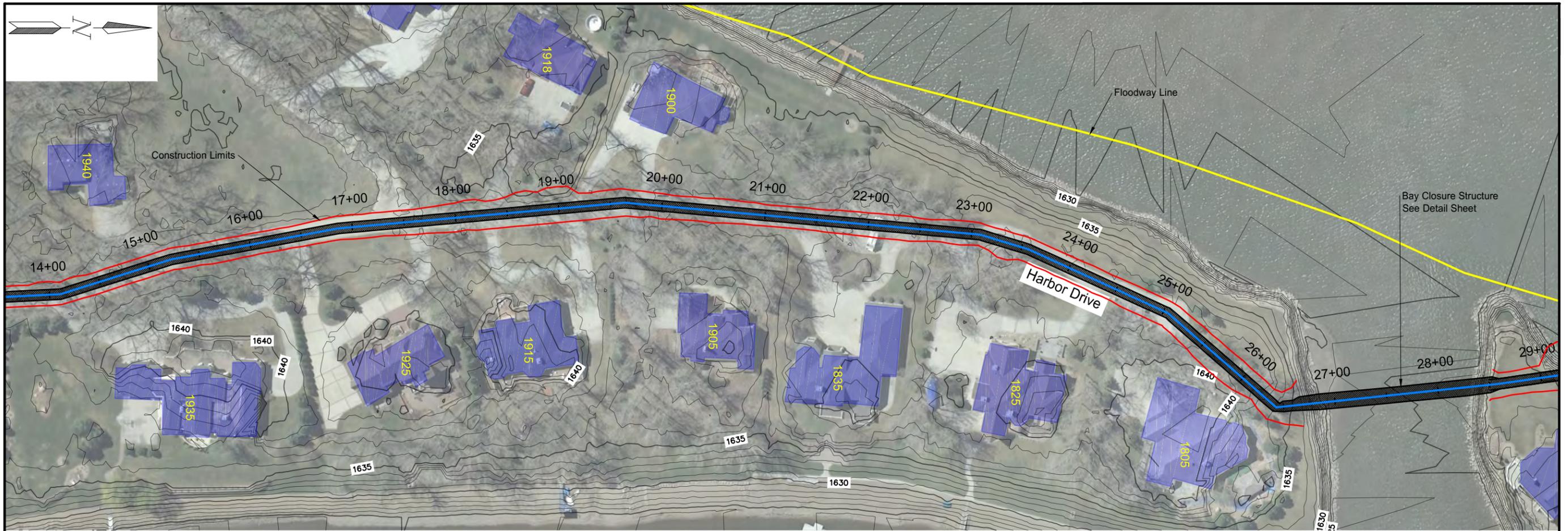


Mills Avenue Gate Well - Elevation View  
Structure #3  
Sta. 22+75

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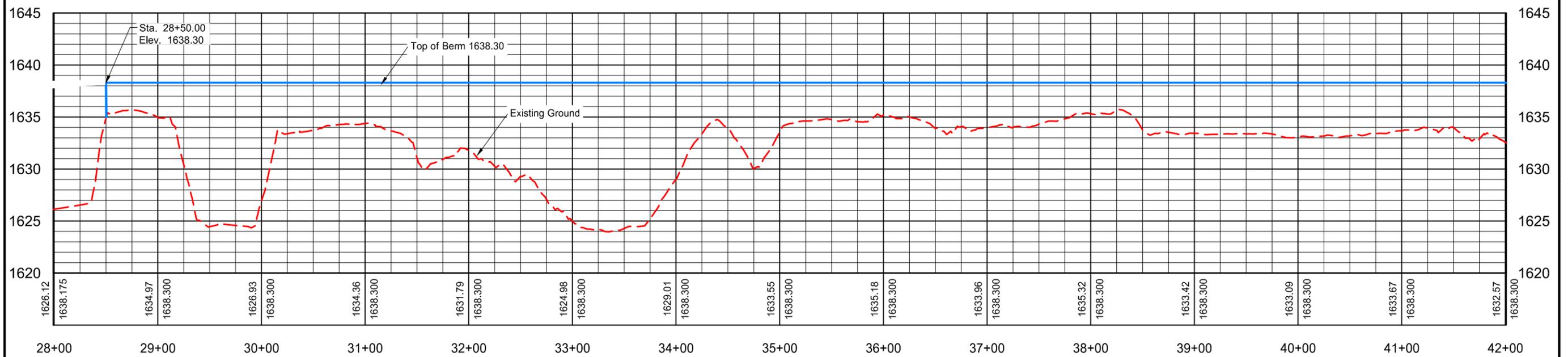
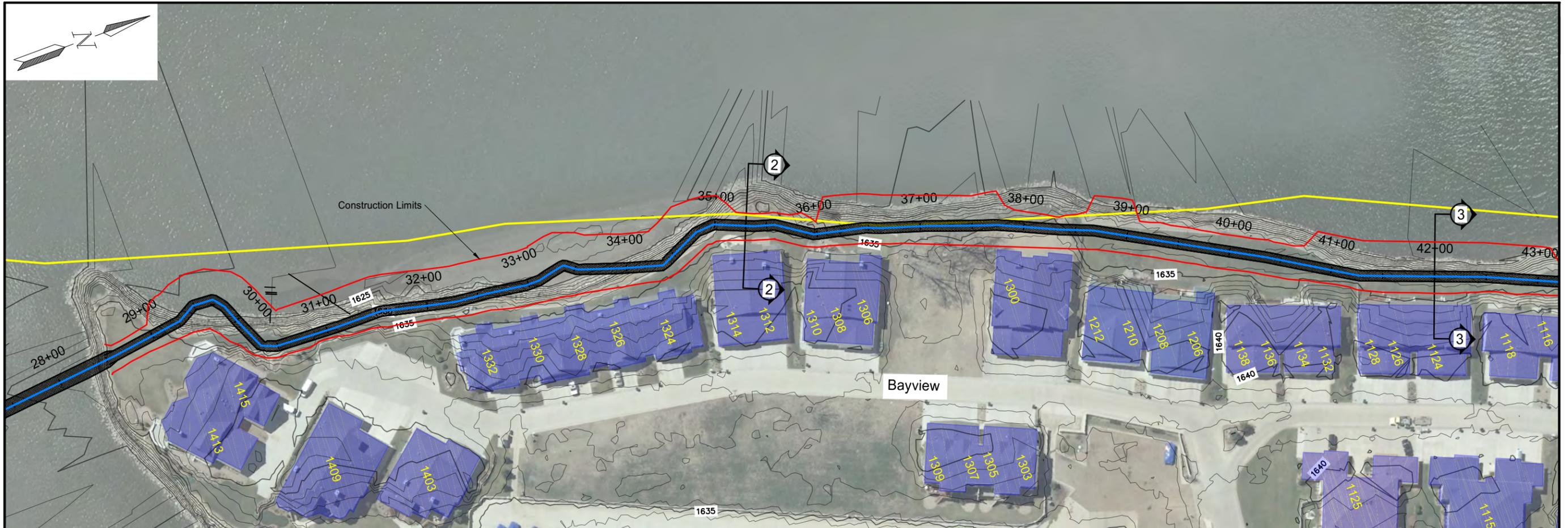
NOTE:  
Where gates are to be installed Reinforced Concrete Pipes shall be sawed flush with the interior wall of the structure

Gate Well  
General Details



Plan and Profile  
 Southport Permanent Flood Protection  
 Sta. 14+00 to Sta. 28+00

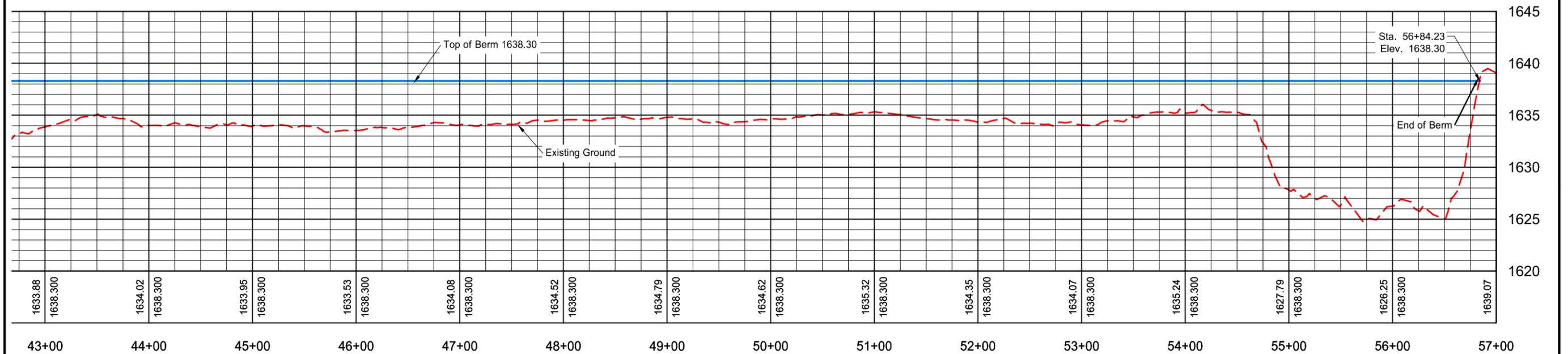
PRELIMINARY  
 NOT FOR CONSTRUCTION



Plan and Profile  
 Southport Permanent Flood Protection  
 Sta.28+00 to Sta. 42+00

PRELIMINARY  
 NOT FOR CONSTRUCTION





Plan and Profile  
 Southport Permanent Flood Protection  
 Sta. 42+00 to Sta. 56+00

PRELIMINARY  
 NOT FOR CONSTRUCTION