



# TECHNICAL MEMORANDUM

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**TO:** John Kuntz, P.E., City Engineer

**FROM:** Drew O. Flamion, P.E., Project Manager, Commonwealth Engineers, Inc.  
Travis S. Harper, E.I., Commonwealth Engineers, Inc.  
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**DATE:** 4/4/2022

**SUBJECT:** Showers Property Drainage Study – D21138  
“Summary of Findings”

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## Showers Property Drainage Study

### A. Preface

The City of Shelbyville has a history of documented flash flooding within the southwest corner of the City. Large open farm field areas, located outside of City incorporated limits, drain southeast to the State Road 44 and Miller Road intersection area. At this intersection, the drainage enters the City’s incorporated limits and drains to the City’s problematic Glessner Ditch area.

The City’s 2011 Stormwater Master Plan identified four (4) problem areas associated with Glessner Ditch. Problems identified in the report included insufficient storm sewers, flooding and/or backwater effects from Glessner Ditch, houses constructed in legal drain area, no outlet for sump pumps and street flooding. Since that time, the City has been approached by investors looking to develop the northwest corner of State Road 44 and Miller Road area. This northwest vacant property is termed the “Showers Property.”

The City has concerns that the added development could increase flooding downstream. The City stated that Glessner Ditch lacks property rights and or easements to control or maintain the downstream channel. Private property owner obstructions, such as bridges or landscaping, are located within floodway areas. Commonwealth field investigations further identified ditch and culvert sedimentation issues due to limited slope and backwater settling affects. Multiple factors are compounding the flooding and any potential increase in flow, could exasperate the issue.

The City hired Commonwealth Engineers, Inc. (CEI) to complete a technical evaluation of the Showers Property. The intent is to re-direct all flows, near the State Road 44 and Miller Road intersection area, north to the Big Blue River, to reduce flow to the lower

Glessner Ditch flood areas. The City can then re-evaluate downstream Glessner Ditch flooding to assess future additional needs.

The technical evaluation consist of the following:

1. Glessner Ditch Watershed Basin and Study Area
2. Project Kick-off Meeting
3. Data Collection, Conceptual Design Basis and Existing Structure Condition Review
4. Hydrologic / Hydraulic (H/H) Analysis;
5. Present Alternatives and Recommended Solutions;
6. Project Implementation and Funding; and
7. Provide Technical Memorandum on Summary of Findings.

## **B. Glessner Ditch Watershed Basin and Study Area**

Glessner Ditch is the legal drain name identified from Shelby County and the name utilized through City incorporated limits. From IDNR mapping (Indiana Floodplain Information Portal), Glessner Ditch is considered East Fork Slash Creek. For this report, Glessner Ditch will be considered a tributary to East Fork Slash Creek through City limits and downstream of City Limits, East Fork Slash Creek. The upper Glessner Ditch subbasin begins northwest of the State Road 44 and Miller Road intersection and generally flows south. According to IDNR Indiana Floodplain Information Portal, Glessner Ditch watershed at the southwest Shelbyville City limits, is approximately 640 acres. However, in the early 2000's, INDOT installed a new storm sewer trunk line along Miller Road (SR 44). This storm trunkline picked up the upper Glessner Ditch watershed and re-directed the flows to a new outlet at the Big Blue River. The trunk line picked up areas of the school and businesses along Miller Road. It is unknown on the exact acreage reduction of the watershed because of this project.

This report focuses on the upper Glessner Ditch watershed, mainly north of McKay Road. The upper Glessner Ditch subbasin watershed area contains approximately 203 acres within the study area. **Figure 1** shows the Glessner Ditch upper watershed, study area, and historic flooding areas within the City.

The Study area consist of developable lands located along the State Road 44 corridor. Portions of the developable lands drain to Glessner Ditch. With the land being developed, the City is taking a proactive approach to reduce Glessner Ditch flooding by evaluating options to re-direct all the proposed development areas north, to the Big Blue River. The study area has been divided into five subbasins, in general characterized by the actual property or subdivision boundaries: Showers Property, Duckworth Farms LLC and KAC Properties LLC, Bradley Realty, Grandview Subdivision and Shelbyville Central School, and Southern Duckworth Farms LLC. These subbasins encompass existing flow areas within the upper Glessner Ditch subbasin and additional future areas of development. The Showers Property, Duckworth Farms LLC, and KAC Properties LLC are the areas that have been identified for future development. **Figure 2** shows each subbasin individually delineated. The total study area watershed consists of

approximately 290 acres. The study area watershed generally drains either north to the Big Blue River or south to Glessner Ditch.

As part of controlling the land development process, the City has been annexing the adjacent properties to City incorporated limits. Portion of Showers is currently annexed by the City, with remaining future developments currently residing outside of City limits. By annexing the properties, City of Shelbyville can regulate and control infrastructure requirements. For stormwater, this gives the City an opportunity to avoid further compounding issues within the Glessner Ditch subbasin.

**FIGURE 1  
OVERALL MAP**

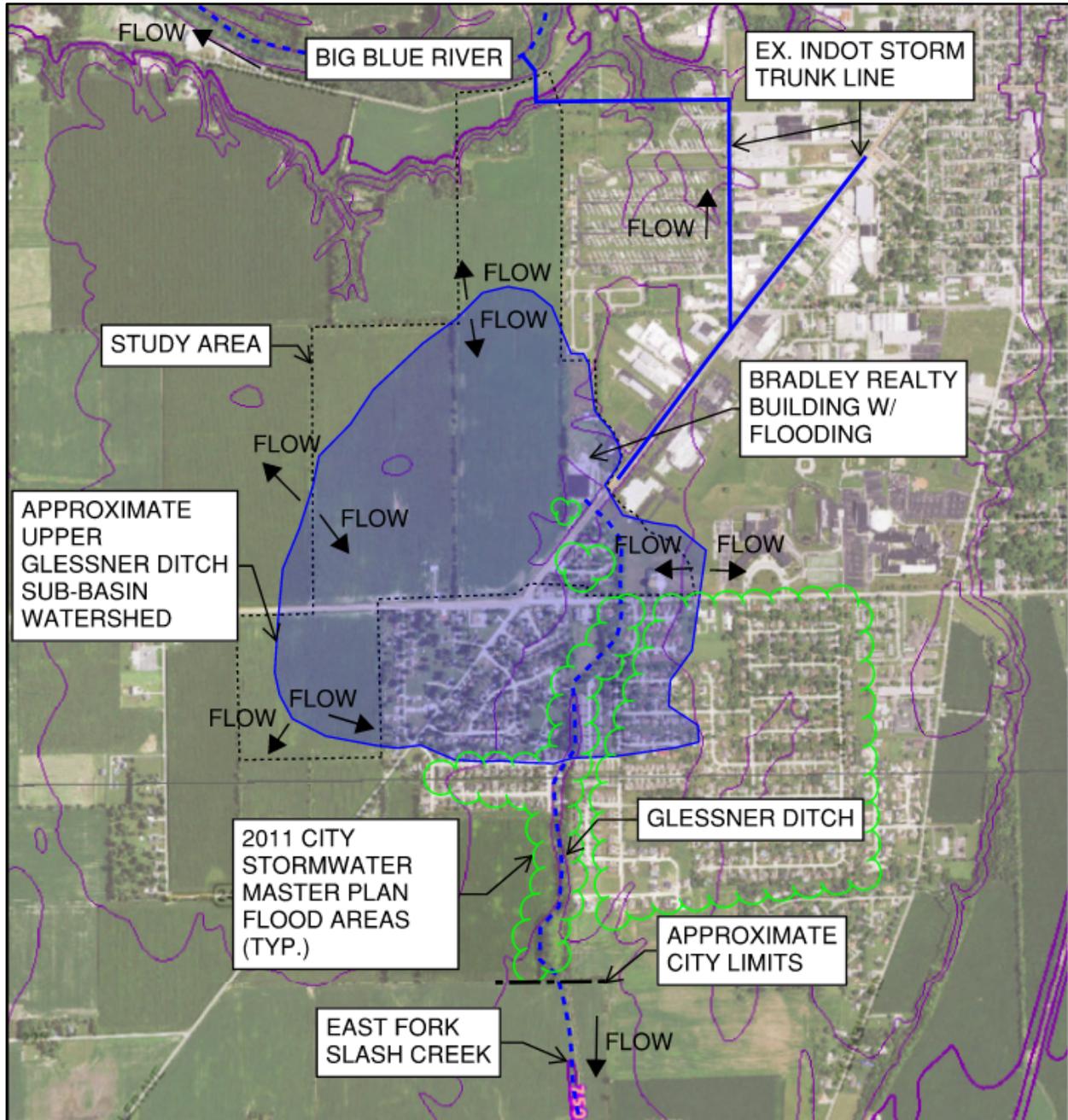
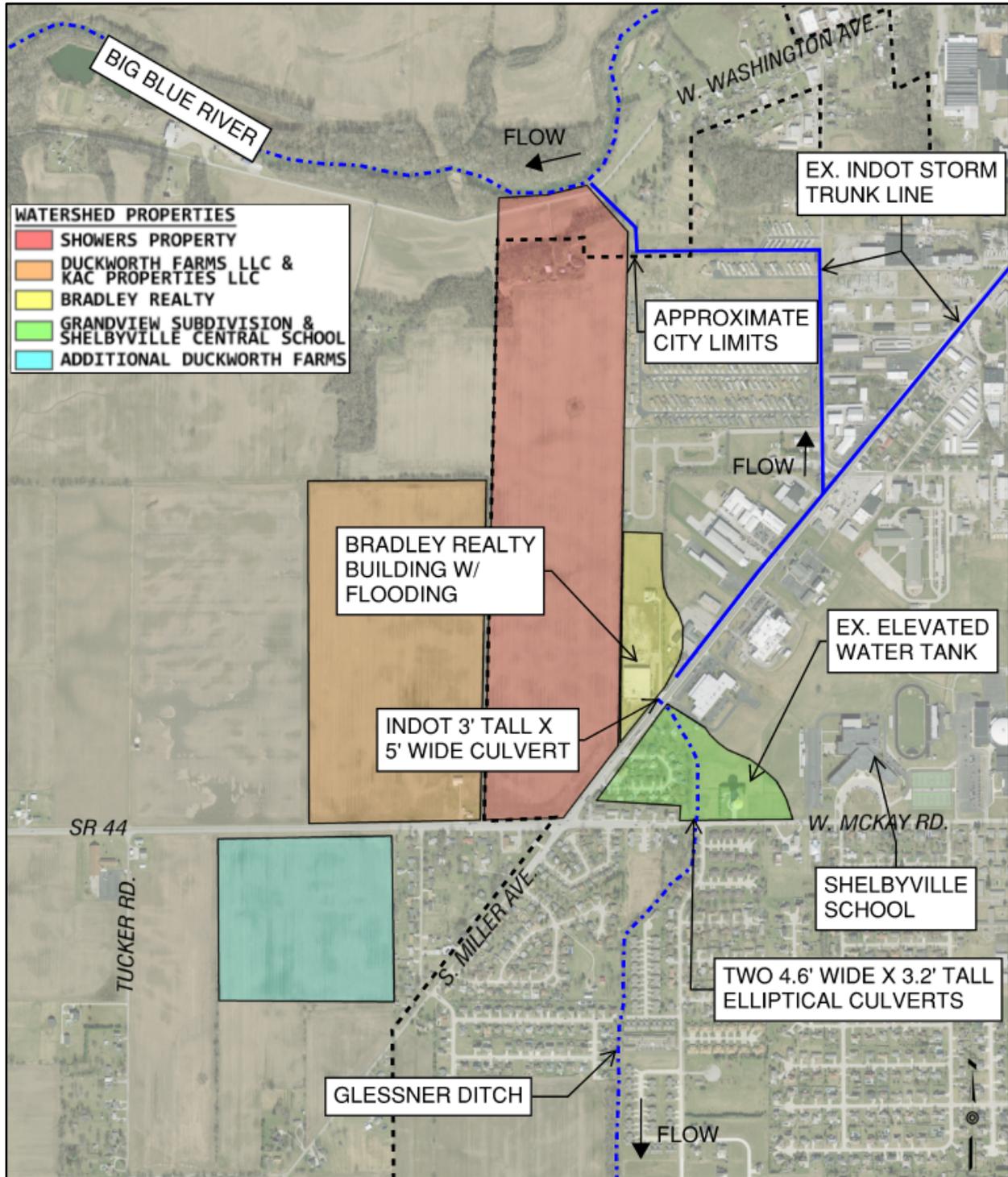


FIGURE 2

STUDY AREA LIMITS AND DEVELOPABLE LAND PROPERTIES



## C. Project Kick-off Meeting

A project kick-off meeting was held on December 21, 2021 with the City and CEI. The intent of the meeting was to clearly define project objectives, expectations, understanding personnel roles and establish milestones and project schedule. This meeting also served to provide an initial exchange of ideas and data.

Project alternatives were discussed in detail. The City's focus would be to provide recommendation on implementing storm sewers to provide flooding relief for the upper Glessner Ditch shed subbasin, as well as provide drainage for future developable lands within the study area.

The City requested CEI to review storm sewer sizing and depth for collecting and conveying flow for the following subbasin alternatives:

1. Showers Property, Duckworth Farms LLC, KAC Properties LLC
2. Showers Property, Duckworth Farms LLC, KAC Properties LLC, and Duckworth Farms South of McKay Road
3. Showers Property, Duckworth Farms LLC, KAC Properties LLC, and Bradley Realty Property
4. Showers Property, Duckworth Farms LLC, KAC Properties LLC, Bradley Realty Property, Grandview Subdivision and Shelbyville School
5. Showers Property, Duckworth Farms LLC, KAC Properties LLC, Bradley Realty Property, Grandview Subdivision and Shelbyville School, and Duckworth Farms South of McKay Road

The City also requested CEI to evaluate the potential for stormwater storage on the property west of the school and west of the existing elevated water tank.

## D. Data Collection, Conceptual Design Basis and Existing Structure Condition Review

### 1. Data Collection and Conceptual Design Basis

The City provided CEI historical images, studies, and storm water infrastructure mapping. CEI performed an initial GPS observation survey to gather critical elevations for initial stormwater model development. CEI GPS observation survey data is provided in North American Vertical Datum of 1988 (NAVD 88). CEI obtained and utilized state LiDAR data for general watershed calculations and proposed alternative vertical alignments. CEI acquired INDOT Road Plans for State Road 44 improvements from the early 2000s.

Conceptual design elements and cost were based on limited plan information from Indiana GIS data, preliminary site assessments, and limited field survey data. A detailed field survey would be necessary to verify elevations, utilities, property approximate limits, etc. for final design location and sizing.

Maps for conceptual design elements utilized 2020 Shelby County select Indiana GIS layers, LiDAR, and Indiana Orthophotography (RGBI).

## 2. Existing Structure Condition Review and Assessment

Existing structures in the study area were generally limited to open ditches and swales, curbs and gutters, culverts and closed conduit drainage systems. Details and observations of the stormwater facilities are further reviewed in this section.

On March 7th, 2022, a storm occurred yielding 1.3-inches of precipitation over a 3 hour duration. This storm equated to an approximate 2-year or 50% risk occurrence interval event. This storm event is referenced throughout the report. Photographs of the existing drainage system, within the study area, have been included at the critical drainage locations.

### a. Existing 5' x 3' INDOT Box Culvert Under Miller Ave. (State Road 44)

The Indiana Department of Transportation (INDOT) maintains a culvert under Miller Avenue near Bradley Realty Property, approximately 1,050 feet north of the intersection of McKay Road. This existing concrete box culvert is 5' wide by 3' high, refer to **Figure 3**. This culvert conveys flow from north of Miller Ave., to Glessner open ditch, north of Grandview Subdivision.

The City has reported during heavy rains, stormwater backs up from Glessner Ditch and has created flooding in the Bradley Realty building. The existing box culvert flowline is at an approximate elevation of 765.76', while the foot of the building is at an approximate elevation of 770.14'. **Figure 4** shows the existing box culvert during the approximate 2-year or 50% recurrence interval rain event which occurred on March 7<sup>th</sup>, 2022.

**Figure 5** shows the same event, looking north along Bradley Realty Ditch where the swale along the northeast side of the Bradley Realty entrance experiences hydraulic capacity limitations. The conveyance swales upstream, appear to have sedimentation and lack of hydraulic slope and has created an overflow into the Bradley Realty northern parking lot.

The existing box culvert is estimated to be rated for a 10-year storm event or 10% risk occurrence interval, assuming no backwater conditions. Based upon the capacity of the existing culvert and testimony from the City, the culvert is assumed to be outlet controlled with backwater effects from Glessner Ditch being the limiting factor and causing ponding upstream of the culvert and restricting the ditch conveyance along the northeast side of Bradley Realty property.

**Figure 3**

**Photo From Miller Ave. Northwest ROW, Looking North to Ex. INDOT Box Culvert**



**Figure 4**

**Photo From Bradley Realty Ditch, Looking South to Ex. INDOT Box Culvert**



**Figure 5**

**Photo From Bradley Realty Entrance, Looking North at Upstream Conveyance**



**b.** Glessner Ditch from Miller Ave. to McKay Road  
(along Grandview Subdivision)

Flow from the Miller Ave., existing INDOT box culvert, discharges to Glessner Ditch. This open ditch carries flow along the east side of Grandview Subdivision for approximately 860 linear feet to McKay Road. This ditch can be seen in **Figure 6**. The ditch contains thick small woody vegetation and larger trees on the lower end. The ditch contains riprap armor on the downstream side of Miller Ave. The City indicated that this section of Glessner Ditch experiences backwater effects with flows overtopping banks during significant rain events.

**Figure 7** shows Glessner Ditch during the March 7, 2022 rain event which is estimated to be a 50% recurrence interval rain event. As seen in the figure, the flow overtops the ditch banks.

**Figure 6**

**Photo From Miller Ave. South ROW, Looking Southeast (Downstream) at Glessner Ditch**



**Figure 7**

**Photo From Miller Ave. South ROW, Looking Southeast (Downstream) at Glessner Ditch During Recent storm event**



**c. Dual Elliptical Culverts under McKay Road**

Glessner Ditch flows under McKay Road via dual arched corrugated metal elliptical culverts. Culverts were estimated to span 55" and rise 38" in height. The existing culverts are shown in **Figure 8**. Initial survey determined the top of culverts being at approximate elevation of 766.11' and the top of the road being at approximate elevation 767.42', resulting in only 1.31 feet of freeboard.

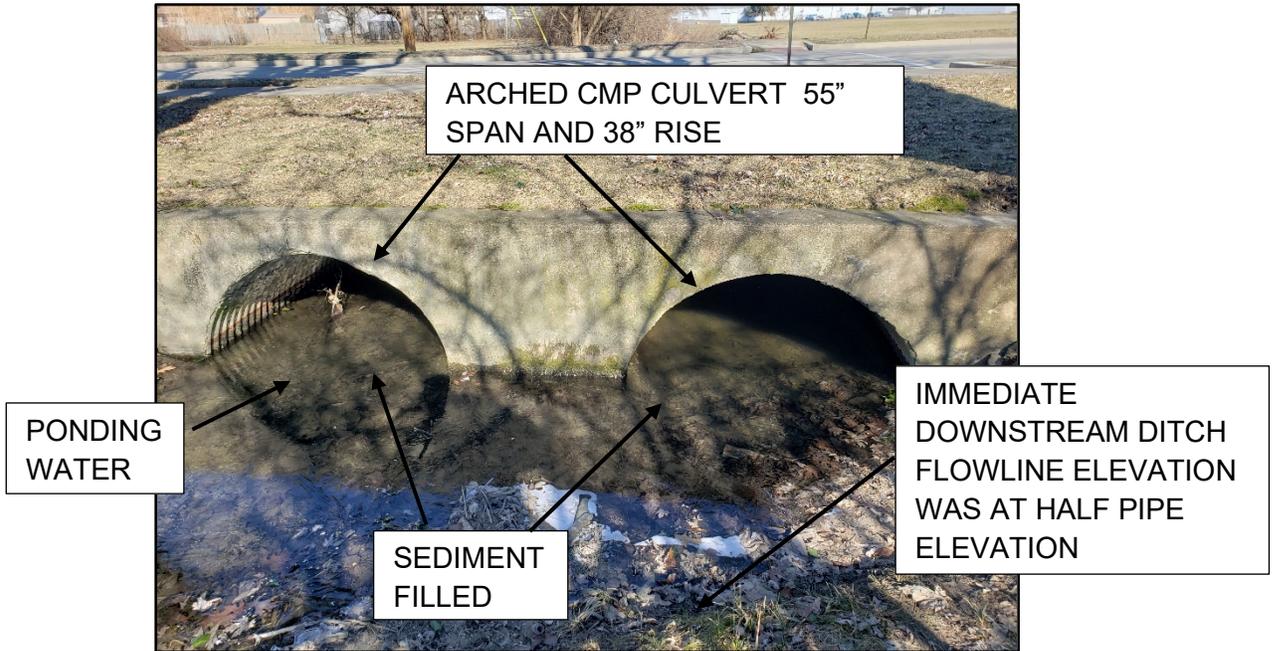
Field investigation identified that the existing culverts are obstructed due to sedimentation. In addition, the immediate downstream ditch, contained sediment that was approximately half the pipe elevation, severely limiting capacity of the culverts, refer to **Figure 8**.

Glessner Ditch, south of McKay Road, is mostly routed through residential subdivisions and small area of vacant land, until the City's south incorporated limits. Through the residential areas, pedestrian bridges, brush, small trees, and debris located within the ditch, refer to **Figure 9**. The City does not have easements or rights to maintain Glessner Ditch in this area.

CEI assumes the downstream in channel restrictions, limited downstream hydraulic slope and Glessner Ditch outlet in low lying floodplain conveyances, have played a role in adding to the channel sedimentation, hydraulic capacity issues, increasing flood elevations and backwater effects felt to Miller Avenue. CEI survey scope did not extend downstream McKay Road culverts. The exact hydraulic slope and potential sedimentation elevations are unknown for Glessner Ditch.

**Figure 8**

**Photo From South of McKay RD. Looking North at Ex. Dual Arched CMP Culverts**



**Figure 9**

**Photo From South of McKay RD. Looking South (Downstream) to Glessner Ditch**



## E. Hydrologic / Hydraulic Analysis

Hydrologic / Hydraulic (H/H) analysis was evaluated for the upper Glessner Ditch watershed subbasin utilizing XPSWMM 2019 computer model software. The City of Shelbyville Stormwater Design Manual, dated October 2006, was utilized for H/H model calculations. NOAA Atlas 14 Rainfall-intensity storm data was utilized for rainfall-intensity storm data.

The March 7<sup>th</sup>, 2022, 2-year, 50% risk occurrence interval event (1.3 inch rain in 3-hour duration) event confirmed much of the flooding discussed. This event unfortunately occurred near the end of the study phase and CEI was unable to utilize the data to calibrate the SWMM model. However, with the data provided, this could be reevaluated upon request.

### 1. General Model Development

For the XPSWMM model, runoff estimation was based on the National Resource Conservation Service (NRCS) Curve Number (CN) Method. For the upper Glessner Ditch watershed subbasin, actual hydrologic soil groups, from Indiana Soil Conservation Service (SCS), were determined for each subbasin. Curve numbers representing average antecedent runoff condition (ARC) or average soil moisture conditions were utilized for model development. Time of concentration calculations were based on the SCS TR-55 "Urban Hydrology for Small Watersheds". NOAA Atlas 14 rainfall intensity-duration storm events were evaluated to determine peak discharge and peak volume for the watershed. The NOAA Atlas data provided incremental rainfall depth relative to time, for each event. Model development determined that the 2-hour duration storm event produced the peak discharge.

In accordance with the Shelbyville Stormwater Design Manual each pipe alternative was sized assuming no surcharges above top of pipe for the 10-year storm, and no observed overflows for the 100-year storm.

The bulk of the study area consist of undeveloped, agricultural land. The Shelbyville Stormwater Design Manual requires that new developments release the 100-year storm event at the pre-development 10-year storm flow rate. As noted earlier in the report, the goal of the storm sewer is to be designed with future development considerations. Considering the language within the stormwater design manual and the overall goal of the report, the following was completed to ensure there were no overflows during the future 100-year storm event. The proposed alternatives were checked with future developable land releasing flow at the existing 10-year rate and existing land / undevelopable land releasing flow at the 100-year rate. The hydraulic grade line of this scenario was checked for each alternative to verify there were no overflows.

The limits of the study are confined to the upper Glessner Ditch watershed. Backwater effects associated with the lower Glessner Ditch area and East Fork Slash Creek was not considered with this scope of work. Additional detailed hydraulic analysis would be required to determine actual detailed effects of the individual alternatives on the overall Glessner Ditch watershed.

Additionally, the Big Blue River backwater effects would be taken into consideration for the model. The proposed storm sewer will discharge into a known floodplain area. Commonwealth would tax the proposed storm sewer to determine worst case scenario and provide effects independent of various flood levels pending the backwater effects on the proposed storm sewer.

## 2. Existing Glessner Ditch XPSWMM Model

The XPSWMM model was utilized to recreate the upper portion of Glessner Ditch from Miller Avenue to McKay Road, utilizing actual elevation and cross section data obtained by survey completed by CEI. The upper Glessner Ditch subbasin consists of approximately 203 acres within the study area. Smaller subbasins were created to model discharge rates at critical nodes. The model consists of 7 nodes modeled as cross sections with connecting links, generally at ditch bend from Miller Road to McKay Road.

As noted previously, reducing flood risk in the upper Glessner Ditch subbasin is a priority of this project. In order to analyze the flood risk reduction for each alternative, the model was utilized to estimate a peak flow and total volume percentage reduction through the link of the model located at the McKay Road dual culvert and modeled as solely receiving flows from the study area. The peak flow and total volume percentage reduction analysis calculations assumed no tailwater effects from downstream conditions in Glessner Ditch.

Each alternative proposes redirecting flow from Glessner Ditch to the Big Blue River. The alternatives were then analyzed to determine impact for both volume and peak flow reduction. The model was ran to determine total volume and peak flow reduction that occurred as a result of each alternative for the 10-year or 10% recurrence interval event. This data is presented below for each alternative. This process allowed each alternative to be analyzed upon the basis of the overall goal of the project, which is to reduce flooding in the upper Glessner Ditch subbasin.

## 3. Big Blue River Proposed Outfall Assessment

The proposed storm trunkline flow re-direction from upper Glessner Ditch watershed, will now discharge to Big Blue River, refer to **Figure 10**. The pool elevation, at time of CEI survey, was at approximate elevation 736.0. The top of bank elevation was at approximate elevation 746.50. The Big Blue River floodway and floodplain extents can be seen in **Figure 11**. The annual flood risk elevations, reported by Federal Emergency Management Agency (FEMA) in the *2020 Revised*

*Flood Insurance Study, Revised Preliminary April 10, 2020 for Shelby County under FIS # 18145CV000B*, are approximated as follows (in NAVD 88):

- 10-Year Flood Elevation = 747.0'
- 50-Year Flood Elevation = 747.7'
- 100-Year Flood Elevation = 748.1'
- 500-Year Flood Elevation = 748.6'

The 100-year flood elevation was modeled for the Big Blue River at the proposed outfall of the storm sewer. This produced worst-case scenario backwater conditions for the alternative analysis. The backwater conditions had negligible effects on the model hydraulics due to the storm sewer outlet being much lower in elevation than the rest of the watershed.

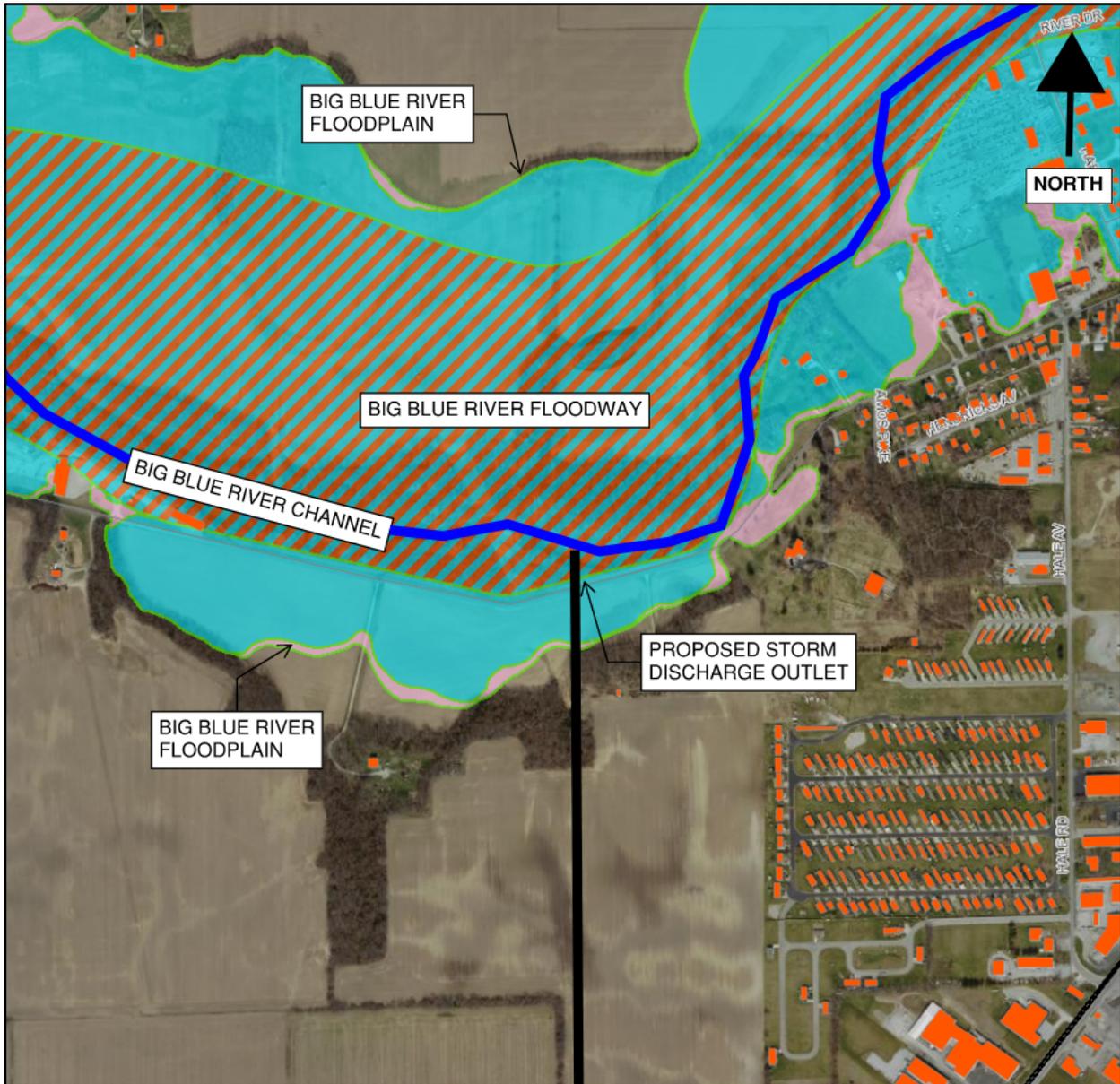
**Figure 10**

**Photo From Big Blue River Looking East Upstream**



Figure 11

Big Blue River Flood Plain and Floodway



## F. Proposed Improvement Evaluation and Alternatives

Conceptual plans and layouts of the alternatives are included in **Appendix A**. Planning level cost estimates of the alternatives are included in **Appendix B**. Model results of hydraulic profiles of each alternative are provided in **Appendix C**.

Proposed storm sewers were generally designed to reduce overall depth of the storm sewer installation due to unknown soil conditions at extended depths. At deeper elevations, consolidated materials are expected to be encountered based on City knowledge. Geotechnical investigation would be required to determine exact limits or constraints. Alternatives, where discharging in floodway and floodplain area, would have closure mechanism to prevent reverse flow during flood events.

The individual alternatives were compared and analyzed to determine the total volume percent reduction and peak flow reduction (from 10 year or 10% occurrence interval, 1-hour duration) being diverted from upper Glessner Ditch subbasin to Big Blue River.

The proposed alternatives are discussed here-in:

### Alternatives Considered

1. Showers Property, Duckworth Farms LLC, KAC Properties LLC
2. Showers Property, Duckworth Farms LLC, KAC Properties LLC, and Duckworth Farms South of McKay Road
3. Showers Property, Duckworth Farms LLC, KAC Properties LLC, and Bradley Realty Property
4. Showers Property, Duckworth Farms LLC, KAC Properties LLC, Bradley Realty Property, Grandview Subdivision and Shelbyville School
5. Showers Property, Duckworth Farms LLC, KAC Properties LLC, Bradley Realty Property, Grandview Subdivision and Shelbyville School, and Duckworth Farms South of McKay Road

#### 1. **ALTERNATE 1** **Servicing Showers Property, Duckworth Farms LLC, and KAC Properties LLC**

This alternative evaluates the benefit of providing a storm sewer to collect flows from Showers Property, Duckworth Farms LLC, and KAC Properties LLC. A 60" storm sewer would be constructed to convey flow along the west property line of the Showers Property from McKay Road and outfall at the Big Blue River. The proposed storm sewer would be buried an average depth of 10 feet below the surface and is designed to pick up storm sewers from future developments. The intention of this alternative is to reduce the total area and flow that currently drains to the INDOT culvert at the Bradley Realty Property and redirect the drainage to the Big Blue River.

The XPSWMM model estimates a total volume flow reduction for the study area currently flowing to Glessner Ditch of approximately 74% during a 10-year or 10% recurrence interval storm event at McKay Road. This reduction of flow is based on volume and is estimated to reduce the surcharge conditions at the Bradley Realty Property during storm events. Benefits of implementing Alternative 1 are summarized in **Table 1** and the proposed improvements can be seen in **Figure 12**.

**Table 1**  
**Alternative 1 – Summary of Implementation**

Item <sup>(1)</sup>	Existing Condition	Post Project Condition
10-year Storm Peak Flow (cfs)	116	36
10-Year Storm Reduction Volume in Flooding - % <sup>(2)</sup>	-	73.6%
<b>Total Project Cost</b>		
\$6,153,450		
<b>Total Watershed Area Reduction from Glessner Ditch</b>		
148 Acres		

- (1) For comparison of alternatives and reduction in peak flow, volume, and watershed; calculations were taken along Glessner Ditch at McKay Road, utilizing study area acreage.
- (2) The percent reduction is based on XPSWMM model 10-year 1-hour calculations, analyzing the total volume reduction possible for this project.

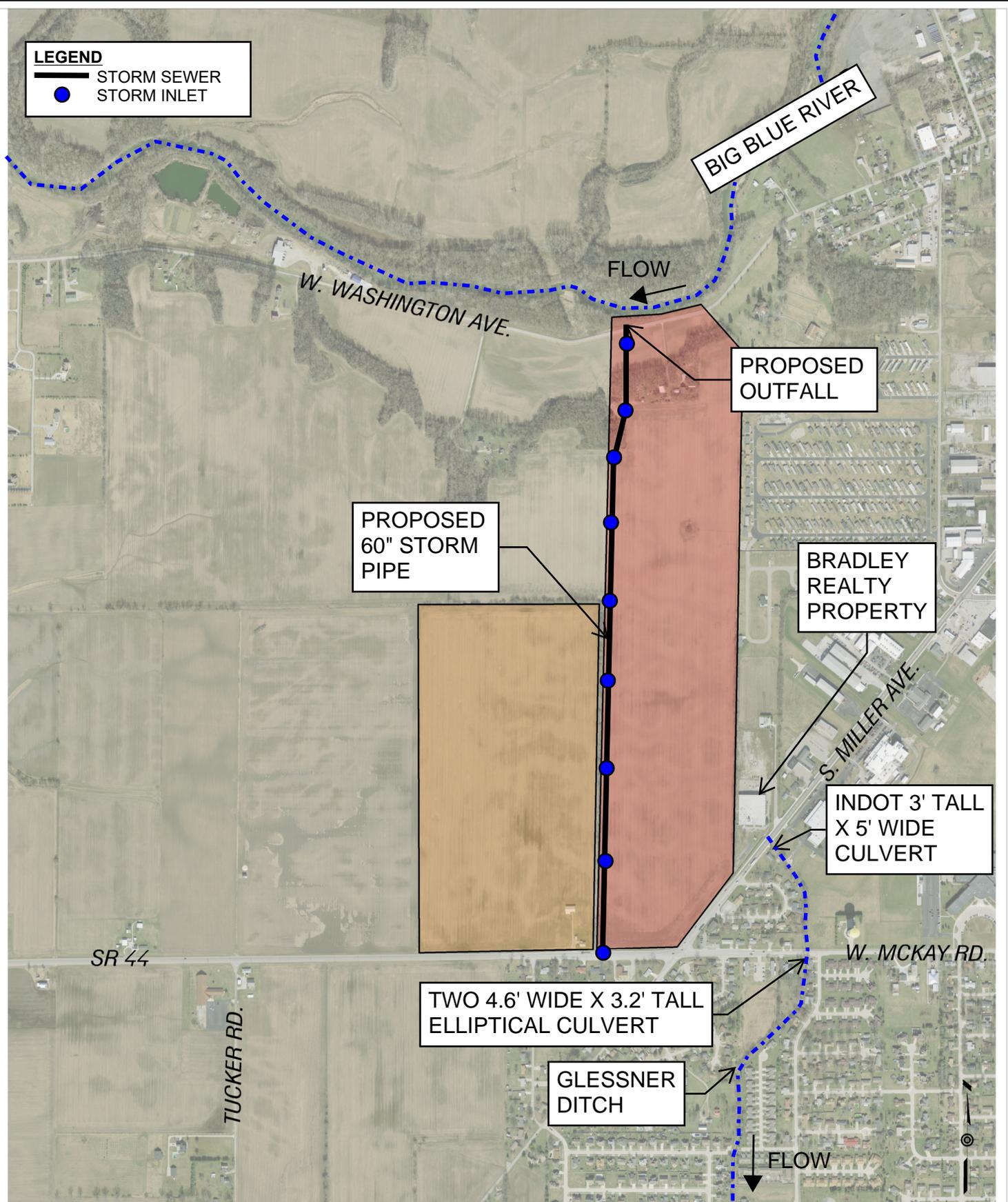
This alternative would require temporary easements for construction purposes and permanent easements for the new storm sewer. The alternative is expected to require a Construction Stormwater General Permit, IDEM 401 Water Quality Certification Permit, USACE 404 Water of the US Permit, and an IDNR Construction in a Floodway Permit. Due to work proposed within the floodway, mitigation would also likely be required.

This alternative does not expect to encounter many utility conflicts, due to routing through an open farm field. The alternative will be required to cross overhead electric transmission lines which may require an encroachment agreement with the power company.

This alternative could be further iterated, by a more concise analysis of uncertainty of soils, bedrock depth, pipe slope, and materials. This would allow for pipe sizes to be stair stepped (smaller piping upstream) in an effort to refine design and provide additional cost savings.

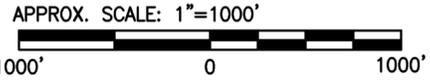
**LEGEND**

- STORM SEWER
- STORM INLET



- WATERSHED PROPERTIES**
- SHOWERS PROPERTY
  - DUCKWORTH FARMS LLC & KAC PROPERTIES LLC
  - BRADLEY REALTY
  - GRANDVIEW SUBDIVISION & SHELBYVILLE CENTRAL SCHOOL
  - ADDITIONAL DUCKWORTH FARMS

CITY OF SHELBYVILLE, INDIANA



CITY OF SHELBYVILLE, INDIANA  
 PRELIMINARY ENGINEERING REPORT  
 STORMWATER SYSTEM  
 FIGURE 12 - ALTERNATIVE 1

## 2. ALTERNATE 2

### **Servicing Showers, Duckworth Farms LLC, KAC Properties LLC, and Duckworth Farms LLC South of McKay Road**

This alternative evaluates the benefit of providing a storm sewer to collect flows from Showers Property, Duckworth Farms LLC, KAC Properties LLC, and Duckworth Farms LLC south of McKay Road. A storm sewer ranging from 48" to 66" would be constructed to convey flow. This alternative proposes collecting and conveying flow from the same areas as Alternative 1 and adding the Duckworth Farms Property south of McKay Road. The proposed storm sewer would be buried an average depth of 15 feet below the surface and is designed to pick up storm sewers from future developments. The intention of this alternative is to reduce the total area and flow that currently drains to the INDOT culvert at the Bradley Realty Property and further reduce lower Glessner Ditch watershed by expanding the storm sewer system to service the Duckworth Farms LLC property south of McKay Road.

The XPSWMM model estimates a total volume flow reduction for the study area currently flowing to Glessner Ditch of approximately 74% during a 10-year or 10% recurrence interval storm event at McKay Road. Further reduction of approximately 9.6% is expected to occur downstream of McKay Road due to Duckworth South properties flows being rerouted from upper Glessner Ditch's watershed to Big Blue River (the portion of the project area flowing to Glessner Ditch can be seen in **Figure 1**). The reduction in flow is estimated to reduce the surcharge conditions at the Bradley Realty Property during storm events. Benefits of implementing Alternative 2 are summarized in **Table 2** and the proposed improvements can be seen in **Figure 13**.

**Table 2**

**Alternative 2 – Summary of Implementation**

<b>Item <sup>(1)</sup></b>	<b>Existing Condition</b>	<b>Post Project Condition</b>
10-year Storm Peak Flow (cfs)	116	36 <sup>(3)</sup>
10-Year Storm Reduction Volume in Flooding - % <sup>(2)</sup>	-	73.6% <sup>(3)</sup>
<b>Total Project Cost</b>		
\$7,607,700		
<b>Total Watershed Area Reduction from Glessner Ditch</b>		
168 Acres		

- (1) For comparison of alternatives and reduction in peak flow, volume, and watershed; calculations were taken along Glessner Ditch at McKay Road, utilizing study area acreage.
- (2) The percent reduction is based on XPSWMM model 10-year 1-hour calculations, analyzing the total volume reduction possible for this project.
- (3) Additional approximate 10 cfs of peak flow (20 acres) or approximately 9.6% of volume is estimated to be reduced downstream of McKay Road due to rerouting Duckworth properties flows.

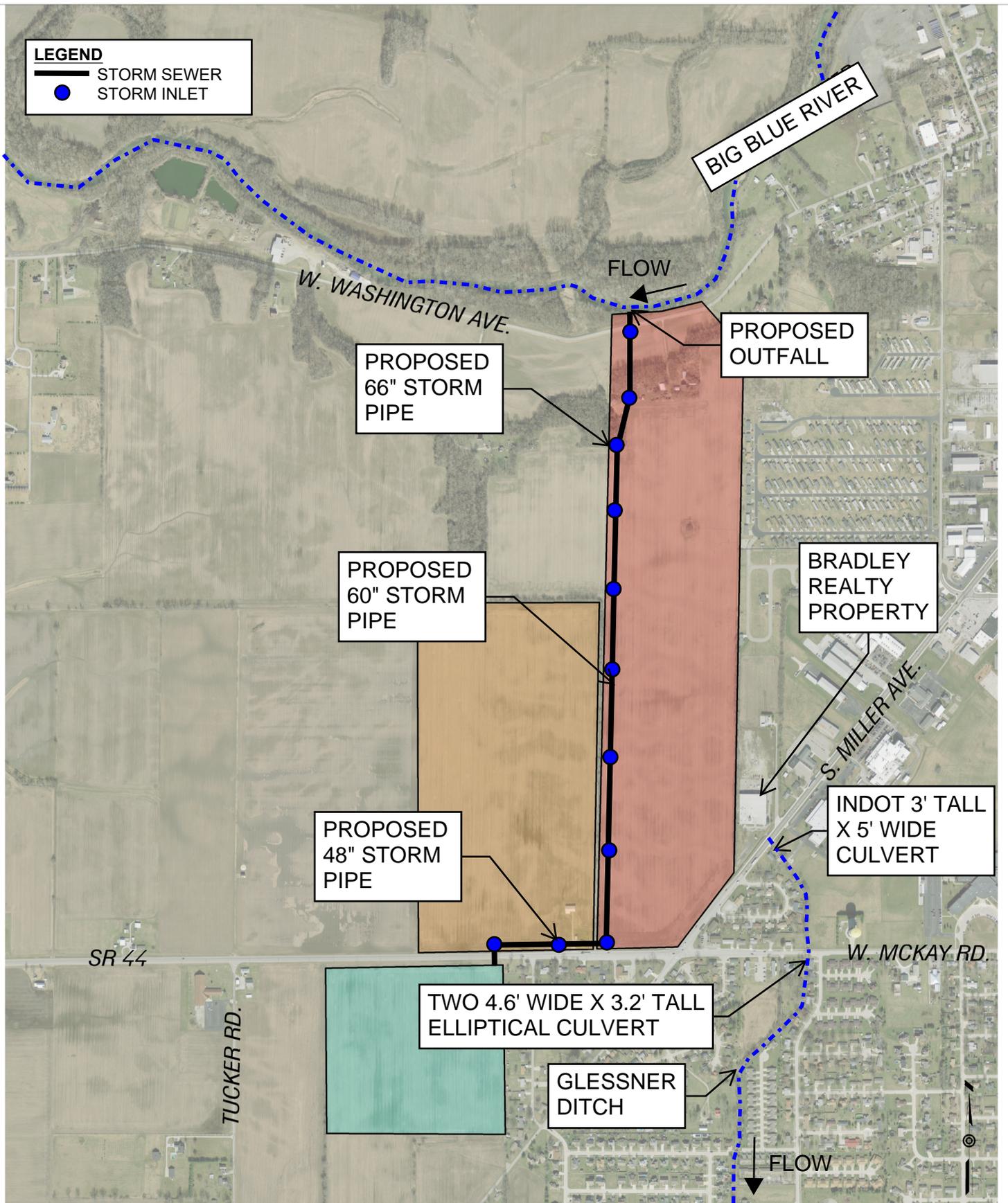
This alternative would require temporary easements for construction purposes and permanent easements for the new storm sewer. The alternative is expected to require a Construction Stormwater General Permit, IDEM 401 Water Quality Certification Permit, USACE 404 Water of the US Permit, IDNR Construction in a Floodway Permit, and an INDOT ROW Permit. Due to work proposed within the floodway, mitigation would also likely be required.

This alternative does not expect to encounter many utility conflicts, due to routing through an open farm field. The alternative will be required to cross overhead electric transmission lines which may require an encroachment agreement with the power company.

This alternative could be further iterated, by a more concise analysis of uncertainty of soils, bedrock depth, pipe slope, and materials. This would allow for pipe sizes to be stair stepped (smaller piping upstream) in an effort to refine design and provide additional cost savings.

**LEGEND**

- STORM SEWER
- STORM INLET

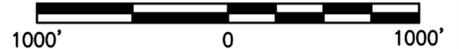


**WATERSHED PROPERTIES**

- SHOWERS PROPERTY
- DUCKWORTH FARMS LLC & KAC PROPERTIES LLC
- BRADLEY REALTY
- GRANDVIEW SUBDIVISION & SHELBYVILLE CENTRAL SCHOOL
- ADDITIONAL DUCKWORTH FARMS

CITY OF SHELBYVILLE, INDIANA

APPROX. SCALE: 1"=1000'



**COMMONWEALTH**  
ENGINEERS, INC.

CITY OF SHELBYVILLE, INDIANA  
PRELIMINARY ENGINEERING REPORT  
STORMWATER SYSTEM

FIGURE 13 - ALTERNATIVE 2

### 3. ALTERNATE 3

#### **Servicing Showers Property, Duckworth Farms LLC, KAC Properties LLC, and INDOT Culvert at Bradley Realty Property**

This alternative evaluates the benefit of providing a storm sewer to collect flows from Showers Property, Duckworth Farms LLC, KAC Properties LLC, and Bradley Realty Property. A storm sewer ranging from 42" to 66" would be constructed to convey flow. This alternative proposes collecting and conveying flow from the same areas as Alternative 1, and additionally from Bradley Realty Property. The proposed storm sewer would be extended north and east along Miller Avenue to the existing INDOT culvert near Bradley Realty Property. This extension to the existing INDOT culvert would increase the storm sewer to be a max depth of 25 feet below the surface on the Shower's property.

The intention of this alternative is to reduce the entire watershed area that drains upstream to the INDOT culvert at Bradley Realty property. This alternative does not consider any potential backwater flow from the downstream drainage area, as this was outside of the scope of work. At the time of this study, the backwater or base flood elevation is unknown at Miller Avenue. As such, the alternative would have to be designed to direct flows from Bradley Realty commercial drive to the proposed storm sewer only. Set points or other diversion mechanisms may be necessary to ensure backwater effects, from the INDOT culvert, do not reach the proposed storm sewer. If the City would want to consider backwater effects, a detailed analysis would need to be complete to properly size the storm sewer. If backwater effects are not properly accounted, the new storm sewer could be taxed and simply re-direct a flooding issue to the new project area.

The XPSWMM model estimates a total flow reduction for the study area currently flowing to Glessner Ditch by approximately 81% during a 10-year or 10% recurrence interval storm event. Note, this does not include additional flow that would be collected based on the backwater effects of Glessner Ditch. This reduction in flow is estimated to reduce the surcharge conditions at the Bradley Realty Property during storm events. Benefits of implementing Alternative 3 are summarized in **Table 3** and the proposed improvements can be seen in **Figure 14**.

**Table 3**

**Alternative 3 – Summary of Implementation**

<b>Item <sup>(1)</sup></b>	<b>Existing Condition</b>	<b>Post Project Condition</b>
10-year Storm Peak Flow (cfs)	116	24
10-Year Storm Reduction Volume in Flooding - % <sup>(2)</sup>	-	81.2%
<b>Total Project Cost</b>		
\$8,340,450		
<b>Total Watershed Area Reduction from Glessner Ditch</b>		
163 Acres		

(1) For comparison of alternatives and reduction in peak flow, volume, and watershed; calculations were taken along Glessner Ditch at McKay Road, utilizing study area acreage.

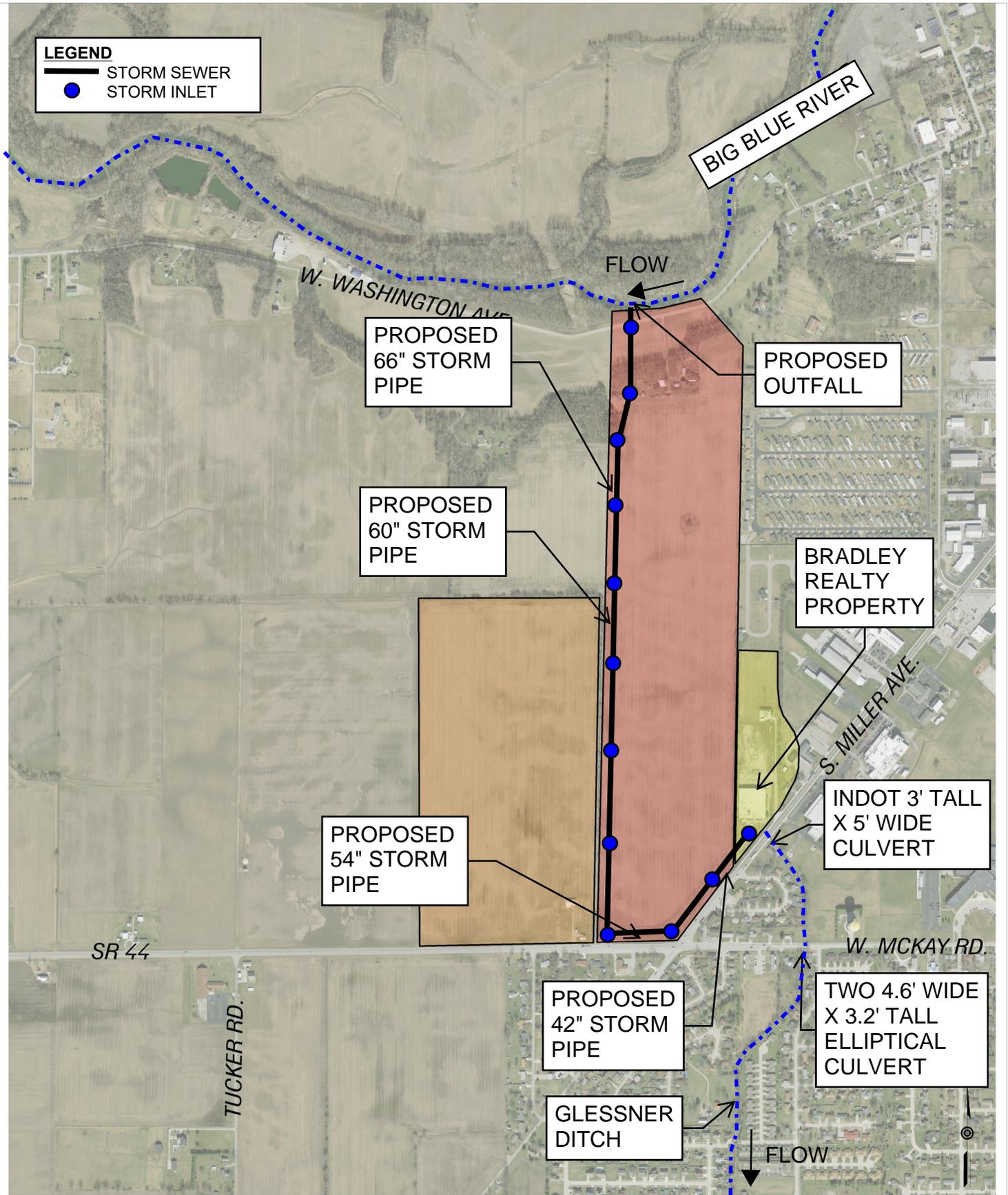
(2) The percent reduction is based on XPSWMM model 10-year 1-hour calculations, analyzing the total volume reduction possible for this project.

This alternative would require temporary easements for construction purposes and permanent easements for the new storm sewer. The alternative is expected to require a Construction Stormwater General Permit, IDEM 401 Water Quality Certification Permit, USACE 404 Water of the US Permit, IDNR Construction in a Floodway Permit, and an INDOT ROW Permit. Due to work proposed within the floodway, mitigation will also likely be required.

This alternative does not expect to encounter many utility conflicts, due to routing through an open farm field. The alternative will be required to cross overhead electric transmission lines which may require an encroachment agreement with the power company.

**LEGEND**

- STORM SEWER
- STORM INLET

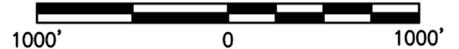


**WATERSHED PROPERTIES**

- SHOWERS PROPERTY
- DUCKWORTH FARMS LLC & KAC PROPERTIES LLC
- BRADLEY REALTY
- GRANDVIEW SUBDIVISION & SHELBYVILLE CENTRAL SCHOOL
- ADDITIONAL DUCKWORTH FARMS

CITY OF SHELBYVILLE, INDIANA

APPROX. SCALE: 1"=1000'



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CITY OF SHELBYVILLE, INDIANA  
PRELIMINARY ENGINEERING REPORT  
STORMWATER SYSTEM

FIGURE 14 - ALTERNATIVE 3

#### 4. ALTERNATE 4

##### **Servicing Showers Property, Duckworth Farms LLC, KAC Properties LLC, INDOT Culvert at Bradley Realty Property, and Grandview Subdivision**

This alternative evaluates the benefit of providing a storm sewer to collect flows from Showers Property, Duckworth Farms LLC, KAC Properties LLC, Bradley Realty Property, and Grandview Subdivision. This alternative was analyzed for total volume percent reduction. Overall, this alternative would reduce the flow from the study area to Glessner Ditch by approximately 90%. Note, this does not include additional flow that would be collected based on the backwater effects of Glessner Ditch.

There are several construction impacts that would be incurred by extending the storm sewer to pick up flows from the Grandview subdivision. A summary of construction concerns is below:

- Open-cut of McKay Road would be required
- Increase in total linear foot of large sewer pipe required
- Overall depth of sewer would be increased to a maximum of 30 feet
- Traffic Control and permitting efforts would be significantly increased

This alternative only proposes picking up a small additional portion of flow from the overall study basin. As the previous alternatives have significant effects on the overall reduction of volume and peak flow from the study area, this alternative would only marginally increase these reductions.

While the overall reduction in flow to Glessner Ditch is anticipated to be substantial, the construction cost of this alternative is estimated to be significantly higher than the other alternatives. Based upon the reduction results of the previous alternatives and the high estimated construction cost of this alternative, it was not pursued farther. This alternative is not deemed a feasible option.

#### 5. ALTERNATE 5

##### **Servicing Showers Property, Duckworth Farms LLC, KAC Properties LLC, Duckworth Farms LLC (South), INDOT Culvert at Bradley Realty Property, and Grandview Subdivision**

This alternative evaluates the benefit of providing a storm sewer to collect flows from Showers Property, Duckworth Farms LLC, KAC Properties LLC, Bradley Realty Property, Grandview Subdivision, and Duckworth Farms LLC south of McKay Road. This alternative was analyzed for total volume percent reduction.

Overall, this alternative would reduce the flow from Glessner Ditch watershed to Glessner Ditch by 100%. Again, it is important to note this percent reduction is based on the total volume reduction possible from this project and does not consider backwater effects of Glessner Ditch.

As a result of this alternative the overall reduction in flow to Glessner Ditch is at maximum potential, the construction cost of this alternative is estimated to be significantly higher than the other alternatives. The construction cost is anticipated to be higher based upon the reasons discussed in the previous alternative. Based on these factors, this alternative is not deemed a feasible option.

## 6. ADDITIONAL CONSIDERATIONS

### a. Detention Basin

The City requested CEI review the feasibility of providing a detention basin on the property west of the Shelbyville Central School, north of McKay Road. CEI conducted field investigation to review the constructability of this alternative. The detention basin was proposed to collect flow from Glessner Ditch during large rain events.

During the field investigation, CEI determined that the area surrounding Glessner Ditch and the ditch itself were very close in elevation. It was determined that there is not enough elevation to provide a conventional detention basin to provide the benefits necessary to reduce flooding. Based upon available area, proximity to the school, and elevations of ditch and surrounding area, it was determined that a detention basin was not a feasible alternative to significantly reduce flooding.

### b. Bradley Realty Ditch

Initially it was estimated that the backwater effects of Glessner Ditch were solely due to downstream limitations, however the March 7<sup>th</sup> event revealed capacity limitations, exist in the Bradley Realty ditch east of the property. These limitations appear to create high water levels in relation to the Bradley Realty building even independent of the Glessner Ditch backwater conditions, refer to **Figure 5**. Rainwater appears to pond both along the access drive and parking lot of Bradley Realty. This ponding water overflows into the Bradley Realty Ditch which collects runoff from north of the property. Both minimal elevations drop, and cross-sectional area of the ditch contribute to the capacity limitation and restrict flow to the INDOT culvert.

It is recommended that the ditch be regraded to mitigate flooding, to adequately convey flow to the existing INDOT culvert. Additionally, Alternative 3 proves to be a realistic option to alleviate these flows. The costs proposed do not include the price of regrading Bradley Realty Ditch.

**c. Big Blue River Outfall**

In all alternatives, the proposed storm sewer was proposed to outfall directly to the Big Blue River. As another option, the proposed storm sewer can outfall near the floodplain, or lower field, and simply provide a new open ditch (approximately 400 linear feet) and culvert under Washington Avenue to the Big Blue River. extents and a new swale can be constructed to convey stormwater to the Big Blue River. This consideration would prove to save money, in magnitude of approximately \$150,000. The property owner may not want an open ditch in the lower farm field. This option would minimize maintenance with the outfall being located outside the floodway.

**G. Recommended Solution and Project Implementation**

**1. 2022 Recommended Capital Improvement**

**Table 4**

**Alternatives Summary**

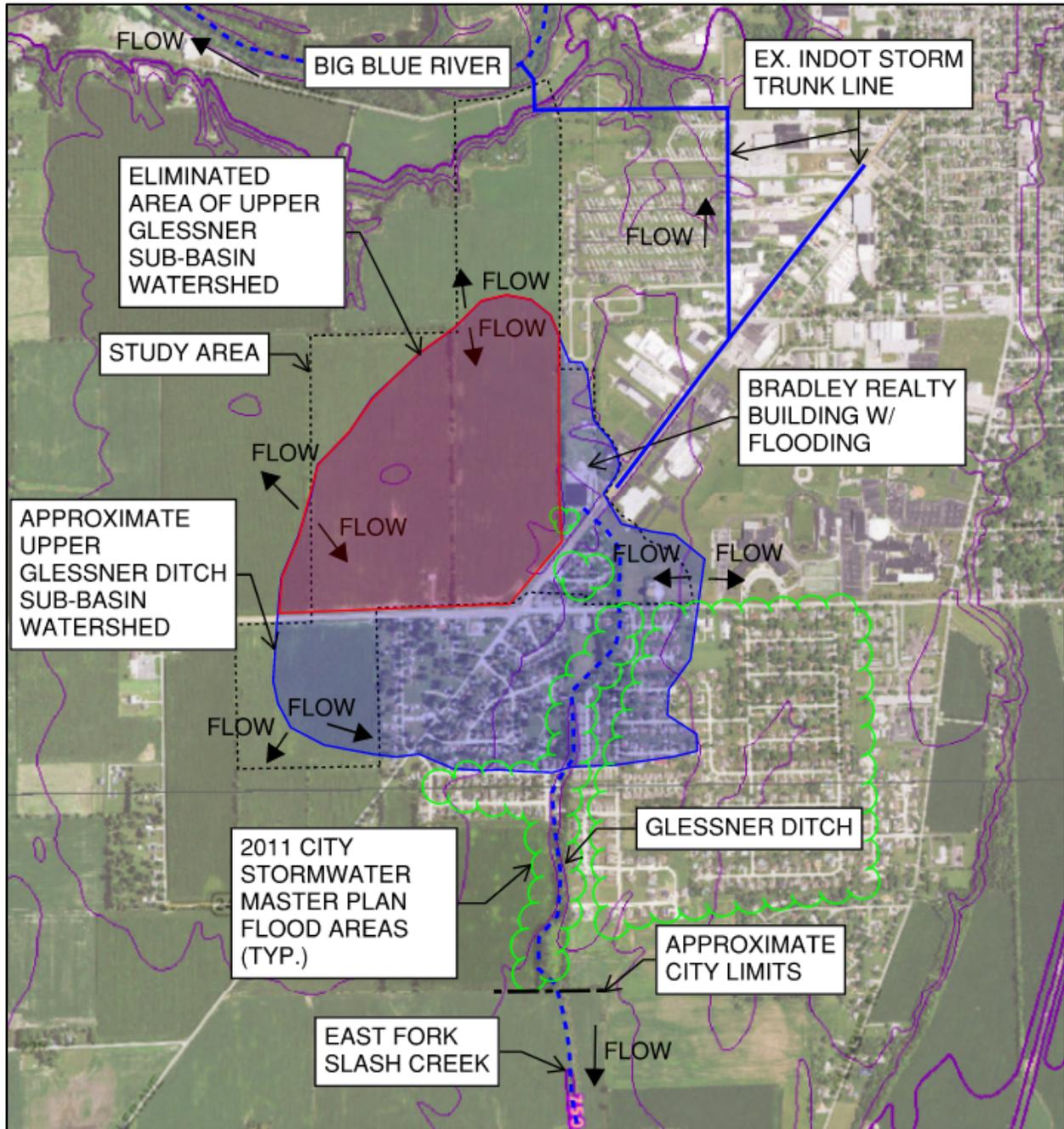
	<b>Existing Condition</b>	<b>Alternative 1 Post Project</b>	<b>Alternative 2 Post Project</b>	<b>Alternative 3 Post Project</b>
10-year Storm Peak Flow (cfs)	116	36	36 <sup>(1)</sup>	24
10-Year Storm Reduction Volume in Flooding - %	-	73.60%	73.60% <sup>(1)</sup>	81.20%
<b>Total Project Cost</b>	-	<b>\$6,153,450</b>	<b>\$7,607,700</b>	<b>\$8,340,450</b>

(1) Additional approximate 10 cfs of peak flow (20 acres) or approximately 9.6% of volume is estimated to be reduced downstream of McKay Road due to rerouting Duckworth properties flows.

CEI recommends that the City proceed with Alternative 1 as the selected Capital Improvement Project to be pursued for funding. This alternative will reduce the flow entering Glessner Ditch from the Study Area by 74%, however it will not pick up the back water effects from Glessner Ditch.

Above **Table 4** summarizes the estimated construction cost and the percent reduction of flow from Glessner Ditch watershed to Glessner Ditch. **Figure 15** shows the upper Glessner Ditch subbasin post project, depicting the reduction of drainage area due to the proposed project.

**Figure 15**  
**Post Project Upper Glessner Subbasin**



## H. Project Funding

### 1. Indiana Office of Community and Rural Affairs-Community Focus Fund (CFF)

The Indiana Office of Community and Rural Affairs (OCRA) distribute Community Focus Fund grants of up to \$600,000 dollars. CFF grants are used to fund municipal improvements projects. CFF grants are funds that can only be provided for improvements to rural communities. Community Focus Fund grants have a set of conditions that must be met for the project to be considered. The population of the community must consist of at least a 51% low to moderate income base to be considered for a Community Focus Fund Grant.

For projects seeking funding from OCRA, an aggressive timetable must be followed. At the time of grant application, the community must show an ability to fund the remaining balance of the project costs. Construction of the project must also be completed within 18 months of the grant award. Plans and specifications for the project must be prepared within the first 6 months after grant funding is awarded allowing 12 months for construction. Local match funding through another of the funding options listed in the report must be pursued to obtain the additional monies. Local match funds should be acquired as soon as possible to meet the requirements of the OCRA CFF program.

City currently has an open OCRA stormwater project, the City would not be eligible for OCRA stormwater funds for 5-years after release of funds.

### 2. Revenue Bond

A revenue bond is a special type of municipal bond distinguished through its guarantee of repayment solely from the revenue generated by the completion and use of certain facilities associated with the company for which the improvements are performed. In this case, the City of Shelbyville would utilize the Stormwater Utility to provide a revenue stream to pay back to revenue bond. The interest and principal on a revenue bond can only be paid out of the revenue generated by the utility.

Revenue bonds are made available on the open market and can be sold at an interest rate as determined by market conditions.

### 3. Tax Increment Financing (TIF)

The City can invest in infrastructure or other improvements by utilizing the increase in property taxes generated from the developments. The TIF can be set up for a 20 year period to assist with the financing of the project.

### 4. State Revolving Fund (SRF) Loan Program

#### a. Traditional SRF Loan Program and Bipartisan Infrastructure Legislation

The State Revolving Fund loan program provides low-interest financing for construction of water and wastewater infrastructure. Cities, Towns, Counties, regional water or sewer districts, privately owned utilities, and not-for-profit facilities are eligible to apply for financing through the SRF Loan Program.

SRF loans are fixed-rate, 20-year loans. Interest rates are reset quarterly and are typically at or below general obligation bond municipal market data. Interest rates can be discounted based on the applicant's user rates and median household income. With the traditional program, PERs are required to be submitted to SRF by May 1st for each year.

On November 15, 2021, the Infrastructure Investment & Jobs Act was signed into law, now termed the Bipartisan Infrastructure Legislation. Indiana Finance Authority (IFA) will be in charge of administering \$751 million over 5 years (\$150 million per year) to improve water/wastewater/storm infrastructure. With the money, the law requires half to be given as grant. The City is required to submit a SRF style traditional PER to qualify.

**b. State Water Infrastructure Funds (SWIF)**

The Indiana General Assembly via HEA 1001 (2021), has allocated \$100 Million of federal Coronavirus State and Local Fiscal Recovery Funds to the Indiana Finance Authority (IFA) to provide grant funding to Indiana utilities for wastewater, stormwater, and drinking water projects that either protect or improve public health or water quality. This new program is called the State Water Infrastructure Fund or "SWIF" Program.

The goal of the program will be to finance projects that protect and improve public health and water quality, satisfy a regional solution, and provide substantial rate relief to Indiana utility customers most in need. The funds will be provided in the form of co-funded grants to communities. Funds on hand, a community's allocation of their own American Rescue Plan Act funds, or a State Revolving Fund loan may be used to co-fund an awarded SWIF Grant.

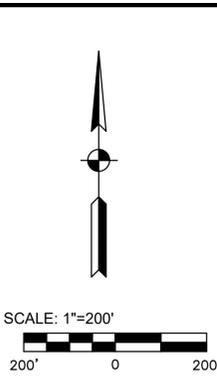
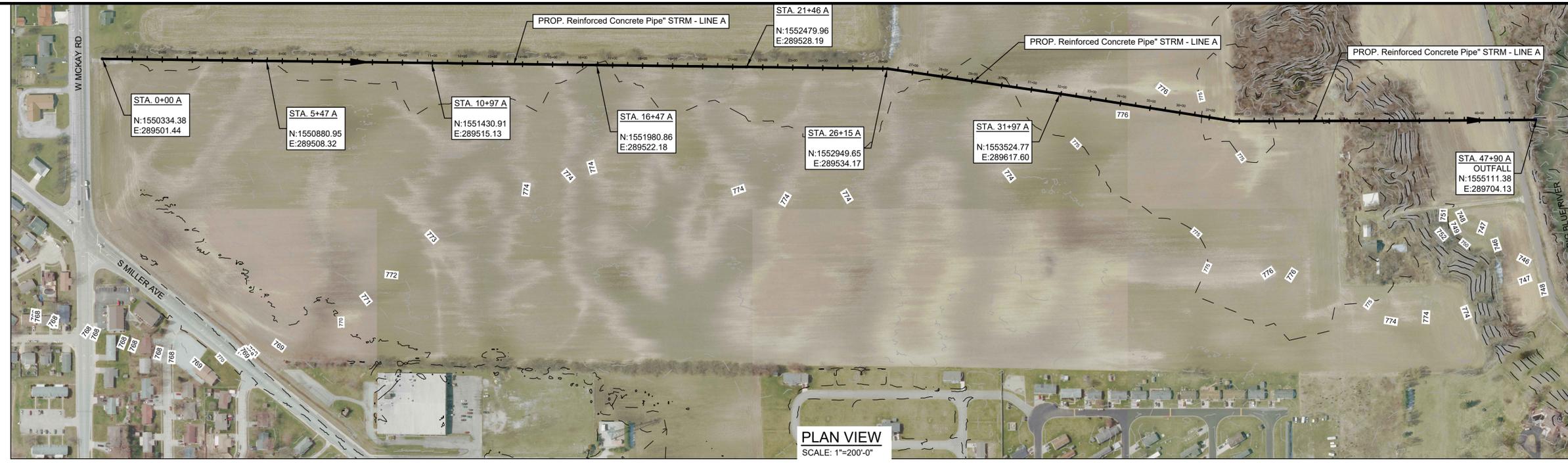
However indicators point to SWIF round 2 funding will not be available, as funds were exhausted through SWIF in round 1. More information is said to be released in the spring of 2022.

## **APPENDIX A**

### **CONCEPTUAL PLANS AND LAYOUTS**

**NOTE: APPENDIX A WAS DEVELOPED TO PROVIDE GENERAL DEPTH AND SEWER LAYOUT. ALTERNATIVE 2 IS NOT INCLUDED.**

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NOTE: THIS FIGURE IS CREATED TO SHOW APPROXIMATE DEPTH OF STORM LINE.  
 DISTANCE AND MANHOLE SPACING IS NOT REFLECTIVE OF PLANNING LEVEL COST ESTIMATES.

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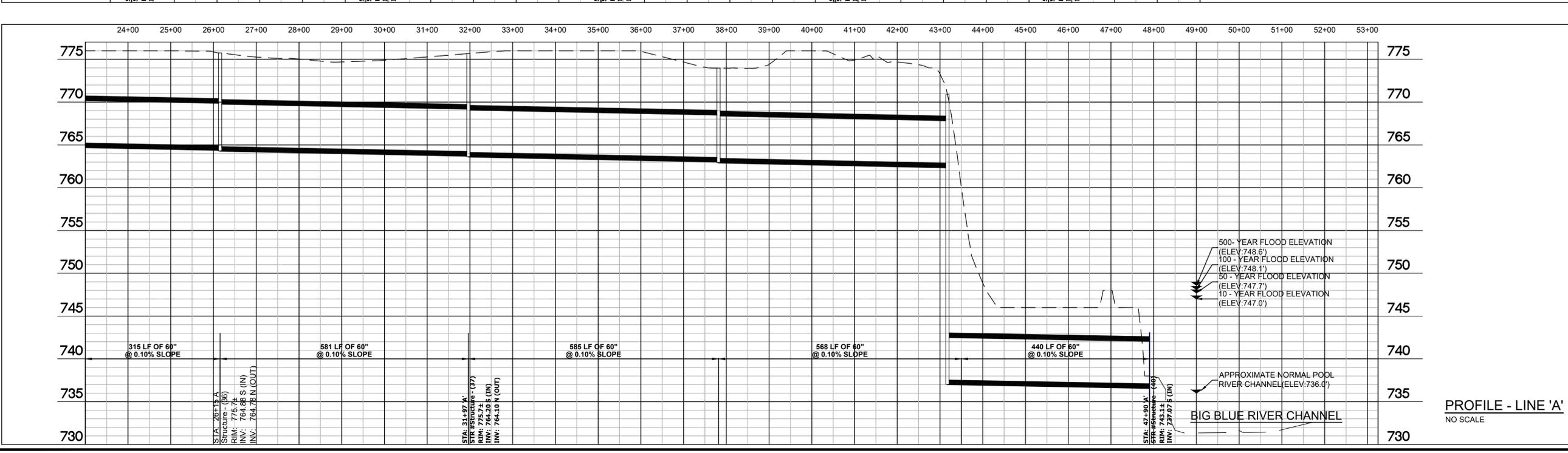
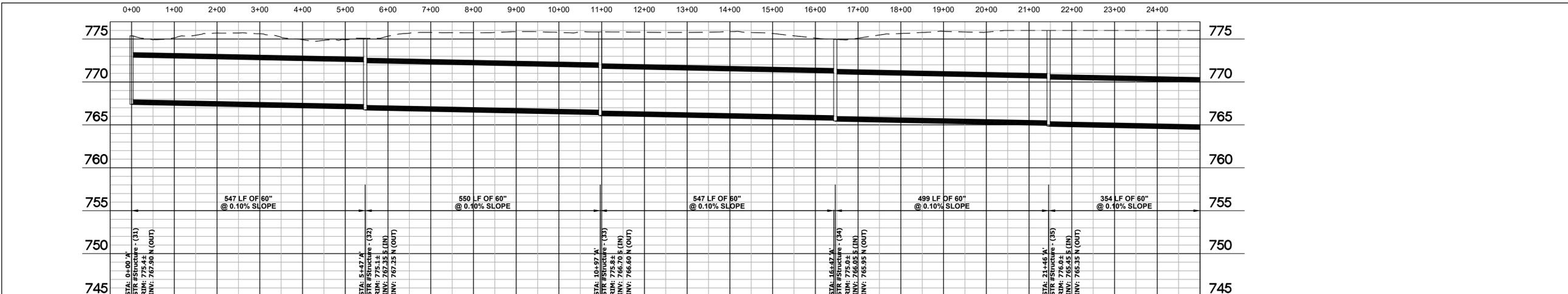
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**CITY OF SHELBYVILLE  
 SHELBY COUNTY, INDIANA**

**ALTERNATIVE 1**



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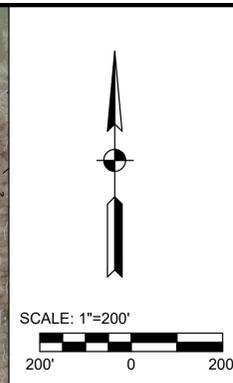
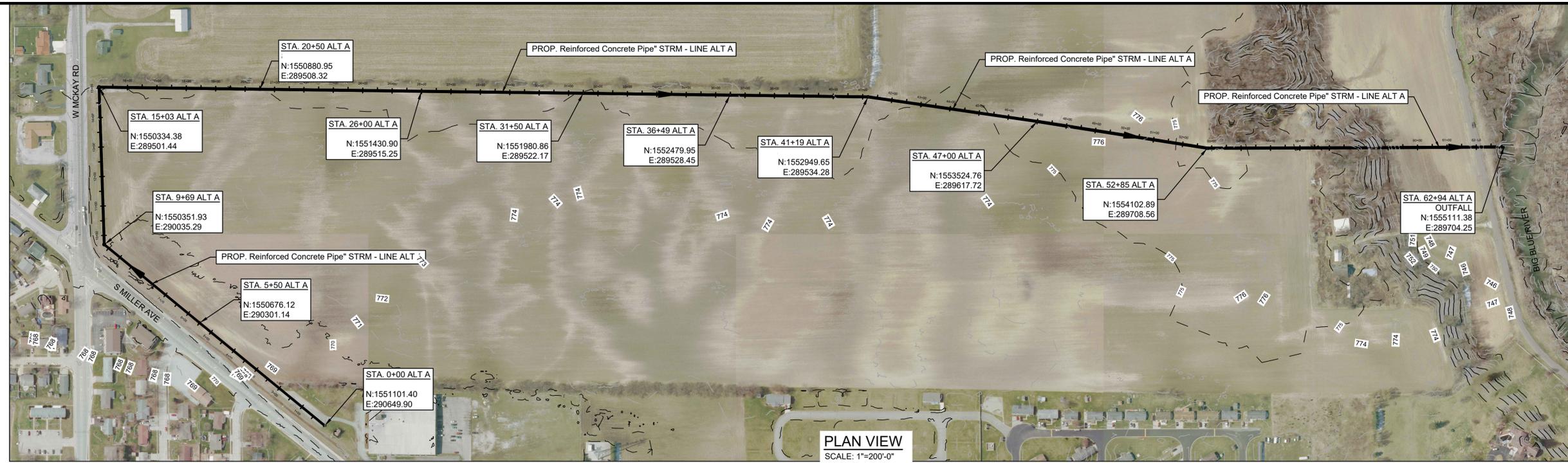
No.	Submittal/Revision	By	Date

Designed By: XXX  
 Drawn By: XXX  
 Checked By: DOF

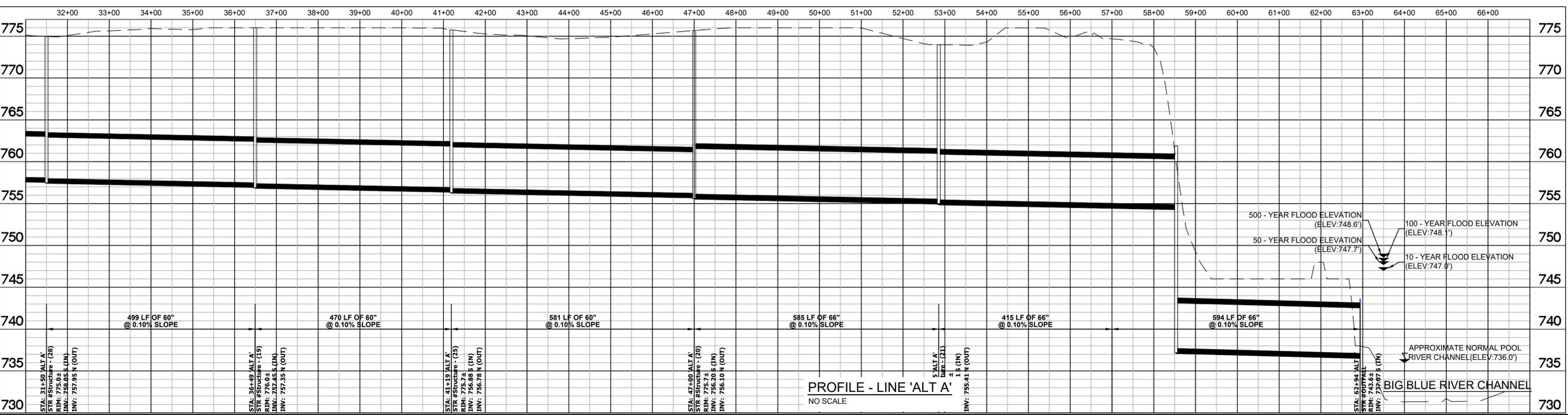
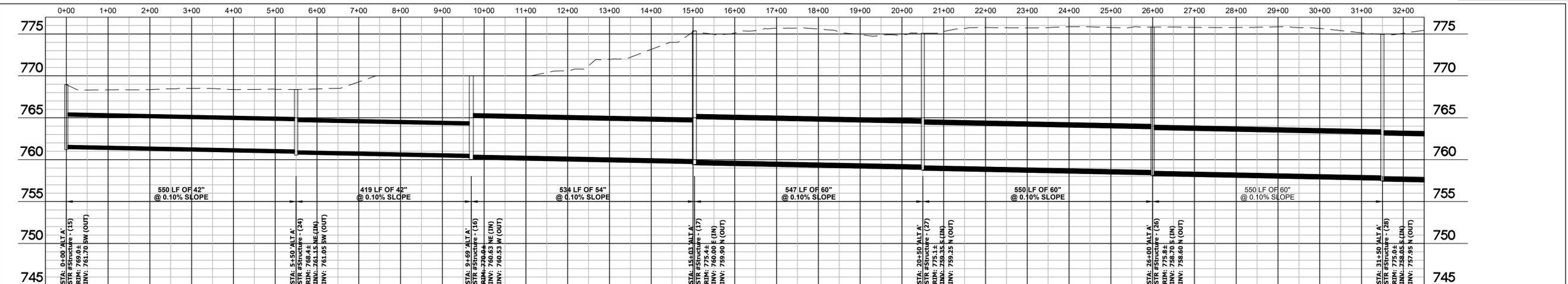
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 Project No: J21049  
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NOTE: THIS FIGURE IS CREATED TO SHOW APPROXIMATE DEPTH OF STORM LINE.  
 DISTANCE AND MANHOLE SPACING IS NOT REFLECTIVE OF PLANNING LEVEL COST ESTIMATES.



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**CITY OF SHELBYVILLE**  
**SHELBY COUNTY, INDIANA**

**ALTERNATIVE 3**

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 Project No: J21049  
 Scale: AS SHOWN

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 Sheet: \_\_\_\_\_ OF XX

**APPENDIX B**  
**PLANNING LEVEL COST ESTIMATE**

**ENGINEER'S OPINION OF PROBABLE COST**  
**SHELBYVILLE, INDIANA**  
**SHOWERS DRAINAGE IMPROVEMENTS - ALTERNATIVE 1**

Item Description	Estimated Quantity	Units	Unit Price	Item Total Amount
<b>Open-Cut Installation</b>				
60"Ø Storm Pipe, Depth 4'-8'	1400	LF	\$ 600	\$ 840,000
60"Ø RCP, Depth 8'-12'	2900	LF	\$ 650	\$ 1,885,000
60"Ø RCP, Depth 12'-15'	500	LF	\$ 700	\$ 350,000
<b>Manholes, Inlets, and End Sections</b>				
102"Ø Manhole, Depth 4-8'	4	EA	\$ 15,000	\$ 60,000
102"Ø Manhole, Depth 8-12'	8	EA	\$ 18,000	\$ 144,000
102"Ø Manhole, Depth 12-15'	1	EA	\$ 25,000	\$ 25,000
Outlet Structure	1	LS	\$ 100,000	\$ 100,000
Class 1 Rip Rap	150	SYS	\$ 75	\$ 11,300
60" Flap Gate	1	EA	\$ 10,000	\$ 10,000
Pipe Stubbing and Future Connections	1	LS	\$ 100,000	\$ 100,000
<b>Misc.</b>				
Clearing and Grubbing	1	LS	\$ 30,000	\$ 30,000
Dewatering	1	LS	\$ 50,000	\$ 50,000
Bank Stabilization	1	LS	\$ 100,000	\$ 100,000
Utility Adjustment Allowance	1	LS	\$ 50,000	\$ 50,000
Final Grading and Seeding	1	LS	\$ 50,000	\$ 50,000
Mobilization and Demobilization	6	%	\$ 229,000	\$ 229,000
Maintenance of Traffic	1	%	\$ 39,000	\$ 39,000
Erosion Control	0.75	%	\$ 29,000	\$ 29,000
<b>SUB-TOTAL CONSTRUCTION COST</b>				<b>\$ 4,102,300</b>
			<b>Contingency</b>	<b>20%</b>
				\$ 820,460
<b>TOTAL CONSTRUCTION COST</b>				<b>\$ 4,922,760</b>
			<b>Non-Construction Cost</b>	<b>25%</b>
				\$ 1,230,690
<b>TOTAL PROJECT COST<sup>(1)</sup></b>				<b>\$ 6,153,450</b>

<sup>1</sup> Construction cost estimate is based on 2022 construction dollars and construction trends. For each year construction takes place after the year 2022, an inflation percentage of 5% minimum or per current trends should be added. Percentage based on Indiana Department of Transportation 2013 Design Manual Chapter 102 Project Development - Chapter 07 Environmental Procedures/Design Summary.

**ENGINEER'S OPINION OF PROBABLE COST  
SHELBYVILLE, INDIANA  
SHOWERS DRAINAGE IMPROVEMENTS - ALTERNATIVE 2**

Item Description	Estimated Quantity	Units	Unit Price	Item Total Amount
<b>Open-Cut Installation</b>				
48"Ø Storm Pipe, Depth 4'-8'	850	LF	\$ 450	\$ 382,500
60"Ø RCP, Depth 8'-12'	600	LF	\$ 650	\$ 390,000
60"Ø RCP, Depth 12'-15'	1000	LF	\$ 700	\$ 700,000
66"Ø RCP, Depth 4'-8'	400	LF	\$ 675	\$ 270,000
66"Ø RCP, Depth 12'-15'	2200	LF	\$ 725	\$ 1,595,000
66"Ø RCP, Depth 15'-20'	600	LF	\$ 850	\$ 510,000
<b>Manholes, Inlets, and End Sections</b>				
102"Ø Manhole, Depth 4-8'	4	EA	\$ 15,000	\$ 60,000
102"Ø Manhole, Depth 8-12'	2	EA	\$ 18,000	\$ 36,000
102"Ø Manhole, Depth 12-15'	8	EA	\$ 25,000	\$ 200,000
102"Ø Manhole, Depth 15-20'	2	EA	\$ 30,000	\$ 60,000
Outlet Structure	1	LS	\$ 100,000	\$ 100,000
Class 1 Rip Rap	150	SYS	\$ 75	\$ 11,300
66" Flap Gate	1	EA	\$ 10,000	\$ 10,000
Pipe Stubbing and Future Connections	1	LS	\$ 100,000	\$ 100,000
<b>Misc.</b>				
Clearing and Grubbing	1	LS	\$ 30,000	\$ 30,000
Dewatering	1	LS	\$ 50,000	\$ 50,000
Bank Stabilization	1	LS	\$ 100,000	\$ 100,000
Utility Adjustment Allowance	1	LS	\$ 50,000	\$ 50,000
Final Grading and Seeding	1	LS	\$ 50,000	\$ 50,000
Mobilization and Demobilization	6	%	\$ 283,000	\$ 283,000
Maintenance of Traffic	1	%	\$ 48,000	\$ 48,000
Erosion Control	0.75	%	\$ 36,000	\$ 36,000
<b>SUB-TOTAL CONSTRUCTION COST</b>				<b>\$ 5,071,800</b>
			<b>Contingency 20%</b>	<b>\$ 1,014,360</b>
<b>TOTAL CONSTRUCTION COST</b>				<b>\$ 6,086,160</b>
			<b>Non-Construction Cost 25%</b>	<b>\$ 1,521,540</b>
<b>TOTAL PROJECT COST<sup>(1)</sup></b>				<b>\$ 7,607,700</b>

<sup>1</sup> Construction cost estimate is based on 2022 construction dollars and construction trends. For each year construction takes place after the year 2022, an inflation percentage of 5% minimum or per current trends should be added. Percentage based on Indiana Department of Transportation 2013 Design Manual Chapter 102 Project Development - Chapter 07 Environmental Procedures/Design Summary.

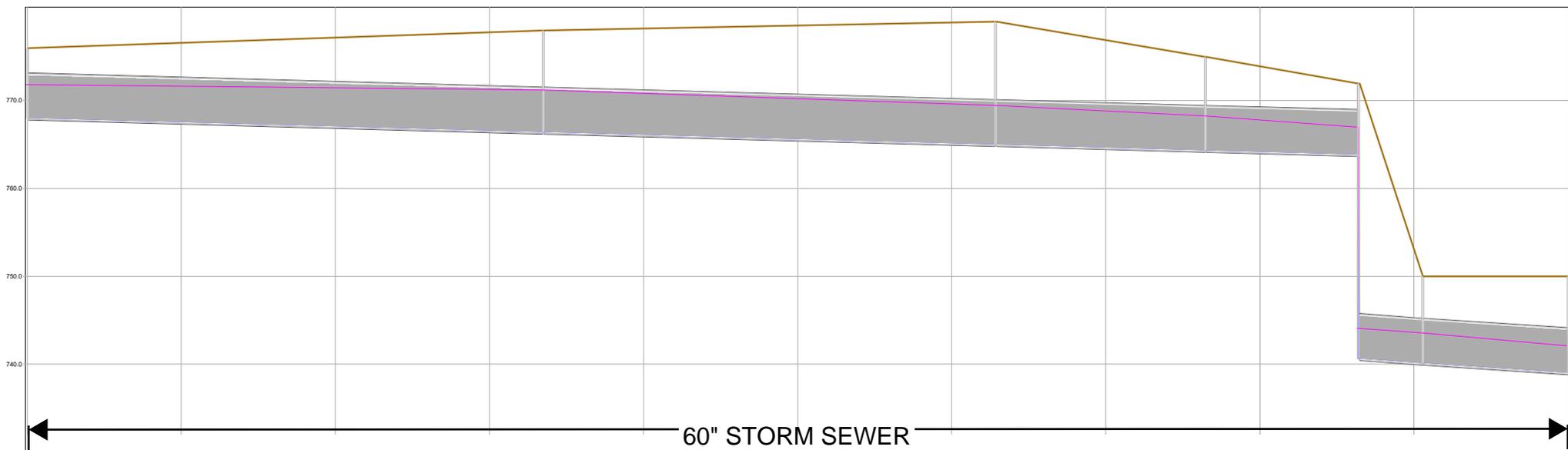
**ENGINEER'S OPINION OF PROBABLE COST  
SHELBYVILLE, INDIANA  
SHOWERS DRAINAGE IMPROVEMENTS - ALTERNATIVE 3**

Item Description	Estimated Quantity	Units	Unit Price	Item Total Amount
<b>Open-Cut Installation</b>				
42"Ø Storm Pipe, Depth 4'-8'	700	LF	\$ 325	\$ 227,500
42"Ø RCP, Depth 8'-12'	300	LF	\$ 350	\$ 105,000
54"Ø RCP, Depth 8'-12'	350	LF	\$ 550	\$ 192,500
54"Ø RCP, Depth 12-15'	150	LF	\$ 600	\$ 90,000
60"Ø RCP, Depth 15'-20'	3000	LF	\$ 725	\$ 2,175,000
66"Ø RCP, Depth 4'-8'	400	LF	\$ 675	\$ 270,000
66"Ø RCP, Depth 15'-20'	1400	LF	\$ 825	\$ 1,155,000
<b>Manholes, Inlets, and End Sections</b>				
102"Ø Manhole, Depth 4-8'	3	EA	\$ 15,000	\$ 45,000
102"Ø Manhole, Depth 8-12'	1	EA	\$ 18,000	\$ 18,000
102"Ø Manhole, Depth 12-15'	2	EA	\$ 25,000	\$ 50,000
102"Ø Manhole, Depth 15-20'	11	EA	\$ 30,000	\$ 330,000
Outlet Structure	1	LS	\$ 100,000	\$ 100,000
Class 1 Rip Rap	150	SYS	\$ 75	\$ 11,300
66" Flap Gate	1	EA	\$ 10,000	\$ 10,000
Pipe Stubbing and Future Connections	1	LS	\$ 100,000	\$ 100,000
<b>Misc.</b>				
Clearing and Grubbing	1	LS	\$ 30,000	\$ 30,000
Dewatering	1	LS	\$ 50,000	\$ 50,000
Bank Stabilization	1	LS	\$ 100,000	\$ 100,000
Utility Adjustment Allowance	1	LS	\$ 50,000	\$ 50,000
Final Grading and Seeding	1	LS	\$ 50,000	\$ 50,000
Mobilization and Demobilization	6	%	\$ 310,000	\$ 310,000
Maintenance of Traffic	1	%	\$ 52,000	\$ 52,000
Erosion Control	0.75	%	\$ 39,000	\$ 39,000
<b>SUB-TOTAL CONSTRUCTION COST</b>				<b>\$ 5,560,300</b>
			<b>Contingency</b>	<b>20%</b>
				\$ 1,112,060
<b>TOTAL CONSTRUCTION COST</b>				<b>\$ 6,672,360</b>
			<b>Non-Construction Cost</b>	<b>25%</b>
				\$ 1,668,090
<b>TOTAL PROJECT COST<sup>(1)</sup></b>				<b>\$ 8,340,450</b>

<sup>1</sup> Construction cost estimate is based on 2022 construction dollars and construction trends. For each year construction takes place after the year 2022, an inflation percentage of 5% minimum or per current trends should be added. Percentage based on Indiana Department of Transportation 2013 Design Manual Chapter 102 Project Development - Chapter 07 Environmental Procedures/Design Summary.

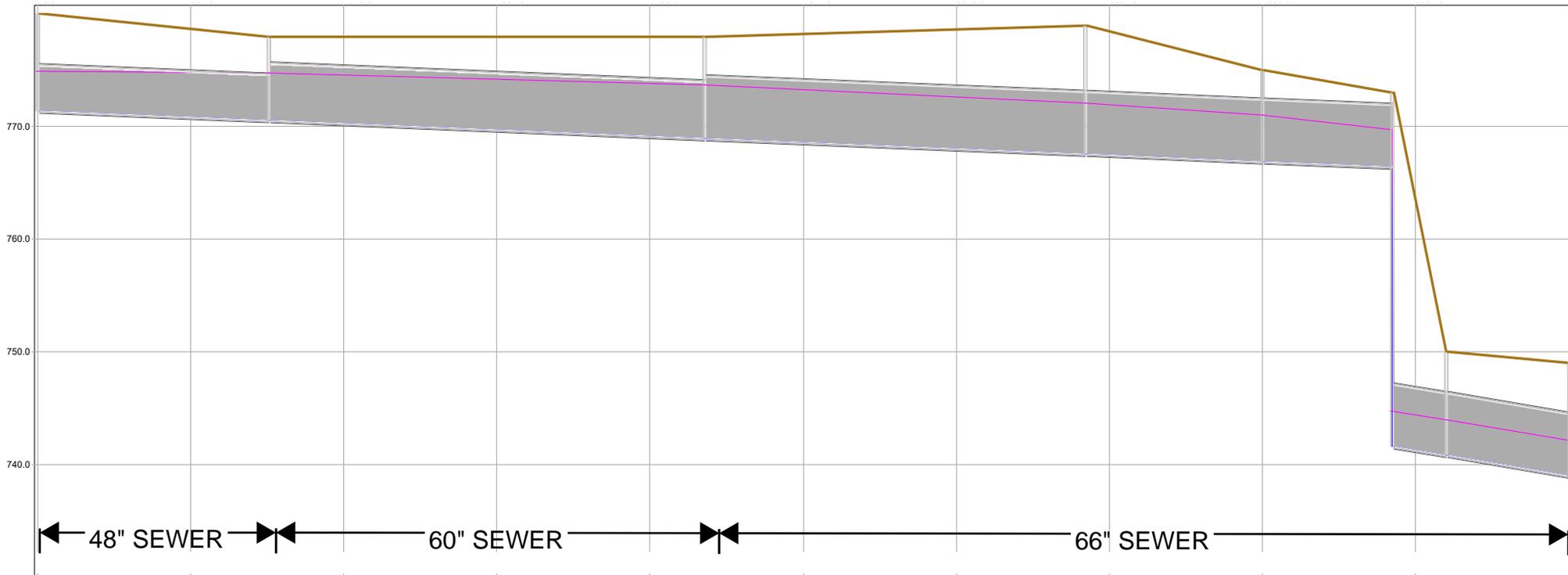
**APPENDIX C**  
**MODEL RESULTS**

# ALTERNATIVE 1 - HYDRAULIC PROFILE



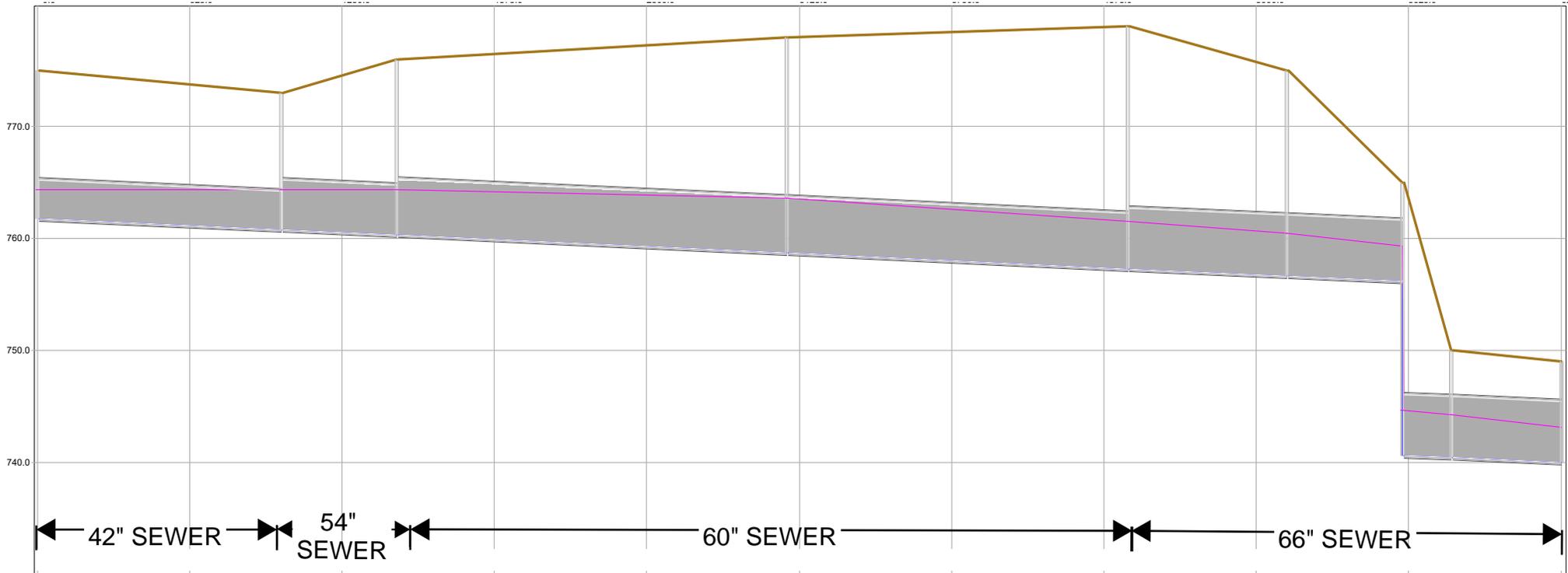
NOTE: THE GROUND ELEVATION SEEN IS USED FOR VISUAL PRESENTATIONS PURPOSES ONLY, AND IT IS NOT TO SCALE

# ALTERNATIVE 2 - HYDRAULIC PROFILE



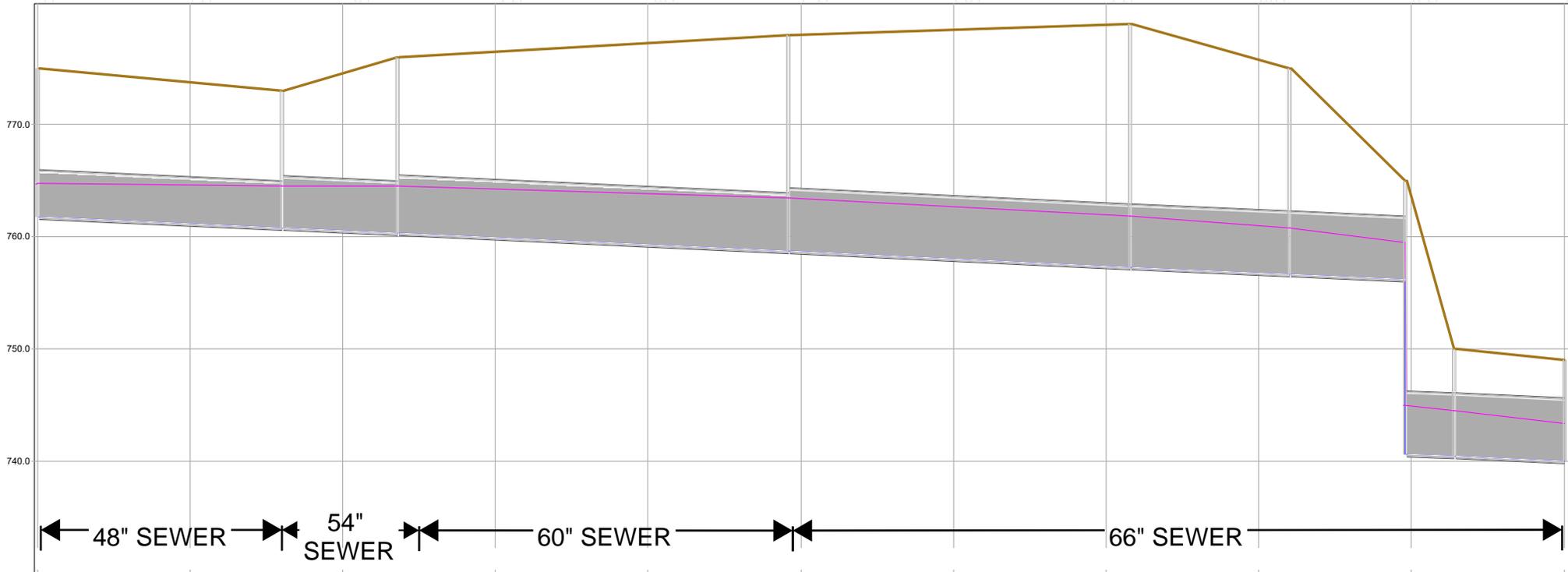
NOTE: THE GROUND ELEVATION SEEN IS USED FOR VISUAL PRESENTATIONS PURPOSES ONLY, AND IT IS NOT TO SCALE

# ALTERNATIVE 3 - HYDRAULIC PROFILE



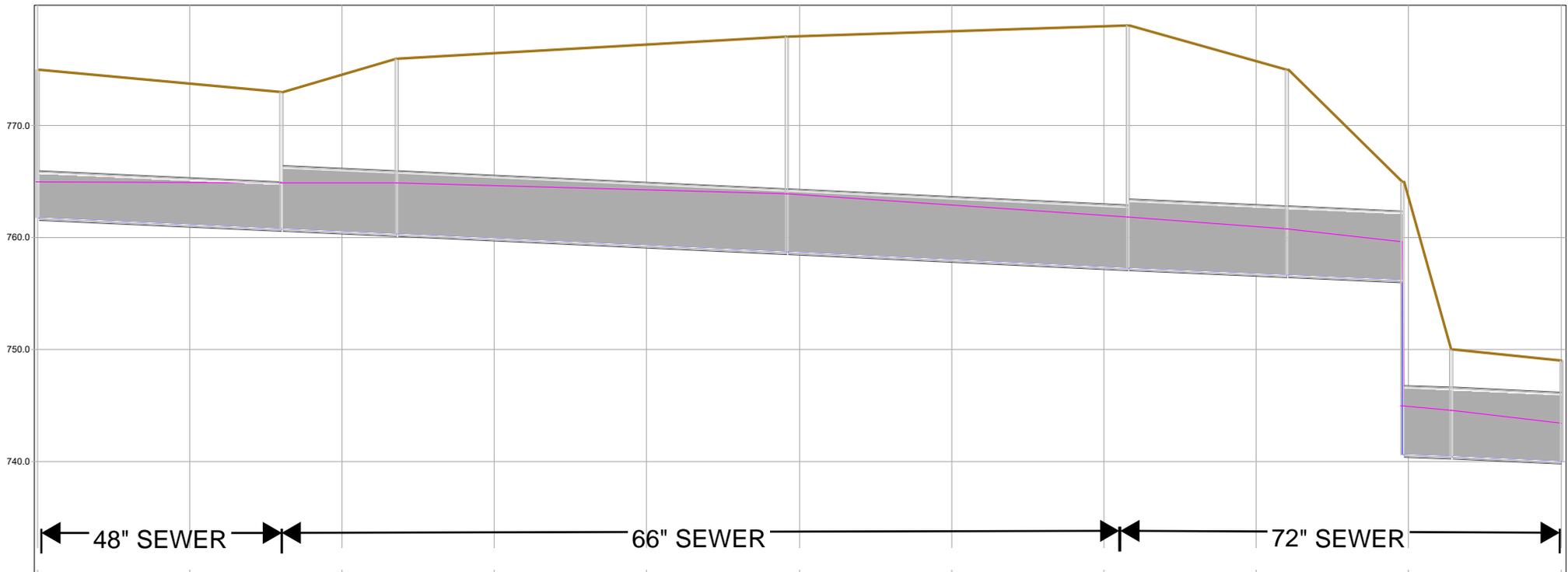
NOTE: THE GROUND ELEVATION SEEN IS USED FOR VISUAL PRESENTATIONS PURPOSES ONLY, AND IT IS NOT TO SCALE

# ALTERNATIVE 4 - HYDRAULIC PROFILE



NOTE: THE GROUND ELEVATION SEEN IS USED FOR VISUAL PRESENTATIONS PURPOSES ONLY, AND IT IS NOT TO SCALE

# ALTERNATIVE 5 - HYDRAULIC PROFILE



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