Wyandotte County- 26th and Miami Avenue Technical Assistance Report

PREPARED FOR:

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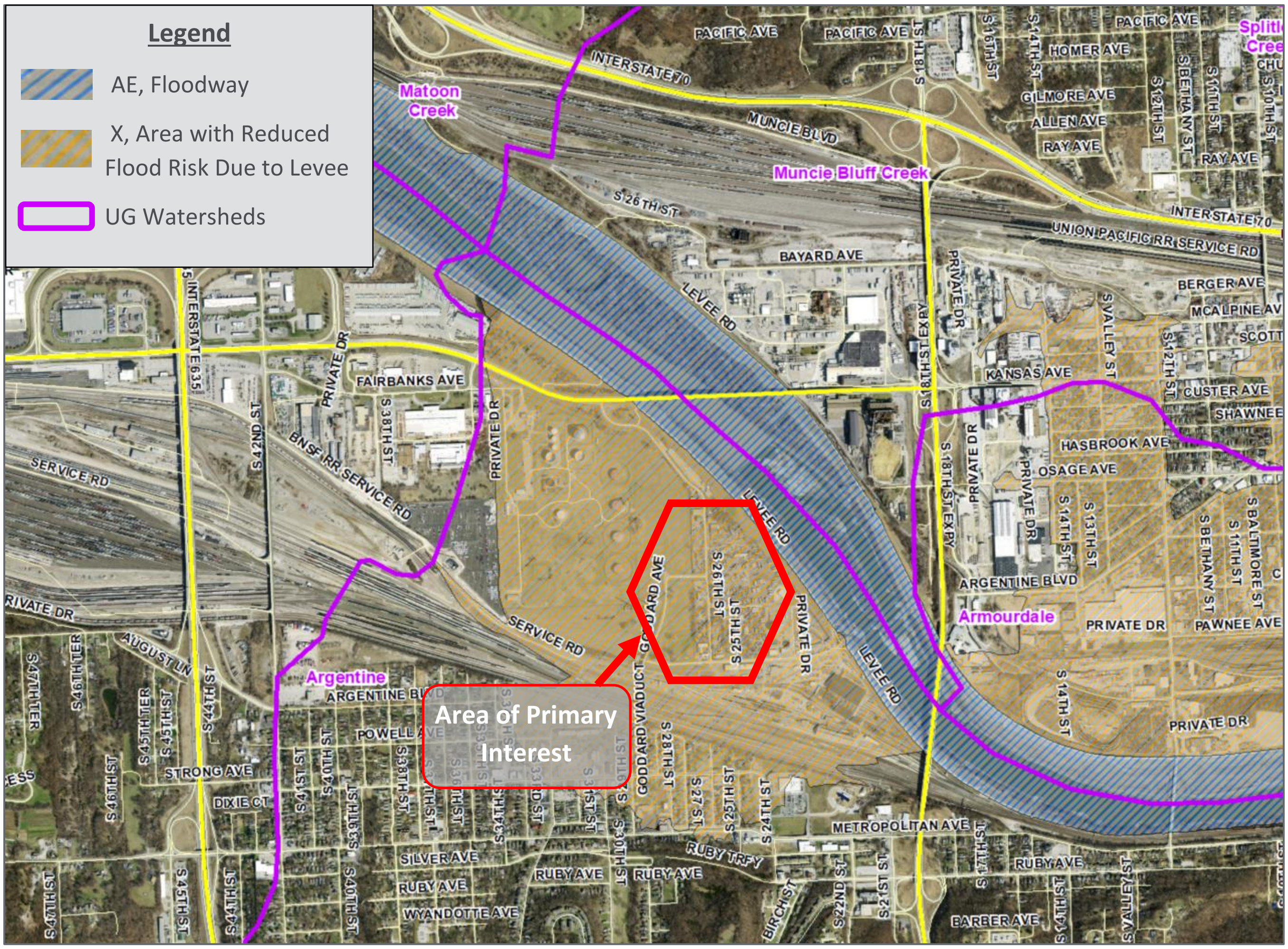
1 INTRODUCTION

The Kansas Department of Agriculture (KDA) received funding from FEMA to complete a technical assistance project for the Unified Government of Wyandotte County, KS (UG) to study potential mitigation measures for the existing flooding issues near S 26th Street and Miami Avenue. The area of primary interest is located just south of the Kansas River and I-70, north of the BNSF Railroad, and east of I-635. This area is within the UG's Argentine watershed. A map of the area of interest is shown in Figure 1. This area has recurring flooding that routinely covers the street. This flooding leads to difficult and unsafe travel for vehicles and pedestrians and causes residents to be unable to access their homes. The flooding also hinders the primary access point for rail services. This area is flat with poor drainage and is located behind a levee system. The nearby properties include industrial businesses, salvage yards, residential homes, and BNSF Railyards.

FIGURE 1- AREA OF PRIMARY INTEREST FOR PROJECT



The Wyandotte County Flood Insurance Study is dated September 2, 2015. The area of primary interest is located within a shaded Zone X area that is protected by levees from the 1% annual chance flood, which is correlated to the reduced occurrence of flooding from the Kansas River due to the Argentine Unit levee system. The area of primary interest also experiences localized flooding, which is not represented on the FEMA Flood Insurance Rate Map (FIRM).

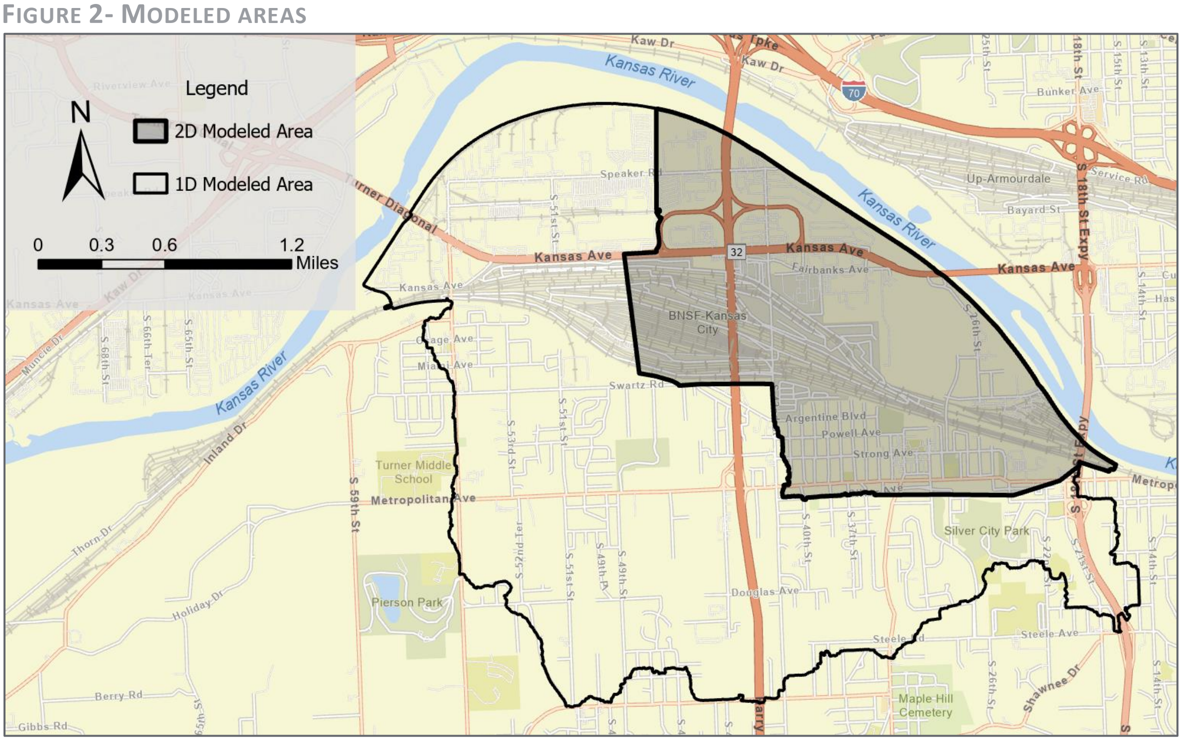
The overall goal of the project was to evaluate the existing and future flooding conditions in the area of interest and develop conceptual flood mitigation alternatives to reduce flood risk, particularly along the streets. Currently, the area suffers from significant flooding during approximately a 10% (10-year) annual chance storm event and larger. The scope of work for the project included the use of PC-SWMM hydrologic and hydraulic modeling due to the urban nature of the watershed. SWMM modeling was selected to accurately represent surface flow, subsurface flow through the pipe network, and interconnecting flow between the two. An existing conditions model was developed, which was then used to develop a future conditions model and evaluate several flood mitigation alternatives. Flood inundation maps were developed for each scenario, to illustrate the impact that the conceptual flood mitigation alternatives would have on both the existing and future flood conditions. Planning level cost estimates were also developed for conceptual flood mitigation alternatives to aid the UG in future planning and decisions.

2 MODELING METHODS

2.1 Modeling Software

The detailed model for this flood study was generated using PC-SWMM. The PC-SWMM software is a modeling interface with various tools to develop files that are still compatible with the open-source EPA-SWMM engine. For this project PC-SWMM version 7.5 was used in conjunction with EPA-SWMM engine version 5.1.015. The area of primary interest was modeled using a 2-Dimensional (2D) approach to incorporate surface flow and subsurface flow to a greater degree of detail. The remainder of the contributing drainage area was modeled using a 1-Dimensional (1D) approach to reduce run times while still providing adequate detail to the study area. Figure 2 shows the extents of 1D and 2D modeled areas within the PC-SWMM model.

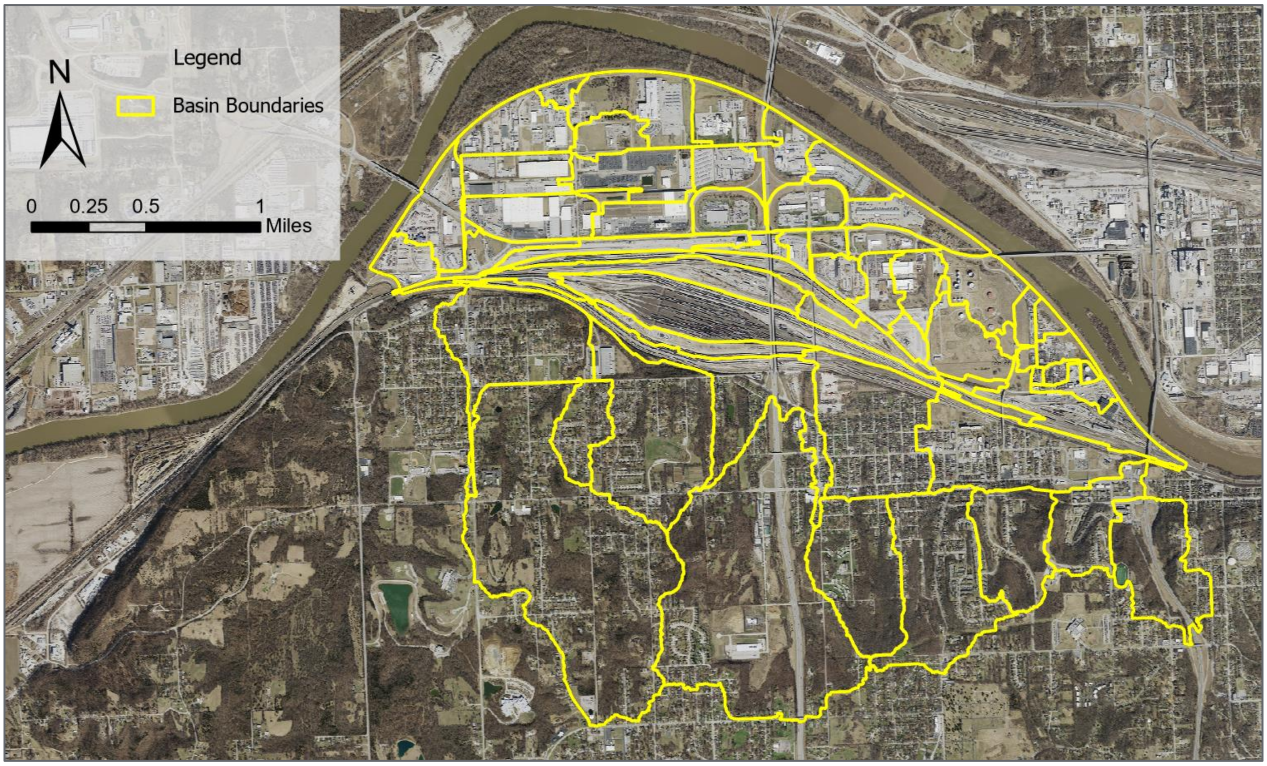
FIGURE 2- MODELED AREAS



2.2 Basin Delineation

The modeled area is located within the UG's Turner Creek watershed and portions of the Argentine watershed. The drainage area subbasins were generated based on the local topography. The topography for this project was obtained from the State of Kansas Data Access and Support Center. One-meter resolution LiDAR from 2018 was utilized for the elevation data. From the LiDAR Digital Elevation Models (DEM), GIS processes were completed using ArcGIS Pro to obtain preliminary basin delineations. The preliminary basins were then manually adjusted based on the LiDAR and storm systems. For this project, there were 62 basins ranging from approximately 2 acres in the 2D section to 511 acres in the 1D section.

FIGURE 3- SUBBASIN BOUNDARIES



2.3 Rainfall

The modeling includes the 10% (10-year), 4% (25-year), 2% (50-year), and 1% (100-year) annual chance exceedance storm events. Rainfall depths were developed by taking the average values of the partial-duration gridded rainfall data developed by the National Oceanic and Atmospheric Administration (NOAA) as part of Atlas 14, Volume 8: Precipitation-Frequency Atlas of the United States (National Oceanic and Atmospheric Administration (NOAA), 2013). The rainfall depths are shown in Table 1. The rainfall distribution for this area is the Natural Resource Conservative Service (NRCS) Midwest and Southeast (MSE) Region Type 4.

TABLE 1- RAINFALL DEPTHS

Storm Event	Rainfall Depth (in)
10% AC (10-yr)	5.4
4% AC (25-yr)	6.7
2% AC (50-yr)	7.7
1% AC (100-yr)	8.7

2.4 Landuse

The base landuse data within this model is the latest data from the National Land Cover Database (NLCD) 2019 products. In the upper reaches, the landuse is used to generate a curve number for the generalized basins. For the 2D study area, the landuse data was manually refined to accurately represent the building footprints, streets, and impervious areas. This refined landuse dataset was used during the generation of a 2D-mesh, which applies Manning's roughness values to the surface flow paths. Table 2 describes the Manning's roughness value for each landuse type.

TABLE 2 – MANNING'S VEGETATIVE ROUGHNESS FOR UPDATED LANDUSE

Landuse Description	Manning's Roughness
Barren Land / Bare Soil	0.03
Buildings	0.015 - 1
Channel	0.03 – 0.05
Cultivated Crops	0.05
Deciduous Forest	0.16
Developed, Low Intensity	0.06
Developed, Medium Intensity	0.06
Developed, High Intensity	0.06
Developed, Open Space	0.03-0.04
Emergent Herbaceous Wetlands	0.07
Evergreen Forest	0.16
Grassland-Herbaceous	0.05
Impervious	0.015
Mixed Forest	0.16
Open Water	0.03
Pasture-Hay	0.05
Shrub-Scrub	0.1
Woody Wetlands	0.12

2.5 Infiltration

Infiltration losses were computed using USDA's Soil Conservation Service (SCS) Curve Number Method, detailed in the National Engineering Handbook Part 630, Chapter 10. The curve number is a function of both hydrologic soil group and land use. To determine the curve number values utilized by the model, refined landuse data described in the previous sections was utilized. Soils data was obtained from the United Stated Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey, which includes an aggregate hydrologic soil group for individual soil series. Assuming an antecedent runoff condition (ARC) of II, a curve number value was defined for each category of the landuse and soil layers. The following table summarizes these curve number values, which were applied as a polygon layer to the model. A tool within the PC-SWMM software was able to spatially weight the curve number values for each subbasin.

TABLE 3 – CURVE NUMBER VALUES FOR SPATIALLY VARYING INFILTRATION

	Curve Number by Hydrologic Soil Group			
Landuse Description	**A**	**B**	**C**	**D**
Developed Open Space	49	69	79	84
Barren/Bare	77	86	91	94
Deciduous/Evergreen/Mixed Forest	30	55	70	77
Shrub/Scrub	43	65	76	82
Herbaceous	43	65	76	82
Hay/Pasture	49	69	79	84
Cultivated Crops	65	75	82	86
Woody Wetlands	36	60	73	79
Emergent Herbaceous Wetlands	36	60	73	79
Impervious Surfaces	98	98	98	98
Open Water	98	98	98	98

Subbasin runoff hydrographs were developed using the SWMM runoff block methodology utilizing appropriate flow length and width values, based on the basin shape. Basin slope was computed from the LIDAR data.

2.6 Hydraulic Routing

The dynamic wave routing method was used so that the model can properly estimate reverse flow in pipes, backwater effects, and divided flow. In the SWMM modeling environment, links are used to represent conveyance through open channels, pipe networks, gutters, streets, pumps, weirs, and orifices. Pipe lengths, diameter, roughness coefficients, and entrance and exit loss coefficients were established. Surface dimensions for channels, gutters, streets, and overflows were estimated based on LIDAR elevation data while roughness coefficients were estimated from imagery and landuse data. Flow between subsurface pipes and surface elements was shared using direct connections of the respective elements at stormwater inlets, manholes, and outfalls. In the SWMM modeling environment, nodes are used to represent manholes, pipe junctions, inlet locations, storage areas, and outfalls. Junction inverts and maximum depth elevations were established. Outfalls were placed at all model outflow locations.

Runoff from the 1D areas is routed through downstream basins using a series of links and nodes that represent subsurface pipes, bridges, channels, and overflow paths. The discharges from the 1D subbasins either outlet into the Kansas River or into downstream 2D areas.

The 2D mesh was developed using PC-SWMM mesh generation tools. Elevation data for the mesh was taken from the LIDAR elevation data. Mesh resolution and alignment was set to accurately represent surface flow paths through channels and streets, as well as embankments and other features critical to hydraulic computations. Building footprints were represented as obstructions in the mesh. Vegetative roughness coefficients were estimated from imagery and landuse data. Ties to subsurface pipes were implemented using direct connections.

FIGURE 4- ILLUSTRATION OF 2D MESH

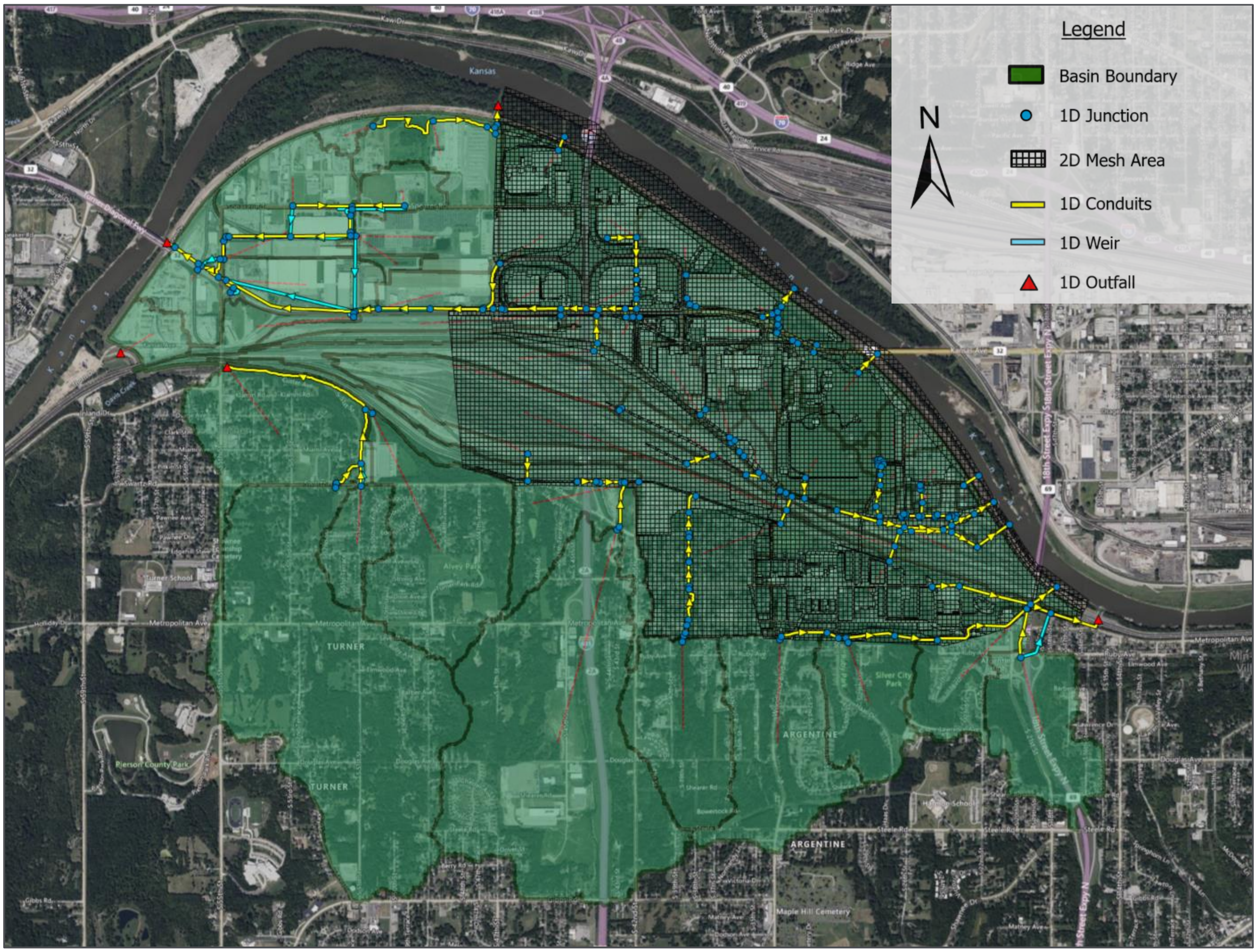
2.7 Infrastructure Incorporation

The UG's GIS shapefiles were utilized for inclusion of culverts and pipes into the SWMM model and supplemented with information from aerial imagery, field collection, as-built plans, and engineering judgement. It is noted that a number of pipes are located within inaccessible private areas. Details that were incorporated into the model included pipe placement, dimensions, material type, elevations, and the number of barrels.

While the area of interest is protected by a levee system, no levee evaluations, including any assessment of 44 CFR 65.10 criteria, were included in this technical assistance project. The area also has various pump stations. However, the pump stations were excluded from the modeling as their impacts are not expected to have significant impacts on less frequent (larger) flood events and the pump stations are not located in the primary area of interest. The gravity fed portions of the pump station locations were, however, included in the modeling.

An overview of the PC-SWMM model is shown in Figure 5.

FIGURE 5- OVERVIEW OF THE PC-SWMM MODEL



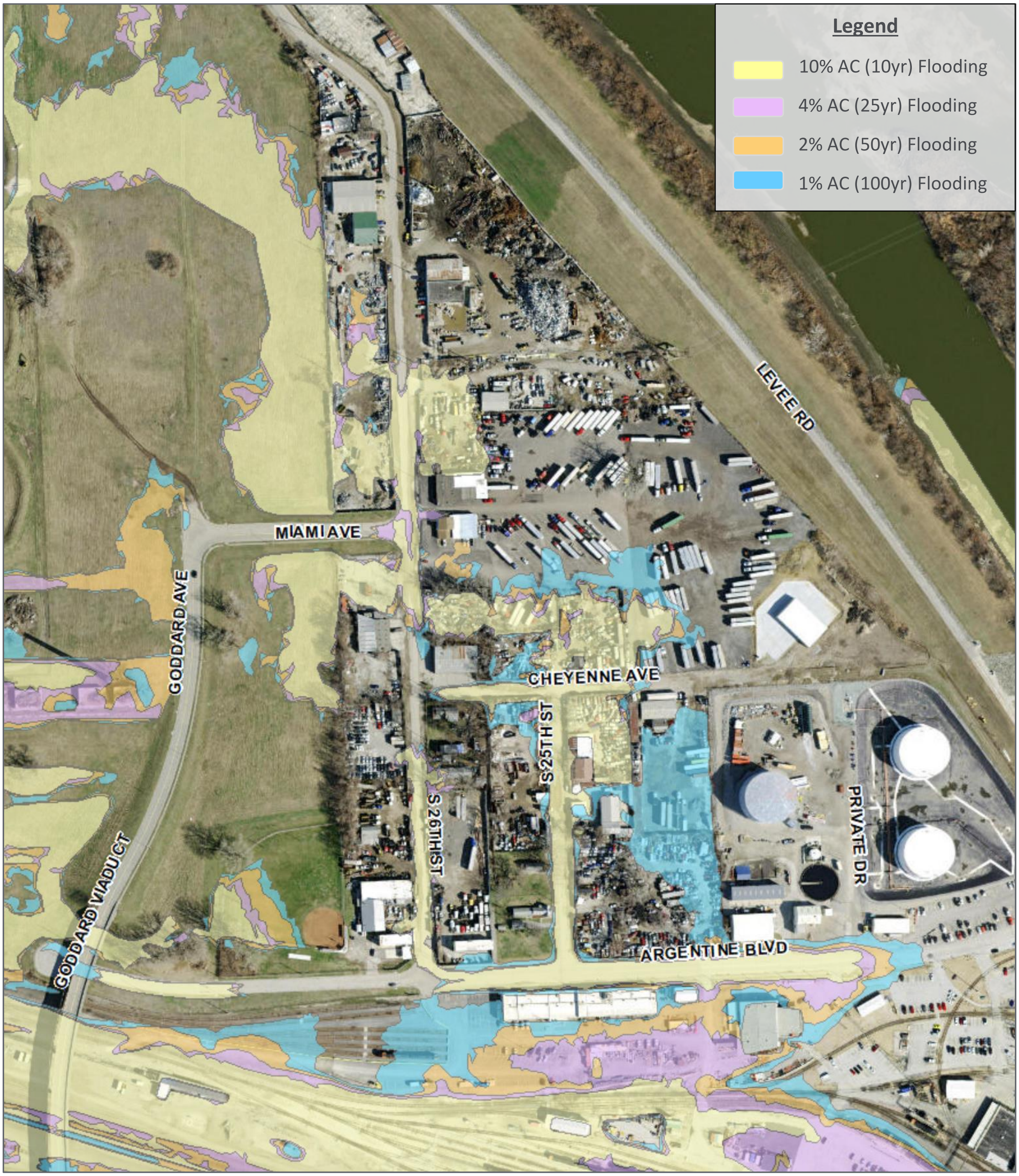
3 EXISTING CONDITIONS

The existing conditions model was developed using the methods described in the previous section of the report. The model includes the 10%, 4%, 2%, and 1% storm events. For additional model refinement and verification of the modeling results, the resulting flooding was compared to pictures that were provided by the UG and noticeable ponding observed from Google Earth imagery dated April 2021, which are shown in Figure 6.

FIGURE 6- EXISTING CONDITIONS FLOOD PICTURES

The resulting floodplains for the existing conditions modeling are shown in Figure 7. Based on the modeling performed, the flooding along S 26th Street appears to be predominantly caused by localized drainage issues in the near vicinity, as opposed to flooding impacts from the larger basin.

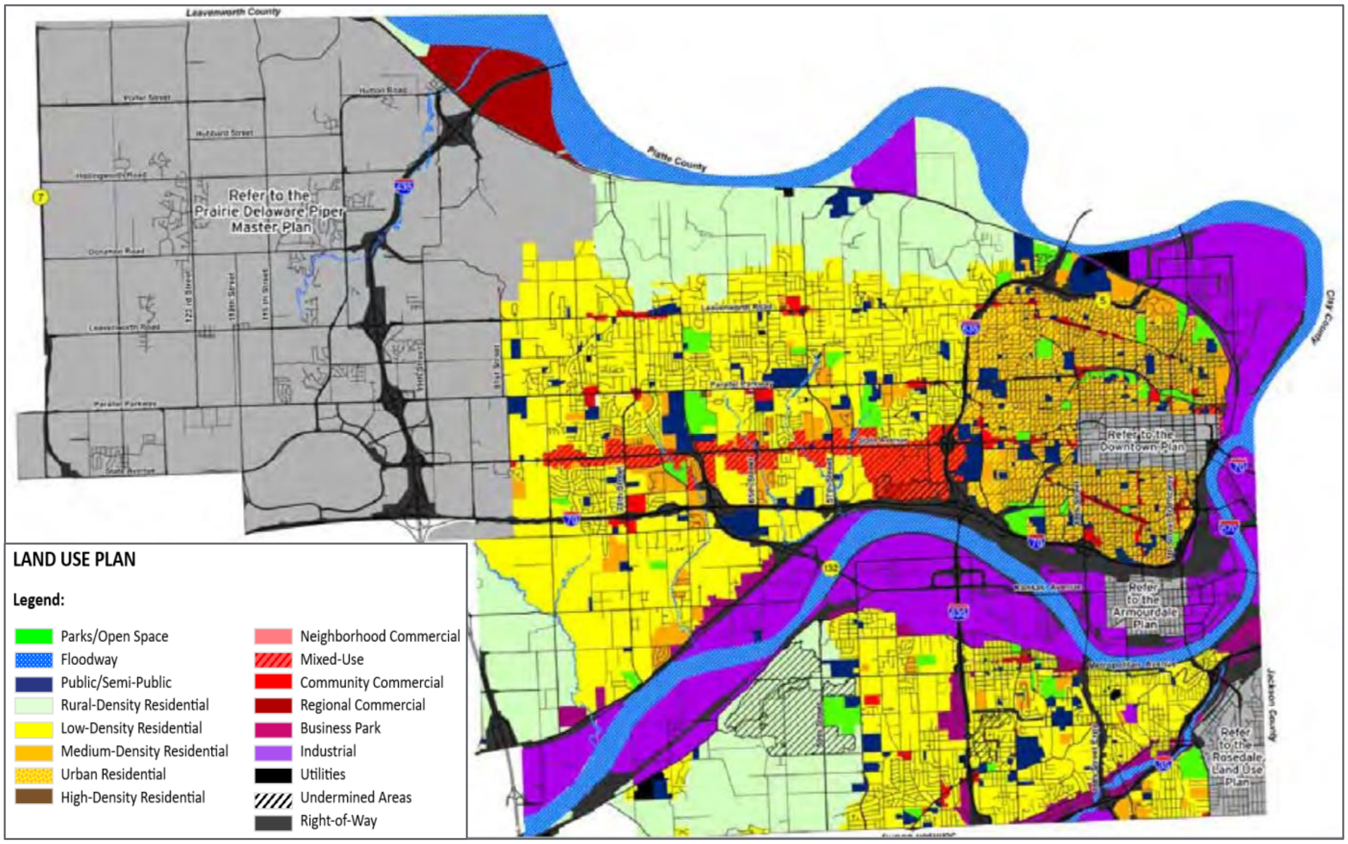
FIGURE 7- EXISTING CONDITIONS FLOODPLAINS



4 FUTURE CONDITIONS

The UG completed a City-Wide Comprehensive Plan in 2008 that was designed to achieve the community's vision of a forward looking, environmentally minded city with development that supports healthy neighborhoods and the City's rich and diverse cultural history. The Comprehensive Plan includes information on future land use, providing a guide for future development within the UG by outlining recommended uses and densities. Figure 8 is an image from the 2008 Comprehensive Plan illustrating the future land use guide. A shapefile of this land use guide was provided by the UG.

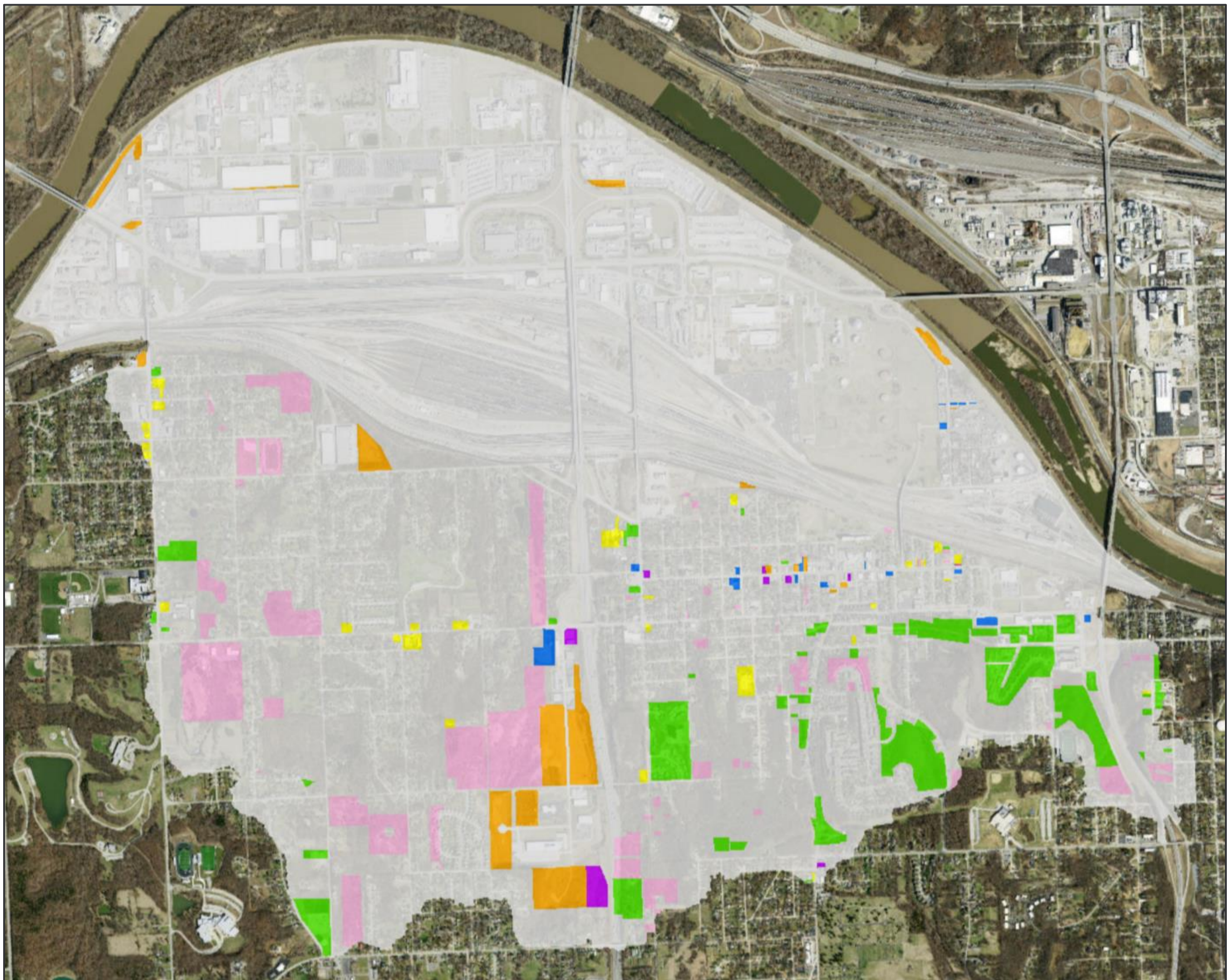
FIGURE 8- 2008 FUTURE LAND USE GUIDE



The UG is currently working on a 2023 Citywide Comprehensive Plan, which will be an update to the 2008 plan. The 2023 Comprehensive Plan will include an update to land use, but the information is not yet complete or available. Therefore, the future conditions modeling utilizes the 2008 future land use guide.

To evaluate the changes to flood risk associated with anticipated development/redevelopment in the area, future conditions modeling was performed using an adjusted landuse layer. The adjusted landuse layer resulted in changes to curve numbers and Manning's roughness values within the model. Figure 9 provides an overview of the potential land use changes anticipated with future development/redevelopment in the modeled area, based on the 2008 future land use guide compared to current land use types. The gray areas represent negligible differences in the land use types. The land use classifications have been grouped into categories for the presentation of Figure 9.

Figure 9- Overview of Potential Land Use Changes within Modeled Area

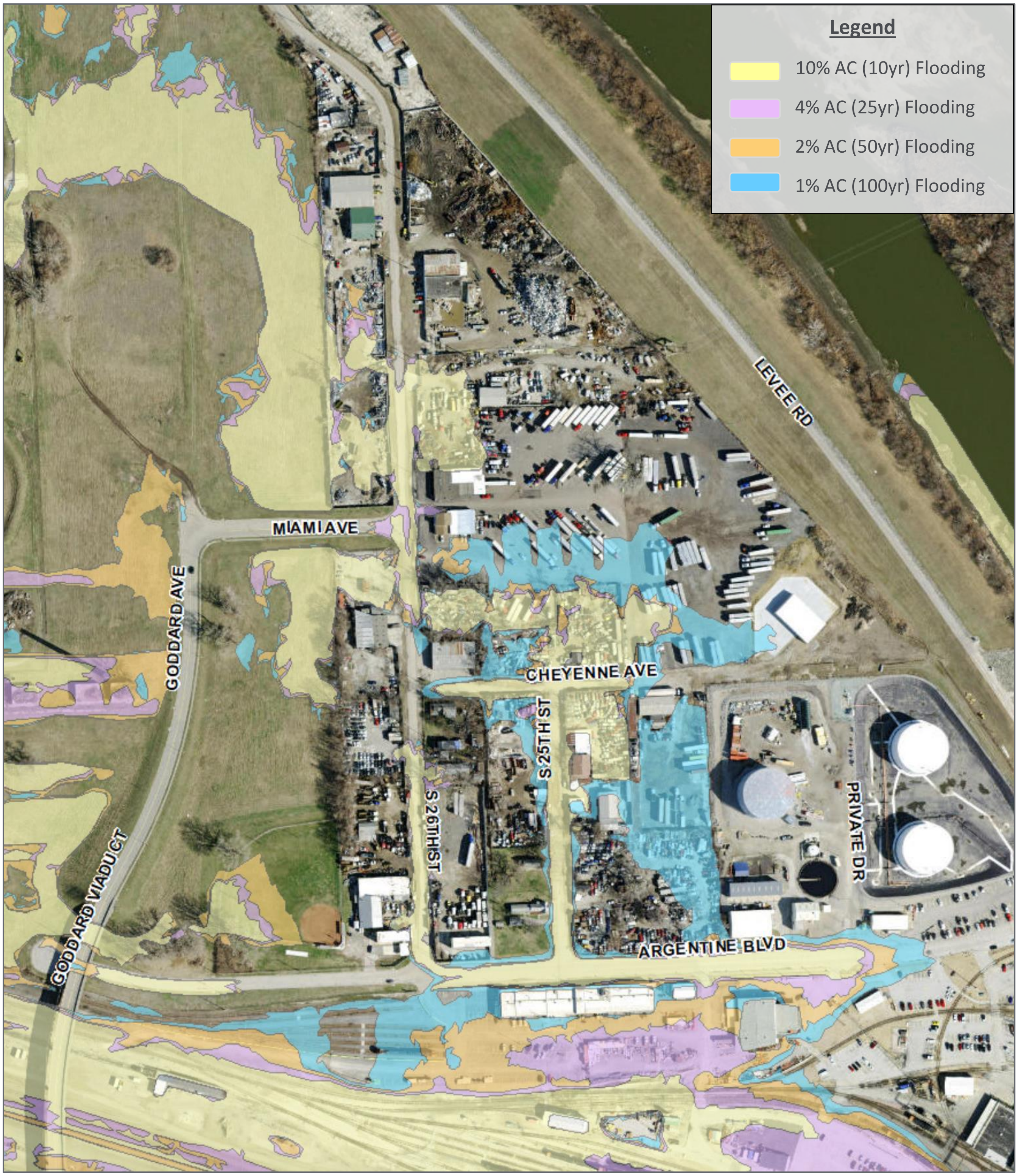


Legend

Negligible Change to Land Use	Residential to Business/Commercial
Agricultural/Vacant to Business/Commercial/Industrial	Public to Business/Commercial/Industrial
Agricultural/Vacant to Residential	Public to Residential
Commercial to Residential	

Most of the potential land use changes in the watershed are located south of the railroad. There are very few anticipated land use changes near this project's primary area of interest. Since the flooding near S 26th Street and Miami Avenue is largely driven by localized drainage issues, there are little changes to the future condition floodplains near the area of interest, shown in Figure 10.

FIGURE 10- FUTURE CONDITIONS FLOODPLAINS



5 FLOOD MITIGATION ANALYSIS

Several flood mitigation alternatives were evaluated as part of this project, with a focus of reducing flooding potential along S 26th Street and the adjacent streets, which impact vehicle and pedestrian traffic to businesses, residential homes, and rail services. goal of reducing the flooding along S 26th St and Miami Ave area for the existing conditions and the future conditions. Several storm sewer improvements were evaluated and were determined to be viable options for flood mitigation. These improvements are described in more detail below as Alternative A and Alternative B.

Ditch and channel improvements were considered in this area, but the terrain relief makes ditch and channel improvements relatively infeasible due to the associated grading and footprints that would be needed to achieve adequate capacity and sufficient slopes. In addition, the minimal slopes would likely deposit sediments during certain events and would require some level of ongoing sediment removal and maintenance. Stormwater detention was also considered in this area but was determined to have little impact to the flooding on the streets. The localized nature of the flooding and the low elevations of the roads would still allow water to be carried and ponded on the streets. Therefore, significant street reconstruction would be needed, with profile changes, in order to address the drainage concerns.

5.1 Alternative A- 25yr Storm Sewer Improvements

Alternative A includes storm sewer improvements that target flood risk reduction for the 4% annual chance (25-yr) storm event along S 26th Street and the adjacent streets. The proposed improvements for Alternative A include new storm sewer pipes along a portion of the streets and an increase in pipe sizes for a portion of the system. The proposed alternatives were incorporated into an alternative scenario within the PC-SWMM model, optimizing pipe sizing to address the street flooding for the 4% annual chance (25-yr) storm event. Flow lines were set such that sufficient velocities could be maintained. Table 4 provides a summary of the proposed improvements included in Alternative A. Table 5 provides a description of each storm pipe included in the Alternative A scenario. Figure 11 provides an image of the proposed improvements included in Alternative A.

TABLE 4- ALTERNATIVE A SUMMARY

Location	Facility ID	Existing Structure	Proposed Structure
Crosses Miami Ave	N/A	N/A	24-inch RCP
Extends east to S 26th St	N/A	N/A	24-inch RCP
Along S 26th St	N/A	N/A	36-inch RCP
Along S 26th St	N/A	N/A	36-inch RCP
Along S 26th St	N/A	N/A	36-inch RCP
Along Cheyenne Ave	N/A	N/A	36-inch RCP
Along Cheyenne Ave	N/A	N/A	36-inch RCP
Along S 25th St	N/A	N/A	48-inch RCP
Along S 25th St	090638-089608	18-inch HDPE	48-inch RCP
Along S 25th St	089608-089607	18-inch RCP	48-inch RCP
Along S 25th St	089607-089606	18-inch HDPE	48-inch RCP
Along S 25th St	089606-089605	18-inch HDPE	48-inch RCP
Along S 26th St	N/A	N/A	24-inch RCP
Along S 26th St	114700-114648	18-inch RCP	24-inch RCP
Along Argentine Blvd	114648-089614	18-inch RCP	24-inch RCP

Location	Facility ID	Existing Structure	Proposed Structure
Along Argentine Blvd	089614-089605	18-inch RCP	24-inch RCP
Along Argentine Blvd	089605-089604	24-inch RCP	48-inch RCP
Along Argentine Blvd	089604-089603	24-inch RCP	54-inch RCP
Along Argentine Blvd	089603-089587	30-inch RCP	54-inch RCP
Extends into Argentine Blvd System	N/A	N/A	24-inch RCP
Extends into Argentine Blvd System	N/A	N/A	24-inch RCP
Extends south from Argentine Blvd	089587-089588	30-inch RCP	54-inch RCP

TABLE 5- ALTERNATIVE A PIPE DESCRIPTIONS

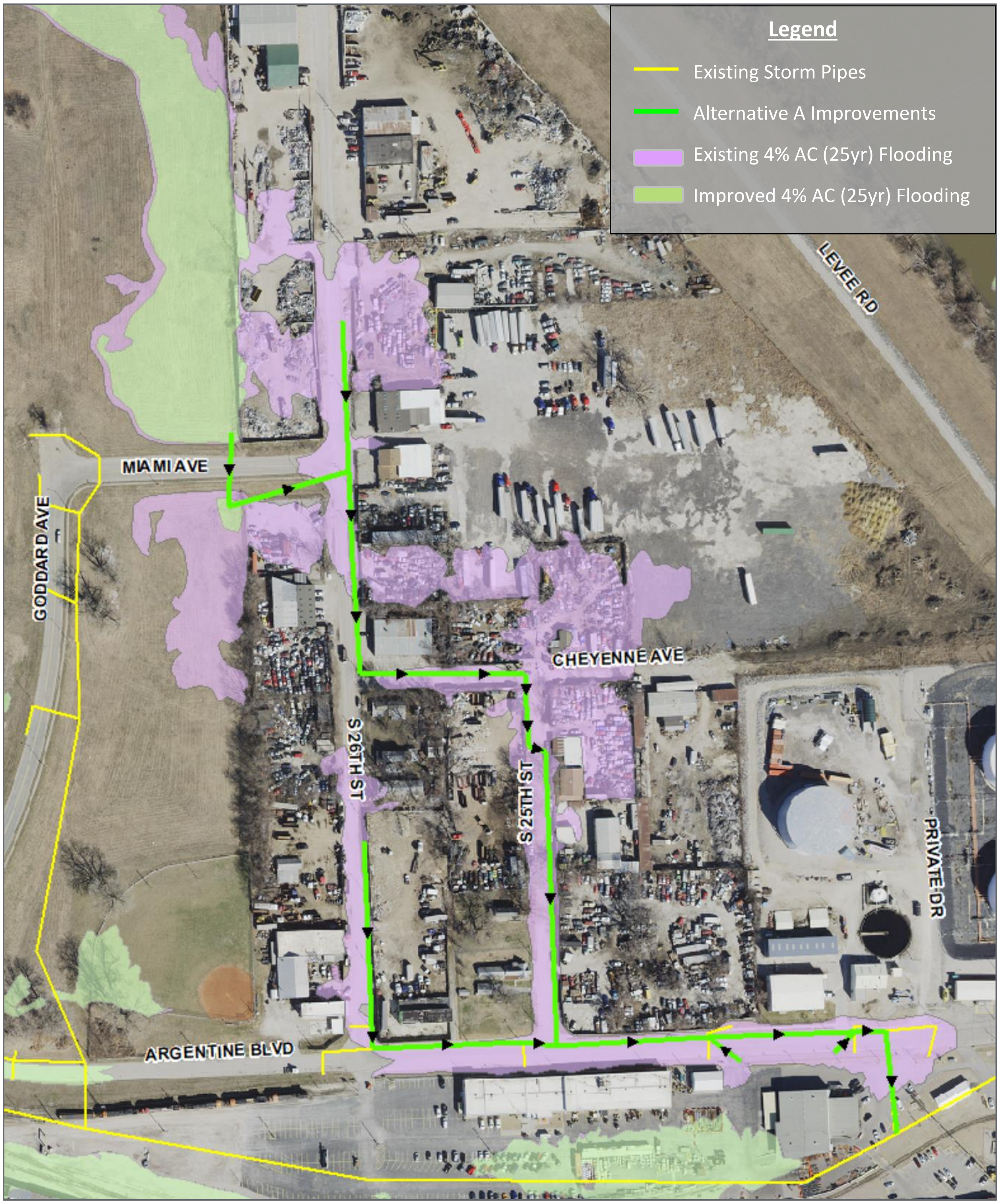
Location	Facility ID	Pipe Size	Pipe Length (ft)	Inlet Elevation (NAVD88)	Outlet Elevation (NAVD88)
Crosses Miami Ave	N/A	24-inch	126.6	750.0	749.8
Extends east to S 26th St	N/A	24-inch	214.9	749.8	749.5
Along S 26th St	N/A	36-inch	256.6	750.5	749.5
Along S 26th St	N/A	36-inch	152.5	749.5	749.0
Along S 26th St	N/A	36-inch	193.7	749.0	748.0
Along Cheyenne Ave	N/A	36-inch	143.2	748.0	747.3
Along Cheyenne Ave	N/A	36-inch	138.4	747.3	746.6
Along S 25th St	N/A	48-inch	53.4	745.6	745.3
Along S 25th St	090638-089608	48-inch	70.4	745.3	744.9
Along S 25th St	089608-089607	48-inch	30.4	744.9	744.7
Along S 25th St	089607-089606	48-inch	251.0	744.7	743.4
Along S 25th St	089606-089605	48-inch	252.9	743.4	742.0
Along S 26th St	N/A	24-inch	315.8	751.0	748.4
Along S 26th St	114700-114648	24-inch	39.7	748.4	748.0
Along Argentine Blvd	114648-089614	24-inch	255.2	748.0	745.3
Along Argentine Blvd	089614-089605	24-inch	58.9	745.3	744.0
Along Argentine Blvd	089605-089604	48-inch	260.2	742.0	740.7
Along Argentine Blvd	089604-089603	54-inch	241.8	740.2	738.1
Along Argentine Blvd	089603-089587	54-inch	61.8	738.1	737.7
Extends into Argentine Blvd System	N/A	24-inch	68.6	746.0	742.7
Extends into Argentine Blvd System	N/A	24-inch	49.0	746.0	740.6
Extends south from Argentine Blvd	089587-089588	54-inch	176.5	737.7	736.5

The inlet and outlet elevations in the above table represent the elevations used in the modeling and provide a guide for each of the pipe slopes. If these pipe slopes are generally maintained, the elevations could be slightly adjusted without impacting the flood results.

FIGURE 11- IMAGE OF ALTERNATIVE A IMPROVEMENTS

As previously mentioned, the Alternative A improvements target the reduction of flood risk to S 26th Street and the adjacent streets during the 25-yr storm event. Figure 12 compares the existing conditions floodplains, which uses existing land use, before and after the Alternative A improvements for the 25-yr storm event.

Figure 12- Alternative A Flood Comparisons for Existing Land use and 25yr Storm Event



The improvements were also included in an alternative scenario for the 100-yr storm events to evaluate the benefits during larger storm events. Figure 13 compares the existing conditions floodplains before and after the Alternative A improvements for the 100-yr storm event. There would be minimal flooding along S 26th Street and Cheyenne Ave during the 100-yr storm events, but some flooding along S 25th St and Argentine Blvd with depths in some spots that exceed 1 foot.

FIGURE 13- ALTERNATIVE A FLOOD COMPARISONS FOR EXISTING LAND USE AND 100YR STORM EVENT

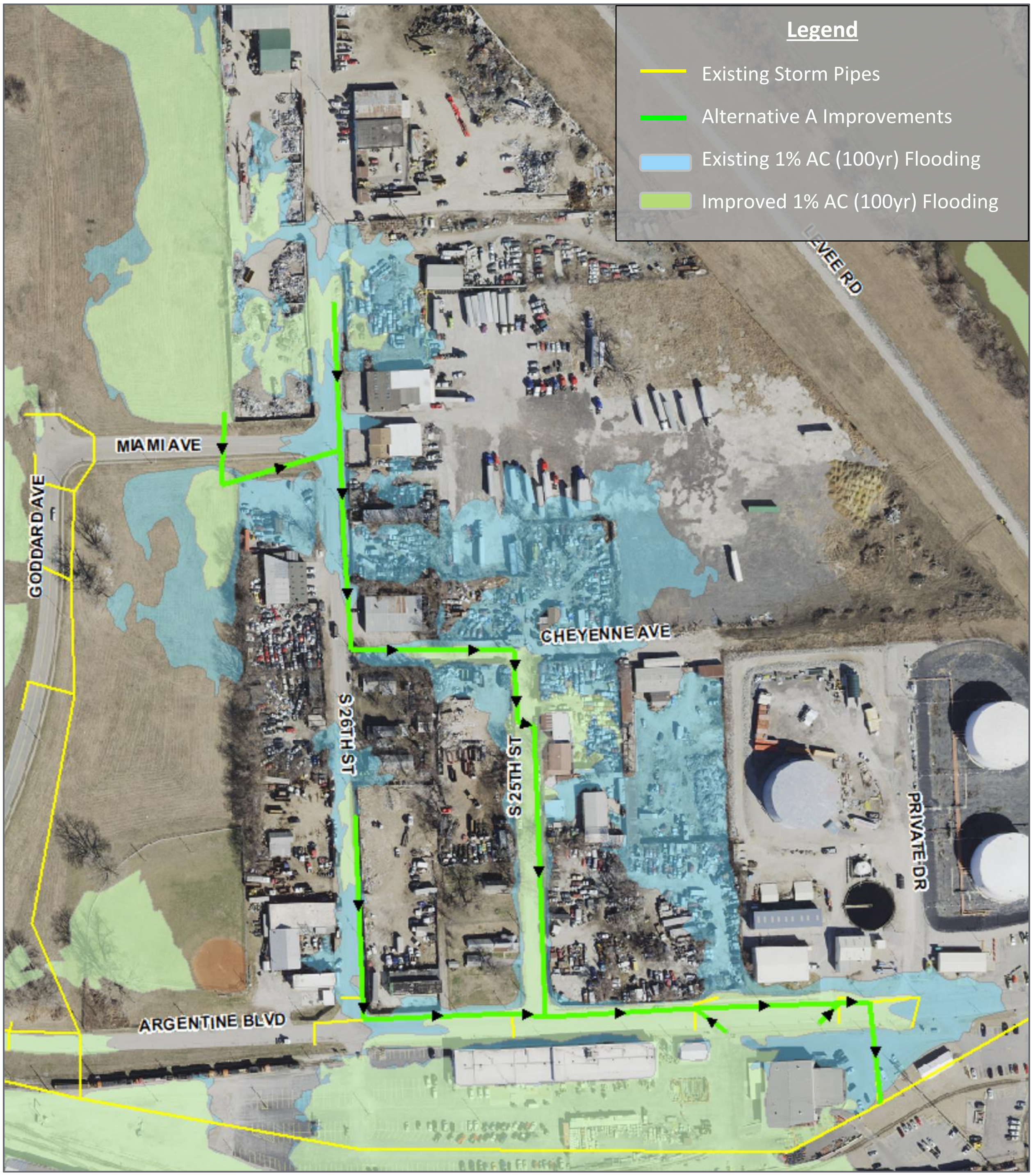
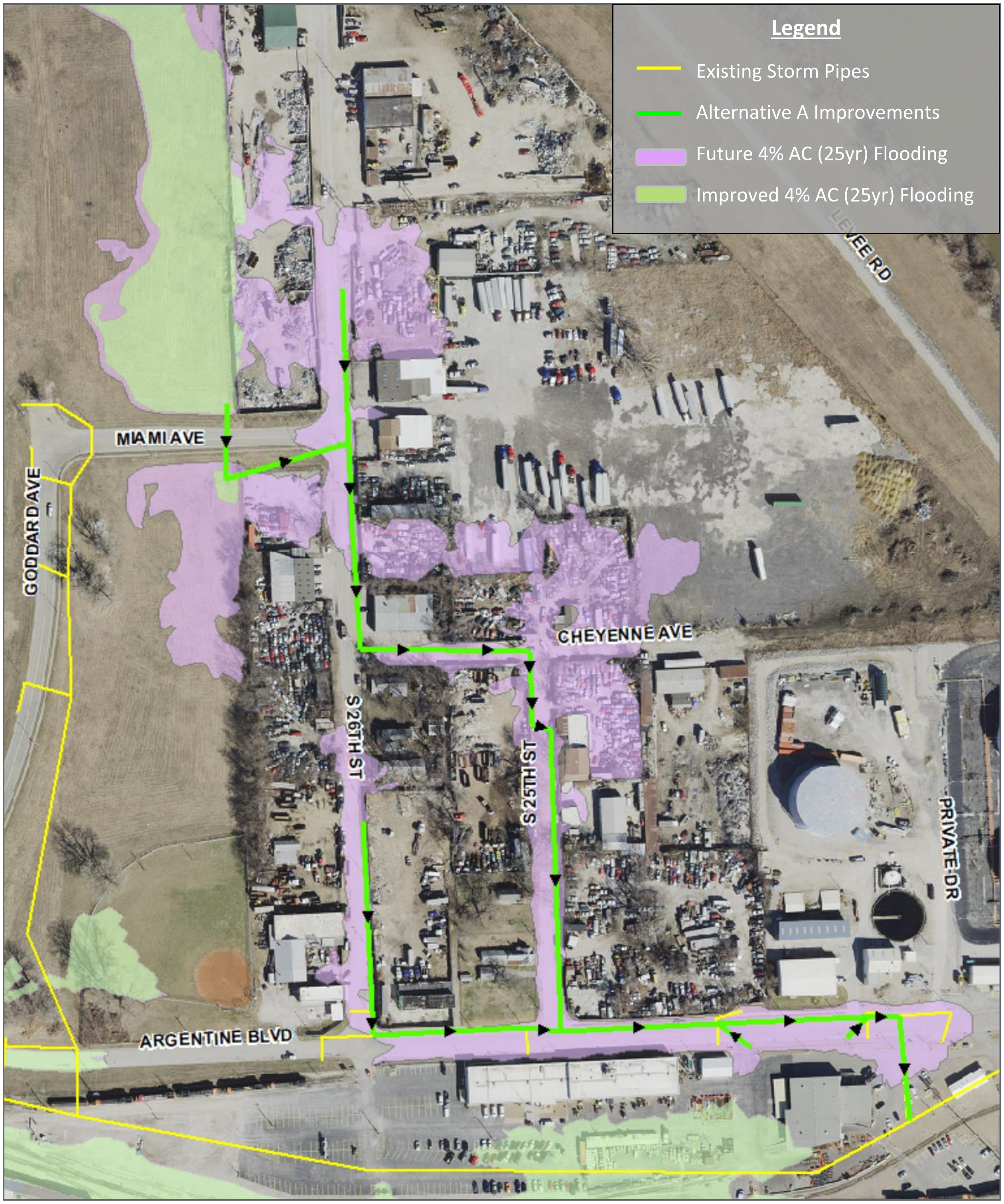


Figure 14 compares the future conditions floodplains, which uses future land use, before and after the Alternative A improvements for the 25-yr storm event. The improvements perform well for the potential changes to land use, with the streets of interest still being free from flooding.

FIGURE 14- ALTERNATIVE A FLOOD COMPARISONS FOR FUTURE LAND USE AND 25YR STORM EVENT



5.2 Alternative B- 100yr Storm Sewer Improvements

Alternative B includes storm sewer improvements that target flood risk reduction for the 1% annual chance (100-yr) storm event along S 26th Street and the adjacent streets. The proposed pipes associated with this alternative are larger than those described in Alternative A, which will impact the cost of the project. The proposed improvements for Alternative B include new storm sewer pipes along a portion of the streets and an increase in pipe sizes for a portion of the system. The proposed alternatives were incorporated into an alternative scenario within the PC-SWMM model, optimizing pipe sizing to address the street flooding for the 1% annual chance (100-yr) storm event. Flow lines were set such that sufficient velocities could be maintained. Table 6 provides a summary of the proposed improvements included in Alternative B. Table 7 provides a description of each storm pipe included in the Alternative B scenario. Figure 15 provides an image of the proposed improvements included in Alternative B.

TABLE 6- ALTERNATIVE B SUMMARY

Location	Facility ID	Existing Structure	Proposed Structure
Crosses Miami Ave	N/A	N/A	24-inch RCP
Extends east to S 26th St	N/A	N/A	24-inch RCP
Along S 26th St	N/A	N/A	36-inch RCP
Along S 26th St	N/A	N/A	42-inch RCP
Along S 26th St	N/A	N/A	42-inch RCP
Along Cheyenne Ave	N/A	N/A	48-inch RCP
Along Cheyenne Ave	N/A	N/A	48-inch RCP
Along S 25th St	N/A	N/A	60-inch RCP
Along S 25th St	090638-089608	18-inch HDPE	60-inch RCP
Along S 25th St	089608-089607	18-inch RCP	60-inch RCP
Along S 25th St	089607-089606	18-inch HDPE	60-inch RCP
Along S 25th St	089606-089605	18-inch HDPE	60-inch RCP
Along S 26th St	N/A	N/A	30-inch RCP
Along S 26th St	114700-114648	18-inch RCP	30-inch RCP
Along Argentine Blvd	114648-089614	18-inch RCP	36-inch RCP
Along Argentine Blvd	089614-089605	18-inch RCP	36-inch RCP
Along Argentine Blvd	089605-089604	24-inch RCP	60-inch RCP
Along Argentine Blvd	089604-089603	24-inch RCP	60-inch RCP
Along Argentine Blvd	089603-089587	30-inch RCP	60-inch RCP
Extends into Argentine Blvd System	N/A	N/A	60-inch RCP
Extends into Argentine Blvd System	N/A	N/A	36-inch RCP
Extends south from Argentine Blvd	089587-089588	30-inch RCP	72-inch RCP

TABLE 7- ALTERNATIVE B PIPE DESCRIPTIONS

Location	Facility ID	Pipe Size	Pipe Length (ft)	Inlet Elevation (NAVD88)	Outlet Elevation (NAVD88)
Crosses Miami Ave	N/A	24-inch	126.6	750	749.8
Extends east to S 26th St	N/A	24-inch	214.9	749.8	749.4
Along S 26th St	N/A	36-inch	256.6	751	749.9
Along S 26th St	N/A	42-inch	152.5	749.4	748.8
Along S 26th St	N/A	42-inch	193.7	748.8	748.1
Along Cheyenne Ave	N/A	48-inch	143.2	747.6	747
Along Cheyenne Ave	N/A	48-inch	138.4	747	746.3
Along S 25th St	N/A	60-inch	53.4	745.8	745.5
Along S 25th St	090638-089608	60-inch	70.4	745.5	745.1
Along S 25th St	089608-089607	60-inch	30.4	745.1	744.9
Along S 25th St	089607-089606	60-inch	251.0	744.9	743.5
Along S 25th St	089606-089605	60-inch	252.9	743.5	742
Along S 26th St	N/A	30-inch	315.8	751	748.1
Along S 26th St	114700-114648	30-inch	39.7	748.1	747.6
Along Argentine Blvd	114648-089614	36-inch	255.2	747.1	744.5
Along Argentine Blvd	089614-089605	36-inch	58.9	744.5	744
Along Argentine Blvd	089605-089604	60-inch	260.2	742	740.4
Along Argentine Blvd	089604-089603	60-inch	241.8	740.4	738.2
Along Argentine Blvd	089603-089587	60-inch	61.8	738.2	737.7
Extends into Argentine Blvd System	N/A	60-inch	68.6	743	740.4
Extends into Argentine Blvd System	N/A	36-inch	49.0	745.5	741.2
Extends south from Argentine Blvd	089587-089588	72-inch	176.5	736.7	735

The inlet and outlet elevations in the above table represent the elevations used in the modeling and provide a guide for each of the pipe slopes. If these pipe slopes are generally maintained, the elevations could be slightly adjusted without impacting the flood results.

FIGURE 15- IMAGE OF ALTERNATIVE B IMPROVEMENTS

As previously mentioned, the Alternative B improvements target the reduction of flood risk to S 26th Street and the adjacent streets during the 100-yr storm event. Figure 16 compares the existing conditions floodplains, which uses existing land use, before and after the Alternative B improvements for the 100-yr storm event. While the improved conditions floodplain shows a small amount of flooding along Argentine Blvd, this water is generally limited to the gutter locations of the street. A raise to the road profile at this location could be included in the project to eliminate any flooding along Argentine Boulevard.

FIGURE 16- ALTERNATIVE B FLOOD COMPARISONS FOR EXISTING LAND USE AND 100YR STORM EVENT

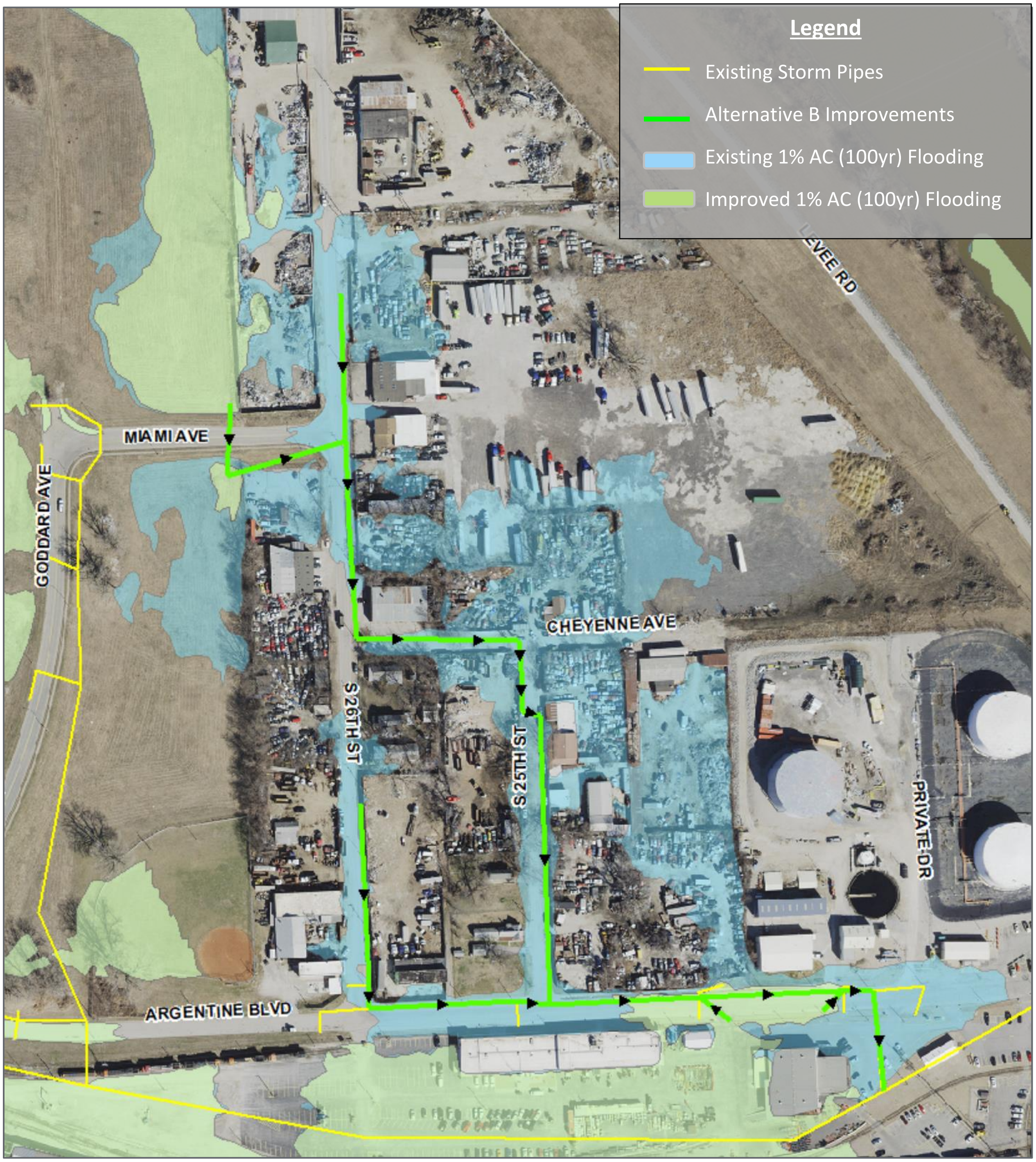
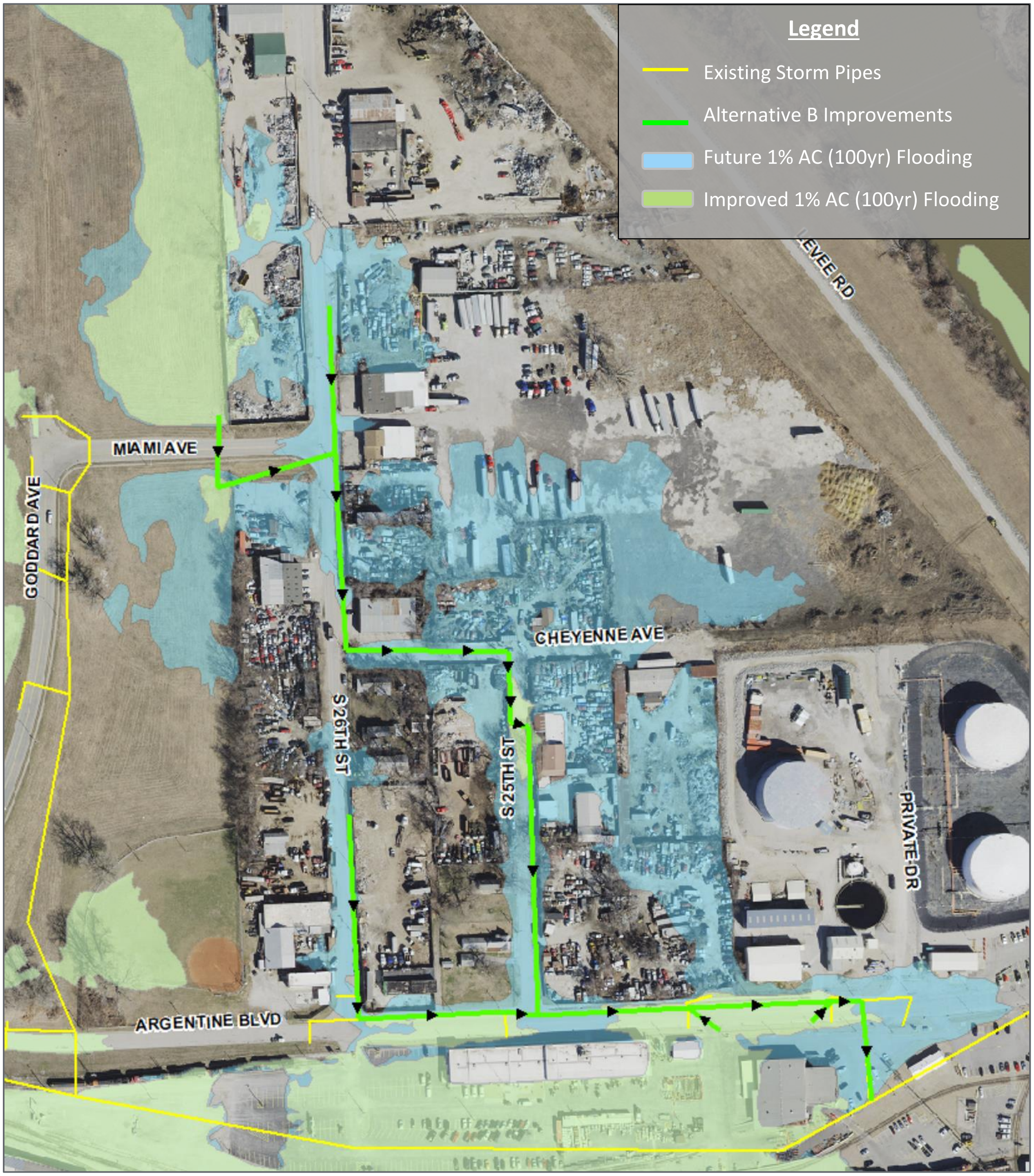


Figure 17 compares the future conditions floodplains, which uses future land use, before and after the Alternative B improvements for the 100-yr storm event. It is noted that there is a small amount of flooding along Argentine Blvd for the potential changes to land use, that are a result of overflows from the south. A raise to the road profile at this location could be included in the project to eliminate any flooding along Argentine Boulevard.

FIGURE 17- ALTERNATIVE B FLOOD COMPARISONS FOR FUTURE LAND USE AND 100YR STORM EVENT



6 COST ESTIMATES

Budget-level cost estimates have been developed for the conceptual flood mitigation alternatives, described as Alternatives A and B. The cost estimates include estimated pricing for contractor construction staking, pavement removal, unclassified excavation, removal of existing structures, tree removal/clearing and grubbing, inlet and manhole connections, pavement placement, combined curb and gutter, temporary traffic control, erosion control, reinforced concrete pipes, utility relocation, project contingency, design fees, financing and inspection costs.

Contractor construction staking is shown as a lump sum item. This cost is estimated using a price of $5,150 per 500 feet of street length that is impacted by the project.

Pavement removal is shown as a unit price per square yard, with a cost of $15 per square yard. The quantity is determined by taking the length multiplied by the width of all areas in which pavement needs to be removed, including asphalt removal and concrete removal. It is noted that pavement removal widths for projects that run parallel to a road assume pavement removal for the entire trench area, which is intended to conservatively capture other incidentals that are parallel to the road, such as sidewalks and driveways. This project area has limited open space adjacent to the road, due to the close proximity of fences and barriers. The proposed pipes along Miami Ave and S 26th Street could likely be situated adjacent to the road, due to the smaller pipe sizes and modest availability of space to avoid large-scale pavement removal. However, the proposed pipes along S 25th Street and Argentine Blvd would likely require pavement removal.

Unclassified excavation is shown as a unit price per cubic yard, with a cost of $22 per cubic yard. The quantity is determined by taking the sum of the length multiplied by the cross-sectional area of excavation for each section of storm pipe. The cross-sectional area is determined by calculating the bottom width of the trench, top width of the trench, and depth of the trench. The volume associated with pavement removal is removed from the excavation volume. It is assumed that pavement depth is 8 inches.

Removal of existing structures is shown as a lump sum item. This cost is estimated using two components, removal of existing storm pipes and structure removal associated with inlet and manhole connections. For each section of the project in which pipe replacement is recommended, the total length of that section is multiplied by a cost of $25 (per foot) to estimate the cost associated with removal of the existing storm pipes. A count was determined for the number of inlet connections and manhole connections that tie to the existing pipes recommended for replacement. That quantity is then multiplied by a cost of $500 (per connection) to estimate the cost associated with any structure removal correlated with inlet/manhole connections. The total price for removal of existing structures includes the sum of the two components.

Tree removal, with clearing and grubbing, is shown as a lump sum item. The tree removal /clearing and grubbing costs are estimated by multiplying the length of the proposed project by $15.

Costs for inlet and manhole connections are shown as a lump sum item. This cost is estimated by counting the number of inlet connections and manhole connections that currently tie to the existing storm sewer in the area of the proposed project plus an estimation for the number of inlet connections and manholes for new storm sewer locations. The total number of connections is multiplied by $6,000. This estimation captures the costs that would be associated with any new connections and associated pipes.

The cost for asphaltic concrete pavement (8”) is shown as a unit price per square yard, with a cost of $95 per square yard. The $95 includes $15 per square yard for 6 inches of AB-3 pavement base. The quantity of new asphalt pavement is the same quantity that was used for removal of the asphalt pavement, mentioned earlier. The lengths associated with street crossings includes some overage for sidewalk replacement costs. It is noted that pavement replacement costs for projects that run linear to a road assume pavement replacement for the entire trench area, which is intended to capture the costs associated with other incidentals that are parallel to the road, such as sidewalk replacement, ADA ramp replacement, driveway replacement, sodding and seeding, and tree planting.

Combined curb and gutter is shown as a unit price per linear foot, with a cost of $50 per linear foot. This cost captures both removal of existing curb and gutter and replacement of new curb and gutter. Currently, the only street within the project area that appears to have existing curb and gutter is Argentine Blvd. This cost estimate assumes that new curb and gutter will not be constructed on the other streets within the project. If curb and gutter is desired for the other streets, the project cost would need to be adjusted upward accordingly. The estimated length of new curb and gutter is equal to the project length along Argentine Blvd. It is assumed that only one side of the street will need the curb and gutter replaced.

Temporary Traffic Control is shown as a lump sum item. This cost is estimated using a price of $5,000 per 500 feet of street length that is impacted by the project.

Erosion Control is shown as a lump sum item. This cost is estimated using a price of $7,350 per 500 feet of street length that is impacted by the project.

Costs for reinforced concrete pipes (RCPs) are shown as a unit price per linear foot. The length of linear pipe for each section of the project is estimated using GIS measurements. Several sources were used for estimating costs for the various sizes of RCPs, including recent bids, discussions with local suppliers, and market conditions.

Easement acquisition is expected to be relatively minimal for this project area, as most of the work is anticipated within the right-of-way area. The exception to this is the private property adjacent to Miami Ave. An estimated easement cost of $3 per square foot is being used for these budgetary estimates. The cost estimate is determined by multiplying the total length of the proposed storm sewer extending through private property (in feet) by a width of 20 feet by a cost of $3 (per square foot).

Mobilization is shown as a lump sum item. This cost is estimated as 5% of the subtotal of the pavement, excavation, removal of existing structures, tree removal/clearing and grubbing, storm sewers, inlet/manhole connections, pavement, and combined curb and gutter costs.

Utility Relocation is estimated as a percentage of the subtotal of the other construction estimates. This cost estimate is intended to capture the additional construction costs that could be anticipated when working in close proximity to other utilities, such as costs associated with repositioning or relocation of infrastructure both temporarily and permanently. For these budgetary estimates, this cost is estimated as 5% of the subtotal of the other construction estimates.

The contingency is intended to cover additional or unexpected costs that could arise during design or construction of the project, as well as a moderate amount of market inflation. The cost estimates use a 25% contingency on the subtotal of the construction estimates. It is noted that market inflation is unpredictable and may not be fully captured in the contingency percentage.

The cost estimates also include a financing cost of 5% on the subtotal of the construction estimates to account for any costs associated with financing the improvements and/or administration.

The cost estimates use a design fee cost of 15% on the subtotal of the construction estimates to account for expenses associated with survey and design of the proposed projects. Survey and design fees may cost less than this estimation, but this budgetary estimate percentage is intended to be a conservative value.

The cost estimates use an inspection cost of 10% on the subtotal of the construction estimates to account for costs associated with inspection services for the proposed improvement projects. These services are meant to include half to full-time inspection and construction management services for the proposed projects.

Tables 8 and 9 provide the cost estimates for Alternative A and Alternative B.

TABLE 8- COST ESTIMATE FOR ALTERNATIVE A (25YR ALTERNATIVE)

Alternative A- Preliminary Cost
Stormwater Project

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Oct-23

-- ENGINEER'S OPINION OF PROBABLE COST --

ITEM No.	BID ITEMS	QUANTITY	UNITS	ESTIMATED UNIT PRICE	TOTAL
1	Contractor Construction Staking	1	LS	$34,763.00	$34,763.00
2	Pavement Removal	3,789	SY	$15.00	$56,840.00
3	Unclassified Excavation	5,390	CY	$22.00	$118,589.00
4	Removal of Existing Structures	1	LS	$49,471.00	$49,471.00
5	Tree Removal/Clearing & Grubbing	1	LS	$51,173.00	$51,173.00
6	24" Storm Sewer (RCP)	1,129	LF	$125.00	$141,103.00
7	36" Storm Sewer (RCP)	884	LF	$205.00	$181,295.00
8	48" Storm Sewer (RCP)	918	LF	$310.00	$284,669.00
9	54" Storm Sewer (RCP)	480	LF	$370.00	$177,632.00
10	Inlet/Manhole Connections	1	LS	$156,000.00	$156,000.00
11	(8") Asphaltic Concrete Pavement	3,789	SY	$95.00	$359,988.00
12	Combined Curb and Gutter	911	LF	$50.00	$45,550.00
13	Temporary Traffic Control	1	LS	$33,750.00	$33,750.00
14	Erosion Control	1	LS	$49,613.00	$49,613.00
15	Easement Acquisition	1	LS	$11,400.00	$11,400.00
16	Mobilization	1	LS	$81,116.00	$81,116.00
	Subtotal				***$1,832,952.00***
	Utility Relocation			*5%*	*$91,648.00*
	Construction Cost				***$1,924,600.00***
	Contingency			*25%*	*$481,150.00*
	Financing Costs			*5%*	*$96,230.00*
	Design Fees			*15%*	*$288,690.00*
	Inspection Costs			*10%*	*$192,460.00*
		PROJECT TOTAL			***$2,983,130.00***

TABLE 9- COST ESTIMATE FOR ALTERNATIVE B (100YR ALTERNATIVE)

Alternative B- Preliminary Cost
Stormwater Project

Oct-23

-- ENGINEER'S OPINION OF PROBABLE COST --

ITEM No.	BID ITEMS	QUANTITY	UNITS	ESTIMATED UNIT PRICE	TOTAL
1	Contractor Construction Staking	1	LS	$34,763.00	$34,763.00
2	Pavement Removal	4,727	SY	$15.00	$70,899.00
3	Unclassified Excavation	7,757	CY	$22.00	$170,643.00
4	Removal of Existing Structures	1	LS	$49,471.00	$49,471.00
5	Tree Removal/Clearing & Grubbing	1	LS	$51,173.00	$51,173.00
6	24" Storm Sewer (RCP)	342	LF	$125.00	$42,690.00
7	30" Storm Sewer (RCP)	356	LF	$160.00	$56,892.00
8	36" Storm Sewer (RCP)	620	LF	$205.00	$127,050.00
9	42" Storm Sewer (RCP)	346	LF	$255.00	$88,269.00
10	48" Storm Sewer (RCP)	282	LF	$310.00	$87,300.00
11	60" Storm Sewer (RCP)	1,290	LF	$435.00	$561,349.00
12	72" Storm Sewer (RCP)	176	LF	$570.00	$100,594.00
13	Inlet/Manhole Connections	1	LS	$156,000.00	$156,000.00
14	(8") Asphaltic Concrete Pavement	4,727	SY	$95.00	$449,026.00
15	Combined Curb and Gutter	911	LF	$50.00	$45,550.00
16	Temporary Traffic Control	1	LS	$33,750.00	$33,750.00
17	Erosion Control	1	LS	$49,613.00	$49,613.00
18	Easement Acquisition	1	LS	$11,400.00	$11,400.00
19	Mobilization	1	LS	$102,845.00	$102,845.00
	Subtotal				***$2,289,277.00***
	Utility Relocation			*5%*	*$114,464.00*
	Construction Cost				***$2,403,741.00***
	Contingency			*25%*	*$600,935.00*
	Financing Costs			*5%*	*$120,187.00*
	Design Fees			*15%*	*$360,561.00*
	Inspection Costs			*10%*	*$240,374.00*
		PROJECT TOTAL			***$3,725,798.00***

These budget-level cost estimates should be used as a planning tool to help inform the implementation of a mitigation project. The future design phase for a mitigation project in this area should define project specifications and costs.

7 CONCLUSION

The primary goal of this project was to evaluate the flooding conditions along S 26th Street, near Miami Ave, and determine potential mitigation options. Flood water routinely covers the streets and makes vehicle and pedestrian traffic difficult and unsafe during moderate rainfall events. This has impacted residents in the area who have been unable to access their homes and has hindered the primary access point for rail services. The existing conditions modeling indicates that the majority of the flooding concerns in this area are due to localized drainage issues. Alternative options were evaluated that would reduce flooding along the area streets, keeping them more accessible and safer. The first alternative that was identified targets flood elimination along the streets of interest for the 4% annual chance (25-yr) storm event. The second alternative that was identified targets flood elimination along the streets of interest for the 1% annual chance (100-yr) storm event. Both alternatives include storm sewer improvements that would both add new storm sewer to streets that currently do not have a storm sewer system and upsize the current storm sewer system for other streets. As expected, the second alternative that targets the 1% annual chance (100-yr) storm event includes larger storm pipes than the first alternative. Both alternatives connect to a large underground system that carries runoff from the west through the levee and into the Kansas River. The future conditions, based on potential changes to land use, were also evaluated as part of the project and both alternatives appear to perform well for those potential changes, still achieving flood reductions for their design storms. Budget-level cost estimates were developed to help inform the decision-making process of moving forward with a mitigation project for this area of concern.

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9 APPENDIX ITEMS- ELECTRONIC DELIVERABLES

PC-SWMM Models

- Existing Conditions
- Future Conditions
- Alternative A Scenarios
- Alternative B Scenarios

Digital Supporting Data

- SWMM Shapefiles
- Resulting Grids
- Resulting Floodplains