Wyandotte County- 65th and Kansas Avenue Technical Assistance Report

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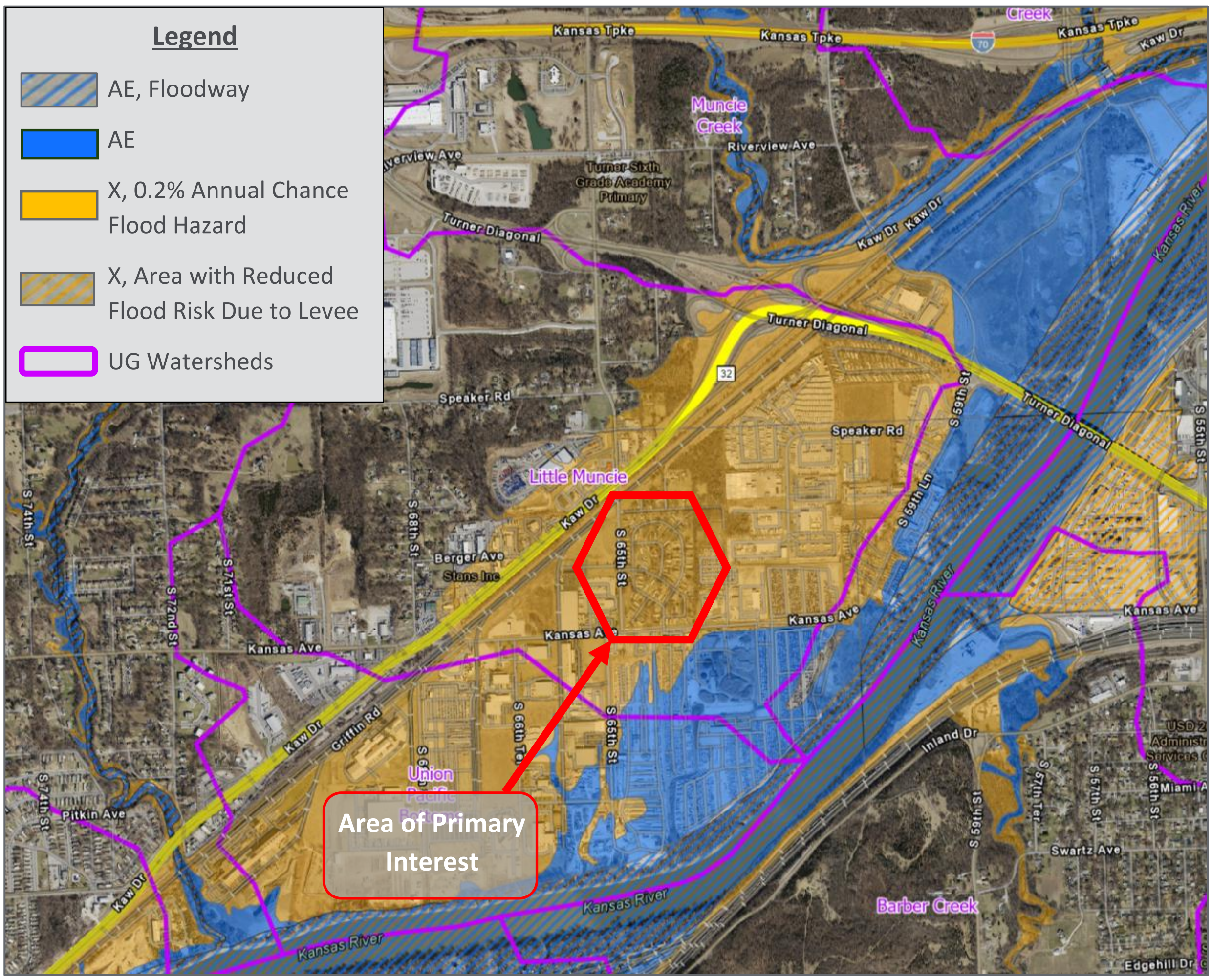
1 INTRODUCTION

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 65th Street and Kansas Avenue. The area of primary interest is located just north of the Kansas River, south of the Union Pacific Railroad and southwest of the Highway 32 and Turner Diagonal interchange. This area is within the UG's Little Muncie watershed. A map of the area of interest is shown in Figure 1. The focus of the project is the S 65th Street and mobile home area, which experiences recurring flooding and damage to private property and public roads. This flooding leads to difficult and unsafe travel for vehicles and pedestrians and causes residents to be unable to access their homes. Currently, the property manager of the mobile home park is using small temporary pumps to convey flood water into adjacent ditches when needed.

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 represents the 0.2% annual chance (500-year) floodplain. The area of primary interest also experiences localized flooding, which is not represented on the FEMA Flood Insurance Rate Map (FIRM).

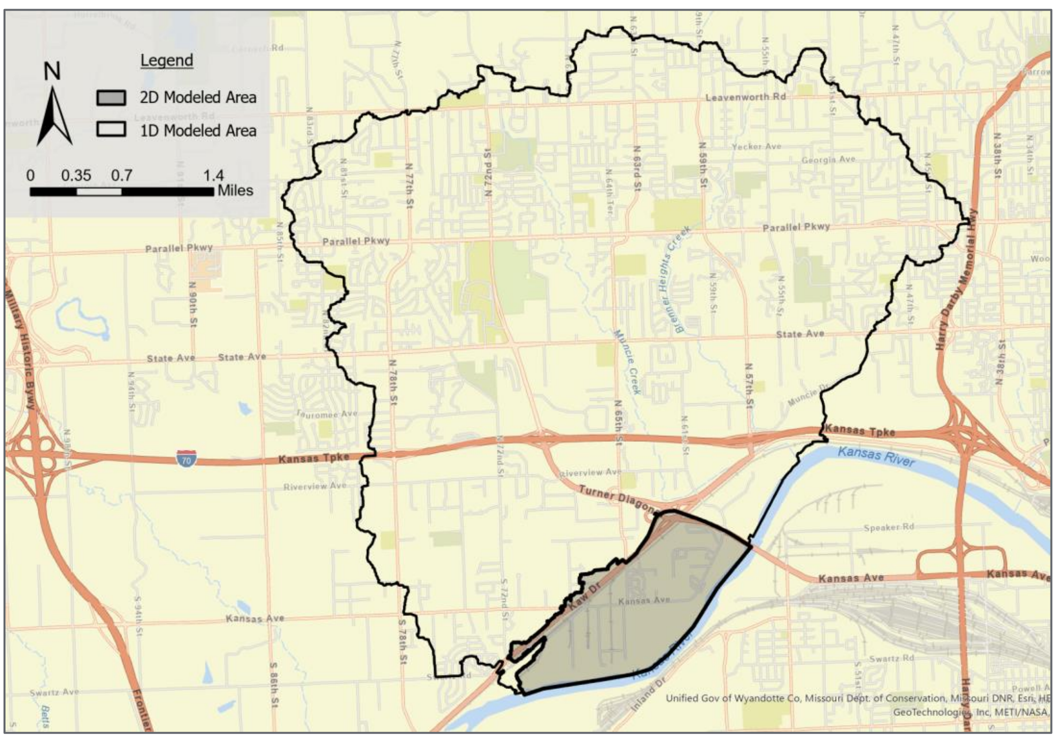
The overall goal of the project was to evaluate the existing and future flooding conditions in the area of interest and develop conceptual flood mitigation alternatives to reduce flood risk, particularly along S 65th Street and the mobile home area. Currently, the area suffers from significant flooding 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 the 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 the 1D and 2D modeled areas within the PC-SWMM model.

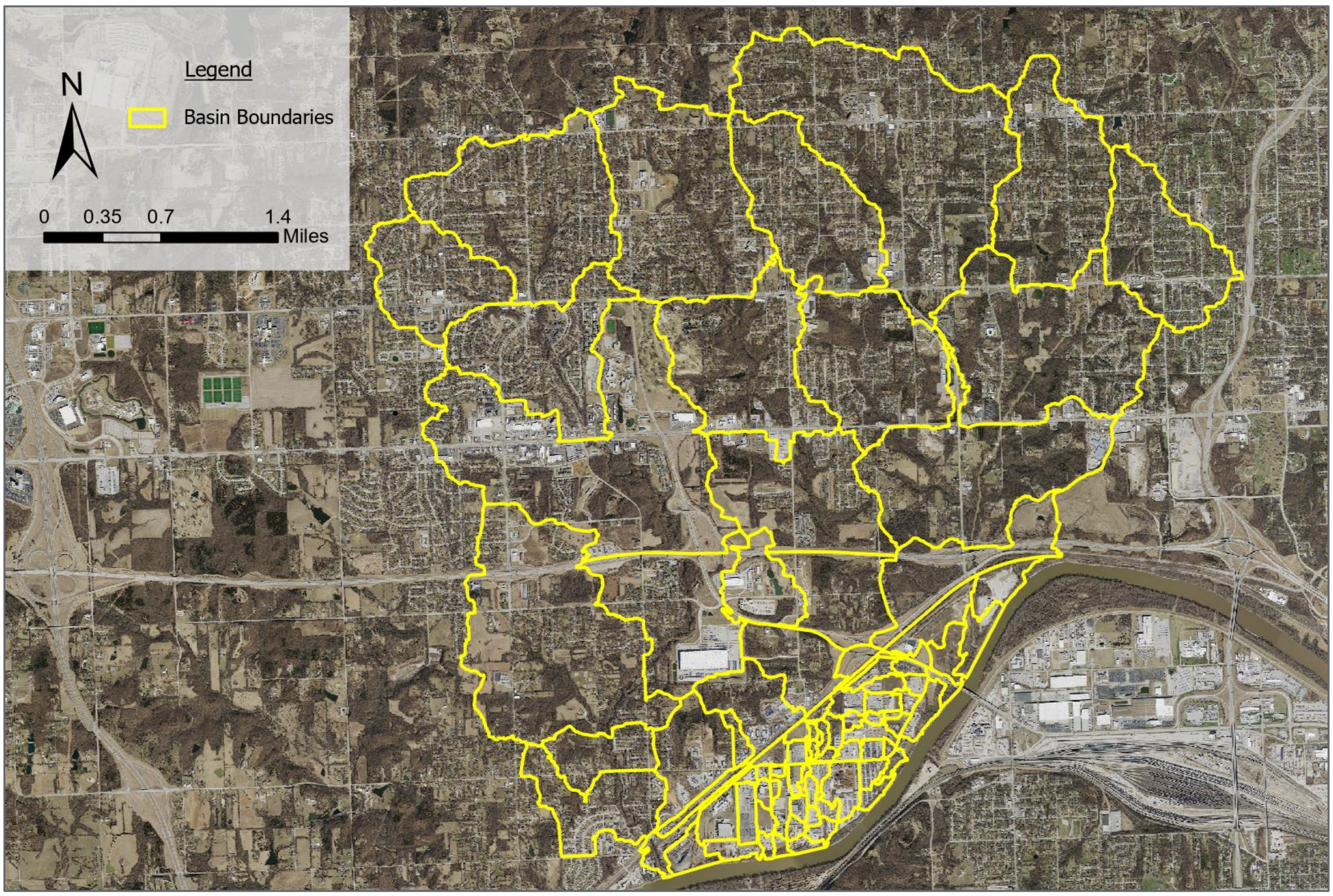
FIGURE 2 - MODELED AREAS



2.2 Basin Delineation

The modeled area is located within the UG's Mill Creek, Union Pacific Bottoms, Muncie Creek, Little Muncie, Brenner Heights Creek, Brenner Heights Tributary and Santa Fe Bluff watersheds. 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 89 basins ranging from approximately 1.22 acres in the 2D section to 968 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. 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. The available tool within the PC-SWMM software was used to develop spatially-weighted 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 NRCS hydrograph computations, available as an alternative runoff method (ARM) within PC-SWMM. Appropriate basin longest flowpaths and time of concentrations were computed from the LIDAR and landuse data using methodologies outlined in NRCS Technical Release 55 (TR-55).

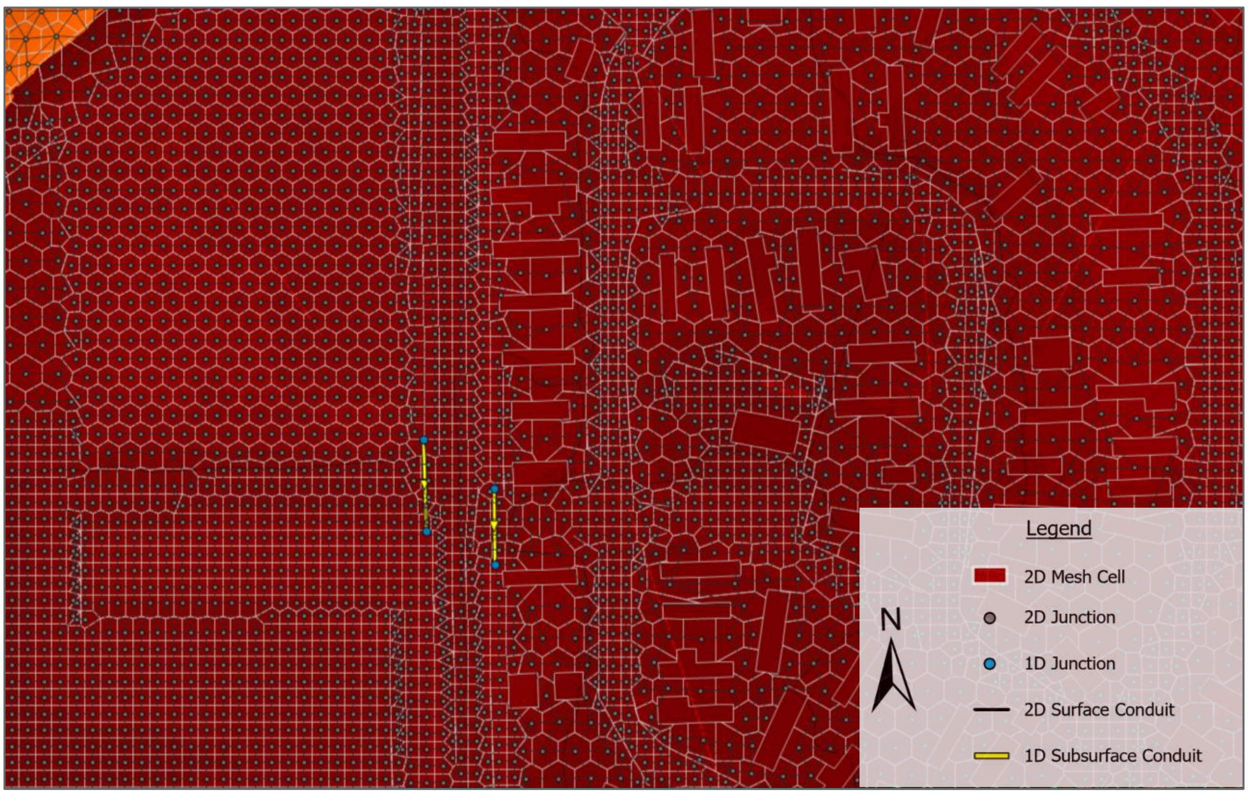
2.6 Hydraulic Routing

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, diameters, 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

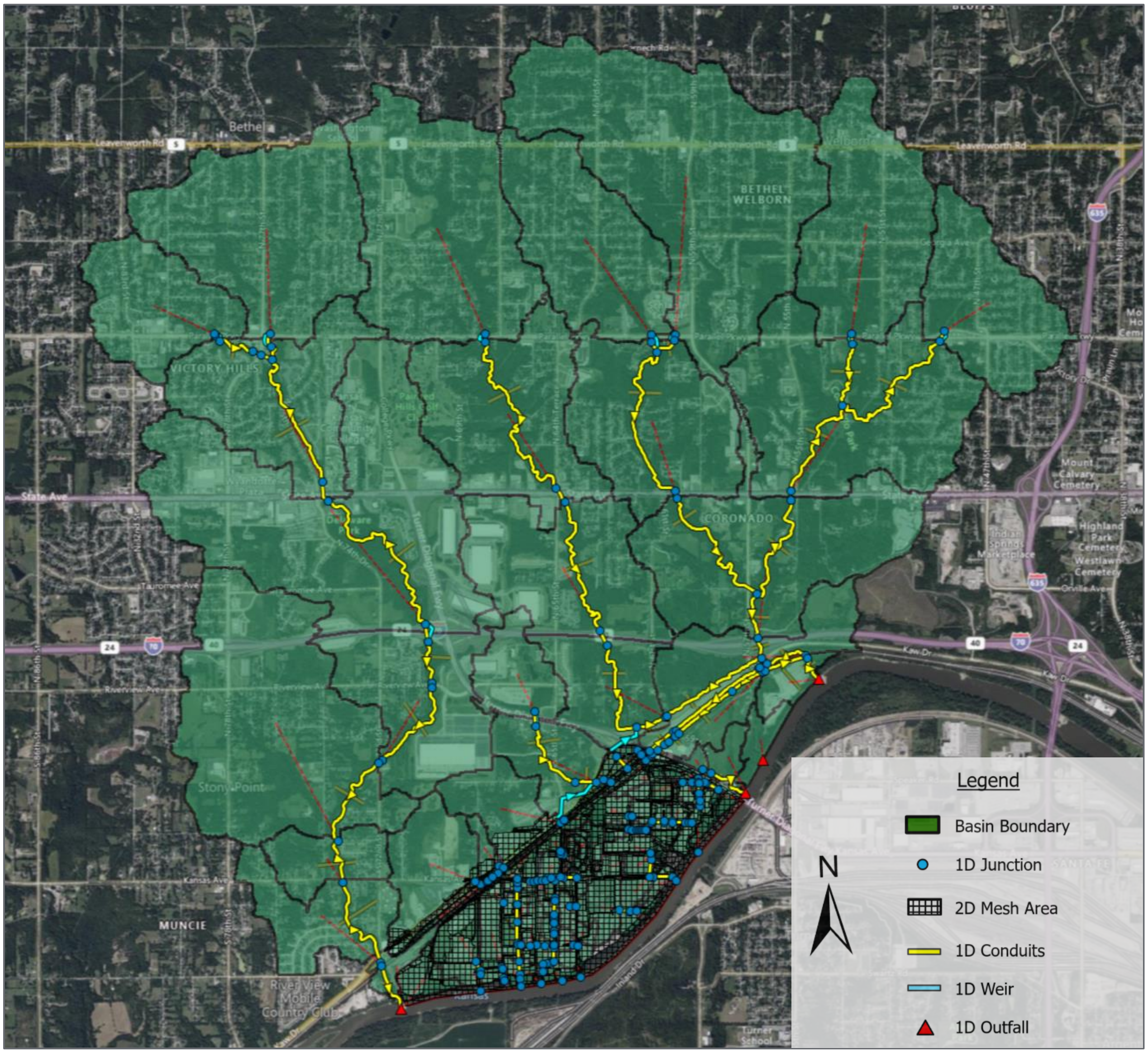


2.7 Infrastructure Incorporation

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 and information was estimated when appropriate. Details that were incorporated into the model included pipe placement, dimensions, material type, elevations, and the number of barrels.

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 computed flooding was compared to pictures that were provided by the UG and noticeable basining observed from Google Earth imagery dated April 2021, examples of which are shown in Figure 6.

FIGURE 6 - EXISTING CONDITIONS FLOOD PICTURES

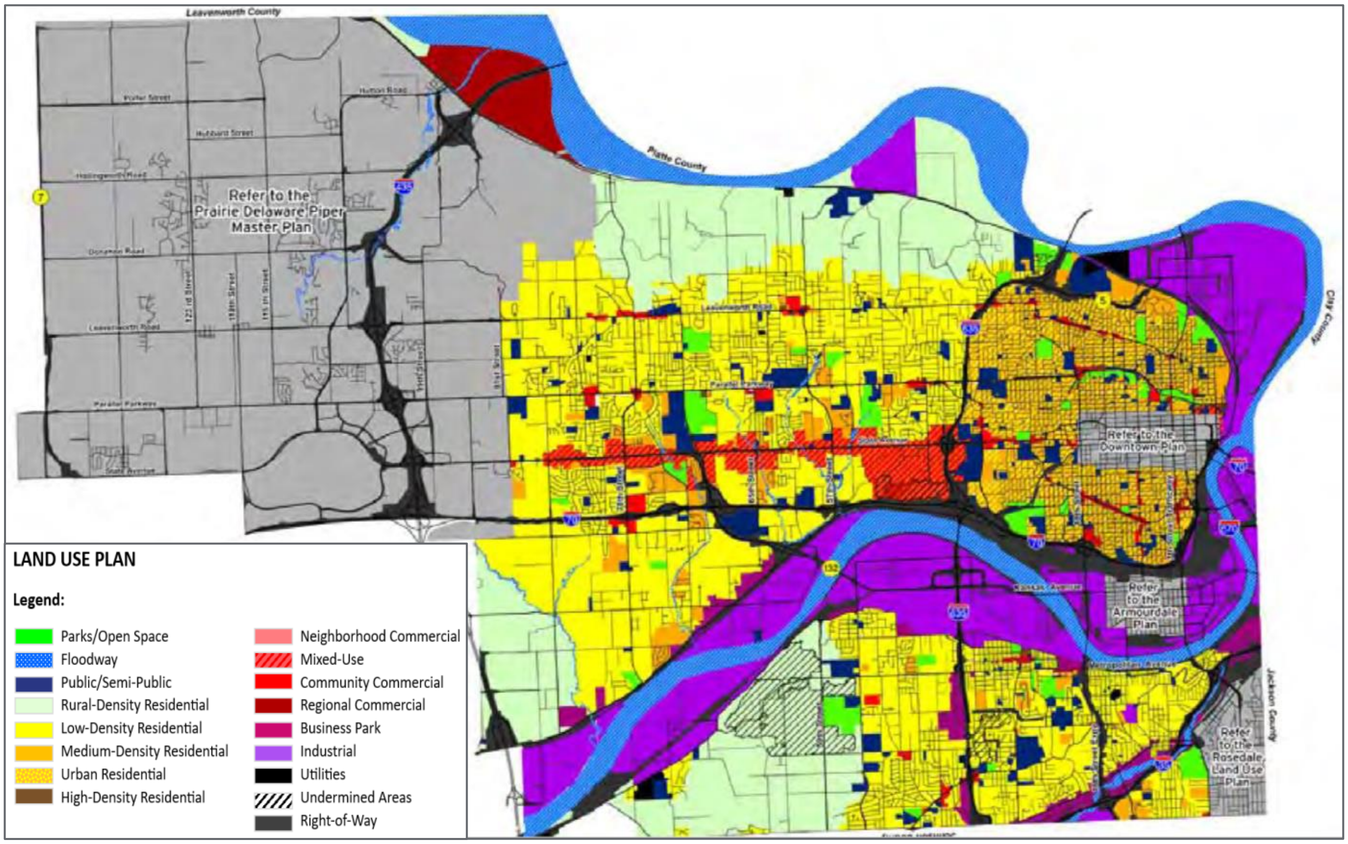
The resulting floodplains for the existing conditions modeling are shown in Figure 7. Based on the modeling performed, the flooding along S 65th Street and the adjacent neighborhood appears to be predominantly caused by localized drainage issues in the near vicinity, as opposed to flooding impacts from 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.

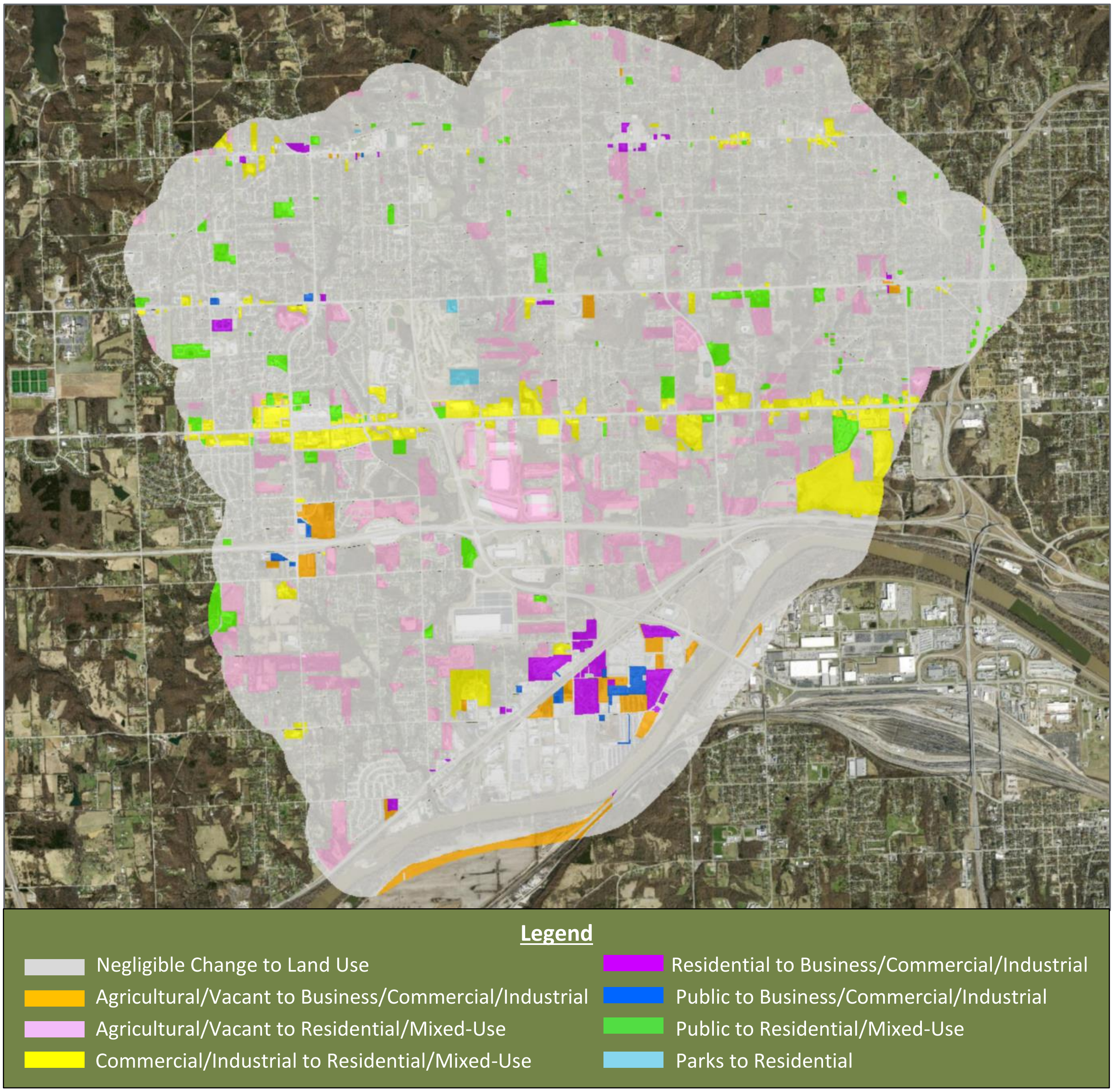
FIGURE 8 - 2008 FUTURE LAND USE GUIDE



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



The 2008 future land use guide includes several potential land use changes within the watershed, which would generally increase the Curve Number within the watershed. Furthermore, there are several anticipated land use changes notably near this project's primary area of interest, which describe the transition of vacant and residential areas to industrial areas. The resulting floodplains for the future conditions modeling are shown in Figure 10. Unmitigated industrial development in the area would likely increase the amount of runoff and worsen flooding of the nearby streets and existing properties unless mitigation measures are implemented. While the impacts aren't as noticeable when compared to the existing conditions flooding, they are more impactful when evaluating the alternatives.

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 65th Street and the mobile home area, which impacts vehicle and pedestrian traffic and causes damage to private property and public roads. The goal is to reduce the flooding for both the existing conditions and future conditions. Several improvements were evaluated and were determined to be viable options for flood mitigation. These improvements are described in more detail below as Alternative A, Alternative B, and Alternative C.

Ditch and channel improvements were considered in this area, but the local topography 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 sediment during certain events and would require some level of ongoing sediment removal and maintenance.

Stormwater detention and retention were considered in this area due to undeveloped land near the area of primary interest. Wyandotte County landbank locations were considered, but the two locations in the general vicinity, shown in Figure 11, are lacking sufficient storage potential or require extensive lengths of storm pipe to receive runoff from the area of concern, making these locations infeasible. Alternatives A and B will discuss storage alternatives that are closer to the area of primary interest.

FIGURE 111 - WYANDOTTE COUNTY LANDBANK OVERVIEW

5.1 Alternative A: 100-yr Alternative with Basins

Alternative A includes stormwater infiltration basins and stormwater drainage pipes that target flood risk reduction for the 1% annual change (100-yr) storm event along S 65th St and the mobile home area. The proposed improvements for Alternative A include new storm sewer pipes across S 65th Street that carry runoff from existing sumps in the privately-owned roads in the mobile home park to a proposed retention basin located west of S 65th Street. In addition, this alternative includes a basin on the east side of the mobile home area, located to the east of Kingswood Dr. The proposed improvements were incorporated into an alternative scenario within the PC-SWMM model, optimizing pipe sizing and basin sizing to address the street flooding for the 1% annual chance (100-yr) storm event. It is noted that this alternative does not include storm pipes along the privately-owned streets within the mobile home park area. As a result, some minor sheet flow will be observed along the streets until runoff reaches the location of the proposed storm pipes due to the elevations of these streets. Flow lines were set for the pipes such that minimum pipe slopes and sufficient velocities could be maintained. Figure 12, shown on the next page, provides an overview of the proposed improvements. 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.

TABLE 4 - ALTERNATIVE A SUMMARY

Location	Facility ID	Existing Structure	Proposed Structure
A- Kingswood Ct to West	N/A	N/A	48-inch RCP w/ flap gate
B- Along Park Town Dr (N)	N/A	N/A	24-inch RCP
C- Across Park Town Dr	233596-233597	Unknown	24-inch RCP
D- Across 65th St	N/A	N/A	30-inch RCP
E- Along 65th St (W)	N/A	N/A	30-inch RCP
F- West of 65th St	N/A	Open Space/Field	West Basin
G- East of Kingswood Dr	N/A	Undeveloped Land	East Basin
H- Along Kingswood Dr (E)	N/A	Street Curb	Flume into East Basin
I- East and West of S 65th St	N/A	N/A	Minor Ditch Regrading

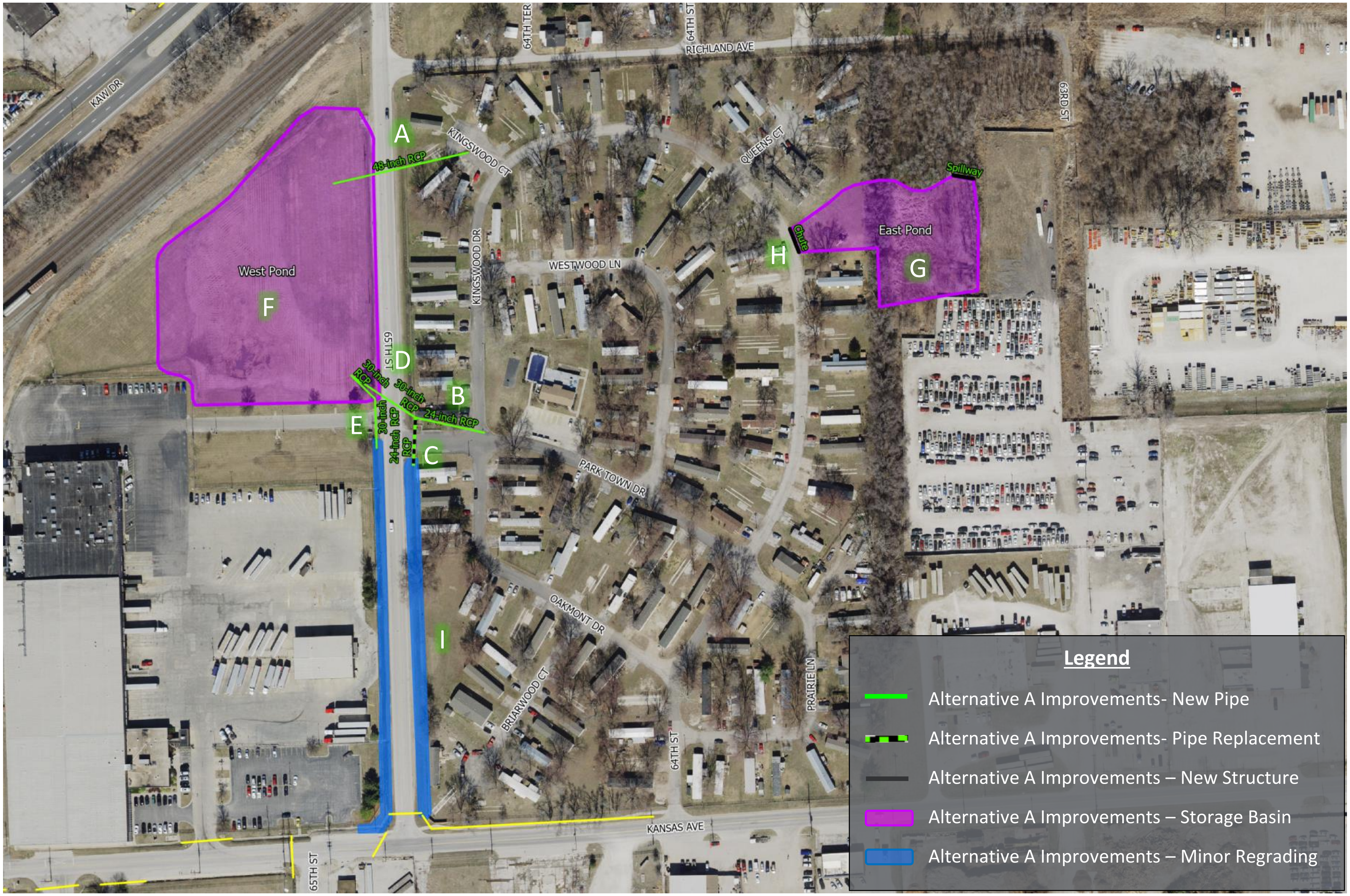
**Location Letter/Identifier is also shown on Figure 12*

TABLE 5 - ALTERNATIVE A PIPE DESCRIPTIONS

Location	Facility ID	Pipe Size	Pipe Length (ft)	Inlet Elevation (NAVD88)	Outlet Elevation (NAVD88)
Kingswood Ct to West	N/A	48-inch RCP	235.7	758.3	752.0
Along Park Town Dr (N)	N/A	24-inch RCP	122.0	760.2	758.9
Across Park Town Dr	233596-233597	24-inch RCP	56.1	761.0	758.9
Across 65th St	N/A	30-inch RCP	131.5	758.9	754.0
Along 65th St (W)	N/A	30-inch RCP	140.8	761.0	752.0

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 pipe capacities are generally maintained, the elevations could be slightly adjusted without significantly impacting the flood study results.

FIGURE 12 - IMAGE OF ALTERNATIVE A IMPROVEMENTS



The west basin is a designed depression that captures runoff and alleviates flooding on S 65th Street and the west side of the mobile home area. The maximum water surface elevation in the basin during the 100-year storm has greater than one foot of freeboard below the lowest elevation of S 65th Street and the private drive to the south and is such that water can still drain into the basin from the Kingswood Ct cul-de-sac area of the mobile park. A natural spillway is located on the southwest side of the basin at elevation 763.0. The east basin is a designed depression that captures runoff and alleviates flooding on the east side of the mobile home area. During the 100-year storm, the basin as modeled overflows to the east and south, in a similar way that runoff flows in the existing conditions. A spillway is located on the east side of the basin at elevation 758.0. Runoff from Kingswood Drive enters the basin via a concrete flume near Queens Court. Table 6 provides a description of each storage basin included in the Alternative A scenario. Table 7 provides an approximate stage-storage table for each storage basin included in the Alternative A scenario.

TABLE 6 – ALTERNATIVE A STORAGE BASIN DESCRIPTIONS

	West Basin	East Basin
Location	West of 65th St	East of Kingswood Dr
Bottom Elevation of Basin	752.0	750.0
Side Slopes	3:1	3:1
Spillway Elevation	763.0	758.0
Max 100-yr WSE	761.9	761.3
Storage Volume at Spillway Elevation (acre-ft)	31.9	5.5
Approximate Excavation (cubic yards)	48,600	12,500

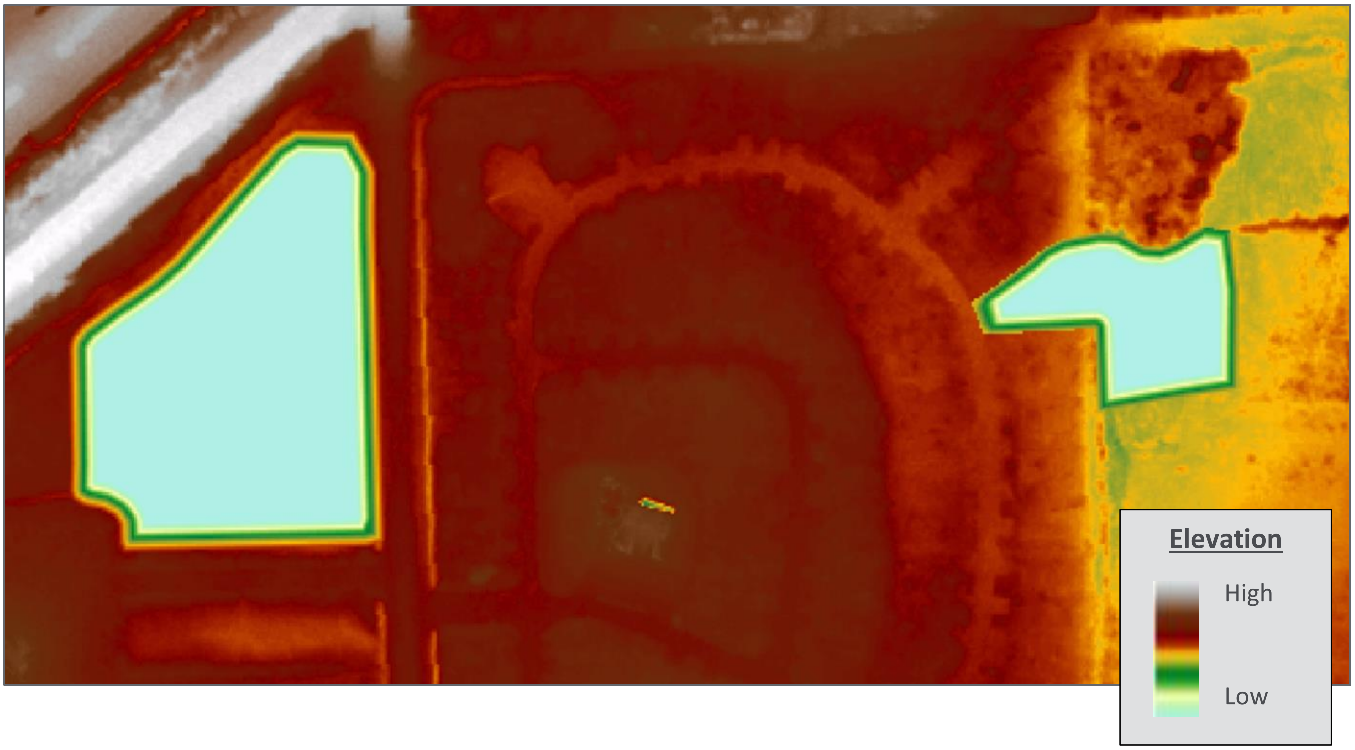
TABLE 7 – ALTERNATIVE A STAGE-STORAGE TABLES

West Basin		East Basin	
Elevation (NAVD88)	**Storage Capacity (acre-ft)**	**Elevation (NAVD88)**	**Storage Capacity (acre-ft)**
752	0	750	0
753	2.4	751	0.5
754	4.9	752	1.0
755	7.5	753	1.6
756	10.2	754	2.3
757	13.0	755	3.0
758	15.9	756	3.8
759	18.9	757	4.6
760	22.0	758	5.5
761	25.1		
762	28.4		
763	31.9		

The basin dimensions and capacities in the above table represent those used in the modeling and provide a guide for each of the storage basins. If the available storage capacities are generally maintained, the layout of each basin could be slightly adjusted without significantly impacting the flood results.

The modified terrain that was used in the Alternative A modeling is shown in Figure 13.

FIGURE 13 - MODIFIED TERRAIN FOR ALTERNATIVE A MODELING



To alleviate minor flooding across S 65th Street closer to the Kansas Ave intersection, this alternative also includes some minor regrading to the 65th Street ditches, to smooth out the bottoms of the ditches and allow runoff to flow more efficiently.

As previously mentioned, the Alternative A improvements target the reduction of flood risk to S 65th Street and the mobile home area during the 100-yr storm event. Figure 14 compares the existing conditions floodplains, which uses existing land use, before and after the Alternative A improvements for the 100-yr storm event.

Figure 15 compares the future conditions floodplains, which uses future land use, before and after the Alternative A improvements for the 100-yr storm event. The improvements perform well for the potential changes to land use, with S 65th Street and much of the mobile home park still being free from flooding.

FIGURE 14 - ALTERNATIVE A FLOOD COMPARISONS FOR EXISTING LAND USE AND 100-YR STORM EVENT

FIGURE 15 - ALTERNATIVE A FLOOD COMPARISONS FOR FUTURE LAND USE AND 100-YR STORM EVENT

Alternative A Project Considerations

As previously mentioned, this alternative does not currently include storm pipes along the privately-owned streets within the mobile home park area. As a result, some minor sheet flow would be observed along the streets until runoff reaches the location of the proposed storm pipes due to the elevations of these streets. However, storm inlets and pipes could be added along these streets to effectively remove all sheet flow.

The soils in the vicinity of the west basin are generally Kimo silty clay loam with somewhat poorly drained soils that have a moderate ability to transmit water (ksat of 0.06 to 0.2 in/hr). The soils in the vicinity of the east basin are generally Eudora-Urban land complex with well drained soils and a moderately high ability to transmit water (ksat of 0.60 to 2.0 in/hr). A monitoring well is located to the northwest of the proposed west basin, near the railroad. The recorded depth to water for the monitoring well is about 43.5 ft, which is likely measured from the top of the railroad embankment. Based on this information, there should be adequate depth for excavation of the basins. Given the drainage condition of the soils for the west basin, consideration should be given to incorporating a designed soil media to promote infiltration and drawdown in the structure, along with a potential underdrain system. However, determining a suitable location to release water from an underdrain system will be challenging given the flat terrain in the area.

The size of the west basin could be reduced if it were designed as a detention basin with a drainage structure and/or stormwater pump station. However, this would require incorporation of a relatively extensive stormwater network for the releases, similar to what is presented in Alternative C, due to the topographic limitations. If a pump station is required to achieve drainage, the operations and maintenance requirements can be significant and should also be considered. It should also be noted that the east basin does not retain the full 100-year volume. The downstream flooding is still improved with the basin in-place, compared to existing conditions.

Since this alternative targets risk reduction for the 100-year storm event, a large amount of storage volume is needed in the proposed basins. This limits the ability to incorporate a multi-use area around the basins, such as a park or other amenities.

This alternative provides a general concept of basins that could be implemented to mitigate flood risk in the area. A more thorough evaluation of the functional nature and operation of the basins is warranted during a future design phase.

5.2 Alternative B: 25-yr Alternative with Basins

Alternative B includes stormwater infiltration basins and stormwater drainage pipes that target flood risk reduction for the 4% annual change (25-yr) storm event along S 65th St and the mobile home area. The proposed improvements for Alternative B include new storm sewer pipes across S 65th Street that carry runoff from existing sumps in the privately-owned roads in the mobile home park to a proposed storage basin located west of S 65th Street. In addition, this alternative includes a storage basin on the east side of the mobile home area, located to the east of Kingswood Dr. The proposed improvements were incorporated into an alternative scenario within the PC-SWMM model, optimizing pipe sizing and basin sizing to address the street flooding for the 4% annual chance (25-yr) storm event. Similar to Alternative A, this alternative does not include storm pipes along the privately-owned streets within the mobile home park area. As a result, some minor sheet flow will be observed along the streets until runoff reaches the location of the proposed storm pipes due to the elevations of these streets. Flow lines were set for the pipes such that minimum pipe slopes and sufficient velocities could be maintained. Figure 16, shown on the next page, provides an image of the proposed improvements included in Alternative B. Table 8 provides a summary of the proposed improvements included in Alternative B. Table 9 provides a description of each storm pipe included in the Alternative B scenario.

TABLE 8 - ALTERNATIVE B SUMMARY

Location	Facility ID	Existing Structure	Proposed Structure
A- Kingswood Ct to West	N/A	N/A	48-inch RCP w/ flap gate
B- Along Park Town Dr (N)	N/A	N/A	24-inch RCP
C- Across Park Town Dr	233596-233597	Unknown	24-inch RCP
D- Across 65th St	N/A	N/A	30-inch RCP
E- Along 65th St (W)	N/A	N/A	30-inch RCP
F- West of 65th St	N/A	Open Space/Field	West Basin Series
G- Between West Basin Cells	N/A	Open Space/Field	Minor Regrading
H- Between 2 West Basin Cells	N/A	N/A	24-inch RCP
I- Between 2 West Basin Cells	N/A	N/A	24-inch RCP
J- Between 2 West Basin Cells	N/A	N/A	24-inch RCP
K- East of Kingswood Dr	N/A	Undeveloped Land	East Basin
L- Along Kingswood Dr (E)	N/A	Street Curb	Flume into East Basin
M- East and West of S 65th St	N/A	N/A	Minor Ditch Regrading

Location Letter/Identifier is also shown on Figure 16

TABLE 9 - ALTERNATIVE B PIPE DESCRIPTIONS

Location	Facility ID	Pipe Size	Pipe Length (ft)	Inlet Elevation (NAVD88)	Outlet Elevation (NAVD88)
Kingswood Ct to West	N/A	48-inch RCP	235.7	758.3	752
Along Park Town Dr (N)	N/A	24-inch RCP	122.0	760.2	758.9
Across Park Town Dr	233596-233597	24-inch RCP	56.1	761.0	758.9
Across 65th St	N/A	30-inch RCP	131.5	758.9	754.0
Along 65th St (W)	N/A	30-inch RCP	140.8	761.0	752.0
Between 2 West Basin Cells	N/A	24-inch RCP	103.9	751.0	751.0
Between 2 West Basin Cells	N/A	24-inch RCP	120.0	751.0	751.0
Between 2 West Basin Cells	N/A	24-inch RCP	146.2	753.0	753.0

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 pipe capacities are generally maintained, the elevations could be slightly adjusted without significantly impacting the flood results. The pipes connecting the four cells of the West Basin series act as equalization pipes in large part.

FIGURE 16 - IMAGE OF ALTERNATIVE B IMPROVEMENTS

The four-cell west basin series, as modeled, includes multiple designed depressions that are connected via pipes to capture runoff and alleviate flooding on S 65th Street and the west side of the mobile home area. The basins could be designed as bioretention cells. Minor regrading between the cells is included in the alternative to allow for additional storage during larger events. The maximum water surface elevation in the four-cell structure during the 25-year storm is about 1.0 ft below the lowest elevation of S 65th Street and the private drive to the south and is such that water can still drain into the northeast cell from the Kingswood Ct cul-de-sac area of the mobile park. A natural spillway is located on the west side of the four-cell structure at elevation 763.0. The east basin is a designed depression that captures runoff and alleviates flooding on the east side of the mobile home area, and is the same configuration as in Alternative A. During the 25-year storm, the basin as modeled overflows to the east and south, in a similar way that runoff flows in the existing conditions. A spillway is located on the east side of the basin at elevation 758.0. The storage capacity for the East Basin at elevation 758.0 is the same in Alternatives A and B; however, this alternative results in a smaller amount of overflow from the basin. Runoff from Kingswood Drive enters the basin via a concrete flume near Queens Court. Table 10 provides a description of each storage basin included in the Alternative B scenario. Table 11 provides an approximate stage-storage table for each storage basin included in the Alternative B scenario.

TABLE 10 – ALTERNATIVE B STORAGE BASIN DESCRIPTIONS

	West Basin Series	East Basin
Location	West of 65th St	East of Kingswood Dr
Number of Cells	4	1
Bottom Elevation of Basin	751.0	750.0
Side Slopes	3:1	3:1
Spillway Elevation	763.0	758.0
Max 25-yr WSE	762.3	760.6
Storage Volume at Spillway Elevation (acre-ft)	20.5	5.5
Approximate Excavation (cubic yards)	30,400	12,500

TABLE 11 – ALTERNATIVE B STAGE-STORAGE TABLES

West Basin Series		East Basin	
Elevation (NAVD88)	**Storage Capacity (acre-ft)**	**Elevation (NAVD88)**	**Storage Capacity (acre-ft)**
751	0	750	0
752	0.9	751	0.5
753	1.8	752	1.0
754	3.0	753	1.6
755	4.2	754	2.3
756	5.6	755	3.0
757	7.1	756	3.8
758	8.7	757	4.6
759	10.6	758	5.5
760	12.5		
761	14.7		
762	17.2		
763	20.5		

The basin dimensions and capacities in Tables 10 and 11 represent those used in the modeling and provide a guide for each of the storage basins. If the available storage capacities are generally maintained, the layout of each basin could be slightly adjusted without significantly impacting the flood results.

The modified terrain that was used in the Alternative B modeling is shown in Figure 17.

FIGURE 17 - MODIFIED TERRAIN FOR ALTERNATIVE B MODELING

To alleviate minor flooding across S 65th Street closer to the Kansas Ave intersection, this alternative also includes some minor regrading to the 65th Street ditches, to smooth out the bottoms of the ditches and allow runoff to flow more efficiently.

As previously mentioned, the Alternative B improvements target the reduction of flood risk to S 65th Street and the mobile home area during the 25-yr storm event. Figure 18 compares the existing conditions floodplains, which uses existing land use, before and after the Alternative B improvements for the 25-yr storm event.

The improvements were also included in a 100-yr storm event scenario to evaluate the benefits during larger storm events. Figure 19 compares the existing conditions floodplains before and after the Alternative B improvements for the 100-yr storm event. The improved conditions would result in minimal flooding along S 65th Street and reduced flood extents in the neighborhood during the 100-yr storm event.

Figure 20 compares the future conditions floodplains, which uses future land use, before and after the Alternative B improvements for the 25-yr storm event. The improvements perform well for the potential changes to land use, with S 65th Street and much of the mobile home park still being free from flooding.

Figure 21 compares the future conditions floodplains, which uses future land use, before and after the Alternative B improvements for the 100-yr storm event. The improvements with potential changes to land use would result in minimal flooding along S 65th Street and reduced flood extents in the neighborhood during the 100-yr storm event.

FIGURE 18- ALTERNATIVE B FLOOD COMPARISONS FOR EXISTING LAND USE AND 25-YR STORM EVENT

FIGURE 19 - ALTERNATIVE B FLOOD COMPARISONS FOR EXISTING LAND USE AND 100-YR STORM EVENT

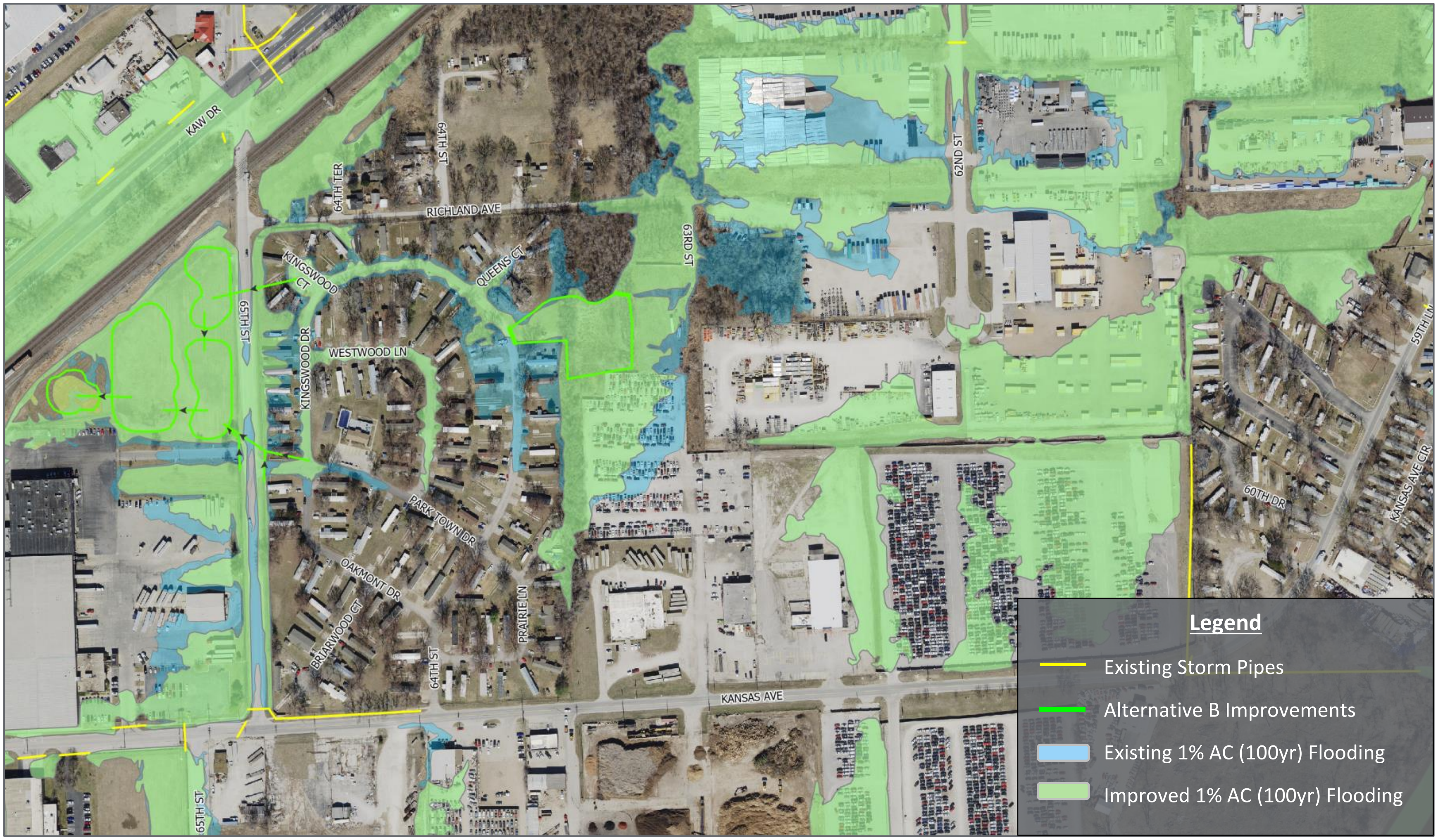


FIGURE 20 - ALTERNATIVE B FLOOD COMPARISONS FOR FUTURE LAND USE AND 25-YR STORM EVENT

FIGURE 21 - ALTERNATIVE B FLOOD COMPARISONS FOR FUTURE LAND USE AND 100-YR STORM EVENT

Alternative B Project Considerations

As previously mentioned, this alternative does not currently include storm pipes along the privately-owned streets within the mobile home park area. As a result, some minor sheet flow would be observed along the streets until runoff reaches the location of the proposed storm pipes due to the elevations of these streets. However, storm inlets and pipes could be added along these streets to effectively remove all sheet flow.

The four-cell west basin series could be incorporated into a multi-use area. To achieve the flood reduction benefits that are shown in this report, the overall storage flood storage volume described will need to be achieved, which would be in addition to any permanent or semi-permanent storage. The multi-cell structure could be designed as a bioretention feature that incorporates water quality benefits and provides a nature-based feel to the area. This goes beyond the typical storage requirements of water quality BMPs. A well-designed bioretention feature may provide aesthetic enhancements to the area and promotes environmental stewardship and community pride, with native grasses, trees and shrubs incorporated into the design. A designed soil mixture of organic mulch, planting soil, and sand is typically incorporated into these structures to achieve proper operation. Most bioretention areas are equipped with an underdrain system to increase the ability of the soil to drain. However, determining a suitable location to release water from an underdrain system will be challenging given the flat terrain in the area. Pretreatment is also typically incorporated into the design of bioretention features. Regardless of whether the west basin series is designed as a true bioretention feature or not, it could still be incorporated into a park plan that includes sidewalks/trails, park benches, landscaping features and shelter buildings that could serve as an amenity for the area; and would still offer some level of water quality benefits. However, if this is pursued, we strongly recommend community outreach efforts to determine community buy-in for this type of feature. While many will see this area as an amenity, others may see it as a nuisance attracting unwanted wildlife and potentially mosquitos to the area, as each neighborhood is different in how they see these types of features. A concept plan has been prepared, as is shown in Figure 22, that illustrates what a potential multi-use park for the west basin series could look like.

FIGURE 22 - CONCEPT PLAN OF MULTI-USE PARK

As previously described, the soils in the vicinity of the west basin are generally Kimo silty clay loam with somewhat poorly drained soils that have a moderate ability to transmit water (ksat of 0.06 to 0.2 in/hr). The soils in the vicinity of the east basin are generally Eudora-Urban land complex with well drained soils and a moderately high ability to transmit water (ksat of 0.60 to 2.0 in/hr). A monitoring well is located to the northwest of the proposed west basin, near the railroad. The recorded depth to water for the monitoring well is about 43.5 ft, which is likely measured from the top of the railroad embankment. Based on this information, there should be adequate depth for excavation of the basins. Given the drainage condition of the soils for the west basin, consideration should be given to incorporating a designed soil media to promote infiltration and drawdown in the structure, along with a potential underdrain system. However, determining a suitable location to release water from an underdrain system will be challenging given the flat terrain in the area.

The size of the west basin could be reduced if it were designed as a detention basin with the ability to release flows. However, this would require incorporation of a relatively extensive stormwater network for the releases, similar to what is presented in Alternative C, due to the terrain limitations. It should also be noted that both basins do not retain the full 100-year volume. The downstream flooding is still improved with both basins in-place, compared to existing conditions.

This alternative provides a general concept of basins that could be incorporated to alleviate some flooding concerns. A more thorough evaluation of the functional nature and operation of the basins is warranted during a future design phase.

5.3 Alternative C: 25-yr Alternative with Storm Network

Alternative C includes storm sewer improvements that target flood risk reduction for the 4% annual chance (25-yr) storm event along S 65th Street and the mobile home area. The proposed improvements for Alternative C include new storm sewer pipes along several streets and an increase in pipe sizes for a small portion of the system. A concrete flume and grass swale is also proposed on the east side of Kingswood Dr, south of Queens Ct. 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 minimum pipe slopes and sufficient velocities could be maintained. Figure 23 provides an image of the proposed improvements included in Alternative C. Table 12 provides a summary of the proposed improvements included in Alternative C. Table 13 provides a description of each storm pipe included in the Alternative C scenario.

TABLE 12 - ALTERNATIVE C SUMMARY

Location	Facility ID	Existing Structure	Proposed Structure
A- Kingswood Dr to S 65th St	N/A	N/A	30-inch RCP
B- Along S 65th St	N/A	N/A	30-inch RCP
C- Lateral Across S 65th St	N/A	N/A	24-inch RCP
D- Along S 65th St	N/A	N/A	30-inch RCP
E- Park Town Dr to S 65th St	N/A	N/A	24-inch RCP
F- Along S 65th St	N/A	Unknown	36-inch RCP
G- Along S 65th St	N/A	N/A	36-inch RCP
H- Lateral Across S 65th St	N/A	N/A	24-inch RCP
I- Along S 65th St	N/A	N/A	42-inch RCP
J- Lateral Across S 65th St	N/A	N/A	24-inch RCP
K- Across Kansas Ave	N/A	N/A	42-inch RCP
L- Along Kansas Ave	N/A	N/A	42-inch RCP
M- Extends from Kansas Ave to Kansas River	220533-220507/ 220507-220532/ 220532-220508	48-inch RCP	54-inch RCP
Across S 65th St	233530-233625	18-inch RCP	Remove
Along Kansas Ave	233550-233551	12-inch RCP	Remove
Along Kansas Ave	233622-233550	12-inch RCP	Remove
N- Along Kingswood Dr (E)	N/A	Street Curb	Flume into Grass Swale
O- East of Kingswood Dr	N/A	Undeveloped Land	Grass Swale

**Location Letter/Identifier is also shown on Figure 23*

TABLE 13 - ALTERNATIVE C PIPE DESCRIPTIONS

Location	Facility ID	Pipe Size	Pipe Length (ft)	Inlet Elevation (NAVD88)	Outlet Elevation (NAVD88)
Kingswood Dr to 65th St	N/A	30-inch RCP	92.9	758.1	757.4
Along 65th St	N/A	30-inch RCP	197.7	757.4	756.4
Lateral Across 65th St	N/A	24-inch RCP	73.3	758.6	756.9
Along 65th St	N/A	30-inch RCP	225.6	756.4	755.4
Park Town Dr to 65th St	N/A	24-inch RCP	122.0	760.0	755.9
Along 65th St	N/A	36-inch RCP	69.9	754.9	754.6
Along 65th St	N/A	36-inch RCP	233.8	754.6	753.6
Lateral Across 65th St	N/A	24-inch RCP	69.0	758.7	754.6
Along 65th St	N/A	42-inch RCP	363.0	753.1	751.5
Lateral Across 65th St	N/A	24-inch RCP	64.3	758.0	753.0
Along 65th St	N/A	42-inch RCP	76.2	751.5	751.2
Along Kansas Ave	N/A	42-inch RCP	2405.5	751.2	742.2
Extends from Kansas Ave to Kansas River	220533-220507/ 220507-220532/ 220532-220508	54-inch RCP	613.3	742.3	730.3

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 pipe capacities are generally maintained, the elevations could be slightly adjusted without significantly impacting the flood results.

FIGURE 23 - IMAGE OF ALTERNATIVE C IMPROVEMENTS

The proposed concrete flume would allow runoff from Kingswood Drive to flow to the east and into the proposed grass swale in an efficient manner. The proposed grass swale has a 5-foot wide bottom and 2.5 to 1 side slopes, with an average depth of 2 feet and a minimum bottom slope of 0.5%. This would convey runoff to the east without obstruction.

As previously mentioned, the Alternative C improvements target the reduction of flood risk to S 65^{th} Street and the mobile home area during the 25-yr storm event. Figure 24 compares the existing conditions floodplains, which uses existing land use, before and after the Alternative C improvements for the 25-yr storm event.

The improvements were also included in a 100-yr storm event scenario to evaluate the benefits during larger storm events. Figure 25 compares the existing conditions floodplains before and after the Alternative C improvements for the 100-yr storm event. The improved conditions would result in very little to no flooding along S 65^{th} Street and reduced flood extents in the neighborhood during the 100-yr storm events.

Figure 26 compares the future conditions floodplains, which uses future land use, before and after the Alternative C improvements for the 25-yr storm event. The improvements perform well for the potential changes to land use, with S 65^{th} Street being free from flooding and much of the mobile home park still showing significant flood risk improvements.

Figure 27 compares the future conditions floodplains, which uses future land use, before and after the Alternative C improvements for the 100-yr storm event. The improvements perform well for the potential changes to land use, with S 65^{th} Street resulting in very little to no flooding along S 65^{th} Street and reduced flood extents in the neighborhood during the 100-yr storm events.

FIGURE 24 - ALTERNATIVE C FLOOD COMPARISONS FOR EXISTING LAND USE AND 25-YR STORM EVENT

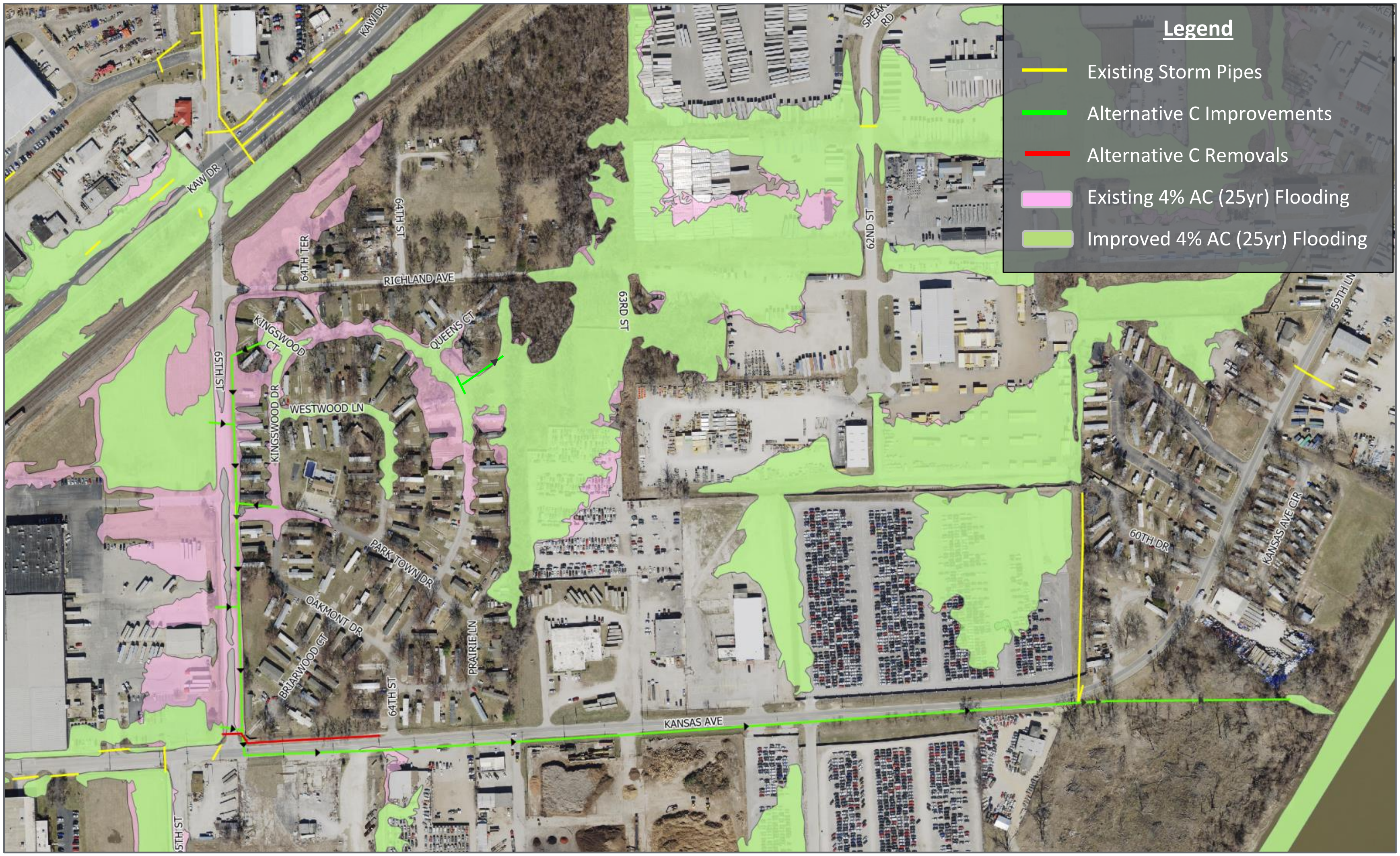


FIGURE 25 - ALTERNATIVE C FLOOD COMPARISONS FOR EXISTING LAND USE AND 100-YR STORM EVENT

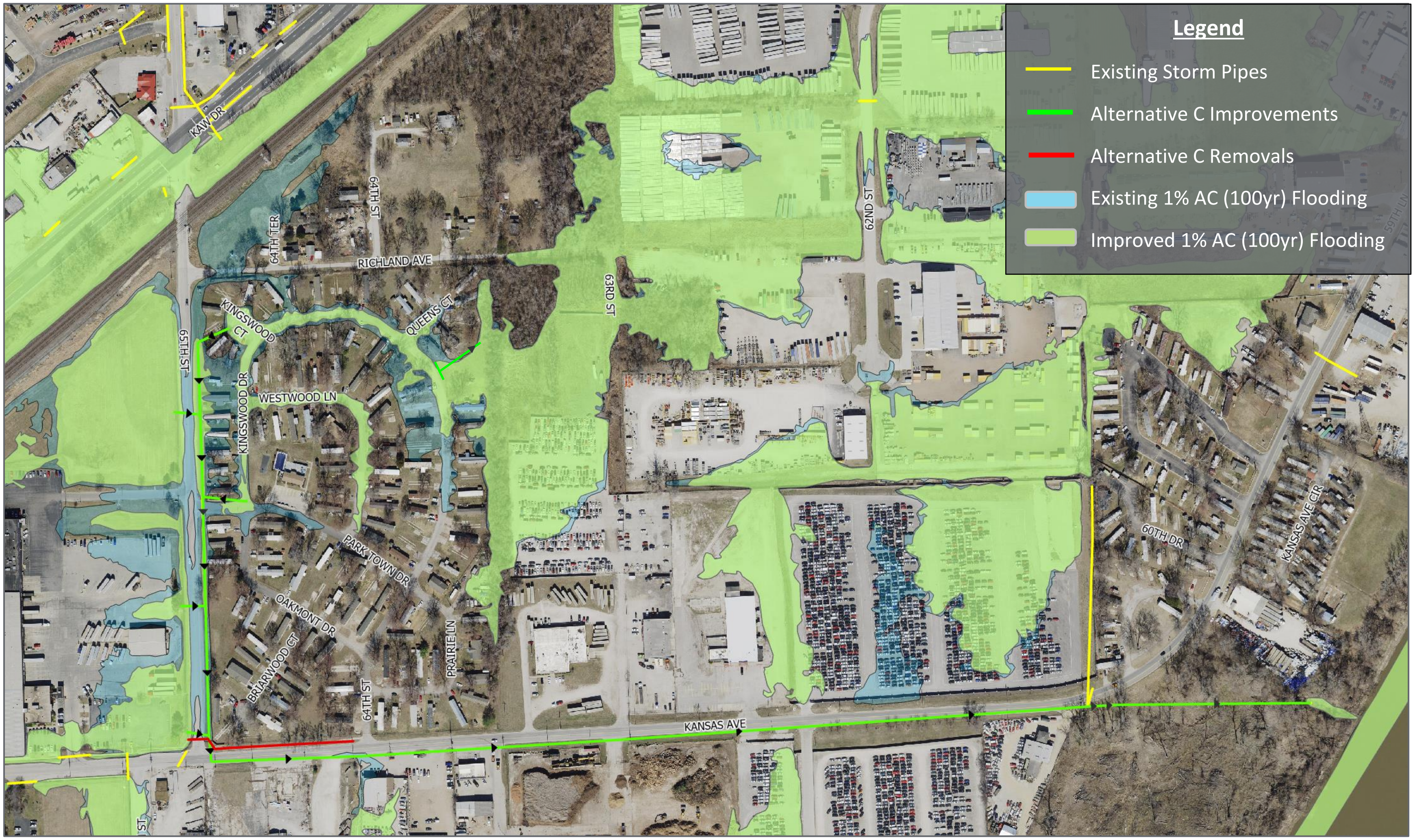


Figure 26 - Alternative C Flood Comparisons for Future Land use and 25-Yr Storm event

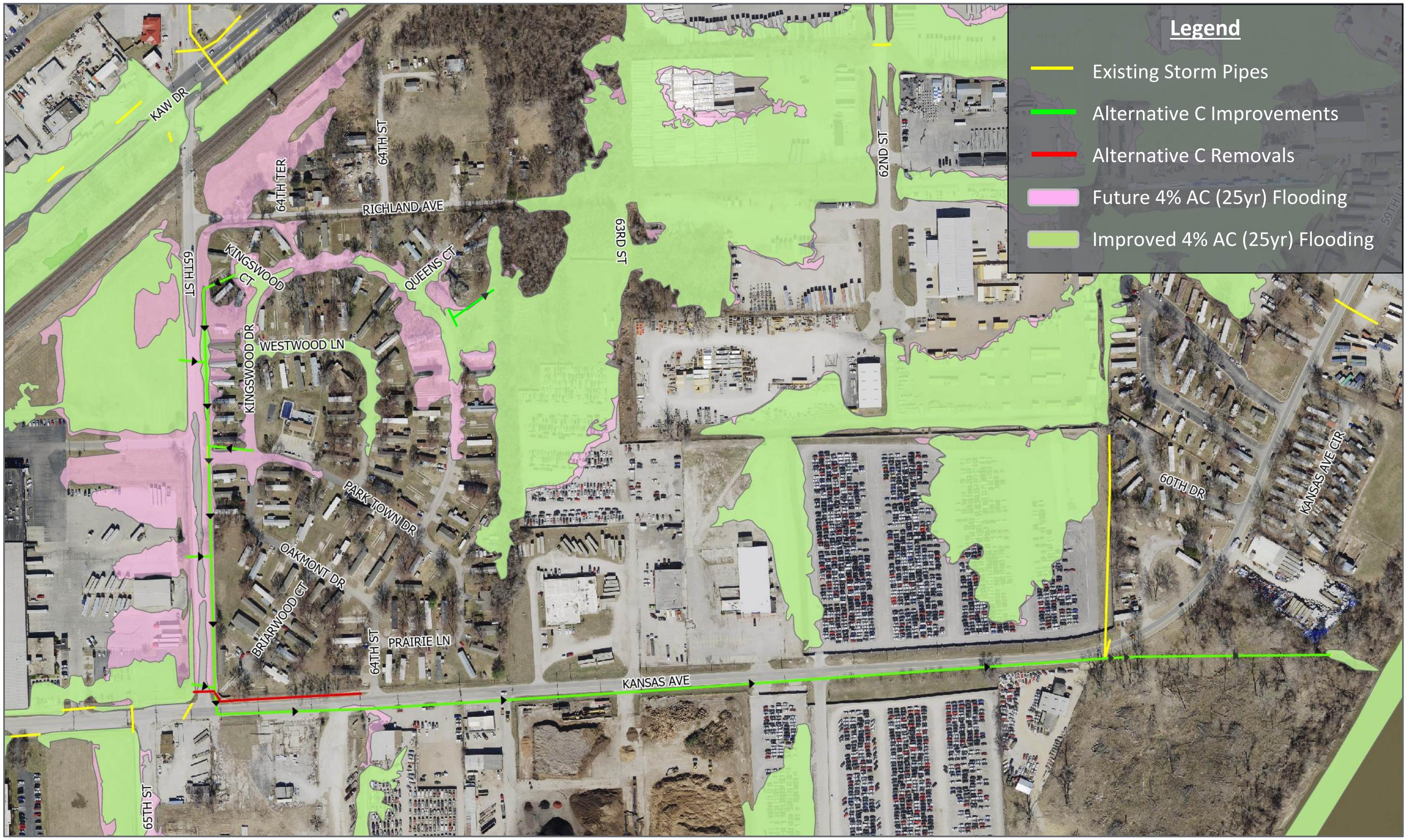
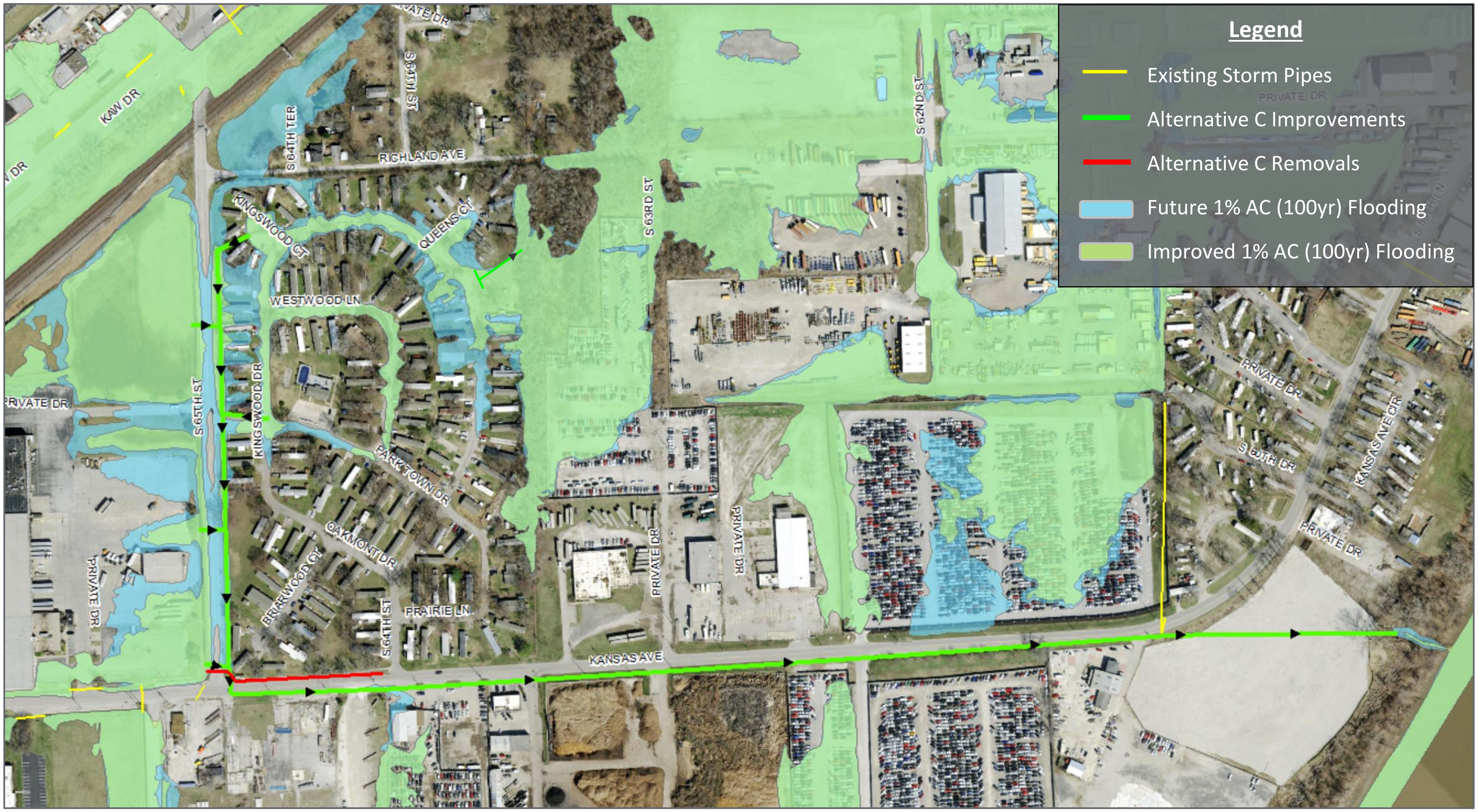


FIGURE 27 - ALTERNATIVE C FLOOD COMPARISONS FOR FUTURE LAND USE AND 100-YR STORM EVENT



Alternative C Project Considerations

This alternative primarily targets flood risk reduction of S 65th Street and the western portion of the mobile home park. A small improvement is proposed for the eastern portion of the mobile home park, which includes the construction of a concrete flume from Kingswood Dr, south of Queens Ct, entering a proposed grass swale located in the open space to the east. The grass swale will convey runoff to the east. By removing a section of the curb and directing runoff more efficiently to the east, the static ponding of water is removed along the street. This effectively lowers the flooding in the area. While sheet flow still exists in the streets and flooding still appears to touch or get close to a few homes, this relatively small modification has a positive impact to flooding on the east side of the mobile home park.

This alternative, like Alternatives A and B, does not currently include storm pipes along the privately-owned streets within the mobile home park area. As a result, some minor sheet flow would be observed along the streets until runoff reaches the location of the proposed storm pipes due to the elevations of these streets. However, storm inlets and pipes could be added along these streets to effectively remove all sheet flow.

It should be noted that the existing storm pipes that extend from Kansas Avenue to the Kansas River are currently failing and will need to be replaced in the very near future. While this alternative recommends upsizing the pipes from 42-inch diameter to 56-inch diameter, the difference in the overall costs is relatively small. Also, while this alternative is more costly, a portion of the costs would be in lieu of a necessary replacement project.

Consideration was given to taking the storm pipes from the S 65th St and Kansas Ave area to an alternative route to the south. Achieving positive slopes in the system were more difficult toward the south. The existing open channels did not have enough adjacent space to achieve necessary footprints that would be needed to carry the flows. In addition, the UG puts a strong emphasis on the ability to flush their system when necessary for maintenance purposes. Therefore, channel systems are not as desirable. The need to replace the existing structure to the east, as mentioned above, also made that route a more desirable option.

Consideration could be given to designing a storm sewer system that would more completely reduce flood risk on the western portion of the mobile home park during the 100-year storm event. This would require increases to the pipe sizes and could require the use of squash pipes or double pipes (in parallel) due to the shallow depths that are available to maintain adequate slopes.

The incorporation of a storm sewer network to address the flooding concerns in the area of interest could offer more benefits into the future if the area is redeveloped for different uses, as a storm sewer network could be expanded to serve multiple areas and needs.

6 COST ESTIMATES

Budget-level cost estimates have been developed for the conceptual flood mitigation alternatives, described as Alternatives A, B, and C. 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 pipe length that is included in the project plus $10,300 per 500 feet of basin perimeter length that is included in 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. Additional costs for tree removal are included for the east basin.

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. For Alternatives A and B, temporary traffic control is estimated a $7,500 as the project has a more limited impact on traffic.

Erosion Control is shown as a lump sum item. This cost is estimated using a price of $7,350 per 500 feet of pipe length that is included in the project plus $14,700 per 500 feet of basin perimeter length that is included in 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 shown as a lump sum item. Easement acquisition will be necessary for the basins. It is assumed that the storm pipes can be placed adjacent to the roads, but that approximately half of the necessary excavation widths will require easement acquisition. An estimated easement cost of $3 per square foot is being used for these budgetary estimates.

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.

Table 14 provides the cost estimate for Alternative A, which is the 100-yr alternative with basins. A large portion of the cost includes excavation and easement acquisition for the basins.

TABLE 14 - COST ESTIMATE FOR ALTERNATIVE A (100-YR ALTERNATIVE WITH BASINS)

Alternative A- Preliminary Cost
Stormwater Project

benesch

Oct-23

-- ENGINEER'S OPINION OF PROBABLE COST --

ITEM No.	BID ITEMS	QUANTITY	UNITS	ESTIMATED UNIT PRICE	TOTAL
1	Contractor Construction Staking	1	LS	$56,713.00	$56,713.00
2	Pavement Removal	367	SY	$15.00	$5,500.00
3	Unclassified Excavation	62,105	CY	$22.00	$1,366,316.00
4	Removal of Existing Structures	1	LS	$1,403.00	$1,403.00
5	Tree Removal/Clearing & Grubbing	1	LS	$69,663.00	$69,663.00
6	24" Storm Sewer (RCP)	178	LF	$125.00	$22,263.00
7	30" Storm Sewer (RCP)	272	LF	$160.00	$43,568.00
8	48" Storm Sewer (RCP)	236	LF	$235.70	$55,554.00
9	Inlet/Manhole Connections	1	LS	$30,000.00	$30,000.00
10	(8") Asphaltic Concrete Pavement	367	SY	$95.00	$34,833.00
11	Concrete Chute	1	LS	$3,000.00	$3,000.00
12	48" RCP Flap Gate Structure	1	LS	$10,000.00	$10,000.00
13	Temporary Traffic Control	1	LS	$7,500.00	$7,500.00
14	Erosion Control	1	LS	$80,940.00	$80,940.00
15	Easement Acquisition	1	LS	$582,900.00	$582,900.00
16	Mobilization	1	LS	$82,105.00	$82,105.00
	Subtotal				***$2,452,258.00***
	Utility Relocation			*5%*	*$122,613.00*
	Construction Cost				***$2,574,871.00***
	Contingency			*25%*	*$643,718.00*
	Financing Costs			*5%*	*$128,744.00*
	Design Fees			*15%*	*$386,231.00*
	Inspection Costs			*10%*	*$257,487.00*
		PROJECT TOTAL			***$3,991,051.00***

Table 15 provides the cost estimate for Alternative B, which is the 25-yr alternative with basins. This cost estimate provides a base cost and assumes that the constructed basins are simple retention/infiltration basins, not part of a multi-use park. If it is the desire to utilize the basins as water quality BMPs or part of a park plan, the associated cost of the project would be higher than what is shown. A large portion of the cost includes excavation and easement acquisition for the basins.

TABLE 15 - COST ESTIMATE FOR ALTERNATIVE B (25-YR ALTERNATIVE WITH BASINS)

Alternative B- Preliminary Cost
Stormwater Project

benesch

Oct-23

-- ENGINEER'S OPINION OF PROBABLE COST --

ITEM No.	BID ITEMS	QUANTITY	UNITS	ESTIMATED UNIT PRICE	TOTAL
1	Contractor Construction Staking	1	LS	$60,524.00	$60,524.00
2	Pavement Removal	367	SY	$15.00	$5,500.00
3	Unclassified Excavation	44,258	CY	$22.00	$973,671.00
4	Removal of Existing Structures	1	LS	$1,403.00	$1,403.00
5	Tree Removal/Clearing & Grubbing	1	LS	$77,988.00	$77,988.00
6	24" Storm Sewer (RCP)	548	LF	$125.00	$68,513.00
7	30" Storm Sewer (RCP)	272	LF	$160.00	$43,568.00
8	48" Storm Sewer (RCP)	236	LF	$235.70	$55,554.00
9	Inlet/Manhole Connections	1	LS	$30,000.00	$30,000.00
10	(8") Asphaltic Concrete Pavement	367	SY	$95.00	$34,833.00
11	Concrete Chute	1	LS	$3,000.00	$3,000.00
12	48" RCP Flap Gate Structure	1	LS	$10,000.00	$10,000.00
13	Temporary Traffic Control	1	LS	$7,500.00	$7,500.00
14	Erosion Control	1	LS	$86,379.00	$86,379.00
15	Easement Acquisition	1	LS	$582,900.00	$582,900.00
16	Mobilization	1	LS	$65,202.00	$65,202.00
	Subtotal				***$2,106,535.00***
	Utility Relocation			5%	*$105,327.00*
	Construction Cost				***$2,211,862.00***
	Contingency			25%	*$552,966.00*
	Financing Costs			5%	*$110,593.00*
	Design Fees			15%	*$331,779.00*
	Inspection Costs			10%	*$221,186.00*
		PROJECT TOTAL			***$3,428,386.00***

Table 16 provides the cost estimate for Alternative C, which is the 25-yr alternative with storm network. The cost estimate assumes that adequate space exists adjacent to S 65th Street and Kansas Ave for the storm pipes. This will reduce the costs associated with removal and replacement of pavement, along with curb and gutter, but will likely require some easement acquisition for the full width needed for excavation. Also, as mentioned in the project considerations for this alternative, the existing pipe from Kansas Ave to the Kansas River is currently failing and will need to be replaced in the near future. If it is replaced with a 54" RCP, then those associated costs could be removed from the cost estimate for this project alternative.

TABLE 16 - COST ESTIMATE FOR ALTERNATIVE C (25-YR ALTERNATIVE WITH STORM NETWORK)

Alternative C- Preliminary Cost Stormwater Project					benesch
					Oct-23
	-- ENGINEER'S OPINION OF PROBABLE COST --				
ITEM No.	BID ITEMS	QUANTITY	UNITS	ESTIMATED UNIT PRICE	TOTAL
1	Contractor Construction Staking	1	LS	$54,075.00	$54,075.00
2	Pavement Removal	3,662	SY	$15.00	$54,930.00
3	Unclassified Excavation	8,816	CY	$22.00	$193,953.00
4	Removal of Existing Structures	1	LS	$30,180.00	$30,180.00
5	Tree Removal/Clearing & Grubbing	1	LS	$78,158.00	$78,158.00
6	24" Storm Sewer (RCP)	329	LF	$125.00	$41,075.00
7	30" Storm Sewer (RCP)	516	LF	$160.00	$82,592.00
8	36" Storm Sewer (RCP)	304	LF	$205.00	$62,259.00
9	42" Storm Sewer (RCP)	2,845	LF	$255.00	$725,399.00
10	54" Storm Sewer (RCP)	613	LF	$370.00	$226,921.00
11	Inlet/Manhole Connections	1	LS	$90,000.00	$90,000.00
12	(8") Asphaltic Concrete Pavement	3,662	SY	$95.00	$347,893.00
13	Combined Curb and Gutter	410	LF	$50.00	$20,500.00
14	Concrete Flume	1	LS	$3,000.00	$3,000.00
15	Temporary Traffic Control	1	LS	$52,500.00	$52,500.00
16	Erosion Control	1	LS	$77,175.00	$77,175.00
17	Easement Acquisition	1	LS	$164,796.00	$164,796.00
18	Mobilization	1	LS	$97,843.00	$97,843.00
	Subtotal				***$2,403,249.00***
	Utility Relocation			*5%*	*$120,162.00*
	Construction Cost				***$2,523,411.00***
	Contingency			*25%*	*$630,853.00*
	Financing Costs			*5%*	*$126,171.00*
	Design Fees			*15%*	*$378,512.00*
	Inspection Costs			*10%*	*$252,341.00*
		PROJECT TOTAL			***$3,911,288.00***

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 65th Street, north of Kansas Ave, along with the nearby areas of the mobile home park and determine potential mitigation options. It was noted, however, that the streets within the mobile home area are privately-owned and construction efforts within those streets would likely not be pursued by the UG or would be limited in nature. Flood water routinely covers S 65th Street and the nearby residential 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. Flood water has also caused damage to public roads and private property. 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 S 65th Street and the nearby residential area, keeping the area more accessible and safer from flood risk. The first alternative that was identified (Alternative A) targets flood elimination along S 65th Street and flood reduction in the mobile home area for the 1% annual chance (100-yr) storm event. This alternative uses a few storm pipes and a large retention/infiltration basin to reduce flood risk to S 65th St and the northwestern portion of the mobile home area, along with a retention/infiltration basin to reduce flood risk to the northeastern portion of the mobile home area. The second alternative that was identified (Alternative B) targets flood elimination along S 65th Street and flood reduction in the mobile home area for the 4% annual chance (25-yr) storm event. This alternative uses a few storm pipes and a four-cell retention/infiltration basin to reduce flood risk to S 65th St and the northwestern portion of the mobile home area, along with a retention/infiltration basin to reduce flood risk to the northeastern portion of the mobile home area. The third alternative that was identified (Alternative C) targets flood elimination along S 65th Street and flood reduction in the mobile home area for the 4% annual chance (25-yr) storm event. This alternative uses a storm sewer system to reduce flood risk to S 65th St and the northwestern portion of the mobile home area, along with a simple concrete flume and grass swale to reduce flood risk to the northeastern portion of the mobile home area. The future conditions, based on potential changes to land use, were also evaluated as part of the project and all 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.

When evaluating the flood risk reductions for the northeastern portion of the mobile home area, it appears that the benefits associated with a retention/infiltration basin, as shown in Alternatives A and B, are not substantially greater than the benefits associated with a simple concrete flume and grass swale alternative, which would allow water to flow to the east more freely from Kingswood Drive, as shown in Alternative C, for the 25-yr storm event. Given the sizeable difference in costs between those two options, it is likely more practical to opt for the simple flume and swale alternative, which would reduce the ponding along Kingswood Drive and the backup of flood water onto adjacent properties.

When evaluating the flood risk reductions for S 65th Street and the northwestern portion of the mobile home area, the conceptual alternatives presented in this report provide solutions that can be weighed by the community based on the desires and ultimate goals of a mitigation project. Considering the future plans for the area will likely be an important factor in the decision-making process. For example, a multi-use park would likely have more community value to a residential or mixed-use area, rather than an industrial or commercial area. We strongly recommend community outreach efforts to determine community buy-in prior to initiating a multi-use park project. The design of a functional infiltration/bioretention basin with adequate drawdown time may also prove to be challenging given the specific site characteristics. Therefore, the storm sewer system alternative, Alternative C, may prove to be the most implementable and feasible option. It is also recommended that both short-term and long-range plans for the area be considered when implementing a mitigation project for this area.

8 REFERENCES

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9 APPENDIX ITEMS- ELECTRONIC DELIVERABLES

PC-SWMM Models

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

Digital Supporting Data

- SWMM Shapefiles
- Resulting Grids
- Resulting Floodplains