Delmar-Fontana Low-Water Crossing Removal and Stormwater Improvements
DB-11-015

City of Prairie Village, Kansas

Water Resources Solutions

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1-11-2017

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January 11, 2017

Mr. Keith Bredehoeft
Public Works Director
City of Prairie Village
3535 Somerset Drive
Prairie Village, Kansas 66208

Subject: Delmar-Fontana Low-Water Crossing Removal and Stormwater Improvement Project
DB-11-015

Dear Mr. Bredehoeft:

Water Resources Solutions is pleased to submit the Preliminary Engineering Study report for the Delmar-Fontana Low-Water Crossing Removal and Stormwater Improvement Project.

The report was prepared according to the requirements of Johnson County Stormwater Management Advisory Committee.

The recommended alternative for this project is comprised of the construction of a new culvert under Somerset Drive, the construction of a new channel from Somerset Drive to upstream of Fontana Street, and the construction of culverts at the Delmar Lane and Fontana Street low-water crossings. The construction cost for this alternative is estimated to be $3,972,240.00. The overall project cost is estimated to be $4,465,720.00.

If you have any questions, please contact me at 913-302-1030 or DBaker@wrs-rc.com.

Sincerely,
Water Resources Solutions, LLC

Donald W. Baker, P.E., D. WRE, CPESC
Principal and Owner

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I. Project Overview

The Delmar-Fontana Low-Water Crossing Removal and Stormwater Improvement Project is located in Prairie Village, Kansas and is associated with flood risk mitigation improvements for two low-water crossings and 7 private homes.

A. Flood Problem Rating Table

The Flood Problem Rating Table for the project is shown in Figure 1. Based on the flooding factors on the form, the project is rated at 250 points.

The first point category is Number 2 – Flooding of Habitable Buildings. The total points for this factor is 120 points. A frequency multiplier of 2 was chosen due to flooding of the homes on October 4, 1998 and that updated Northeast Johnson County Watershed Study modeling shows that the 7 homes would flood during the 100-year design storm. This modeling also shows three homes would flood during the 10-year design storm. The hydrology and hydraulic models were updated in 2015 by Larkin Lamp Rynearson. A severity multiplier of 2 was selected since the number of homes impacted is greater than 6.

The second point category selected is Number 6 – Flooding Residential Streets of More Than 7 Inches. The total points for this factor is 90 points. A frequency multiplier of 3 was chosen since the water depth over the Delmar Lane and Fontana Street low-water crossings exceeds 7 inches at much less than a 5-year design storm and has occurred much more frequently than 3 times in the past 10-years. A severity multiplier of 1.5 was selected since the flooded low-water crossings restrict emergency vehicle access.

B. Background

The Delmar-Fontana Low-Water Crossing Removal and Stormwater Improvement Project is located in Prairie Village, Kansas. The project is bounded by 83rd Street to the north, Mission Road to the east, Roe Avenue to the west and 84th Street to the south.

The purpose of this Preliminary Engineering Study (PES) is to evaluate flood mitigation risk measures to reduce the occurrence of flooding of Delmar Lane and Fontana Street between 83rd and 84th Streets and to reduce the flood risk for 7 homes located in the area.

The flooding issues for this project include the flooding of 7 homes by the 1% annual occurrence flood event and the flooding of two low-water crossings located on Delmar Lane and Fontana Street that flood at less than the 20% annual occurrence flood event. The homes that flood are listed in Table 1.

Johnson County Stormwater Management Plan
Flood Problem Rating Table 1999

City: Prairie Village Basin & Watershed Dykes Branch
Location: Between 83rd & 86th From Fontana east of Somerset
Description of Problem: Multiple home and roadway flooding issues

Flood Problem Rating

Factor #	Factor Description	Eliminates Factor	Rating Points	Frequency Multiplier	Severity Multiplier	Total Points
1	Loss of Life		40			0
2	Flood of habitable building	3	40	2	2	160
3	Flooding of garages and outbuildings	2	20			0
4	Flooding of arterial street of more than 7 inches	5,6,7	30			0
5	Flooding of collector street of more than 7 inches	4,6,7	25			0
6	Flooding of residential street of more than 7 inches	4,5,7	20	3	1.5	90
7	Widespread or long-term ponding in streets	4,5,6	20			0
8	Erosion threatens habitable buildings, utilities, streets, bridges	9	30			0
9	Erosion significant in unmaintained areas	8	10			0
10	Erosion causes imminent drainage structure collapse	11,12	30			0
11	Erosion causes marginal drainage structure collapse	10,12	15			0
12	Erosion causes failure of drainage structure	10,11	10			0
13	Other cities receiving benefits		20			0
14	Other cities contributing to the flooding problem		10			0
	Project Toal Points					250
	Estimated Total Project Cost					$4,000,000.00
	Priority Rating = Total Project Cost/Total Points					16000

Applies to #	Frequency Multiplier	Muliplier Value
2-7	One time in ten years or by 10- to 100-year design storm	1
2-7	Two times in ten years or by 5- to 10-year design storm	2
2-7	Three or more times in 10-years or less than under 5-year design storm	3
14	One city receiving benefit	1
13,14	Two cities receiving benefit or second city contributing to flooding problem	2
13,14	Three or more cities receving benfit or three or more cities contributing to the flooding problem	3

Applies to #	Severity Description	Muliplier Value
1	Number of deaths * = 1 for each death	*
2,3	1-5 buildings flooded historically or by the 100-year existing or future design flow	1
2,3	6-9 buildings flooded historically or by the 100-year existing or future design flow	2
2,3	10 or more buildings flooded historically or by 100-year existing or future design flow	3
4,5,6	Restricts emergency vehicles	1.5
8	Nuisance erosion creates maintenance problems	1
8	Moderate erosion, failure of structure or facility within next 5 years possible	2
8	Severe erosion, failure of structure or facility imminent	3
10-12	Collapse causes flooding of land by 100-year design storm	1
10-12	Collapse causes flooding of garages/outbuildings by 100-year design storm	1.5
10-12	Collapse causes 1-3 habitable buildings to be flooded	2
10-12	Collapse causes 4-6 habitable buildings to be flooded	3
10-12	Collapse causes more than 6 habitable buildings to be flooded	4

Figure 1 Flood Problem Rating Table

Table 1 Addresses of Flooding Houses

8316 Delmar Lane
8317 Delmar Lane
8333 Delmar Lane
8340 Somerset Drive
8348 Somerset Drive
8356 Somerset Drive
8400 Somerset Drive

The homes identified have flooded in the past. In particular, there was significant flooding on October 4, 1998. Over the past 20 years, at least two vehicles have been washed off the low-water crossings. The first occurred on October 4, 1998. The latest occurred in August of 2016. Fortunately, no loss of life occurred during those events. Figure 2 and Figure 3 show the cars impinged on the Somerset Drive culvert.

Figure 2 Car in 1998

Figure 3 Car in 2016

The project impact limits are isolated to the project location. Specifically, the project and its impacts begin just downstream of Roe Avenue and extend to the open channel approximately 440 feet east of Somerset Drive. The project is contained in a narrow corridor between these two points.

While the flow through the project area is subcritical, the Froude numbers approach 1. As a result, the impact to energy grade line is limited to a few hundred feet upstream. At the downstream end of the project, the channel flattens and the Froude number drops. This results in the downstream flow controlling the outlet of the project, and any downstream effects are eliminated. The upstream and downstream points are all located in Prairie Village. Overland Park is located upstream at Nall Avenue, well beyond the impact area. Leawood is located well downstream, east of Mission Road at 83rd Street.

C. Existing Conditions

The project lies near the upstream of the Dykes Branch watershed. The flooding source is Dykes Branch as it winds through the Town & Country subdivision between Roe Avenue and Somerset Drive.

The existing channel through the neighborhood is a trapezoidal concrete channel approximately two feet in height. Above this height, the channel banks slope up to the surrounding grade. The majority of the slopes are covered with turfgrasses. The remaining slopes are covered with woody vegetation. There are also some small retaining walls that line the stream. Figure 4 through Figure 7 provide views of the existing channel.

Figure 4 Looking Downstream from Delmar Lane

Figure 5 Looking Upstream for Delmar Lane

Figure 6 Looking Upstream from Fontana Street

Figure 7 Looking Downstream from Fontana Street

Both Delmar Lane and Fontana Street cross the channel as low-water crossings. Figure 8 and Figure 9 illustrate the Delmar Lane and Fontana Street low-water crossings.

Figure 8 Delmar Low-Water Crossing

Figure 9 Fontana Low-Water Crossing

Another trapezoidal concrete channel enters this main channel from the north halfway between Fontana Street and Delmar Lane. This channel drains the watershed north of 83rd Street. The confluence of the two channels is not efficient and is a location of turbulence and backwater. This channel from the north accounts for approximately one-third of the watershed drainage.

The channel enters a double cell corrugated arch culvert upstream of Somerset Drive at the back lot lines of houses along the west side of Somerset Drive. The size and grade of the culvert create a constriction to flow. This constriction is one cause of the flooding for the houses along Somerset Drive.

As described earlier in this report, there are significant flooding issues along this reach of Dykes Branch. Several homes have historically flooded. In addition, 7 homes are shown by numerical hydraulic model to flood during the 1 percent annual occurrence design flood event. In addition to the 7 homes, the two low-water crossings at Delmar Lane and Fontana Street continue to flood. The depth of water over the roadway routinely exceeds seven inches. At least two cars have been swept off the low-water crossings over the past 20 years.

The project area is underlain by deep silty clay and silty clay loams of the Grundy Silt Loam according to the U.S. Department of Agriculture soil survey for the area. The depth to bedrock is unknown. However, the soil survey does not record any bedrock to a depth of at least seven feet. Previous engineering designs to mitigate this flood damage do not indicate the presence of bedrock to the depths that would be impacted by the project.

There are several utilities that will be impacted by the project. Two sanitary sewer mains parallel the channel as it winds through the neighborhood. At the crossing with Somerset Drive, the project will impact water, telephone, cable, gas, electric and sanitary utilities. It is anticipated relocations of these utilities will be required.

The existing channel lies within an existing permanent drainage easement except where it enters the culvert system under Somerset Drive. The channel turns southeast out of the easement to enter the culvert system. The existing easement is not wide enough to accommodate the proposed flood risk mitigation improvements.

D. Standards

The Kansas City Chapter of the American Public Works Association Design Criteria Section 5600 will be the basis of design for this project. Any deviations from this standard will be noted during the design of the project.

The construction will be completed using the City of Prairie Village construction specifications and standard details. Additional details and specifications will be supplemented as necessary for the project.

E. Utility Contacts

The following utilities could be impacted by the project.

- Kansas City Power & Light
- AT&T
- Time Warner Cable
- Google Fiber
- Kansas Gas Service
- WaterOne
- Consolidated Communications
- Johnson County Wastewater

Table 2 provides the contact information for these utilities.

Table 2 Utility Contact Information

Time Warner Cable 8221 W. 199th Street Overland Park, Kansas 66213 913-915-0553 Alex Cashman	Kansas Gas Service 11401 W. 89th Street Overland Park, Kansas 66214 913-599-8964 Chris Collins
WaterOne 10747 Renner Boulevard Lenexa, Kansas 66219 913-428-6474 Dana Williams	AT&T 9444 Nall Overland Park, Kansas 66207 913-383-4936 Darren Ostrom
Johnson County Wastewater 4800 Nall Avenue Mission, Kansas 66202 913-715-8501 Charles McAllister	Kansas City Power & Light 16215 W. 108th Street Lenexa, Kansas 66219 913-810-7623 Gary Price
Consolidated Communications 9701 Lackman Road Lenexa, Kansas 66219 913-322-6922 Melissa Stringer	Google Fiber 870-219-5630 Craig Young

F. Permits

A section 404 Department of Army Permit will be required for this project. The U.S. Army Corps of Engineers (USACE) has jurisdiction over all waters of the United States. The Dykes Branch channel meets all requirements to fall under the USACE jurisdiction.

The land disturbance associated with the project will almost definitely be greater than one acre. As a result, the project must be permitted under the National Pollution Discharge Elimination System for construction activities. The project will meet the requirements of the General Permit for Stormwater Runoff from Construction Activities held by the Kansas Department of Health & Environment (KDHE). A Notice-of-Intent must be provided to KDHE to be covered under this General Permit.

Since the drainage area to the downstream end of the project is less than 640 acres, no permits will be required from the Kansas Department of Agriculture, Division of Water Resources. No permit or certifications will be required as part of the Federal Emergency Management Agency's National Flood Insurance Program either.

G. Conformance with Watershed Studies

This project falls within the Dykes Branch portion of the Northeast Johnson County Watershed Study completed by Johnson County. The hydrologic model from this study was used as the basis of the updated model completed by Larkin Lamp Rynearson in 2015. The hydraulic model for the watershed study was used as the basis of the model used to identify the existing conditions

flooding for the project. This model was updated to reflect revised flowrates, recent grading, new home construction and new home additions.

Since the proposed alternatives include a dramatic change to the existing topography, a smaller hydraulic model was used to model the improvements. This new model used the information from the watershed study model as upstream and downstream boundary conditions. This ensures that the new model results match the upstream and downstream flow results in the County watershed model.

II. Summary of Findings

The following section outlines the history of our team's working relationship and provides more detailed information for each of our key team members.

A. Project Limits

The Delmar-Fontana Low-Water Crossing Removal and Stormwater Improvement Project is located in Prairie Village, Kansas. The project is bounded by 83rd Street to the north, Mission Road to the east, Roe Avenue to the west and 84th Street to the south.

The project impact limits are isolated to the project location. Specifically, the project and its impacts begin just downstream of Roe Avenue and extend to the open channel approximately 440 feet east of Somerset Drive. The project is contained in a narrow corridor between these two points.

While the flow through the project area is subcritical, the Froude numbers approach 1. As a result, the impact to energy grade line is limited to a few hundred feet upstream. At the downstream end of the project, the channel flattens and the Froude number drops. This results in the downstream flow controlling the outlet of the project and any downstream effects are eliminated. The upstream and downstream points are all located in Prairie Village. Overland Park is located upstream at Nall Avenue, well beyond the impact area. Leawood is located well downstream east of Mission Road at 83rd Street.

B. Hydrology and Hydraulics

This section outlines the hydrology and hydraulics for the proposed improvements.

1. Hydrology

Larkin Lamp Rynearson in 2015 updated the hydrology for the watershed to more accurately reflect the runoff situation at the project location. The revised hydrology included a more detailed delineation of the watershed to better apportion runoff flowrates at proper locations in the watershed. The revised hydrology also corrected the parameters of the junction of the Dykes Branch channel and the tributary from the north that enters the channel between Delmar Lane and Fontana Street. This study used the hydrology models from the Northeast Johnson County Watershed Study. In addition, this study evaluated alternatives to provide flood risk mitigation for the project area. The drainage area map from this unpublished report is shown in Figure 10.

The flowrates used for the hydraulic model are illustrated in Table 3. Figure 11 shows the locations of these flowrate in relation to the Dykes Branch channel.

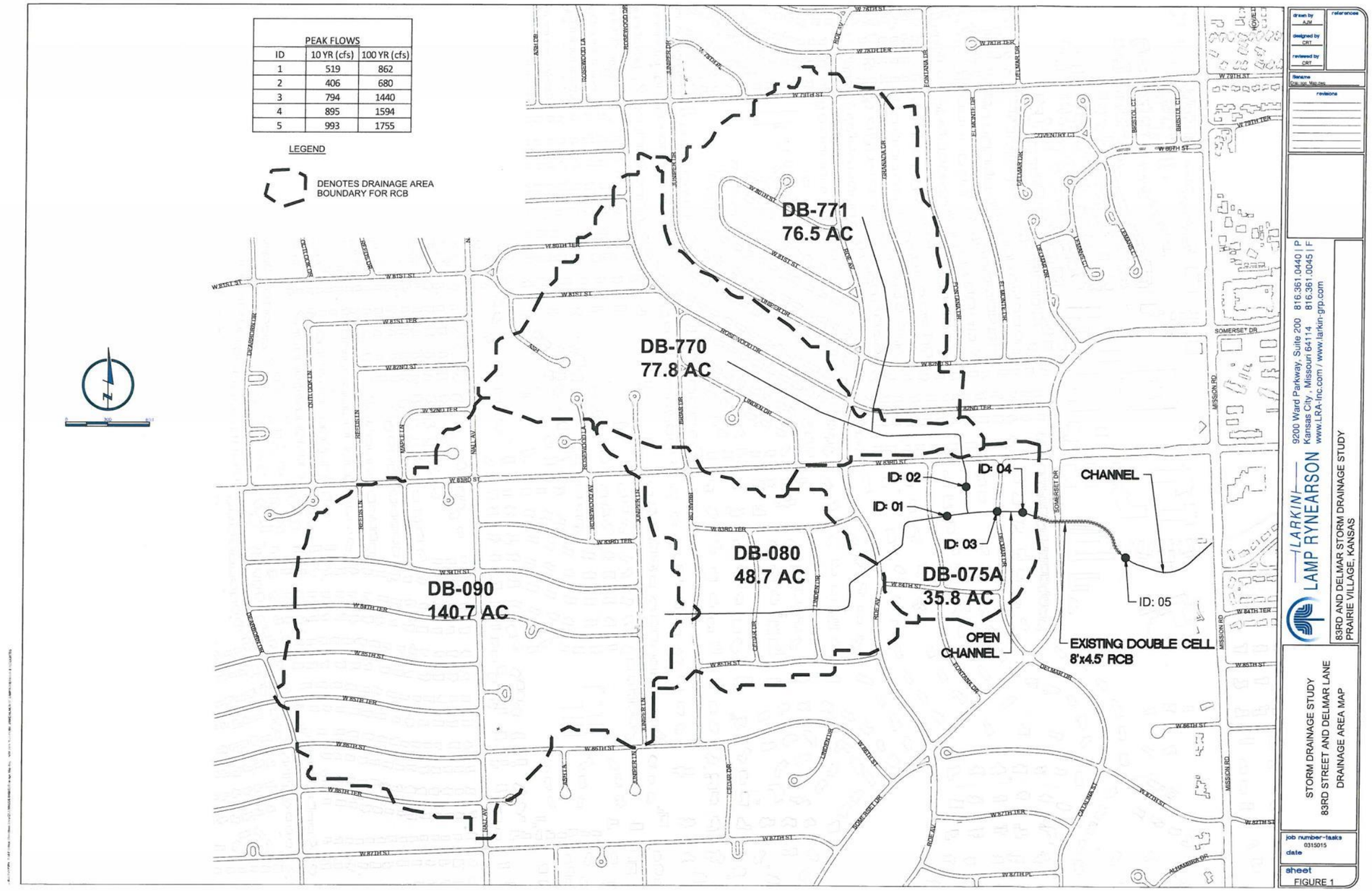

Figure 10 Drainage Area Map

Table 3 Project Flowrates

Location ID	10-yr Flowrate (cfs)	100-yr Flowrate (cfs)
1	519	862
2	406	680
3	794	1440
4	895	1594
5	993	1755

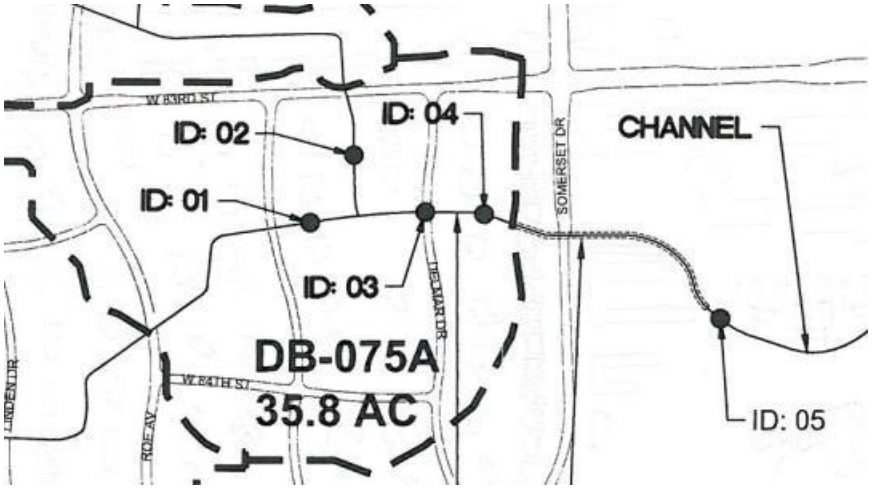

Figure 11 Flow Locations (Adapted from Larkin Lamp Rynearson, 2015)

2. Hydraulics

The hydraulics for this project were modeled using the U.S. Army Corps of Engineers' Hydrologic Engineering Center River Analysis System (HEC-RAS) software.

The existing flooding conditions were established from the HEC-RAS model developed by Larkin Lamp Rynearson in 2015. This 2015 model was created using the model from the Northeast Johnson County Watershed Study. The flowrates were updated to the revised flowrates discussed in the previous section. The cross-sections were updated to reflect recent grading changes, new homes and additions to homes.

In order to make the modeling runs simpler and easier to manipulate, a new HEC-RAS model was developed to model the proposed flood mitigation improvements. The new HEC-RAS modeled used the downstream 100-year flood elevation as a downstream boundary condition. This ensured that the new model accurately predicted flood elevations upstream through the project reach. Since the flows through the project reach are subcritical, no upstream boundary condition other than normal depth was selected.

The results of the hydraulic analysis show that 7 homes have low-opening elevations below the water surface elevation of the 100-year flood event. The home address and associated elevations are shown in Table 4.

Table 4 Comparison of Low-Opening Elevations to the 100-Year Water Surface Elevations

Address	Low Opening/Floor Elevation	100-Yr Water Surface Elevation
8316 Delmar Lane	950.99	952.55
8317 Delmar Lane	949.05	952.50
8333 Delmar Lane	948.65	952.50
8340 Somerset Drive	951.25	951.93
8348 Somerset Drive	949.99	951.93
8356 Somerset Drive	950.42	951.93
8400 Somerset Drive	851.23	951.93

C. Field Investigations

The project design team walked the entire project reach to become familiar with the site. In addition, the team met with property owners onsite to discuss the project.

Limited topographic survey was also completed to update existing survey information for the site and to confirm low-opening elevations for the seven flooding homes.

D. Improvement Alternatives

While many alternatives have been developed, and studied over the years for this project, three alternatives were chosen for this study. These include:

- Home buyouts with cul-de-sacs at Delmar Lane and Fontana Street
- Construction of an open channel with culverts at Delmar Lane and Fontana Street and a new culvert under Somerset Drive
- Construction of an open channel with cul-de-sacs at Delmar Lane and Fontana Street and a new culvert under Somerset Drive.

1. Description of Alternative 1

Alternative 1 includes a home buyout of the 7 seven flooding homes and the construction of cul-de-sacs at Delmar Lane and Fontana Street to address the street flooding issue. This alternative is illustrated in Figure 12.

a. Facilities

This alternative leaves that existing conveyance channel in-place without any modifications. The flood risk mitigation for the flooding homes is based on purchasing and removing them from the floodplain.

b. Road/Traffic

In order to eliminate the flood risk for Delmar Lane and Fontana Street, this alternative includes the construction of hammerhead cul-de-sacs on the north and south sides of the channel on both streets.

c. Utilities

No utility relocations would be required for this alternative. The tops of several sanitary sewer manholes will be required to be raised as part of the cul-de-sac construction.

d. Rights-of-Way/Easements

In addition to the land purchase of the flooding homes, additional right-of-way will need to be purchased to accommodate the hammerhead cul-de-sacs.

e. Preliminary Drawings

Preliminary drawings for this alternative are shown in Figure 12.

f. Opinions of Probable Cost

The cost estimate for this alternative is based on the cost of the 7 properties and construction of cul-de-sacs to eliminate road flooding. The cost for Alternative 1 is presented in Table 5.

The costs of the houses were taken from the Johnson County Appraiser's website and then increased by two percent based upon comparable home prices obtained from Reese Nichols for homes that sold in the area within the past year.

Table 5 Alternative 1 Project Cost

Item	Item Description	Unit	Quantity	Unit Cost	Total Cost
1	Clearing, Grubbing & Demolition	LS	1	$37,530.00	$37,530.00
2	Erosion & Sediment Control	LS	1	$10,760.00	$10,760.00
3	Mobilization	LS	1	$43,020.00	$43,020.00
4	Traffic Control	LS	1	$10,760.00	$10,760.00
5	Asphalt Pavement – Full Depth	SY	1920	$70.00	$134,400.00
6	Curb & Gutter	LF	1420	$35.00	$49,700.00
7	Home Buyout	LS	1	$4,059,804.00	$4,059,804.00
8	Demolition	EA	7	$50,000.00	$350,000.00
9	Additional Right-of-Way	SF	5000	$3.40	$17,000.00
10	Site Restoration	SF	473	$7.50	$3,550.00
Subtotal Construction Cost					**$4,716,524.00**
Contingencies (20%)					$943,305.00
Total Construction Cost					**$5,659,829.00**
Engineering & Legal					$131,344.00
Utilities (2%)					$113,197.00
Total Project Cost					**$5,904,370.00**

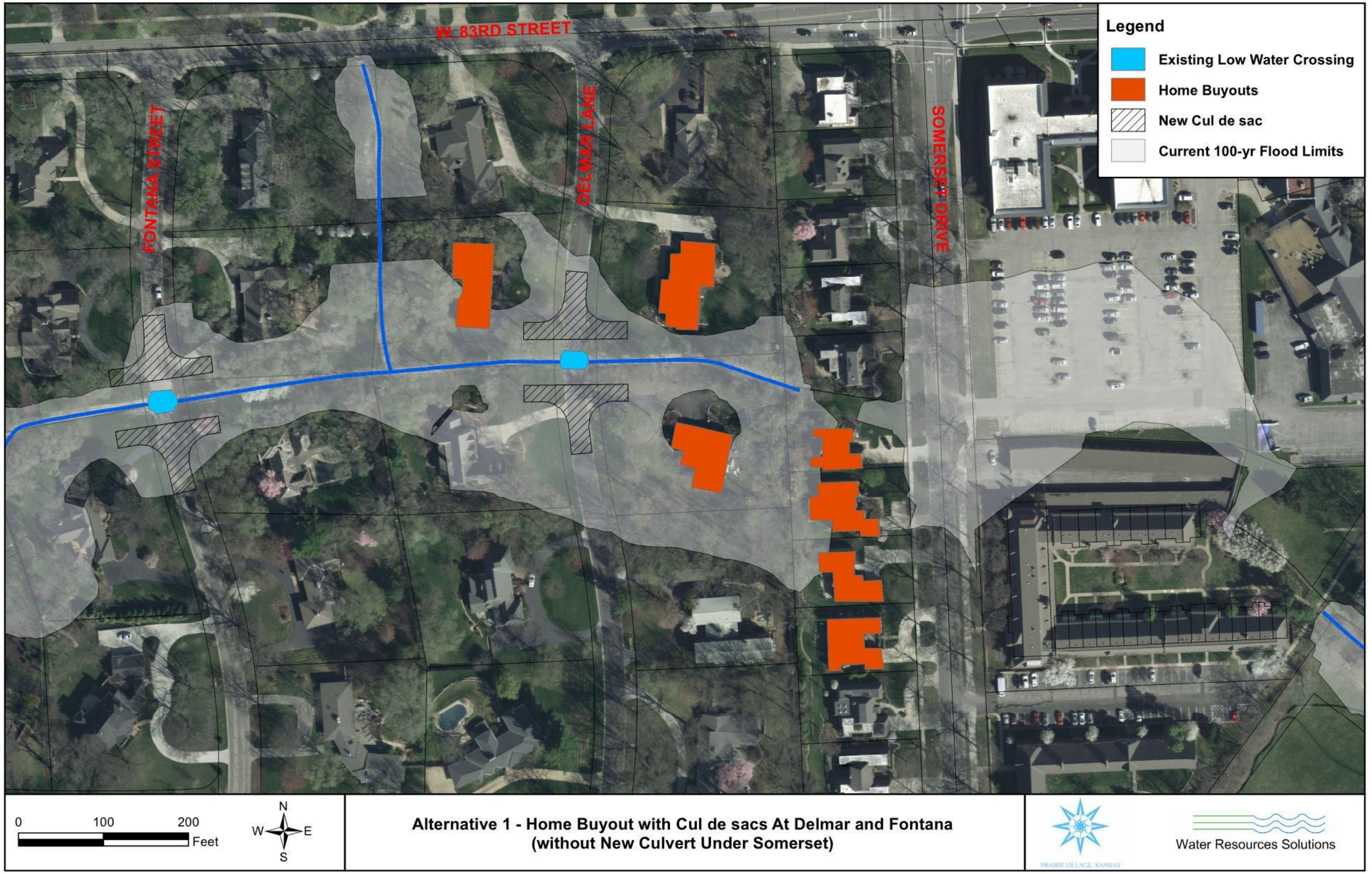

Figure 12 Alternative 1 Preliminary Drawing

g. Relationship to Other City Stormwater Facilities

Since no improvements will be made to any of the stormwater infrastructure, there will be no impact to other stormwater facilities.

h. Effects on Surrounding Cities

This alternative will not have any effect on flood conditions in the City of Overland Park or Leawood since, no changes will be made to the stormwater infrastructure.

i. Conformance with Current Design Standards

This alternative will meet the requirements of City of Prairie Village and Johnson County design standards.

2. Description of Alternative 2

Alternative 2 includes the construction of a new culvert under Somerset Drive, a new channel from Somerset Drive to upstream of Fontana Street and cul-de-sacs at Fontana Street and Delmar Lane to address the road flooding concerns.

a. Facilities

Alternative 2 includes the construction of a new triple 9'x7' reinforced concrete box (RCB) culvert under Somerset Drive to the open channel behind the Somerset Apartments. This is the same location as the outfall for the exiting culvert under Somerset Drive. The proposed RCB will have a flatter grade resulting in a deeper inlet at the opening just upstream of Somerset Drive.

The existing culvert under Somerset Drive will be bulkheaded on the upstream end and left in-place. The culvert does not lie within a permanent drainage easement and provides stormwater runoff conveyance for several drains located on the Somerset Apartments property. The downstream end of the culvert will remain open and will be connected to the outfall of the proposed triple cell RCB.

The channel that runs from Roe to Somerset and crosses Delmar Lane and Fontana Street will be widened and deepened to convey the 1% annual occurrence flood past the flooding residences. A main channel approximately two feet deep and seven feet wide will be lined with concrete or stone walls and will have a rock bottom. A flood bench approximately 9.5 feet wide on each side of the main channel will be constructed to convey the flood flows. Two-foot high walls will be constructed at the edge of the flood bench. A 3:1 slope will be graded from this wall to match existing grade. The resulting channel will range from 35 to 50 feet wide. Figure 13 and Figure 14 illustrate typical cross-sections for the channel.

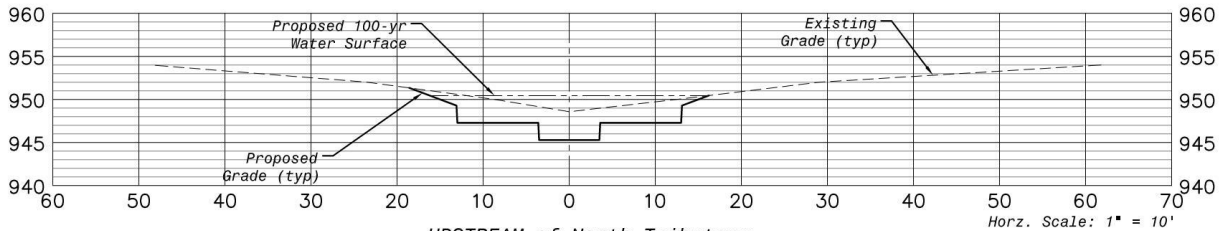

Figure 13 Typical Cross-Section with No Wall

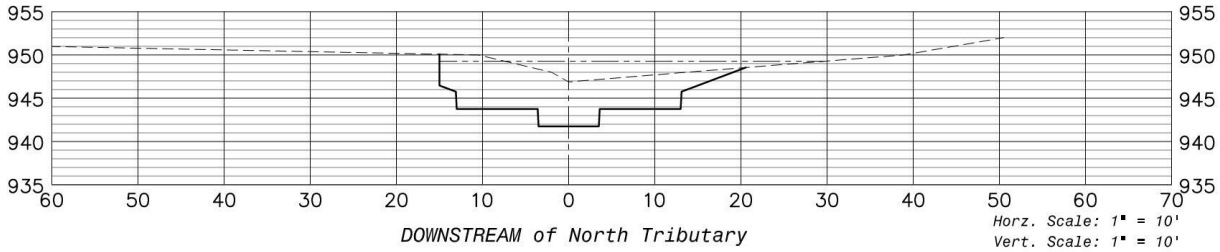

Figure 14 Typical Cross-Section with Wall

b. Road/Traffic

As with Alternative 1, this alternative includes the construction of hammerhead cul-de-sacs on the north and south sides of the channel on both streets to eliminate the flood risk for Delmar Lane and Fontana Street.

c. Utilities

Approximately 1,750 linear feet of sanitary sewer relocation will be required for this project. These sanitary sewers parallel the channel upstream of Somerset Drive.

As the channel and RCB system crosses the Somerset Drive right-of-way, the project will impact water, telephone, cable, gas, electric and sanitary utilities. It is anticipated that relocations of these utilities will be required.

d. Rights-of-Way/Easements

It is anticipated that additional right-of-way and easements will need to be purchased to accommodate the hammerhead cul-de-sacs and the expansion of the new channel.

e. Preliminary Drawings

Preliminary drawings for this alternative are shown in Figure 15.

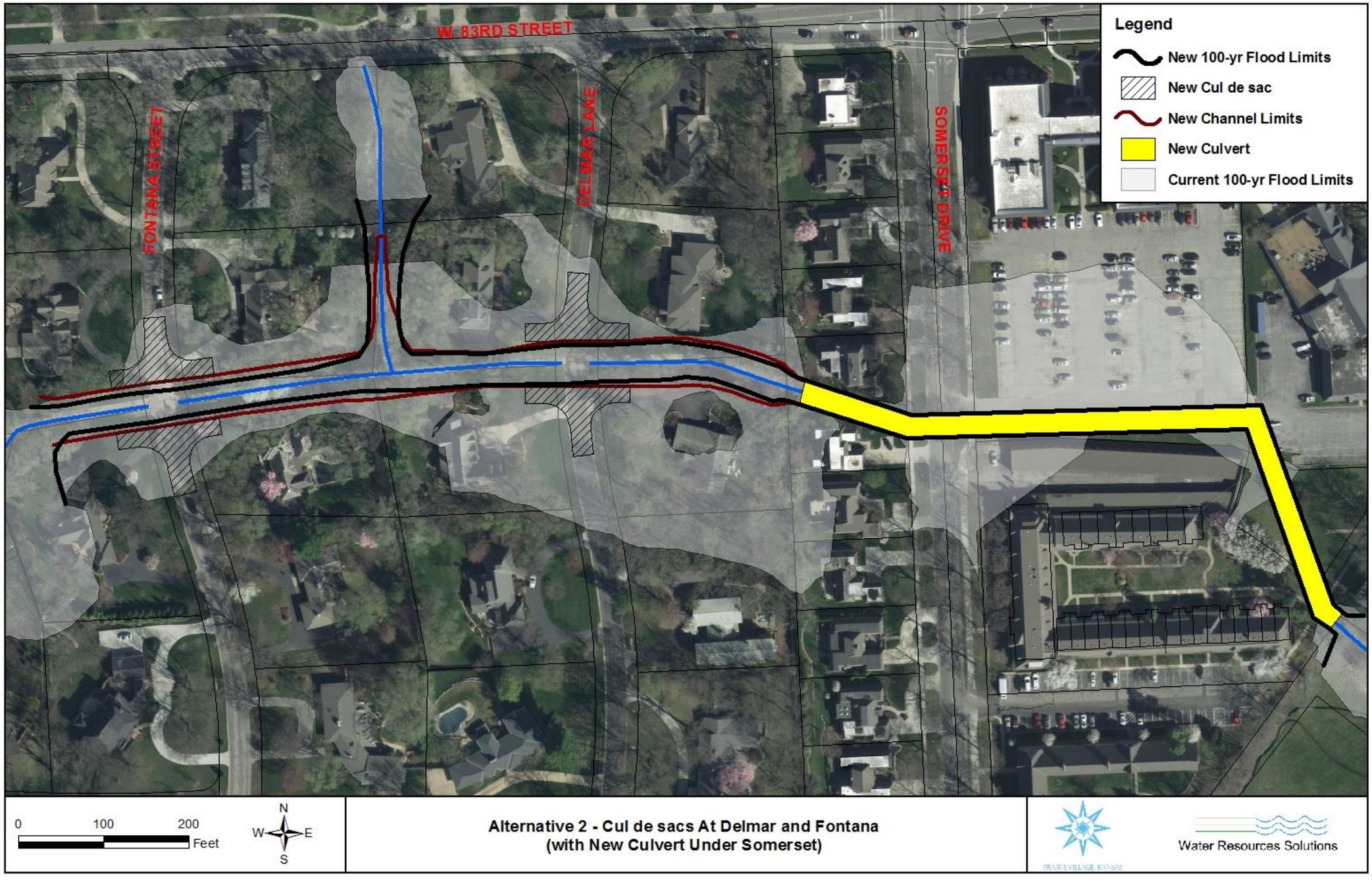

Figure 15 Alternative 2 Preliminary Drawing

f. Opinions of Probable Cost

The cost estimate for this alternative is based on the cost of the channel, Somerset RCB and cul-de-sacs to eliminate road flooding. The cost for Alternative 2 is presented in Table 6.

Table 6 Alternative 2 Project Cost

Ite	Item Description	Unit	Quantity	Unit Cost	Total Cost
1	Clearing, Grubbing & Demolition	LS	1	$475,820.00	$475,820.00
2	Erosion & Sediment Control	LS	1	$47,890.00	$47,890.00
3	Mobilization	LS	1	$191,530.00	$191,530.00
4	Traffic Control	LS	1	$47,890.00	$47,890.00
5	Asphalt Pavement – Full Depth	SY	1920	$70.00	$134,400.00
6	Curb & Gutter	LF	1420	$35.00	$49,700.00
7	Somerset Culvert	LF	775	$1,600.00	$1,240,000.00
8	Channel	LF	875	$600.00	$525,000.00
9	Sanitary Sewer Relocation	LF	1720	$250.00	$430,000.00
10	Additional Right-of-Way	SF	5000	$3.40	$17,000.00
11	Site Restoration	LS	1	$15,000.00	$15,000.00
Subtotal Construction Cost					**$3,174,230.00**
Contingencies (20%)					$634,850.00
Total Construction Cost					**$3,809,080.00**
Engineering & Legal					$386,850.00
Utilities (2%)					$76,180.00
Total Project Cost					**$4,272,110.00**

g. Relationship to Other City Stormwater Facilities

Since no improvements will be made to any of the stormwater infrastructure, there will be no impact to other stormwater facilities.

h. Effects on Surrounding Cities

The project impact limits are isolated to the project location. While the flow through the project area is subcritical, the Froude numbers approach 1. As a result, the impact to energy grade line is limited to a few hundred feet upstream. At the downstream end of the project, the channel flattens and the Froude number drops. This results in the downstream flow controlling the outlet of the project and eliminates any downstream effects. The upstream and downstream points are all located in Prairie Village. Overland Park is located well beyond the impact are upstream at Nall Avenue and Leawood is located downstream at Mission Road.

i. Conformance with Current Design Standards

This alternative will meet the requirements of City of Prairie Village and Johnson County design standards.

3. Description of Alternative 3

As with Alternative 2, Alternative 3 includes the construction of a new culvert under Somerset Drive and a new channel from Somerset Drive to upstream of Fontana Street. Instead of cul-de-sacs at Fontana Street and Delmar Lane, culverts will be constructed to address the road flooding concerns.

a. Facilities

Alternative 3 includes the construction of a new triple 9'x7' reinforced concrete box (RCB) culvert under Somerset Drive to the open channel behind the Somerset Apartments. This is the same location as the outfall for the exiting culvert under Somerset Drive. The proposed RCB will have a flatter grade resulting in a deeper inlet at the opening just upstream of Somerset Drive.

As in Alternative 2, the existing culvert under Somerset Drive will be bulkheaded on the upstream end and left in-place. The downstream end of the culvert will remain open and will be connected to the outfall of the proposed triple cell RCB.

The channel that runs from Roe to Somerset and crosses Delmar Lane and Fontana Street will be widened and deepened to convey the 1% annual occurrence flood past the flooding residences. A main channel approximately two feet deep and seven feet wide will be lined with concrete or stone walls and will have a rock bottom. A flood bench approximately 9.5 feet wide on each side of the main channel will be constructed to convey the flood flows. Two-foot high walls will be constructed at the edge of the flood bench. A 3:1 slope will be graded from this wall to match existing grade. The resulting channel will range from 35 to 50 feet wide. Figure 17 and Figure 18 illustrate typical cross-sections for the channel.

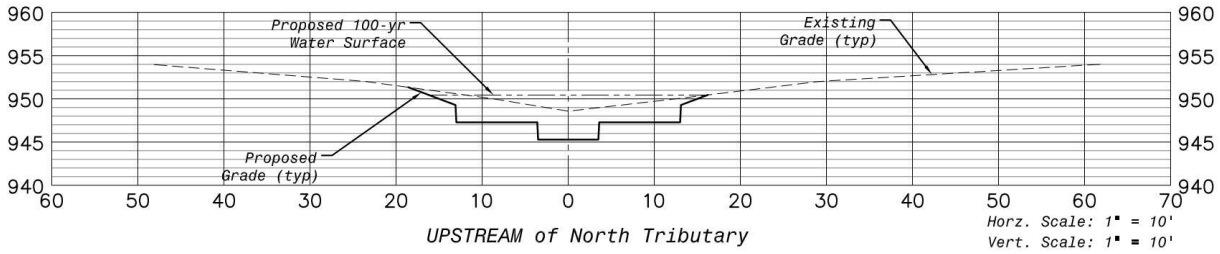

Figure 17 Typical Cross-Section with No Wall

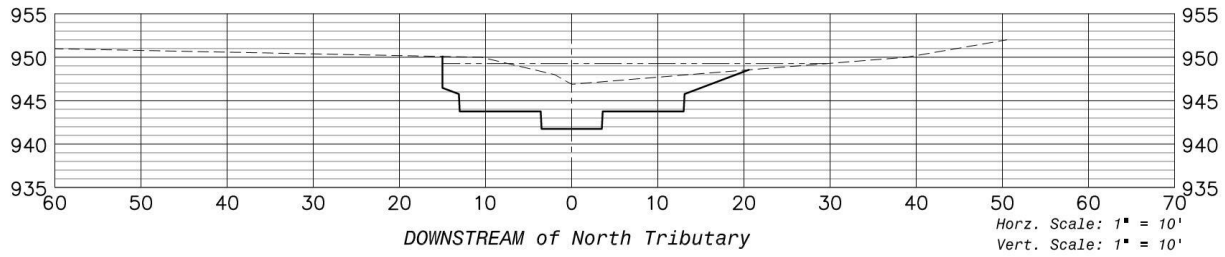

Figure 18 Typical Cross-Section with Wall

b. Road/Traffic

Instead of the construction of cul-de-sacs, this alternative includes the construction of culverts on Delmar Lane and Fontana Street at the low-water crossing locations.

The culvert at Delmar Lane will be comprised of one 7'x7' RCB and two 8'x5' RCBs. The culvert at Fontana Street will be comprised of one 7'x6' RCB and two 8'x4' RCBs. Figure 19 and Figure 20 illustrate cross-sections for the proposed culverts at Delmar Lane and Fontana Street, respectively.

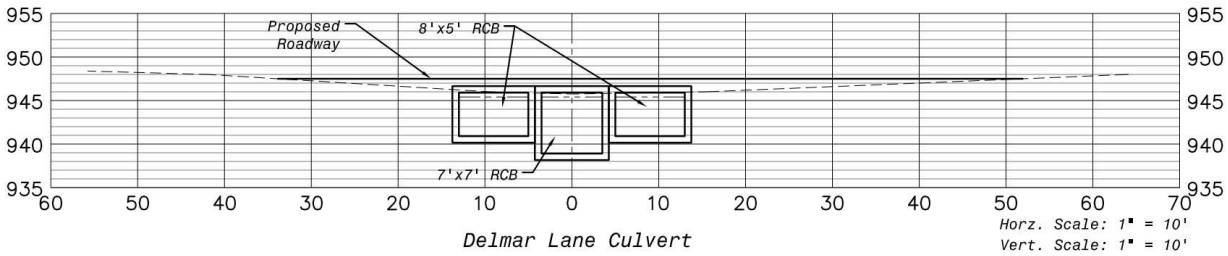

Figure 19 Delmar Lane Culvert Cross-Section

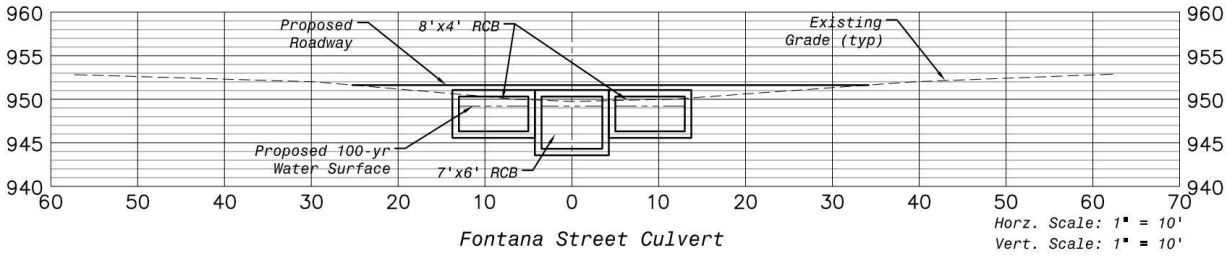

Figure 20 Fontana Street Culvert Cross-Section

c. Utilities

Approximately 1,750 linear feet of sanitary sewer relocation will be required for this project. These sanitary sewers parallel the channel upstream of Somerset Drive.

As the channel and RCB system crosses the Somerset Drive right-of-way, the project will impact water, telephone, cable, gas, electric and sanitary utilities. It is anticipated that relocations of these utilities will be required.

d. Rights-of-Way/Easements

It is anticipated that easements will need to be obtained to accommodate the expansion of the new channel.

e. Preliminary Drawings

The preliminary layout drawing for this alternative is shown in Figure 22.

f. Opinions of Probable Cost

The cost estimate for this alternative is based on the cost of the channel, Somerset RCB and culverts to eliminate road flooding. The cost for Alternative 3 is presented in Table 7.

Table 7 Alternative 3 Project Cost

Ite	Item Description	Unit	Quantity	Unit Cost	Total Cost
1	Clearing, Grubbing & Demolition	LS	1	$499,000.00	$499,000.00
2	Erosion & Sediment Control	LS	1	$50,200.00	$50,200.00
3	Mobilization	LS	1	$200,800.00	$200,800.00
4	Traffic Control	LS	1	$50,200.00	$50,200.00
5	Delmar Culvert	EA	1	$150,000.00	$150,000.00
6	Fontana Culvert	EA	1	$150,000.00	$150,000.00
7	Somerset Culvert	LF	775	$1,600.00	$1,240,000.00
8	Channel	LF	875	$600.00	$525,000.00
9	Sanitary Sewer Relocation	LF	1720	$250.00	$430,000.00
10	Site Restoration	LS	1	$15,000.00	$15,000.00
Subtotal Construction Cost					**$3,310,200.00**
Contingencies (20%)					$662,040.00
Total Construction Cost					**$3,972,240.00**
Engineering & Legal					$414,040.00
Utilities (2%)					$79,440.00
Total Project Cost					**$4,465,720.00**

g. Relationship to Other City Stormwater Facilities

Since no improvements will be made to any of the stormwater infrastructure, there will be no impact to other stormwater facilities.

h. Effects on Surrounding Cities

As with Alternative 2, the upstream and downstream impacts are isolated to Prairie Village.

i. Conformance with Current Design Standards

This alternative will meet the requirements of City of Prairie Village and Johnson County design standards.

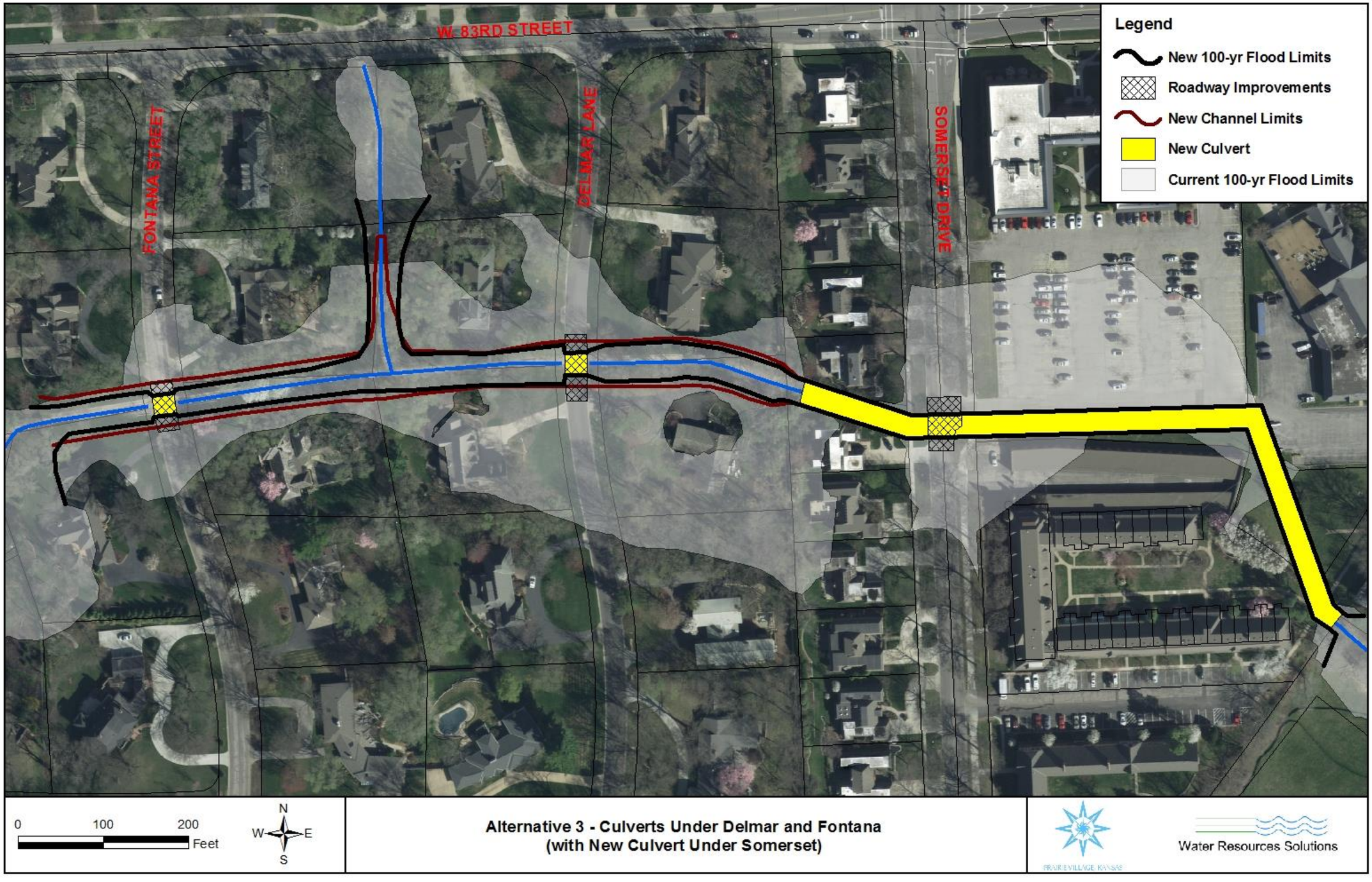

Figure 22 Alternative 3 Preliminary Layout Drawing

III. Recommendations

This section provides recommendations for the proposed project.

A. Evaluation of Alternatives

All three alternatives provide a complete solution for the flooding issues associated with this project. The following section discusses the evaluation of each alternative.

1. Alternative 1

Alternative 1 is comprised of home buyouts and the construction of cul-de-sacs on Delmar Lane and Fontana Street. This alternative has a large impact on the neighborhood with the purchase and removal of 7 homes that flood.

The alternative also includes the construction of hammerhead cul-de-sacs in the neighborhood that impact the private property of 8 properties in the neighborhood. The cul-de-sacs do not fit well within the neighborhood and will disrupt driveways of the adjacent properties. During the public meetings for this project, the adjacent property owners expressed the most displeasure at the idea of cul-de-sacs in the neighborhood.

The construction cost for this alternative is estimated to be $5,659,830.00. The overall project cost is estimated to be $5,904,370.00.

2. Alternative 2

Alternative 2 is comprised of the construction of a new culvert under Somerset Drive, the construction of a new channel from Somerset Drive to upstream of Fontana Street, and the construction of hammerhead cul-de-sacs at the Delmar Lane and Fontana Street low-water crossings.

During the public meetings for the project, the adjacent property owners were dissatisfied with this alternative due to the cul-de-sacs. They consider the cul-de-sacs to be unfitting in the neighborhood.

The construction cost for this alternative is estimated to be $3,809,080.00. The overall project cost is estimated to be $4,272,110.00. This is the least cost alternative.

3. Alternative 3

Alternative 3 is comprised of the construction of a new culvert under Somerset Drive, the construction of a new channel from Somerset Drive to upstream of Fontana Street, and the construction of culverts at the Delmar Lane and Fontana Street low-water crossings.

During the public meetings for the project, the adjacent property owners expressed concern that the culverts would remove the dips at the low-water crossings which as vehicular speed controls. Their concerns also included apprehensions about the aesthetics of the culverts.

The construction cost for this alternative is estimated to be $3,972,240.00. The overall project cost is estimated to be $4,465,720.00. This alternative has an estimated construction cost of approximately $163,000 more than Alternative 2.

B. Recommended Alternative

The recommended alternative for this project is Alternative 3, which is comprised of the construction of a new culvert under Somerset Drive, the construction of a new channel from Somerset Drive to upstream of Fontana Street, and the construction of culverts at the Delmar Lane and Fontana Street low-water crossings. The construction cost for this alternative is estimated to be $3,972,240.00. The overall project cost is estimated to be $4,465,720.00.

While this alternative's construction cost is approximately $163,000 more than Alternative 2, this alternative meets with greater approval of the adjacent property owners. The culverts at Delmar Lane and Fontana Street can be constructed to fit with the character of the neighborhood while providing capacity to convey the 1% annual occurrence flood under the roadway.

All other aspects of the project are identical to Alternative 2.

IV. Acceptance by Cities within Upstream and Downstream Limits of Project

This project will not affect either the City of Overland Park upstream at Nall Avenue or the City of Leawood at Mission Road.

The City of Prairie Village has been in contact with the two cities. They have been aware of this project since at least 2007 and have expressed no concerns regarding the project.

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