Solomon River Tributary Watershed Stormwater Technical Assistance

October 26, 2020

Kansas Department of Agriculture
Division of Water Resources

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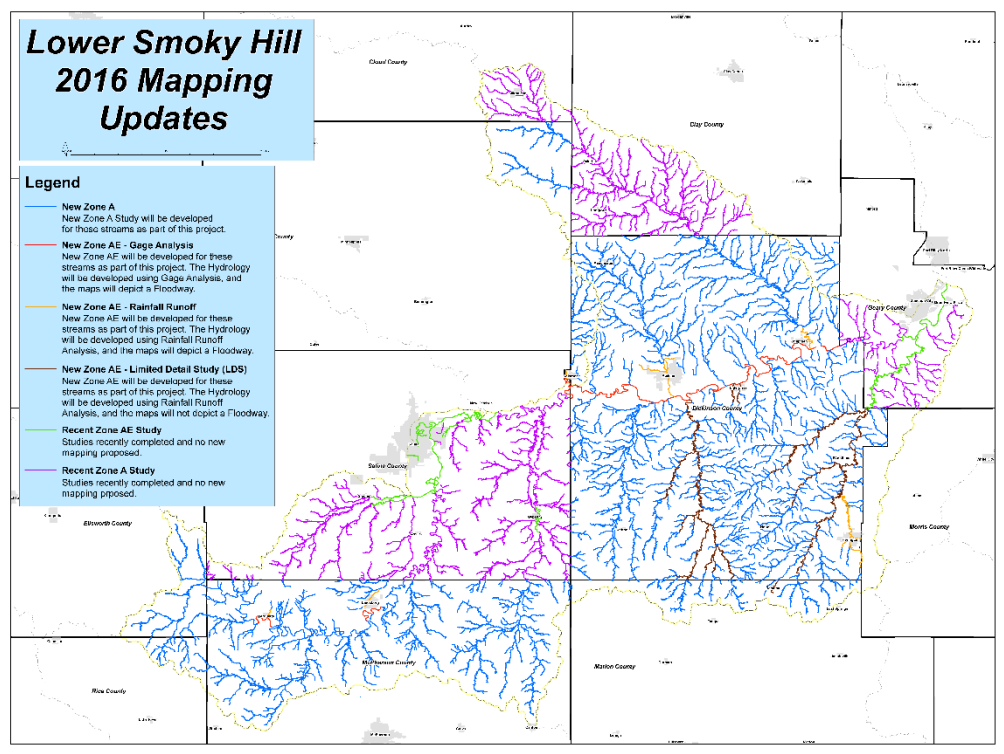
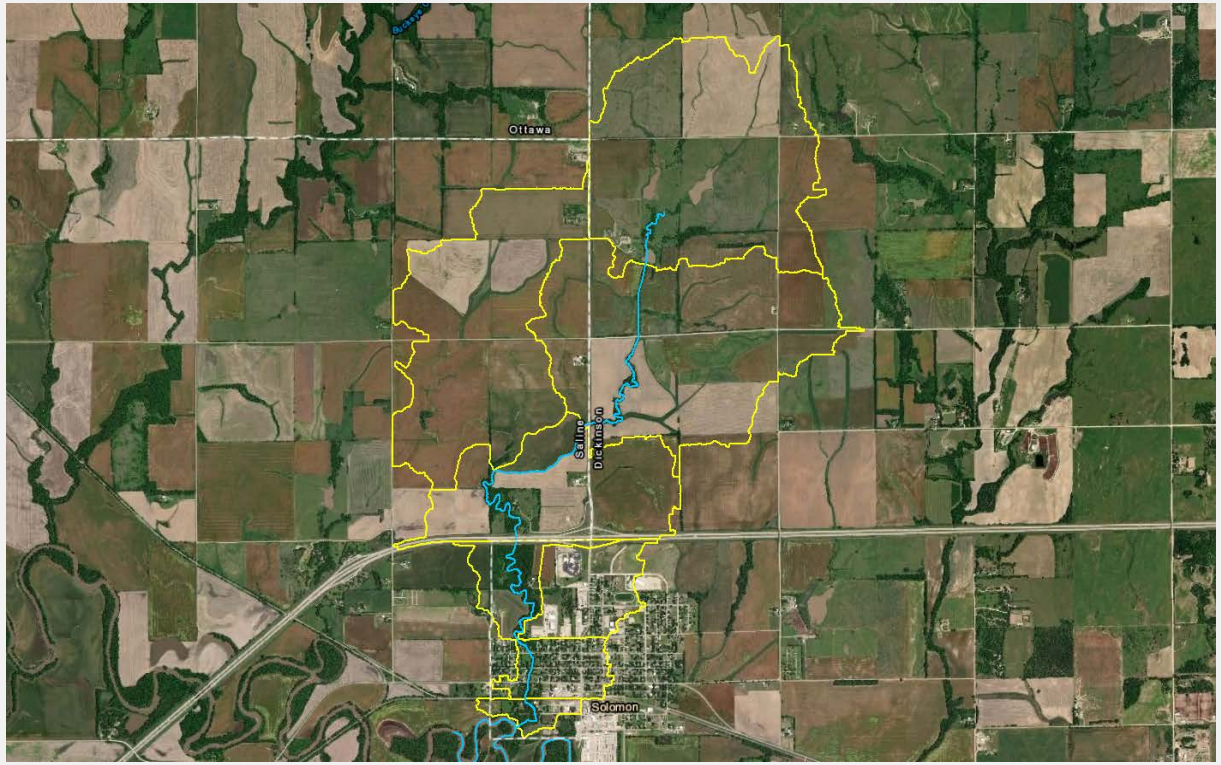
History

- FY2016 FEMA-funded Floodplain Mapping Project for the Lower Smoky Hill Watershed (Under RiskMAP Program).
  - Included new Zone AE mapping for Solomon, KS
    - Solomon River Tributary
  - Detailed analyses was performed using rainfall-runoff HEC-HMS methods for hydrology coupled with 1D/2D HEC-RAS methods for hydraulics.
  - Analyses were verified using historical flood inundation information.



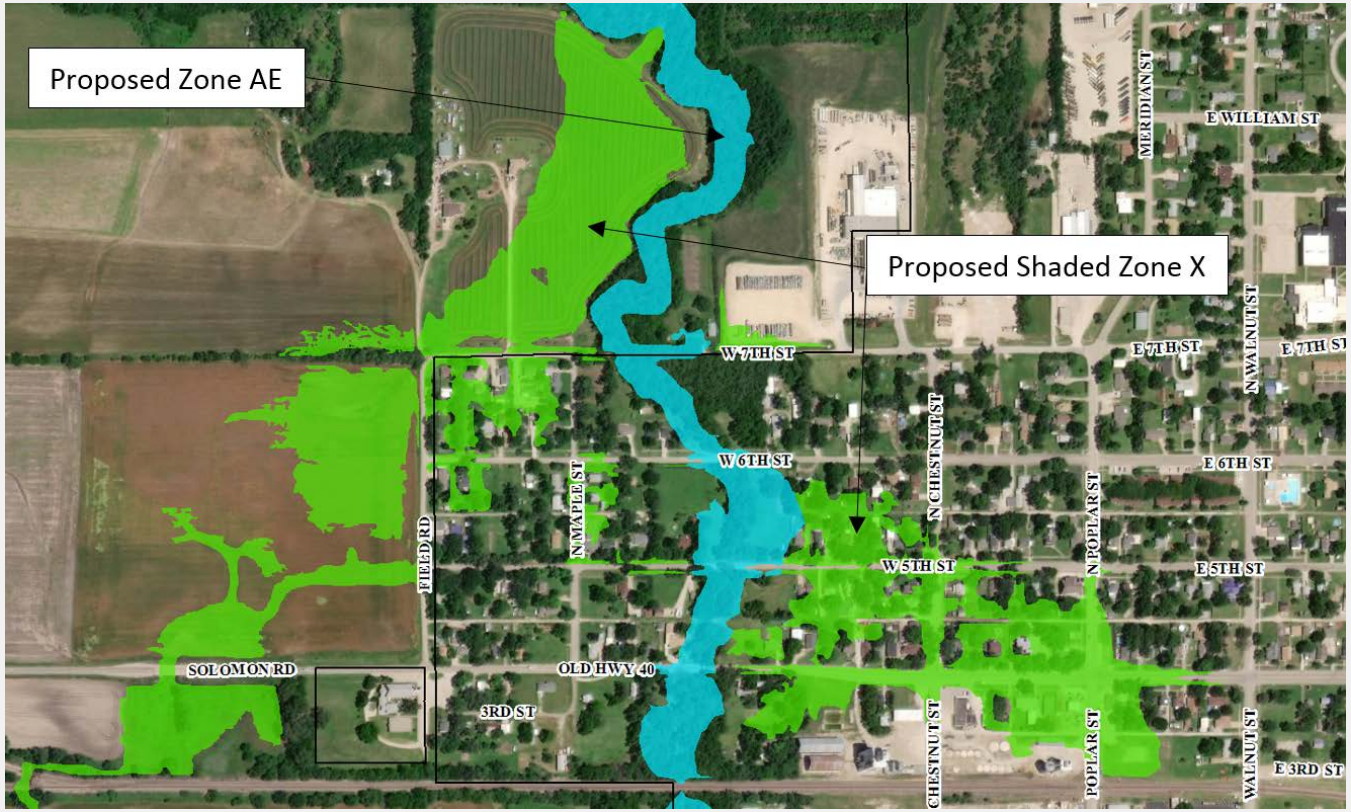
Technical Assistance through RiskMAP Program

- Technical Assistance projects have been completed as another "type" of project funded through RiskMAP.
- This project was selected for funding in FY2018 due to identified needs from the Lower Smoky Hill Watershed project.



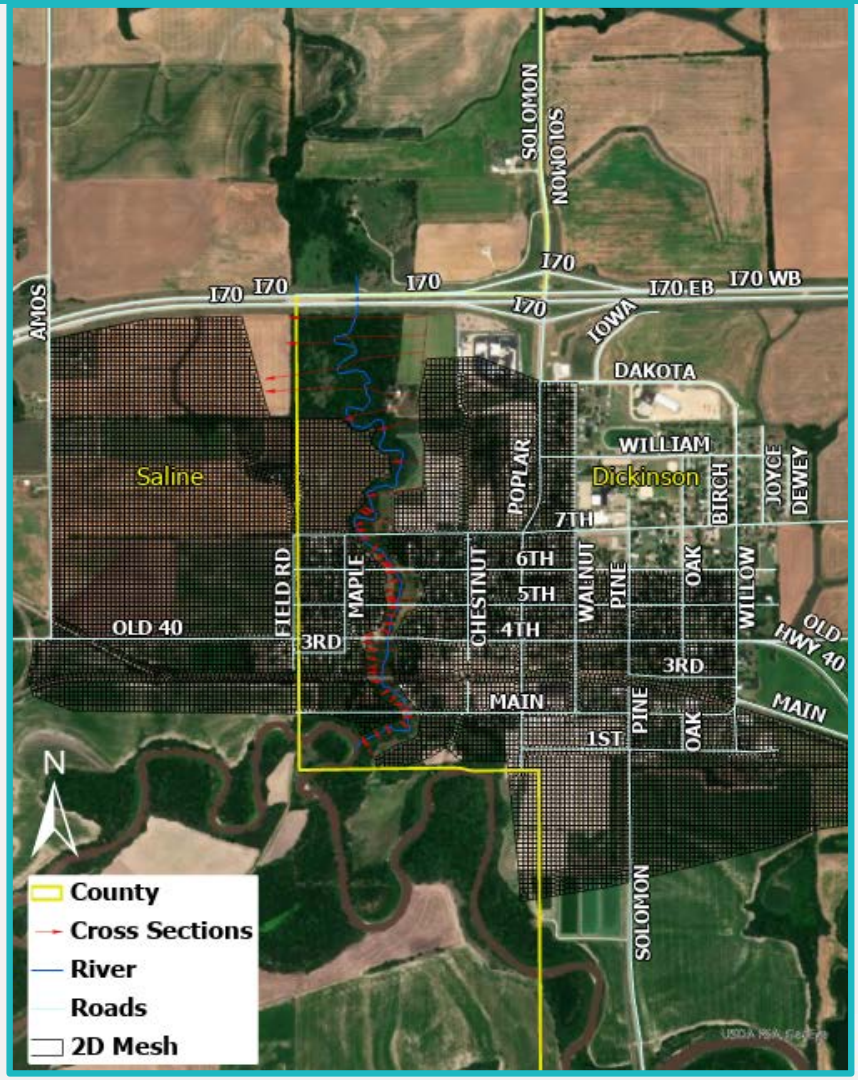
Purpose of Project

- Address flooding issues from Solomon River Tributary
  - Reduce current flood risk
  - Increase Resilience



Existing Conditions Analysis

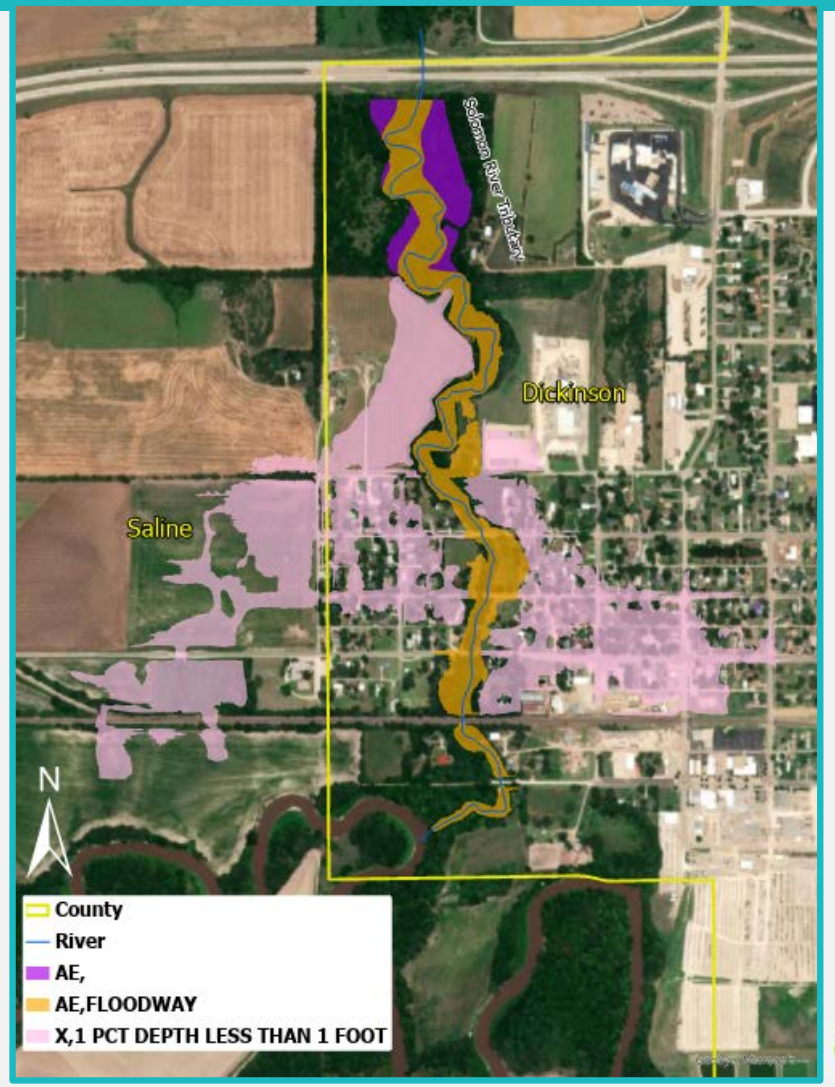
- Unsteady-State 1-D and 2-D combined HEC-RAS Model.
- 1.6 miles of Solomon River Tributary from its confluence with Solomon River to Interstate-70 modeled.
- Complex overland flow between channel and overbanks.
- Average depth analysis performed for overflow areas within the 2-D areas.



Existing Conditions Analysis

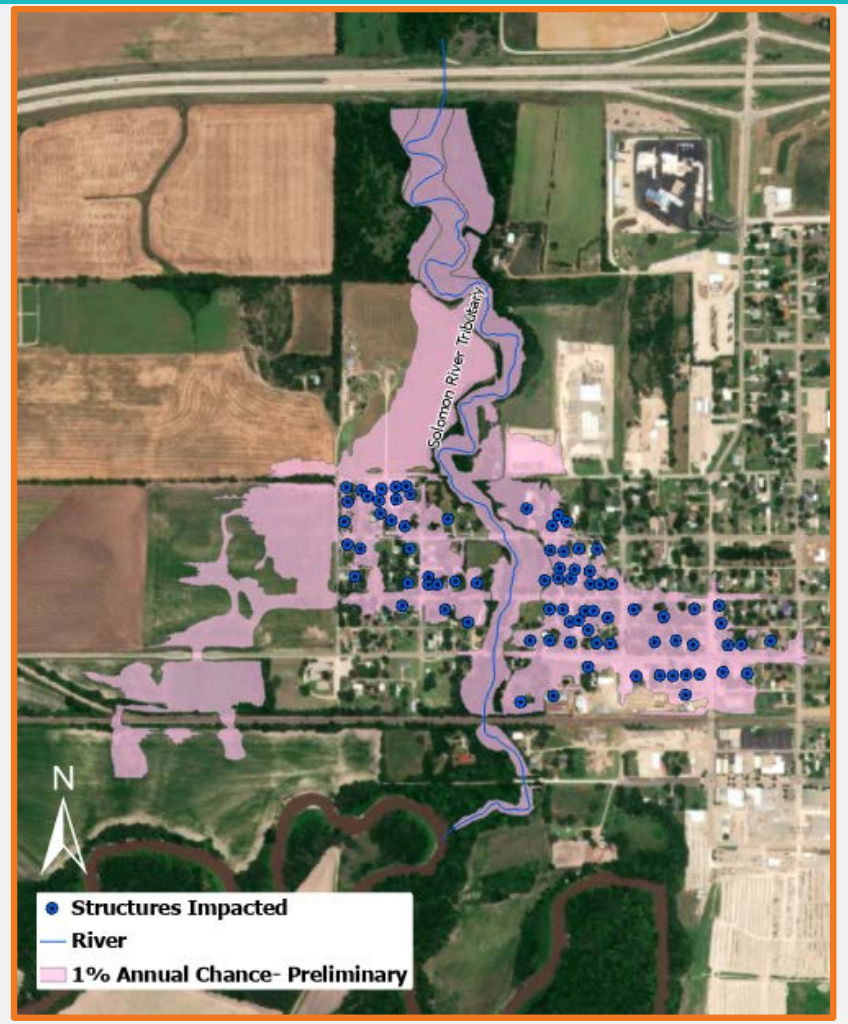
- 0.3 feet average depth in west overbank.
- 0.5 feet average depth in east overbank.
- Discussions with KDA and FEMA to designate these areas as shaded Zone X-1% depth less than 1-foot floodplains on preliminary maps.
- Main channel conveyance remained as AE.

The figure on the right does not show backwater effects from Solomon River.



Existing Flooding Concerns

- Primary channel does not have 1% annual chance design storm capacity.
- Approximately 80 structures impacted.



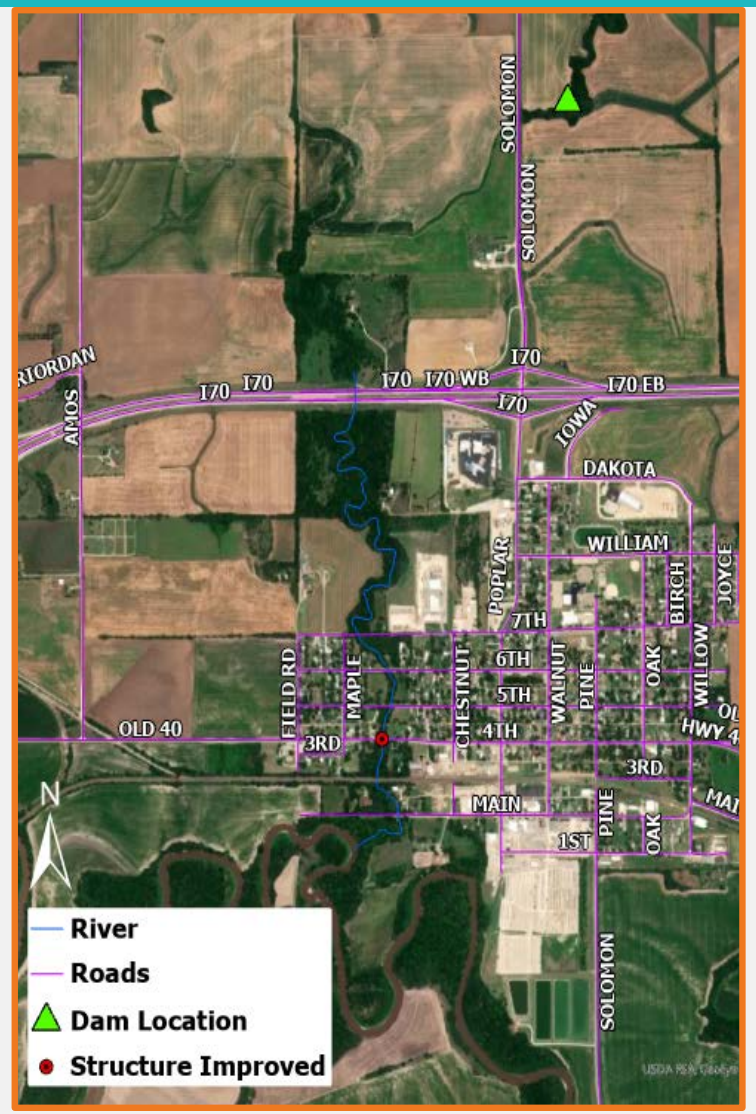
Conceptual Mitigation Alternatives Analyses

- Scenario 1- Inline detention- Upstream of I-70
- Scenario 2- Bypass channel- Upstream of 7th Street
- Scenario 3- Bypass channel- Upstream of Railroad
- Scenario 4- Channel Improvements

Conceptual Mitigation Alternatives Analyses

- Scenario 1- Dry Detention- Upstream of Solomon Road
  - Conceptual dam upstream Solomon Road using HEC-HMS
  - 4th Street
    - 20-feet bridge replaced with additional 3-10X10 RCB

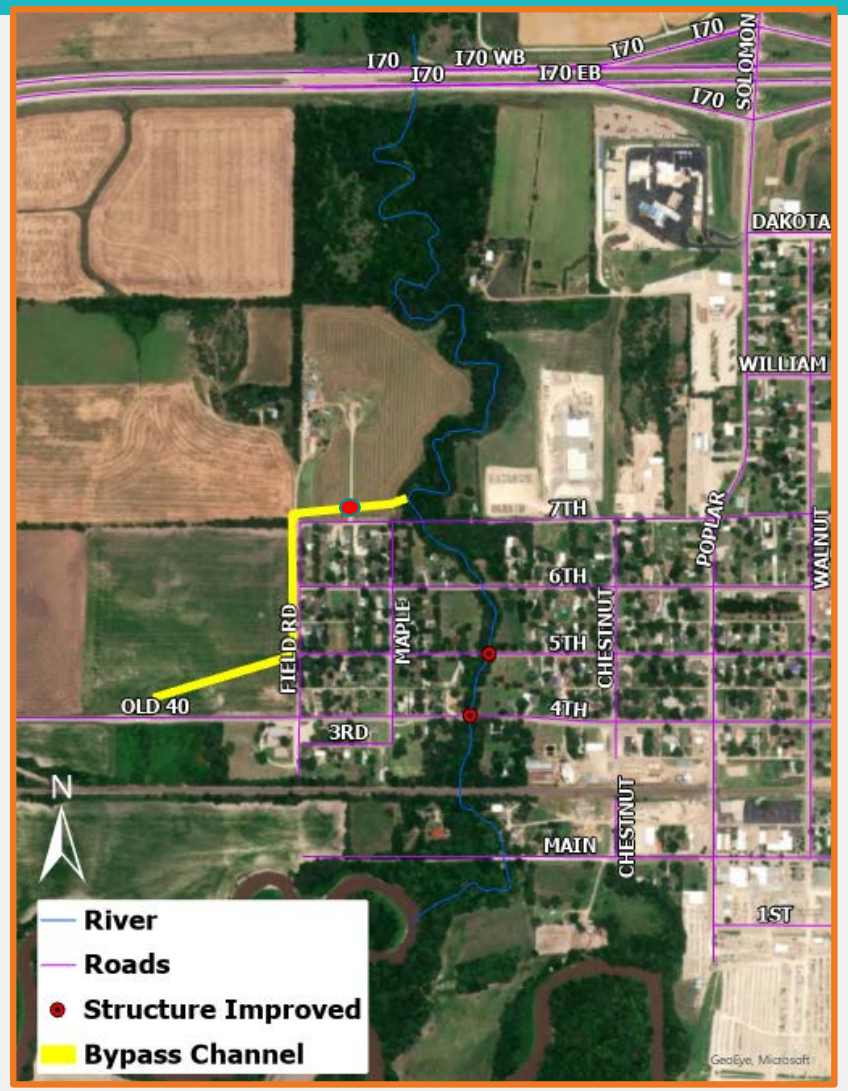
All 80 impacted structures removed from the floodplain in this scenario.



Conceptual Mitigation Alternatives Analyses

- Scenario 2- Bypass Channel- Upstream of 7th Street
  - Bypass channel- 4:1 slope
  - N. Field Road
    - New structure-Added- 3-8X8 RCB
  - 4th Street
    - 20-feet bridge replaced with additional 3-10X10 RCB
  - 5th Street
    - Added 1-10X10 RCB

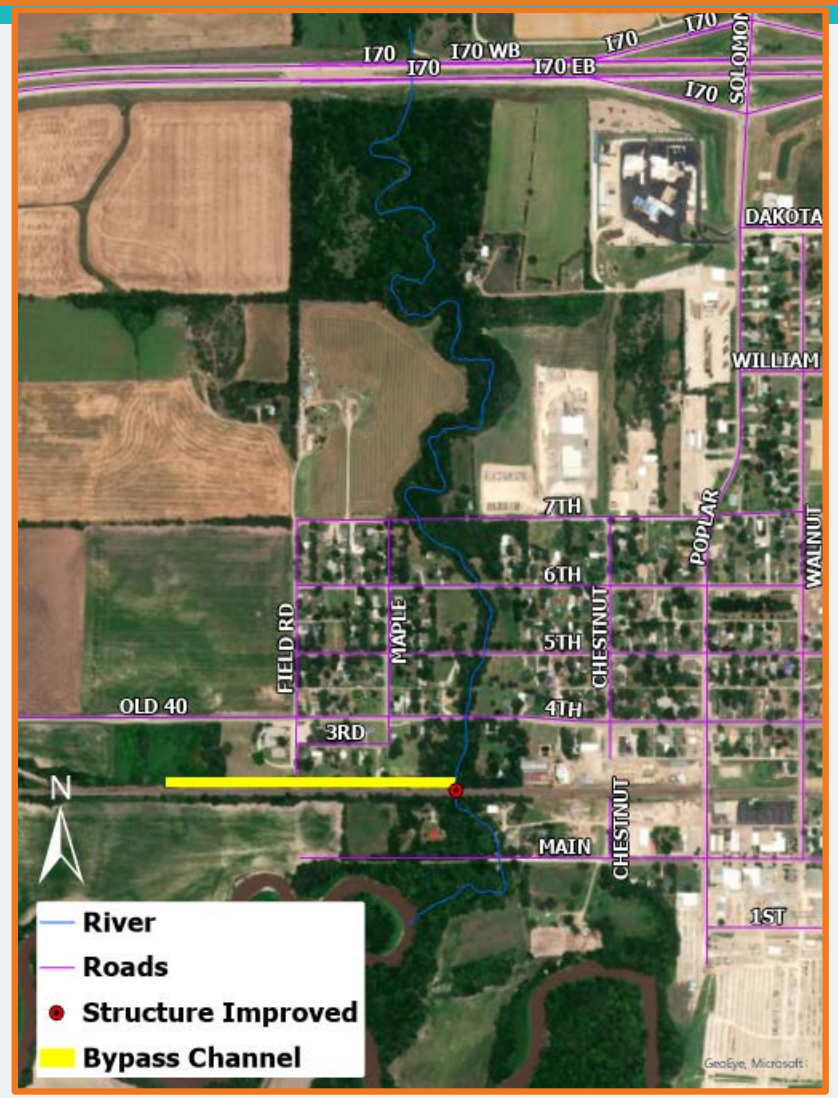
All 80 impacted structures removed from the floodplain in this scenario.



Conceptual Mitigation Alternatives Analyses

- Scenario 3- Bypass Channel- Upstream of Railroad
  - Bypass channel- 4:1 slope
  - Railroad
    - 3 6-feet CMP added to existing 10X15 box culvert

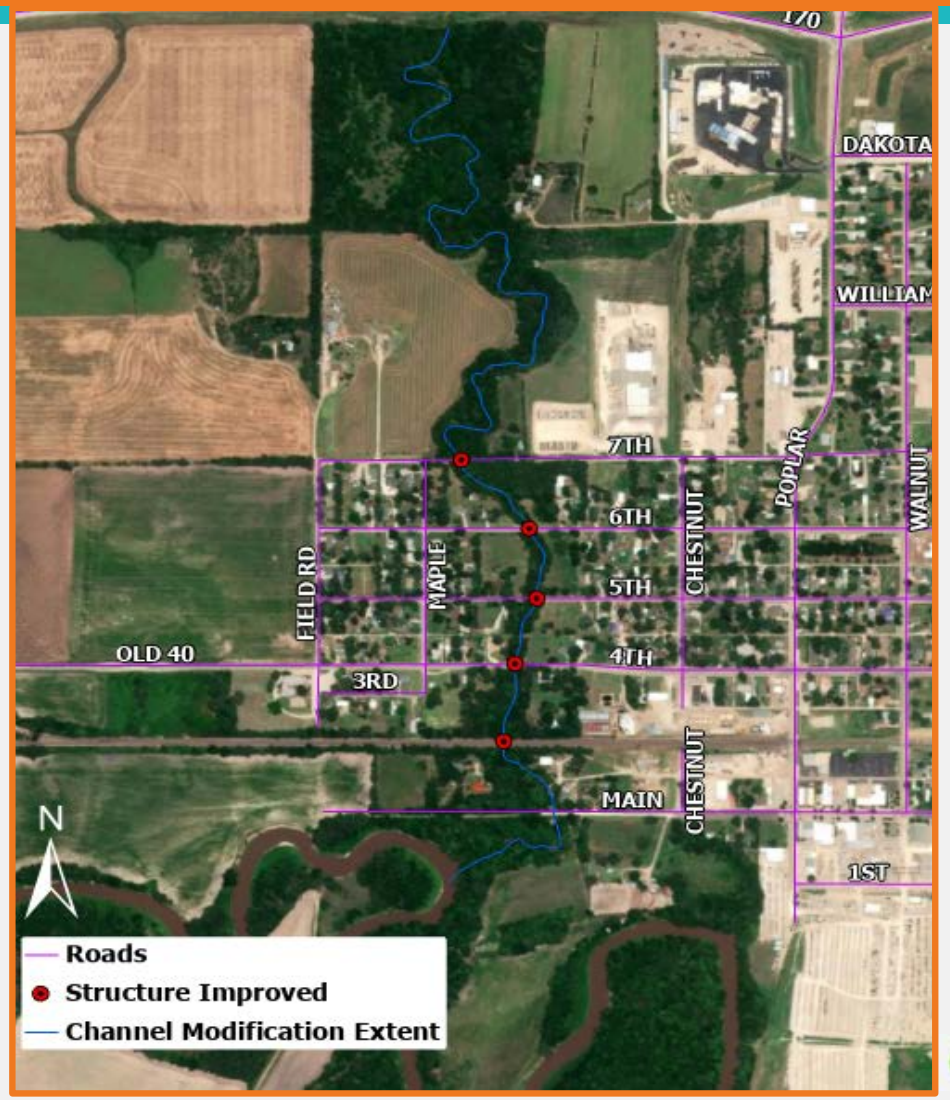
Only 8 out of 80 impacted structures removed from the floodplain in this scenario. No costs developed.



Conceptual Mitigation Alternatives Analyses

- Scenario 4- Channel Improvements
  - Primary channel widened to 50 feet with 3:1 slope

Structure Name	Existing	Modification
7th Street	25 feet bridge	Replace with 4- 12X10 RCB
6th Street	3- 10X10 feet RCB	Add 2- 10X10 feet RCB
5th Street	3- 10X10 feet RCB	Add 2- 10X10 feet RCB
4th Street	20 feet bridge	Add 3- 10X10 feet RCB
Railroad	1-10X15 feet RCB	Add 3- 6 feet CMP
Main Street	17 feet CMP	No change



All 80 impacted structures removed from the floodplain in this scenario.

Conceptual Cost Estimates

Scenario	Preliminary Construction Estimate	Contingency (30%)	Land Purchase	Project Costs	Total Project Probable Cost	Number of Structures Benefitted
Existing conditions	*Currently 80 structures within the shaded Zone X- 1PCT Depth less than 1-foot floodplains on the preliminary maps.*					
1-Inline Detention	$ 1,020,250	$ 306,075	$ 600,000	$ 255,062.5	$ 2,181,400	80
2-Bypass channel- Upstream of 7th Street	$ 889,000	$ 266,700	$ 52,000	$ 266,700	$ 1,474,400	80
3-Bypass channel- Upstream of Railroad	*Did not meet project objectives. No cost estimates developed.*					*8*
4-Channel improvements	$ 1,976,000	$ 592,800	N/A	$ 494,000	$ 3,062,800	80

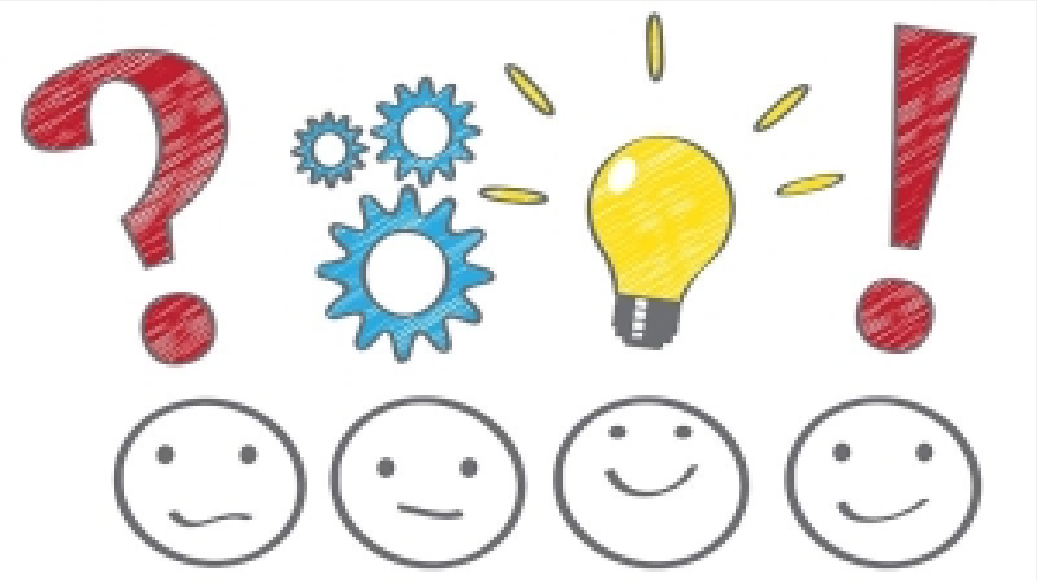
The total project cost includes construction cost, contingency cost, estimated land acquisition and project cost, which would include legal, fiscal, financing, engineering design, construction administration, inspection, and staking. Costs do not include maintenance cost.

Conclusions

- Recent modeling performed for Solomon River Tributary indicates the primary channel does not have enough capacity to convey the 1% annual chance design storm event.
- Shallow overland flow outside of the channel banks. Numerous existing structures impacted in the City of Solomon.
- Three conceptual mitigation scenarios would remove all the houses and business in the City of Solomon from the 1% annual chance floodplain.

Flood mitigation alternatives were developed without considering backwater effects from the Solomon River.

Questions?



Conceptual Cost Estimates- Scenario 1

S. No.	Description	Quantity	Unit	Unit Costs	Total Costs
Detention Dam					
1	Detention Dam and Earthwork	110,000	CY	$5	$550,000
2	Principle Spillway (48" RCP)	145	LF	$350	$50,750
3	Emergency Spillway	100	LF	$150	$15,000
4	Traffic Control	1	LS	$5,000	$5,000
5	Erosion Control	1	LS	$12,000	$12,000
4th Street Structure Improvements					
6	10' X 10' RCB	150	LF	$1,150	$172,500
7	Concrete Headwall for RCB	2	EA	$55,000	$110,000
8	Remove and replace pavement	50	LF	$200	$10,000
9	Utility conflict resolution	1	LS	$5,000	$5,000
Miscellaneous					
10	Site Clearing and Restoration*	1	LS	$90,000	$90,000
PRELIMINARY COSTRUCTION ESTIMATE					$1,020,250
Contingency @ 30%					$306,075
Land Purchase for Detention Facility (200 Acres @ $4,500/Acre)					$600,000
Project Costs @ 25%**					$255,062.50
TOTAL PROJECT PROBABLE COSTS					$2,181,400

**Includes seeding*
***Does not include any easement acquisitions*

Conceptual Cost Estimates- Scenario 2

S. No.	Description	Quantity	Unit	Unit Costs	Total Costs
Bypass channel and Field Road (new structure addition)					
1	Channel Excavation	21,000	CY	$9	$189,000
2	8' X 8' RCB	150	LF	$1,000	$150,000
3	Concrete Headwall for RCB	2	EA	$55,000	$110,000
5th Street Structure Improvements					
4	10' X 10' RCB	40	LF	$1,150	$46,000
5	Concrete Headwall for RCB*	2	EA	$18,000	$36,000
6	Remove and Replace Pavement	50	LF	$200	$10,000
4th Street Structure Improvements					
7	10' X 10' RCB	120	LF	$1,150	$138,000
8	Concrete Headwall for RCB	2	EA	$55,000	$110,000
9	Remove and Replace Pavement	50	LF	$200	$10,000
Miscellaneous					
10	Utility Conflict Resolution	1	LS	$15,000	$15,000
11	Traffic Control	1	LS	$10,000	$10,000
12	Erosion Control	1	LS	$15,000	$15,000
13	Site Clearing and Restoration**	1	LS	$50,000	$50,000
PRELIMINARY COSTRUCTION ESTIMATE					$889,000
Contingency @ 30%					$266,700
Land Purchase for Detention Facility (8 Acres @ $6,500/Acre)					$52,000
Project Costs @ 30%*					$266,700
TOTAL PROJECT PROBABLE COSTS					$1,474,400

**Since a new headwall is not required for 5th Street, the estimate is provided only for the new cell that will be added.*
***Includes seeding*
****Includes some flood easement acquisition on farm field*

Conceptual Cost Estimates- Scenario 4

S. No.	Description	Quantity	Unit	Unit Costs	Total Costs
Channel Excavation					
1	Channel Excavation	19,000	CY	$9	$171,000
7th, 6th, 5th, 4th Streets and Railroad Structure Improvements					
2	12' X 10' RCB	160	LF	$1,350	$216,000
3	10' X 10' RCB	360	LF	$1,150	$414,000
4	Concrete Headwall for RCB	6	EA	$60,000	$360,000
5	Bore & Jack Railroad Crossing 72" RCP	200	LF	$2,500	$500,000
6	Concrete Headwall for 3-72" RCP's	2	EA	$45,000	$90,000
7	Remove and Replace Pavement	200	LF	$200	$40,000
Miscellaneous					
8	Utility Conflict Resolution	1	LS	$70,000	$70,000
9	Traffic Control	1	LS	$25,000	$25,000
10	Erosion Control	1	LS	$15,000	$15,000
11	Site Clearing and Restoration*	1	LS	$75,000	$75,000
PRELIMINARY COSTRUCTION ESTIMATE					$1,976,000
Contingency @ 30%					$592,800
Project Costs @ 25%**					$494,000
TOTAL PROJECT PROBABLE COSTS					$3,062,800

**Includes seeding*
***Includes some temporary and permanent easement acquisitions*