Emergency Action Plan and Evacuation Plan

City of De Soto
Jefferson County, Missouri

Prepared for:
City of De Soto, Missouri

Prepared by:
United States Army Corps of Engineers
St. Louis District

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1.0 General Information

1.1 Statement of Purpose

This Emergency Action Plan (EAP) is specifically written for the City of De Soto in Jefferson County, Missouri. This plan is intended to serve as a guideline for the city government to effectively prepare and respond to flood events. These flood events include overbank flooding of Joachim Creek, upstream dam breaches and heavy rainfall events. Most of the practical flood fight activities will be related to flash flooding with little-to-no preparation time with significant dependence on rainfall forecasts from the National Weather Service. **The City of De Soto should tailor each flood response for the duration and magnitude of each event.**

1.2 Plan Updates

Updates are intended to capture as much institutional knowledge as possible and provide detailed information on the experiences and lessons learned during that event. Because large scale flood events happen so infrequently, a person charged with executing this plan may not have any personal flood experience.

With each flood event, this plan should be updated with new information and improved procedures. Examples of information that can and should be updated include but are not limited to: contact information, shelter locations, material and equipment storage locations and quantities, training records, etc. It is the responsibility of the City of De Soto to update this plan.

1.3 Location

The City of De Soto is situated in Jefferson County, Missouri, approximately 45 miles south of St. Louis in the Upper Joachim Creek watershed (HUC12). The watershed has a total drainage area of 39,154 acres, and the City of De Soto, at the downstream end, is the only incorporated city in the watershed.

Joachim Creek bisects the City of De Soto with both residential, commercial, and critical infrastructure on both sides of the Creek. Unique study area features include State Highways 110, Highway V, and Highway E, all of which are important emergency response and evacuation routes, historic main street in downtown De Soto, the Union Pacific (UP) rail yard, Veterans Drive, which experiences flooding, De Soto Rural Fire Protection Station One, which sits in the floodway, and an Ameren substation near the UP rail yard. See **Figure 1** with the location of De Soto and the features referenced in this section.

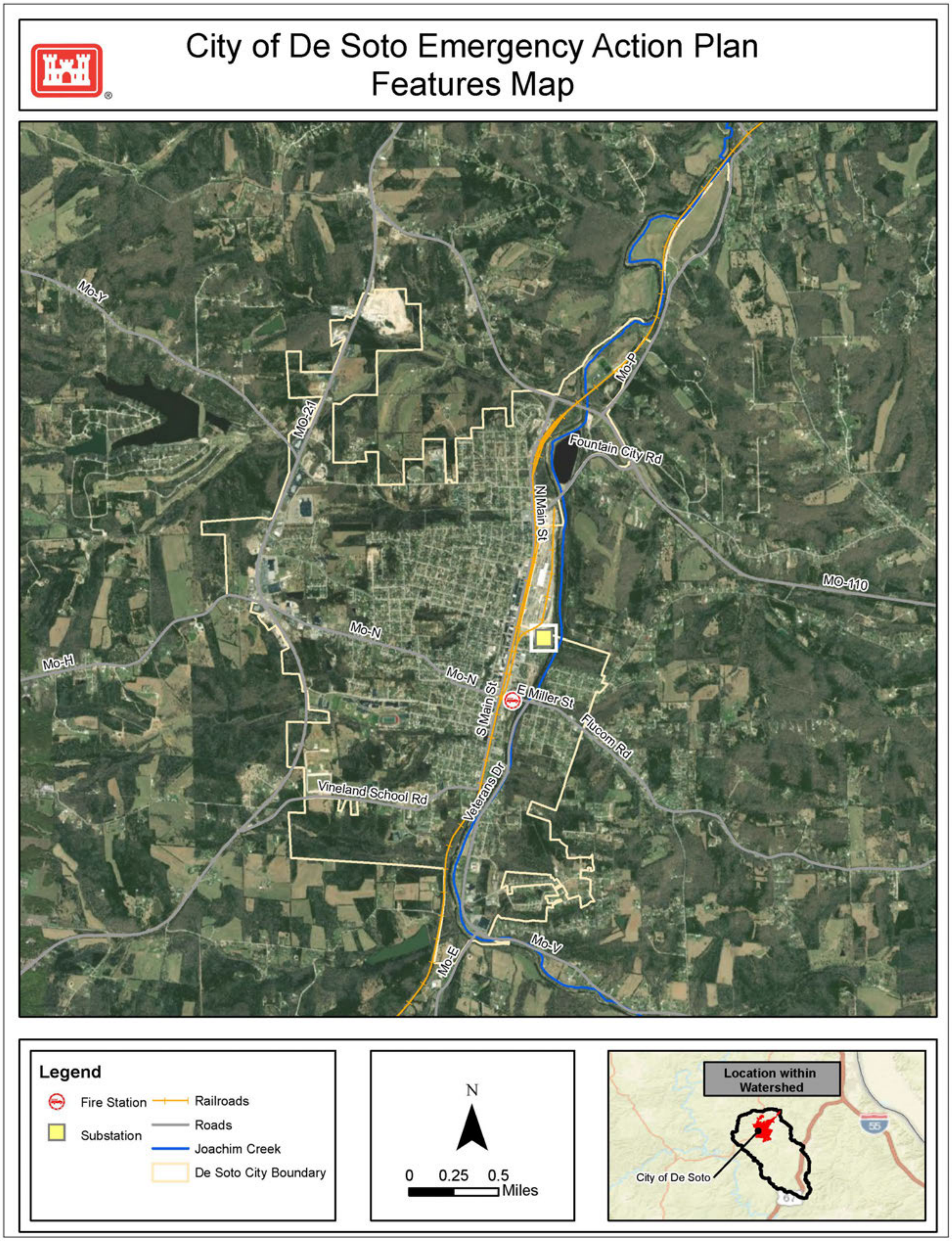


Figure 1. City of De Soto Features Map

1.4 Flood Fight on Private Property

During a flood event, the City of De Soto and Jefferson County are responsible for monitoring and responding to creek levels as well as organizing flood fighting. They do not become involved with issues that arise on private property unless it is deemed a threat to the flood risk reduction infrastructure, even if the problems result from high river levels.

Flood fighting activities and/or corrective measures needed on private property will be the responsibility of the landowner. Upon request, the City of De Soto may be able to provide technical assistance by reviewing action plans in coordination with the USACE. Appendix D describes flood fighting techniques, such as sandbagging, as well as other best practices.

It is recommended that the City of De Soto formalize any plan that includes using private property for emergency access or flood fighting. This can be done by entering into a Memorandum of Understanding or Agreement (MOU or MOA) with the private landowner. This will help to identify and mitigate any potential legal liabilities caused by property damage or in the unfortunate event of loss of life. For example, during flood events, residents on the west side of Joachim Creek between the creek and railroad tracks, at times, use the privately-owned Union Pacific Railroad access road to evacuate to higher ground. This practice should be formalized in an agreement so that residents are not expecting to use that roadway when it may be unavailable for public use.

1.5 Duties of the Sponsor

The City of De Soto is responsible for monitoring the current and forecasted stages of Joachim Creek in the project vicinity. Recommendations for performing the monitoring are provided in Section 2 – Flood Warning Systems.

Personnel shall be alerted to report for flood duty when knowledge of a forecasted river rise above flood stage is obtained, by either the United States Geological Survey (USGS) WaterAlert, National Weather Service, or any other credible source.

1.6 Action by the Sponsor

- Conduct a check of inventory of flood fighting materials and equipment and assess the condition.
- List available heavy equipment, trucks, and motorboats.
- Arrange for continuous recording of stage readings.

1.7 Flood History

The city has historically been prone to flash flooding but has experienced an increase in both frequency and intensity in recent years. Flood depths and the rate of flood-waters inundating the community have increased over time. The city has experienced 5 flood events in the last 4 years and has had fatalities associated with flooding, and emergency services were unable to reach those in need due to inundated roads. In addition to residential and commercial structures located in the 1-percent annual exceedance probability (AEP) floodplain, the De Soto

Rural Fire Station #1 and public library are also located in the floodway and floodplain, respectively. This fire station has been impacted by recent flood events, and one of the flood related fatalities occurred when a vehicle was swept away near the DeWitt Street Bridge on Veterans Drive. **Table 1** lists historic flood events in the City of De Soto, Missouri, which was identified in the USACE-produced *Upper Joachim Creek Floodplain Management Plan,* dated September 2019.

Table 1. Historic Flood Events in De Soto, Missouri

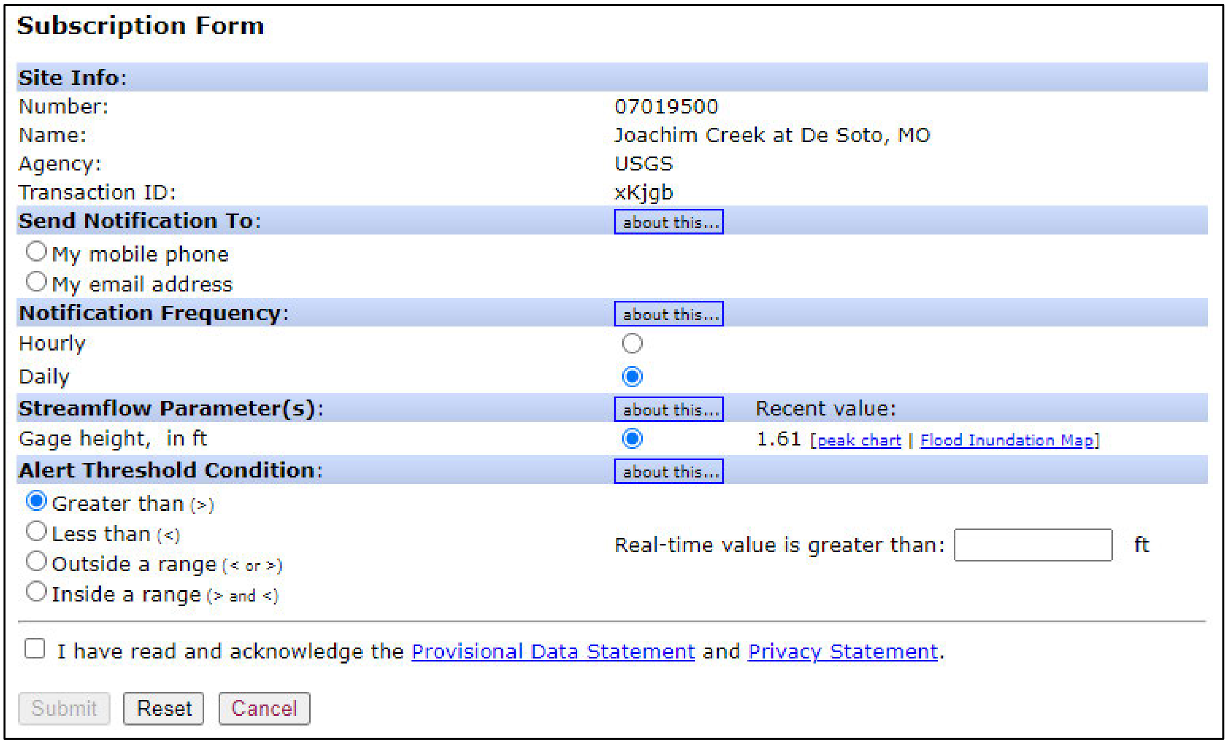
Month	Year	Approximate Precipitation Annual Exceedance Probability [1]	Common "year" Event Terminology	Federal Disaster Declaration[2]
April	2013	99%	1-year event	
June	2015	50%	2-year event	
December	2015	10-20%	5-year to 10-year event	Disaster Recovery (DR)-4250; IA & PA
May	2016	50-20%	2-year to 5-year event	
August	2016	20%	5-year event	
April	2017	4%	25-year event	DR-4317; IA & PA

[1] Annual Exceedance Probability (%AEP) is commonly referred to as x-year flood or y-year event. For example: a 1-percent AEP is commonly referred to as the 100-year flood or 100-year event. The approximations in this table are based on rainfall data, not flood heights.
[2] Declared pursuant to the Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. 5121-5207). FEMA has codified the declaration process at 44 C.F.R. Part §206.

2.0 Flood Warning Systems

2.1 USGS Water Alert

The USGS Water Alert allows users to sign up for notifications on river stages. Notifications can be received by mobile phone or email address. Parameters include: notification frequency, streamflow parameters and alert threshold condition. See below for an example of the subscription form on USGS's website.



Subscription Form

Site Info:		
Number:	07019500	
Name:	Joachim Creek at De Soto, MO	
Agency:	USGS	
Transaction ID:	xKjgb	
Send Notification To:	about this...	
My mobile phone		
My email address		
Notification Frequency:	about this...	
Hourly		
Daily		
Streamflow Parameter(s):	about this...	Recent value:
Gage height, in ft		1.61 [peak chart | Flood Inundation Map]
Alert Threshold Condition:	about this...	
Greater than (>)		
Less than (<)	Real-time value is greater than: ft	
Outside a range (< or >)		
Inside a range (> and <)		

I have read and acknowledge the Provisional Data Statement and Privacy Statement.

Submit Reset Cancel

2.2 National Weather Service

The National Weather Service (NWS) will provide a river forecast if river stage is forecasted to exceed 8.0 ft. at Joachim Creek at De Soto. Flood categories include: action stage at 8 ft., flood stage at 10 ft., moderate flood stage at 12 ft., and major flood stage at 13 ft. See Section 5 – Activation Levels for description of levels for additional information.

2.3 USACE Forecast

The U.S. Army Corps of Engineers, St. Louis District, Water Management Office, does not provide river forecasting for Joachim Creek at De Soto, Missouri.

2.4 U.S. Geological Survey Real Time Data

The U.S. Geological Survey (USGS) – Rolla Field Office provides operation and maintenance of Joachim Creek at De Soto streamflow gage, USGS 07019500. The streamflow gage is operated in cooperation with Jefferson County, City of De Soto, and National Weather Service River Forecast.

2.5 USACE Rainfall to Stream Stage

Table 2 below provides Joachim Creek at De Soto gage stream stages based upon forecasted rainfall for a given duration. Forecasted rainfall can be obtained from local National Weather Service (NWS) or local news channel weather department. Note assumptions made in calculation.

Table 2. Joachim Creek Gage Data and Action Stage

	Storm Duration					
	1 hr.	**2 hr.**	**3 hr.**	**6 hr.**	**12 hr.**	**24 hr.**
8 ft. - Action Stage	1.8 in	1.8 in	1.8 in	2.0 in	-	-
10 ft. - Flood Stage	2.3 in	2.2 in	2.3 in	2.4 in	2.6 in	2.8 in
12 ft. - Moderate Flood Stage	2.7 in	2.7 in	2.8 in	2.9 in	3.2 in	3.4 in
13 ft. - Major Flood Stage	3.0 in	3.0 in	3.1 in	3.3 in	3.5 in	3.8 in

Several conditions to consider before using above table: (1) seasonal average soil parameters were used in calculating runoff volume. (2) stream stages will be higher if soil conditions are wetter than average before rainfall hits. (3) stream stages will be lower if soil conditions are dryer than average before rainfall hits. (4) assumption is made that entire watershed will receive equal amount of rainfall. (5) these values are an approximation to be used for planning purposes. (6) each rainfall amount will provide slightly different stream stages, as there are many factors which can impact the rainfall/runoff process.

3.0 Organization

3.1 City of De Soto, Missouri

The City of De Soto is governed by a City Council and Mayor. The City employs a City Manager to carry out daily executive functions of the City. Additional departments in the City that are involved in emergency management are the De Soto Police Department, De Soto Fire Department, Valle Ambulance District, and the De Soto Rural Fire Protection District.

3.2 U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers (USACE) – St. Louis District is located in downtown St. Louis and is commanded by a Colonel in the U.S Army. The USACE – St. Louis District has a variety of resources and expertise to provide the City of De Soto and Jefferson County before, during, and after flood events.

3.3 Jefferson County, Missouri

Jefferson County's Office of Emergency Management's mission is to make the whole of Jefferson County more disaster-resilient through implementation of best practices, active engagement of community partners and the coordination of public safety initiatives and resources, locally and regionally, in all phases of emergency management.

3.4 Contractors

The City of De Soto may rely on the manpower provided by professional engineering and/or construction contractors. De Soto city government will be responsible for the coordination of all contractors employed by the City during a flood response.

3.5 Volunteers

The Citizens Committee for Flood Relief is a non-for-profit community organization within the City of De Soto that currently includes approximately 845 members. The Committee's members are concerned citizens who represent residents, business owners, and families in De Soto. The organization is committed to working alongside city, county, state and federal government to implement solutions and adopt methodology to reduce the impact of flood damage, both structural and non-structural.

There are also other community volunteers who assist during flood fight operations who may not be part of the Citizens' Committee for Flood Relief.

4.0 Preparedness

4.1 Training

Training for emergency response for both the emergency personnel, volunteers and the public should occur at least annually. One method that should be conducted each year is a tabletop exercise, which is a scenario-based training to ensure that all emergency personnel know and understand their roles during an event. See Appendix H for an outline of a tabletop exercise that can be used for training purposes.

4.2 Materials and Equipment

Boats

Although the City of De Soto does not own any boats for water-related emergency events, numerous local agencies have boats available. The De Soto Rural Fire District has two boats available and the City of Hillsboro will have two in-service in the coming months. It is recognized that availability of boats owned by other entities is dependent on their need during emergency situations. An additional consideration is whether or not those entities or even the City of De Soto employs qualified boat operators.

Ambulances

The Valle Ambulance District has three ambulances staffed 24 hours a day, 7 days a week along with a fourth crew during daytime hours.

There is no longer a yearly mutual aid agreement with other agencies to bring in additional ambulances to the community; however, there is currently a state-wide implied Mutual Aid agreement for all emergency service providers per Missouri State Statute 44.090.3. If the City of De Soto has a mass casualty incident with large numbers, City leadership believes that at a minimum, six nearby communities can send ambulances within a 20-minute time frame.

De Soto Rural Fire Department Equipment

Trained personnel:

- 14 Swift Water Technicians and Boat Operators
- 4 Swift Water Technicians (Not Boat Operators)
- 22 Basic water rescue operations trained (8 members do not swim and are trained for land service only)

Water rescue equipment:

- 22 PFD sets (including helmets, gloves and boots)
- 8 Rescue Drysuits
- 13 Rescue ICE suits
- 9 Throw Disks (rope)
- 16 Throw Bags (rope)
- 4 floating Throw Devices
- 5899R is a 18' rigid flat bottom rescue boat with a 40hp jet drive motor stationed at #3 on Ware Road.
- 5829I is a 15' Inflatable rescue boat with a 40hp prop drive motor stationed at #2 on State Rd. V.

City of De Soto Fire Department Equipment:

- 5710 - 2 PFD & Helmets
- 5712 - 2 PFD & Helmets
- 5714 - 4 Rescuer PFD & Helmets / 2 Rescue Flotation Devices and Helmets
- 5716 - 2 PFD & Helmets

Sandbags
Sand and sandbags have been provided by the City prior to flooding possibility events from the Public Works Department, in the rear of the station for a centralized location.

4.3 Pet/Animal

Small animals will be accepted at the City of De Soto Kennel for short durations during flood emergencies, but note that space is limited. Jefferson County is expected to have a larger animal shelter facility available in the near future. Citizen volunteers are available to assist with pet evacuations. Point of contact is Paula Arbuthnot at (636) 575-6646.

5.0 Activation Levels

5.1 Notifications

Action levels range from 8.0 to 13.0 feet. The 8 ft. stage is approximately bankfull and is defined by the NWS as the action stage. Further levels include flood stage at 10 ft., moderate flood stage at 12 ft., and major flood stage at 13 ft.

The Mobile Home Park located at 1009 Dewitt St. and structures located on East Third Street are the first affected, at approximately 10 ft. At that time, the water does start reaching some areas on E. St. Louis Street, Rollins Street, Joachim Street, and Stone Street.

Per the USGS Flood inundation mapper, the Commercial Street crossing becomes inundated at approximately 15 ft. at which point residents can only evacuate using the Union Pacific Railroad access road. **Table 3** describes the National Weather Service stages and corresponding elevations and frequency designations. **Table 4** describes the flood impacts experienced in De Soto at the various flood stages of Joachim Creek.

Table 3. National Weather Service Flood Stages

	National Weather Service - Stages					
	Yellow	Orange	Red	Purple	Grey	Black
Type	Action	Minor	Moderate	Major	-	-
Stage (feet)	8.0	10.0	12.0	13.0	19.6	23.5
Elevation (feet, NAVD88)	499.9	501.9	503.9	504.9	511.5	515.4
Frequency*	-	-	-	-	100-year	500-year

*Frequencies are from FEMA FIS, dated 06/20/2019.
**Flood Inundation Mapper by USGS can be utilized to related stage to flood inundation.
***Stages are for USGS 07019500 Streamgage, Joachim Creek at De Soto, MO.

Table 4. City of De Soto Impacts by Flood Stage

Stage (feet)	Flood Impacts
19.5	Near this height, the bridge surface on the Kingston Street bridge will begin flooding.
17.4	Near this height, Kingston Street will begin flooding west of the bridge.
15.3	At this height, Highway E near the gage will begin flooding.
14.5	Near this height, water will begin entering the fire station at Miller and Rollins Streets.
14.3	DeWitt Street begins flooding near this height.
14.2	Structure on Miller Street west of the fire station and house south of fire station will begin flooding near this height.
14.0	Near this height, the ballfield between DeWitt and Kingston will begin flooding.
13.6	Near this height, the base of a shed and house at Kingston Street and Main Street will begin flooding.
13.3	A shed in the yard on the downstream side of DeWitt Street will begin flooding at this height.
13.2	A driveway on the north side of DeWitt Street begins flooding near this height.
13.1	Several homes near Rollins and Miller streets begin flooding near this height.
13.0	Near this height, the bases of mobile homes downstream (north) of Kingston Street will begin flooding.
11.1	Near this height, the red brick structure at Rollins and Miller will begin flooding.
10.8	This is the height of the storm drain grate at Rollins Street and Miller Street.
10.5	Near this height, the tennis courts and basketball courts at Miller Street and the parking lot just north of Miller Street will begin flooding.
8.0	A pedestrian path along the creek begins flooding near this height about 70 yards above the gage.

*Stages are for USGS 07019500 Streamgage, Joachim Creek at De Soto, MO.
**Source: National Weather Service, Joachim Creek at De Soto, MO, page, Flood Impacts and Photos Section.
***Information was obtained August 2020, revisit website after high water events, as information will be updated and new information added.

6.0 Consequences

6.1 Population and Property At Risk

Table 5 shows population and property at risk. The general study area includes about 500 structures and a population between 950 and 1,200. These structures are within 100 feet of the .002 AEP (500-year) floodplain. The .04 AEP (25-year) floodplain includes about 100 structures and a population between 100 and 250. The 1 AEP (1-year) and .1 AEP (10-year) floodplains have no structures at risk. **Figure 2** shows the location of structures and the floodplain to which they belong.

Table 5. City of De Soto Population and Property at Risk

Population and Property at Risk							
Floodplain	**Daytime Population**			**Nighttime Population**			**Structures**
	Under 65	**Over 65**	**Total**	**Under 65**	**Over 65**	**Total**	
25 Year	87	28	115	191	33	224	98
100 Year	421	77	498	479	81	560	288
500 Year	590	103	693	619	103	722	398
General	991	143	1134	833	143	976	527
*All values are cumulative							
*General floodplain includes structures within 100 ft of the 500 year floodplain							

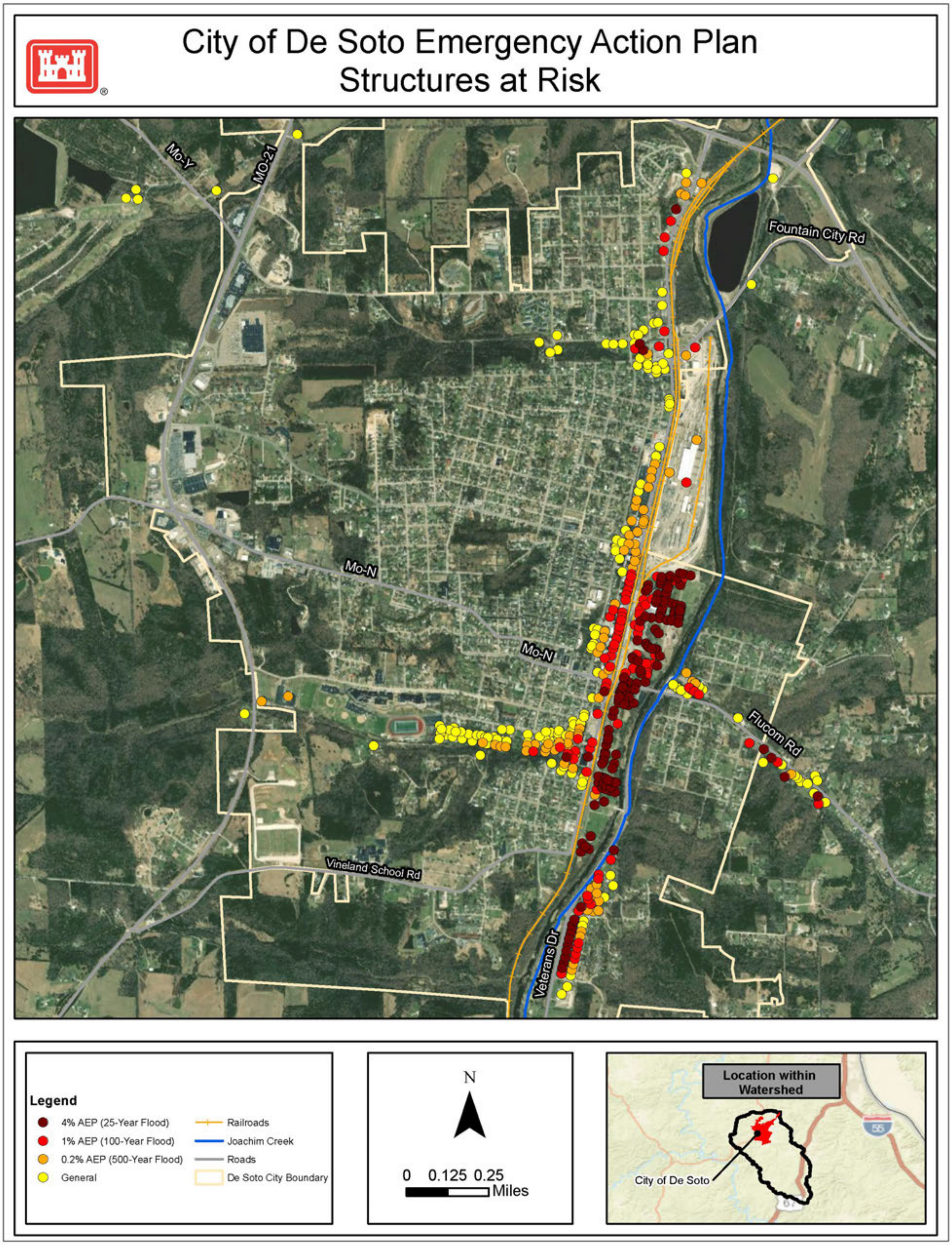


Figure 2. City of De Soto Structures at Risk

6.2 Consequence Narrative

The estimated consequences due to flash-flooding (non-breach) scenarios in the Upper Joachim include Population at Risk (PAR) and potential life loss. Consequence modeling was performed using the Hydrologic Engineering Center's Loss of Life Simulation (LifeSim) software, HEC-LifeSim 2.0.

The model utilizes Monte Carlo analysis and computes multiple iterations (in this case, 500 per scenario) in order to obtain a range of possible life loss outcomes for a selected hazard event-exposure scenario while accounting for uncertainty in the parameters, given a structure inventory with initial population distributed to each structure, and given a road network (used when simulating evacuation to estimate life safety risk on roads). The structure inventory was developed from the Upper Joachim FMP as well as National Structure Inventory (NSI) 2.0. NSI 2.0 is an inventory of structures for the whole nation developed by USACE for use as a base inventory for studies.

6.2.1 Existing Condition

There are several assumptions that must be made in order to perform all the necessary computations in the model. Those are warning time relative to imminent hazard, hazard communication delay, warning issuance delay, first alert, and protective action initiation. An informal interview by email with De Soto's City Manager was conducted in order to inform those assumptions for the emergency planning zone (EPZ). The results of that interview and how it impacted those assumptions for the existing condition and the with-project conditions are below. **Figure 3** illustrates the assumed timeline from the moment the hazard is identified by emergency management to the moment protective action is taken by residents.

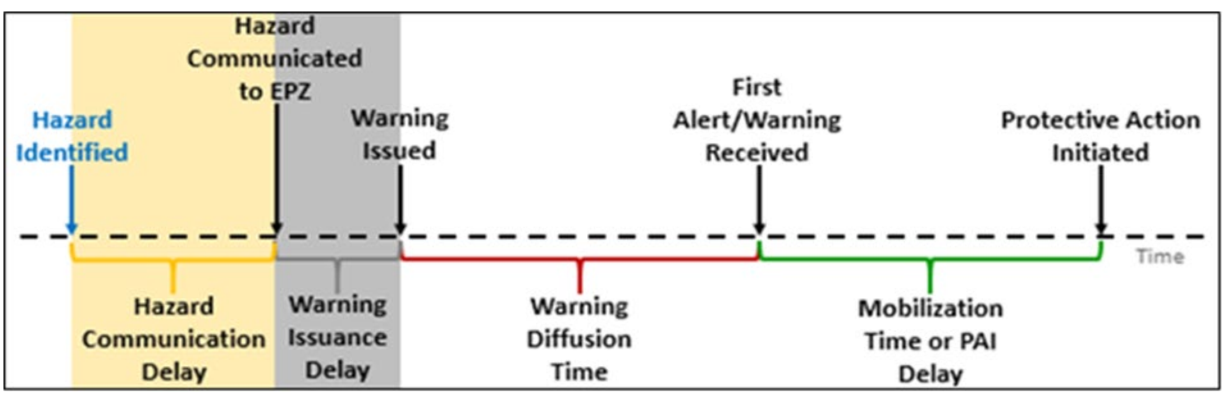


Figure 3. City of De Soto Emergency Response Process

6.2.1.1 Assumptions

Warning time relative to imminent hazard - triangular distribution with -12 hours minimum, -0.5 hour most likely, and 2 hours maximum.

Imminent hazard is defined as the time at which water begins to overflow the banks of Joachim Creek, which is 10 feet on the gage. Police begin going door to door when the gage is at 8 feet, which is approximately 30 minutes before the imminent hazard, according to data provided by the St. Louis District Hydraulic Engineering Branch. In the worst-case scenario, the warning process does not begin until 2 hours after water reaches the banks of Joachim Creek, so a maximum value of 2 hours is used in the model. In the best-case scenario, the warning process begins 12 hours prior to the water reaching the banks, so a minimum value of -12 is used in the model. Approximately twelve hours prior to bankfull is when rainfall would begin, according to data provided by the St. Louis District Hydrologic and Hydraulics Branch, Engineering Division (CEMVS-EC-HH).

Hazard communication Delay - triangular distribution with 0 hours minimum, 0.1 hour most likely, and 0.5 hour maximum.

This represents how quickly gage data is updated on the EOC dashboard for the City of De Soto to interpret. There may be some delays due to internet availability or reports coming into the field, but this is unlikely. It is assumed that this delay is negligible or non-existent.

Warning Issuance Delay – well-prepared.

There are only 3 people (city manager, chief of police, and chief of the fire department) that must concur with the warning before being issued as per the guidelines of Table 2 on Page 9 of this EAP.

First Alert – day: moderate / night: moderate.

The city relies on the CodeRED Alert System, an emergency alert system, to get out the warning message. This message is supplemented with police going door to door, signage from the public works department, and Facebook and website alerts going out. It is unknown how many people have signed up for the CodeRED Alert System and how effective it would be during a flooding event. It is further described in Section 6.5

Based on the current alert systems, the maximum time to alert the PAR was estimated to be approximately 3 hours, therefor a moderate designation was given to the City of De Soto.

Protective Action Initiation – preparedness: unknown / perception: unknown.

Half of the homes in the floodplain are rental properties that contain PAR that may not be aware of the flood risk. There is also a vocal minority of the population at risk that is highly aware of the flooding situation. It cannot be determined if the population is either aware or unaware and therefore perception was set to unknown. Preparedness of the City of De Soto is unknown as there is not enough information to say that the local emergency manager is properly prepared to issue a well-crafted and convincing message that will motivate the population to cause people to act.

6.2.1.2 Output

Five hydraulic frequency events were provided by CEMVS-EC-HH: 1 AEP (1-year), .1 AEP (10-year), .04 AEP (25-year), .01 AEP (100-year) and .002 AEP (500-year). The .002 AEP (500-

year) event was the only event showing the potential for significant life loss and so that is the focus of the remaining analysis. The other events did not show significant risk for loss of life during the modeling process, which is not to say that risk does not exist, but rather that it can be mitigated with current and existing conditions. These conditions include monitoring and reacting to real-time gage data, hydrologic forecasts, having prepared warning issuance scripts, continuing to use an evacuation alert system (CodeRED), and making police and emergency staff available to go door to door to warn citizens. Any degradation in the readiness of the City of De Soto's emergency planning, response, or mitigation activities could result in life loss during these more frequent flood events. The narratives and figures below help further describe the existing conditions for the City of De Soto.

Results were obtained from HEC-LifeSim for simulations of the .002 AEP (500-year) event taking place at 2am and 2pm utilizing the assumptions described above. The estimated mean life loss for 2pm is about 23 and the estimated mean life loss at 2am is about 29. The whisker plots in **Figure 4** show the minimum, 25th and 75th percentile, and the maximum life loss values.

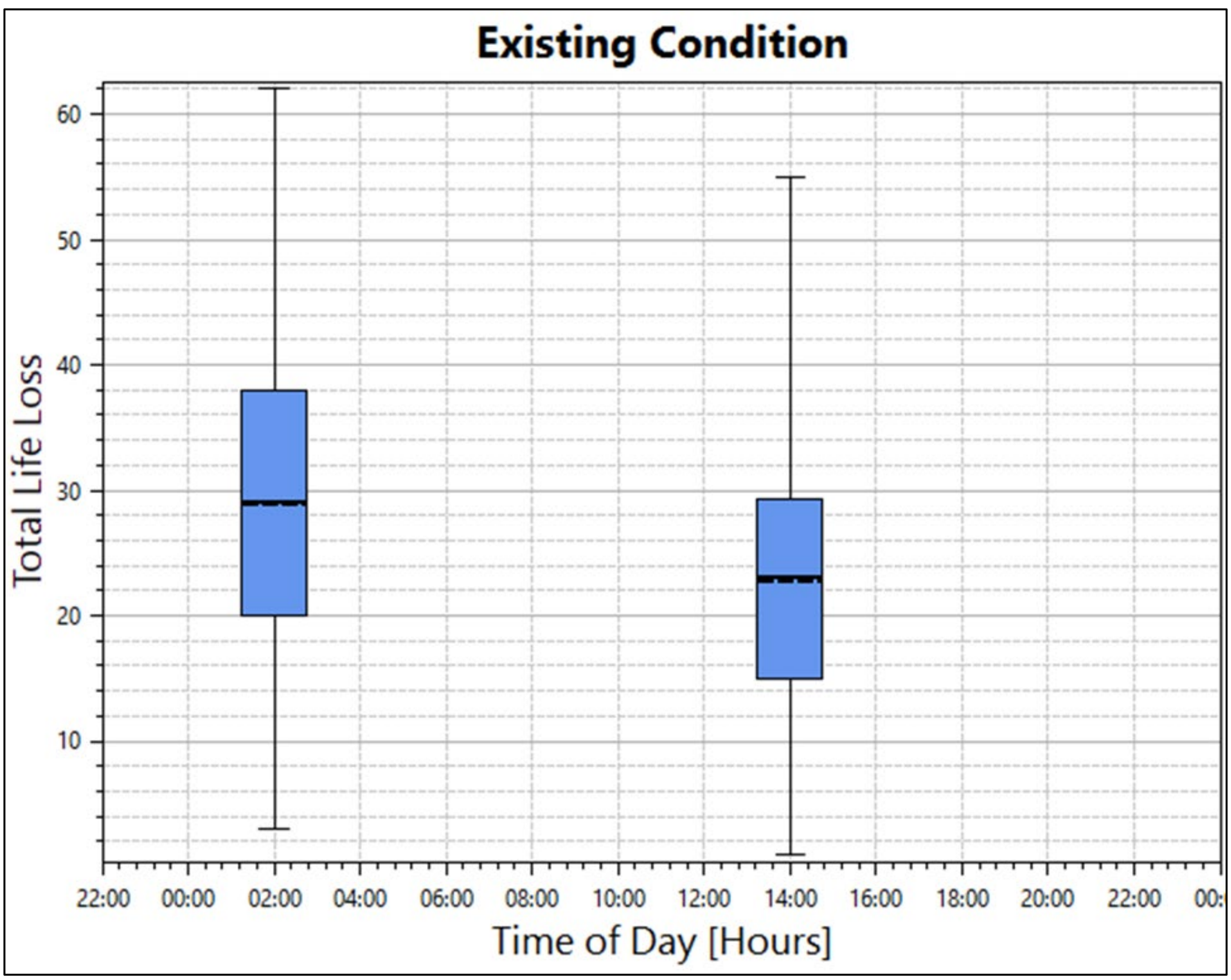


Figure 4. Existing Conditions Life Loss

6.2.2 With Project Conditions

Two primary areas of greater potential for life loss were identified from the existing conditions modeling: a mobile home park near East Kingston Street and East Main Street shown in **Figure 5**, and a section of Veterans Drive near the entrance to Walther Park shown in **Figure 6**.

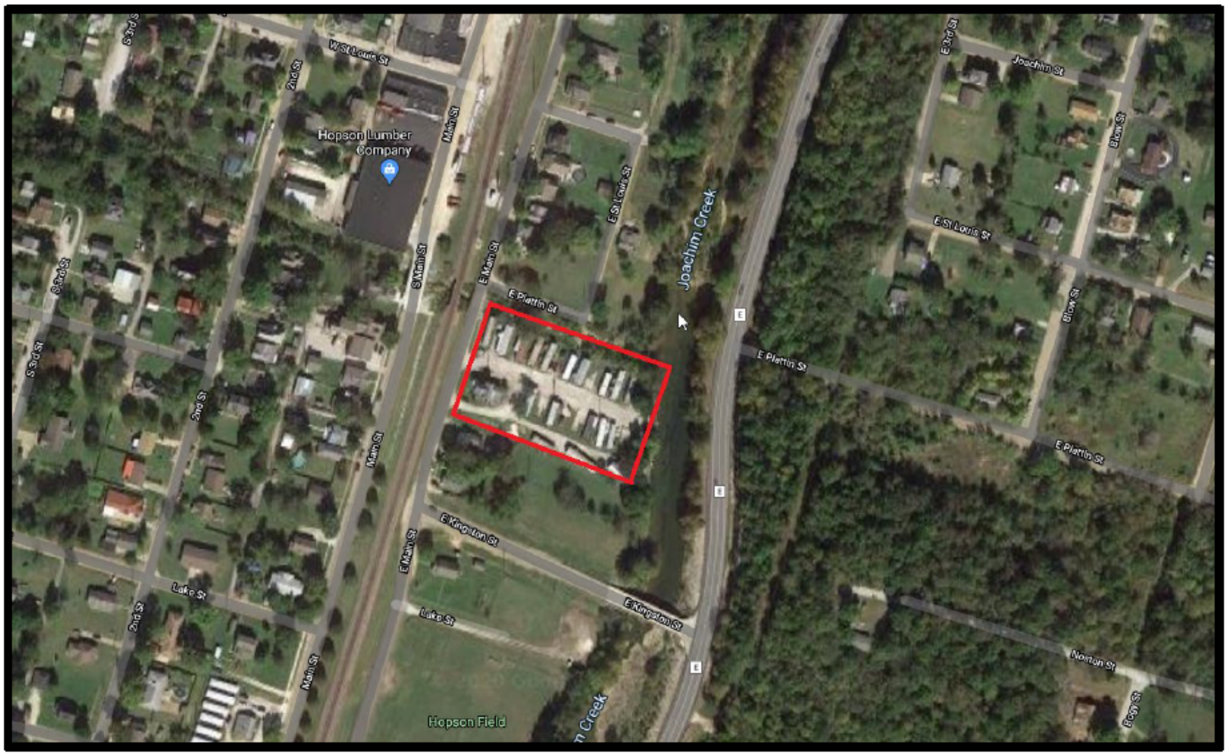


Figure 5. Greater Life Loss Area Potential Location #1

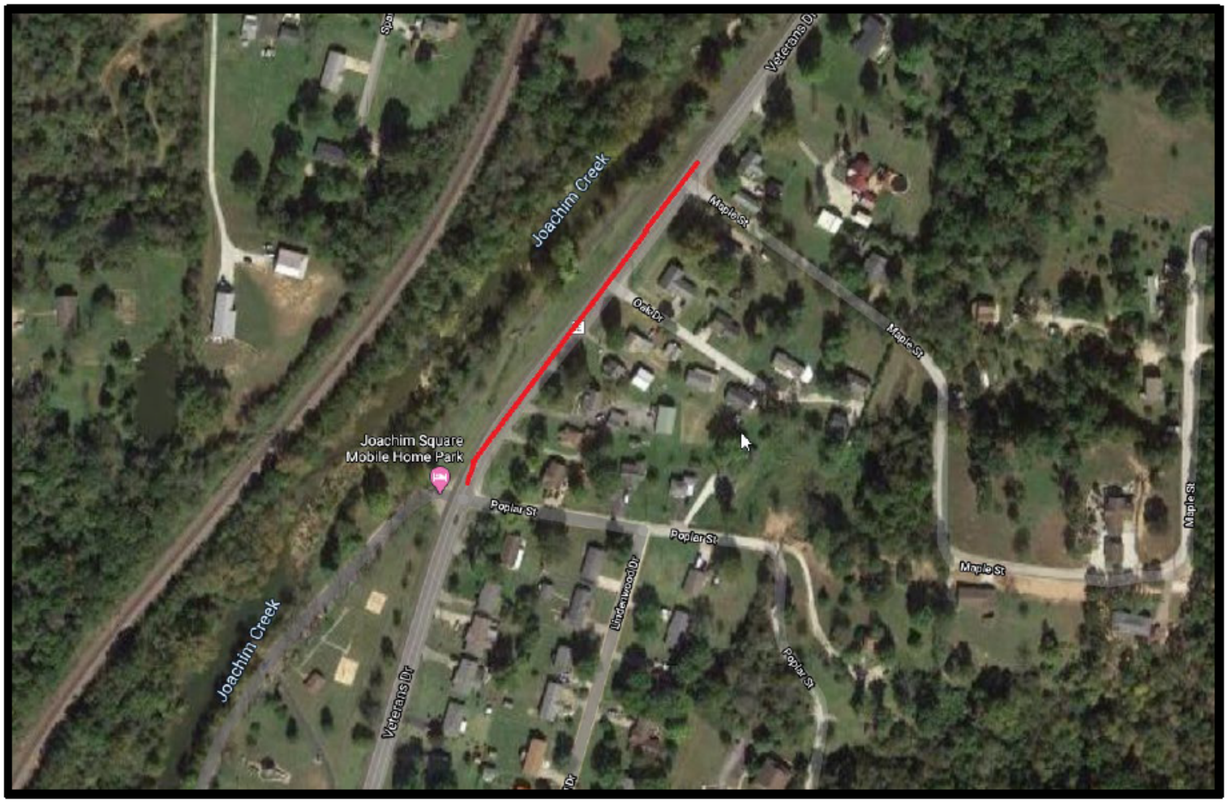


Figure 6. Greater Life Loss Potential Location #2

This greater potential for life loss is the basis for the recommendations. Three different recommendations were simulated:

1. The first (**Recommendation 1**) provides the residents of the mobile home park with a much faster first alert, better preparedness and perceptiveness.
2. The second (**Recommendation 2**) includes the improvements for the mobile home park as well as more modest improvements to those same parameters for the rest of the population. This assumes the City adopts all recommendations from the EAP.
3. The third (**With Acquisitions**) includes all of the structures recommended for acquisition in the FMP being removed from the structure inventory.

6.2.2.1 Output

The whisker plots, as before, show the minimum, 25th and 75th percentile, and the maximum life loss values for the with-project conditions. **Figures 7, 8,** and **9** show estimated mean life lost and **Table 6** shows the reduction in life lost from the with-project conditions.

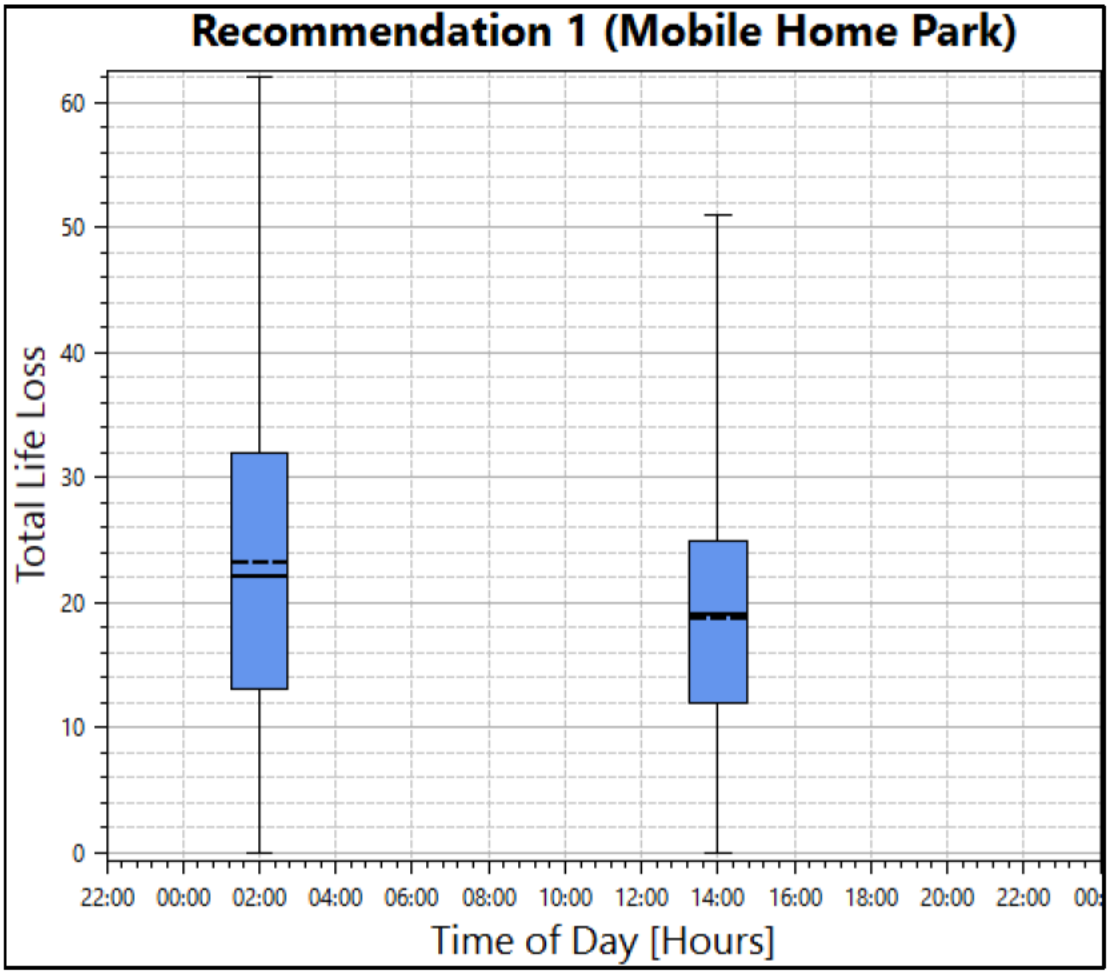


Figure 7. Recommendation 1 Life Loss at Mobile Home Park

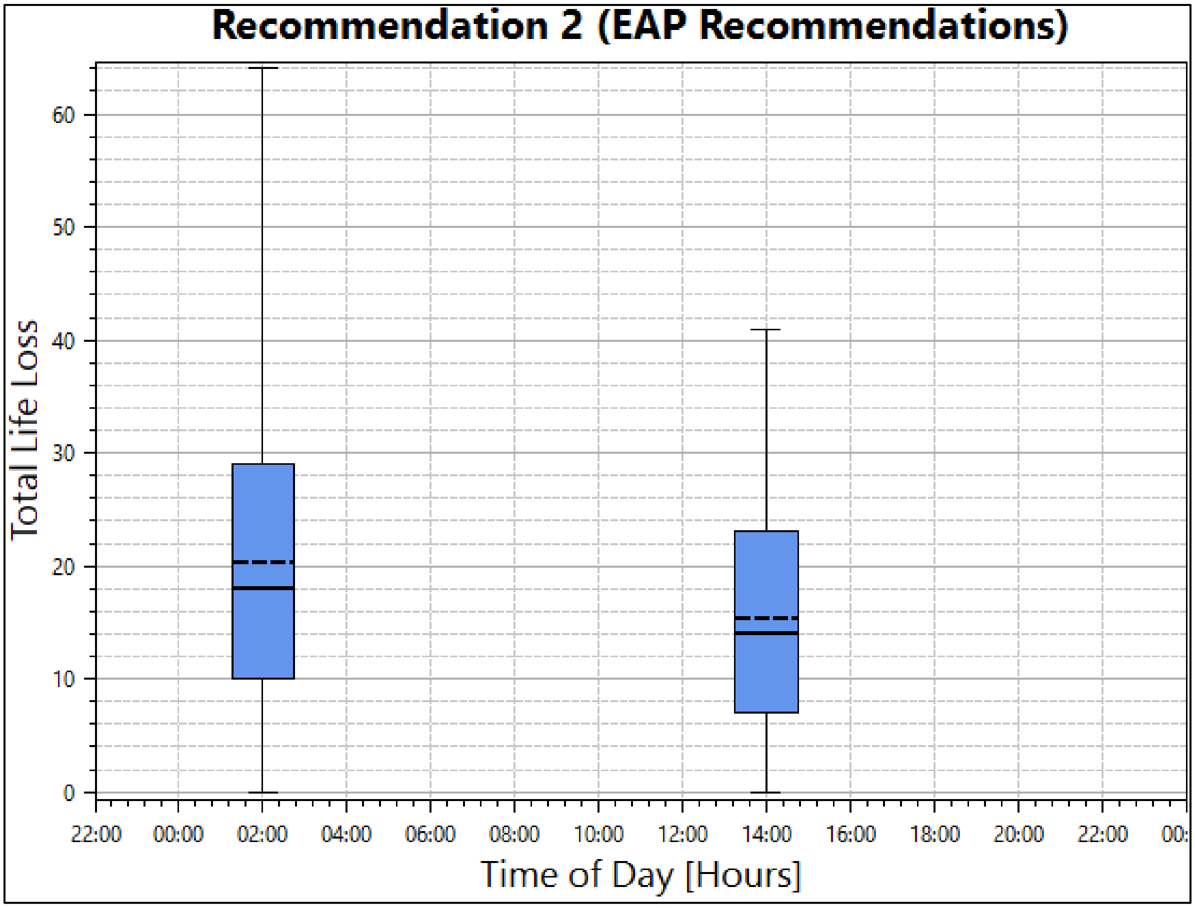


Figure 8. Recommendation 2 Life Loss

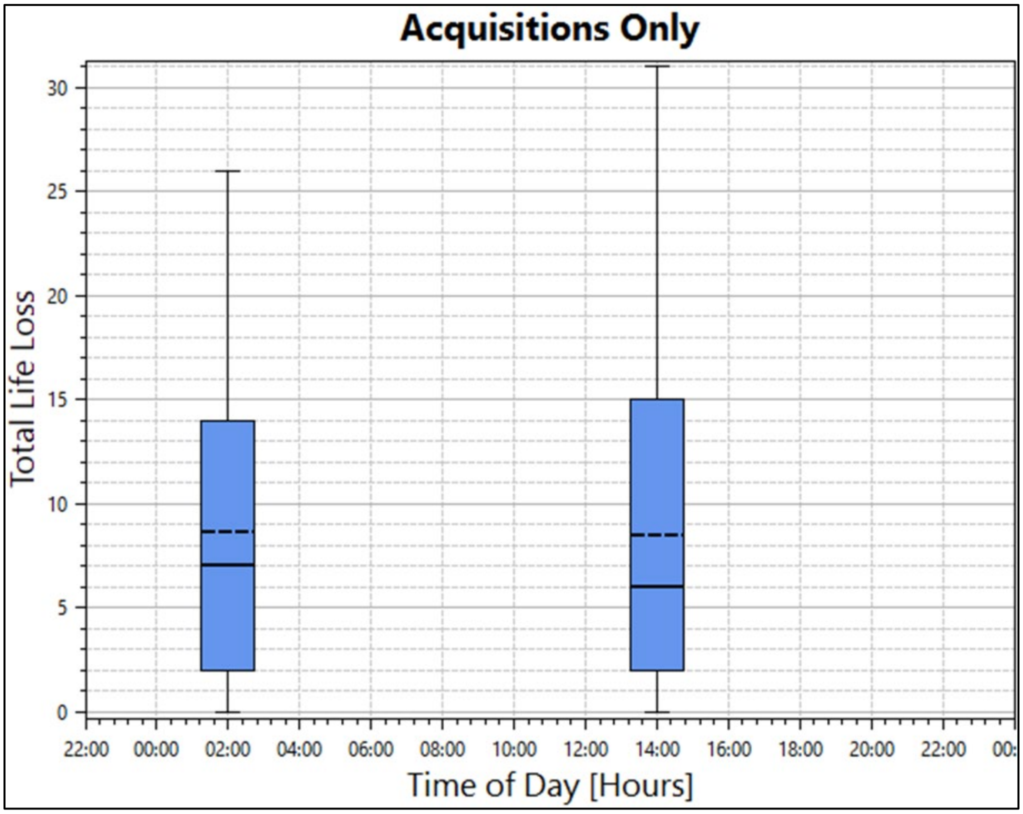


Figure 9. With Acquisitions Only Life Loss

Table 6 describes the mean estimated life loss under existing conditions and with several with-project conditions. The table includes two different time windows, one in the early morning and one twelve hours later in the early afternoon. These different times have a direct relationship with the life loss because more people will be in their homes at night than traveling throughout the afternoon or at work or school.

Table 6. Life Loss Statistics

.002 AEP Event	Estimated Life Loss*		Percent Decrease**	
(500-Year Event)	2am	2pm	2am	2pm
Existing Condition	20-38	15-29	-	-
Recommendation 1	13-32	12-25	20.7%	17.4%
Recommendation 2	10-29	7-23	31.0%	34.8%
With Acquisitions	2-14	2-15	69.0%	65.2%

*The reported range of values represent the estimated 25th and 75th percentiles
**Percent decrease in mean estimated life loss

6.3 Inundation Maps

The inundation maps, **Figures 10 and 11**, demonstrate the 1% AEP (100-year flood) and 0.2% (500-year flood) floodplain with depths designated from greatest depth in dark blue to the least depth in light blue. Critical infrastructure are also identified in the legend.

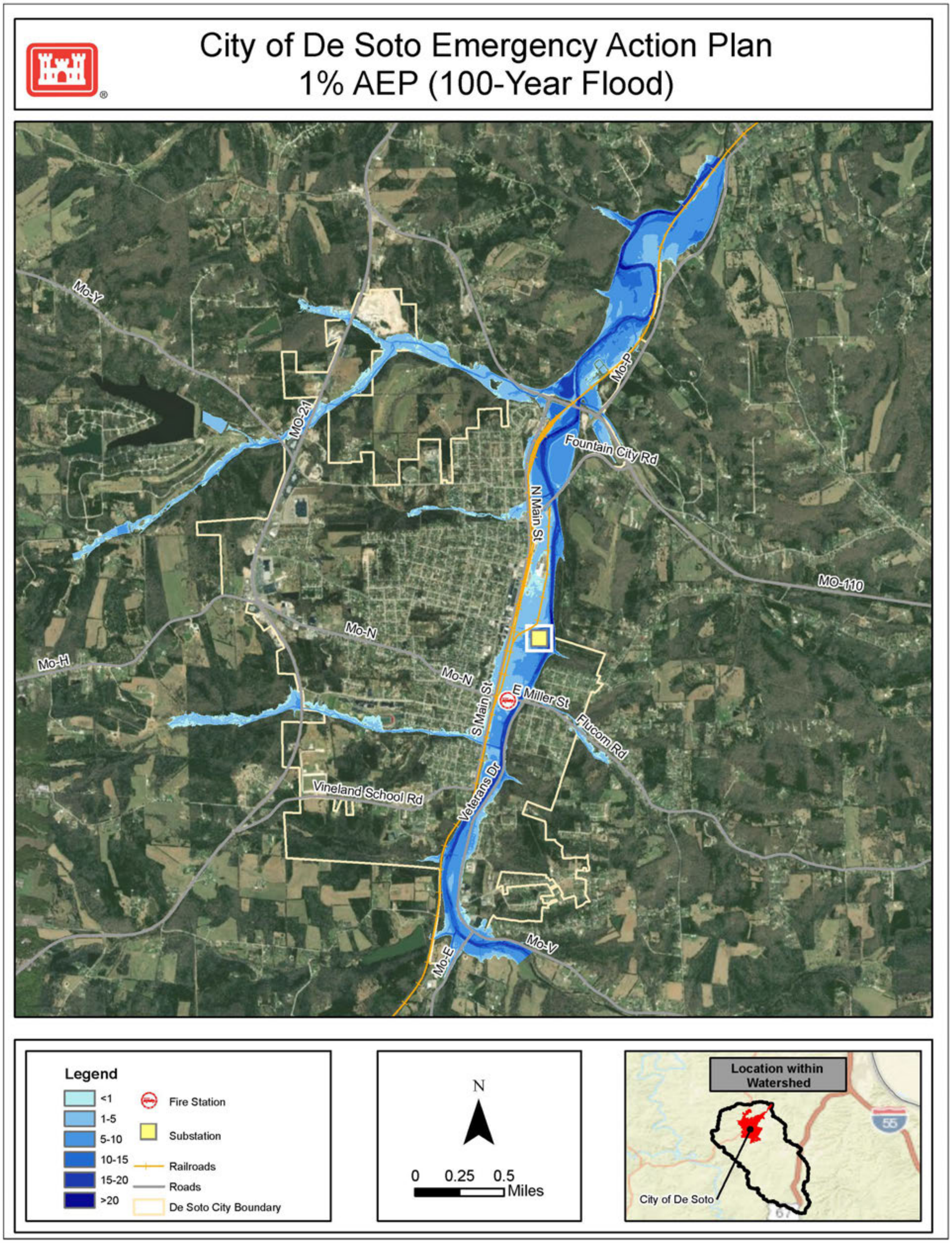


Figure 10. 1% AEP (100 Year) Inundation Map

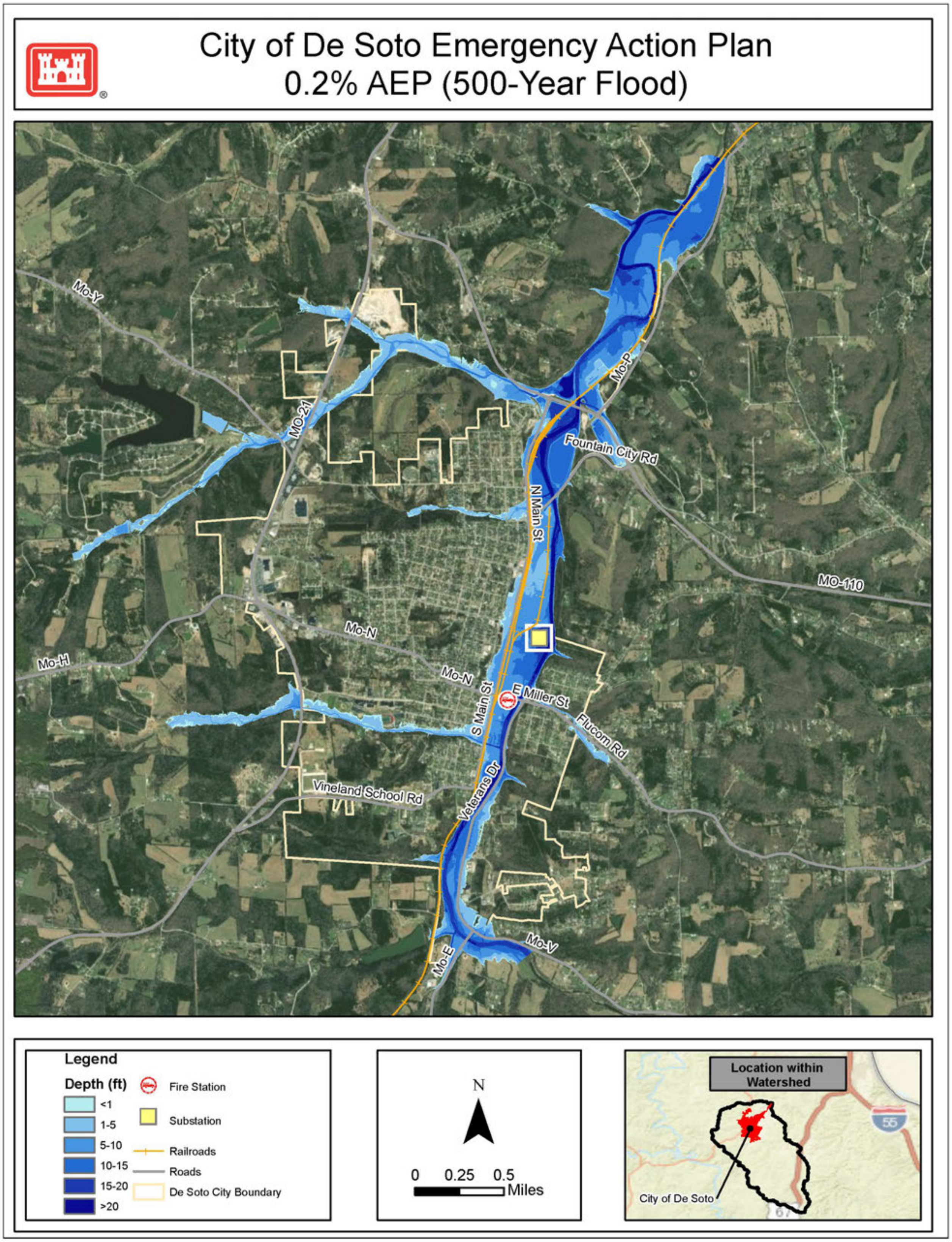


Figure 11. 0.2% AEP (500 Year) Inundation Map

6.4 Inundation Scenarios

USGS Flood Inundation Mapper provides inundation scenarios for Joachim Creek based upon De Soto gage stages 8 ft. to 17 ft. Inundation mapping is available at one foot increments from 8 ft. to 17 ft. The inundation mapping starts at approximately State Road V and Bader Road, and ends at approximately State Road P. Flood depths are also available for one foot increments from 8 ft. to 17 ft.

If Joachim Creek is forecasted to exceed 8 ft. at De Soto gage, the National Weather Service (NWS) will provide stream stage forecast. Forecasted stream stage can then be related to the inundation mapper to identify flooding extent.

The maximum 17 ft. stage corresponds to estimated 0.2-percent annual exceedance probability (AEP), or 500-year annual chance of exceedance (ACE). USGS utilized the USGS StreamStats application to come to this determination.

The latest FEMA Flood Insurance Study (FIS) (effective June 20, 2019) utilized a different method to calculate the 0.2-percent and 1-percent AEPs: 0.2-percent AEP is 23.5 ft. and 1-percent AEP is 19.6 ft. FEMA FIS utilized software programs Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS) and Hydrologic Engineering Center – River Analysis System (HEC-RAS), which is standard for FISs.

6.5 Evacuation

Two primary temporary shelter sites have been identified for residents that evacuate when a warning is received: Park View Baptist Church on the east side of the Joachim Creek, and the De Soto Community Center on Boyd Street on the west side of the Joachim Creek. Residents who have received the warning to evacuate should proceed to a shelter point. If a resident encounters rising waters or water covering the roads during evacuation, higher ground and shelter should be sought until the flooding recedes.

Figures 12 and 13 show dry (non-inundated) and wet (inundated) roadways during a 500-year event. The Community Center and Park View Baptist Church are indicated on the maps as shelter points for evacuating residents. Residents that live in high-risk areas should be familiar with these maps and use them to plan a route for use in the event of an evacuation alert. Wet roadways should be avoided where possible.

As mentioned in Section 6.2.2, there is a portion of Veteran's Drive near the entrance to Walther Park that presents a greater potential for life loss indicated in **Figure 13**. This segment of roadway should be avoided. Residents on Oak Lane and Maple Street should be aware of this risk when planning an evacuation route.

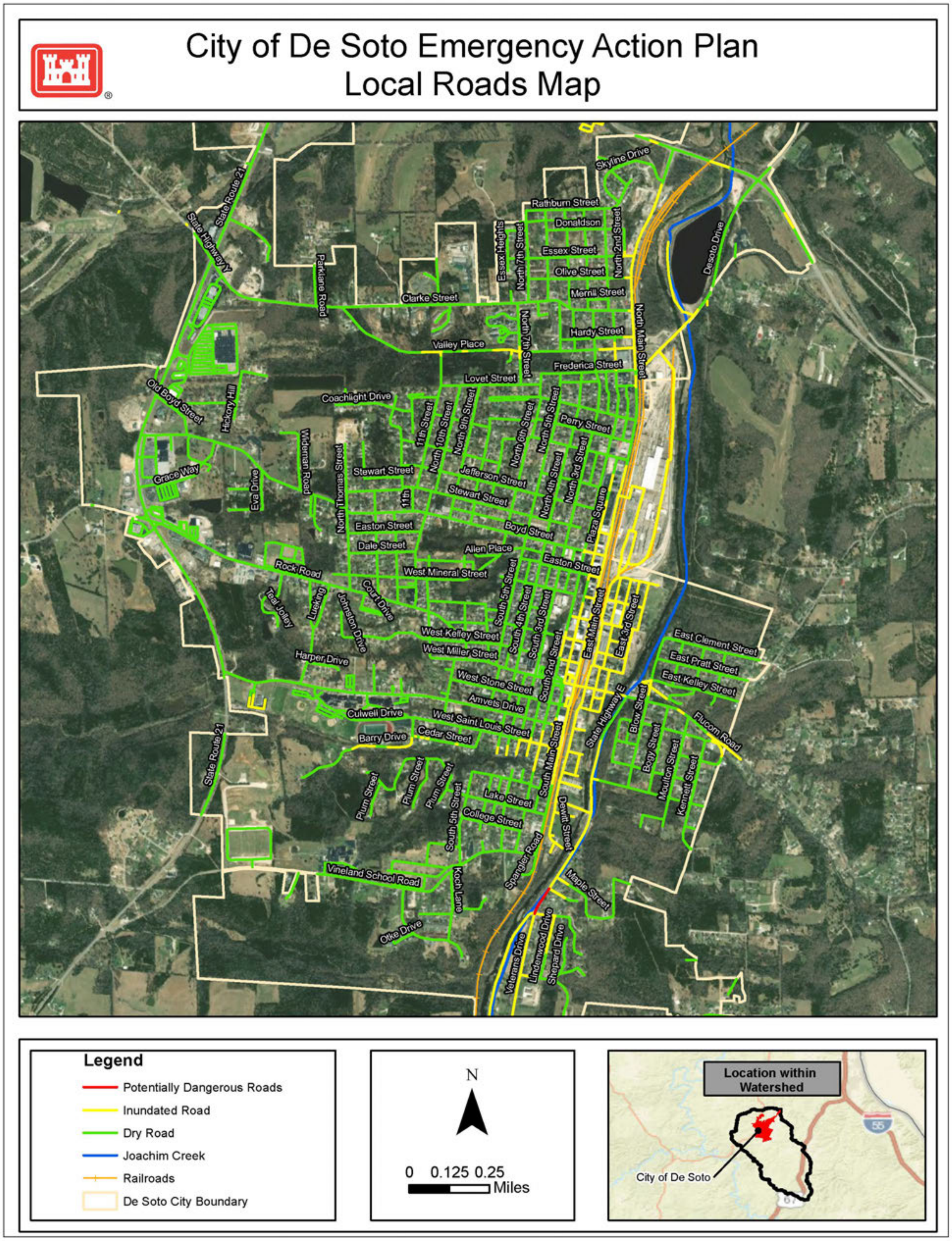


Figure 12. Roadway Inundation for the 500-year event (Main Street)

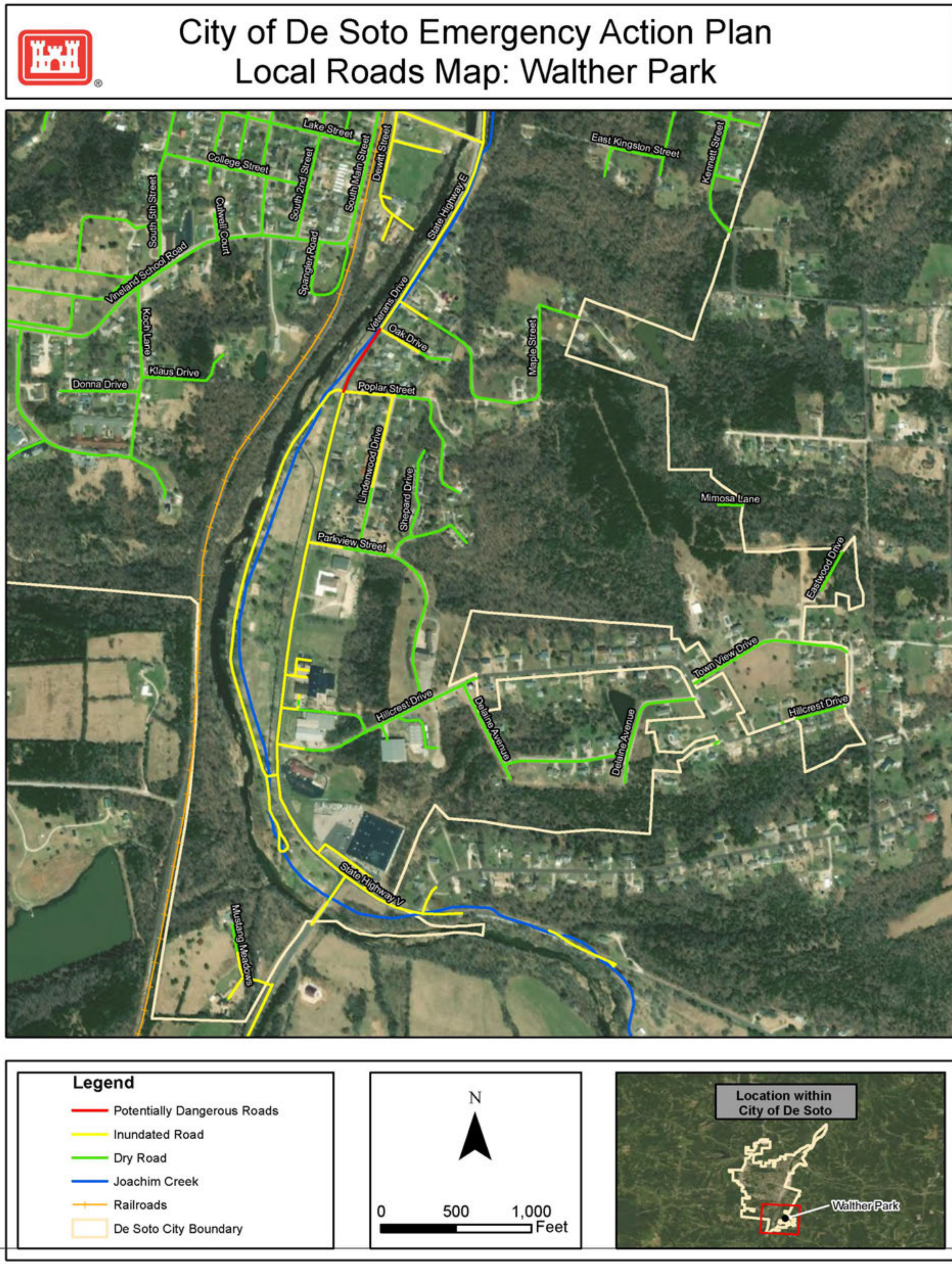


Figure 13. Roadway Inundation for the 500-year event (Walther Park)

6.6 Public Outreach Warning Systems

Both Jefferson County and the City of De Soto participate in and promote the CodeRED Alert System, each municipality administering its own system. It is a reverse 911 system that informs the public of weather conditions and weather watches and warnings via phone call or text. Citizens may sign up at no cost to them by calling 9-1-1 Dispatch. In addition, other medium forums are used such as social media sites Twitter and Facebook. These various mediums can be promoted more to reach a broader audience and provide high quality emergency notification. Appendix E provides pre-scripted messages for the CodeRED Alert System to alert the public when flood risk has increased and when to evacuate.

7.0 Flash Flooding

7.1 Flood Fighting Techniques

7.1.1 Recommended Sandbagging Procedures

The recommended procedures for sandbagging, which includes filling, placement, and estimates of bags required, are provided in Appendix D – Sandbagging Techniques. It is recommended that the public be given access to Appendix D to ensure proper sandbagging technique.

7.1.2 Sandbag Berms

A common flood fighting technique is the construction of small berms made of stacked sandbags and sometimes strengthened with plastic sheets or wooden boards strengthening the structure.

7.1.3 Dry Flood Proofing Buildings

There are several flood fighting techniques that aim to keep water out of structures, and this is considered dry flood proofing. One method is to apply polyethylene sheeting, which is attached or hung onto the structure's exterior (usually to a height of 3 feet above the first floor elevation and continued on the ground surface 4 feet out from the structure exterior), in combination with door and window closures. An additional method is to apply clear liquid sealant to the structure's exterior in combination with caulking of large cracks in the exterior and placement of door and window closures.

Appendix A – Dam Inventory

There are no known levees within the Upper Joachim Creek Watershed; however, there are 19 dams in the watershed (**Table 7**), 15 of which are upstream of the City of De Soto. These dams were mostly constructed in the 1950s through the 1970s with one outlier built in the early 1990s.

One of the missions of the Missouri Department of Natural Resources - Water Resources Center is to ensure that dams in the state are constructed, maintained and operated in a safe manner through its Dam and Reservoir Safety Program. This Program is accomplished by regulation (10 CSR 22-1.020 (13)) of all non-agricultural, non-federal dams 35 feet or more in height and by providing technical assistance and informational resources to all dam owners.

Table 7. Joachim Creek Dam Inventory

Dam Name	NID ID (MO)	River	Year Completed	State Regulated	Owner Name	Height (ft)	Storage (acre-ft)	Type	Purpose	Hazard Potential	EAP	Last Inspection
Clear Lake Dam	30437	TR to Joachim Creek	1961	No	Sunrise Lakes Association	34	236	Earth	Recreation	High	Not Required	5/7/1981
Dierberg Lake Dam	30441	TR to McMullen Branch	1968	No	WM C DIERBERG	26	56	Earth	Flood Control	High	Not Required	-
Fisherman's Lake Dam	31035	TR to Ball Branch	1970	No	Briarwood Development CO	34	236	Earth	Recreation	High	Not Required	8/2/1978
Lake Kearbey Dam	11099	TR to Sugar Creek	-	No	Dave Kearney	25	54	Earth	Recreation	High	Not Required	9/9/1980
Lake Briarwood Dam	30400	Ball Branch	1970	Yes	Schmitt	65	1840	Earth	Recreation	High	Yes	3/10/2016
Lembeck Lake Dam	30369	Whitehead Creek	1958	No	DR. Chang K. Yang	26	348	Earth	Recreation	High	Not Required	3/5/1981
Little Lake Dam	30456	TR to Joachim Creek	1961	No	Sunrise Lakes Association	32	68	Earth	Recreation	High	Not Required	5/8/1981
Lower Valle Mines Dam	30439	TR to Joachim Creek	1952	No	Valle Mining Company	22	82	Earth	Other	High	Not Required	8/15/1980
Lucas Lake Dam	30454	TR to Joachim Creek	1960	No	Edwin+Thelma Lucas	25	94	Earth	Flood Control	High	Not Required	-
Rustic Hills Resort Lake Dam	30458	TR to Joachim Creek	1957	No	Rustic Hills Resort LTD	28	90	Earth	Recreation	High	Not Required	-
Siesta Lake Dam	31199	TR to Fritz Creek	1957	No	Joe+Rebecca Merten	30	160	Earth	Recreation	High	Not Required	3/4/1981
Spring Lake Dam	31193	TR-Falling Rock Branch	1976	Yes	Summerset POA	42	178	Earth	Recreation	High	Yes	7/27/2016
Spring Lake Dam (2)	30401	TR Ball Branch	1970	No	Briarwood Development CO	20	64	Earth	Recreation	High	Not Required	8/2/1978
Summer Set Lake Dam	30459	Falling Rock Branch	1974	Yes	Summer Set POA	63	3750	Earth	Recreation	High	Yes	7/26/2016
Sunrise Big Lake Dam	30457	TR to Joachim Creek	1961	Yes	Sunrise Lakes Association	38	168	Earth	Recreation	High	Yes	1/17/2017
Sunrise Lake Upper Dam	31190	TR to Joachim Creek	1961	Yes	Sunrise Lakes Trustees	37	360	Earth	Recreation	High	Yes	10/31/2017
Upper Valle Mines Dam	30370	TR to Joachim Creek	1958	No	Valle Mining Company	34	291	Other	Tailings	High	Not Required	8/15/1980
Valle Lake Dam	30438	Fletcher Branch	1955	Yes	Valle Lake Prop Own Assn	39	800	Earth	Recreation	High	Yes	10/3/2017
Winter Haven Lake Dam	31192	Falling Rock Branch	1978	Yes	Summerset POA	49	301	Earth	Recreation	High	Yes	7/26/2016

Source: USACE - National Inventory of Dams (NID)

Figure 14 shows the location of dams in the watershed as identified by the National Inventory of Dams (NID). They are all classified as high hazard dams due to a probable loss of human life if the dam fails or is operated inappropriately. They are all privately owned and range in height from 20 to 65 feet.

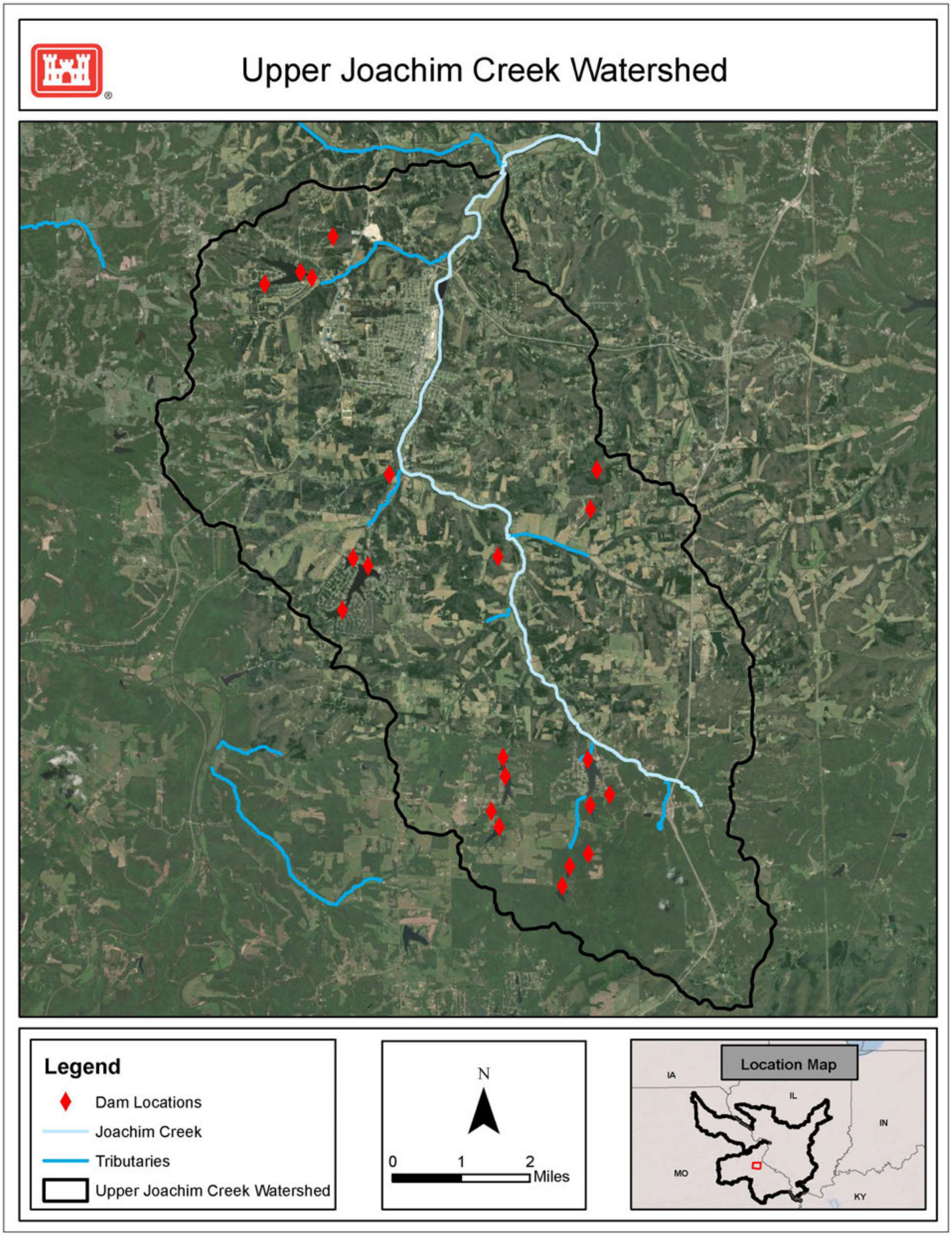


Figure 14. Location of dams in the Upper Joachim Creek Watershed

Valle Lake Dam is 39 feet tall and is identified as a State Regulated Dam (Permit Number R-381) and has a hazard class 2. Hazard class 2 dams are considered by the State to be significant risk structures based on downstream consequences of the dam should it fail. By State regulation, Missouri dam owners are required to complete and have an emergency action plan that is coordinated between the MDNR - Dam and Reservoir Safety Program, County Emergency Management Director and other state and federal agencies.

In 1981, the USACE, St. Louis District performed a field inspection and evaluation of the Valle Lake Dam, one of the largest lakes which drains into Joachim Creek because it was identified as a concern by De Soto residents. The 1981 report determined that the combined capacity of the spillways will not pass 50% of the Probable Maximum Flood without overtopping the dam. This means the dam has limited flood storage function and is susceptible to overtopping during heavy precipitation events. The USACE's 1981 Valle Lake Dam Report is available in the 2019 Upper Joachim Creek Floodplain Management Plan Appendices.

Figure 15 contains photographs of Valle Lake Dam and Spillway taken in August of 2018 during a USACE site visit.

Figure 15. Valle Lake Dam and Spillway Photos, 2018

Appendix B – Critical Infrastructure

In addition to the previously discussed hazards, there are also critical facilities within the watershed that are vulnerable to flooding, potentially causing life-safety issues if inundated with flood water. One such facility is the De Soto rural fire station in De Soto, which was inundated during several flood events and prevented emergency personnel from performing their duties.

Due to security issues, the exact location of these facilities are not included in the report, but the number of each type of facility located within the watershed and within 500 feet of the 1-percent AEP floodplain is included in **Table 8** below (Environmental Protection Agency (EPA) Facility Registry, 2012).

Table 8. EPA Facility Registry, 2012

Facility Type	Upper Joachim Creek Watershed Totals	Within 500 feet of a mapped floodplain in the Upper Joachim Creek Watershed
Chemical industry	1	0
EPA FRS Facility	25	7
Cellular towers	2	0
Day care centers	3	0
Schools (K-12)	1	0
Emergency Medical Services	5	2
Law enforcement	1	1
Cemeteries & crematories	4	3
Nursing homes	3	0
Pharmacies	4	1
Veterinarian	3	1
Wastewater treatment plant	1	1

Appendix C – Directory of Key Personnel

City of De Soto, Missouri			
City Manager	Todd Melkus	[redacted]	Incident Management, Media Relations
Police Department			
Fire Department	James Maupin	[redacted] [redacted]	
Public Works	Kevin Warden	[redacted]	
City Clerk	Ann Baker	[redacted]	Deputy Officer, Responsible for City Hall
Deputy City Clerk	Crystal Barton		Assistant to the Deputy Officer, Calls day cares, schools, and nursing home
Finance Department	Tasha Dennis		• Track all incident cost • Evaluate financial and administrative considerations of the incident • Oversee budgeting and future payments • Assign responsibilities, as needed, to time Procurement, Compensation/claims, Cost, and Cost Recovery units
Utility Billing Clerk	Daphne Jennewein		Answer phones, Collect information concerning water leaks and blocked roads, Advise citizens of shelter locations

Jefferson County, Missouri			
Emergency Management	Warren Robinson	[redacted]	
De Soto School District			
John Hedger	Head of Maintenance	[redacted]	
Josh Issacson	Superintendent	[redacted]	
Dorean Dow	Assistant Superintendent	[redacted]	
Religious Institutions			
First Baptist Church	Jeremy Muniz, Jason Aarons	[redacted]	Kitchen NG
Redeemer Lutheran Church	Pastor Rose	[redacted]	Kitchen LP
Christian Church		[redacted]	Kitchen, Electric, Showers
De Soto Community Church of God		[redacted]	Kitchen Electric
Rural Fire Station			
Miscellaneous			
National Guard		[redacted]	Kitchen NG

Appendix D – Sandbagging Techniques

Sandbagging is a century's old, tried and true method of flood fighting. See below for procedures and safety tips on efficient bagging operations.

1. Sandbags: A Steadfast Tool for Flood Fighting

Sandbagging is one of the most versatile of flood fighting tools and is a simple, effective way to prevent or reduce floodwater damage. Although sandbags do not guarantee a watertight seal, they are a proven deterrent to costly water damage.

Sandbags have been used to:

- Direct a river's current flow to specific areas
- Act as a temporary floodwall

Read this page to learn proper filling and placement methods aimed at increasing productivity of sandbagging operations. Included are hints, safety tips and correct procedures which will minimize work-related injuries and will maximize essential time.

2. The First Line of Defense

Sandbag construction is a century's old technique that has changed little over the years. Bags are made from different materials. They measure approximately 14 inches wide and 24 inches long. Sandbags filled two-thirds full should be left untied for most uses. Tied bags, filled slightly fuller, have specific purposes such as filling holes, holding visquine or straw bales in place, or forming barriers backed by supportive planks or aluminum sheet piles. If access to the flood site is limited to boat, tractor or helicopter, then pallets and forklifts may be needed to load and off- load sandbags. Unused empty bags can be stockpiled for emergency use and will be serviceable for years if kept dry and properly stored.

3. Fill Materials

Sand is by far the easiest material for filling and shaping sandbags and becomes heavier when saturated from rain or moisture. In emergencies, other materials such as silt, clay, gravel or a mixture of these may be used, but none work as well as sand. When vehicle access is cut off to the flood site and you have no other choice, use the back side of the levee or an adjacent dry field to find whatever material is available to fill sandbags.

Here are pros and cons on use of other materials:

- Silty soils get soft when wet and are more difficult to shape, and finer particles leak through the weave in the material.
- Clay materials are difficult to shape and to bag.
- Coarse-grained gravels are pervious and are also difficult to shape but can be used for redirecting the main-stream flow while allowing seepage through bags.

4. Correct Filling Procedures

Filling sandbags is normally a two or three-person operation. One member of the team, while crouching with feet apart and arms extended, should place the bottom of the empty bag on the ground. The opening of the bag is folded outward about 1-1/2 inches to form a collar and held open to allow the second team member to empty a fully rounded No. 2 shovel of material into the open end of the bag. Don't hurry. Haste can result in undue spillage and added work. The third team member stockpiles or stacks the open sacks. The three team members should rotate duties often to reduce job-specific muscle fatigue.

Untied bags should be filled approximately two-thirds full. Tied bags can be filled slightly more, but with enough room left at the top to properly tie off the bag. Always use gloves to protect your hands during the filling operation. After handling treated bags, avoid contact with your eyes and mouth. Dress appropriately and layer clothing. Safety goggles should be used on dry and windy days.

Sandbag filling operations are done either near the actual placement site or at centrally located filling sites such as fire stations, diking districts or sand pits. If the bags are filled at a distant location, vehicle transportation and access to the flood site are primary planning considerations. For large scale operations, a variety of specialized filling equipment, such as funnels on the back of dump trucks, is commercially available. Such equipment is not always available during an emergency and may be best suited for a staging area where bags can be filled and then delivered to the site.

5. Proper Placement

Remove any debris from the areas where bags are to be placed. Place the bags lengthwise and parallel to the direction of flow with the untied open ends of the bags facing upstream. Fill the low spots first before placing bags the full length of the area to be raised. Start at the downstream end of the sandbag operation about 1 foot landward from the river or levee's edge and continue upstream.

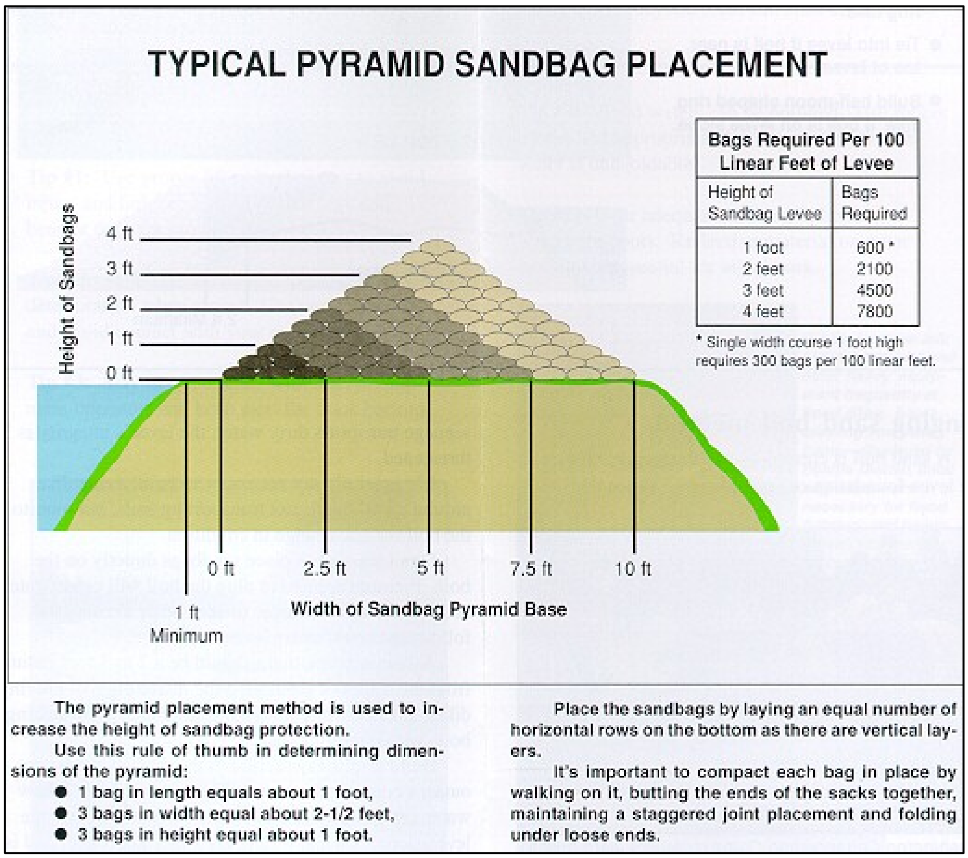
Fold the open end of the bag under the filled portion. Place succeeding bags with the bottom of the bag tightly and partially overlapping the previous bag. Offset adjacent rows or layers by one-half bag length to avoid continuous joints. To eliminate voids and form a tight seal, compact and shape each bag by walking on it and continue the process as each layer is placed. This flattens the top of the bag and prevents slippage between succeeding layers.

Single Stack Placement

Sandbags stacked in a single row work well in flood areas where there is no streamflow velocity or danger from floating debris, such as logs and tree stumps or from wave action which could topple the bags. Although generally recommended not to be above three courses or layers in height (approximately 1 foot), higher single stack placement can be effectively used as a barricade to protect structures from impending water damage as shown in the photo.

Pyramid Placement Method

Use pyramid placement to increase the height of sandbag protection; however, use caution when raising the levee height. Determine the height of the sandbag raise by using the best available forecasts of flood conditions.



Bags Required Per 100 Linear Feet of Levee	
Height of Sandbag Levee	Bags Required
1 foot	600 *
2 feet	2100
3 feet	4500
4 feet	7800

An example: When the water level is currently 1 foot below the top of the levee and is predicted to rise 3 more feet, construct a 2.5-foot sandbag operation which includes one-half foot of height as a safety factor.

It is important to compact each bag in place by walking on it, butting the ends of the sacks together, maintaining a staggered joint placement and folding under all loose ends. Watch for flooding elsewhere and watch for boils on the landward side of the levee due to the increased water elevation.

6. Safety Tips

Tip #1: Use proper lifting techniques to avoid injury and fatigue. Lift with your legs and bend at the knees to save your back.

Tip #2: Sandbags are treated to prevent deterioration when stored. Use work gloves and avoid contact with your eyes and mouth.

Tip #3: Stay in eye contact with heavy equipment operators and keep alert for truck backup alarms.

Tip #4: Flood waters can be polluted. Use rubber gloves and appropriate clothing if contact with water is unavoidable.

Tip #5: Wear adequate clothing in layers and watertight boots. Reflective material on outer clothing is essential for night work.

Appendix E – Pre-scripted Messages

Draft Public Announcement Message #1:

The National Weather Service has issued a flood warning that encompasses the Upper Joachim Creek Watershed. This means that high water along Joachim Creek is very likely. Residents should voluntarily evacuate to higher ground. The City of De Soto and Jefferson County are providing updates to the radio and TV stations. Residents should remain vigilant to these updates.

Draft Public Announcement Message #2:

The City of De Soto has announced that flooding of Joachim Creek is imminent. Residents should evacuate to higher ground immediately.

Appendix F – History and Records

1. Record of Emergency Action Plan Distribution

The EAP (Emergency Action Plan) and all updates shall be distributed to the City of De Soto's emergency response partners.

1. USACE
2. FEMA
3. SEMA
4. Jefferson County Emergency Management

2. Record of Emergency Preparedness Plan Updates

The EAP is periodically updated in order to capture as much institutional knowledge of flood fight operations as possible. As changes are made to the EAP, details pertaining to the edits shall be listed in **Table 9** below. The updated EAP will be distributed to those parties listed on the distribution list within the EAP.

Table 9. Emergency Action Plan Change Log

Version #	Description of Change (Section #)	Date	Changed by:
		/ /	
		/ /	
		/ /	
		/ /	
		/ /	
		/ /	
		/ /	
		/ /	
		/ /	
		/ /	

3. Record of Routine Inspections & Maintenance

Record of bi-annual inspections can be very useful during a flood event. The City of De Soto should inspect and maintain its gear and equipment including but not limited to:

- Sandbags
- Test notification system
- Emergency contact phone numbers

These inspections of equipment should be documented and the records should be kept in a centralized location.

4. Record of Emergency Action Plan Training Exercises

EAP Training Exercises should be conducted as needed to ensure all parties can sufficiently perform their role during an actual emergency situation. The training exercises should include communication activities, exercising equipment, and operation of closure structures. Documentation of the training activities shall be recorded in **Table 10** below.

Table 10. Emergency Action Plan Training Exercise

Description of Exercise	Date	Supervised by:
Tabletop Exercise – Simulated flood emergency with sponsors, state & local EMA, and USACE.	11/16/2020	USACE
	/ /	
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Appendix G – Glossary of Terms

100-Year Flood (for National Flood Insurance Program (NFIP) evaluation and FEMA mapping accreditation) – A 100-year flood is a statistical event that has a 1% chance of occurring each year in a given area. So, a better term might be the "1-in-100 chance flood. The 100-year flood is also referred to as the 1% flood, since its annual exceedance probability is 1%, or as having a return period of 100- years. The 100-year flood is generally expressed as a flow rate.

Accredited Map – The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) that depicts the leveed area as having reasonable assurance that the 1% annual chance exceedance flood will be excluded. This determination is based on the submittal of data and documentation as required by Section 65.10 of the National Flood Insurance Program regulations specifying that it has been determined that the associated flood risk management system is found to be in accordance with requirements by Federal agencies with levee design and construction competence (such as a registered professional engineer).

Annual Chance Exceedance Flood (ACE) – The flood that has a (stated percent - %) chance of being exceeded in any given year, such as the 1% annual chance exceedance flood. It is based on how often flood waters would be higher than certain elevations. This term has been replaced with the term Annual Exceedance Probability.

Annual Exceedance Probability (AEP) – The flood that has a (stated percent - %) probability of occurring in any given year, such as the 1% annual exceedance probability flood. It is based on how often flood waters would be higher that certain elevations. This term replaced the term Annual Chance Exceedance.

Community – Any state or area or political subdivision thereof, or any Indian tribe or authorized tribal organization that has the authority to adopt and enforce floodplain management regulations for the areas within its jurisdiction.

Consequences (**of Inundation**) **-** The effect, result, or outcome of inundation as reflected in the potential loss of life, economic losses, and adverse environmental impacts.

Evacuation –The organized, phased, and supervised withdrawal, dispersal, or removal of civilians from a designated flood area where a threat to life and property exists or is likely to exist in the immediate future.

Evacuation Map – A map displaying the geographic area within and immediately outside the FRMS inundation area that identifies routes to be used for evacuating the public to higher ground if threatened by flood. Specific routes for identified populations (special needs, inmates, livestock, etc.), hazardous materials, and on-going movement of supplies and materials for flood fights should all be highlighted on the evacuation map. Evacuation Map may be found in the County's All-Hazard Mitigation Plan.

Federal Emergency Management Agency (FEMA) – The agency within the Emergency Preparedness and Response Directorate of the U.S. Department of Homeland Security. FEMA facilitates coordination of Federal dam safety programs and administers the NFIP and several flood mitigation planning and grant programs.

Flood – A general and temporary condition of partial or complete inundation of normally dry land areas from overflow of inland or tidal waters, unusual or rapid accumulation or runoff of surface waters, or mudslides/mudflows caused by accumulation of water.

Flood-Frequency – A graph, table, or single tabulation showing the relationship of the flood variable of interest (peak flow, peak stage, 3-hour volume, etc.) to the probability of the variable being exceeded in any given year.

Flood Warning System – A flood warning system should be put in place to warn the threatened public that a flood is imminent, and they should move to higher ground. Examples of flood warning systems are reverse 911, sirens and sensors that automatically read instrumentation during an emergency.

Incident – An occurrence or event—natural, technological, or human-caused—that requires a response to protect life, property, or the environment (e.g., flood).

Incident Commander – Is a term used by FEMA to be the designated lead person responsible for all aspects of an emergency response and is the primary point of contact that sets priorities, coordinates incident response teams, and prepares the After Action Report. The Incident Commander could be the President of the Levee District or one of the Commissioners.

Incident Action Plan – The Incident Action Plan is a term used by FEMA and includes a description of the incident, location, objectives, execution narrative, related tasks, support mechanisms, communication plan, and other required information.

Inundation Area – The footprint of the area that will flood due to overtopping or malfunction of the FRMS.

Inundation Scenarios (for FRMS) – Hypothetical situations demonstrating how flooding can occur behind a levee. The four inundation scenarios considered are: 1) breach prior to overtopping; 2) overtopping without breach; 3) overtopping with breach; and 4) malfunction of a FRMS components.

Life Safety (Life Risk) – The threat of loss of life resulting from a flood or other emergency or disaster.

Mitigation – Activities providing a critical foundation in the effort to reduce the loss of life and property from natural and/or human-caused disasters by avoiding or lessening the impact of a disaster and providing value to the public by creating safer communities. Mitigation seeks to fix the cycle of disaster damage, reconstruction, and repeated damage. These activities or actions, in most cases, will have a long-term sustained effect.

National Flood Insurance Program (NFIP) – Federal program under which flood-prone areas are identified and flood insurance is made available to the owners of the property in participating communities.

Non-Structural Measures – Non-structural measures reduce the consequences of flood by: 1) changing the use made of the floodplains through land use controls, 2) through relocation of structures, or 3) by reducing vulnerability of existing uses to adverse consequences from inundation through flood proofing and flood warning and preparedness systems, including associated emergency measures of evacuation and search and rescue.

Probability (Likelihood) – Likelihood is a measure of the chance, or degree of belief that a particular outcome or consequence will occur. Probability provides a quantitative description of the likelihood of occurrence of a particular event. Probability is expressed as a value between 0 (impossible) and 1 (certain).

Preparedness – Actions that involve a combination of planning, resources, training, exercising, and organizing to build, sustain, and improve operational capabilities. Preparedness is the process of identifying the personnel, training, and equipment needed for a wide range of potential incidents, and developing jurisdiction-specific plans for delivering capabilities when needed for an incident.

Risk – The potential for an unwanted outcome resulting from an incident or occurrence as determined by its likelihood and the associated consequences. Risk is a calculated estimate of the probability and severity of undesirable consequences.

Risk Analysis – Risk analysis is a framework that comprises three tasks: Risk assessment, risk management, and risk communication.

Risk Identification – The process of finding, recognizing, and describing potential risks.

Risk Management – The process of identifying, analyzing, assessing, and communicating risk and accepting, avoiding, transferring, or controlling it to an acceptable level at an acceptable cost.

Standard Operating Procedure (SOP) – An SOP is a reference document or operations manual that provides the purpose, authorities, duration, and details for the preferred method of performing a single function or a number of interrelated functions in a uniform manner.

Warning – The alerting of emergency response personnel and the public to the threat of extraordinary danger and the related effects that specific hazards may cause.

Appendix H – Tabletop Exercise

November 16, 2020 Tabletop Exercise:

Purpose: Assist City personnel with identifying strengths and weaknesses in these areas

- Facilities
  - Structural maintenance considerations; flood mitigation; back-up power supplies; supplies for staying on-site; accessibility considerations; and emergency repairs.
- Human Resources Policies
  - Employee notification and alerts; early release/telework policies; flexible work schedules; payroll and insurance policies; employees trained in first-aid with access to medical supplies; and capacity to ensure accessibility for individuals with disabilities or access and functional needs.
- Continuity of Operations Plans
  - Plans to operate at an alternate location; access to important data; roles and responsibilities; and plans and processes to resume operations.
- Emergency Operations Plans
  - Ability to provide critical information and updates during the emergency through multiple notification systems; guidance on how to protect critical assets; plans to provide first aid; and protocols for communicating with local first responders and critical infrastructure providers.

Attendees:
USACE

- Hal Graef (Project Manager/Tabletop Exercise Facilitator)
- Matt Jones (EAP Planner)
- Davor Karic (Hydraulic Engineer)
- Jordan Lucas (Economist/LifeSim Modeler)
- Janet Meredith (Public Affairs)

De Soto

- Todd Melkus (City Administrator)
- Jeff Wynn (Police Captain)
- Chief Jeff McCreary (Police Chief)
- Kevin Warden (Public Works)
- Charles Roop (Asst. Public Works Director)
- Jesse Martin (Valley Ambulance)
- James Maupin (Fire Chief)

Citizens' Committee for Flood Relief (CCFR)

- Paula Arbuthnot
- Susan Liley

Hypothetical Scenario:
Saturday, September 5, 2020, 1 p.m. - It has been a relatively wet summer. Rain has saturated the Upper Joachim Creek Watershed in the past weeks. Although no heavy rains have occurred, there is a tropical storm that has made landfall in the Gulf of Mexico and is forecast to head north into the Desoto area over Memorial Day weekend. The National Weather Service

Forecast is for up to 9" of rain in some areas. Hail and high winds have been reported as the system traveled through Arkansas. Local rainfall totals reportedly range from 5 to 9 inches. Thunderstorm watches are posted until 7:00 a.m. Monday morning. Heavy rain is expected to produce thunderstorms throughout the night and into tomorrow morning.

Injects used to guide the Tabletop Exercise discussion

SUBJECT	EVENT DESCRIPTION	DISCUSSION / NOTES
Forecast	It has rained several days this week and major thunderstorms are forecast for overnight	T. Melkus to monitor forecast and radar.
Event Start	Event begins Sunday at 5am	
Gage	Joachim Creek gage reading has reached 6'	T. Melkus would reach out to Police Department (PD) and Fire Department (FD) but no official action would be taken. Monitor radar. T. Melkus to watch the detailed gage that has height updated every 5 minutes. 8 ft is when the call is made to put it on CodeRED. T. Melkus tries to not send something out if the forecast shows that 8 ft may be briefly topped so that the alert doesn't go out and no flooding occurs. PD has a procedure and goes on watch in certain locations (see hand-out from PD); the PD will watch the gage and visually inspect the creek. Alerts for the PD Chief start at 4 ft. CCFR (S. Liley) to monitor both NOAA and FEMA websites
Accident	A truck struck a pole and has knocked out power and phone service to several blocks by the fire house on Miller and Rollins	Unified Command post established at FD; notify Ameren and Spire gas if pole is struck; Spire will start pulling gas meters to prevent damage.
Gage	Joachim Creek Gage reading has reached 8'	Initiate CodeRED alert; may hold off if no other rain is forecasted; PD ceases other law enforcement duties and focuses on flood duties.
Weather	National Weather Service has issued a Flash Flood Warning for De Soto	Social media notification is initiated in addition to the CodeRED alert
Gage	Joachim Creek Gage reading has reached 10'	Rural Fire Department evacuates because of flooding. Sandbagging: volunteers; not priority for the City due to the limited time available.
Evacuation	A man reports chest pains when police arrive by boat to evacuate	2nd ambulance would be available (total of three, 24-hours a day). - No ideal place to put a boat in safely; debris in the creek causes issues with boats. Even if City requests additional units, that doesn't change the flashy nature;

		- CCFR (P. Arbuthnot): this comes back to the education of the citizens; perhaps asking the citizens for who needs oxygen and who has medical needs that a flood would affect. - PD could double the staff within 15-20 minutes because police staff have vehicles. - City has an alert system with a loud speaker used solely for tornados [City to research feasibility of expanding its use to include flood alerts]
Gage	Joachim Creek Gage reading has reached 11'	
Gage	Joachim Creek Gage reading has reached 12'	Expanding areas; shutting down main street.
Accident	A local resident in a truck has driven into floodwaters along Valley and 11th and becomes stranded.	Notice of truck flooded will route through Unified Command post; 3 different areas of responsibility (north, east, and south areas). Mass Casualty incidents allow for more units; Hillsboro Police Chief (20 minutes from St. Francois County ambulance to De Soto). Water by Casey's is backup water. Temporary barricades don't work because many people ignore the notice. When the CodeRED is sent, PD Dispatch reaches out to shelter points. Could take up to an hour to get folks to shelter points. Homeowners unwilling to leave their homes without their pets is to be expected.
Gage	Joachim Creek Gage reading has reached 13'	
Evacuation	Police officers report homeowner refusing to leave their pets behind in a home with water already in the home	Homeowners unwilling to leave their homes without their pets is to be expected.
	Baptist Church is requesting Red Cross assistance at the shelter	Request routed through Unified Command; CCFR (S. Liley) seeks additional information on United Way's 211 program. Further research needed.
Gage	Joachim Creek Gage reading has reached 14'	T. Melkus and Unified Command to monitor flood inundation mapper to project impact to this extreme event.
Gage	Joachim Creek Gage reading has reached 16'	
Gage	Joachim Creek Gage reading has reached 18'	
Medical	911 reports a citizen wanting to leave the trailer park is on crutches and is requesting transportation	

Exercise Summary:
Exercise attendees used this “what if” scenario to confirm the content of this Emergency Action Plan. Requesting aid from nearby communities was discussed several times. The City’s ability to respond to a flash flood appears to be maximized at approximately 13’ on the Joachim Creek’s gage. At this stage, all resources are fully utilized and aid requested.

Post-Exercise Considerations:
- City to further research use of modifying tornado siren for flood warning.
- City to further research/document sandbagging details (i.e., where supplies are kept, how they are distributed, details on periodic training, etc.).