

SAN JACINTO

REGIONAL WATERSHED MASTER DRAINAGE PLAN



Harris County Flood Control District
San Jacinto River Authority
Montgomery County
City of Houston

APPENDIX J OTHER FLOOD HAZARD MITIGATION ACTIONS



12/07/2020
TBPE FIRM NO. 312

Appendix J: Other Flood Hazard Mitigation Actions

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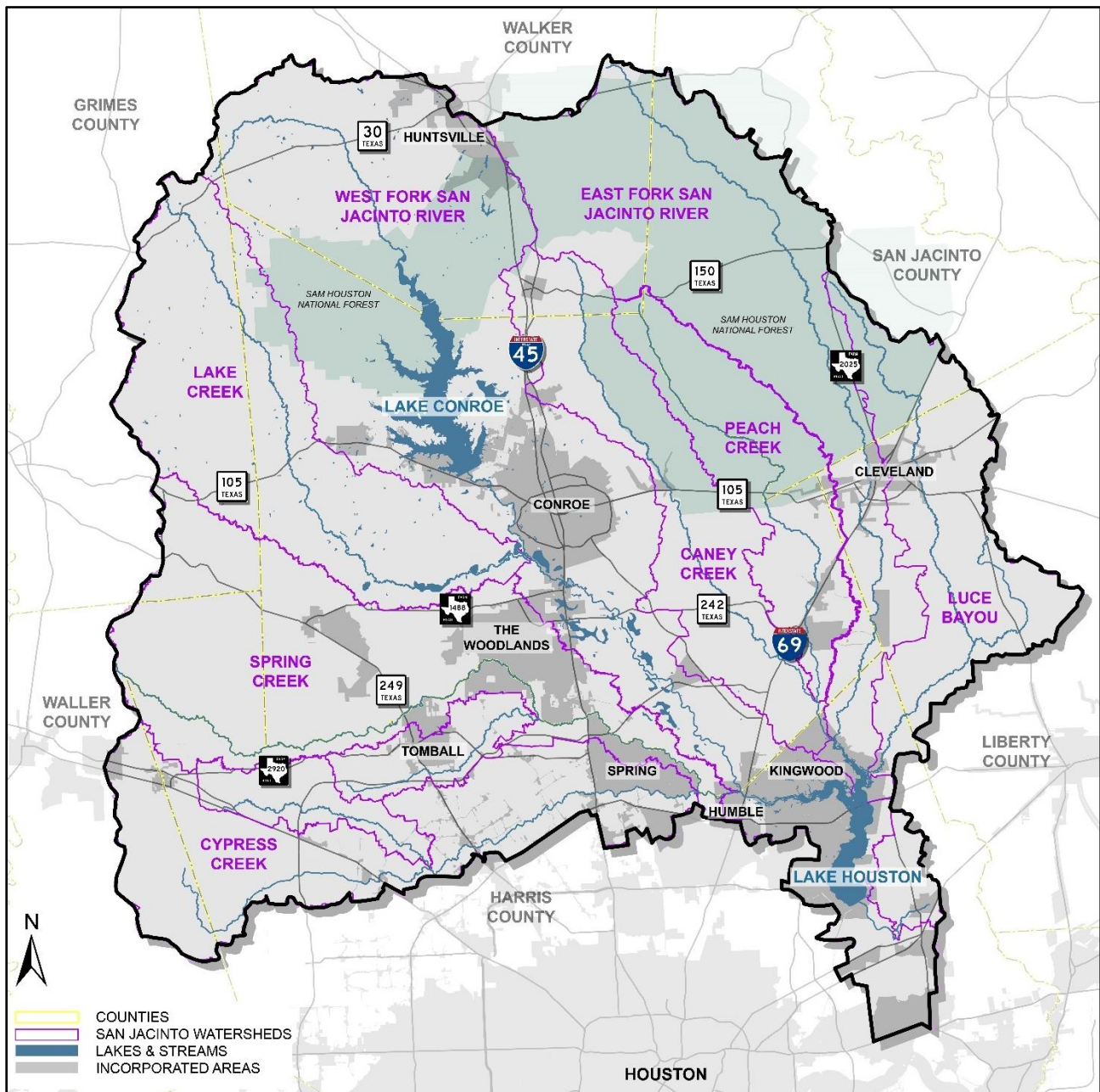
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Figure 1. Upper San Jacinto River Watershed Map



1.0 Introduction

The San Jacinto Regional Watershed Master Drainage Plan (SJMDP) area encompasses the Upper San Jacinto River (SJR) watershed which is comprised of:

- West Fork San Jacinto River (Including Lake Creek and the Lake Conroe watershed)
- East Fork San Jacinto River (Including Peach Creek and Caney Creek)
- Spring Creek Watershed (including Willow, Cypress, and Little Cypress Creeks)
- Luce and Tarkington Bayou
- Jackson Bayou and Gum Gully

The map in **Figure 1** above shows the Upper San Jacinto watershed, which encompasses an area of more than 2,880 square miles and generally drains through Lake Houston to Galveston Bay. The San Jacinto Regional Watershed Master Drainage Plan has four primary goals:

- **Primary Mitigation Planning** – Structural improvements and policy that help to **reduce flooding**
- **Secondary Mitigation Planning** – Enhance **flood warning** capabilities in the basin
- **Other Flood Hazard Mitigation Actions** – Improve **flood response** through risk identification and communication.
- **Community Outreach** – **Education** of decision makers and the public about flood risks and mitigation strategies

The focus of this document is improving flood response for the watershed, identified in the study scope of services as Other Flood Hazard Mitigation Actions. This memo will discuss several items, including Flood Response Coordination with agencies in the San Jacinto River watershed responsible for emergency management as well as a summary of communications plans and protocols that are utilized by the various agencies and potential improvements to those protocols, if warranted.

In addition, the location of critical infrastructure and its relative flood risk will be discussed. The relative risk is based on the updated hydrologic and hydraulic modeling and associated inundation mapping prepared as part of this study. Finally, the memo includes discussion of the expected flood frequency of roadways in the watershed

1.1 Other Flood Hazard Mitigation Actions Goals

There are several goals that were established for the Other Mitigation Actions task, each of which will be addressed in subsequent sections of this appendix.

- Coordinate with responsible emergency management personnel
- Review communications plans/protocols and recommend potential improvements
- Locate critical infrastructure and compare to inundation
- Identify evacuation routes and related flood frequency

2.0 Flood Response and Communication

The study team coordinated with several agencies that are responsible or are involved in emergency management. This includes representatives of each of the seven counties that are located, in whole or in part, within the San Jacinto River watershed. These include Harris, Montgomery, Liberty, San Jacinto, Walker, Grimes, and Waller County. In addition, the team conducted discussions with the San Jacinto River Authority (SJRA), the Houston-Galveston Area Council (H-GAC), and the cities of Houston and Conroe.

Each meeting included discussion on a variety of topics, including a general overview of the study, a discussion of each jurisdiction's communication practices, their knowledge about critical infrastructure in their jurisdiction, known flooding areas and roads, and recommendations for improvements. The notes from each of these meetings are included as an appendix to this document.

2.1 Flood Response Coordination Summary

Meetings were conducted with agency leadership and/or personnel familiar with the emergency management practices of that jurisdiction. Figure 1 provides a map of the study area and the cities and counties within the area. The interviews provided information from each of the various jurisdictions relating to communications, flood monitoring, data gaps, and best practices. The following meetings were conducted as part of the study team's investigation:

- Montgomery County, City of Conroe – January 30, 2020
- Grimes County – January 30, 2020
- Waller County – January 31, 2020
- Walker County – January 31, 2020
- Houston-Galveston Area Council – February 5, 2020; February 27, 2020 (VAST)
- Harris County EMC, HCFCD, City of Houston – February 7, 2020
- Liberty County – February 7, 2020
- San Jacinto River Authority and Montgomery County – February 26, 2020
- San Jacinto County – Several attempts to coordinate; no meeting conducted partially due to COVID-19

In addition, an Emergency Management Workshop was conducted on March 11, 2020, which included participants from several of the agencies listed. The workshop discussed the preliminary findings of the interviews as well as potential gaps in information and some preliminary recommendations for improvement to the communications practices. The presentation and meeting notes are included with this document as well.

2.2 Communication Summary

The communications discussion included both internal and external communications, which include both the public and neighboring jurisdictions. In general, the various jurisdictions indicated that communication during a disaster was effective and, while some adjustments or efficiencies could be made, significant changes are not necessary.

2.2.1 Internal Communication

Internal communication included those contacts between departments within a common jurisdiction that have emergency management related tasks. These include the local government (Mayor and Council members or County Judges and Commissioners), designated Emergency Management Coordinators

(EMC), Police or Sheriffs, Fire Departments and Emergency Medical Service (EMS), Public Works personnel, and others.

Each of the counties/cities indicated that there were good relationships between the various entities within common jurisdictions and that internal communication was effective. Communication between the various groups is done via phone, text, email, and radio. Most communities/agencies interviewed leverage FirstNet® to provide priority network access, such that communications disruptions are minimized during a disaster.

In addition, all the counties and cities utilize WebEOC for resource requests or response to requests; however, this is not a primary form of communication. The SJRA does not use WebEOC. In some of the more rural areas, there may be coverage gaps due to limited telecommunications infrastructure. Additionally, there was some interest in improving internal alerts, specifically alerts about flooding and infrastructure failures.

2.2.2 Communication with Neighboring Jurisdictions

As with the internal communication, the interviews revealed that the counties/agencies are generally pleased with their cross-jurisdictional communication. In particular, each of the counties indicated that the relationship with cities in that county are very good and there is regular contact between the entities. Communication with the Texas Department of Transportation (TXDOT) was also cited as important to the county representatives.

While the various counties do not have a set communication protocol for their neighbors, they do interact when dealing with issues that cross county boundaries, such as roadway closures that could affect evacuation or specific requests being made for assistance or resources. All the counties indicated that they are willing to assist the neighboring counties if asked and that they would anticipate receiving the same courtesy.

The Harris County Office of Emergency Management (HCOEM) has communication protocols set with the Harris County Flood Control District (HCFCD) and the SJRA in the case of flood related emergencies. These entities, along with representatives from the Harris County Sheriff's Office (HCSO) and many others, are co-located in the Harris County Emergency Operations Center during a disaster. In addition, communications relating to the San Jacinto River or Lake Conroe discharges or conditions are issued via joint press release by SJRA and HCFCD, indicating a united front for these agencies.

Harris County also coordinates with the Montgomery County Office of Emergency Management but has limited contact with the surrounding counties unless there is an issue with resource needs or evacuation routes. The SJRA is responsible for communications with neighboring jurisdictions related to the Lake and River. HCOEM also coordinates extensively with the City of Houston (COH), the Houston Police Department (HPD), and others. Coordination with the remaining 33 municipal jurisdictions in Harris County is done through the OEM as needed.

2.2.3 Communication with the Public

Each of the counties/agencies within the San Jacinto watershed communicate with the public during a disaster. Each entity has a website that provides information and the use of social media is prevalent, but to different extents depending on the jurisdiction. Most of the surrounding counties that lie partially within the watershed use Facebook to share information. These jurisdictions may have several agencies that have Facebook accounts, such as OEM, Sheriff's Offices, or County Commissioners, but they are not necessarily linked or sharing consistent information.

Harris County uses several social media platforms, leveraging Facebook, Twitter, YouTube, and LinkedIn. In addition, there are linkages between the OEM and the City of Houston, Police and Sheriff's

Departments, Fire, County Judge and Commissioners, and HCFCD, such that consistent information is being shared across multiple agencies and platforms. HCFCD and other agencies also share information from the National Weather Service (NWS) and the US Geological Survey (USGS) that relate to weather and flood conditions.

In addition to social media, each of the jurisdictions have emergency notification capabilities through either Nixle, CodeRed, or Civic Ready, which push information to the public via the phone system. These jurisdictions can send notifications to all recipients or target certain zip codes or defined geographical areas. However, in order to receive alerts, participants must register, which can be a challenge for the jurisdiction. Participation in these notifications varies but is far from 100 percent. In addition, each of the counties/agencies maintain relationships with local media outlets, including television and radio.

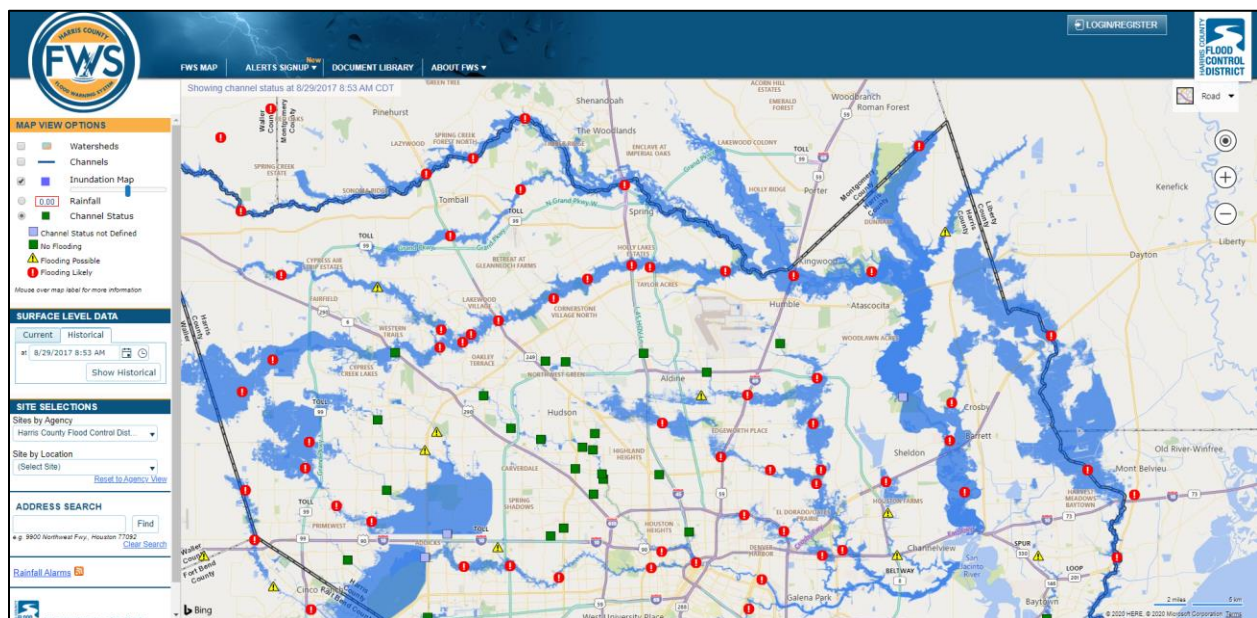
3.0 Flood Monitoring and Assessment

There are a variety of ways in which the various jurisdictions monitor flood conditions during a disaster or major rainfall event. These range from electronic monitoring, to staff reconnaissance, to public reporting of flood conditions. The interviews with the counties/agencies included a discussion of the flood monitoring approaches across the watershed.

3.1 Harris County Flood Warning System

The Harris County Flood Warning System (FWS) is extensively utilized by both local agencies and the public. The system provides real-time rainfall and stage information using a network of 184 gages across Harris and the surrounding counties. The website provides a user-friendly interface that allows users to monitor rainfall totals, elevations at each gage, the status of the channel at the gage (i.e. No Flooding, Flooding Possible, Flooding Likely), and approximate inundation limits within Harris County, which are based on the FEMA effective models. The FWS (<https://www.harriscountyfws.org/>) is shown below in **Figure 2**.

Figure 2. Harris County Flood Warning System



Most of the surrounding counties indicated that they use the FWS to provide information where gages are available in their jurisdiction. There are HCFCD gages in Liberty, Montgomery, Waller, and Grimes Counties. In addition, there are SJRA gages in Montgomery and Walker Counties. Gages from other agencies such as TXDOT and The Woodlands are also leveraged.

There are several upgrades to the HCFWS that are in progress, including the addition of several gages that are currently being or have recently been installed. These gages are being added along Luce and Tarkington Bayous, as well as the East Fork of the San Jacinto and Winters Bayou, which is a tributary to the East Fork. Several gages have been added in the Spring Creek watershed over the last few years, including on Walnut Creek, Threemile Creek, and Mill Creek. As part of the SJMDP, recommendations for augmenting the FWS were provided in **Appendix I: Secondary Flood Hazard Mitigation Memorandum** (August 2020). HCFCD is also working to expand the inundation mapping capabilities of the FWS and adding the potential for flood forecasting in the future. These features will leverage the modeling

developed as part of this study to increase coverage into Montgomery County and the other 5 counties within the watershed.

3.2 Physical Flood Monitoring

While electronic monitoring of flood conditions is prevalent in Harris County, limited gage availability in the outlying counties requires more in-person monitoring. This includes receiving information from the public and responsible departments about roadway flooding conditions at stream crossings and potential actions that need to be taken, such as placing barricades. In-person monitoring is not done for every rain event, but when weather predictions are evaluated for potential severe weather conditions, such that the responsible agencies can be proactive. In addition, some communities have rainfall thresholds, such that if the rainfall depth or intensity exceeds a certain limit, monitoring will begin. The physical flood monitoring information comes from a variety of sources:

- Emails, calls, photos and text messages from the public
- County Commissioners and their staff
- Police and/or Sheriff's Departments and Fire Departments
- Texas Department of Transportation
- Local School District Bus Drivers

Each of the jurisdictions except the SJRA identified specific roadways that are subject to flooding on a relatively frequent basis. These include local county roads, state highways and some major freeways. Specific information related to roadway flooding frequency is provided in subsequent sections of this appendix.

3.3 H-GAC Vulnerability Assessment Scoring Tool (VAST)

The study team met with representatives of the H-GAC to discuss the Vulnerability Assessment Scoring Tool (VAST), which is intended to help transportation planners conduct a quantitative assessment of the transportation system's vulnerability to natural disasters, such as storm surge, inland flooding and other events. VAST for the Houston-Galveston region is currently being developed as part of a pilot study funded by FHWA, which involves multiple Metropolitan Planning Organizations (MPO) across the nation. There're 8 counties within the HGAC MPO – Harris, Waller, Montgomery, Liberty, Brazoria, Fort Bend, Chambers, Galveston.

- Information in this section as well as detailed information relating to the pilot study being conducted by H-GAC is provided at <http://www.h-gac.com/resiliency-planning/documents/draft-resiliency-and-durability-pilot-study-methodology.pdf>
- Additional information related to H-GAC and VAST can be found on their website <http://www.h-gac.com/home/residents.aspx>

VAST looks at a combination of the road criticality and vulnerability and uses several indicators, which are individually scored and aggregated. Data for the tool includes TXDOT road data, LiDAR terrain information, FEMA flood depths, sea level rise data from NOAA, storm surge and historical events data.

The Vulnerability Assessment looks at several components:

- Exposure: the potential for exposure of assets to climate stressors like heat and rainfall
- Sensitivity: the likelihood that access to the asset is disrupted
- Adaptive Capacity: how easily can people adapt if the asset is inaccessible

The Criticality Assessment looks at the following factors

- Socioeconomic Importance
- Operational Usage
- Health and Safety
- Emergency Response

Using these two assessments, the assets are divided into several categories that range from Highly Critical-Highly Vulnerable to Less Critical-Less Vulnerable for a given rainfall or storm event. In the long term, H-GAC would like the tool to be leveraged for Hazard Mitigation Planning such that the transportation networks can be evaluated for a variety of natural hazards. This could be helpful information for long-range transportation planning.

The VAST process is set up to be repeatable for a variety of events, provided information is available for each event, specifically flood depth grids. The San Jac study team discussed the possibility of making depth grids available to H-GAC once the study is finalized and approved for release to the public. The process relies heavily on LiDAR data for elevation calculations of both natural ground and hydraulic crossings like bridges and uses the depth grid information, which will be available for a range of frequency events upon completion of the study.

H-GAC is working toward securing funding from the Federal Highway Administration (FHWA) to continue the development and implementation of VAST. There are several other entities across the state that are currently working, or will soon be working, on similar pilot studies. There are stakeholder meetings planned for Spring 2020, after which the pilot study information for VAST will be available online.

4.0 Information Gaps

During the interviews and workshop, several potential information gaps were identified. These include floodplain mapping, gage coverage, and the availability of real-time information.

4.1 Emergency Management Staff and Documentation

Most of the surrounding counties within the San Jacinto watershed have small emergency management staff and limited resources. In some instances, there may not be the same staff redundancy or availability as in Harris or Montgomery County. One person is in charge, which may overextend the individual in an emergency or create a situation where, if that person is unavailable, there may not be another experienced person available. Decades worth of experience and institutional knowledge may not be replaceable during an emergency.

Written procedures are available in most of the jurisdictions; however, there may not be a consistent effort to update or to review the procedures. Written plans were requested from each of the jurisdictions, but none were received. Our interviews revealed that although periodic review of these plans is conducted, regular exercises are not as common due to the difficulty of pulling everyone together. Many jurisdictions have volunteer fire departments, with fire and EMS staff that have primary jobs, which makes scheduling exercises more difficult. A lack of practice and familiarity with the planning documents could potentially lead to additional effort or even errors during a disaster. Many agencies respond on-the-fly, pulling available resources needed for emergency response and making decisions based on experience. It should be noted that each emergency is different, and not every scenario can be conceived and planned.

4.2 Floodplain Mapping

One of the concerns expressed by many of the counties interviewed was the lack of coverage and quality of FEMA floodplain mapping information. Floodplain mapping and models are a valuable source of information for emergency responders and accurate and up-to-date information is crucial.

4.2.1 Existing Floodplain Mapping

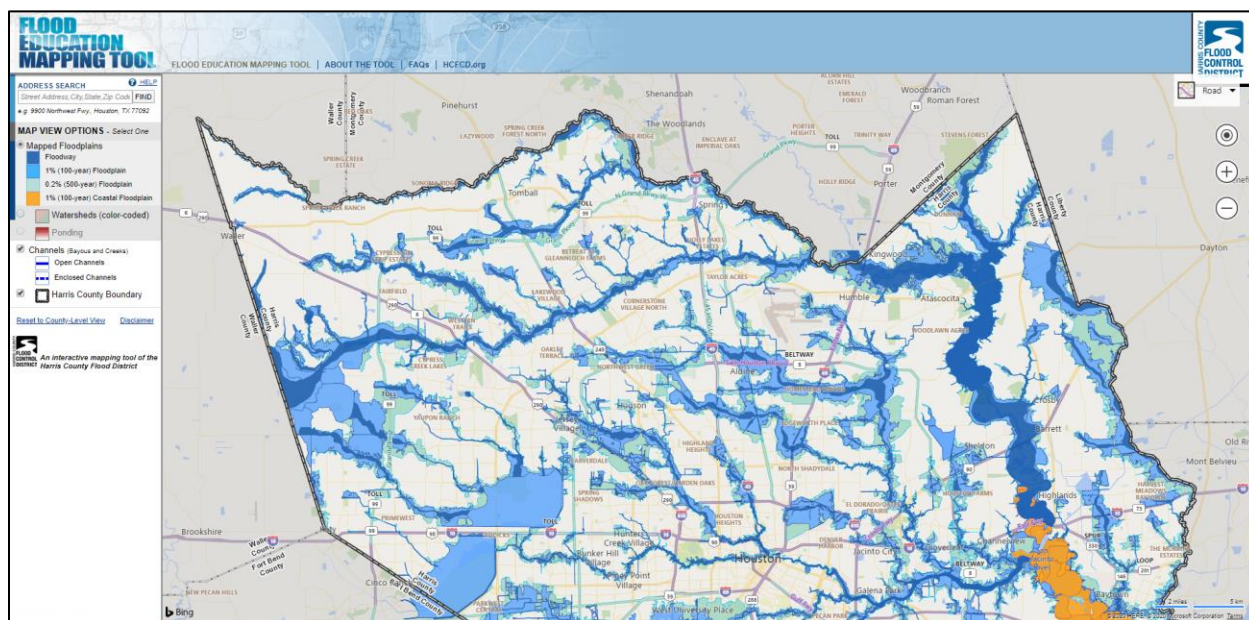
The floodplain mapping for most of the counties in the San Jacinto watershed varies by jurisdiction. Montgomery, Liberty, and Waller Counties have Zone AE with floodways on their major streams; however, the age and quality of the modeling is unclear. Based on our interviews, there was a general concern regarding the existing FEMA mapping and information used to generate the maps. Each of the counties, who are responsible for flood mapping, was interested in the potential to use the models developed as part of this study for FEMA mapping updates or best available information. While the goal of this study is not to prepare FEMA ready models, the models are of a quality that they could be leveraged to update the current effective maps. The current effective maps do not reflect new rainfall rates as published by NOAA. As a result, the current floodplain maps generally underestimate the flood risk in the watershed.

Walker, San Jacinto, and Grimes Counties have Zone A Approximate mapping, which indicates that there is no modeling along the streams. This lack of information poses a challenge when officials in those jurisdictions evaluate the potential impacts of development or need information about potential flood depths and velocities, particularly at road crossings.

Harris County has detailed modeling for all its major bayous and numerous tributaries and sub-tributaries that provide extensive floodplain coverage. The models are maintained by HCFCD and are utilized for flood hazard reduction projects, public infrastructure projects, and development analysis. Updates to FEMA mapping made via Letters of Map Change are incorporated into the models such that they are a current representation of the flood risks. **Figure 3** below shows the floodplain coverage of the northern portion of Harris County, which includes Spring Creek, Willow Creek, Cypress Creek, Little Cypress

Creek, Jackson Bayou, Luce Bayou, and the lower portions of the West Fork and East Fork of the San Jacinto River. The Harris County Flood Education Mapping Tool (FEMT) is available at <https://www.harriscountyfemt.org/>.

Figure 3. Harris County Flood Education Mapping Tool



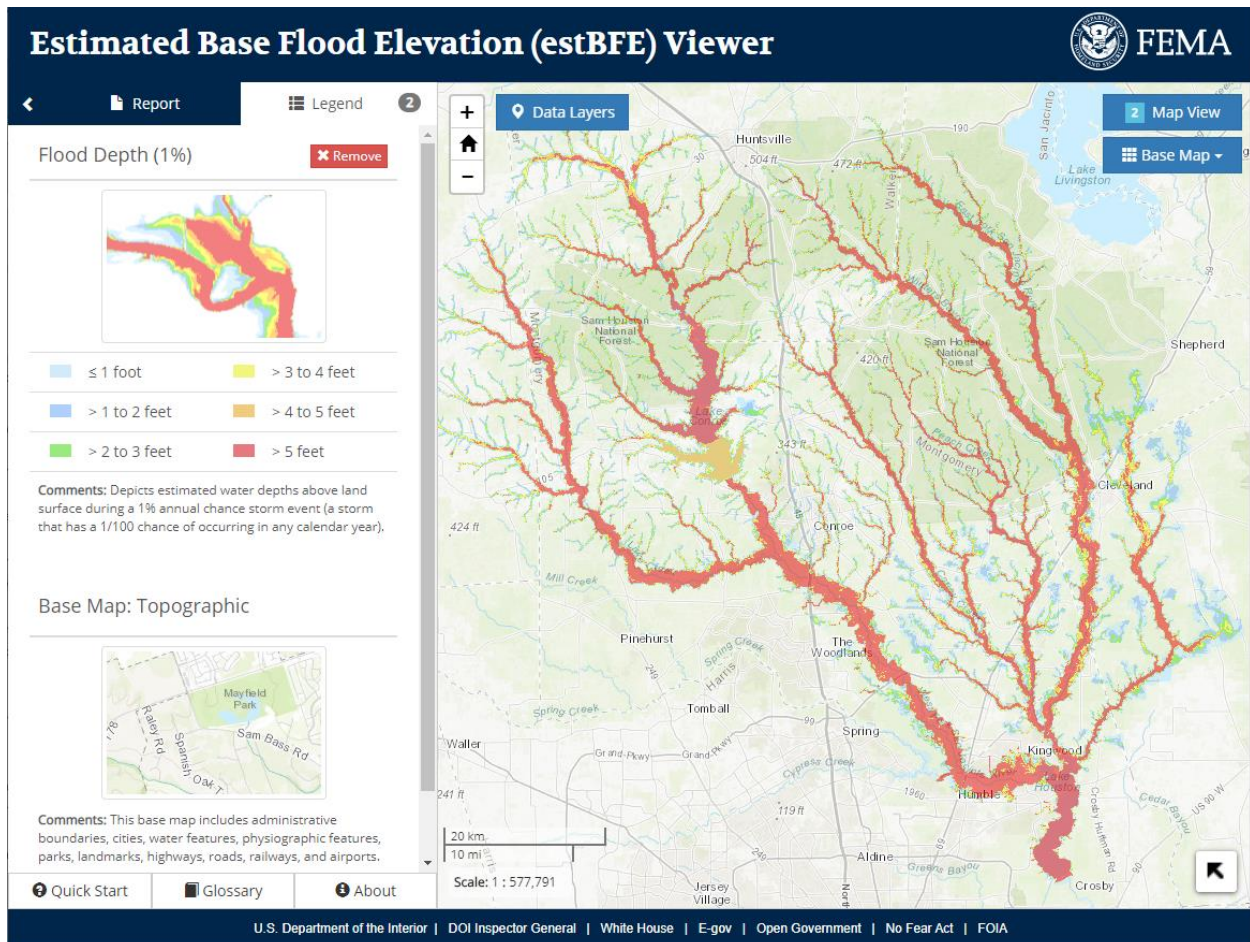
4.2.2 Potential Modeling Improvements

Improved modeling data for these cities/counties would provide better and more comprehensive information to these communities and, in particular, emergency managers responsible for these areas. There are a few options that could be exercised to obtain better floodplain information.

- Base Level Engineering (BLE)** – Much of the upper San Jacinto River watershed has been studied using FEMA BLE. BLE is an automated process to develop riverine hydrologic and hydraulic models based on the most recent topographic information. The process includes cross sectional areas of the riverine systems and discharge rates developed from regional regression data but does not include crossing structures such as bridges and culverts. While the level of detail is limited, BLE modeling provides a reasonable approximation of flood elevations and inundation, especially for areas include as Zone A or without mapping. Areas with BLE in FEMA Region 6 are shown in **Figure 4** and can be viewed at the following website: <https://webapps.usgs.gov/infrm/estBFE/>
- San Jacinto Regional WMDP Models** – The San Jacinto WMDP included the development of 535 miles of detailed hydrologic and hydraulic models for the major rivers and creeks. The models are based on the most recent LiDAR terrain information and use Atlas 14 rainfall and updated hydrologic parameters. The models have been calibrated to 2 historical storms, including Hurricane Harvey (2017) and Memorial Day 2016, and were validated using 2 additional storms. These models could be made available to each of the jurisdictions to use as best available data or leveraged as a basis for updated mapping.
- New FEMA Models** – Each of the counties responsible for floodplain mapping could conduct studies to develop new FEMA models and mapping for their jurisdictions in collaboration with FEMA Region 6. Development and approval of the models through FEMA could take several years; however, the individual jurisdiction would have the options to regulate to the models as

best available information until such time as FEMA approves and updates the mapping on the FIRM panels.

Figure 4. FEMA BLE Coverage in the San Jacinto River Watershed



A combination of the SJMDP, BLE, and new models is probably the most effective way to leverage the available mapping resources in the watershed. The models can be used as best available information and until the resources and/or available grant funding to develop new models of the smaller tributaries becomes available. The SJRWMDP and BLE models cover all the major streams listed in Section 1.0 as well as hundreds of miles of smaller tributaries throughout the San Jacinto River watershed.

4.2.3 Harris County MAAPnext

Harris County is currently engaged in the Mapping, Assessment, and Awareness (MAAPnext) program in coordination with FEMA to update the modeling and mapping within its jurisdiction based on updated Atlas 14 Volume 11 rainfall, 2018 LiDAR terrain, and advanced hydrologic and hydraulic methodologies, including the use of 1D/2D dynamic modeling. This effort will bring the models and maps up-to-date and expand the coverage of flood risk information to account overflow and urban flooding in areas not traditionally captured by 1D steady modeling and the resultant Flood Insurance Rate Maps (FIRM). More information about the MAAPnext program is available at the website; www.maapnext.org. Flood reduction information, including depth grids will provide emergency responders with information about potential urban flooding outside the floodplain, as well as roads that may be inundated, impacting mobility for emergency responders.

4.3 Gage Coverage and Real-time Information

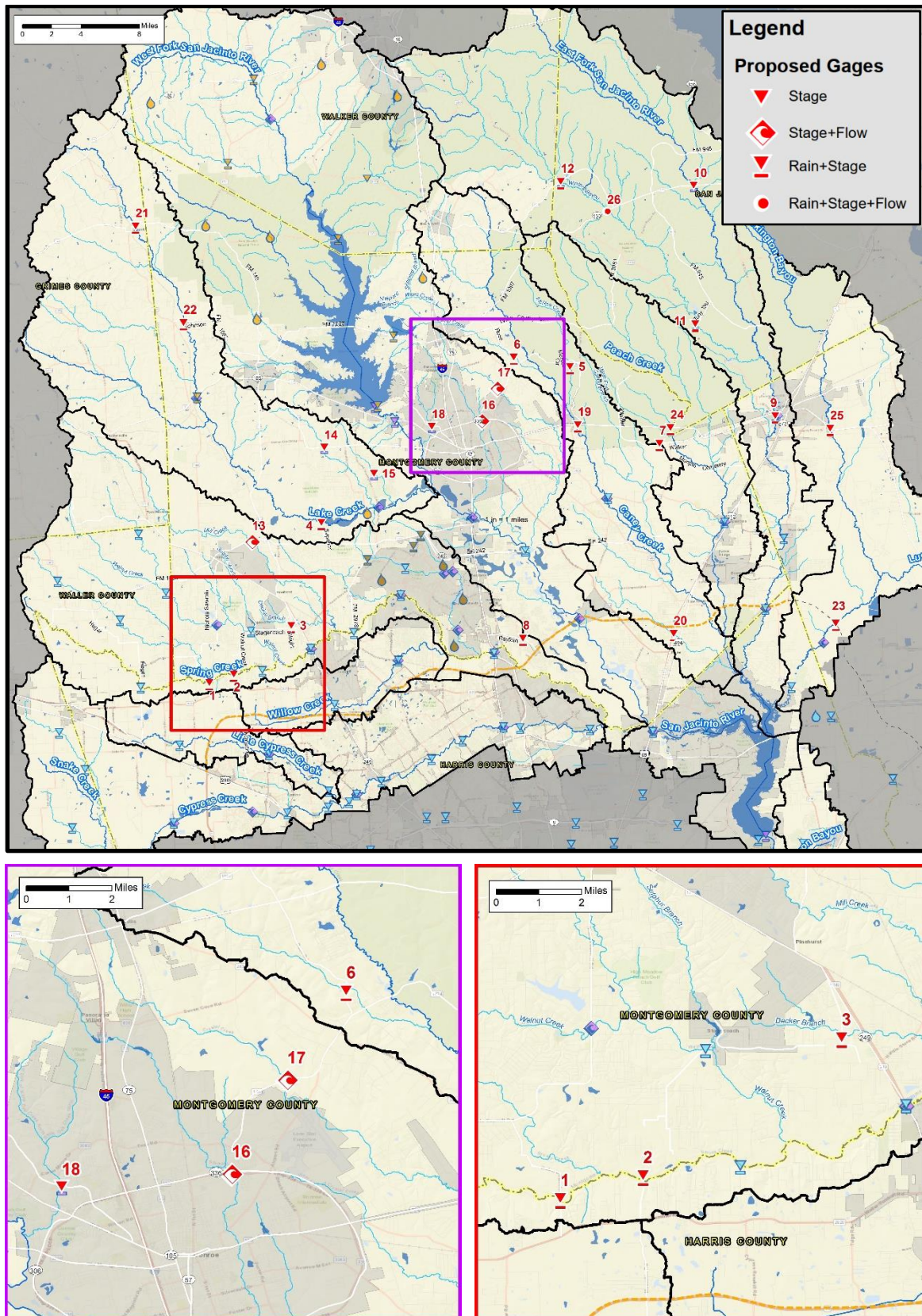
There is also a lack of available real-time information in the outlying counties related to rainfall and flooding. Harris County's Flood Warning System (Section 3.1) includes an extensive network of gages, some of which are located in Waller, Montgomery, and Liberty Counties. There are several gages in Montgomery County that are managed by HCFCD as well as SJRA; however, several of those are rainfall only. There are only a handful of gages in the surrounding counties, mostly around Lake Conroe and in areas in Waller and Liberty Counties that are close to Harris County. The gage concentration in the San Jacinto watershed is approximately 1 gage per 50 square miles, with the concentration much lower outside of Harris County. The average for Harris County is closer to 1 gage per 10 square miles.

As mentioned in Section 3.2, much of the flood monitoring is done in-person by County officials, TxDOT, or area residents. For rainfall information, many of the counties rely on the National Weather Service. Additional gages could be linked to the Harris County Flood Warning System, allowing online access to the information in real-time. As part of the Secondary Mitigation Planning, 26 additional gages were recommended for the system, 5 of which are already being installed by HCFCD. These include combinations of rainfall, stage, flow gages. Figure 4 shows the approximate locations (in red) of the proposed gages. In addition, the SJRA is partnering with San Jacinto county to apply for FIF grant funds to install 3 gages. One of the gages in their application is on the list of recommended locations.

The HCFWS is continuing to add gages and increase capabilities to provide users, including emergency managers, better information. Inundation mapping is one of the tools that can be leveraged with the use of the hydraulic models developed as part of this study. The inundation mapping and roadway stream crossing condition could provide valuable information that is currently not available to many of the jurisdictions in the watershed.

Addressing the gaps in available data could improve the ability of emergency managers to more quickly gather information and respond effectively during a disaster. Recommendations for addressing these issues are discussed in Section 5. A map showing the existing coverage and recommended additional gages is provided in **Figure 5**.

Figure 5. Proposed Flood Warning System Gages



5.0 Best Practices and Recommendations

The consensus among each of the jurisdictions interviewed was that their local communications protocols and procedures work successfully during a disaster. Some minor improvements were considered, but wholesale changes or standardization amongst the various jurisdictions are not necessary to provide effective emergency management. As such, this memorandum does not recommend significantly altering the communications plan and protocols of these jurisdictions. Instead, this section will provide a list of best practices and recommendations that can be employed to streamline the flow of information internally as well as to the public during a flood related event. It should be noted that as each of these jurisdictions continue to grow, the likelihood that emergency management activities overlap will increase. A regular review of how the current protocols are working would be beneficial.

5.1 Documentation and Staffing

With respect to documentation, the most important practice is to have a formal plan and follow it. The internal and external contact information should be kept up to date such that it is available and correct in the event of a disaster. In addition, regular review and practice of the plan is recommended. Drills and exercises will allow emergency management professionals to improve their familiarity with the procedures and work through any issues in advance of a disaster, when there is little time to review the plan. In addition, it is recommended that each jurisdiction regularly review and update their Hazard Mitigation Plan. In some cases, individual counties or cities may be part of a larger regional plan. Having a current plan will ensure that the jurisdiction is eligible for many of the federal disaster relief funding opportunities that may arise in the event of a disaster declaration.

It is recommended that staffing redundancy be implemented for emergency management purposes. As discussed in Section 4.1, some of the jurisdictions interviewed had one person who fulfills the emergency manager function and may have for many years. Cross training multiple people will ensure that emergency management functions can continue uninterrupted if the primary emergency manager is unable to fulfill the necessary duties. Each of these persons should be familiar with the emergency management protocols and procedures.

5.2 Communication

The communications recommendations are primarily focused on equipment and systems used for communicating both internally and with the public, rather than intrapersonal or inter-jurisdictional communication. Our findings indicated that there are solid relationships both internally and across jurisdictional boundaries and that the existing communication protocols are effective.

5.2.1 Communication Infrastructure Improvements

With respect to communication infrastructure, the interviews revealed that there are gaps in cellular coverage in some of the more rural areas. It is recommended that these jurisdictions work with local service providers to improve coverage by adding additional cell towers or negotiating leases with privately owned microwave or radio towers to add cellular infrastructure.

5.2.2 Internal Notifications

Interest was also expressed in improved internal alerts for flood events and infrastructure failure. With respect to flooding, adding gages to critical roadways will provide a mechanism to monitor stage elevations at these locations. If they are tied to the Harris County FWS, the system is set up to provide alerts as selected gages when elevations hit pre-defined thresholds. Alerts for other types of infrastructure, such as dams or levees, will require either in-person or remote monitoring and notification via email, phone or text to a defined group. Another alternative could be to leverage a system like Nixle or CodeRed to push alerts to a specific group of numbers, if the system has that capability.

5.2.3 Public Communication

In addition to internal communication, communication with the public can be improved. Many people receive information through social media and from a variety of sources. In most of the jurisdictions, there are Facebook and/or Twitter pages for the County, the Commissioners, the Sheriff's office or local police department, and other agencies. Linking these social media accounts allows users to see information from a variety of sources without searching during a disaster. In addition, it can give emergency management professionals the opportunity to put forth a consistent message and even link in accounts from other agencies, such as the National Weather Service (NWS), Department of Public Safety (DPS), and others.

Providing links to other agencies on each agency website can also help provide easy connections for the public. As an example, the HCFCD website (www.hcfcd.org) has links for many of its partners in the "partnership" section. In addition, the website for Harris County Office of Emergency Management has links on its website (www.readyharris.org) relating to preparedness and resources.

Partnerships



5.3 Flood Monitoring and Protection

As discussed in Section 3, there are a variety of ways that jurisdictions monitor flood conditions and protect the public from the dangers of flooding. The recommendations in this section discuss remote monitoring and protection measures.

5.3.1 Flood Monitoring and Alerts

Monitoring a large area can be challenging during a flood-related disaster. Using remote monitoring via flood gages allows emergency managers to track the conditions of multiple locations at one time and focus response efforts on those areas that pose the most risk. It is recommended that each jurisdiction identify areas that require monitoring and install gages at those locations. Whether through grant funding, partnerships with other agencies and jurisdictions, or local funds, gages are a safe and relatively inexpensive way to gather information about flood conditions.

There may be opportunities to work with the SJRA or HCFCD to integrate those gages into a larger, regional system like the HCFWS. As discussed in Section 4.3, the SJMDP recommended 26 new gages throughout the San Jacinto River watershed, but additional gages could provide further benefit, both to the local jurisdiction and other jurisdictions in the region. In addition, other cities in Texas, such as San Antonio, have experience with real time flood monitoring and developing safe routes to avoid stream crossings with known flooding issues.

Improved flood monitoring will facilitate more timely alerts to the public. Real-time flood information can be pushed to social media platforms and individuals can elect to receive notifications about specific

crossings that have remote monitoring capabilities. This data is accessible through computers and mobile devices and can arm the public with the knowledge to make better decisions for their safety and that of their families. While a higher concentration of gages may seem excessive, particularly in rural areas, the region will continue to grow over the next several decades and the data gathered from these gages will help those on the private and public side make better decisions about how to develop in a manner that minimizes flood risks.

5.3.2 Flood Barriers

In addition to real-time monitoring, several of the jurisdictions expressed concern about drivers attempting to cross flooded roadways. One way to reduce crossing during dangerous conditions is to employ the use of physical barriers at roadway stream crossings. Flood barriers are more expensive and will require monitoring and maintenance to ensure they are functioning properly.

Given the expense, it is recommended that each jurisdiction identify all crossings where a barrier would be appropriate and prioritize the crossings based on factors such as expected flood frequency, expectations about the depth and velocity of flooding, volume of traffic and others. As funding becomes available, barriers could be implemented starting with the highest priority crossings. There are grant funds available through a variety of agencies, including the Texas Water Development Board (TWDB) for flood warning and flood barriers.

It should be noted that while barriers can deter drivers from crossing flooded roadways, they cannot guarantee attempts will not be made. In some cases, drivers may go around, or even through barriers, to cross. Public education about the use of barriers is necessary and is discussed in Section 5.4. Jurisdictions should consider how to implement fines or other penalties for violations of and damage to the barriers. Barriers should be checked and, if necessary, repaired after every flood event.

5.3.3 Infrastructure Improvements

While not the focus of this appendix, many of the emergency managers also noted that improvements to frequently flooded roadways would improve safety during flood events. It is recommended that these crossings be incorporated into the counties' capital plans. Over the next few decades, the region is expected to grow in population density and portions of the current local/county network will need to be upgraded to accommodate the traffic load. Many of the major roadways are the critical evacuation routes as well and there may be opportunities to partner with TxDOT or local municipalities to improve them. Given the flood hazard mitigation aspects of these improvements, there may also be opportunities for grant funding of the improvements.

5.4 Public Education

One of the primary goals of the SJMDP is to educate the public and decision makers about their flood risks and how those risks can be reduced. As part of the SJMDP, the study team has engaged in 2 rounds of public meetings (December 2019 and August 2020) and has spoken to a variety of stakeholders, including counties, cities, interest groups, government officials, and residents. The goal of each of these meetings was to provide information about the current flood risks and ways to address those risks. With respect to emergency management, education can happen in a variety of ways such as:

- Speaking in schools and/or distributing outreach materials on school platforms, at local public libraries, churches, civic clubs, senior and general public community centers
- Social media campaigns geared toward specific emergency management topics like identifying and avoiding flooded crossings, sources of flooding, evacuation routes, etc.
- Radio or TV public service announcements
- Participation in community activities including fairs and festivals

Agencies like the TWDB have developed a significant number of educational resources. In recent years, the Texas Floodplain Management Association (TFMA) has developed the “Turn Around, Don’t Drown” campaign aimed at teaching the public about the dangers of driving through flood waters.

Many of these materials are designed for school-age children. These materials are available in both English and Spanish. Working with TWDB and the local school systems can help emergency managers reach kids, who are likely to share the information with their parents. Public education is a continuous effort and emergency managers should leverage all tools at their disposal to better prepare the public to respond during an emergency.

5.5 Recommendation Summary

Overall, the recommendations in this section cover documentation and staffing, communication, flood monitoring and protection, and public education. A summary of the recommendations is provided below.

Documentation and Staffing

- Develop a flood emergency response plan and follow as much as possible
- Keep contact information up to date
- Perform regular review of the plan and conduct practices exercises and drills
- Implement staffing redundancy be for emergency management personnel
- Regularly review and update the Hazard Mitigation Plan

Communication

- Work with local service providers to improve radio and cellular coverage
- Link social media accounts so user can see information from a variety of sources
- Adding flood stage gages to critical roadways
- Improve internal alerts for infrastructure flooding or failure

Flood Monitoring and Protection

- Identify areas that require monitoring and install gages at those locations
- Work with other agencies to integrate gages into a larger, regional system
- Leverage flood monitoring to provide timely alerts to the public
- Identify all crossings where flood barriers would be appropriate and prioritize the crossings
- Install barriers at frequently flooded crossings

Public Education

- Develop a public education strategy that includes social media, radio, TV, and face-to-face discussion
- Leverage pre-developed resources from agencies like TWDB and TFMA
- Work with local school districts to provide emergency preparedness and disaster readiness information to kids

6.0 Critical Infrastructure

One of the tasks specified in the scope was to identify critical infrastructure throughout the San Jacinto River watershed that may be susceptible to flooding based on the updated modeling and inundation using Atlas 14 rainfall.

6.1 Types of Critical Infrastructure

A database of critical infrastructure was developed throughout the watershed to identify the structures that may be susceptible to flooding from the model streams. The following categories were assembled to include within the critical infrastructures in the database of communities:

- Essential government buildings
- Major healthcare providers
- Emergency management and response
- Potential shelters during a storm event
- Public works facilities
- Major industrial facilities

The subcategories for these facilities include: Assisted and Senior Care, Chemical or Industrial Facility, Church, City or County Facility, Government Building, Hospital, Police, Sherriff, Fire, EMS, School, Water/Wastewater Treatment Plant and were based on conversations with the emergency managers in the region.

The database was developed using a mixture of data provided by HCFCD and open source GIS libraries such as county appraisal and Google. Following the aggregation of available data, a visual scan was conducted using aerial imagery for quality assurance. This remote inspection was limited to include structures located within 0.5 mile of the FEMA Effective 0.2% Annual Chance Event (ACE). The effective FEMA modeling was used because this task was done before the updated modeling was available. FEMA mapping was only used as the buffer to identify facilities; the updated Atlas 14 modeling was used to identify facilities at risk of flooding. The database included over 1,400 facilities and the breakdown of facility type for the entire watershed is included in **Table 1**.

Table 1. Summary of Critical Facilities

Structure Type	Number of Locations
Assisted and Senior Care	50
Chemical or Industrial Facility	249
Church	410
City or County Facility	81
Government Building	10
Hospital	113
Police, Sheriff, Fire, EMS	150
School	387
Water/Wastewater Treatment Plant	10
Total	1,460

6.2 At-Risk Infrastructure

Following the database development, the structures within the frequency floodplains based on the updated modeling were identified to determine which structures are most susceptible to potential flooding

from the major streams included in this study. For each facility, the finished floor elevation was estimated based on the LiDAR + 1.0' for each structure on the property. The lowest structure elevation was then compared to the water surface elevation for each frequency storm event obtained from the updated hydraulic model.

Table 2 summarizes the number of potentially inundated critical structures for each frequency event as well as a total number of facilities. Of the identified structures, 239 are subject to flooding for the modeled frequency storm events. The critical infrastructure database provided indicates the critical facilities at risk of flooding.

Table 2. Potentially Inundated Critical Facilities

		Frequency Event							
		50% ACE	20% ACE	10% ACE	4% ACE	2% ACE	1% ACE	0.2% ACE	Total
Watershed Critical Infrastructure	Caney Creek	0	0	0	0	0	2	5	7
	Cypress Creek	0	0	3	7	11	16	31	68
	East Fork San Jacinto	0	1	1	1	4	5	5	17
	Jackson Bayou	0	1	1	1	1	1	2	7
	Lake Creek	0	0	0	0	0	0	0	0
	Little Cypress Creek	0	0	2	5	5	6	6	24
	Luce & Tarkington Bayou	0	0	0	0	0	0	0	0
	Peach Creek	0	0	0	0	0	2	6	8
	Spring Creek	0	0	1	5	7	11	22	46
	West Fork San Jacinto	0	0	0	2	2	11	41	56
	Willow Creek	0	0	0	1	1	1	3	6
	Total	0	2	8	22	31	55	121	239

7.0 Roadway Flood Frequency

The hydraulic model of the watershed included 197 transportation crossings to determine the effects of the roadway constrictions on water surface elevations throughout the watershed and the existing level of service of the structures. Flooded roadways and railways exacerbate flooding risk in the region by increasing the potential damage due to flooding, limiting emergency access during the event, and limiting evacuation routes for the public. In general, flooded roads hinder the region's mobility and economic productivity when they are impacted by flood events.

The level of service of each modeled crossing was determined for the roadway crossings at major streams in the San Jacinto River watershed. The level of service was identified as the highest frequency storm event prior to overtopping the roadway at the bridge crossing. The streams reviewed include:

- Cypress Creek and Little Cypress Creek
- Spring Creek and Willow Creek
- Lake Creek
- East and West Forks of San Jacinto River
- Caney Creek and Peach Creek
- Luce and Tarkington Bayous
- Jackson Bayou
- Gum Gully (tributary to San Jacinto River)

Table 3 below displays below summarizes the level of service for the modeled crossings.

Table 3. Crossing Levels of Service

	Level of Service Based on Road Classification								Total
	< 50% ACE	50% ACE	20% ACE	10% ACE	4% ACE	2% ACE	1% ACE	0.2% ACE	
Railroad	0	1	0	2	3	5	5	6	22
Interstate	0	0	0	0	2	1	3	1	7
State Highway	1	1	0	1	0	4	8	14	29
Farm-Market	1	1	2	2	2	6	5	4	23
County/City Road	9	11	4	11	8	7	18	29	97
Private Road	8	4	1	1	1	2	2	2	21
Total	19	18	7	17	16	25	41	56	199
Percent Total	10%	9%	4%	9%	8%	13%	21%	28%	100%

7.1 Inundation Mapping

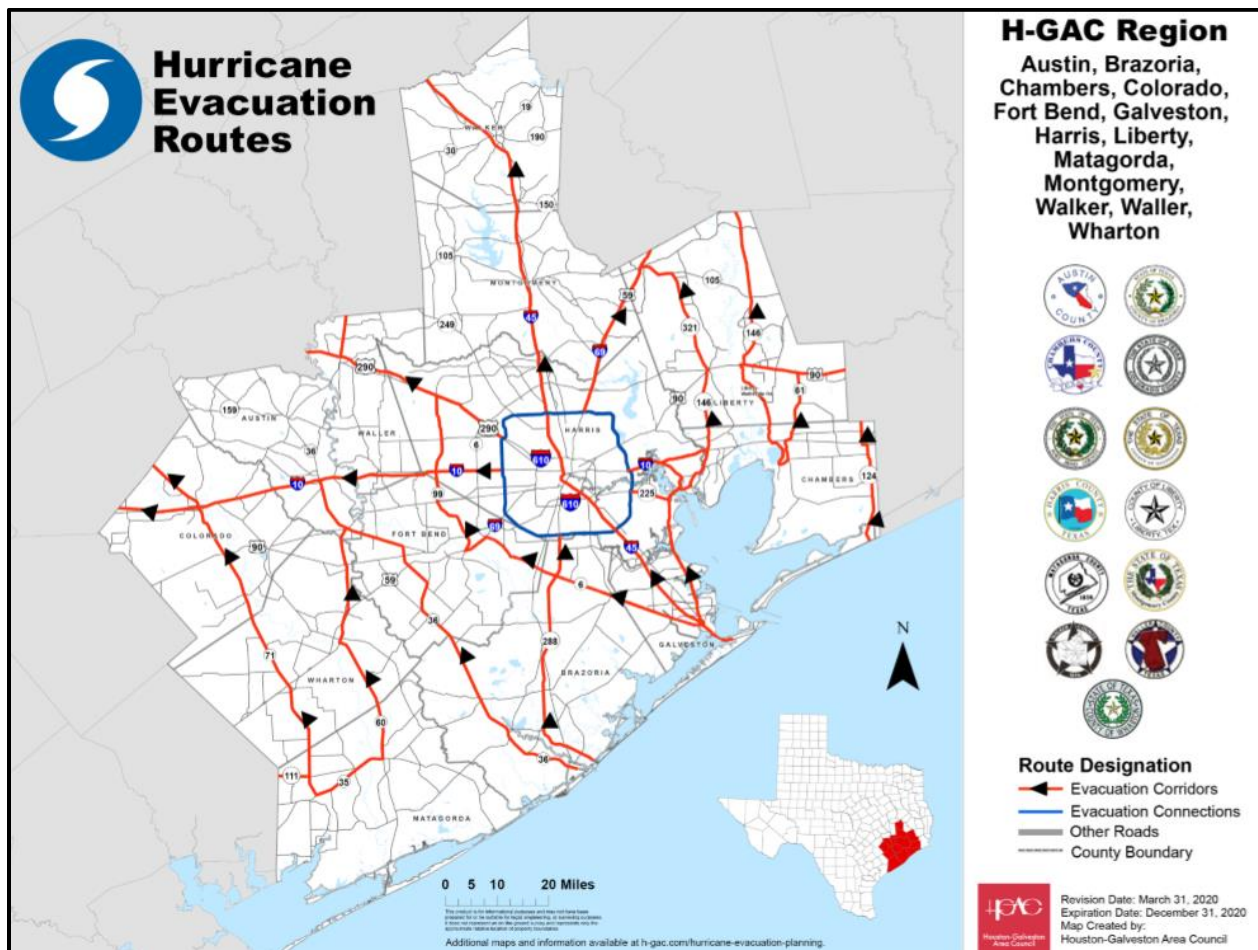
As part of the existing conditions and historical storm analysis, inundation mapping for the various frequency storms was generated to provide a clear picture of the flooding extents. Mapping was generated for the 50%, 20%, 10%, 2%, 1%, and 0.2% ACE events. The modeling provides water surface elevations and ponding depths for each frequency along each of the streams that were modeled. The inundation mapping was used to identify flood risk for critical infrastructure discussed in Section 6.0. Inundation mapping for the 1% ACE event for all watersheds is provided in **Appendix J.2**. The updated mapping and WSEL showed significant differences when compared to the FEMA effective models. Average changes are 1-2 feet with some areas increasing by as much as 5-6 feet.

7.2 Evacuation Routes

The H-GAC evacuation routes for the Upper San Jacinto River watershed include the major highways and interstates, US 290, IH-45 and IH-69. These routes total for 8 crossing of the major streams and are

susceptible to flooding. **Figure 6.** shows the H-GAC designated hurricane evacuation routes for the region.

Figure 6. H-GAC Hurricane Evacuation Routes



Four evacuation route crossings may be inundated by events lower than the updated (Atlas 14) 1% ACE. This may prevent evacuation during a major storm event. The locations include:

- Cypress Creek at IH-45
- West Fork San Jacinto at IH-69
- Peach Creek at IH-69
- East Fork San Jacinto at IH-69

Raising these roadway profiles to above the 1% or even 0.2% ACE water surface elevations would provide reliable evacuation routes during storm events. **Table 4** shows the watershed and crossing along the defined evacuation routes shown on Figure 6, along with the level of service and potential overtopping elevation. The 1% ACE Elevations at these major crossings along with the anticipated flood depth are included in the table below.

Table 4. Major Roadway Crossing Level of Service

Watershed	Major Road	Level of Service (% ACE)	Overtopping Elevation (ft)	Updated 1% ACE Elevation (ft)	Updated 1% ACE Flood Depth (ft)
Cypress Creek	US 290	0.2%	143.6	140.7	0.0
Cypress Creek	IH-45	2%	94.1'	95.8	1.7
Spring Creek	IH-45	1%	114.5'	112.4	0.0
West Fork San Jacinto	IH-45	1%	130.8'	128.4	0.0
West Fork San Jacinto	IH-69	2%	67.5'	63.0	0.0
Caney Creek	IH-69	1%	94.0'	91.2	0.0
Peach Creek	IH-69	4%	96.5'	98.9	2.4
East Fork San Jacinto	IH-69	4%	118.8'	122.7	3.9

Appendix J.3 shows the inundation for the 1% ACE along with the overtopping frequency information for the roadway and the identified hurricane evacuation routes as provided by the H-GAC.

8.0 Conclusions

This memorandum provides a summary of the study teams findings with respect to emergency management practices within the San Jacinto watershed. In general, the various counties and other agencies adhere to a known set of practices and communicate effectively during a disaster, both internally and externally. This cooperation has improved since Hurricane Harvey, which was an unprecedented event that tested all the emergency resources of the region. The study team recommends that this cooperation and communication continue as the region grows and other disasters occur.

The study partners, supporting partners, and study team identified a number of suggestions for improvement through our collaboration. Specific information can be found in the attached notes. The data gaps identified, and recommendations provided are intended to provide helpful information to emergency managers about where there may be deficiencies in available resources and what can be done to improve the quantity and quality of information in the San Jacinto River watershed. If there are specific data requests, such as locations of critical infrastructure, the study team can provide that information to individual counties and agencies through our study partners. Our intent is to make the information available for each jurisdiction to leverage in a way that improves emergency response and protects the lives and livelihoods of the public.

Appendix J.1

Meetings and Presentations

G103-P003 SJMDP Other Mitigation Actions

Meeting Notes

Grimes County

January 30, 2020

San Jacinto River Watershed Master Drainage Plan
HCFCF, Northwest Crossing/Skype from Conference Room 4

Meeting called by:	Jing Chen, P.E., CFM	Type of Meeting:	Other Mitigation Actions Meeting
Facilitator:	Terry M. Barr, P.E., CFM	Meeting Start Time:	1:00 PM
		Meeting Stop Time:	2:00 PM

Agenda

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|-----------|---|
| 1. | Attendees (via Teleconference) <ul style="list-style-type: none"> Terry Barr, Halff Associates, Inc. Sam Hinojosa, Halff Associates, Inc. Jing Chen, HCFCF David Lilly, Grimes County |
| 2. | Study Overview <ul style="list-style-type: none"> No overview needed Flooding History <ul style="list-style-type: none"> May 2015 (DR-4223) April/May 2016 August 2017 October 2017 |
| 3. | Communications Plan/Protocols <ul style="list-style-type: none"> Existing Communication Protocols <ul style="list-style-type: none"> Primary method of communication is radial system; have recently completed trunking 800 MHz radio, consistent with the state standards and how they communicate with their neighbors, including Harris County; If in range of repeaters, coverage is consistent Law enforcement uses trunking BVWACS primary; Smaller version of Harris County VHF fire departments and EMS; 8 VFD in the county For cell phones they are looking at expanding into ATT Firstnet system to see if it will work Public information uses reverse 911 (nixels?); can localize notices to specific areas (evacuation and flood risk); have had for may years, but public must register; lots of people no longer have a land line Media relationships with locals (KBTX, KHOU, KAGS, local radio) Facebook (Grimes Co EM); flood conditions, road closures; in conjunction with Sheriff's Office (coordinated) Communication with neighboring jurisdictions |

	<ul style="list-style-type: none"> ○ Todd Mission does not have an Emergency Manager, but they have a City Manager (Neil Wendely (936) 894-3001); David acts as Emergency Manager during a disaster such as a flood ○ Cell phone and Web EOC (TAMUEM) are the ways they communicate with neighbors; Cell and email for non-BVCOG members ○ Oil well exploded in Burleson County; Grimes reached out to offer assistance ○ If something is happening in a surrounding county, they would reach out and vice versa ● Pros/Cons of Current Protocols <ul style="list-style-type: none"> ○ Switching to trunking system will be consistent with neighbors ○ Transferring to new system can have growing pains for first responders ● Recommendations for Improvement <ul style="list-style-type: none"> ○ How can they expand network? Additional towers, looking for coverage gaps ○ Education on what terminology means (Trunking) ○ Cleaner communication between trunking and VHF; Shift in their traditional usage of VHF could be problematic, takes time; Brazos County has shifted but it took a couple years to get comfortable ○ Grant funding for additional communications improvements ● How do you receive information about rainfall and flood threats? <ul style="list-style-type: none"> ○ Don't have electronic tracking; it is word of mouth or email/text photos ○ Proactive County Commissioners who go and look at their areas ○ A lot of it is David out in the field who works with the County Road and Bridge ○ We can check back with David/Harry for specifics when we make recommendations ● Additional Information <ul style="list-style-type: none"> ○ Current HMP is out of date and they are working on updating it; Likely more than a year out; there used to be a regional plan ○ COGs help locals get grant funding from the State for improvements (BVCOG) ○ HMP Threat Levels: 1) Flood, 2) Hurricane, 3) Wind, 4) Fire ○ Roger Sheridan (BVCOG) (979) 595-2801 ○ They have limited development in flood zones, which helps prevent danger and damages
<p>4.</p>	<p>Locate Critical Infrastructure</p> <ul style="list-style-type: none"> ● Location of Critical Infrastructure <ul style="list-style-type: none"> ○ Don't really have critical infrastructure in the inundation area ○ Most of their industry is in the Navasota area ○ Railheads? Pipelines? Electrical Facility (Tanaska) does not provide electricity to Grimes County; G&W Water just inside county line of Grimes/Waller near FM1774, Plantersville Water ○ High Point school in Plantersville has had some flood damage (Harvey) due to the rain band intensity, which pushed water into building more than traditional flooding normally would ● Comparison of Inundation Mapping to Identified Locations <ul style="list-style-type: none"> ○ Will look at identified areas and compare to model results and some of the 2D rainfall on grid.

5.	<p>Evacuation Routes</p> <ul style="list-style-type: none"> • Review of evacuation routes recommended by agency <ul style="list-style-type: none"> ○ Don't have defined evacuation routes ○ If a flooding situation is identified, they may consider evacuations ○ Usually shelter in place ○ Evacuation during wildfires in 2011 ○ Not determined that there is a need for formal evacuation routes ○ Left to the incident commander on scene to decide how to handle evacuations; may go door to door based on the situation ○ Flooding on FM1774 has happened but it is not typical; State roads are usually very reliable, SH30 flooded on one occasion but it's pretty rare • Comparison of inundation mapping and profiles to evacuation routes <ul style="list-style-type: none"> ○ Inundation mapping pretty limited in that portion of the watershed; they are on the upper end of Lake Creek • Recommendations for evacuation routes <ul style="list-style-type: none"> ○ Currently None
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G103-P003 SJMDP Other Mitigation Actions

Meeting Notes

Montgomery County, City of Conroe

January 30, 2020

San Jacinto River Watershed Master Drainage Plan
HCFCF, Northwest Crossing

Meeting called by:	Jing Chen, P.E., CFM	Type of Meeting:	Other Mitigation Actions Meeting
Facilitator:	Terry M. Barr, P.E., CFM	Meeting Start Time:	2:30 PM
		Meeting Stop Time:	3:30 PM

Agenda

1.	Attendees (via Teleconference) <ul style="list-style-type: none"> • Terry Barr, Halff Associates, Inc. • Sam Hinojosa, Halff Associates, Inc. • Jing Chen, HCFCF • Darren Hess, Montgomery County • Christy Bryant, City of Conroe • Ann Colina, City of Conroe
2.	Study Overview <ul style="list-style-type: none"> • No overview needed; Familiar with the study
3.	Communications Plan/Protocols <ul style="list-style-type: none"> • Existing Communication Protocols <ul style="list-style-type: none"> ○ First response agencies ○ Simple 1-1 phone calls to ensure resources are available (48-72 hours out) ○ Conference calls and webinars as an disaster or weather event progresses ○ They have a direct liaison for area specific issues ○ Talk with SJRA and staff the MCOEM ○ Direct contact with COH and HCOEM ○ Social Media platforms (Facebook, Twitter, Instagram, Nextdoor) ○ County Website ○ 2 Emergency Public Messaging systems ○ MCO uses 800 MHz system across the board (Local, Regional, State-wide systems); Trunking and Microwave; Fire paging system may still be VHF but not sure; Same as Houston and Harris County (Fiber, T1, Microwave backhaul) ○ Not sure what “level” they are on; some Federal guidelines, region has made significant improvement in communications since 9/11 ○ Firstnet communications platform • Communication with neighboring jurisdictions <ul style="list-style-type: none"> ○ Waller, Grimes, Walker, San Jacinto, Liberty ○ Web EOC is used for incident communication; users can login and see status, resources, etc. (SE Texas Region); Fire Dept, Police, Sheriffs, EMS, Local and State Services, City of Conroe as well as Shenandoah, Patton Village, Oak Ridge, etc.

	<ul style="list-style-type: none"> ○ Sharing of resources is based on request; Depends on situation; resource requests funneled through WebEOC and then if someone else has access to the resources they can respond and provide resources ○ Infrastructure is in place for full communications capabilities ● Pros/Cons of Current Protocols <ul style="list-style-type: none"> ○ Needs to think on this a bit and ask some others ● Recommendations for Improvement <ul style="list-style-type: none"> ○ Not sure what improvements could be made; Automatic ringdowns? Older technology for an ensured form of communication ○ Internal alerting system if there is a critical failure or alert to notify EOC and surrounding area short of having everybody together ● Additional information <ul style="list-style-type: none"> ○ Not any known issues during Imelda ○ Separate EOCs for the City and County ○ Montgomery Co. by the airport and the City's is in City Hall ○ How do they determine road closures? 3-pronged approach <ul style="list-style-type: none"> ▪ Each precinct will monitor and barricade flooded roads; City by PW ▪ Notifications pushed through GIS platform and updated on WebEOC ▪ Sheriff's department manages flow of County flow of information re: closures and the City closures are managed through Public Works but notifications are made through PD; Posted on website and apps
4.	<p>Locate Critical Infrastructure</p> <ul style="list-style-type: none"> ● Location of Critical Infrastructure <ul style="list-style-type: none"> ○ MCO has critical infrastructure available in GIS; Update annually ○ Tier 2 – Certain Chemical Facilities and Quantities ○ May not be able to share given the sensitivity; Need to discuss how to present ○ City of Conroe will check internally ● Comparison of Inundation Mapping to Identified Locations
5.	<p>Evacuation Routes</p> <ul style="list-style-type: none"> ● Review of evacuation routes recommended by agency <ul style="list-style-type: none"> ○ Evacuation routes are managed by HGAC and they have a complete plan ○ Inundation will determine what routes are available ○ During Harvey, all roads were impassable ○ 2016 events were a similar issue as Harvey ○ During Imelda US59 and SH99 were closed ○ Montgomery is a pass-through county; no sheltering for out of county people ○ Shelter in place locations for locals (locations, staffing) ○ City of Conroe follows the County and HGAC, they are a pass through as well ● Comparison of inundation mapping and profiles to evacuation routes ● Recommendations for evacuation routes <ul style="list-style-type: none"> ○ Really based on the HGAC plan ○ Different rainfall events will have different impacts so it is hard to predict

G103-P003 SJMDP Other Mitigation Actions

Meeting Notes

Walker County

January 31, 2020

San Jacinto River Watershed Master Drainage Plan
HCFCF, Northwest Crossing/Skype from Conference Room 4

Meeting called by:	Jing Chen, P.E., CFM	Type of Meeting:	Other Mitigation Actions Meeting
Facilitator:	Terry M. Barr, P.E., CFM	Meeting Start Time:	8:00 AM
		Meeting Stop Time:	9:00 AM

Agenda

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|-----------|--|
| 1. | Attendees (via Teleconference) <ul style="list-style-type: none"> Terry Barr, Halff Associates, Inc. Jing Chen, HCFCF Butch Davis, Walker County Sherri Pagoda, Walker County Sam Walker, TXDOT Matt Barrett, SJRA Andrew Moore, Halff Associates, Inc. |
| 2. | Study Overview <ul style="list-style-type: none"> Brief overview of the study objectives provided Walker County has had 7 Federal disasters since 2015 <ul style="list-style-type: none"> 4223, 4245, 4255, 4266, 4272, 4332 (Harvey), 4416 |
| 3. | Communications Plan/Protocols <ul style="list-style-type: none"> Existing Communication Protocols <ul style="list-style-type: none"> For flooding on SJR, they use the OEM Facebook, which is picked up by the Fire Department and County Commissioners; They have a patrol that works with TxDOT, and covers several FM Roads (McGary Creek dumps into San Jac) Will use Code Red if it hits that part of the County (like a reverse 911) WebEOC – tied in with their district coordinator They are on the 800 MHz trunking system Central location that people can go to; Walker County Website, EOC number is provided and EOC is manned 24-hours a day 7 Federal disasters since 2015; Fatality on FM1791 When SH30 floods, they have a variety of agencies that help to provide info Communication with neighboring jurisdictions <ul style="list-style-type: none"> Talk to EMC's above and below on a regular basis during a disaster Talk on the phone, updates through email Single point of contact for the other EMC At least one tabletop, one full scale, and one drill per year, mostly just Walker County |

	<ul style="list-style-type: none"> ○ Huntsville is co-located at the Walker County EOC ○ Most of the time TXDOT is too short staffed for an EOC rep, but they are in constant contact and they talk to them via radio from the EOC ● Pros/Cons of Current Protocols <ul style="list-style-type: none"> ○ Walker County has a pretty good operation, but it doesn't take much rain to result in 3-7 road closures (Davis, Morgan, Loma, Birdwell, Hopewell (County Roads); FM1791, SH30 (State Roads) ○ Communication seems to work pretty well ○ Commissioner White (Pct 2) is very communicative with his constituents ● Recommendations for Improvement <ul style="list-style-type: none"> ○ Widen Channel; Raise FM1791 ○ Would like to have a dedicated EOC webpage rather than go to the County Website; they are too buried and he would like to be able to broadcast to citizens regularly ○ Better system of being able to broadcast information; Code Red is antiquated, and he would like to have a better system that people would register for; Would like to be able to target certain areas ○ Would like a couple of Stage Gages so they can see the rise ○ They focus on the San Jacinto and Trinity; Coverage begins depending on the rainfall patterns; instrumentation that they could pull up online re: stream elevations would help relieve resources ○ TXDOT may have 4-5 people and Walker may only have 2-3; they can't be everywhere; Having people on the ground saves lives and this would enable them to be more selective in their closures and manning ● How do you receive information about rainfall and flood threats? <ul style="list-style-type: none"> ○ Any time it starts raining they have a roving patrol that watches the roads (Comm and Foreman) ○ If rain gets to 1"/hour they will have people on the road ○ Up-to-date with the NWS, start looking at the forecasts early ○ On the San Jac at FM1791 they rely heavily on the SJRA gage; Do we have additional gages recommended in that area for SJRA? Walker County noticed that there are some new rain gages, but no stage gages, get the info from the SJRA public website ● Additional Information <ul style="list-style-type: none"> ○ Davis Road is always the last road that is reopened ○ They use Highway Condition Reporting System (HCRS); they constantly update to give information about roads (flooding, construction, wrecks) ○ NWS Chat room for questions ○ No other Social Media platforms being actively used ○ During a flood event in the morning, his first call is to Sam Walker at TXDOT, Chad Holton at TRA, NWS
4.	<p>Locate Critical Infrastructure</p> <ul style="list-style-type: none"> ● Location of Critical Infrastructure <ul style="list-style-type: none"> ○ On the San Jac through this area it is mostly rural and not at risk from flooding ● Comparison of Inundation Mapping to Identified Locations <ul style="list-style-type: none"> ○ Need to look at San Jac vs roadways

5.	<p>Evacuation Routes</p> <ul style="list-style-type: none"> • Review of evacuation routes recommended by agency <ul style="list-style-type: none"> ○ They flood county roads pretty frequently (10-12 times a year) ○ FM1791 could be closed for 3-5 days depending on the storm ○ People may have to drive 15 miles ○ TXDOT HCRS has a history of the flooding closures (State roads) ○ If the state roads were closed, the county roads are already closed (All the roads mentioned cross the San Jacinto) ○ Physically close with barricades • Comparison of inundation mapping and profiles to evacuation routes <ul style="list-style-type: none"> ○ Inundation mapping pretty limited in that portion of the watershed • Recommendations for evacuation routes <ul style="list-style-type: none"> ○ Upgrade roads, particularly FM1791 ○ Additional culverts under SH30 would help alleviate
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G103-P003 SJMDP Other Mitigation Actions

Meeting Notes

Waller County

January 31, 2020

San Jacinto River Watershed Master Drainage Plan
HCFCF, Northwest Crossing/Skype from Conference Room 4

Meeting called by:	Jing Chen, P.E., CFM	Type of Meeting:	Other Mitigation Actions Meeting
Facilitator:	Terry M. Barr, P.E., CFM	Meeting Start Time:	10:00 AM
		Meeting Stop Time:	11:00 AM

Agenda

1.	Attendees (via Teleconference) <ul style="list-style-type: none"> • Terry Barr, Halff Associates, Inc. • Jing Chen, HCFCF • Andrew Moore, Halff Associates, Inc. • Sam Hinojosa, Halff Associates, Inc. • Brian Cantrell, Waller County EMC
2.	Study Overview <ul style="list-style-type: none"> • Brief overview of the study objectives provided • Workshop on March 11th at SJRA Lake Conroe office • Walker County has had 8 Federal disasters since 2015 <ul style="list-style-type: none"> ○ Tax, Memorial, Harvey
3.	Communications Plan/Protocols <ul style="list-style-type: none"> • Existing Communication Protocols <ul style="list-style-type: none"> ○ Small community has a good relationship with local PD, sheriffs, FD, Road/Bridge ○ Waller County EMP ties all together so communication is good ○ Judge is a good FB guy and uses it actively (Also Twitter) ○ Code Red alert system; Public notification; Can geolocate areas, relies on the resident signing up for it (11k in a 50k population) ○ Support local small cities, provide guidance ○ Volunteer fire departments have varying levels of resources and that needs to be communicated ○ FB page for OEM and Fire Marshall's office; Judge Duhon has a separate page; Waller County Twitter; Not all linked ○ They are involved in the Firstnet system which allows access to a different band of information, Cell phone with better connection and data, but some coverage limitations (Hempstead) ○ Connected to the WebEOC (EMC is only one that really uses it) ○ 800 MHz Trunking system on the Harris County system

	<ul style="list-style-type: none"> ○ County is currently in the process of building a new facility with EOC for County and Cities (Waller, Hempstead, Prairie View) – Summer 2020; Currently at the courthouse and the Sheriff’s office ○ Currently information sharing only, but they work together pretty well ● Communication with neighboring jurisdictions <ul style="list-style-type: none"> ○ Communicates regularly with their neighbors ○ During times of emergency, Harris County has a good central system (HCIS email through PIO) to push out information and helps disseminate information for surrounding counties; If there is big event in Harris County, they might slip through the cracks ○ Haven’t really done too many drills with surrounding agencies, but did some tabletop exercises with surrounding counties; have done some internal (shooting, mass casualty); Haven’t done flood related drill ○ Some after-action plans for flood and fire ○ EMC is the primary contact point for surrounding counties ○ Work closely with TXDOT, particularly for evacuation and road closure (Hegar, Kickapoo, Murell, FM1488, Field Store) ○ Works with NWS to gather information, usually online (river or stream flooding) ● Pros/Cons of Current Protocols <ul style="list-style-type: none"> ○ Code Red system is about \$15k per year, but they think it works pretty well; Company has gotten away from limiting time on it; Free training and good response from them (Harris Co. is not on the system, but it is pretty popular) ● Recommendations for Improvement <ul style="list-style-type: none"> ○ Would like to see more consolidated studies to learn more about the watershed ○ Grants for Hazard Mitigation, but he hasn’t seen much in the way of specific ideas for drainage improvement; what, if anything can be done to fix drainage through private property ○ Potential meeting with Yancey (County Engineer) to discuss Mitigation options ○ What is the potential for a drainage district? You have to have specific projects in mind to develop and a budget so you can determine how much money is needed. Also, is there political will? The State needs to provide authority before you can start working at the local side. ● How do you receive information about rainfall and flood threats? <ul style="list-style-type: none"> ○ Lots of the information about roads comes from the school district (bus traffic) and the sheriff’s office: monitored by Sherriff’s ○ Email alerts from the Harris County FWS for their gages (several in the area) ● Additional Information <ul style="list-style-type: none"> ○ Flooding at Lakeside Estates and Clear Creek Forest is a common problem ○ Flooding from Cypress Creek at Hebert Rd. ○ Lots of growth, including commercial ○ Pretty much get what they need from NWS and others; Get alerts HCFCD; Communicating with TXDOT; No issues
4.	<p>Locate Critical Infrastructure</p> <ul style="list-style-type: none"> ● Location of Critical Infrastructure <ul style="list-style-type: none"> ○ Don’t have a hospital, water treatment plants are in the cities, new Sheriff’s complex in the process, but will be in a better position with respect to flooding

	<ul style="list-style-type: none"> ○ Willow River Farms (vulnerable facility near Pattison), nursing homes, etc. ○ Brookshire does get flooding in the nursing home ○ Nothing in particular along Spring Creek; what about electric cooperative ● Comparison of Inundation Mapping to Identified Locations
5.	<p>Evacuation Routes</p> <ul style="list-style-type: none"> ● Review of evacuation routes recommended by agency <ul style="list-style-type: none"> ○ Haven't had the water levels to where large populations are impacted ○ If there is a true flooding event, some sections of the county may be isolated ○ Issues with FM362 and FM359; can't travel to the central portion ○ FM1488 near Joseph; several pockets ○ Shelters (churches) for each of these areas that are designated that people can reach ● Comparison of inundation mapping and profiles to evacuation routes <ul style="list-style-type: none"> ○ Inundation mapping pretty limited in that portion of the watershed ● Recommendations for evacuation routes <ul style="list-style-type: none"> ○ More concerned about traffic management along US290 and IH-10 ○ Ike (2008) was a significant issue, but lessons have been learned since then ○ Mostly a shelter in place community

G103-P003 SJMDP Other Mitigation Actions

Meeting Notes

Houston-Galveston Area Council

February 5, 2020

San Jacinto Regional Watershed Master Drainage Plan
Conference Call

Meeting called by:	Jing Chen, P.E., CFM	Type of Meeting:	Other Mitigation Actions Meeting
Facilitator:	Stephan Gage & Jing Chen	Meeting Start Time:	9:30 AM
		Meeting Stop Time:	10:30 AM

Agenda

1.	Attendees (via Teleconference) <ul style="list-style-type: none"> • Terry Barr, Halff Associates, Inc. • Jing Chen, HCFCF • Stephan Gage, HGAC • Justin Bowers, HGAC • Anita Hollmann, HGAC
2.	Study Overview <ul style="list-style-type: none"> • Mr. Barr provided a brief overview of the San Jacinto study including the general study area and the study goals and objectives.
3.	<ul style="list-style-type: none"> • Communications Plan/Protocol - Justin Riley works on DHS Homeland Security emergency preparedness related topics, including equipment needs <p>Study team will be working on identifying Critical infrastructure locations compared to inundation mapping; HGAC has some information but it may be in different locations</p> <ul style="list-style-type: none"> • Red Flag analysis looked at this type of information • UASI (urban area security initiative) must update DHS every year (send them an email telling them what we need; Must have, other info that might be helpful) <ul style="list-style-type: none"> ○ Provide Jing a list of infrastructure that the team is interested in ○ UASI is housed out of Harris County OEM ○ Funds larger metro areas' emergency traffic management plans • Study team will also be identifying vulnerable locations along the roadways based on the modeling that was performed as part of this study • HGAC would like to see the inundation mapping for each of the events (March 11th meeting); Study team should have 100-/500-year and an idea of road flooding frequency • When formulating recommendations for evacuation routes need to consider frequency of flooding for the major roadways • Evacuation Routes <ul style="list-style-type: none"> ○ Compare profiles at major roadways ○ Do structures need to be elevated? ○ How is the gage network being used for evacuation? ○ Sections of IH45 and IH-10 are vulnerable; US59 at San Jac River

	<ul style="list-style-type: none"> ○ Shapefiles on the routes, but not necessarily the hot spots (mostly anecdotal) <ul style="list-style-type: none"> ▪ FHWA plan on resiliency may be a good source ○ Developing SOP's for evacuation monitoring <ul style="list-style-type: none"> ▪ Done on an informal basis after Ike ▪ Working to formalize the process so other jurisdictions know their role ○ Potential Improvements? Provide list of roadways and they can direct us to a list of potential improvement plans; Long range plan goes out 25-years ○ Transportation Improvement Plan (TIP) will be built in the next 4 years; remainder is in the Regional Transportation Plan (RTP) ○ 10-year plan includes pre-TIP projects in the RTP ● Other regional EM related efforts <ul style="list-style-type: none"> ○ Talk to Justin Riley, they get the DHS money; help communities get funds to harden security, improve preparedness ● FHWA grant to evaluate the VAST tool. Testing the tool in parts of the country including this region. VAST (vulnerability assessment scoring tool) looks at vulnerability of roads due to flood and surge ● Unified Planning Work Program (UPWP) outlines proposed tasks and costs associated with the region's transportation planning ● May need to do a face-to-face; can schedule something in the next few weeks ● Potential/current HGACs Role in Harris County EMC: situational awareness, traffic control procedures, evacuation monitoring, emergency manager coordination ● For detention policy in the watershed, consider land-use practices and pervious pavement as best management practices ● Come up with a list of needs and roadways
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G103-P003 SJMDP Other Mitigation Actions

Meeting Notes

Harris County – City of Houston

February 7, 2020

San Jacinto River Watershed Master Drainage Plan
Harris County Emergency Operations Center

Meeting called by:	Jing Chen, P.E., CFM	Type of Meeting:	Other Mitigation Actions Meeting
Facilitator:	Terry M. Barr, P.E., CFM	Meeting Start Time:	1:00 PM
		Meeting Stop Time:	2:00 PM

Agenda

1.	Attendees <ul style="list-style-type: none"> • Jing Chen, HCFCD • Terry Barr, Halff Associates, Inc. • Sam Hinojosa, Halff Associates, Inc. • Hector Olmos, Freese & Nichols, Inc. • Cory Stull, Freese & Nichols, Inc. • Cory Golden, City of Houston OEM • James Trammel, Harris County OEM • Stephan Gage, H-GAC • Bill Wheeler, Harris County OEM • Mel Bartis, City of Houston OEM • Jeff Lindner, HCFCD
2.	Study Overview <ul style="list-style-type: none"> • Brief overview of the study objectives provided • Workshop on March 11th at SJRA Lake Conroe office
3.	Communications Plan/Protocols <ul style="list-style-type: none"> • Existing Communication Protocols <ul style="list-style-type: none"> ○ Harris County and Houston have a very robust communication protocol with constant coordination between them as well as SJRA and MCO; SJRA sits in the OEM during a major event ○ For flooding related to Lake Conroe, HCFCD and SJRA use the Lake Conroe Emergency Action Plan (EAP) list for communications ○ HCFCD and SJRA also provide joint press releases related to conditions along the San Jacinto river, on Lake Conroe, and regarding any releases from the Lake ○ SJRA is responsible for the Dam, HCOEM only relays messages released by SJRA ○ Freese & Nichols prepared the Lake Conroe plan; the EAP updates to the communications plan are a good go-by ○ Graphics could be helpful in demonstrating that Lake Conroe only contributes a fraction of the flow entering Harris County, there are several other watersheds that contribute flow to the river and, ultimately, Lake Houston.

	<ul style="list-style-type: none"> ○ If there are changes to the gate operations on Lake Conroe, SJRA communicates that to HCFCD and HCOEM via email. ○ With respect to public notification, HCOEM uses wireless emergency alerts as well as social media platforms such as Facebook, Twitter, YouTube and LinkedIn. Information is shared between HCFCD, HCOEM, Harris County, City of Houston, HSCO, and other agencies on their social media platforms. ○ Officials can also sign up for triggered alerts if certain gages exceed pre-defined thresholds; HCFCD and SJRA are working on messages for certain triggers as well ● Communication with neighboring jurisdictions <ul style="list-style-type: none"> ○ There is some coordination with Montgomery County, specifically relating to conditions within the Spring Creek watershed. ○ There is limited coordination with Liberty, Walker, Waller, Grimes, San Jacinto counties since that flow primarily enters Harris County via the San Jacinto river and SJRA is involved. ○ The SJRA Public Information Office (PIO) communicates frequently with HCFCD and the HCOEM. ○ Communication between HCFCD, HCOEM, and SJRA has improved significantly since Hurricane Harvey and the agencies are continually working to improve that communication. ● Pros/Cons of Current Protocols <ul style="list-style-type: none"> ○ All parties indicated that their communications protocols work very well ● Recommendations for Improvement <ul style="list-style-type: none"> ○ There were no recommendations for improvement of the communications protocols ○ HCFCD is continuing to work on improving the coverage and capabilities of the FWS, including newly added inundation mapping tools and the potential for flood forecasting in the future. Will include major streams in Montgomery County leveraging the SJRMDP models. ○ The forecasting tools are currently in beta testing; They could leverage inundation and depth grids for a variety of depth ranges to convey flood risk to the public ● How do you receive information about rainfall and flood threats? <ul style="list-style-type: none"> ○ HCOEM relies heavily on the information gathered from their Flood Warning System, which has a coverage of more than 170 gages. ○ Additional gages are currently being added by HCFCD at FM321 @ Luce Bayou, FM105 @ Tarkington Bayou, along the East Fork and on Winters Bayou; These are for HCFCD purposes and no agreements are in place with the various counties ○ Nearly every agency in the region uses the HCFWS, including the counties surrounding Harris and Montgomery County that are within the San Jacinto basin ○ Watch the forecast at US59 @ Humble ○ Notification from SJRA if there is a change to Lake Conroe operations ● Additional Information <ul style="list-style-type: none"> ○ Inundation mapping tools are being expanded to the FWS system <ul style="list-style-type: none"> ▪ Inundation mapping leverages available models and gage data; the models developed for the San Jac study could be leveraged to expand the inundation mapping in the upper San Jacinto watershed if additional gages are added ▪ The inundation is rougher in the areas on the outskirts of the county where the gage coverage is less dense. ▪ The FWS system has lots of redundancy to avoid crashing; Eventually the system will be moved to the Cloud
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	<ul style="list-style-type: none"> ○ Flood Forecasting is currently available internally and will be available to the public via the FWS website in the future <ul style="list-style-type: none"> ▪ Current system uses the HCFCD rain gage network and Quantitative Precipitation Estimates (QPE), which approximates the amount of precipitation that has fallen at a location or across a region ▪ The next phase will use Quantitative Precipitation Forecasts (QPF), which estimates the amount of expected rainfall over an area as the current QPF format does not fit our local rainfall patterns well ▪ As it relates to the San Jacinto River, HCFCD is interested in providing forecasts at Peach Creek @ US59, W. Lake Houston Pkwy., FM1960 and others. ○ The H-GAC VAST tool was briefly discussed; it provides a high-level assessment of the vulnerability of roadways to flooding and will also provide scoring metrics for future projects; H-GAC will schedule a separate meeting to discuss the VAST tool ○ Best Practices <ul style="list-style-type: none"> ▪ Practice often (drills/exercises) and make improvements ▪ There are lots of best practices, but they are not necessarily written down ▪ Have a formal written plan and follow it ▪ Keep the contact information current! ○ Ways to help neighboring jurisdictions <ul style="list-style-type: none"> ▪ Provide templates for plans, communications, etc. ▪ Provide a list of resources to help; H-GAC already provides some help ▪ TWDB State Flood Plan may provide some help or guidance to these communities ▪ Harris County offers help to all the surrounding communities if asked, including information, documents, access to the FWS, etc.
4.	<p>Locate Critical Infrastructure</p> <ul style="list-style-type: none"> • Location of Critical Infrastructure <ul style="list-style-type: none"> ○ HCFCD has critical infrastructure and should be able to provide • Comparison of Inundation Mapping to Identified Locations <ul style="list-style-type: none"> ○ The study team will use the critical infrastructure data and our inundation mapping to provide comparisons; Will not show specific locations but will provide a list of areas where one or more critical facilities could experience flooding
5.	<p>Evacuation Routes</p> <ul style="list-style-type: none"> • Comparison of inundation mapping and profiles to evacuation routes <ul style="list-style-type: none"> ○ The team will look at flood frequency at major roadway crossings to get a sense of the expected flooding along potential evacuation routes • Recommendations for evacuation routes <ul style="list-style-type: none"> ○ No information provided

G103-P003 SJMDP Other Mitigation Actions

Meeting Notes

Liberty County

February 7, 2020

San Jacinto River Watershed Master Drainage Plan
HCFCF, Northwest Crossing/Skype from Conference Room 4

Meeting called by:	Jing Chen, P.E., CFM	Type of Meeting:	Other Mitigation Actions Meeting
Facilitator:	Terry M. Barr, P.E., CFM	Meeting Start Time:	3:00 PM
		Meeting Stop Time:	4:00 PM

Agenda

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| 1. | Attendees (via Teleconference) <ul style="list-style-type: none"> Terry Barr, Halff Associates, Inc. Jing Chen, HCFCF Crista Beasley-Adams, Liberty County Sean Anderson, City of Cleveland EMC/Fire Chief Cory Stull, Freese & Nichols, Inc. |
| 2. | Study Overview <ul style="list-style-type: none"> Brief overview of the study objectives provided Project website www.sanjactudy.org |
| 3. | Communications Plan/Protocols <ul style="list-style-type: none"> Existing Communication Protocols <ul style="list-style-type: none"> In Cleveland, FB, Twitter and have also purchased Nixle (Public Safety Alerting Tool CodeRED Emergency Alert System) County uses FB, Nixle can target certain zip codes, but generally goes county wide; also use local media Internally usually on the phone or in the EOC In contact with all cities during a disaster; emails and calling County and Cleveland are the only EOC's; County is in Liberty Have a written Emergency Operations Plan; No protocol for how they communicate as long as they are communicating Plans (TDEM regulates the plans) <ul style="list-style-type: none"> Hazard Mitigation Plan Evacuation Plan Others? Plans required for Emergency Management Preparedness Grant (EMPG) Communication with neighboring jurisdictions <ul style="list-style-type: none"> Use WebEOC for resource requests, easier to use email for normal communication Under the City of Houston umbrella since they don't have their own access due to size; If something goes wrong they contact Houston Have a regional conference call |

	<ul style="list-style-type: none"> ○ TDEM does a conference call; NWS has a call as well • Pros/Cons of Current Protocols <ul style="list-style-type: none"> ○ Limited flexibility with the WebEOC since they are under Houston ○ No complaints on the communication now ○ What does communication chain look like with the drainage districts? No contact with the drainage districts; some are listed but not actually in place anymore • Recommendations for Improvement <ul style="list-style-type: none"> ○ Nothing really causing any issues that they can think of • How do you receive information about rainfall and flood threats? <ul style="list-style-type: none"> ○ Typically, the commissioners will monitor and report ○ Citizens will call into the Sheriff's office ○ Good relationship with TxDOT and share information with them • Additional Information <ul style="list-style-type: none"> ○ FM 2025, 1725, 787, SH321, FM 1010, US59 (all closed during Harvey and Imelda) ○ Recent disasters Imelda, Harvey (8 total disasters, 6 declared) ○ 2 RR in Cleveland overtopped, washed out and closed during Harvey ○ Liberty Co is a part of the HGAC HMP
4.	<p>Locate Critical Infrastructure</p> <ul style="list-style-type: none"> • Location of Critical Infrastructure <ul style="list-style-type: none"> ○ WTP at SH105 and US59 North and was flooded and shut down during Harvey ○ There isn't a list, so we will need to look at that and see what facilities are at risk • Comparison of Inundation Mapping to Identified Locations <ul style="list-style-type: none"> ○ Only portions Luce, Tarkington and East Fork in Liberty County
5.	<p>Evacuation Routes</p> <ul style="list-style-type: none"> • Review of evacuation routes recommended by agency <ul style="list-style-type: none"> ○ SH321 and US59 are both evacuation routes and both flood

G103-P003 SJMDP Other Mitigation Actions

Meeting Notes

San Jacinto River Authority, Montgomery County

February 26, 2020

San Jacinto River Watershed Master Drainage Plan

Skype Conference Call

Meeting called by:	Jing Chen, P.E., CFM	Type of Meeting:	Other Mitigation Actions Meeting
Facilitator:	Andrew Moore, P.E., CFM	Meeting Start Time:	1:30 PM
		Meeting Stop Time:	2:30 PM

Agenda

1.	Attendees (via Teleconference) <ul style="list-style-type: none"> • Andrew Moore, Halff Associates, Inc. • Jing Chen, HCFCD • Matt Barrett, SJRA • Chuck Gilman, SJRA • Heather Cook, SJRA • Bret Raley, SJRA • Mitchell Page, SJRA • Belinda Raindl, SJRA • Darren Hess, Montgomery County
2.	Study Overview <ul style="list-style-type: none"> • No overview needed; Familiar with the study
3.	Communications Plan/Protocols <ul style="list-style-type: none"> • Existing Communication Protocols <ul style="list-style-type: none"> ○ House Bill 26 specifies the responsibilities of owners or operators of state-regulated, intermediate or large-size dams with spillway gates used to make releases to regulate flood waters as well as the responsibilities of emergency management officials of downstream communities. OEMs wish to be informed of release rates/changes in release rates through Lake Conroe Dam spillway but are not interested in operational protocols or reasoning behind those releases. SJRA is being pressed to make public statements on releases ○ Email notifications sent out when changes in release rates through Lake Conroe Dam spillway occur. Notifications are automated and include the calculated release rate. Public officials and invitational only. ○ Public statements are made as needed by SJRA. SJRA may issue public statements even if one of the County EOCs has not been activated. SJRA staff are present at Harris and Montgomery County EOCs and make statements from those facilities as well. ○ Communicate with NWS, OEMs, HCFCD, TDEM, and various other agencies via phone, text, email, webinar, social media, etc. Internal policy of closing lake at certain elevations for safety reasons. Released to partners, marine police, and press releases. Not generated automatically.

	<ul style="list-style-type: none"> ○ Hurricane readiness plan and storm ready plan for both Lake Conroe and Highlands Reservoir. Storm ready action plan for Lake Conroe. ● Communication with neighboring jurisdictions <ul style="list-style-type: none"> ○ Participate in calls with MC, HC, NWS ○ SJRA representatives present at HCOHSEM (Transtar) and MCOHSEM during major events ● Pros/Cons of Current Protocols <ul style="list-style-type: none"> ○ Montgomery County struggles with how much information to share and how often both during and after events ○ SJRA is blamed for not providing information to the public ○ Properties directly downstream of dam can be affected quickly ● Recommendations for Improvement <ul style="list-style-type: none"> ○ Consider ways to bring social media platforms into one to push out notifications through all media ○ Meetings to discuss improvements to the notification process (MOCO, SJRA) ○ Currently developing Lake Conroe reservoir forecasting tool to predict lake elevations and releases, which could be shared with other local entities and the public ○ ○ Sirens to alert public of flood levels (MOCO) ○ Automated gates for closing roadways at flood elevations. (MOCO) Being used in Bexar County ● Additional information <ul style="list-style-type: none"> ○ Implementation of Lake Conroe reservoir forecasting tool may provide more advanced notice of potential releases to other entities. For example, may provide more advanced notice to National Weather Service River Forecast Center for use in forecasting river levels downstream of the Lake Conroe Dam.
4.	Locate Critical Infrastructure <ul style="list-style-type: none"> ● Location of Critical Infrastructure <ul style="list-style-type: none"> ○ Energy providers have list of infrastructure that needs to get power quickly ● Can provide GIS shapefile of any facilities
5.	Evacuation Routes <ul style="list-style-type: none"> ● SJRA does not have any

G103-P003 SJMDP VAST Tool Demonstration

Meeting Notes

Houston-Galveston Area Council

February 27, 2020

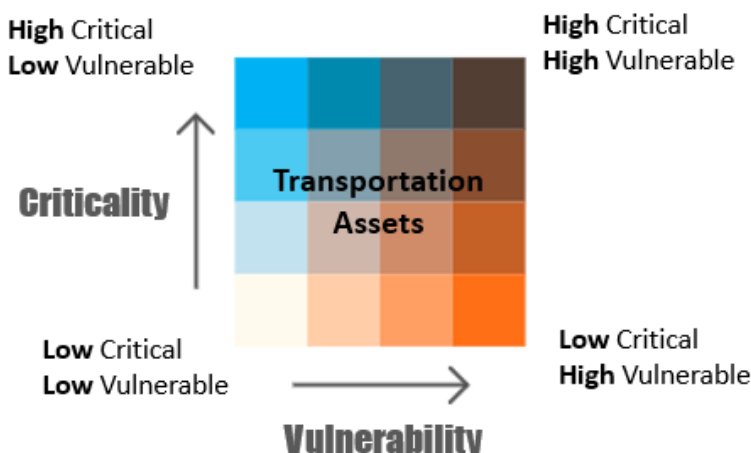
San Jacinto Regional Watershed Master Drainage Plan
HGAC Office

Meeting called by:	Jing Chen, P.E., CFM	Type of Meeting:	Other Mitigation Actions Meeting
Facilitator:	Andrew Moore, P.E., CFM	Meeting Start Time:	1:30 PM
		Meeting Stop Time:	2:30 PM

Agenda

1.	Attendees <ul style="list-style-type: none"> • Andrew Moore, Halff Associates, Inc. • Terry Barr, Halff Associates, Inc. • Pramod Sambidi, HGAC • Sungmin Lee, HGAC • David Dang, HGAC • Thushara Ranatunga, HGAC
2.	Study Overview <ul style="list-style-type: none"> • Mr. Barr provided a brief overview of the San Jacinto study including the general study area and the study goals and objectives. Mr. Barr indicated that VAST was discussed with Stephen Gage (HGAC) at a previous meeting and related to the “Other Mitigation Actions” goal.
3.	VAST Overview <ul style="list-style-type: none"> • Mr. Sambidi provided an overview of the Vulnerability Assessment Scoring Tool (VAST), which is intended to help transportation planners conduct a quantitative assessment of transportation system’s vulnerability to natural disasters, such as storm surge, inland flooding and other events. VAST for the Houston-Galveston region is currently being developed as part of a pilot study funded by FHWA, which involves multiple Metropolitan Planning Organizations (MPO) across the nation. There’re 8 counties within the HGAC MPO – Harris, Waller, Montgomery, Liberty, Brazoria, Fort Bend, Chambers, Galveston • The pilot study includes two phases: Phase I – Criticality of road segments (using major road network) Phase II – Vulnerability (use DTM/DSM from 2018 Lidar, Harvey depth grid & Ike data, floodplain and storm surge data) • The results of the tool arrive at a combination of criticality and vulnerability, with several indicators that are individually scored; those scores are aggregated. • The tool uses information from a variety of sources including: <ul style="list-style-type: none"> ○ TXDOT Data (Roads, Major Highways, etc.) ○ LiDAR Terrain data ○ FEMA Flood Depths (100- and 500-year) ○ Hurricane Harvey data

- Sea Level Rise information from NOAA
- Storm Surge information From Hurricane Ike and other storms
- Using the GIS information listed above, HAZUS for flood assessments, and the VAST, the vulnerability of the transportation network can be assessed
- The Vulnerability Assessment looks at the following components (resulting in vulnerability index score for each road segment from 1 to 5 to identify road segments that are highly critical):
 - Exposure: potential exposure of assets to climate stressors, using indicators based on climate projections like number of extreme heat days, sea-level rise inundation maps, storm surge, and 100-year 24-hour rainfall events. (e.g. How likely is the asset to flood?)
 - Sensitivity: how sensitive the asset is if exposed to particular climate stressors, using indicators related to asset design such as bridge height or culvert size, structural evaluation, and current condition. (e.g. How likely is it that the access to the asset is disrupted?); road ratings, past flooding events
 - Adaptive capacity: how well the system can adjust to disruption, using indicators such as detour length and ability to repair/replace. (e.g. How difficult is it for people to adapt if the asset is not accessible?); cost factors
- The Criticality Assessment looks at the following components and numerical weighting for determining the final scoring:
 - Socioeconomic importance (20%)
 - Operational usage (40%)
 - Health-Safety (30%)
 - Emergency Response (10%)
- Based on the vulnerability and criticality, transportation assets can be divided into several categories that can generally be classified into the categories below. The graphic provided was discussed in the meeting and was obtained from the HGAC website listed below (<http://www.h-gac.com/resiliency-planning/documents/draft-resiliency-and-durability-pilot-study-methodology.pdf>)
 - Highly Critical-Highly Vulnerable
 - Less Critical-Highly Vulnerable
 - Highly Critical-Less Vulnerable
 - Less Critical- Less Vulnerable



- The assessment is performed for a single event (e.g. 100-year, 500-year, etc.) with different vulnerability results for each of the events.

	<ul style="list-style-type: none"> • Mr. Sambidi indicated that public meetings will be held in the spring to present the information to stakeholders and other interested parties. After the meetings the information may be released on the HGAC website. • Final report to be submitted to FHWA by end of July 2020
4.	<p>Long Range Goals</p> <ul style="list-style-type: none"> • In the long term, HGAC would like the tool to be leveraged for Hazard Mitigation Planning such that transportation networks can be evaluated for a variety of natural hazards. In addition, the HGAC Transportation Policy Council could use it for long range planning.
5.	<p>Questions</p> <ul style="list-style-type: none"> • Is the VAST process one that is repeatable if data is available? Yes, the process is set up to be able to perform the assessment for a variety of events. • Would information about more frequent or other historical storms? Yes, if depth grids are available for other storms (25-year, 50-year, other actual events) an assessment could be run using that data. • How did you calculate the bridge elevations? Using LiDAR information • What is the next step? HGAC is hoping for additional funding to continue the development and implementation of VAST. Several other agencies are currently or will be working on similar pilot studies, including Austin, NCTCOG, Corpus Christi, and HGAC. FHWA is gathering the results. • When will the information be available online? After the stakeholder meetings in April, the information will be available online. HGAC can send us an invitation to the stakeholder meeting.



A photograph of a flooded road next to a river. A green sign on a metal pole reads "SAN JACINTO RIVER". The road is partially submerged in water, and a concrete barrier is visible in the foreground. The background shows a line of trees under a cloudy sky.

SAN JACINTO
RIVER

SAN JACINTO

Regional Watershed Master Drainage Plan

Emergency Management Coordinator Workshop
March 11, 2020 - **DRAFT**



Other Mitigation Action Goals

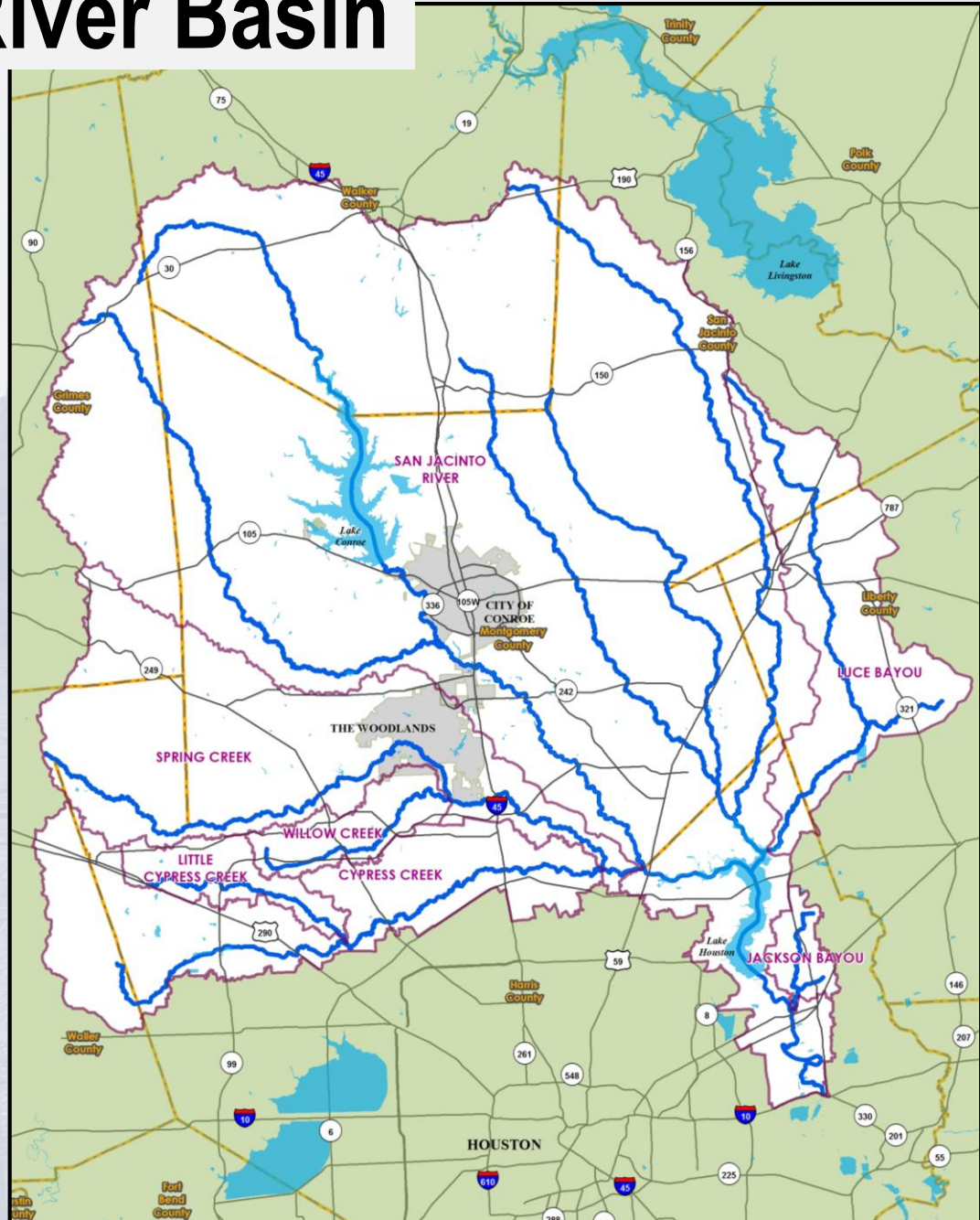
- Scope Goals
 - Coordinate with responsible emergency management personnel
 - Develop a communications plan/protocol to facilitate information sharing
 - Locate critical infrastructure and compare to inundation
 - Identify evacuation routes and related flood frequency
- Workshop Goals
 - Review information gathered during the interviews
 - Discuss information gaps and ways to reduce those gaps
 - Discuss critical infrastructure and gather additional input
 - Discuss preliminary roadway flood frequency and gather input

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San Jacinto River Basin

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6



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Study Overview

- Study Background
 - FEMA HMGP Funded (75/25)
 - Mitigation Actions (Flood Reduction, Flood Warning, Flood Response)
- Other Mitigation Actions (Flood Response)
 - Evaluate communications plan/protocol during emergencies
 - Identify critical infrastructure and compare to inundation
 - Determine expected flood frequency for major roadways (evacuation)



Summary of EMC Interviews

- Conversations with numerous stakeholders
 - Harris County EMC – HCFCD – City of Houston
 - San Jacinto River Authority
 - Montgomery County - City of Conroe
 - Grimes County
 - Waller County
 - Walker County
 - Liberty County
 - Houston-Galveston Area Council
- Brief overview of the San Jacinto study
- Communications protocols
- Critical Infrastructure
- Evacuation routes and flooding

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Communications

- Internal Communication
 - Local government, EMC, Police, Fire, EMS, Public Works, etc.
 - Generally good relationships between agencies in the local community
 - Usually communicate via phone, text, email, or radio
 - Web EOC used for resource requests; not primary communication
 - Many communities use FirstNet to provide priority network access
- Neighboring Jurisdictions
 - Local County/Cities usually have regular contact
 - Good local relationships with TxDOT
 - HCOEM/HCFCD/SJRA communicate during events
 - HCOEM/SJRA joint press releases regarding river or lake conditions
 - Limited HCOEM contact with outer counties; SJRA covers river/lake
 - Counties provide assistance to adjacent counties as needed

Communications

- Public Communication
 - All agencies have websites that share information to some extent
 - Social media usage is prevalent, but to different extents
 - Some agencies use Facebook only
 - Others have wider social media presence (Facebook, Twitter, YouTube, LinkedIn, etc.)
 - Linkage to related accounts varies (i.e. OEM to Police, Fire, Commissioners, News)
 - Nixle or CodeRed used for emergency notifications to public
 - Able to geolocate alerts, but typically push county-wide
 - Participants must register, which can be challenging
 - Relationships with local media outlets (TV, Radio)
 - Harris County Flood Warning System provides real time mapping and out of bank information within county
 - National Weather Service alerts and forecasts

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Flood Monitoring

- Harris County utilizes electronic tracking
 - Uses 170+ gages of FWS, reports, field verification
 - Most agencies in the region use FWS to some extent
 - HCFCD/SJRA communicate related to Lake Conroe/West Fork
- Many communities monitor in person
 - Word of mouth, emails, photos from residents
 - Proactive county commissioners and staff
 - Police and fire departments
 - Relationships with TxDOT personnel
 - School District bus drivers
- Road Closures
 - Some rainfall thresholds (e.g. if it rains X" per hour, they will monitor)
 - City/County staff will visually monitor and place barricades

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Additional Information

- Upgrades to the HCFWS
 - New gages being installed (Luce, Tarkington, East Fork, Winters)
 - Updated inundation capabilities based on available models
- H-GAC VAST tool provides high level roadway vulnerability
 - Currently a pilot study but hope to further develop
 - Public meeting this spring to present current progress
- Numerous roadways identified as overtopping
- Forecasting tools in development for HCFCD/SJRA
- Several agencies have written plans but some are not current

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Potential Information Gaps

- Written plans for procedures and communications
- Staff redundancy and knowledge base
- Floodplain Mapping
 - Base Level Engineering (BLE)
 - Leverage models developed as part of this study (Main Stems)
 - Fund additional model development and mapping efforts
- Gage Coverage
 - Use available data from USGS and Harris County FWS
 - Recommendations for additional gages part of this study
- Availability of real-time information
 - Rainfall information (depth, intensity)
 - Status of roadways (depth of flooding, duration)
 - Inundation mapping outside of Harris County

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Best Practices

- Have a formal plan and follow it
- Keep contact information current
- Practice the plan with drills and exercises and adjust as needed
- Maintain a current Hazard Mitigation Plan
- Leverage available gage information
- Link related social media accounts (e.g. HCFCD to OEM, Commissioners, HCED, COH, HSCO, HPD, etc.)

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Recommendations

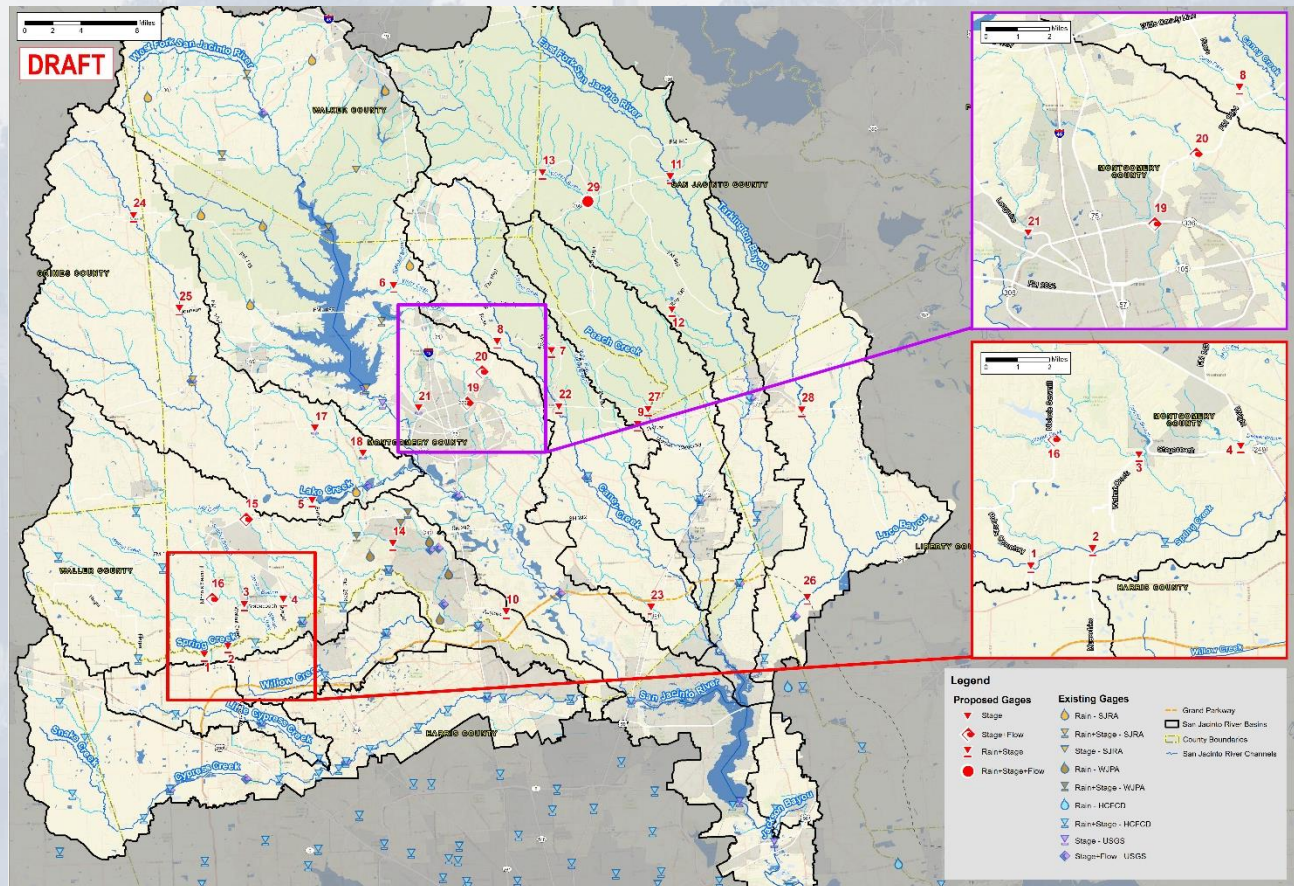
- Additional towers to reduce communication coverage gaps
- Pursue grant funding for additional planning and equipment
- Internal alerts for critical infrastructure failures
- Improve/raise roadways along critical evacuation routes
- Increase FWS gage coverage of all types (rain, stage, flow)
- Improve emergency messaging systems
- Add lake elevation and release prediction for public
- Implement forecasting tools
- Flood barriers for frequently flooded roadways
- Ensure plans and procedures are in a written format
- Educate the public about flooding and information sources

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Secondary Mitigation Planning

- Received input from HCFCFCD, MCO, USGS, Others
- Considered variety of gage types (Rain, Flow, Stage)
- Flood warning and data for future calibration efforts



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Critical Infrastructure

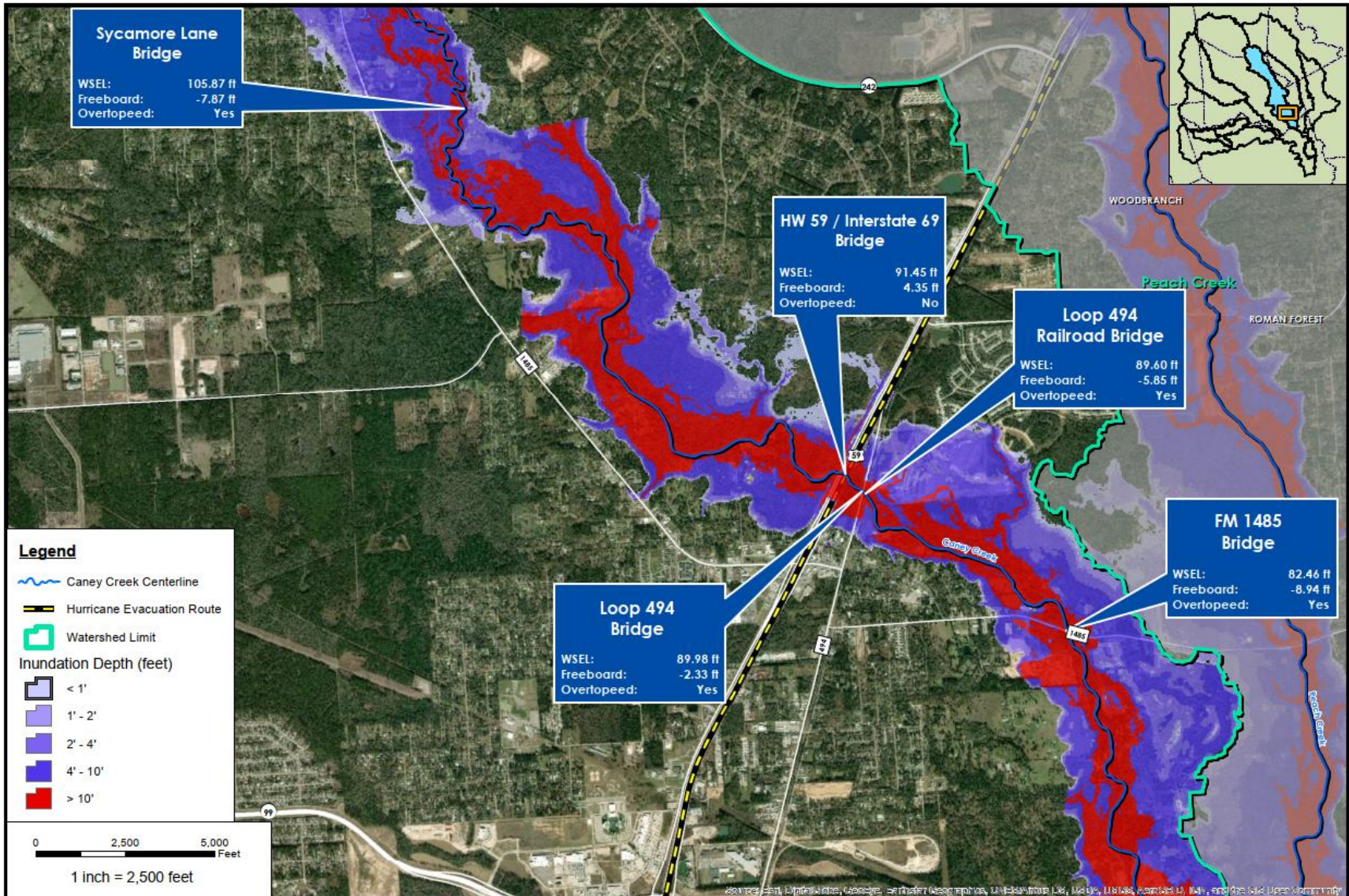
- Types of Critical Infrastructure
 - City or County Facilities
 - Other Government Buildings
 - Police, Sheriff, Fire, EMS
 - Hospitals
 - Schools/Churches (Shelters)
 - Electrical Facilities
 - Water/Wastewater Treatment Plants
 - Chemical or Industrial Facilities
- Are there additional facilities to be considered?
- Currently identifying location of facilities compared to inundation
- Presentation will be limited for security reasons

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Inundation Maps

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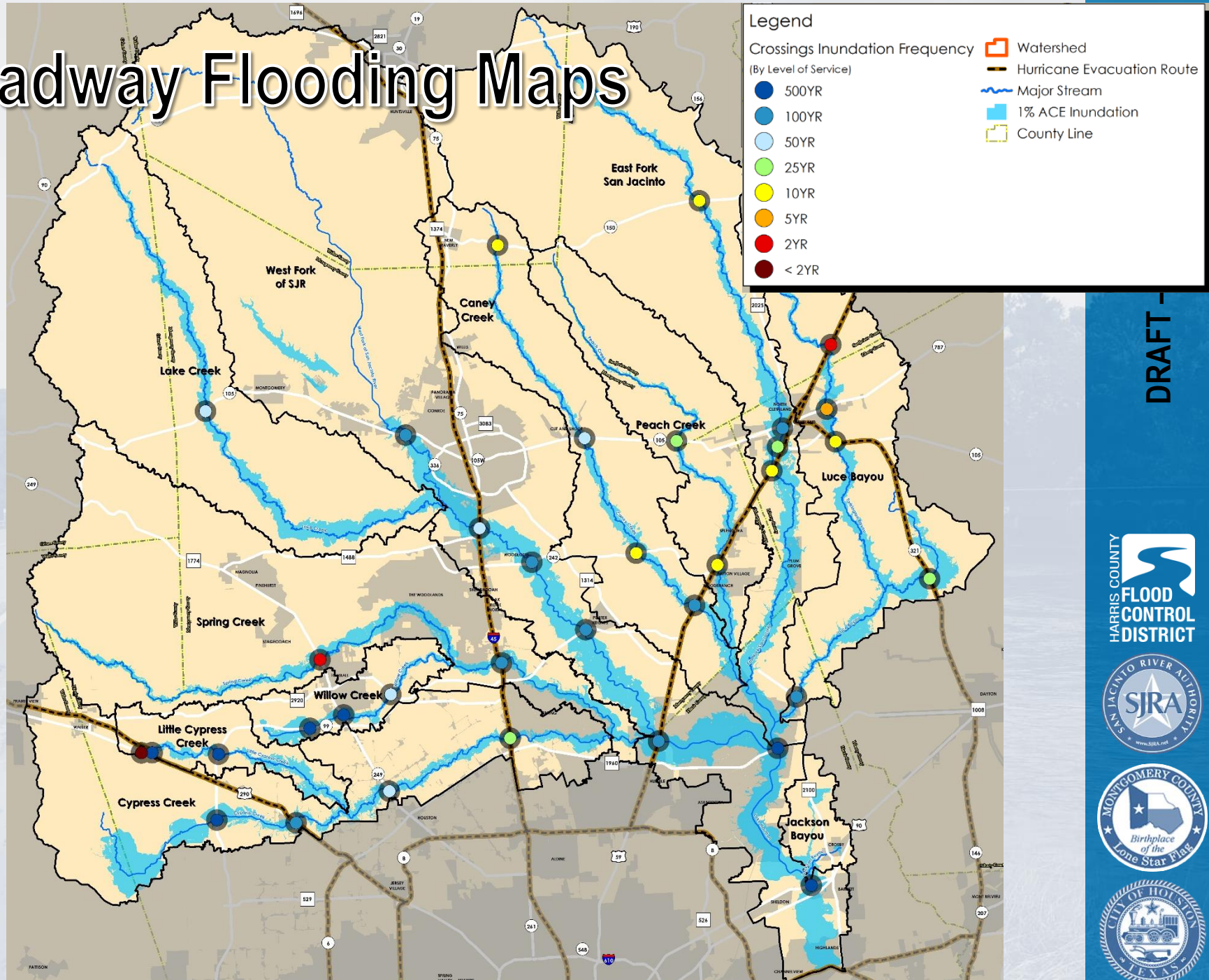
Roadway Flood Frequency

- Critical to identify potential for roadway flooding
 - Evacuation routes for the public
 - Access for emergency services (Police, Fire, EMS)
- Evaluated the frequency of inundation at major road crossings
 - What roads are flooded?
 - How often can they be expected to flood?
 - How much rainfall could result in flooding?
 - How can flooding be monitored? (Depth, Duration)
- Performed preliminary roadway frequency analysis
- Major N/S evacuation routes at risk of flooding (I-45, US59)
- Limited passable E/W roads
- Additional roads will be added as the study progresses

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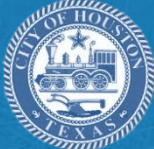


Roadway Flooding Maps



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HARRIS COUNTY
FLOOD
CONTROL
DISTRICT



SAN JACINTO
RIVER

Questions?

Emergency Management Coordinator Workshop
March 11, 2020 - **DRAFT**



G103-P003 SJMDP Other Mitigation Actions

EMC Workshop Agenda

San Jacinto Watershed EMC

March 11, 2020
San Jacinto River Watershed Master Drainage Plan
SJRA G&A Division Office

Meeting called by:	Jing Chen, P.E., CFM	Type of Meeting:	Communication Protocols, Critical Infrastructure, Evacuation Routes
Facilitator:	Terry Barr, P.E., CFM	Meeting Start Time:	1:00 PM
		Meeting Stop Time:	2:00 PM
Agenda			
1.	Introductions GOAL: Coordinate with first responders in the San Jacinto River Basin to develop consistent communications protocols and identify risks to critical infrastructure and roadways.		
2.	Study Overview <ul style="list-style-type: none"> • Study Background • Other Mitigation Actions <ul style="list-style-type: none"> ○ Communications Protocols ○ Critical Infrastructure vs. Inundation ○ Roadway Flood Frequency and Evacuation Routes 		
3.	Summary of EMC Communications <ul style="list-style-type: none"> • General Summary • Communication Procedures (Internal and External) • Best Practices 		
4.	Potential Information Gaps <ul style="list-style-type: none"> • Floodplain Mapping • Gage Coverage • Availability of Real-time Information 		
5.	Critical Infrastructure vs. Inundation <ul style="list-style-type: none"> • Brief overview of potential critical infrastructure inundation • Input from EMC's re: critical infrastructure 		
6.	Roadway Flood Frequency and Evacuation Routes <ul style="list-style-type: none"> • Comparison of inundation mapping to evacuation routes • Identify potential threats to evacuation or emergency access during a storm 		
7.	Closing Remarks and Questions		

MEETING MINUTES

<p>To: Jing Chen, P.E., CFM</p> <p>From: Terry Barr, P.E., CFM</p> <p>Subject: Upper San Jacinto River Regional Flood Mitigation Plan – Other Mitigation Actions Workshop</p> <p>Meeting Date: 03/11/2020 – 1:00 pm</p> <p>Location: SJRA, G&A Division Office</p> <p>Minutes Date: 03/18/2020</p> <p>AVO No.: 033465.002</p>	<p>Attendees: Jing Chen, HCFCD Matt Barrett, SJRA Heather Cook, SJRA Bret Raley, SJRA</p> <p>Belinda Raindl, SJRA Terry Barr, Half Sam Hinojosa, Half Andrew Moore, Half Hector Olmos, Freese & Nichols Cory Stull, Freese & Nichols Rachel Massey, Hollaway Thomas Mumford, Hollaway Stephan Gage, HGAC Mike Lambert, HGAC Justin Bower, HGAC David Lilly, Grimes County Adam Eaton, City of Houston</p>
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Item	Description	Action
1.	<p>Introductions</p> <p>Ms. Chen started the meeting and began with introductions. Mr. Barr asked all individuals participating by phone to email Ms. Chen and let her know they were attending.</p>	
2.	<p>Study Overview</p> <p>Mr. Barr provided an overview of the SJR study that included the general goals and objectives. He specified that the workshop was related to the Other Mitigation Actions task.</p>	
3.	<p>Summary of EMC Communications</p> <p>Mr. Barr provided an overview of the separate EMC communications, including findings of how entities are coordinating during a storm event.</p> <p>After the presentation, Mr. Barr and Ms. Chen opened up the meeting to comments and questions. The following items were discussed:</p> <ul style="list-style-type: none"> Mr. Gage mentioned that HGAC is presenting the VAST tool to the public in the upcoming months. Mr. Barr noted that the study team had met separately with HGAC to learn more about the VAST tool. Mr. Raley stated that he thinks the EOC's should be the leader of the information sharing in emergency events. He stated that other sources can be used to inform the EOC but having one source for public engagement would be helpful. Mr. Raley indicated that the MCOHSEM agreed with that position. Mr. Raley stated that other entities such as San Antonio could provide examples for how to incorporate gages and real time 	

	<p>monitoring and informing the public.</p> <ul style="list-style-type: none"> • Mr. Raley stated that the HCFWS has limitations on the data they will accept and share. He stated that there is other available information in the watershed but is not included on the website due to quality and accuracy. • Mr. Raley asked if there were any specific entities tied to the recommended gages. Mr. Barr stated that any entity could sponsor or install the gages recommended. He stated that different types were recommended but not specified by agency. 	
4.	<p>Potential Information Gaps</p> <ul style="list-style-type: none"> • Mr. Lilly mentioned that in Grimes County the temporary barriers are often disregarded by the public and moved during events. He stated that a permanent barrier may be more effective at blocking roadways during events. • Mr. Lambert mentioned that many of the recommendations provided are well known in the emergency managers. The State has allocated \$20 million for communications improvements. He asked how recommendations from our report could be implemented due to funding limitations. • Public engagement is one of the challenges that the emergency management community faces. Getting people to opt into the Code Red or Nixle systems is often unsuccessful. • Plans are helpful for determining gaps and for pre-disasters training but during actual events the Emergency Management personnel rely on their experience rather than reading the written plans. • Mr. Barr asked if the tabletop exercises are helpful for actual events. Lilly stated that they are helpful if you can get all parties involved and engaged which can be challenging with volunteer driven emergency managers or firefighters. • Ms. Chen mentioned that developing a wish list of the potential needs for the basin could help identify needs that could be used to apply for funding. • Mr. Lambert stated that the WebEOC does not perform well and rural counties do not tend to prefer this platform for sharing. He stated that internal and external coordination are effective during disasters, but best practices outside of disasters are not shared effectively. • Mr. Gage discussed the need for land management to prevent disasters. He stated that emergency management can start with managing land and preventing people from building in certain areas. • Mr. Barrett stated that the SJRA is looking for funding partners for additional rain/stage gages in the watershed. He stated they have the expertise to install and maintain the gages and include 	

	in the SJRA network.	
5.	Critical Infrastructure vs. Inundation <ul style="list-style-type: none"> Mr. Lambert mentioned adding supply chain facilities to the critical infrastructure such as food distributions and warehouses. Ms. Chen mentioned that multi-modal facilities such as railroads should be included. Mr. Gage mentioned he will investigate if the HGAC has any information regarding these facilities for the HGAC area. 	
6.	Roadway Flood Frequency and Evacuation Routes <ul style="list-style-type: none"> Mr. Lilly asked if the new bridge on Spring Creek at SH 249 will be included in the analysis. He stated he is expecting the construction to be completed in the next year. Mr. Barr mentioned that it currently doesn't but could be included if it gets completed or at the very least could be discussed in the report. Mr. Gage mentioned that other routes and detours should be considered. Mr. Lambert stated that the US59 evacuation route is one of concern since it has been overtopped several times in recent events. Mr. Barr noted a lack of major east-west roads, particularly in the upper part of the basin that can make evacuation difficult. Identifying roads that flood and the expected frequency can help emergency managers make more informed decisions about traveling those roads during a disaster. 	
7.	Ms. Chen concluded the meeting.	

This concludes the Meeting Minutes. Our goal is to provide a complete and accurate summary of the proceedings of the subject meeting in these minutes. If you feel that any of the items listed above are not correct, or that any information is missing or incomplete, please contact Halff Associates so that the matter can be resolved, and a correction issued if necessary. These minutes will be assumed to be correct and accepted if we do not hear from you within ten (10) calendar days from your receipt.

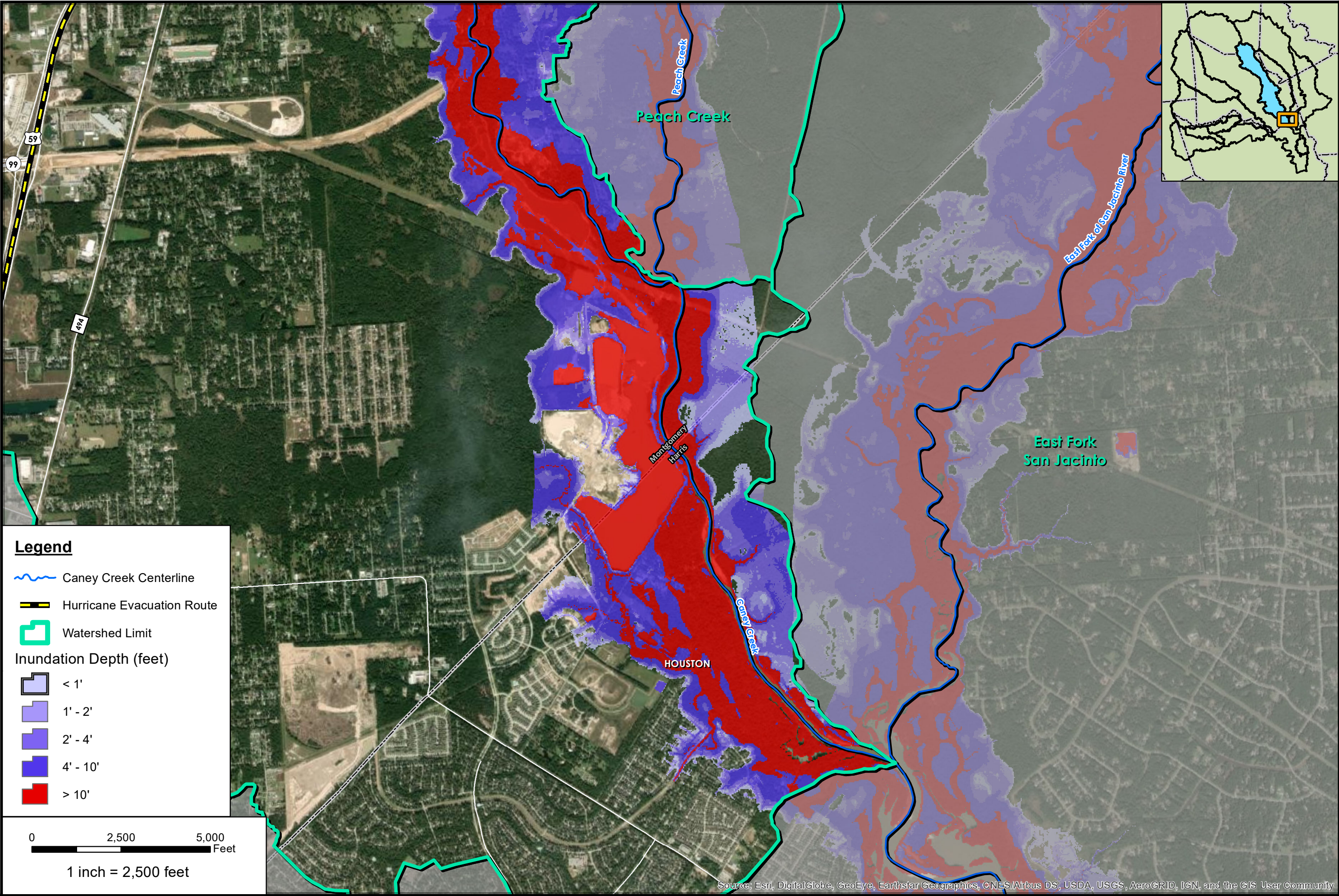
EMERGENCY COORDINATION WORKSHOP
San Jacinto Watershed Emergency Management Coordinators
Other Mitigation Actions
March 11, 2020



Name	Organization	Phone Number	Email
Terry Barr <i>TB</i>	Halff Associates, Inc.	(713) 588-2451	tbarr@halff.com
Jing Chen <i>JC</i>	HCFC	(346) 286-4264	jing.chen@hcfcd.hctx.net
Sam Hinojosa <i>SH</i>	Halff Associates, Inc.	(936) 777-6372	shinojosa@halff.com
Cory Stull <i>CS</i>	Freese & Nichols, Inc.	(713) 600-6809	cory.stull@freese.com
Hector Olmos <i>HO</i>	Freese & Nichols, Inc.	(713) 600-6856	heo@freese.com
Bret Raley	SJRA	936-537-5784	braley@sjra.net
Matt Barrett	SJRA	936-588-7177	mbarrett@sjra.net
Cory Stull	F		
Andrew Moore	Halff	936-777-6372	amoore@halff.com
Belinda Raindl	SJRA	936-588-7444	braindl@sjra.net
Rachel Massey	Hollaway	376-250-8261	rachel.massey@hollawayenv.com
Thom Munford	Hollaway ENV	832-922-5371	thomas@hollawayenv.com
Heather Cook	SJRA		hcook@sjra.net
MICHAEL LAMBERT	H-GAC	713-499-6655	MICHAEL.LAMBERT@H-GAC.COM
David Lilly	Grimes County OEM	979-204-4592	david.lilly@grimescountytexas.gov
STEPHAN GAGE	H-GAC	713/499-6692	stephan.gage@gmail.com

Appendix J.2

Inundation Mapping and Roadway Flooding



Legend

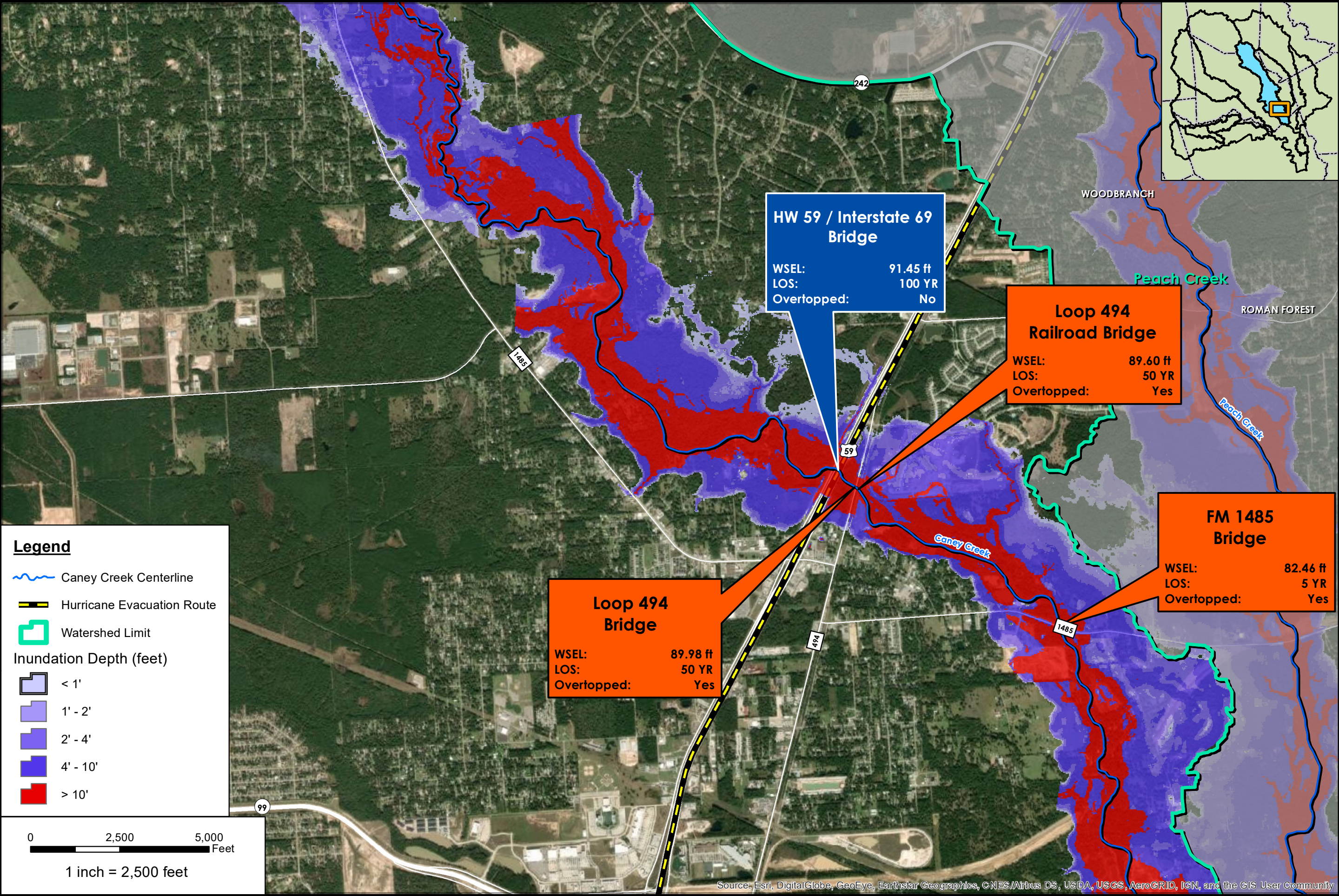
- Caney Creek Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)**
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO 33465	
DATUM & COORDINATE SYSTEM NAD 1983 2011 StatePlane Texas Central FIPS 4203 FUS	
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP CANEY CREEK	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP GCC - A	



PROJECT AVO
33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas Central FIPS 4203 PLUS

HARRIS COUNTY FLOOD CONTROL DISTRICT

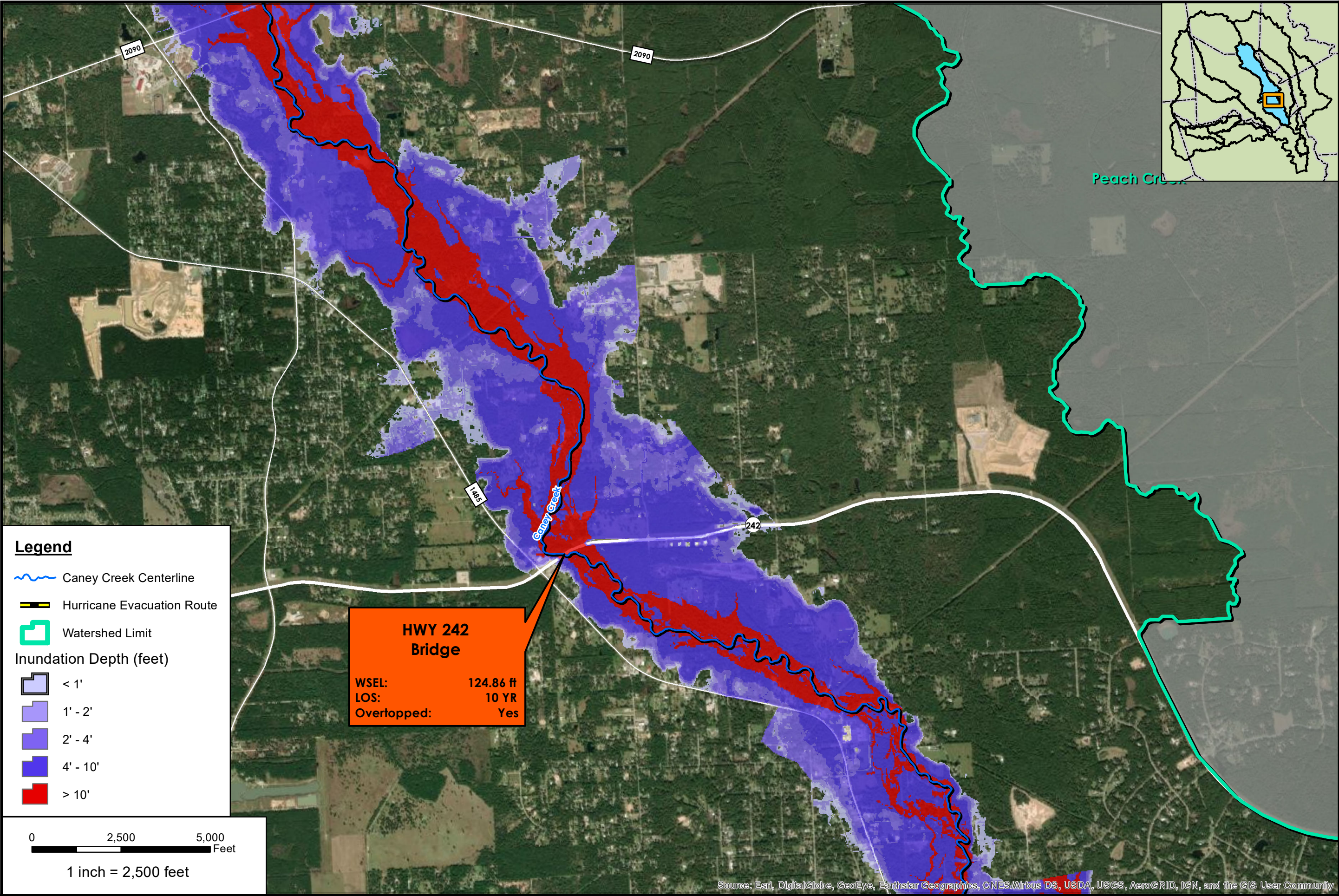
San Jacinto Regional Watershed Master Drainage Plan

100YR EXISTING CONDITIONS MAP | CANEY CREEK

SAN JACINTO
REGIONAL WATERSHED
MASTER DRAINAGE PLAN

APPENDIX
J.2

MAP
GCC - B



Legend

- Caney Creek Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

HWY 242 Bridge
WSEL: 124.86 ft
LOS: 10 YR
Overtopped: Yes

0 2,500 5,000 Feet

1 inch = 2,500 feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas Central FIPS 5003 FUS

HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

100YR EXISTING CONDITIONS MAP | CANEY CREEK

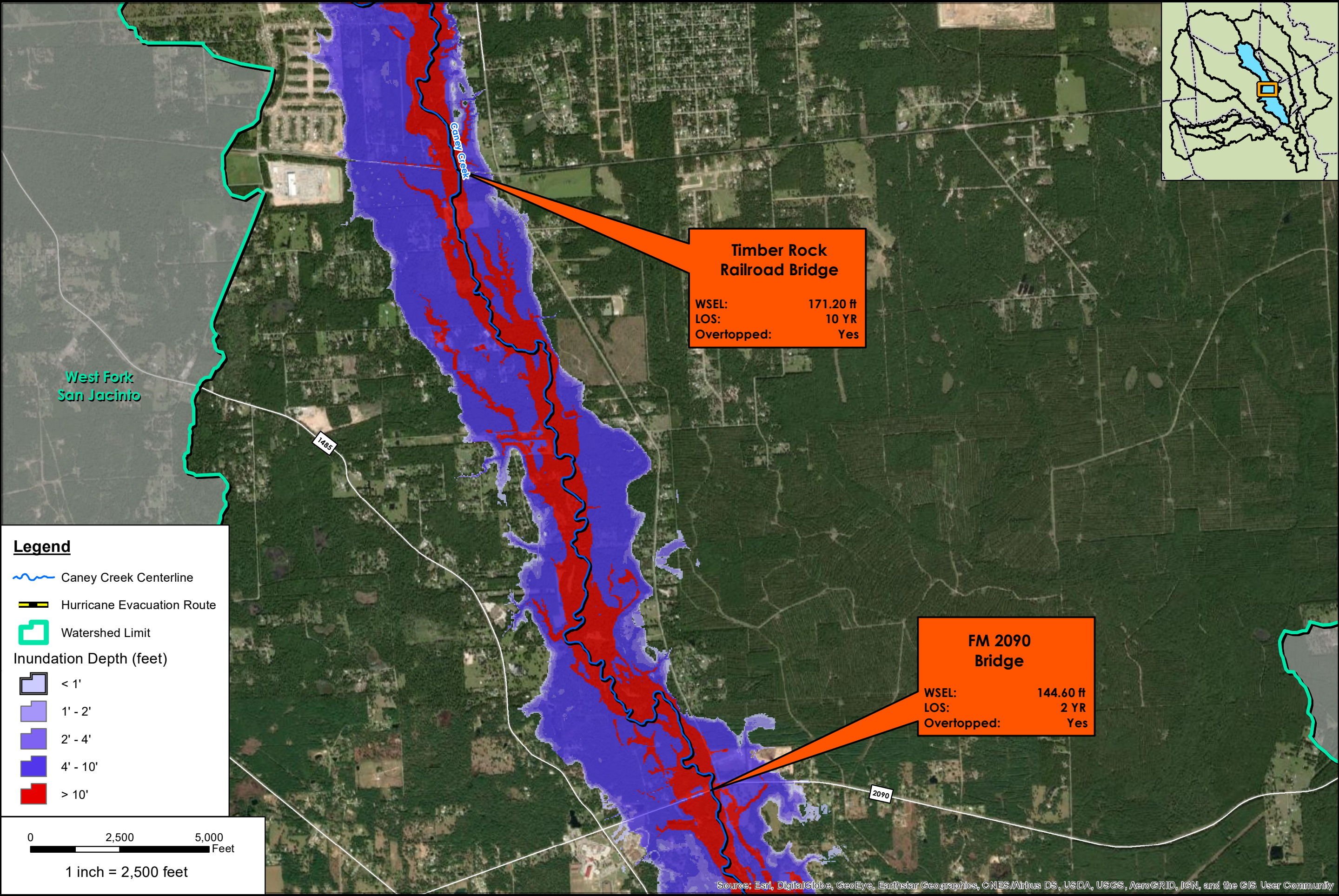
SAN JACINTO

REGIONAL WATERSHED

MASTER DRAINAGE PLAN

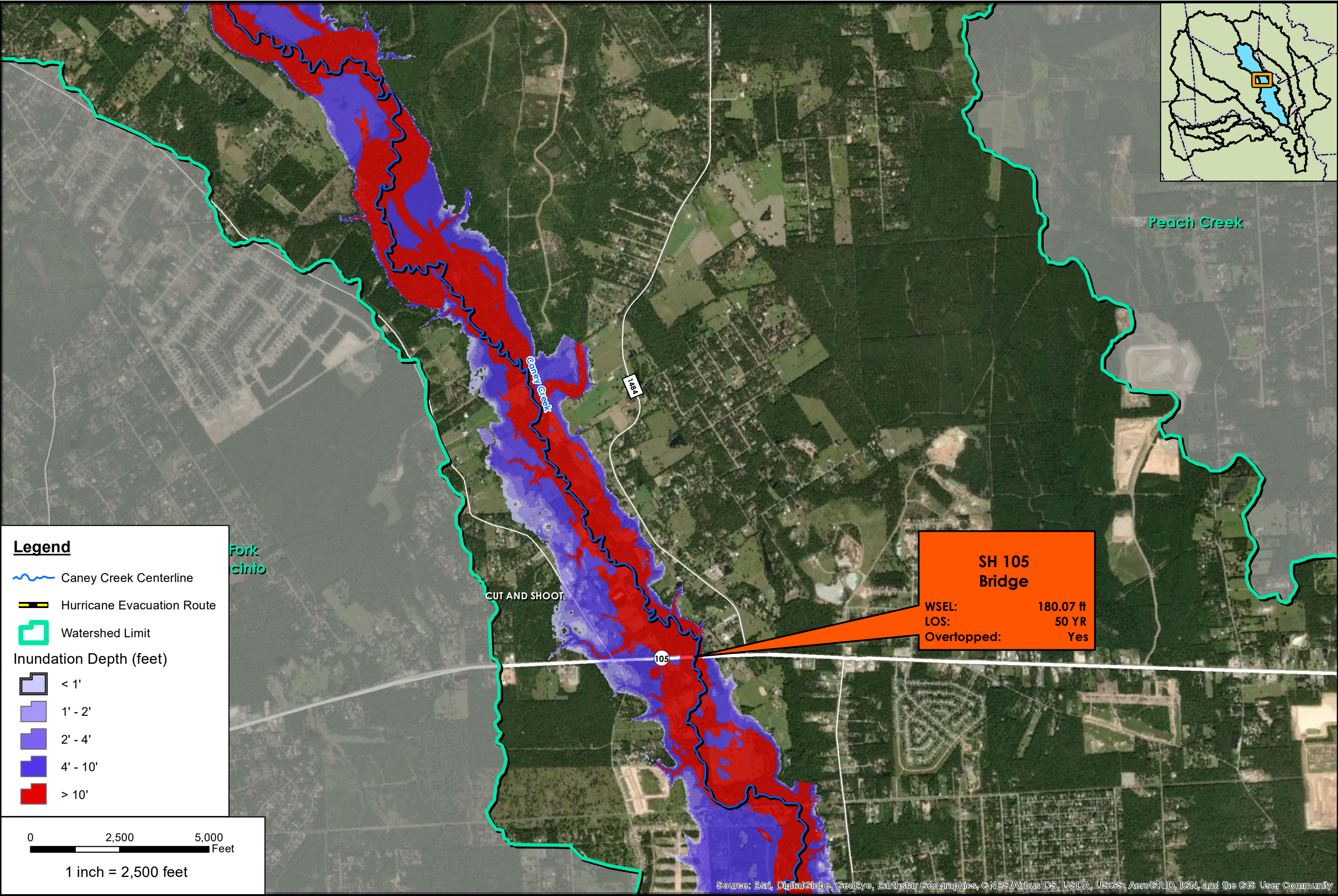
APPENDIX J.2

MAP GCC - C

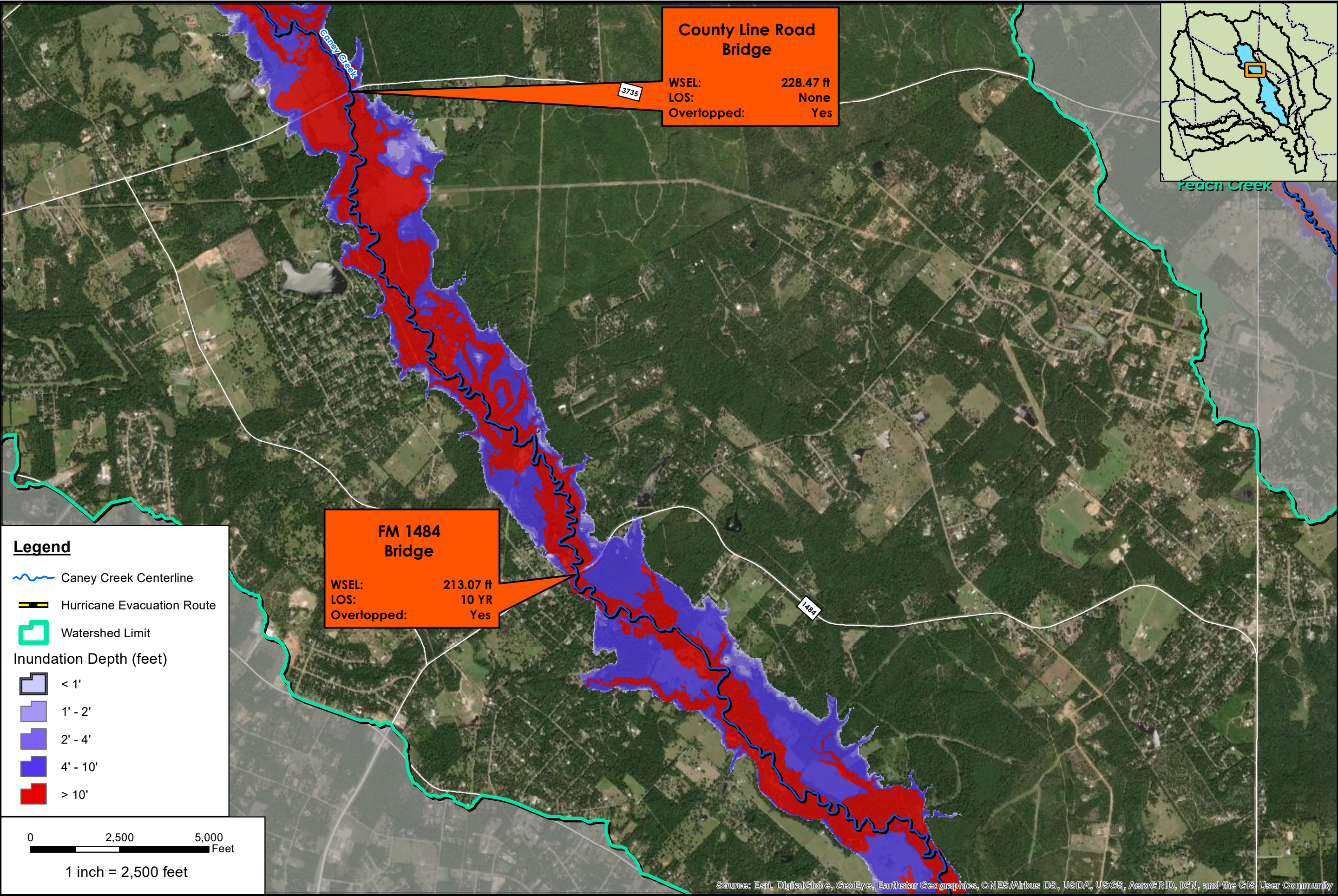


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APPENDIX J.2	
MAP GCC - D	

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



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HARRIS COUNTY FLOOD CONTROL DISTRICT	San Jacinto Regional Watershed Master Drainage Plan
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SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP GCC - E	



County Line Road Bridge

WSEL: 228.47 ft
LOS: None
Overtopped: Yes

FM 1484 Bridge

WSEL: 213.07 ft
LOS: 10 YR
Overtopped: Yes

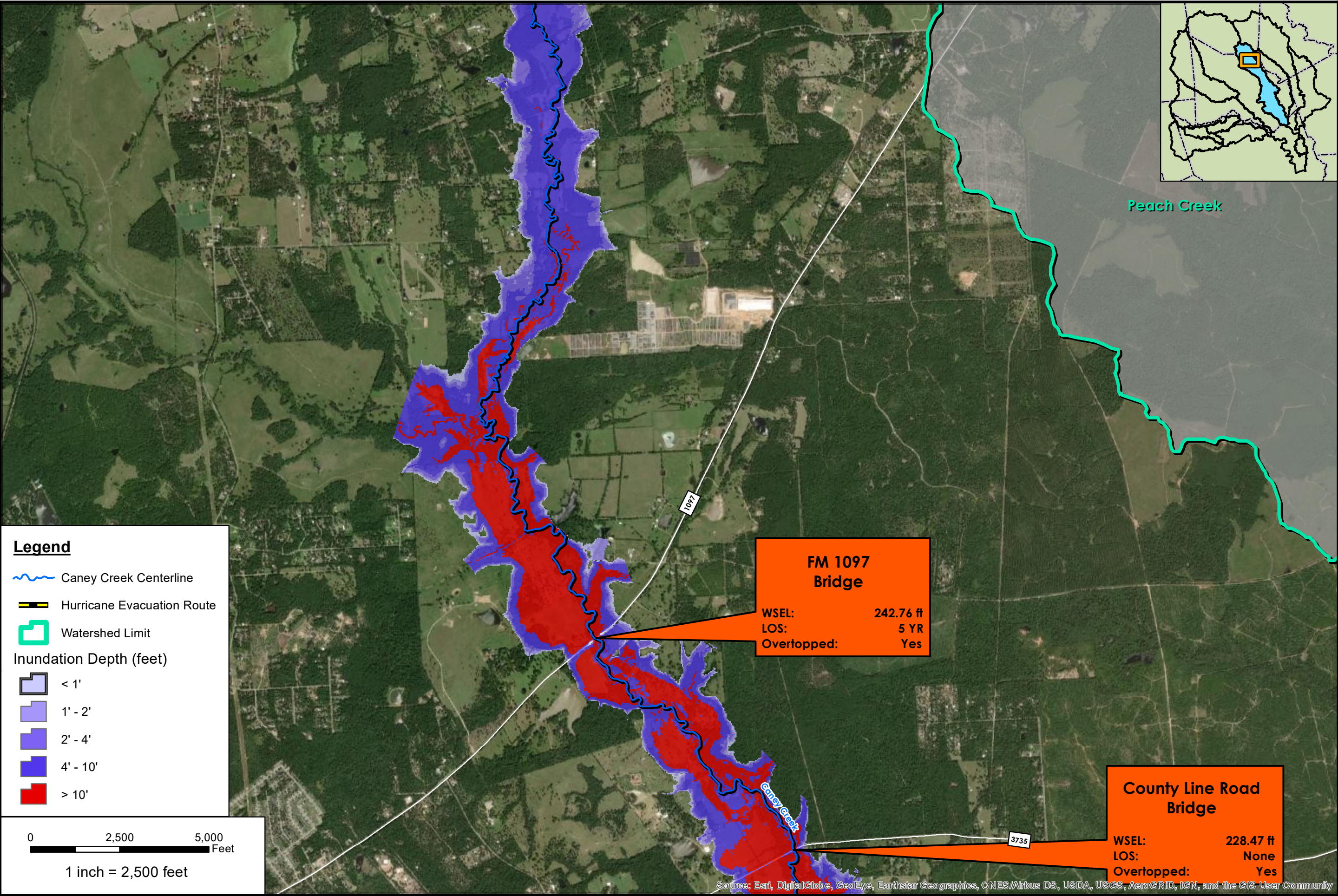
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 - 4' - 10'
 - > 10'

0 2,500 5,000 Feet

1 inch = 2,500 feet

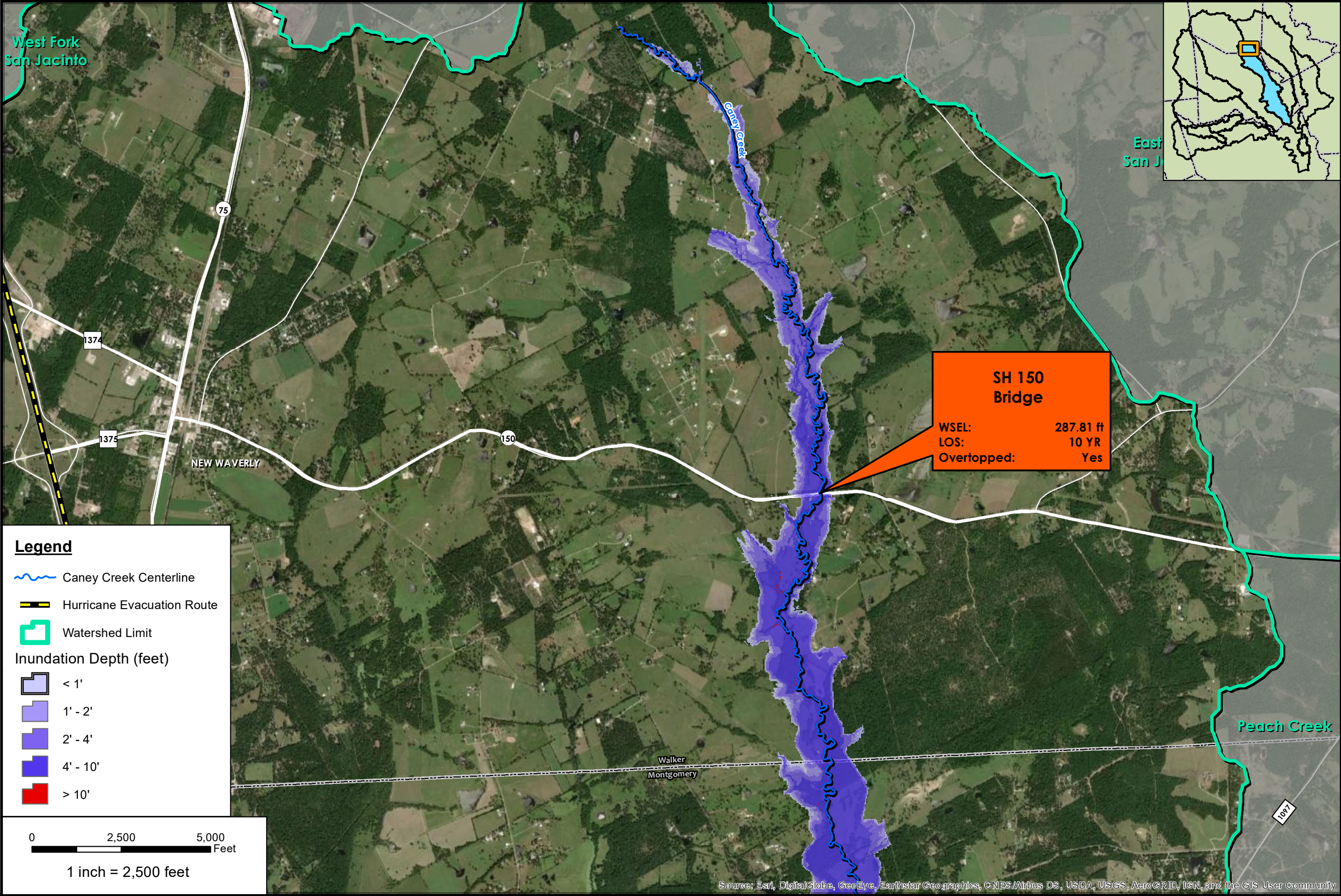
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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MAP GCC - F	



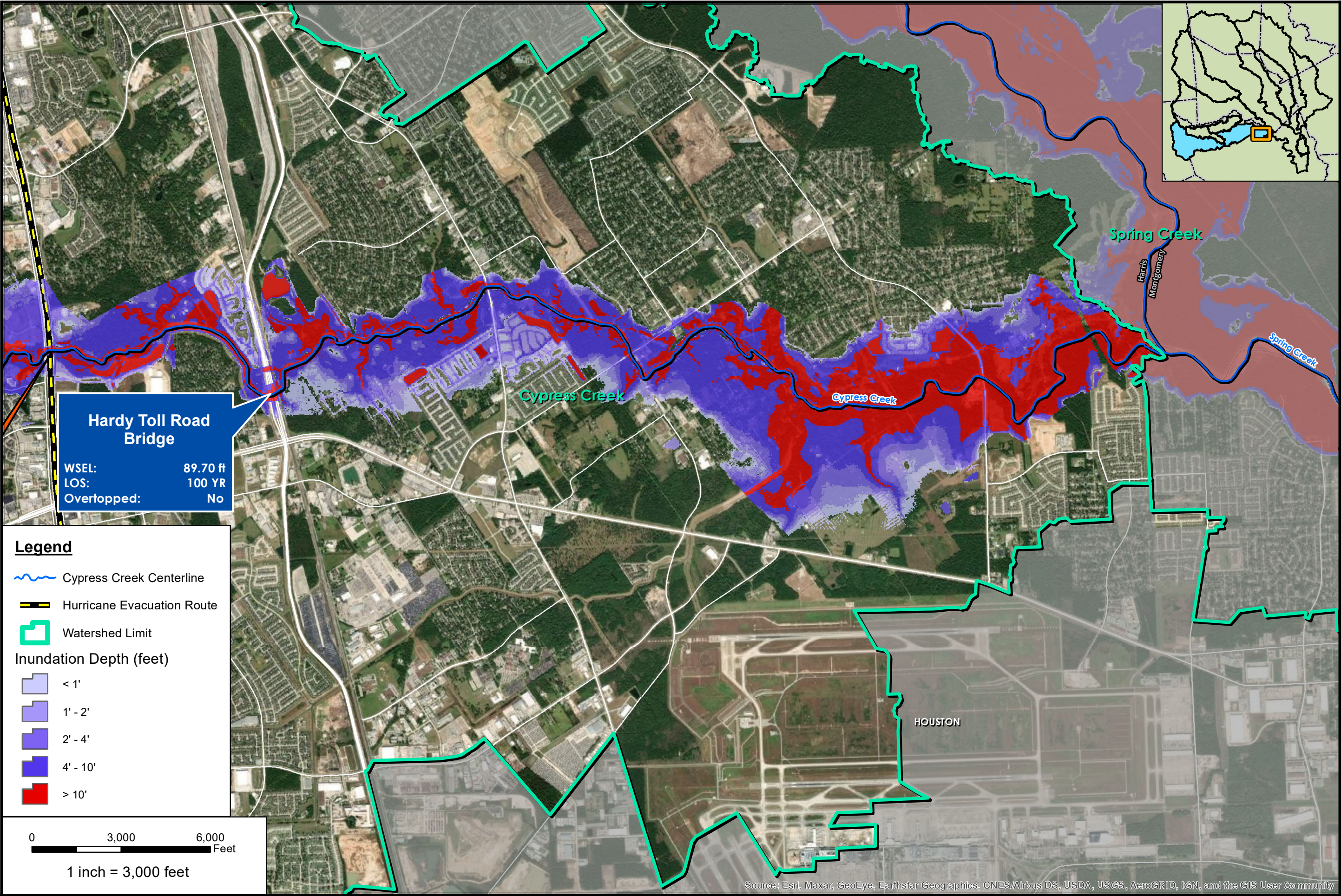
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APPENDIX J.2	
MAP GCC - G	

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



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APPENDIX J.2		
MAP GCC - H		

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Hardy Toll Road Bridge

WSEL: 89.70 ft
LOS: 100 YR
Overtopped: No

Legend

- Cypress Creek Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 3,000 6,000 Feet

1 inch = 3,000 feet

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO
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DATUM & COORDINATE SYSTEM
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HARRIS COUNTY FLOOD CONTROL DISTRICT

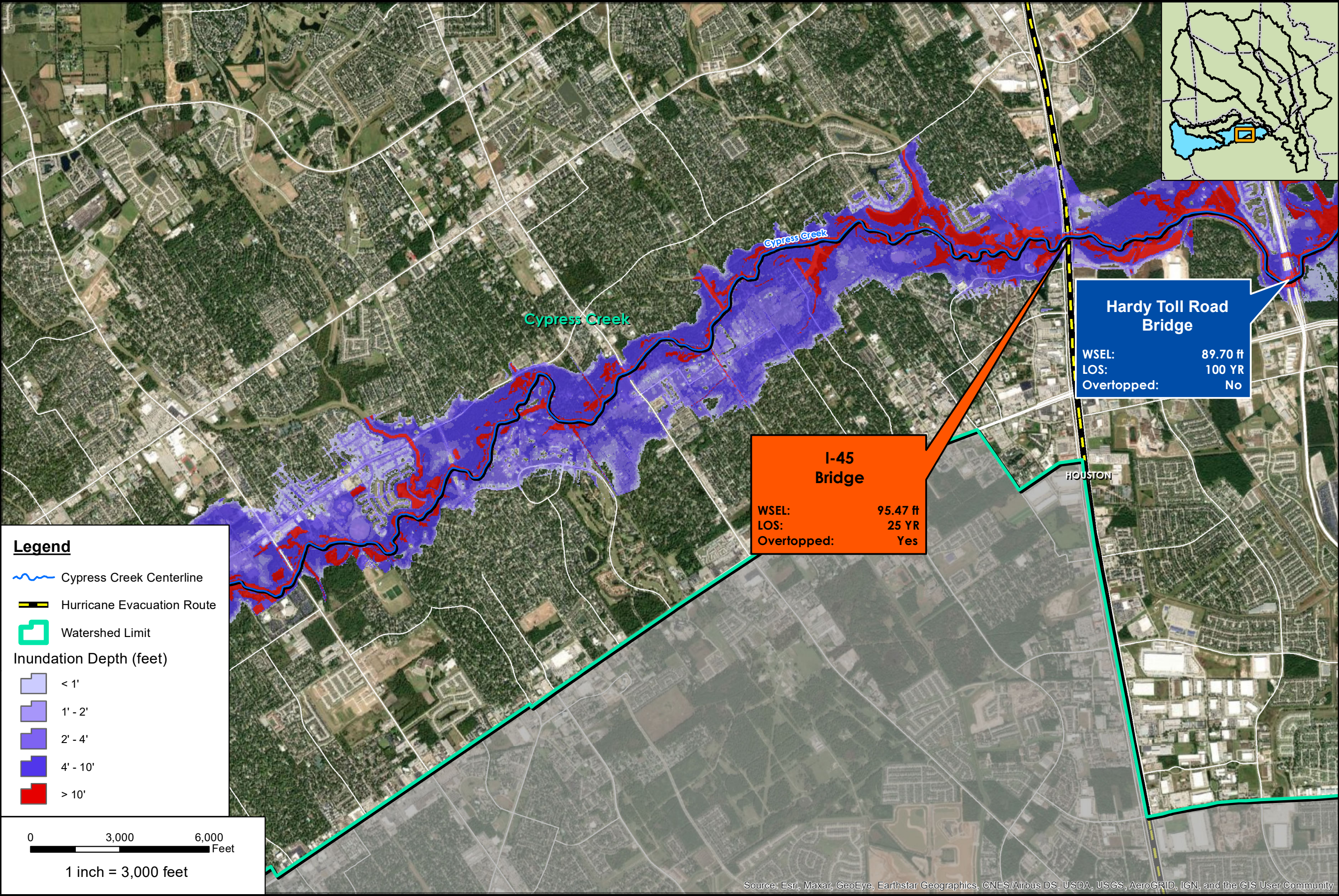
San Jacinto Regional Watershed Master Drainage Plan

100YR EXISTING CONDITIONS MAP | CYPRESS CREEK

SAN JACINTO
REGIONAL WATERSHED
MASTER DRAINAGE PLAN

APPENDIX
J.2

MAP
K100 - A



PROJECT AVO

33465

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HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

100YR EXISTING CONDITIONS MAP | CYPRESS CREEK

SAN JACINTO

REGIONAL WATERSHED

MASTER DRAINAGE PLAN

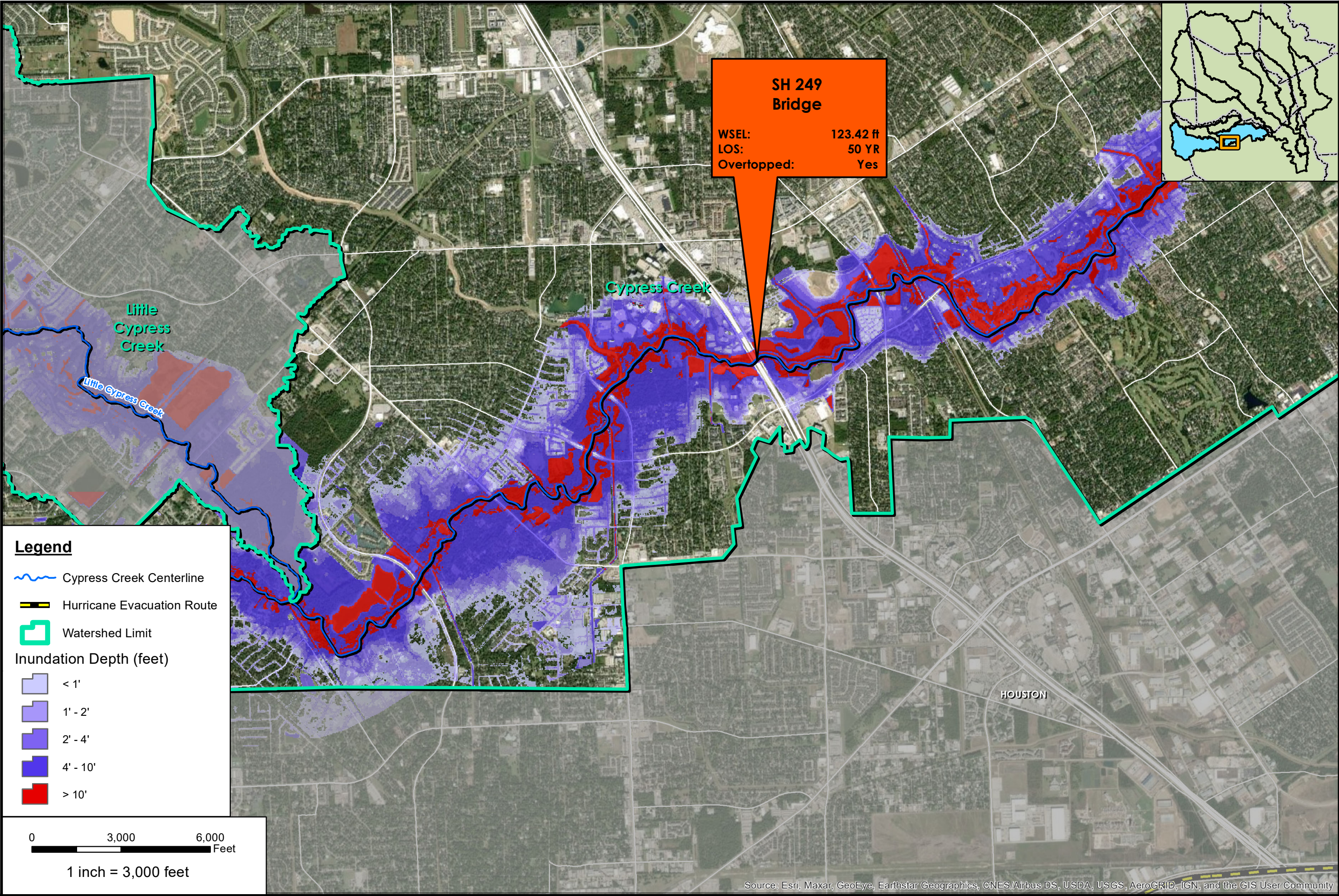
APPENDIX

J.2

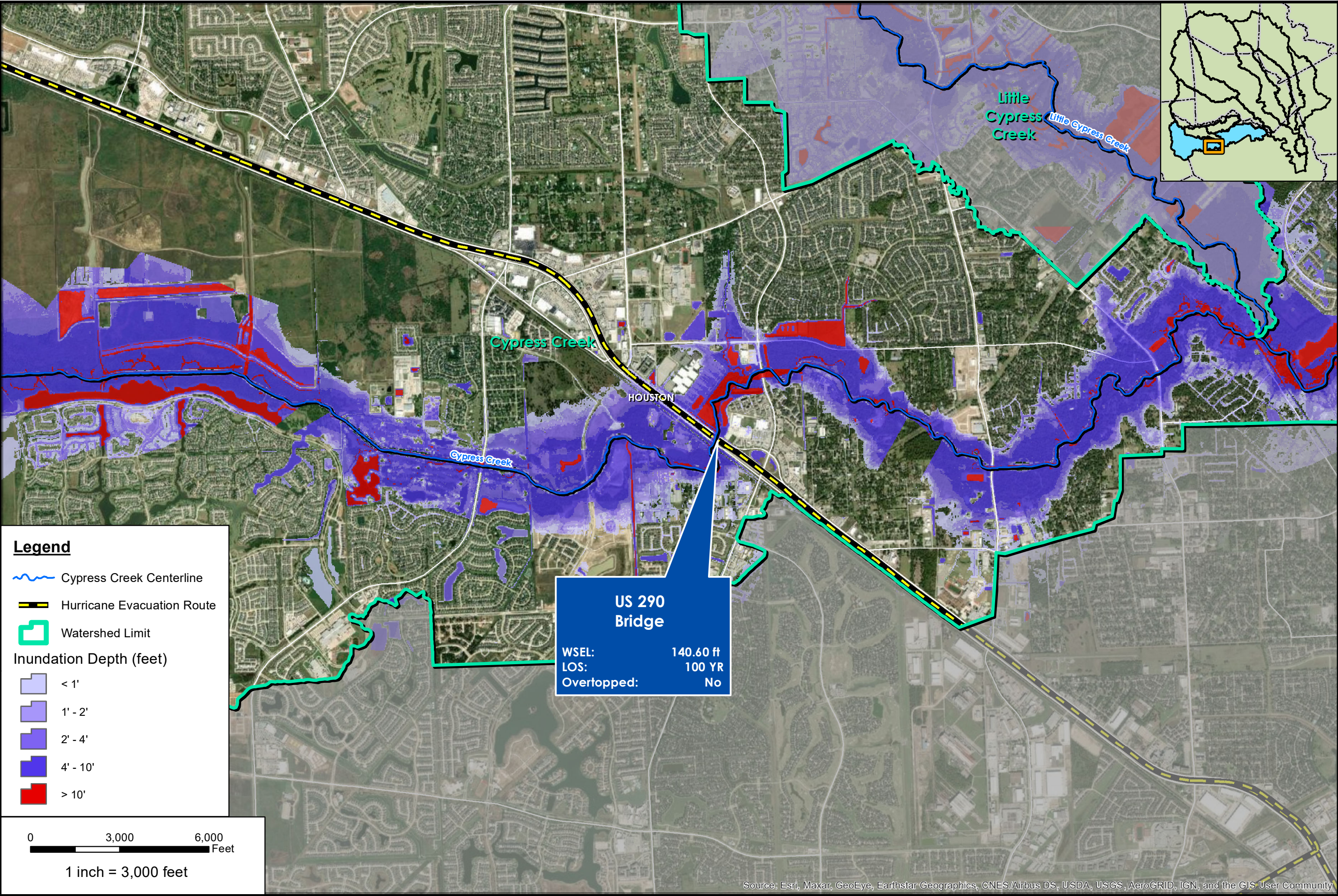
MAP

K100 - B

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APPENDIX J.2		
MAP K100 - C		



**US 290
Bridge**

WSEL:	140.60 ft
LOS:	100 YR
Overtopped:	No

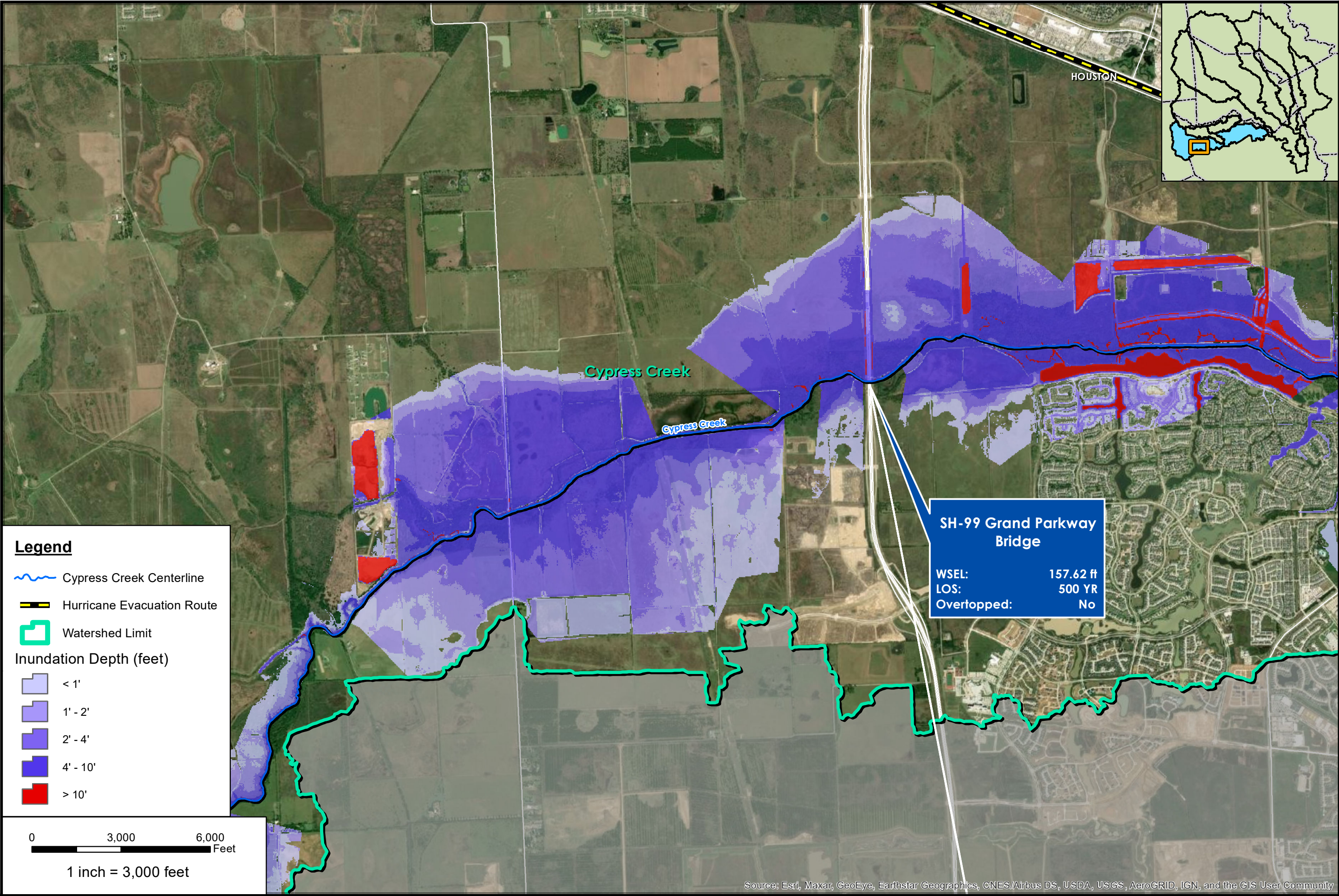
- Legend**
- Cypress Creek Centerline
 - Hurricane Evacuation Route
 - Watershed Limit
- Inundation Depth (feet)**
- < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 3,000 6,000
Feet

1 inch = 3,000 feet

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO	33465
	DATUM & COORDINATE SYSTEM NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP CYPRESS CREEK	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP K100 - D	



PROJECT AVO

33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS

N

E

S

W

HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

100YR EXISTING CONDITIONS MAP | CYPRESS CREEK

SAN JACINTO

REGIONAL WATERSHED

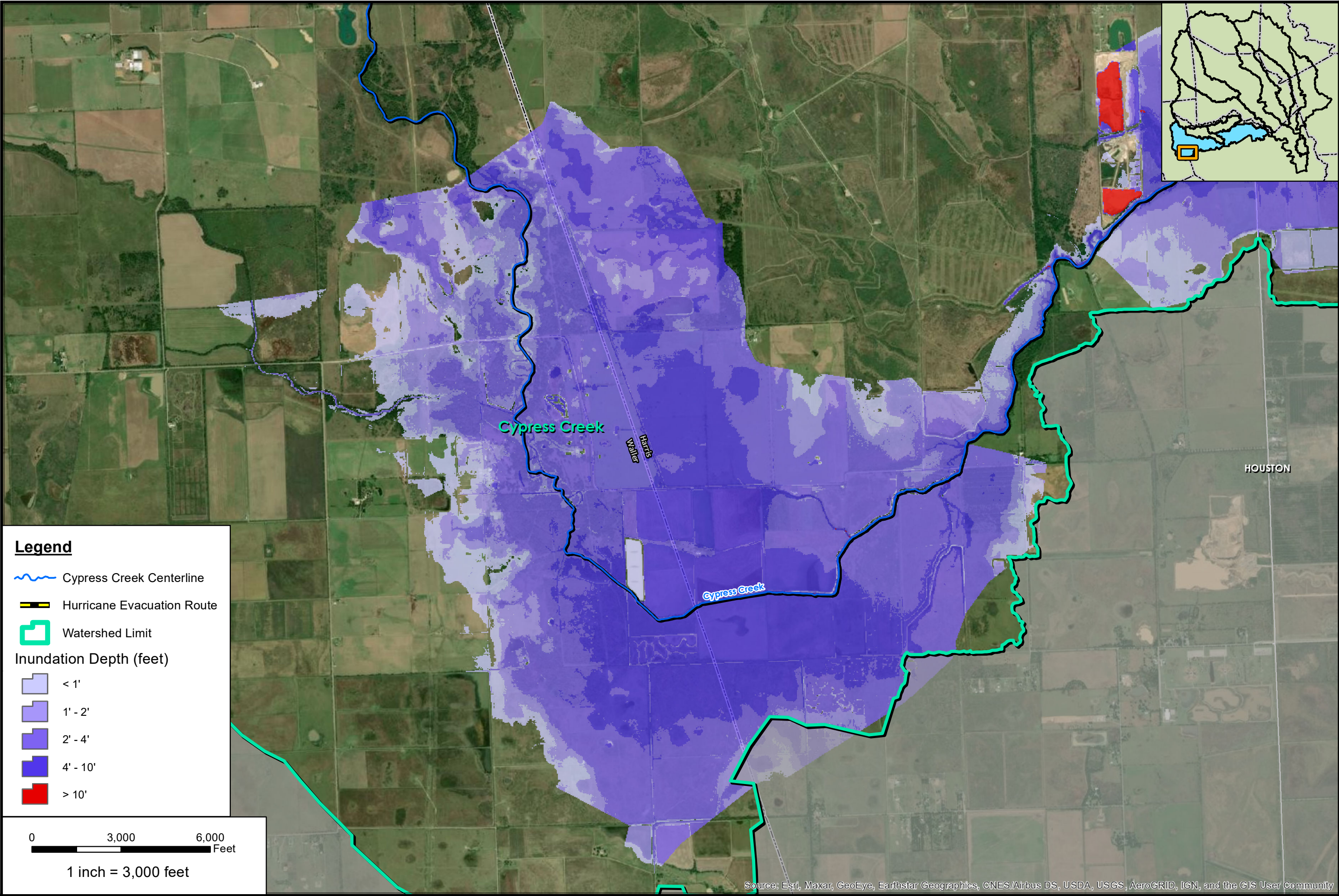
MASTER DRAINAGE PLAN

APPENDIX









J.2

MAP

K100 - E




Legend

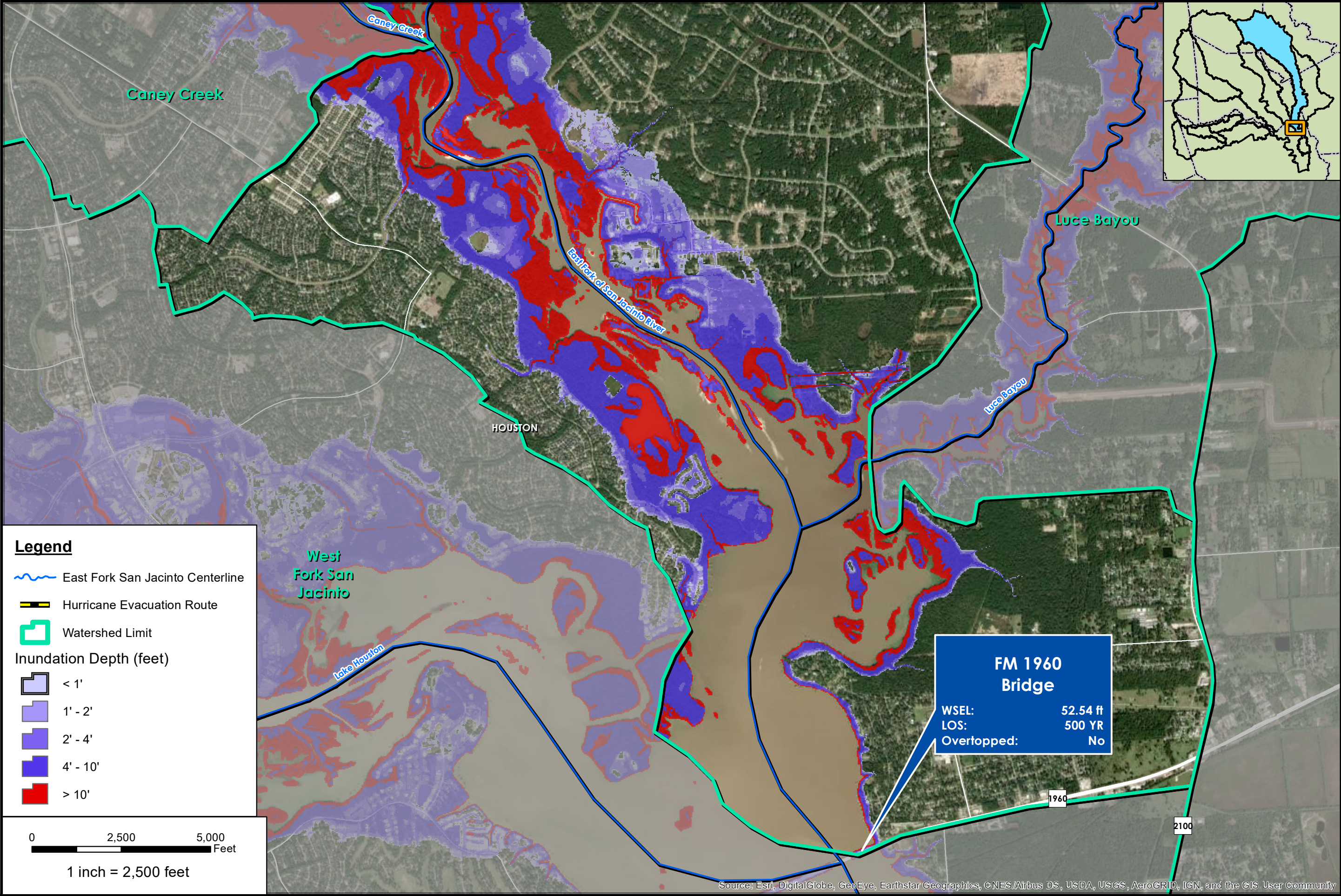
-  Cypress Creek Centerline
-  Hurricane Evacuation Route
-  Watershed Limit
- Inundation Depth (feet)**
 -  < 1'
 -  1' - 2'
 -  2' - 4'
 -  4' - 10'
 -  > 10'

0 3,000 6,000
Feet

1 inch = 3,000 feet

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO 33465	
DATUM & COORDINATE SYSTEM NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS	
	
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP CYPRESS CREEK	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP K100 - F	



Legend

East Fork San Jacinto Centerline

Hurricane Evacuation Route

Watershed Limit

Inundation Depth (feet)

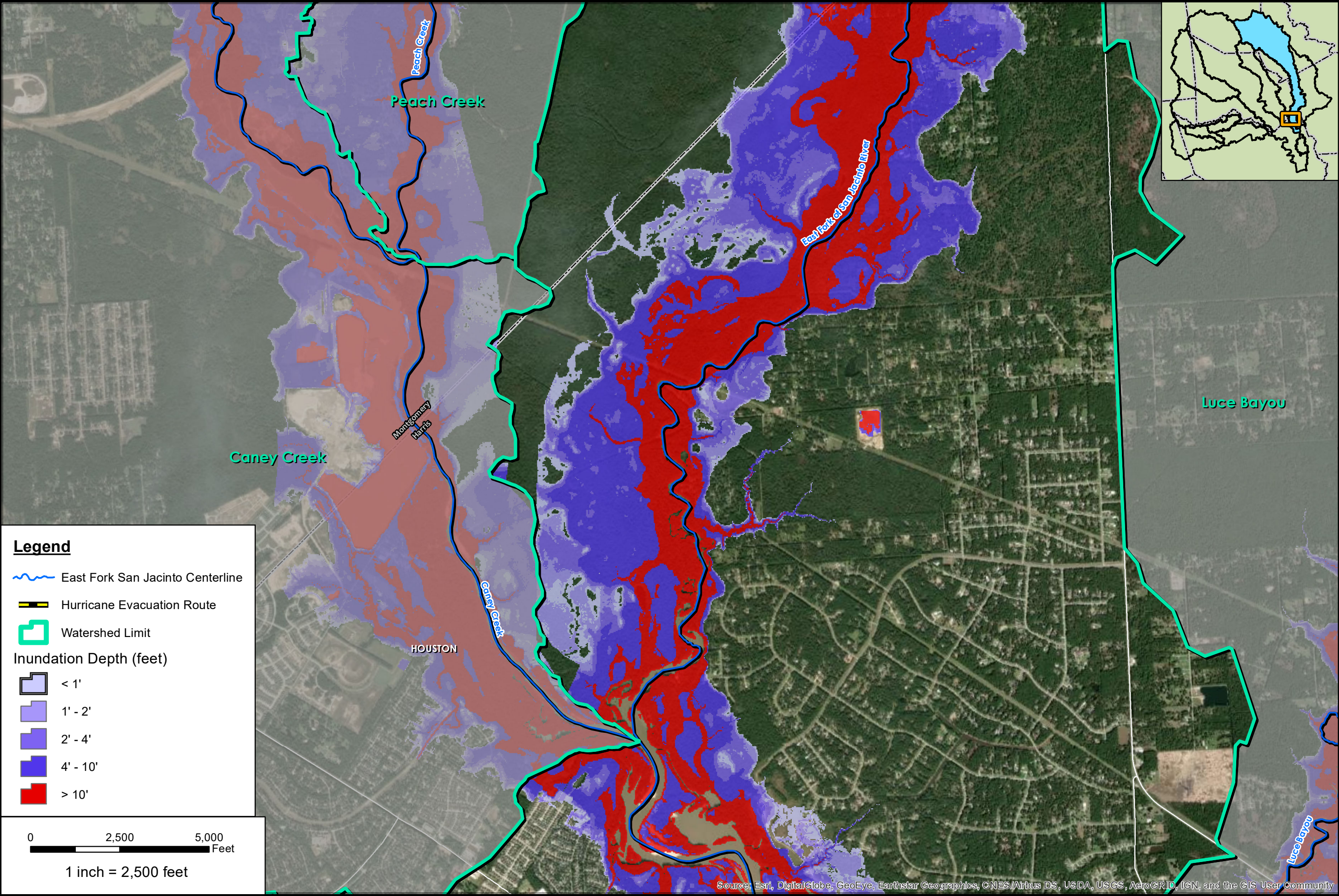
- < 1'
- 1' - 2'
- 2' - 4'
- 4' - 10'
- > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO 33465	
DATUM & COORDINATE SYSTEM NAD 1983 StatePlane Texas Central FIPS 4203 Feet	
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP EAST FORK SAN JACINTO	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP GEF - A	



Legend

East Fork San Jacinto Centerline

Hurricane Evacuation Route

Watershed Limit

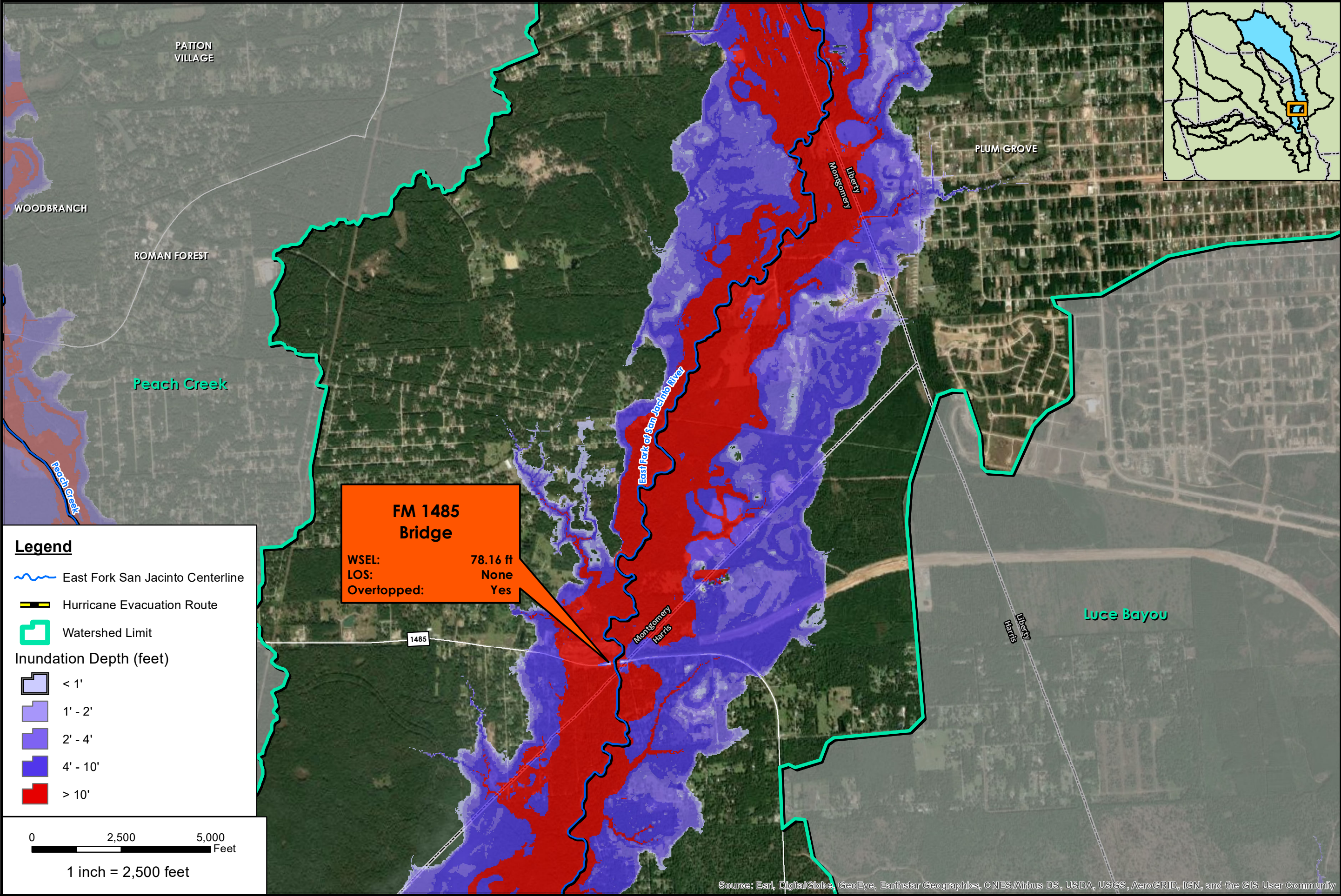
Inundation Depth (feet)

- < 1'
- 1' - 2'
- 2' - 4'
- 4' - 10'
- > 10'

0 2,500 5,000 Feet

1 inch = 2,500 feet

PROJECT AVO		33465
DATUM & COORDINATE SYSTEM		NAD 1983 StatePlane Texas Central FIPS 4203 Feet
		
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP EAST FORK SAN JACINTO		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP GEF - B		

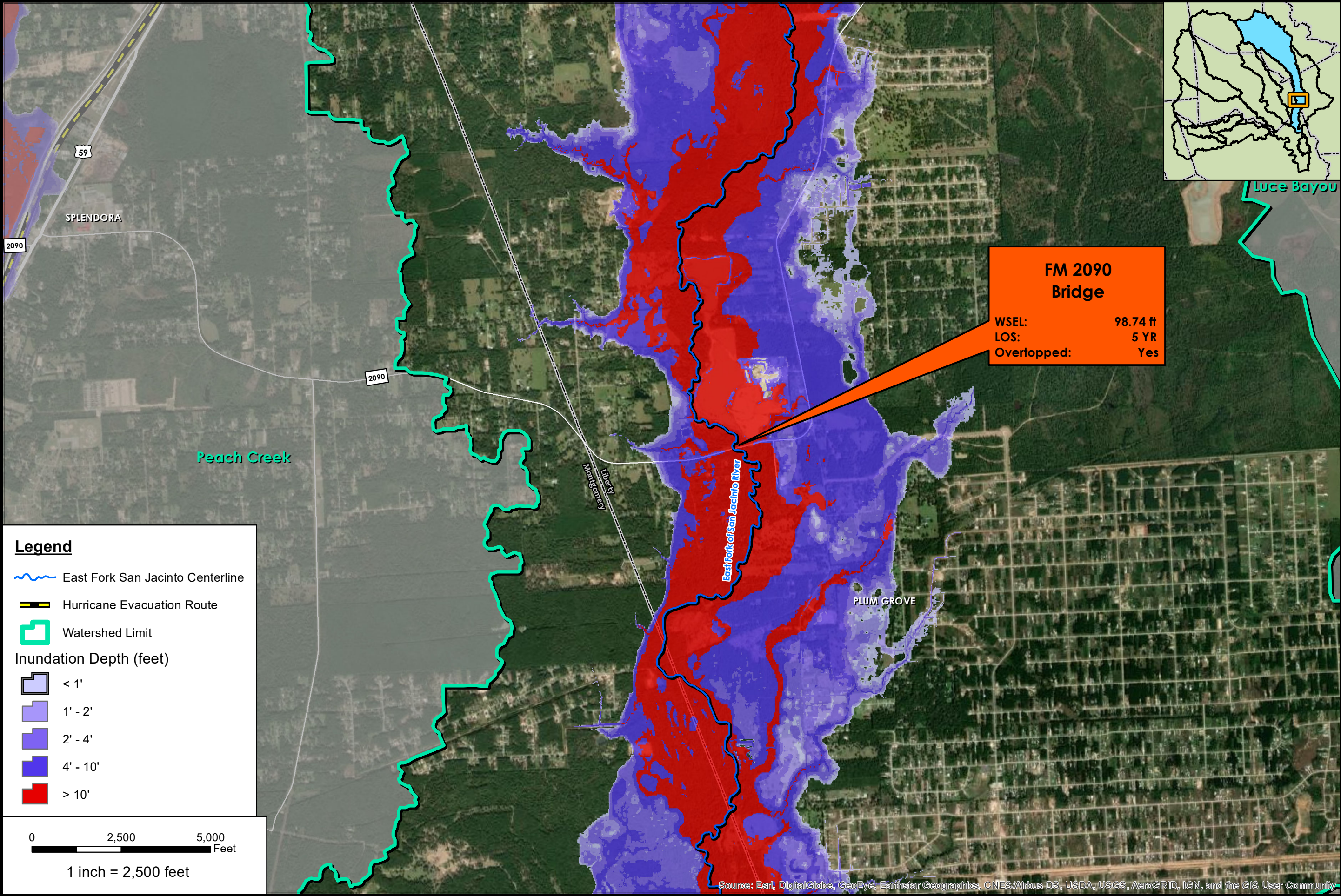


**FM 1485
Bridge**

WSEL:	78.16 ft
LOS:	None
Overtopped:	Yes

PROJECT AVO		33465
DATUM & COORDINATE SYSTEM		NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP EAST FORK SAN JACINTO		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP GEF - C		

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

- East Fork San Jacinto Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000 Feet

1 inch = 2,500 feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO

33465

DATUM & COORDINATE SYSTEM

NAD 1983 StatePlane Texas Central FIPS 4203 Feet

HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

100YR EXISTING CONDITIONS MAP | EAST FORK SAN JACINTO

SAN JACINTO

REGIONAL WATERSHED

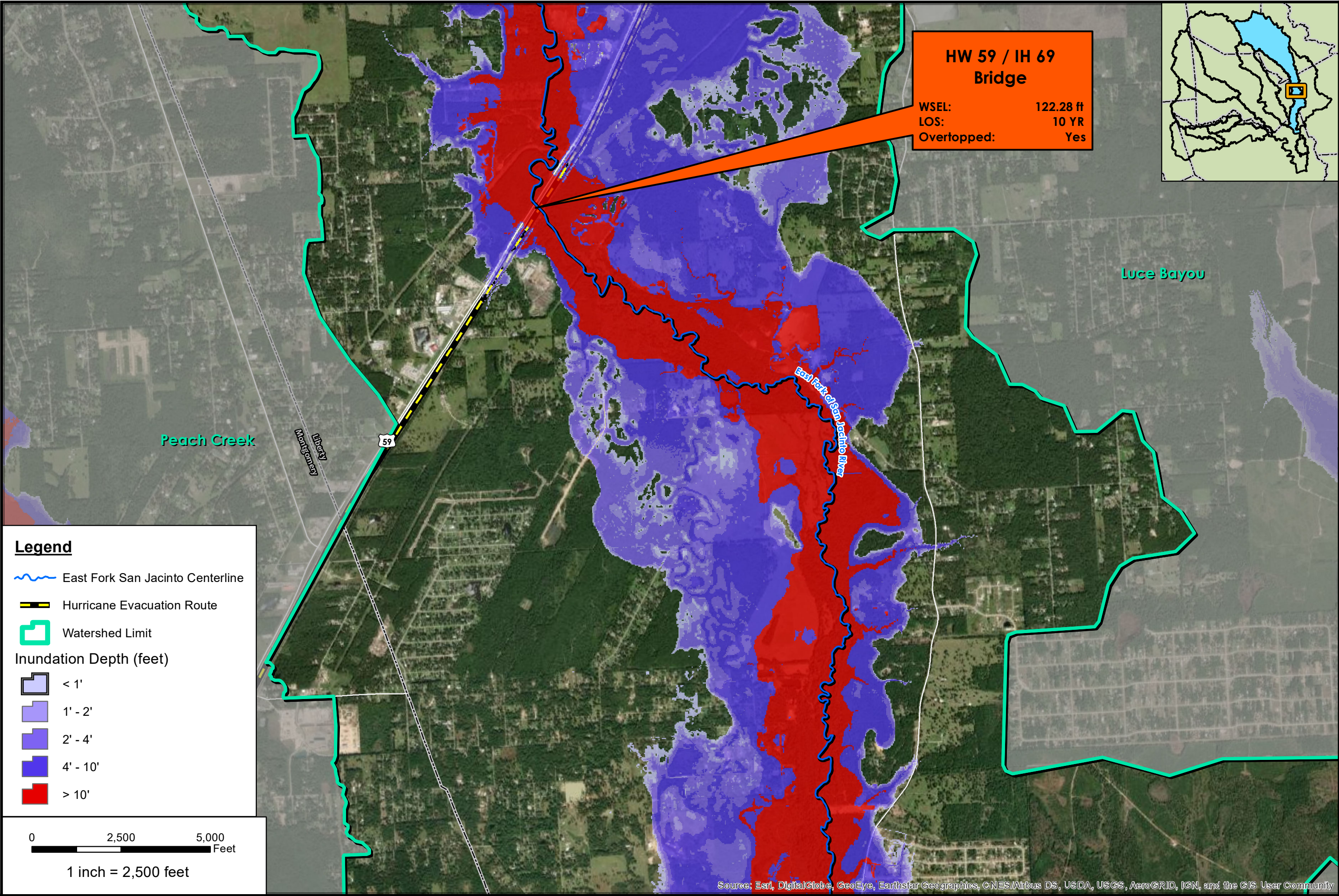
MASTER DRAINAGE PLAN

APPENDIX

J.2

MAP

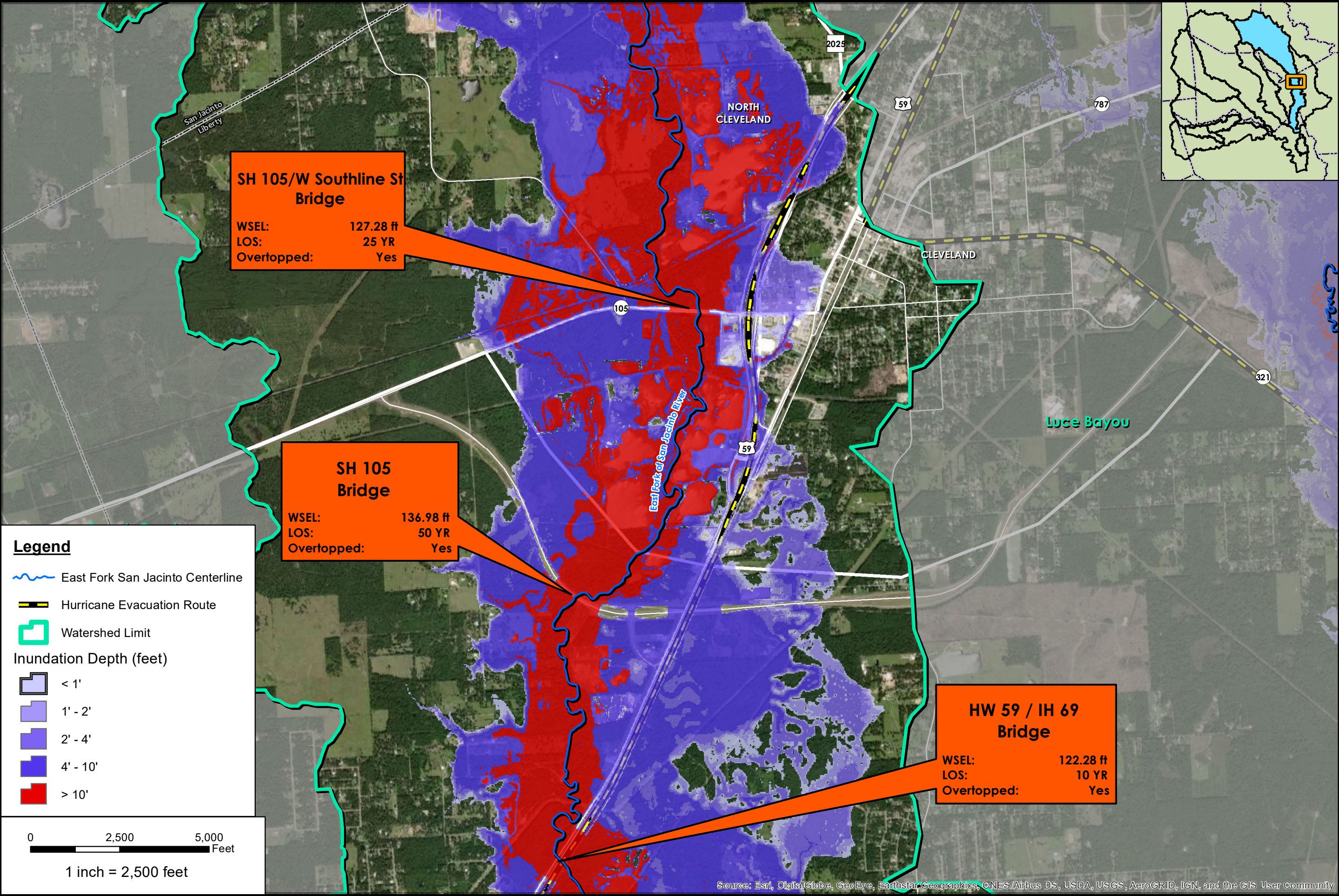
GEF - D



**HW 59 / IH 69
Bridge**

WSEL:	122.28 ft
LOS:	10 YR
Overtopped:	Yes

PROJECT AVO		33465
HARRIS COUNTY FLOOD CONTROL DISTRICT		DATUM & COORDINATE SYSTEM
San Jacinto Regional Watershed Master Drainage Plan		NAD 1983 StatePlane Texas Central FIPS 4203 Feet
100YR EXISTING CONDITIONS MAP EAST FORK SAN JACINTO		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP GEF - E		



SH 105/W Southline St Bridge
WSEL: 127.28 ft
LOS: 25 YR
Overtopped: Yes

SH 105 Bridge
WSEL: 136.98 ft
LOS: 50 YR
Overtopped: Yes

HW 59 / IH 69 Bridge
WSEL: 122.28 ft
LOS: 10 YR
Overtopped: Yes

Legend
East Fork San Jacinto Centerline
Hurricane Evacuation Route
Watershed Limit

Inundation Depth (feet)

- < 1'
- 1' - 2'
- 2' - 4'
- 4' - 10'
- > 10'

0 2,500 5,000 Feet

1 inch = 2,500 feet

PROJECT AVO

33465

DATUM & COORDINATE SYSTEM

NAD 1983 StatePlane Texas Central FIPS 4203 Feet

HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

100YR EXISTING CONDITIONS MAP | EAST FORK SAN JACINTO

SAN JACINTO

REGIONAL WATERSHED

MASTER DRAINAGE PLAN

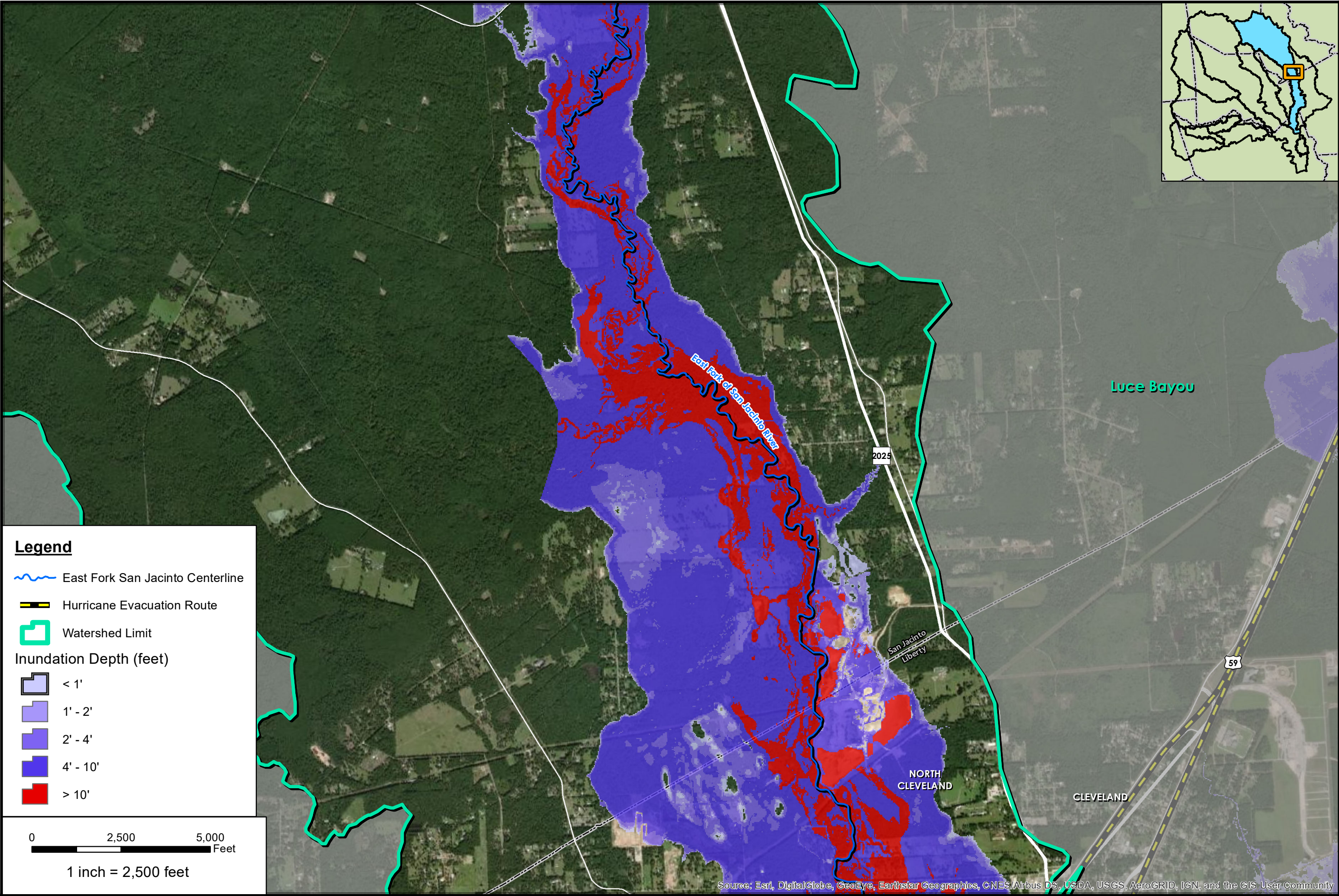
APPENDIX

J.2

MAP

GEF - F

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

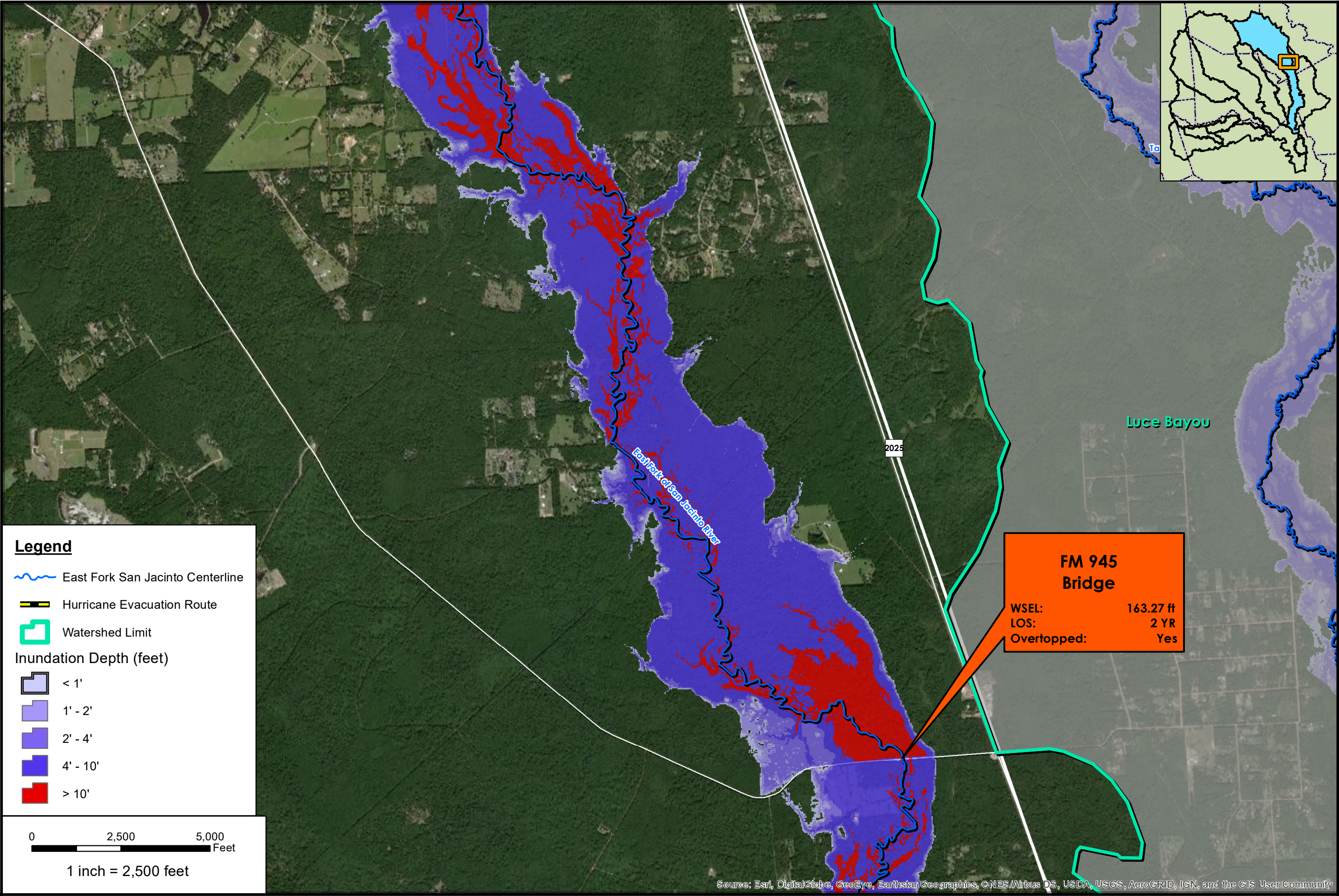
- East Fork San Jacinto Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)**
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO		33465
DATUM & COORDINATE SYSTEM		NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP EAST FORK SAN JACINTO		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP GEF - G		



Legend

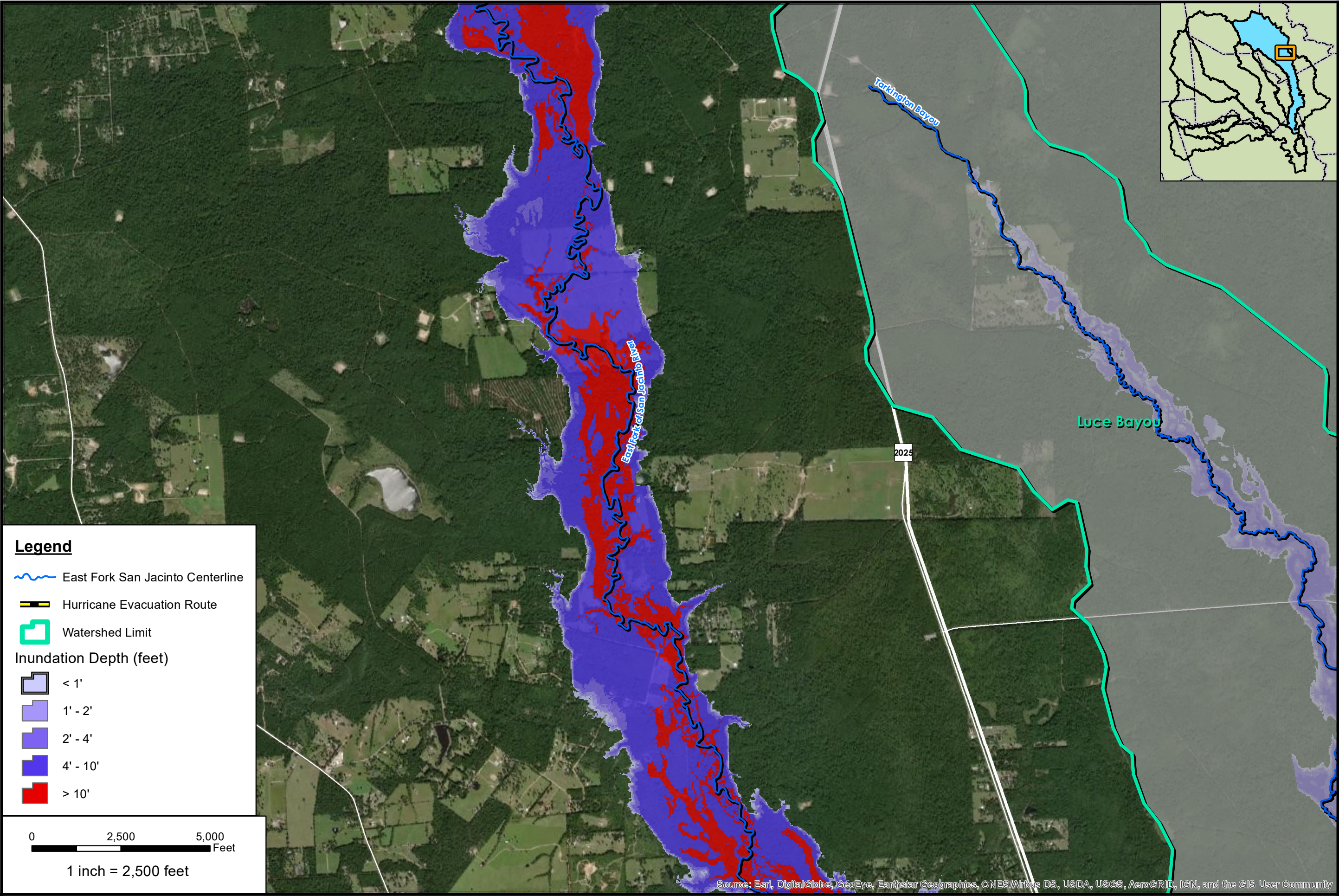
- East Fork San Jacinto Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO		33465
DATUM & COORDINATE SYSTEM		NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP EAST FORK SAN JACINTO		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP GEF - H		



Legend

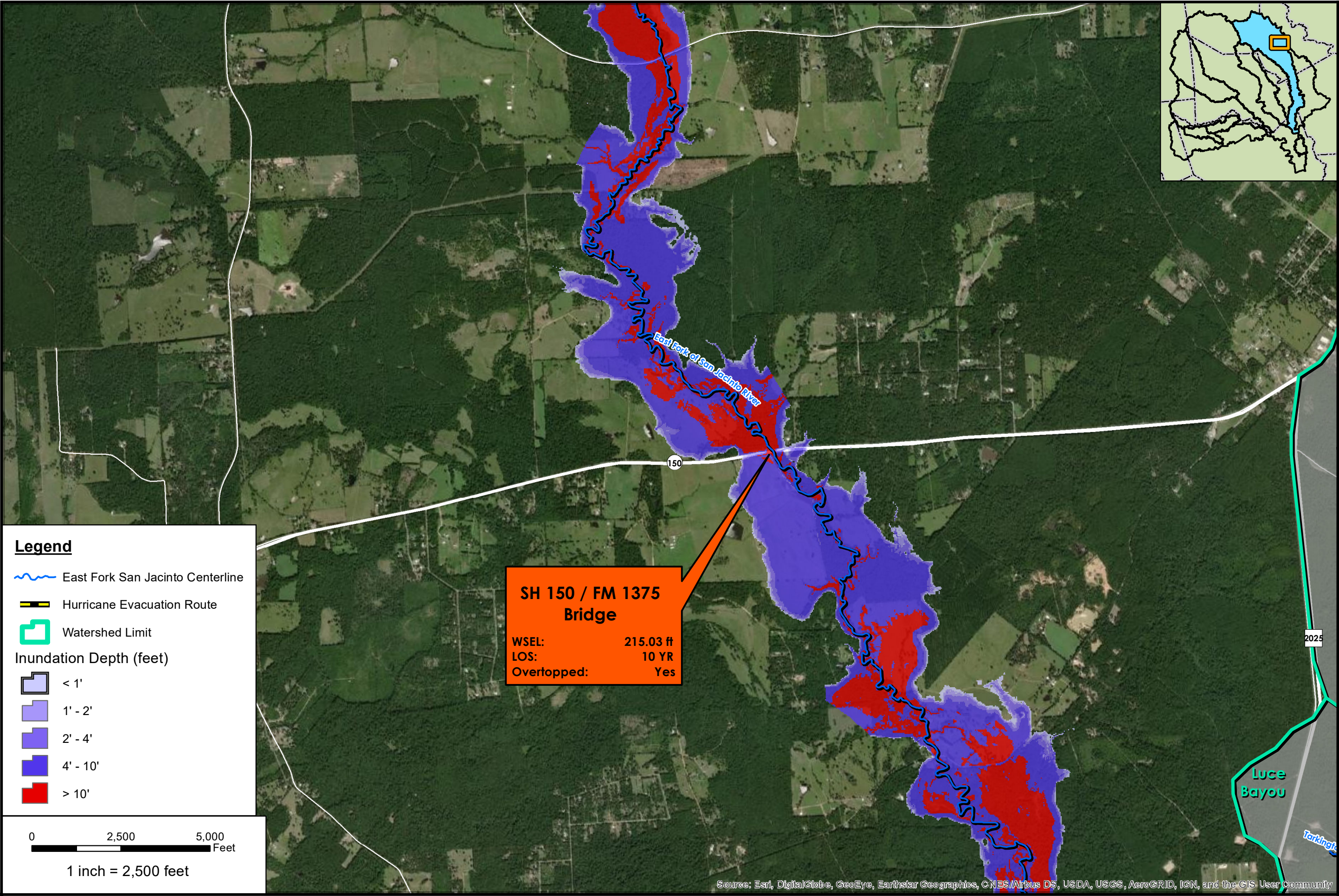
- East Fork San Jacinto Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO		33465
DATUM & COORDINATE SYSTEM		NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP EAST FORK SAN JACINTO		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP GEF - I		



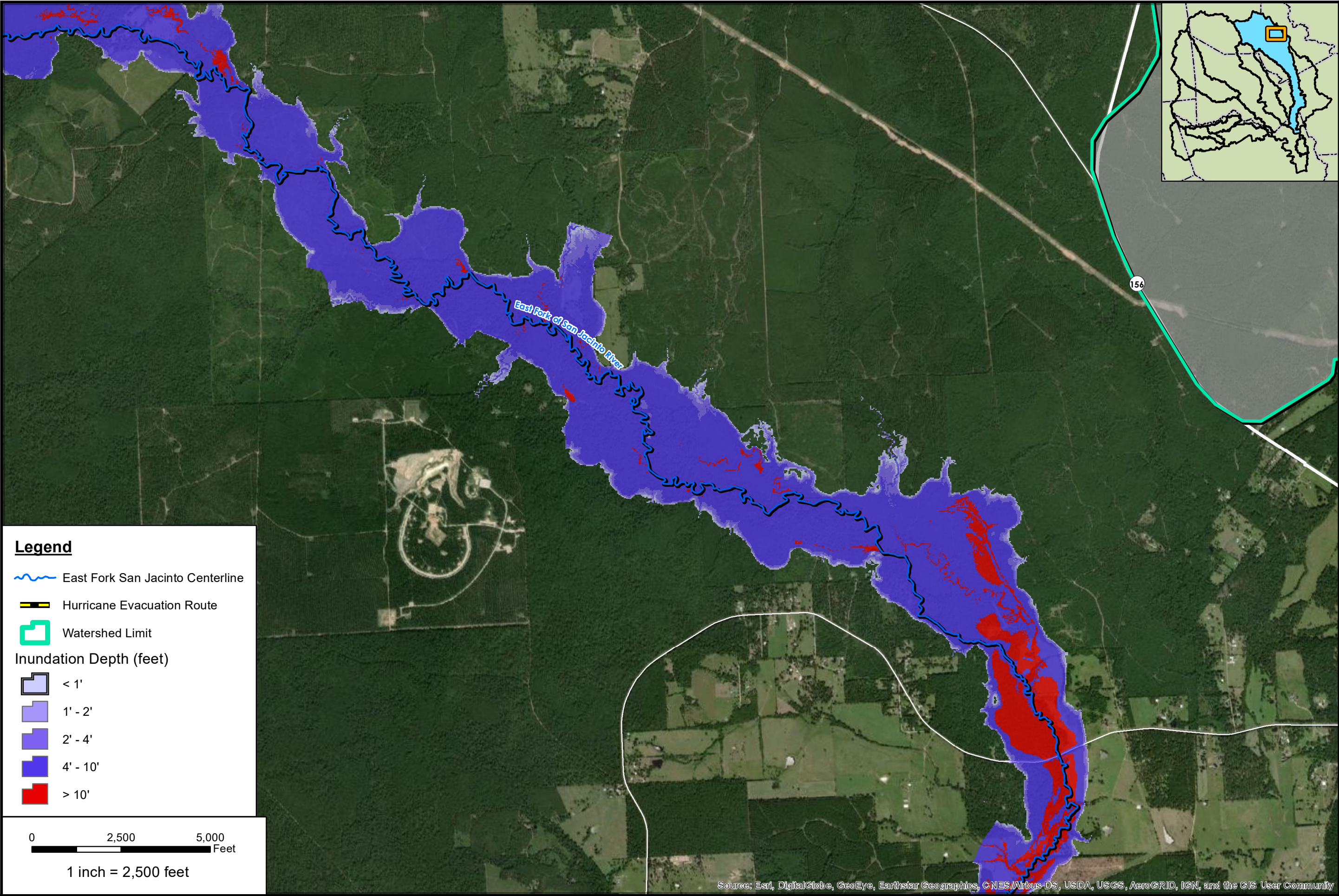
Legend

- East Fork San Jacinto Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)**
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

PROJECT AVO	33465
	DATUM & COORDINATE SYSTEM NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP EAST FORK SAN JACINTO	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP GEF - J	



Legend

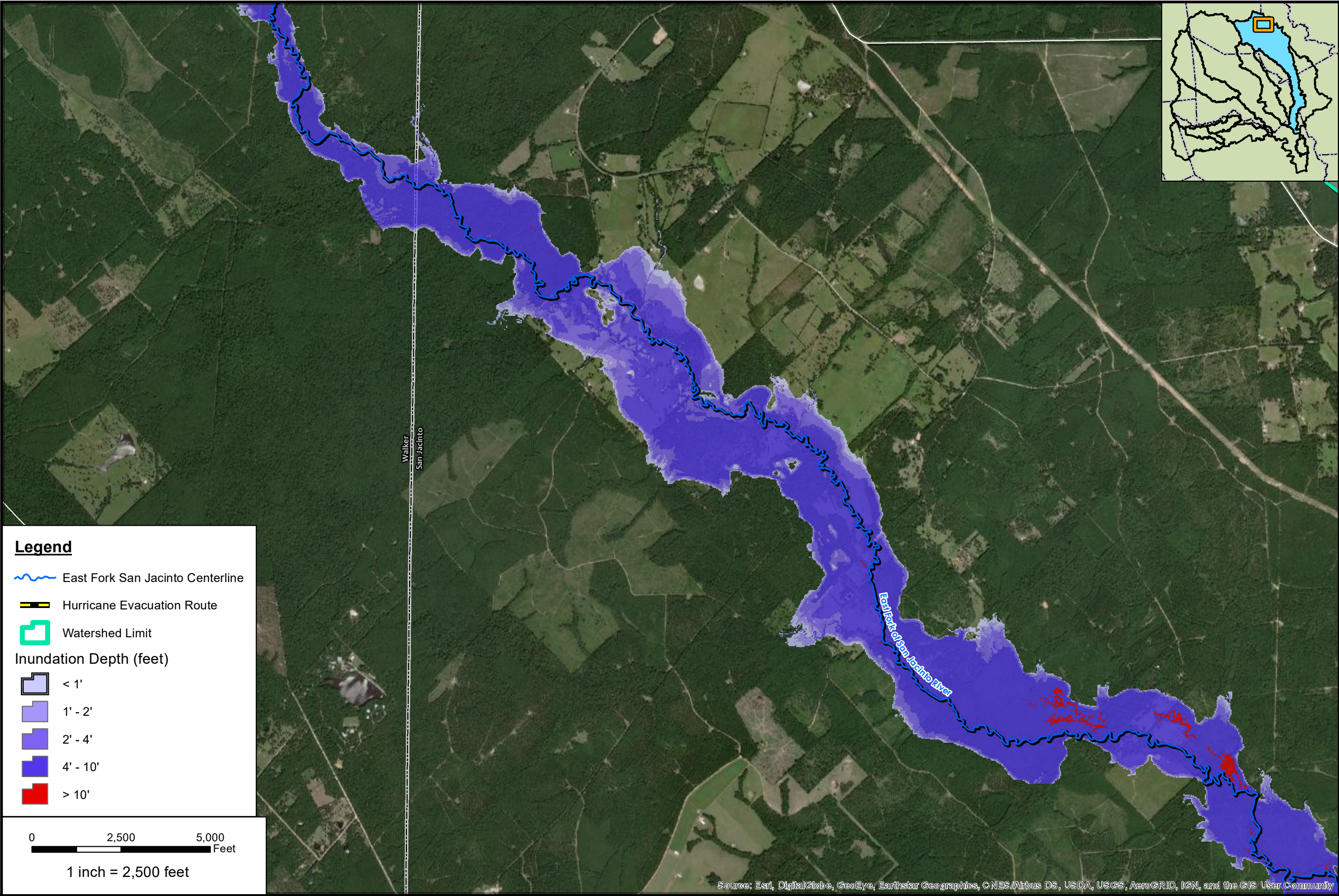
- East Fork San Jacinto Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)**
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO		33465
DATUM & COORDINATE SYSTEM		NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP EAST FORK SAN JACINTO		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP GEF - K		

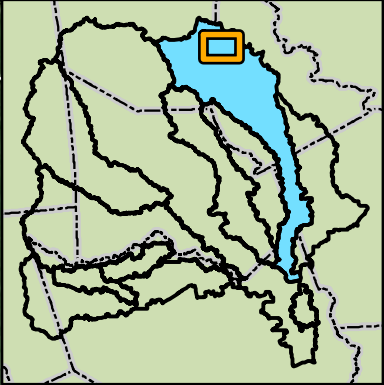


Legend

- East Fork San Jacinto Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)**
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet



PROJECT AVO

33465

DATUM & COORDINATE SYSTEM

NAD 1983 StatePlane Texas Central FIPS 4203 Feet

HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

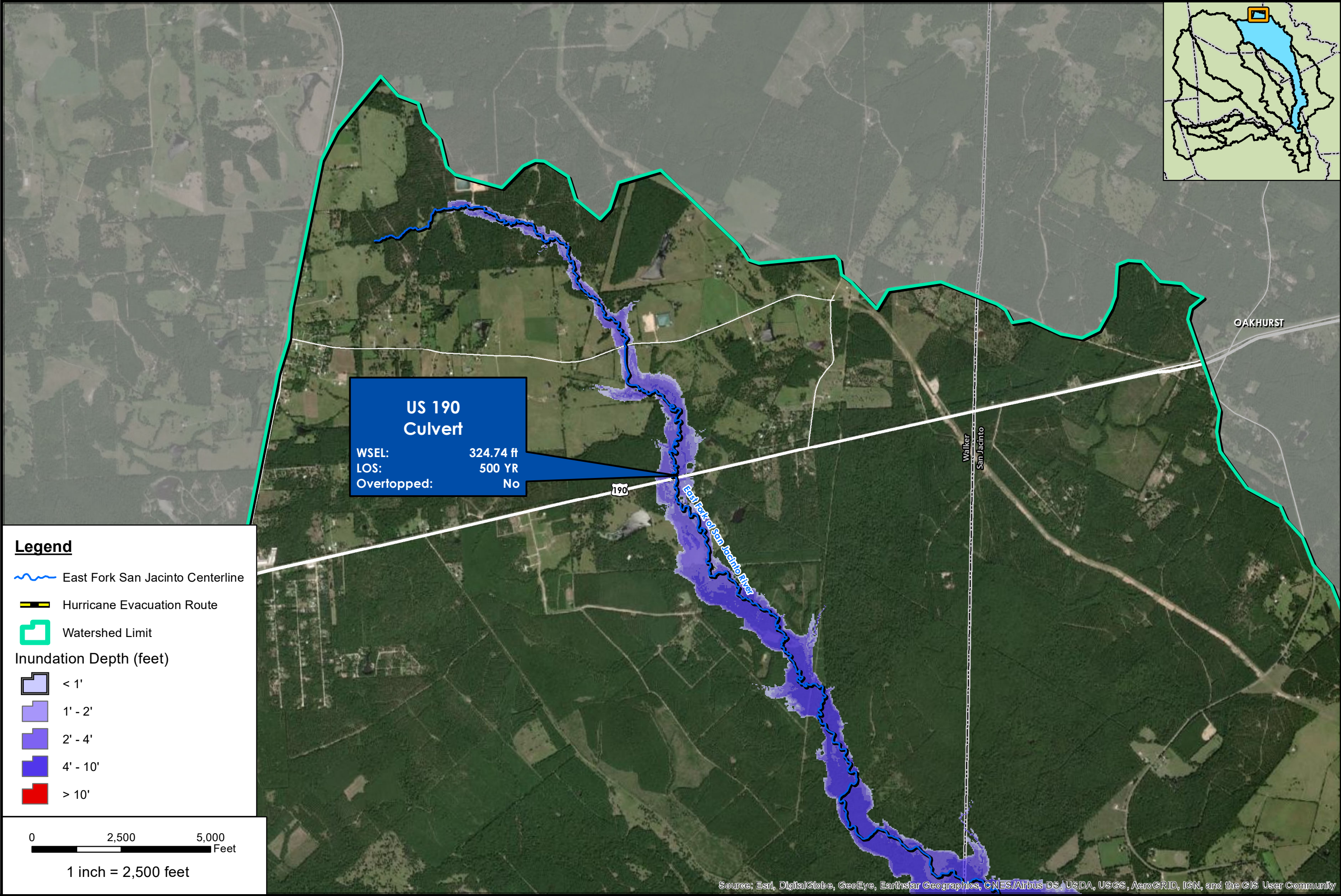
100YR EXISTING CONDITIONS MAP | EAST FORK SAN JACINTO

SAN JACINTO
REGIONAL WATERSHED
MASTER DRAINAGE PLAN

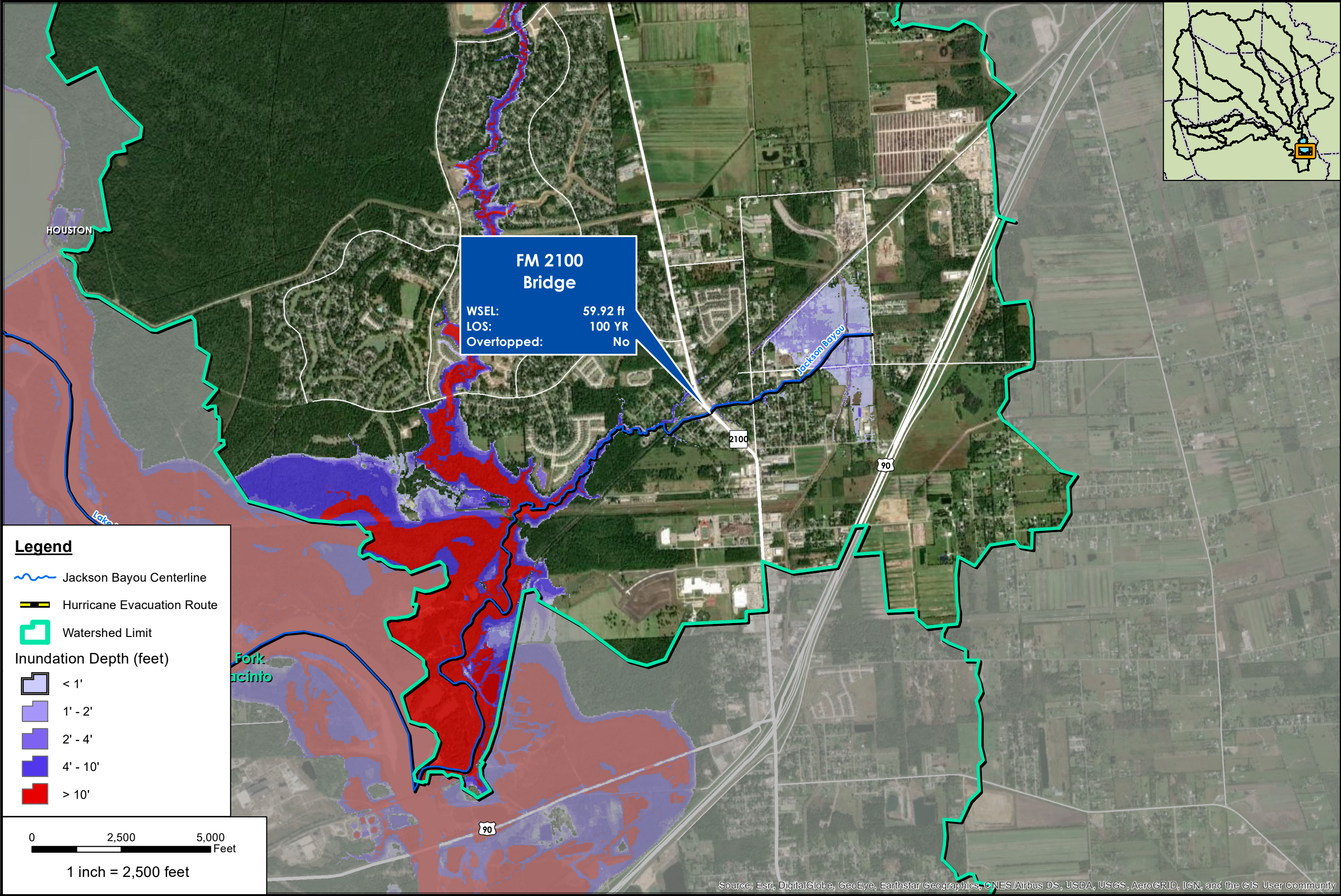
APPENDIX
J.2

MAP
GEF - L

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

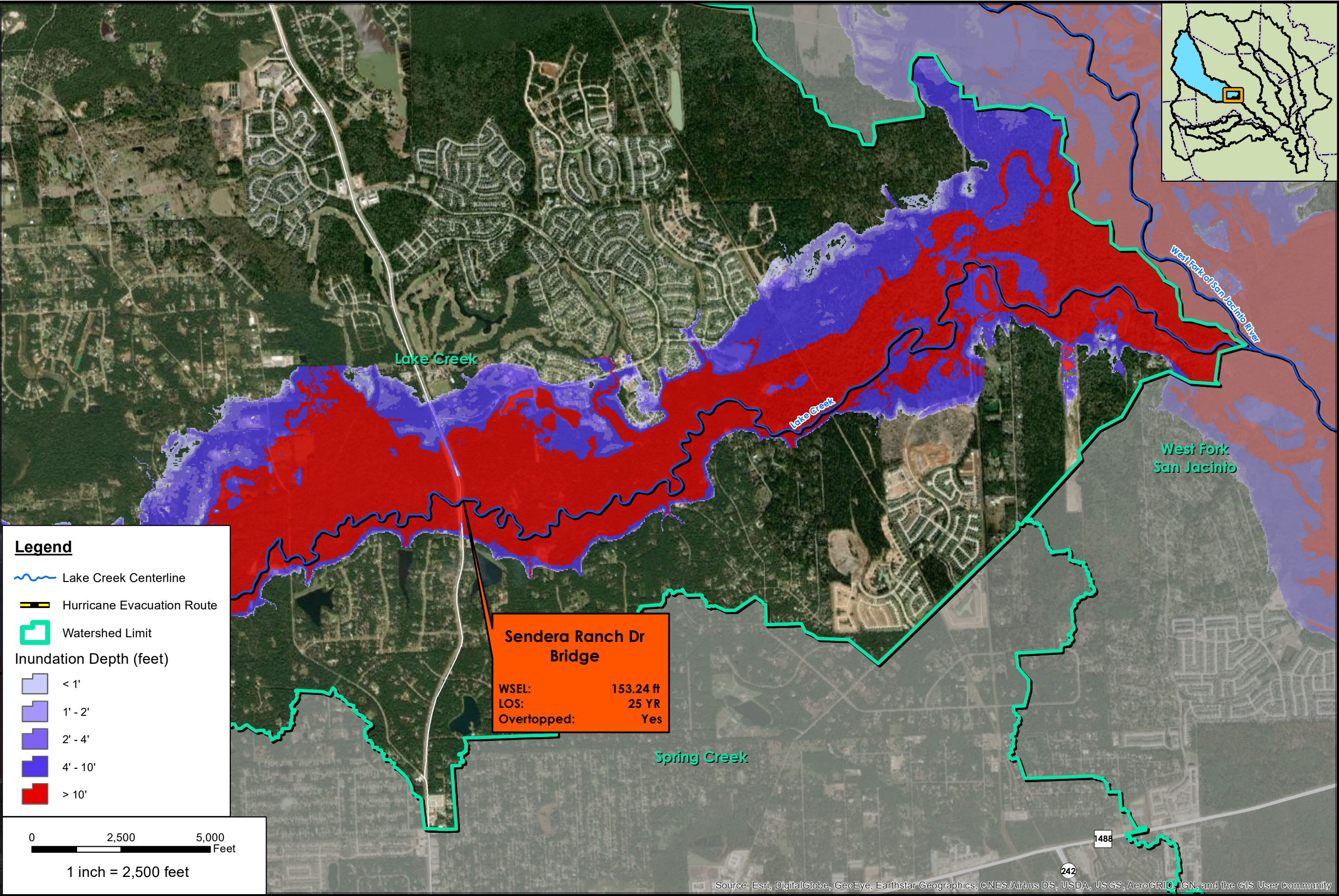


PROJECT AVO		33465
DATUM & COORDINATE SYSTEM		NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP EAST FORK SAN JACINTO		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP GEF - M		



PROJECT AVO		33465
DATUM & COORDINATE SYSTEM		NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP JACKSON BAYOU		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP R100 - A		

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

- Lake Creek Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)**
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

**Sendera Ranch Dr
Bridge**

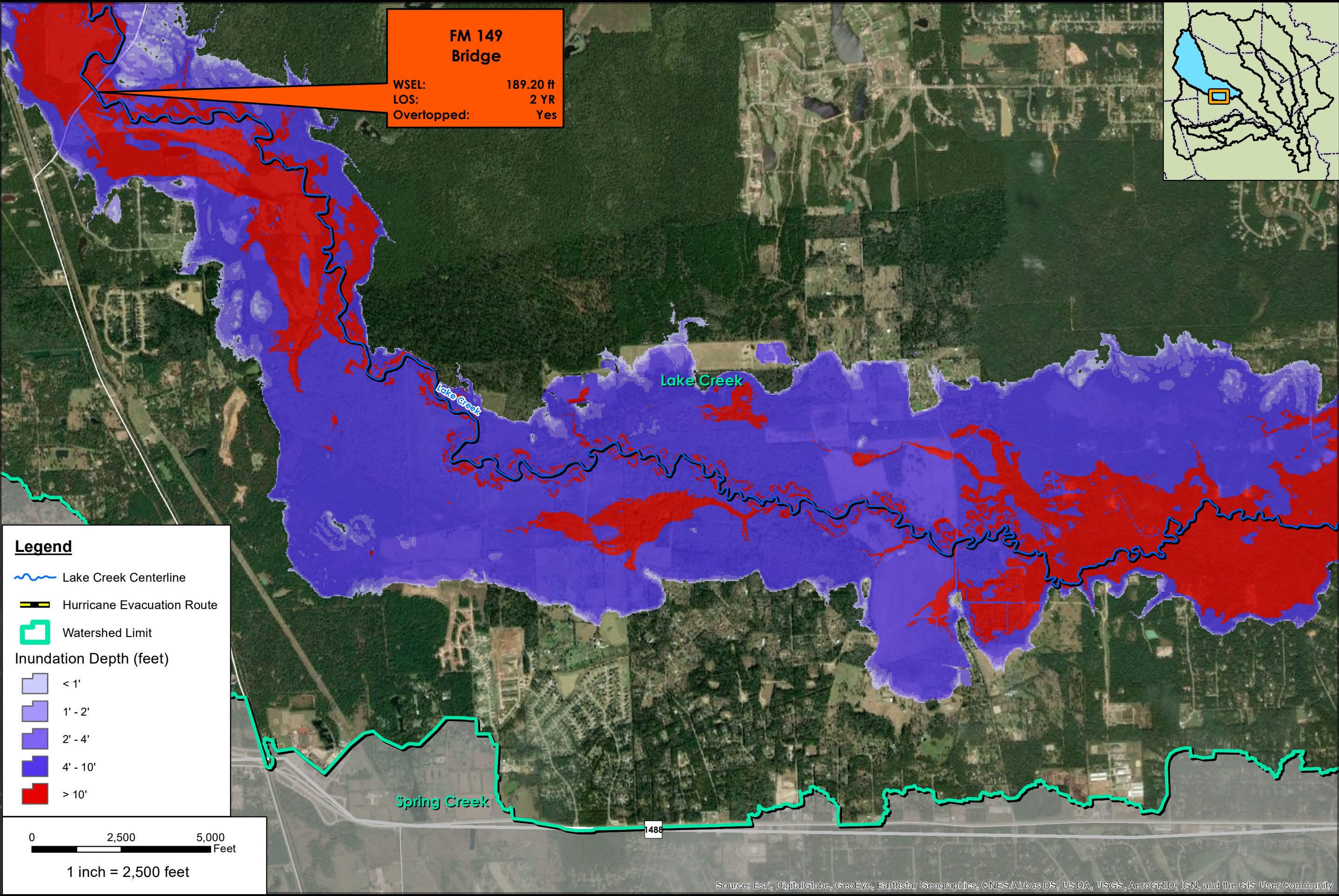
WSEL:	153.24 ft
LOS:	25 YR
Overtopped:	Yes



PROJECT AVO	33465
DATUM & COORDINATE SYSTEM	
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS	

HARRIS COUNTY FLOOD CONTROL DISTRICT	San Jacinto Regional Watershed Master Drainage Plan
100YR EXISTING CONDITIONS MAP LAKE CREEK	

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	APPENDIX J.2
MAP GLC - A	



**FM 149
Bridge**

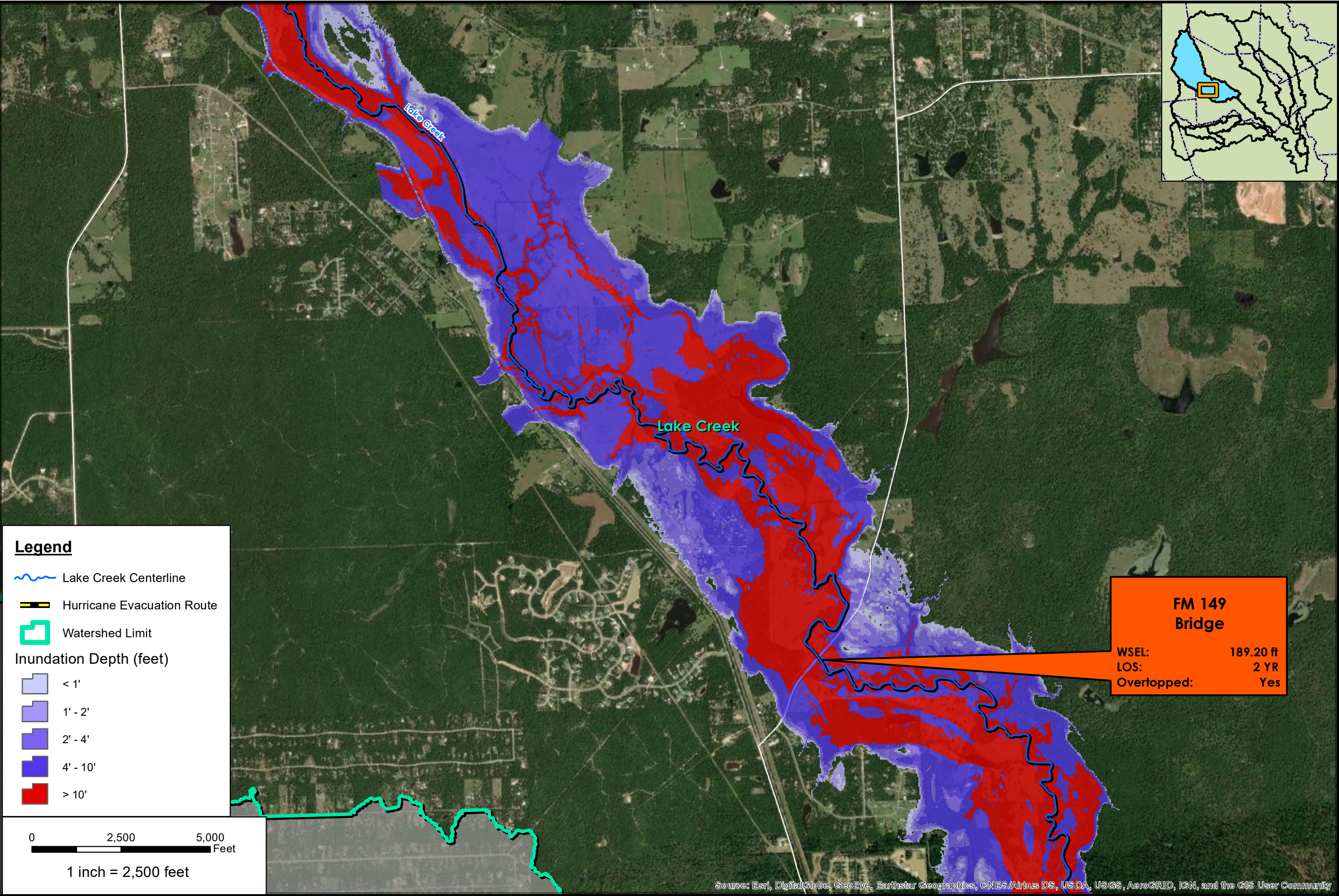
WSEL: 189.20 ft
LOS: 2 YR
Overtopped: Yes

- Legend**
- Lake Creek Centerline
 - Hurricane Evacuation Route
 - Watershed Limit
 - Inundation Depth (feet)
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

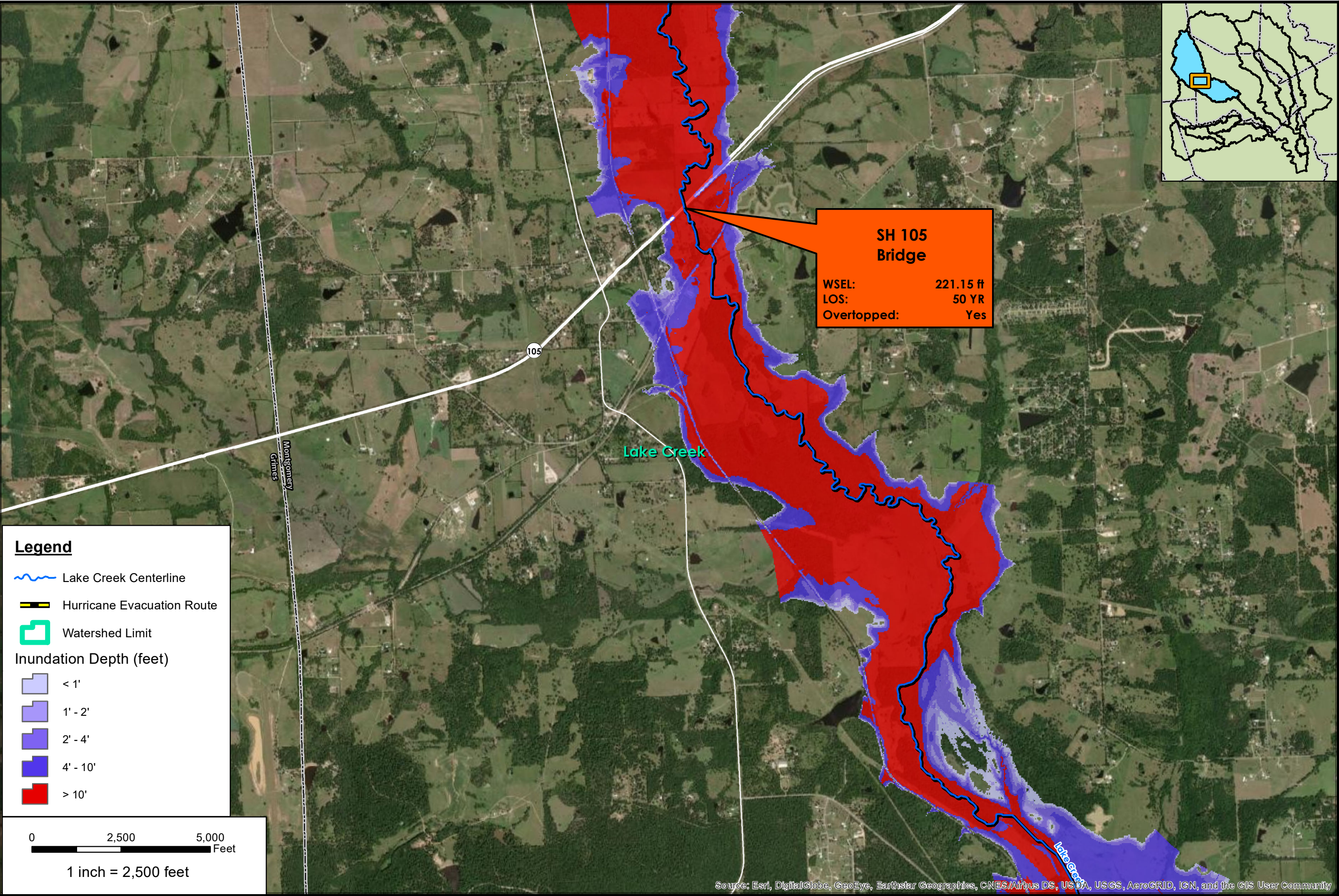
0 2,500 5,000 Feet

1 inch = 2,500 feet

PROJECT AVO	33465
DATUM & COORDINATE SYSTEM	
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS	
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP LAKE CREEK	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP GLC - B	



PROJECT AVO 33465	
DATUM & COORDINATE SYSTEM NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS	
	
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP LAKE CREEK	
	
APPENDIX J.2	
MAP GLC - C	



Legend

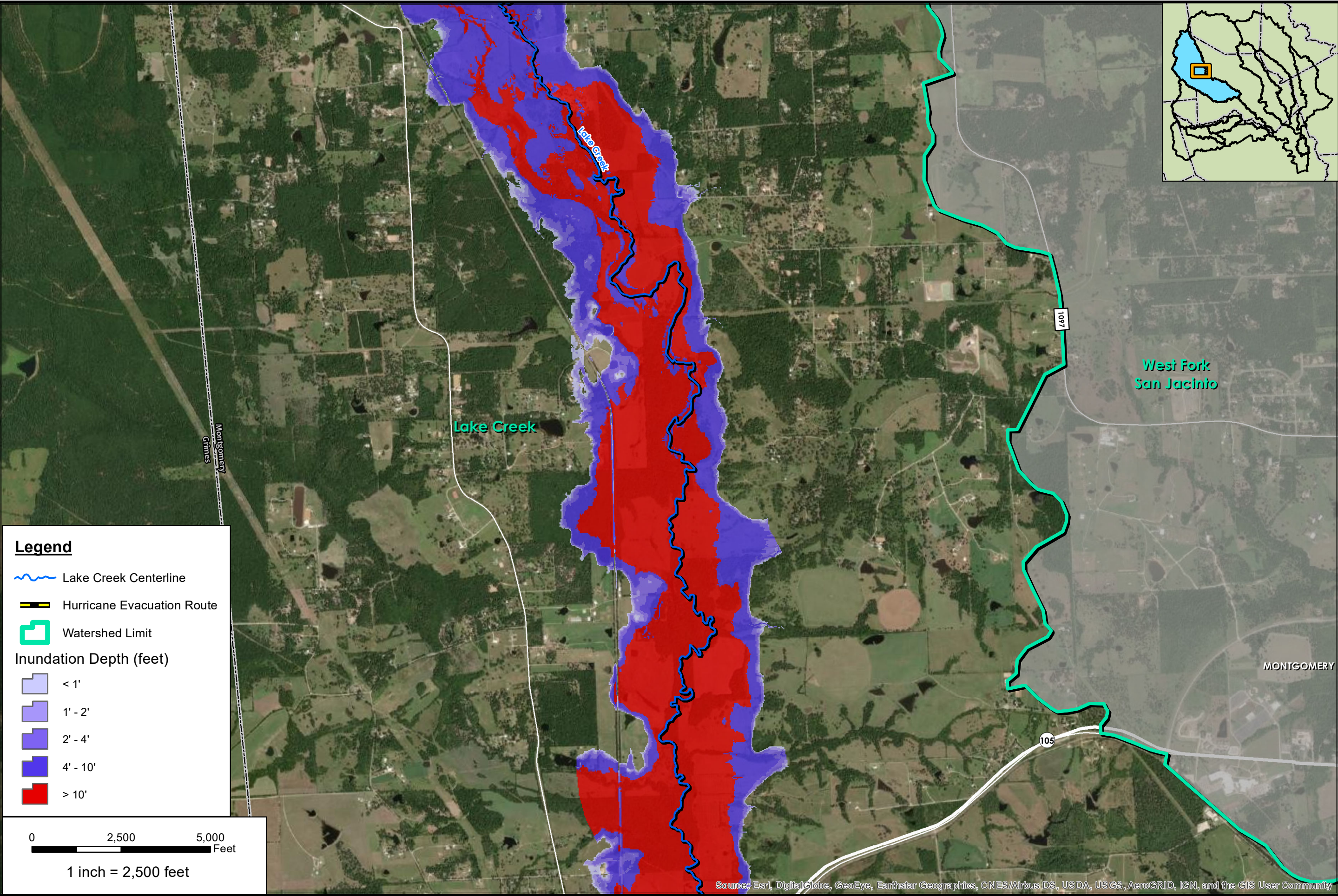
- Lake Creek Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)**
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO		33465
DATUM & COORDINATE SYSTEM		NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP LAKE CREEK		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP GLC - D		



Legend

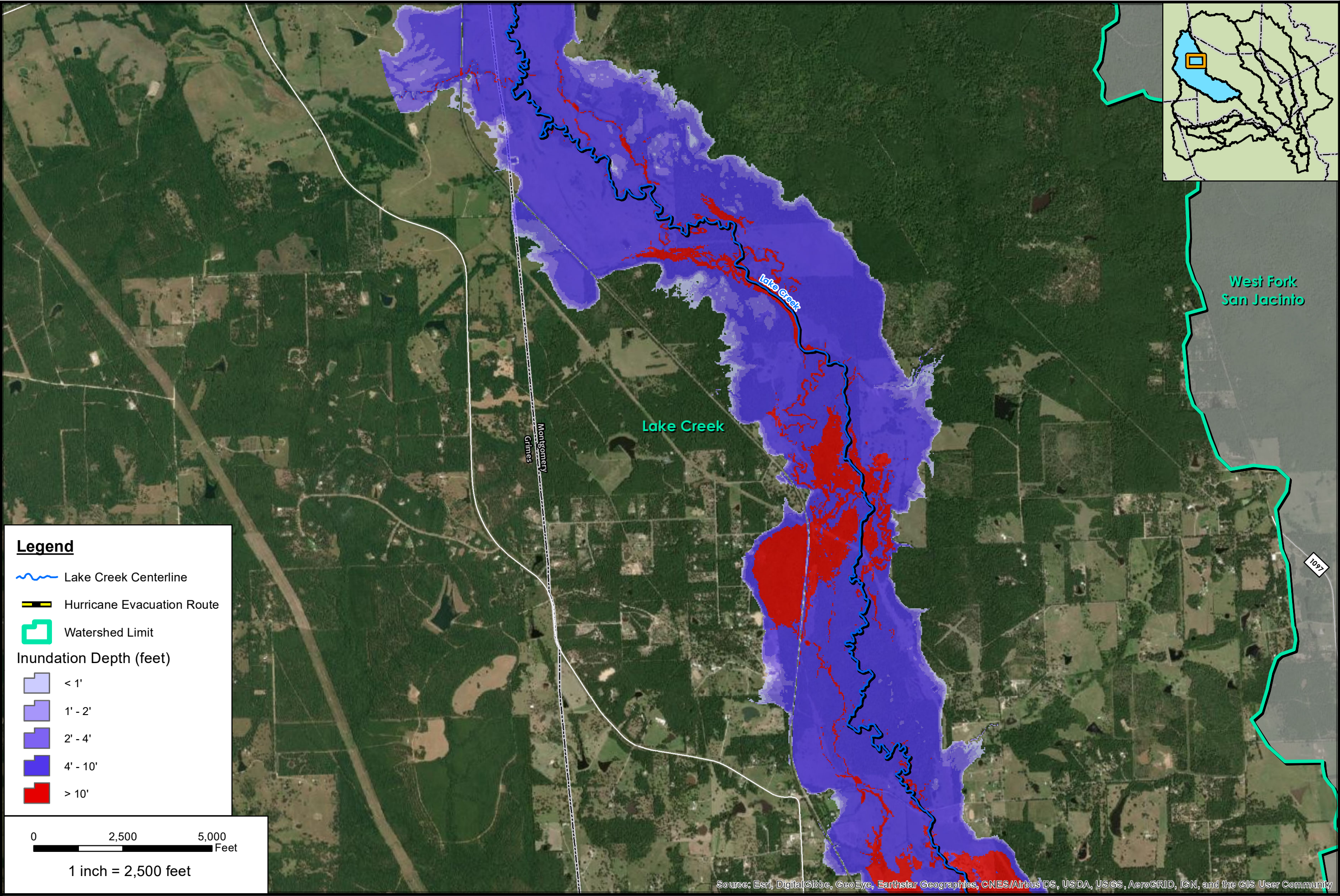
- Lake Creek Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)**
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000 Feet









1 inch = 2,500 feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO		33465	
DATUM & COORDINATE SYSTEM		NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS	
HARRIS COUNTY FLOOD CONTROL DISTRICT			
San Jacinto Regional Watershed Master Drainage Plan			
100YR EXISTING CONDITIONS MAP LAKE CREEK			
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN			
APPENDIX J.2			
MAP GLC - E			



Legend

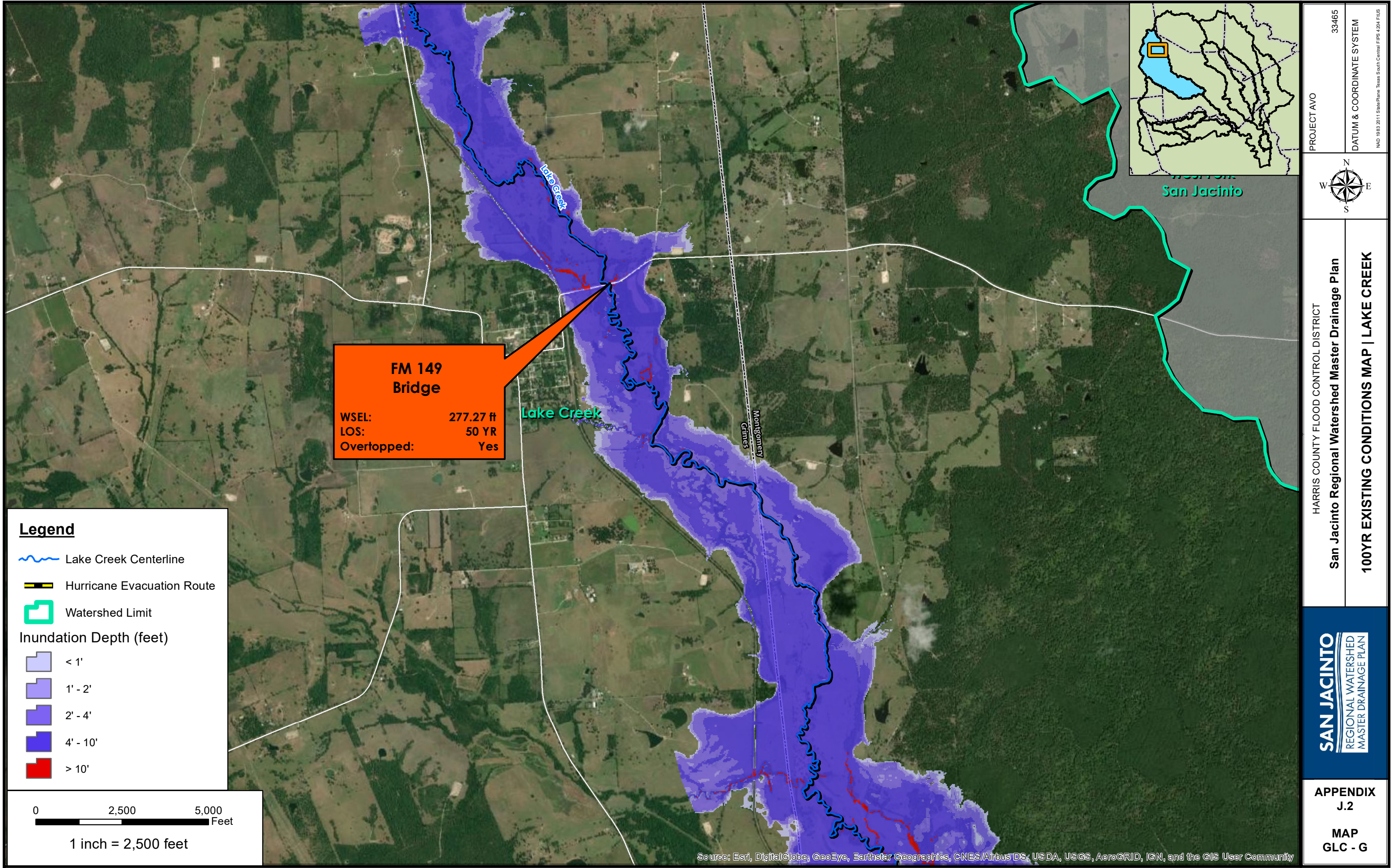
-  Lake Creek Centerline
-  Hurricane Evacuation Route
-  Watershed Limit
- Inundation Depth (feet)**
 -  < 1'
 -  1' - 2'
 -  2' - 4'
 -  4' - 10'
 -  > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO 33465	
DATUM & COORDINATE SYSTEM NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS	
	
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP LAKE CREEK	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP GLC - F	



PROJECT AVO

33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS

HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

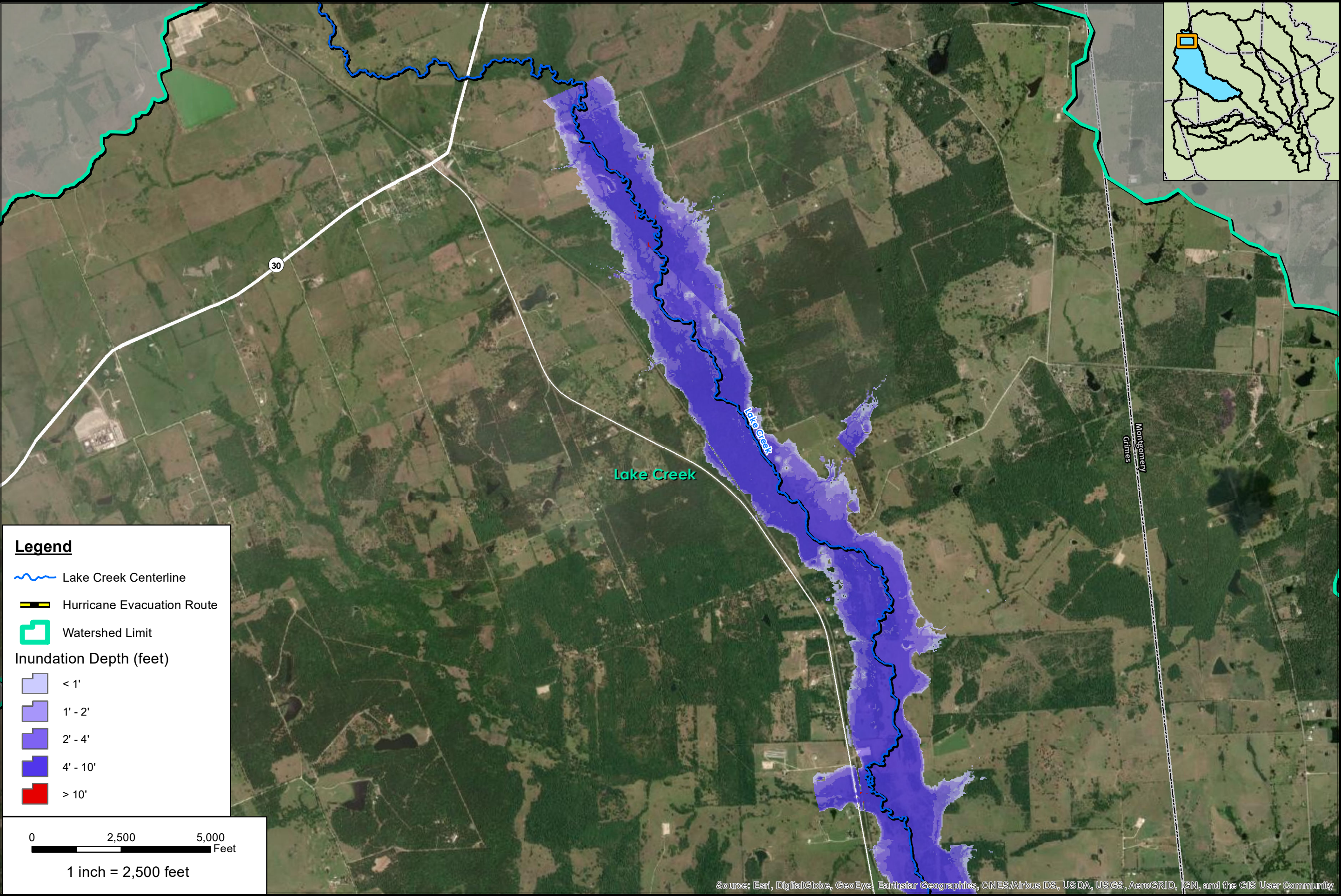
100YR EXISTING CONDITIONS MAP | LAKE CREEK

SAN JACINTO









REGIONAL WATERSHED MASTER DRAINAGE PLAN

APPENDIX J.2

MAP GLC - G



Legend

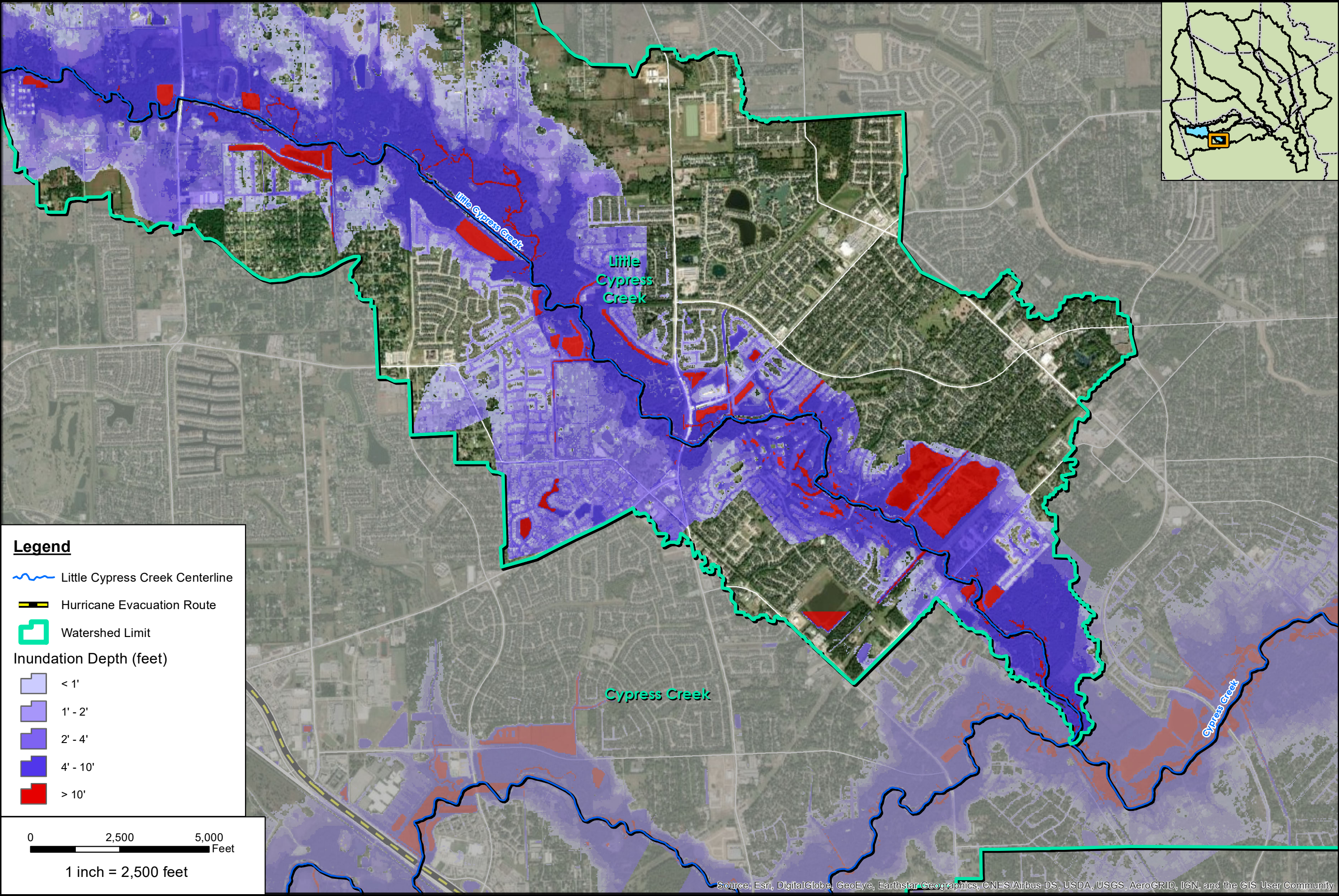
-  Lake Creek Centerline
-  Hurricane Evacuation Route
-  Watershed Limit
- Inundation Depth (feet)**
 -  < 1'
 -  1' - 2'
 -  2' - 4'
 -  4' - 10'
 -  > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO		33465	
HARRIS COUNTY FLOOD CONTROL DISTRICT		DATUM & COORDINATE SYSTEM	
San Jacinto Regional Watershed Master Drainage Plan		NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS	
100YR EXISTING CONDITIONS MAP LAKE CREEK			
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		APPENDIX J.2	
		MAP GLC - H	



Legend

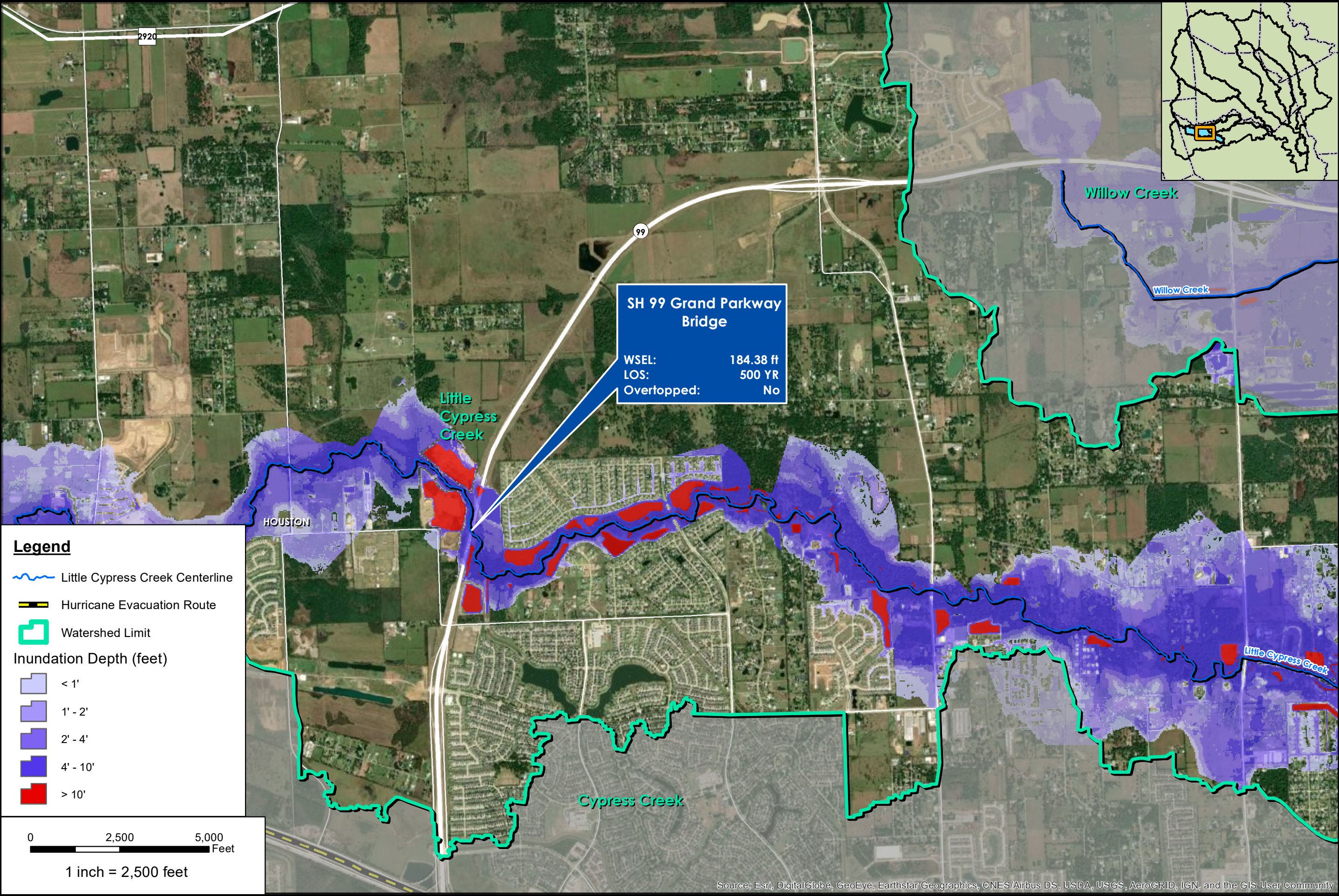
- Little Cypress Creek Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000 Feet

1 inch = 2,500 feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO		33465	
HARRIS COUNTY FLOOD CONTROL DISTRICT		DATUM & COORDINATE SYSTEM	
San Jacinto Regional Watershed Master Drainage Plan		NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS	
100YR EXISTING CONDITIONS MAP LITTLE CYPRESS CREEK			
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		APPENDIX J.2	
		MAP L100 - A	



SH 99 Grand Parkway Bridge

WSEL: 184.38 ft
LOS: 500 YR
Overtopped: No

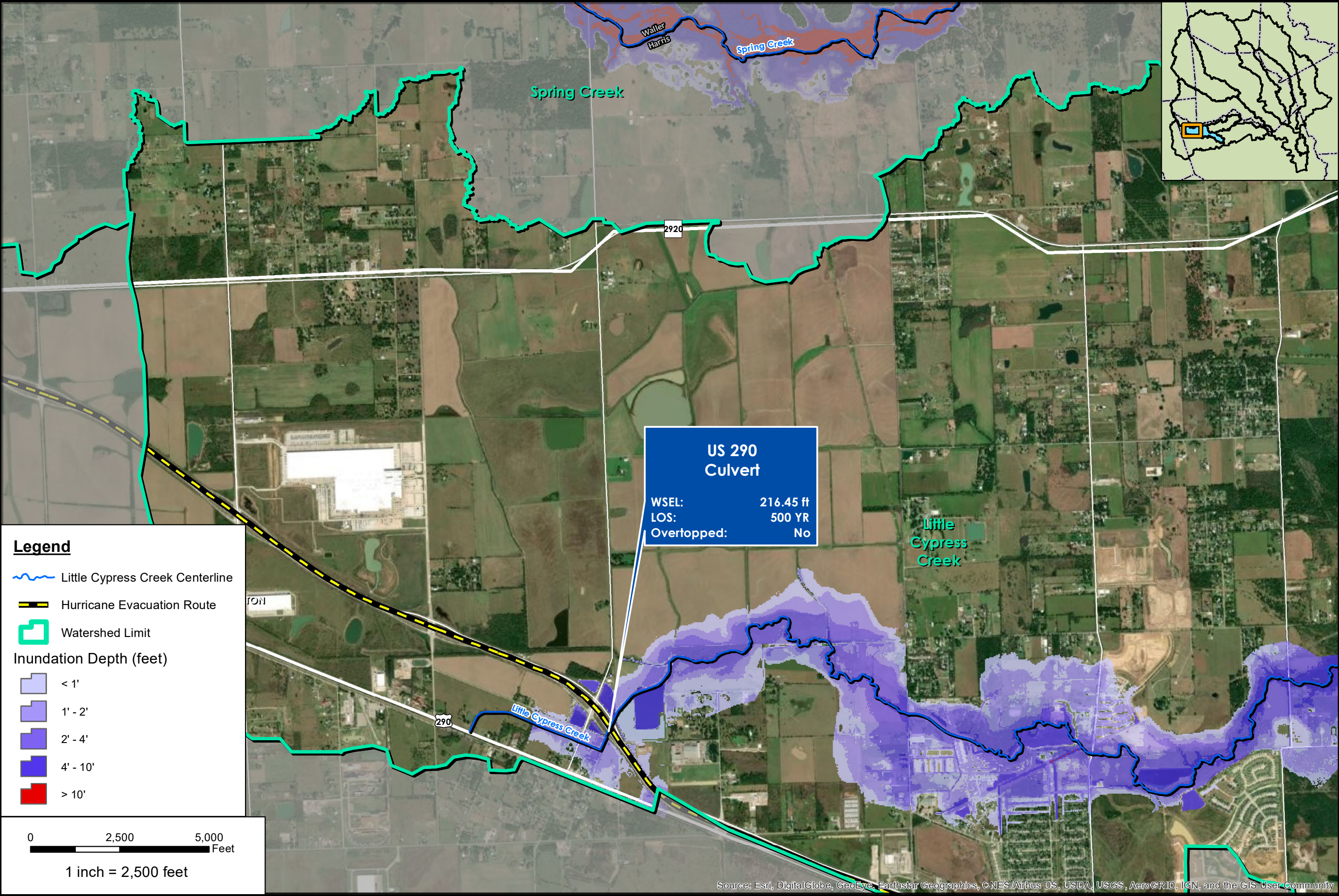
- Legend**
- Little Cypress Creek Centerline
 - Hurricane Evacuation Route
 - Watershed Limit
- Inundation Depth (feet)**
- < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'


0 2,500 5,000 Feet

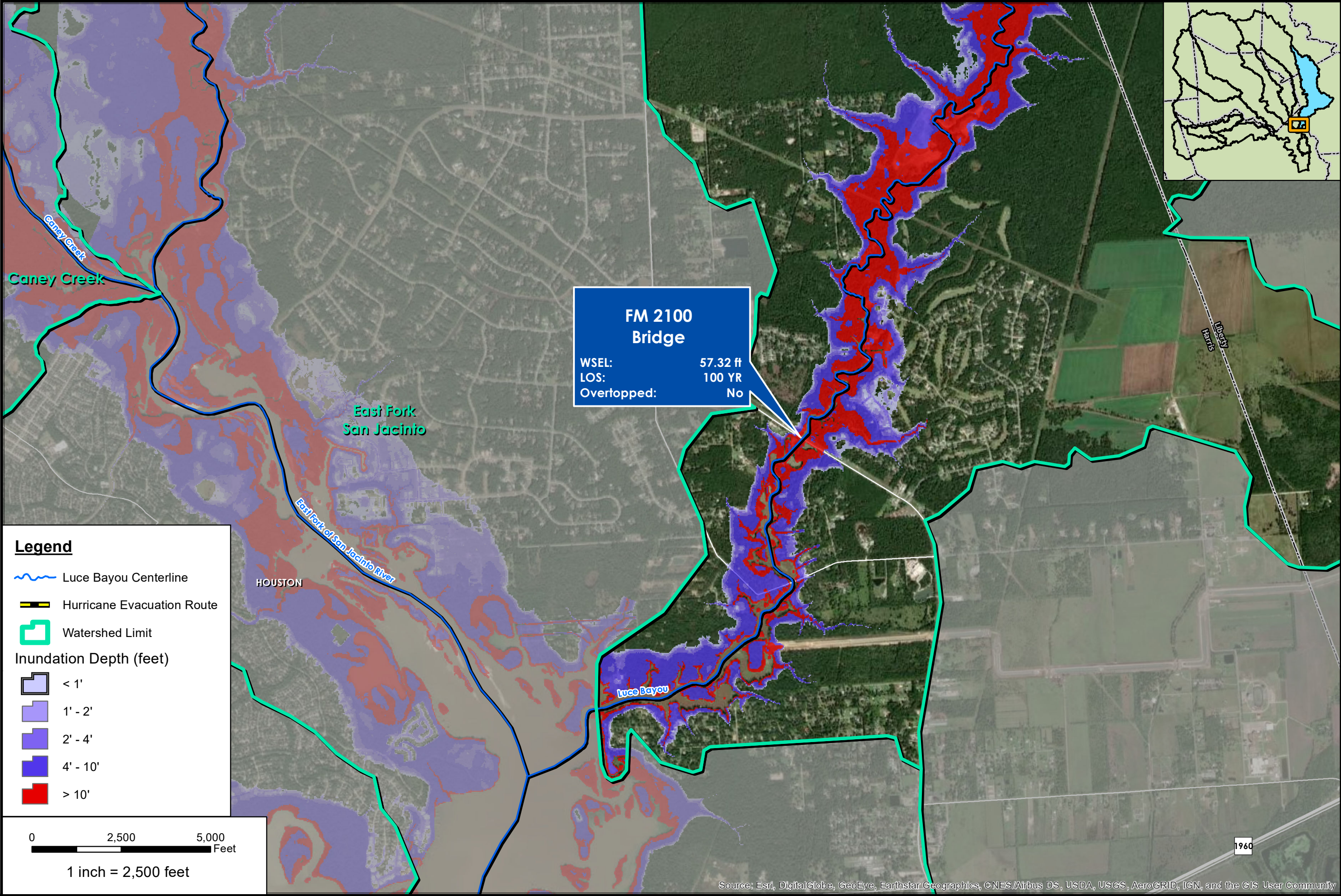
1 inch = 2,500 feet

PROJECT AVO 33465	
DATUM & COORDINATE SYSTEM NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS	
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP LITTLE CYPRESS CREEK	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP L100 - B	

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



PROJECT AVO		33465
DATUM & COORDINATE SYSTEM		NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS
		
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP LITTLE CYPRESS CREEK		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP L100 - C		

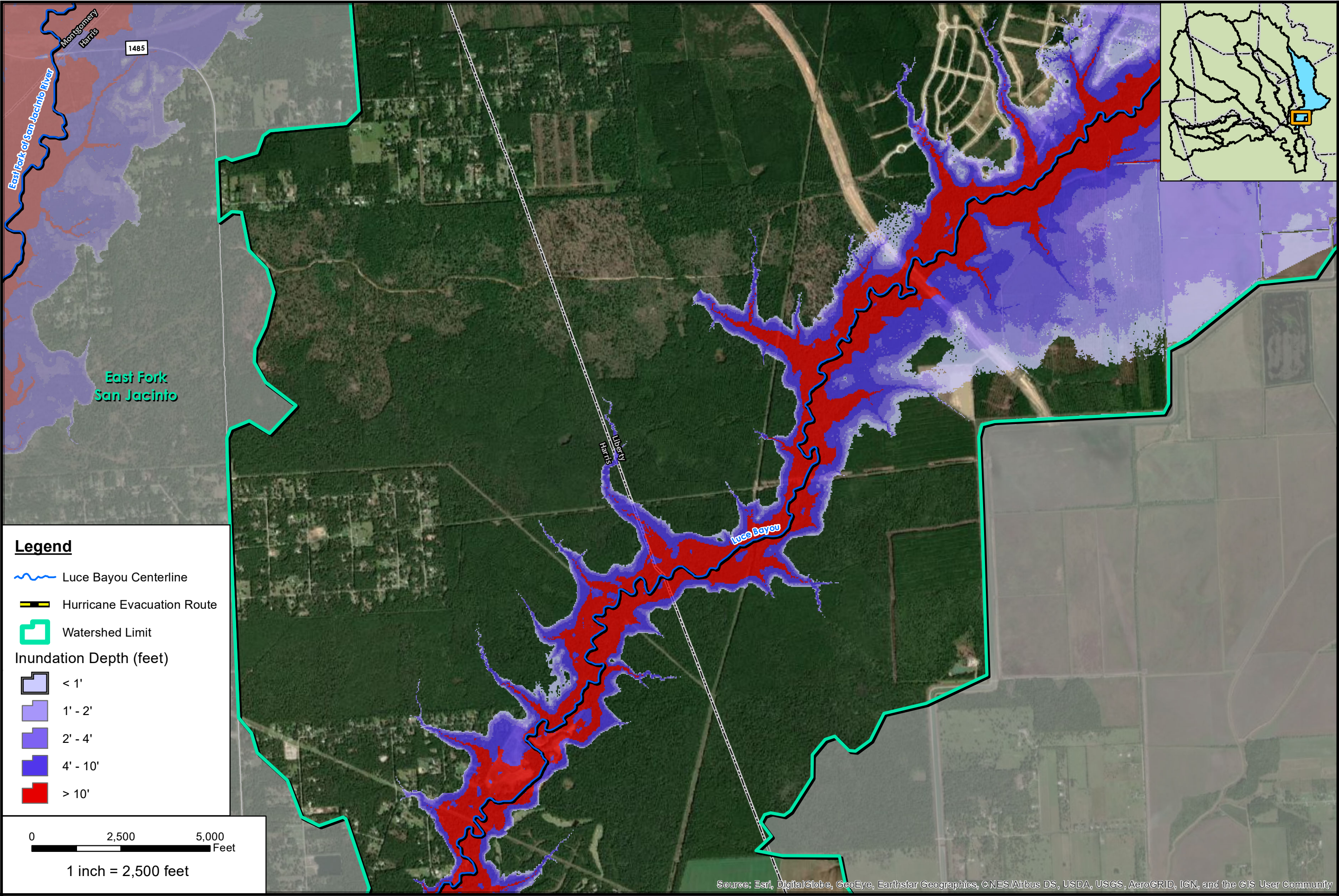


Legend

- Luce Bayou Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)**
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

FM 2100 Bridge
WSEL: 57.32 ft
LOS: 100 YR
Overtopped: No

PROJECT AVO 33465	DATUM & COORDINATE SYSTEM NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP LUCE & TARKINGTON BAYOU	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP S100 - A	



Legend

Luce Bayou Centerline

Hurricane Evacuation Route

Watershed Limit

Inundation Depth (feet)

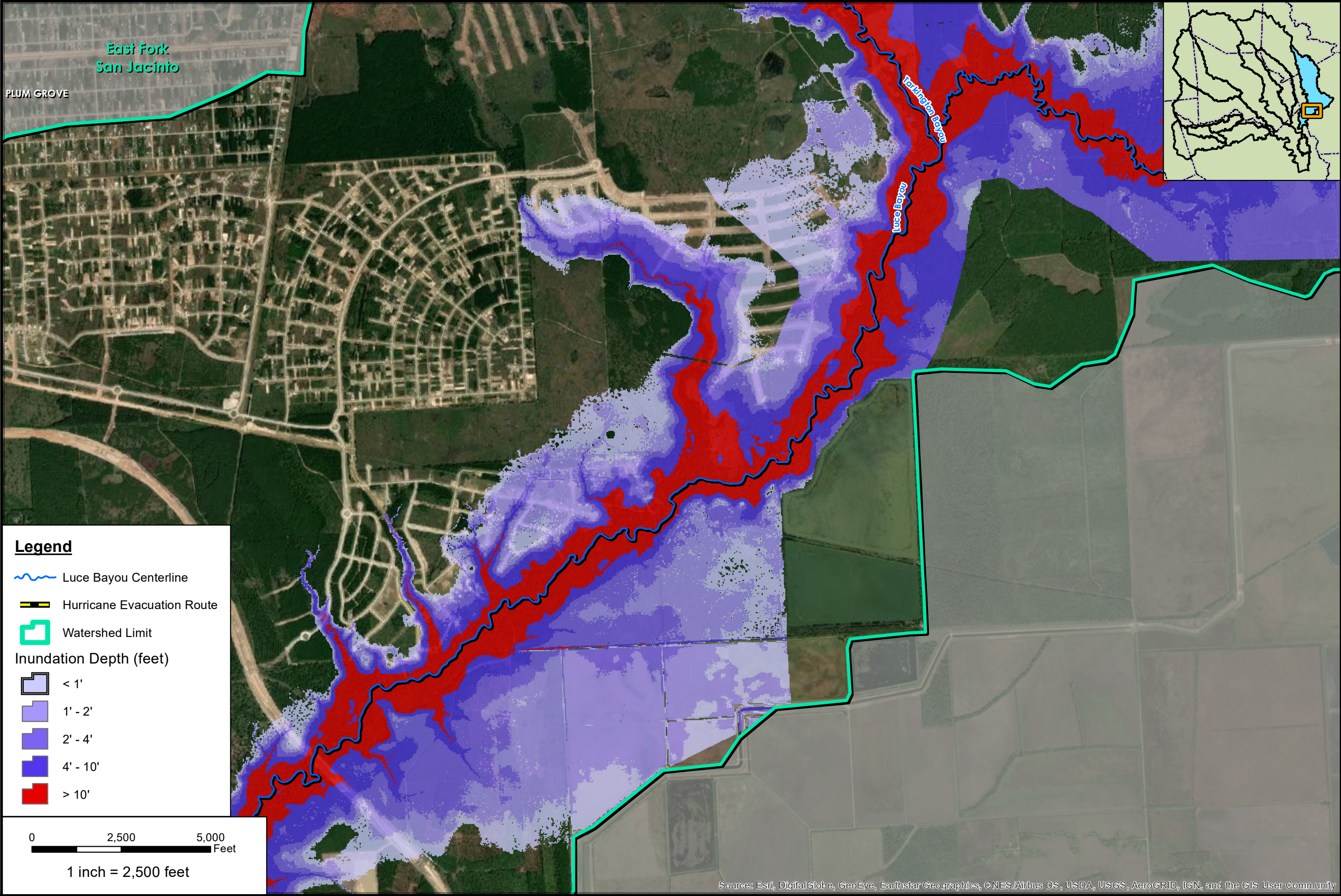
	< 1'
	1' - 2'
	2' - 4'
	4' - 10'
	> 10'

0 2,500 5,000 Feet

1 inch = 2,500 feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

	PROJECT AVO	33465
	DATUM & COORDINATE SYSTEM NAD 1983 StatePlane Texas Central FIPS 4203 Feet	
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP LUCE & TARKINGTON BAYOU		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP S100 - B		



Legend

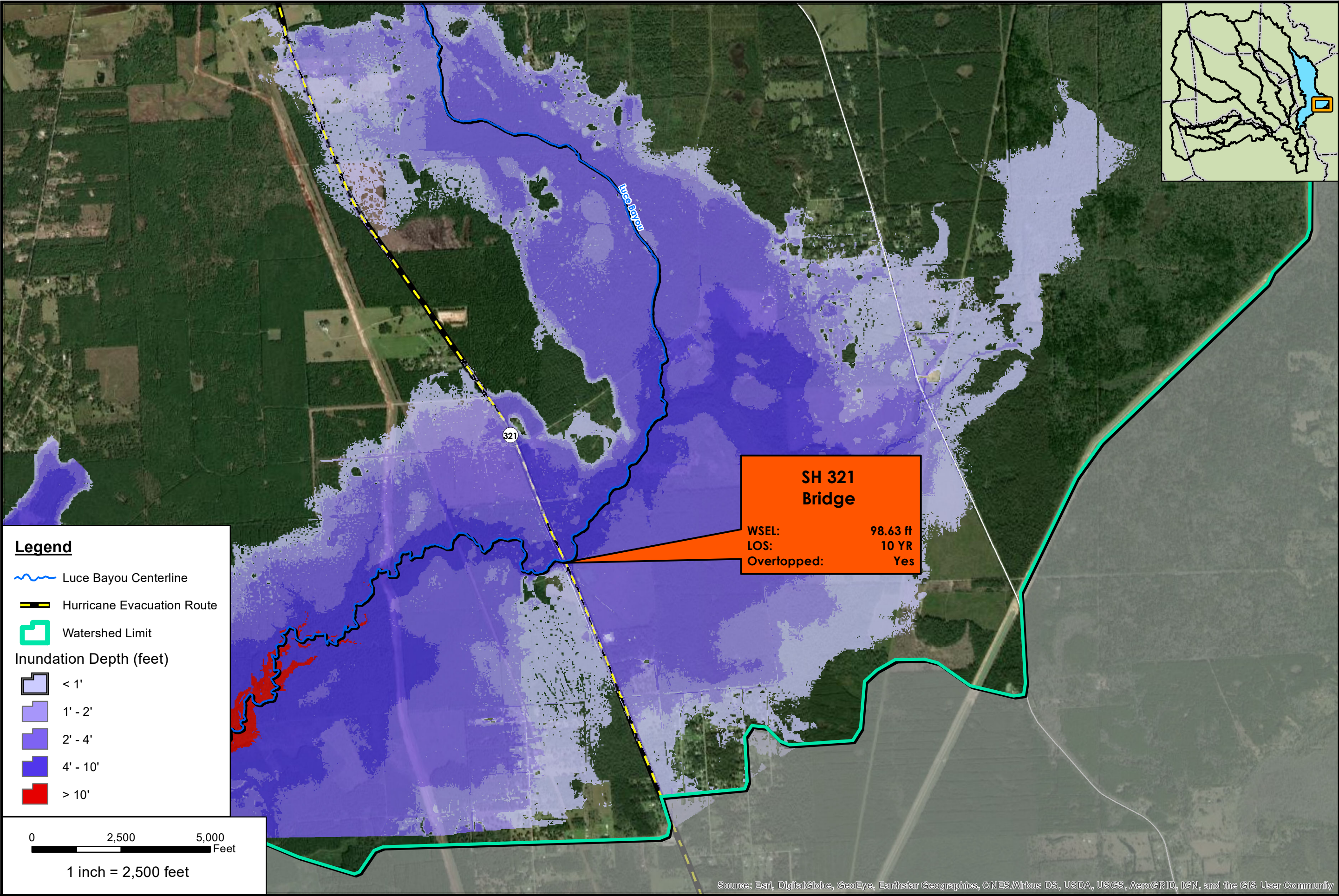
- Luce Bayou Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)**
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

PROJECT AVO		33465
HARRIS COUNTY FLOOD CONTROL DISTRICT		DATUM & COORDINATE SYSTEM
San Jacinto Regional Watershed Master Drainage Plan		NAD 1983 StatePlane Texas Central FIPS 4203 Feet
100YR EXISTING CONDITIONS MAP LUCE & TARKINGTON BAYOU		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP S100 - C		

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

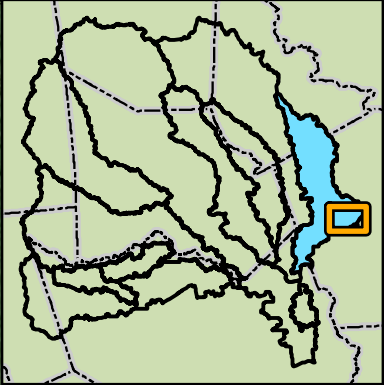


Legend

- Luce Bayou Centerline
 - Hurricane Evacuation Route
 - Watershed Limit
- Inundation Depth (feet)
- < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000 Feet

1 inch = 2,500 feet



PROJECT AVO

33465

DATUM & COORDINATE SYSTEM

NAD 1983 StatePlane Texas Central FIPS 4203 Feet

HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

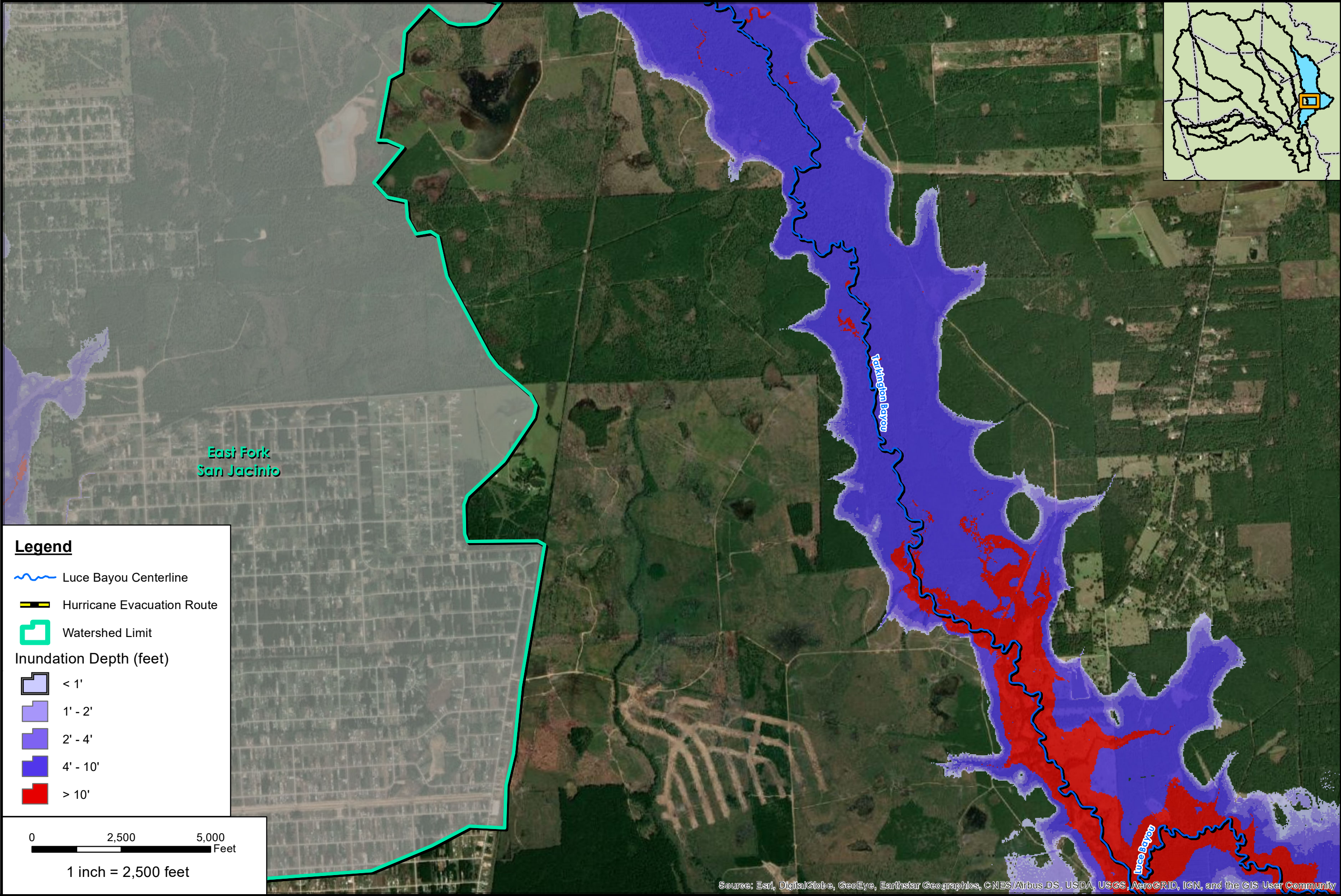
100YR EXISTING CONDITIONS MAP | LUCE & TARKINGTON BAYOU

SAN JACINTO
REGIONAL WATERSHED
MASTER DRAINAGE PLAN

APPENDIX
J.2

MAP
S100 - D

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



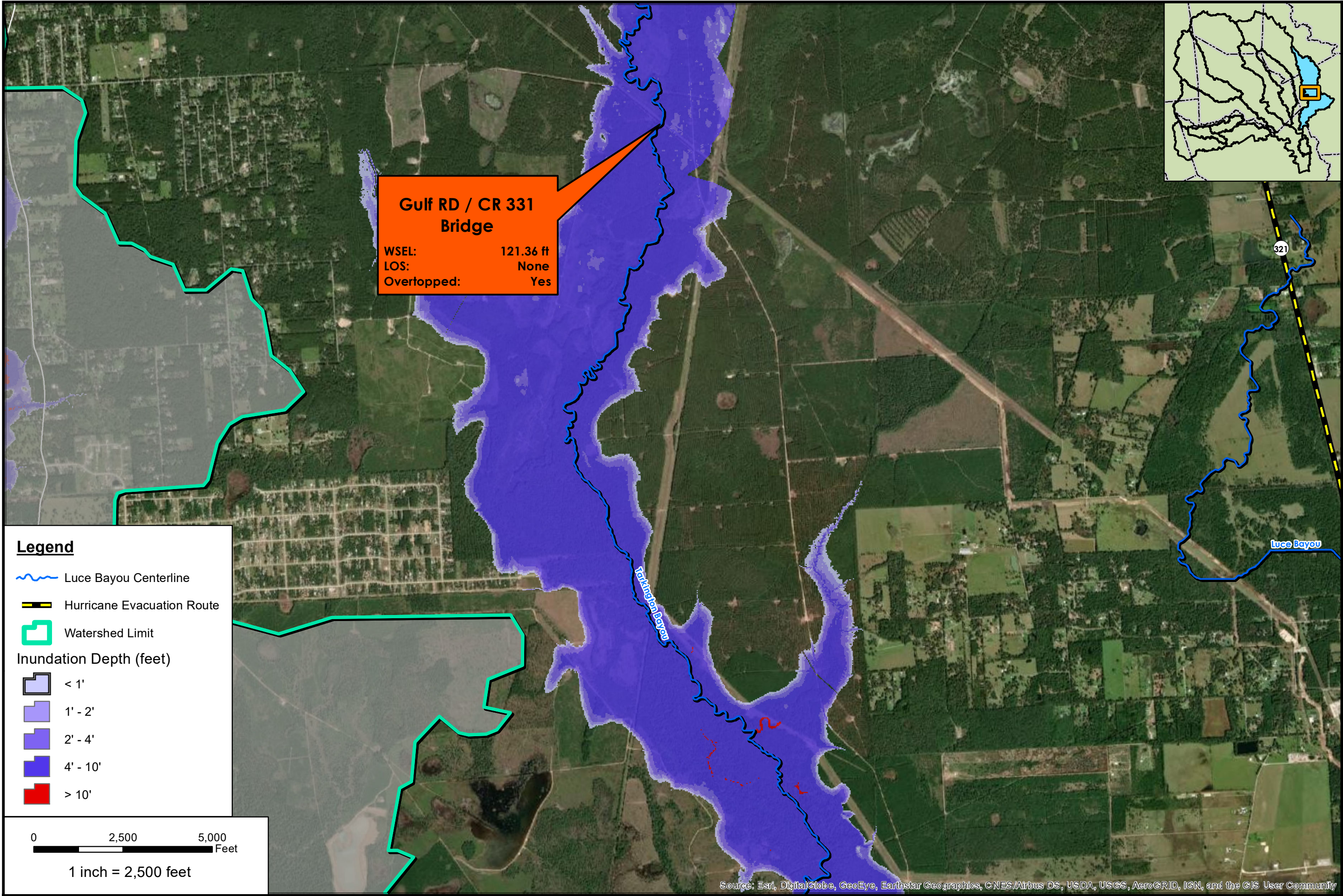
Legend

- Luce Bayou Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)**
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

PROJECT AVO	33465
	DATUM & COORDINATE SYSTEM NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP LUCE & TARKINGTON BAYOU	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP S100 - E	



**Gulf RD / CR 331
Bridge**

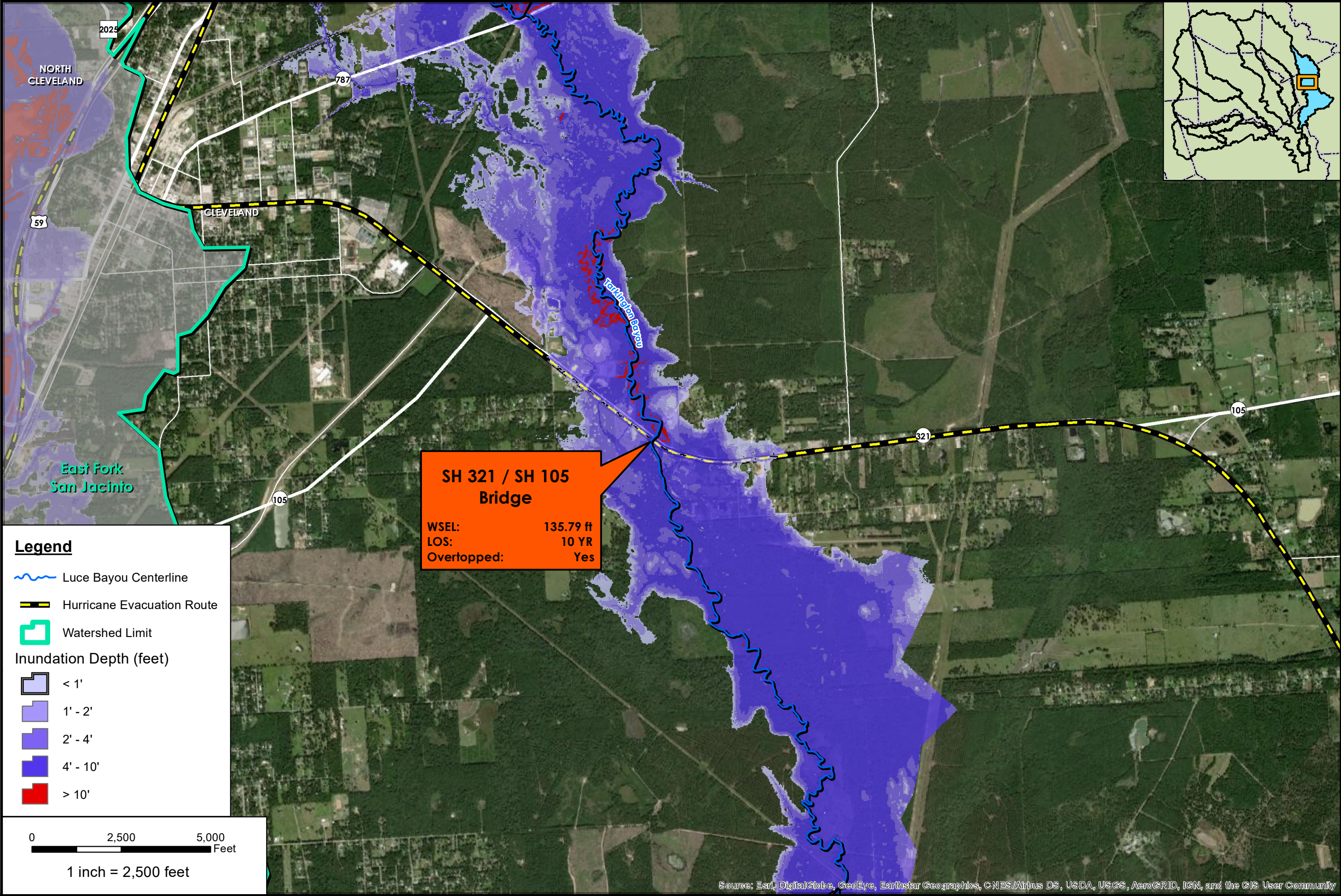
WSEL:	121.36 ft
LOS:	None
Overtopped:	Yes

- Legend**
- Luce Bayou Centerline
 - Hurricane Evacuation Route
 - Watershed Limit
 - Inundation Depth (feet)
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000 Feet

1 inch = 2,500 feet

PROJECT AVO	33465
	DATUM & COORDINATE SYSTEM NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP LUCE & TARKINGTON BAYOU	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP S100 - F	



**SH 321 / SH 105
Bridge**

WSEL: 135.79 ft
LOS: 10 YR
Overtopped: Yes

Legend

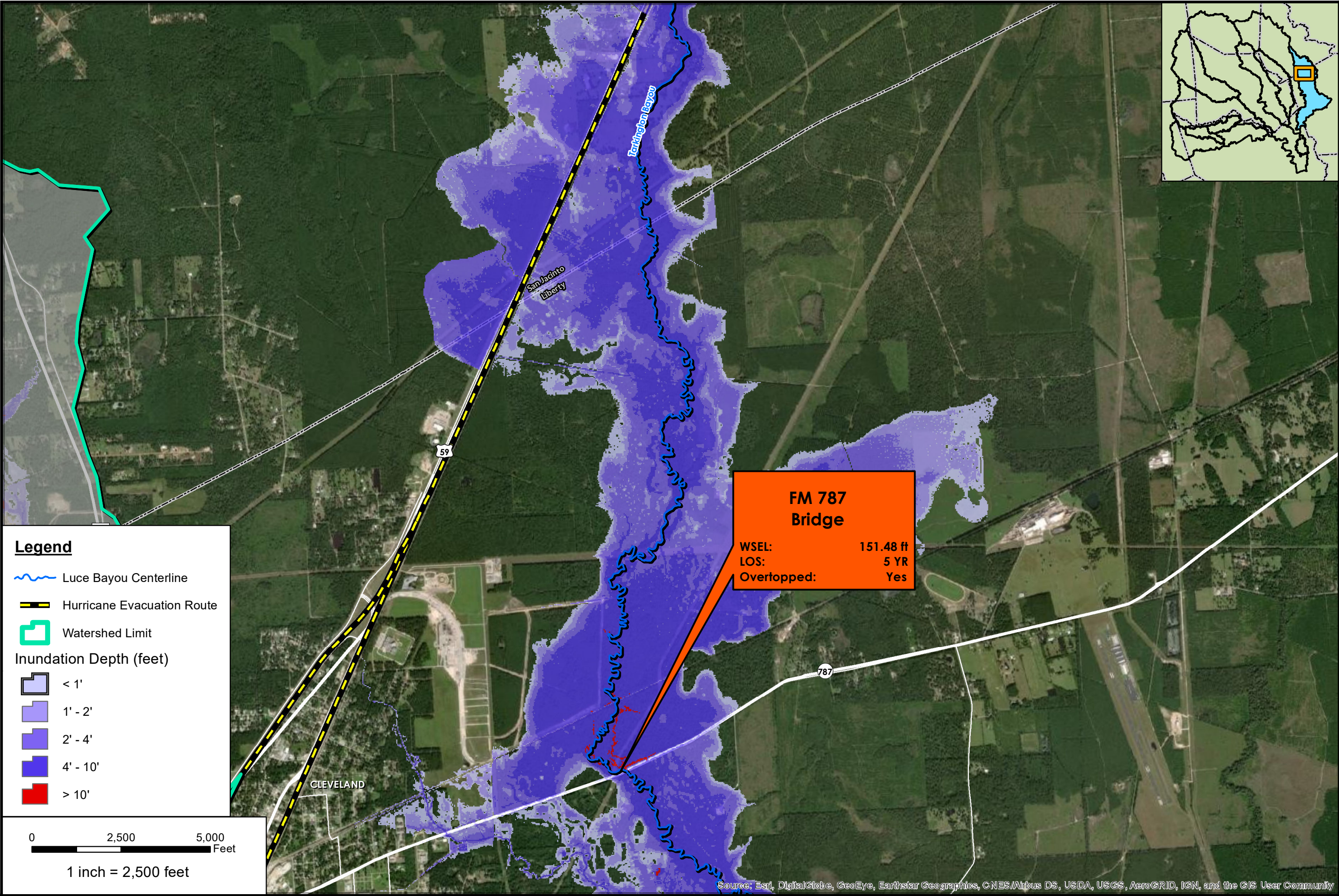
- Luce Bayou Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)**
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

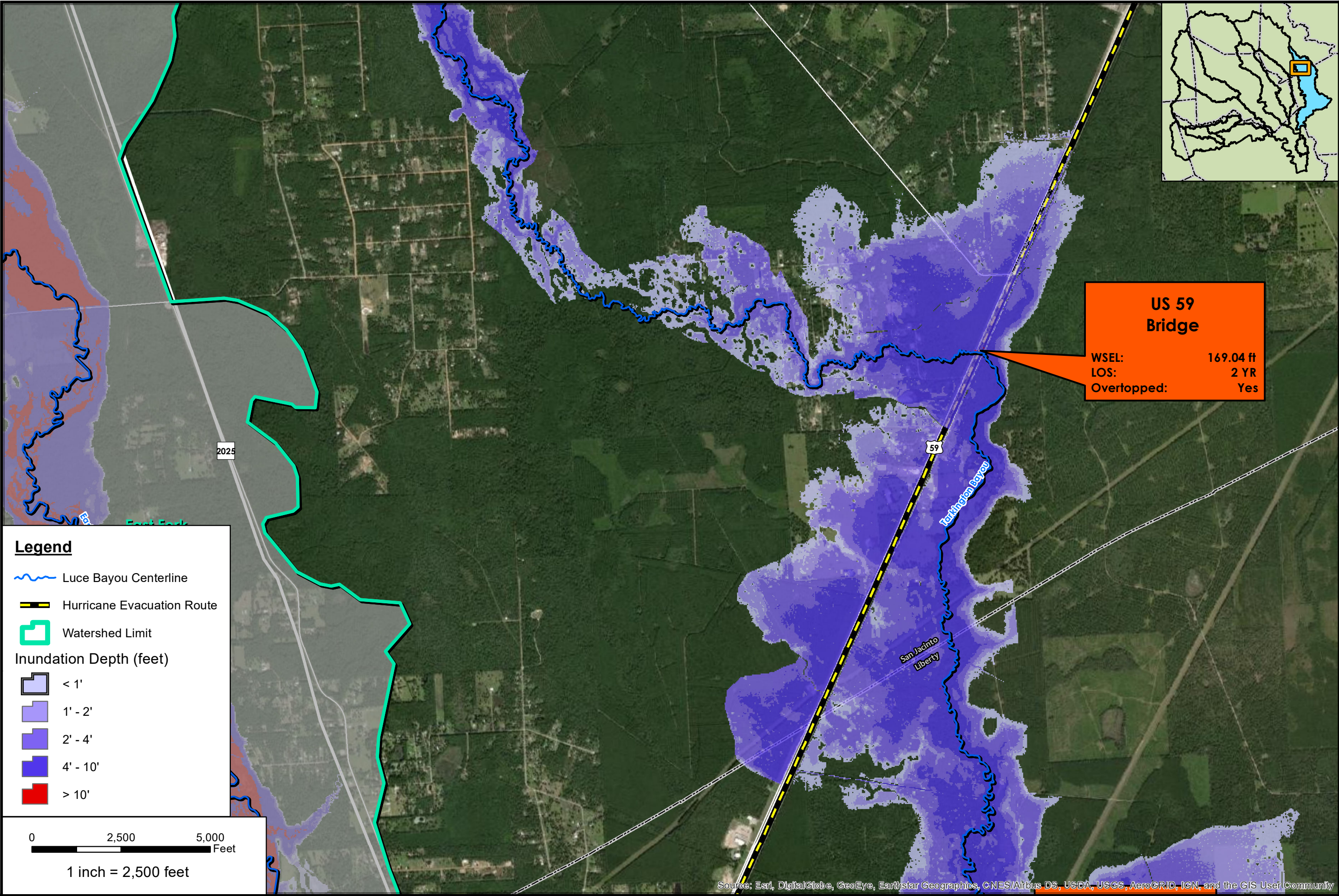
1 inch = 2,500 feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO	33465
	DATUM & COORDINATE SYSTEM NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP LUCE & TARKINGTON BAYOU	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP S100 - G	



PROJECT AVO	33465
	DATUM & COORDINATE SYSTEM NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP LUCE & TARKINGTON BAYOU	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP S100 - H	



Legend

- Luce Bayou Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)**
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

**US 59
Bridge**

WSEL: 169.04 ft
LOS: 2 YR
Overtopped: Yes

PROJECT AVO 33465
DATUM & COORDINATE SYSTEM
NAD 1983 StatePlane Texas Central FIPS 4203 Feet

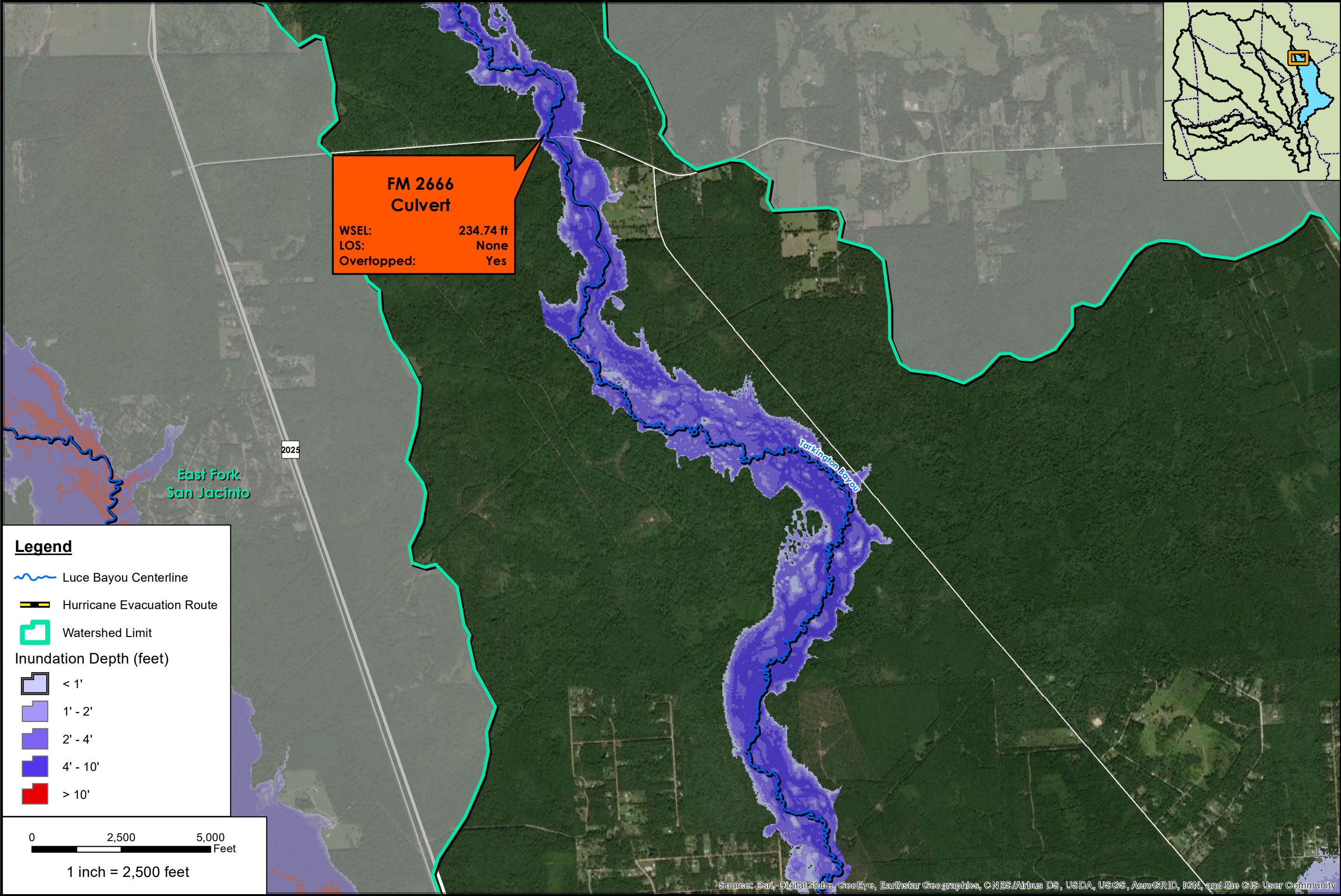


HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan
100YR EXISTING CONDITIONS MAP | LUCE & TARKINGTON BAYOU

SAN JACINTO
REGIONAL WATERSHED
MASTER DRAINAGE PLAN

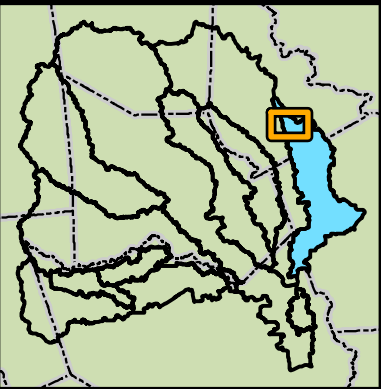
APPENDIX
J.2
MAP
S100 - I

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

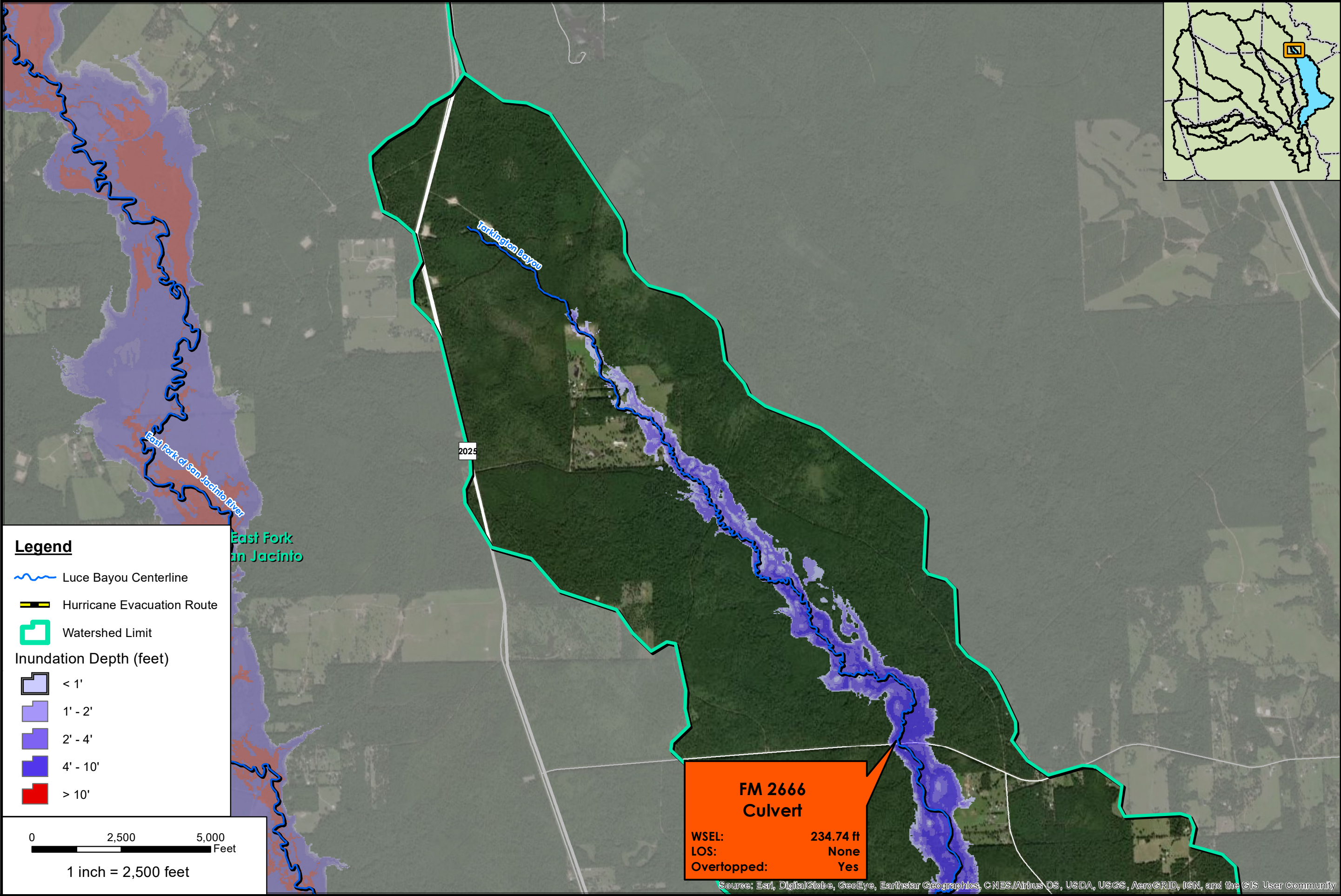


**FM 2666
Culvert**

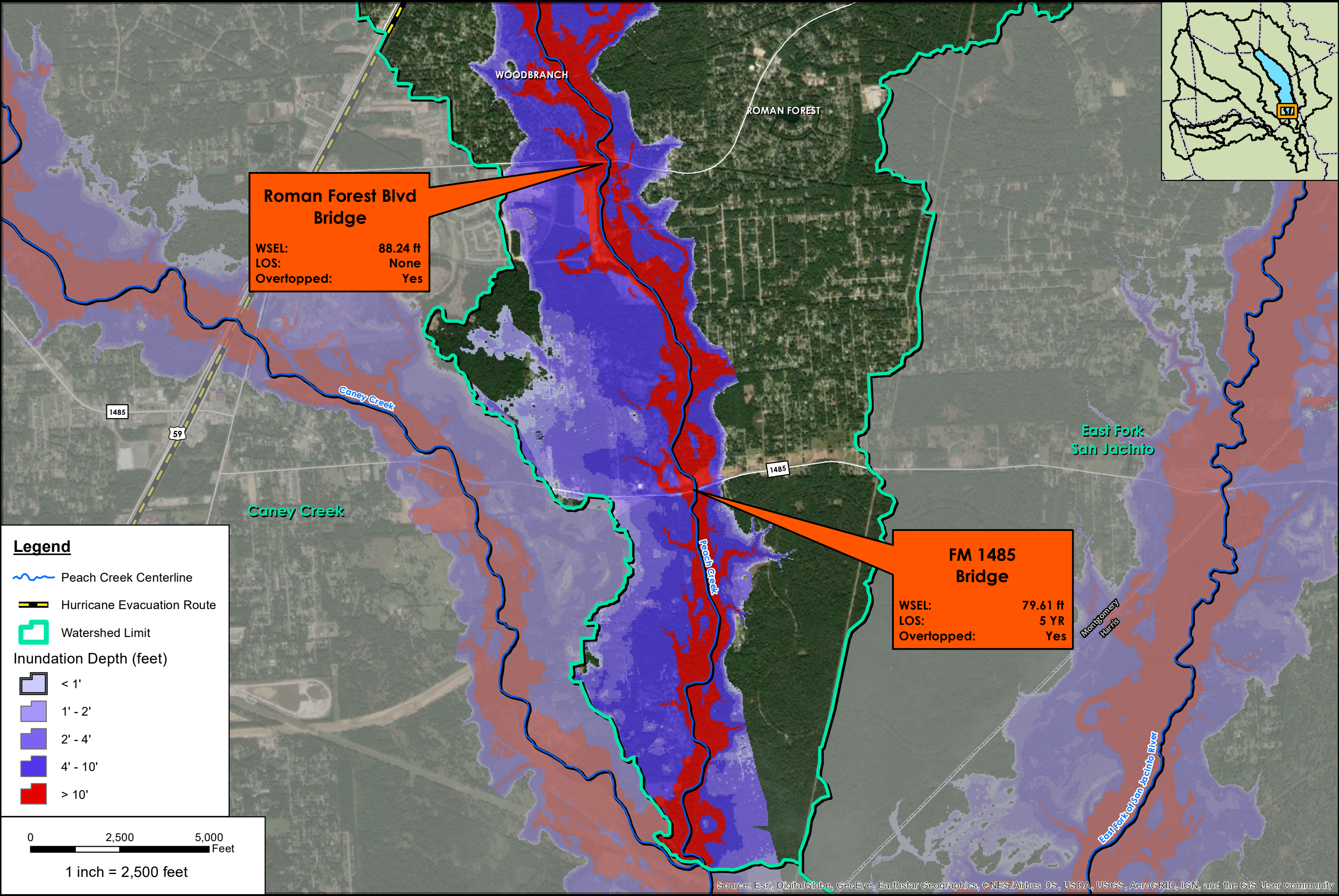
WSEL: 234.74 ft
LOS: None
Overtopped: Yes



PROJECT AVO	33465
	DATUM & COORDINATE SYSTEM NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP LUCE & TARKINGTON BAYOU	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP S100 - J	



PROJECT AVO	33465
	DATUM & COORDINATE SYSTEM NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP LUCE & TARKINGTON BAYOU	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP S100 - K	



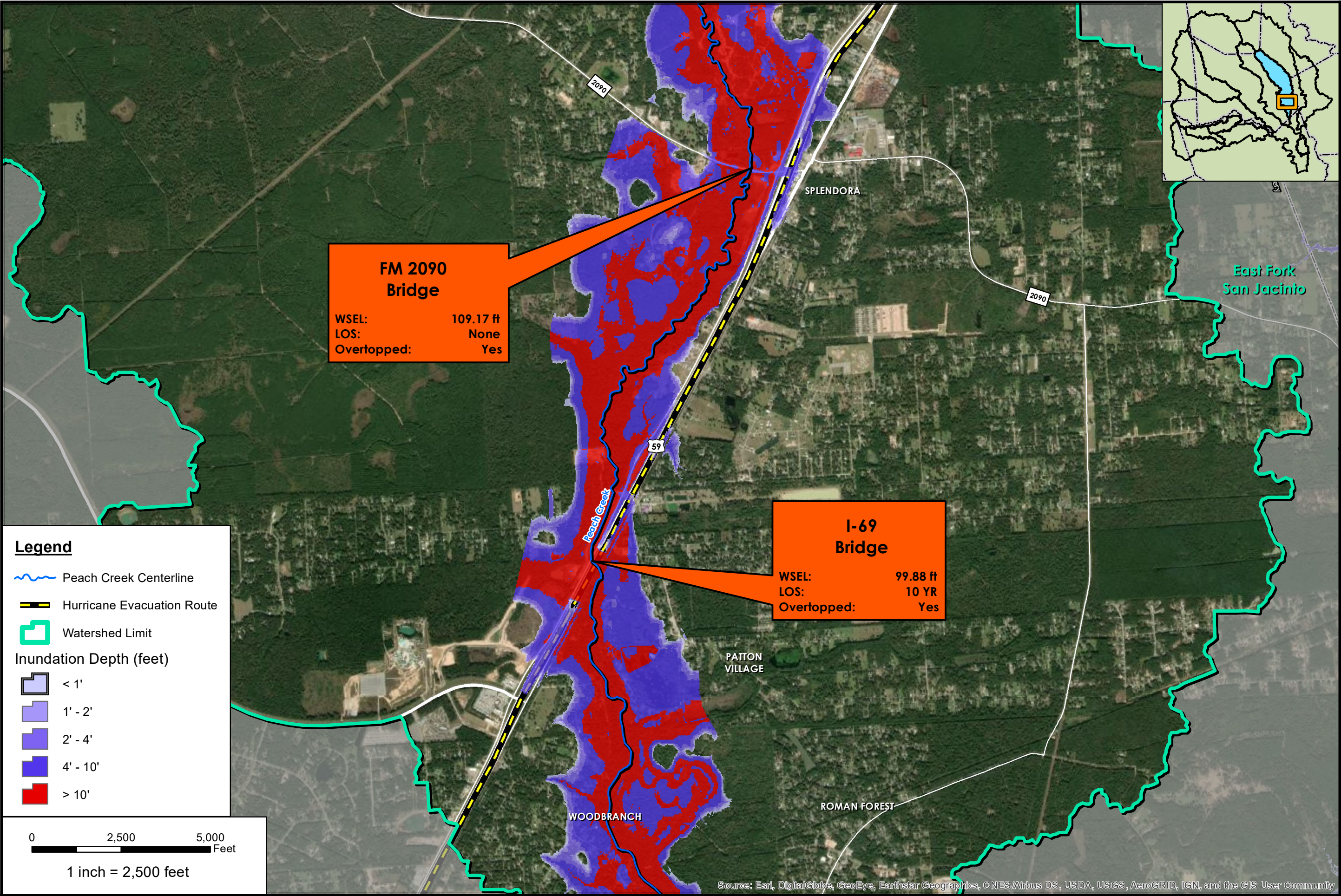
Roman Forest Blvd Bridge

WSEL:	88.24 ft
LOS:	None
Overtopped:	Yes

FM 1485 Bridge

WSEL:	79.61 ft
LOS:	5 YR
Overtopped:	Yes

PROJECT AVO		33465
DATUM & COORDINATE SYSTEM		NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP PEACH CREEK		
APPENDIX J.2		
MAP GPC - A		



Legend

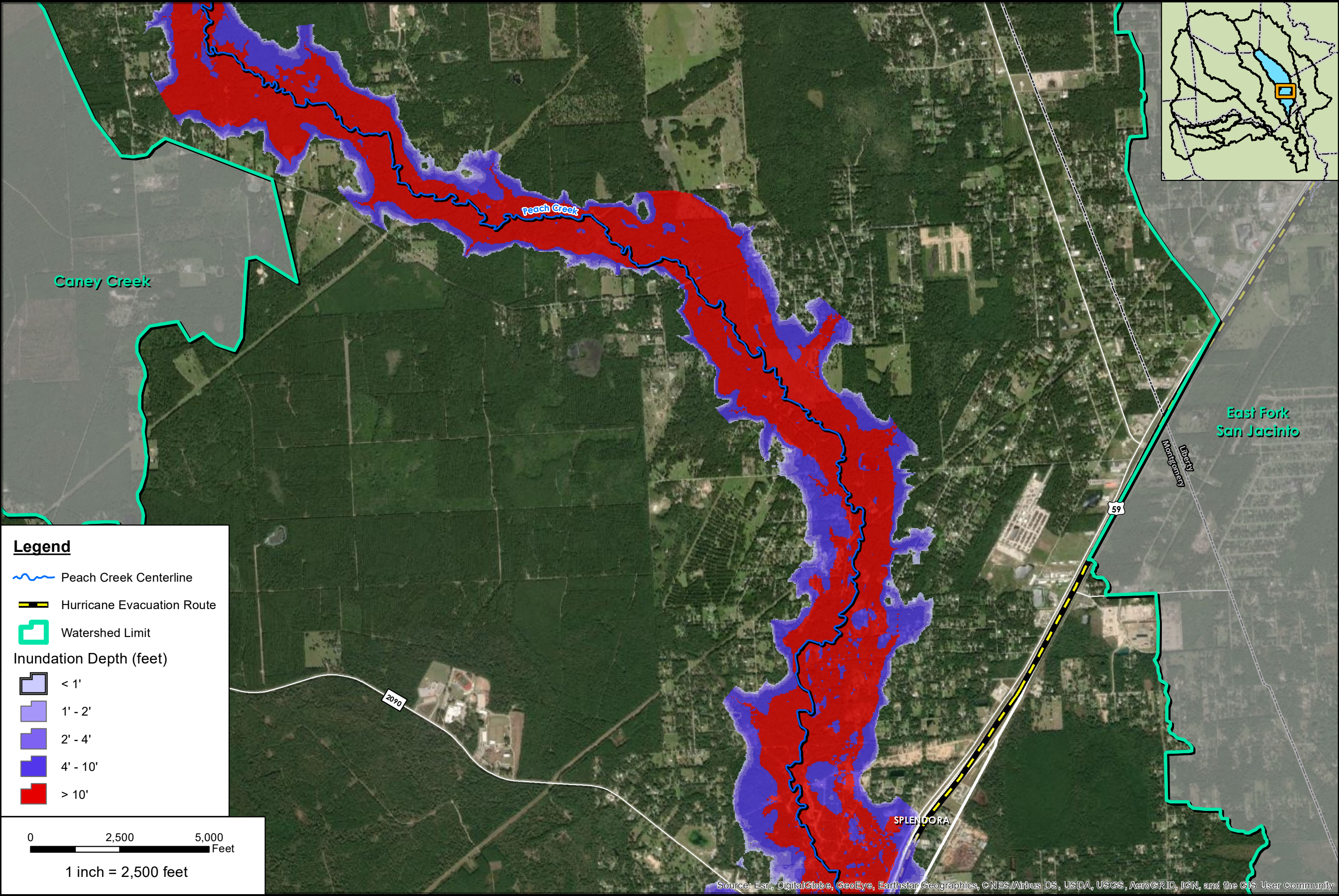
- Peach Creek Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)**
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO	33465
	DATUM & COORDINATE SYSTEM NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT	San Jacinto Regional Watershed Master Drainage Plan
	100YR EXISTING CONDITIONS MAP PEACH CREEK
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP GPC - B	



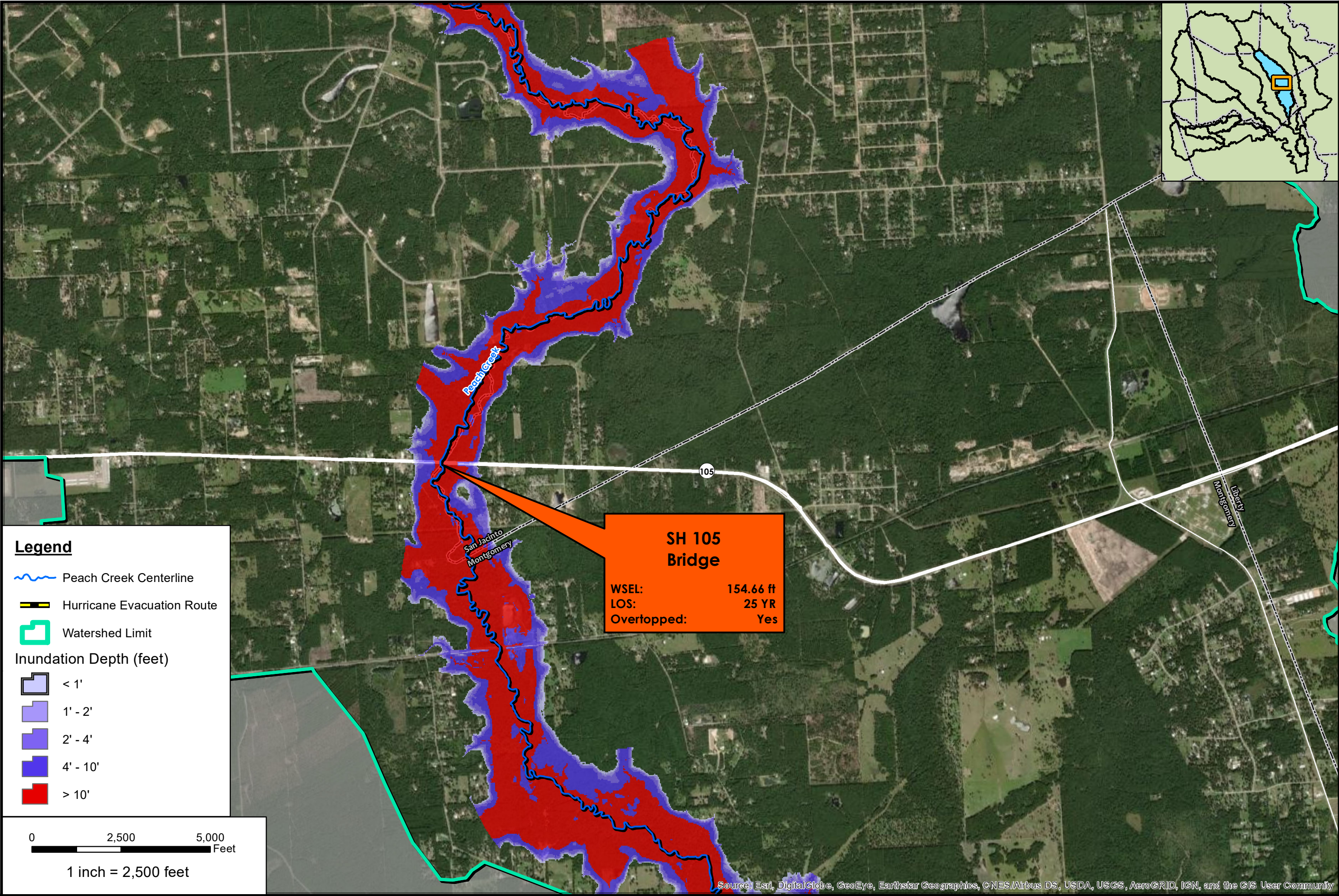
Legend

- Peach Creek Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)**
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

PROJECT AVO		33465
DATUM & COORDINATE SYSTEM		NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP PEACH CREEK		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP GPC - C		



PROJECT AVO

33465

DATUM & COORDINATE SYSTEM

NAD 1983 StatePlane Texas Central FIPS 4203 Feet

N

W

E

S

HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

100YR EXISTING CONDITIONS MAP | PEACH CREEK

SAN JACINTO

REGIONAL WATERSHED

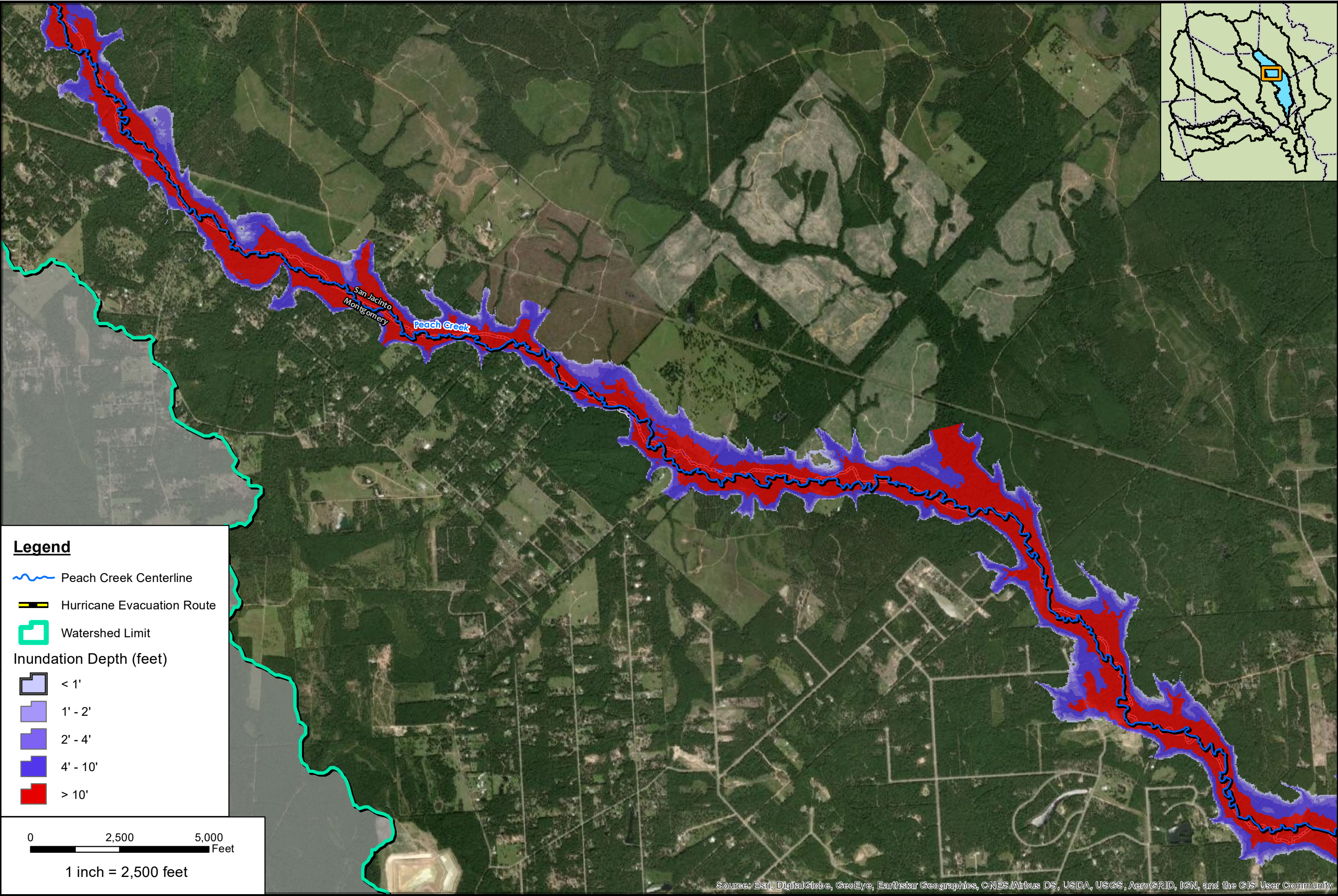
MASTER DRAINAGE PLAN

APPENDIX

J.2

MAP

GPC - D



Legend

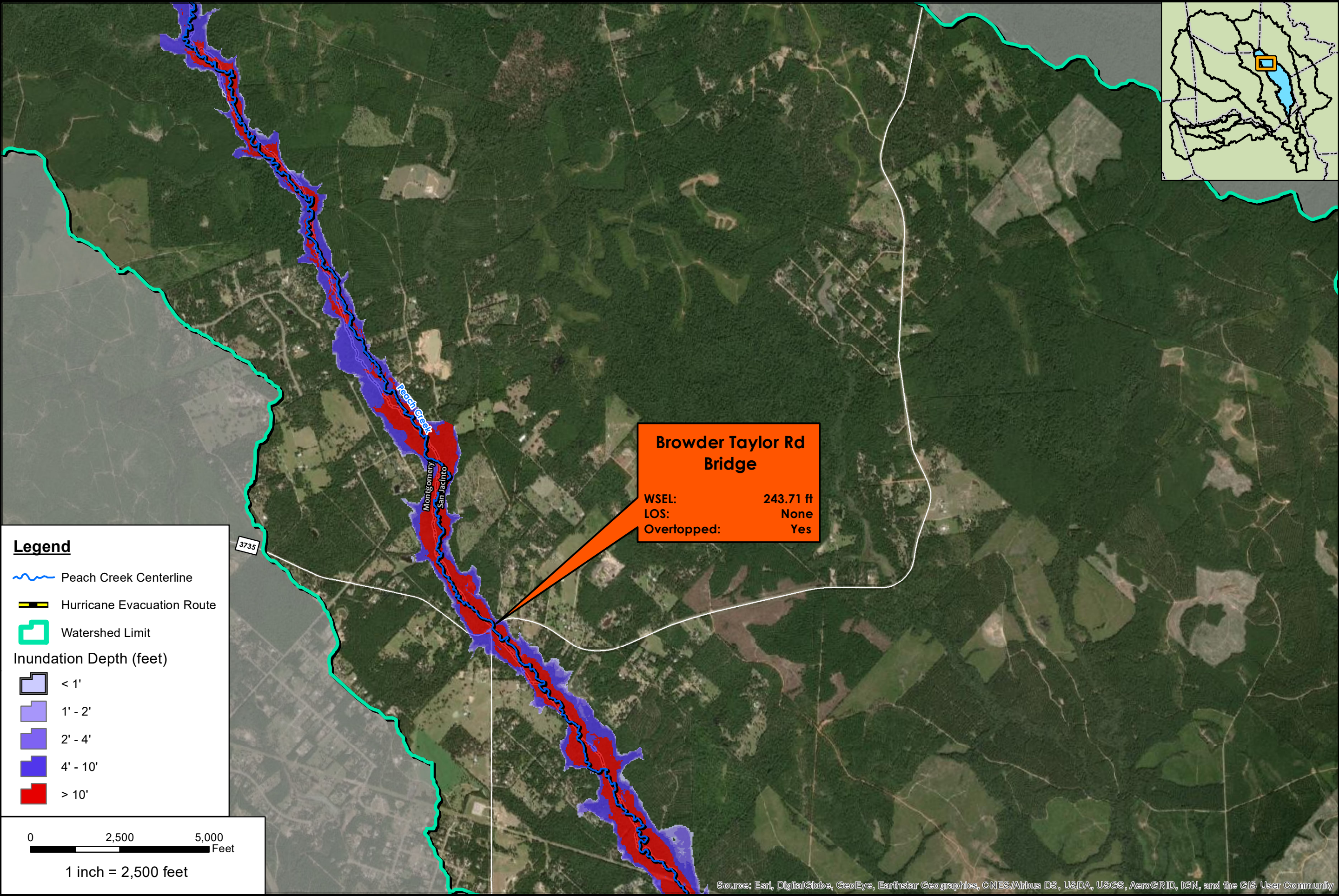
- Peach Creek Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)**
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

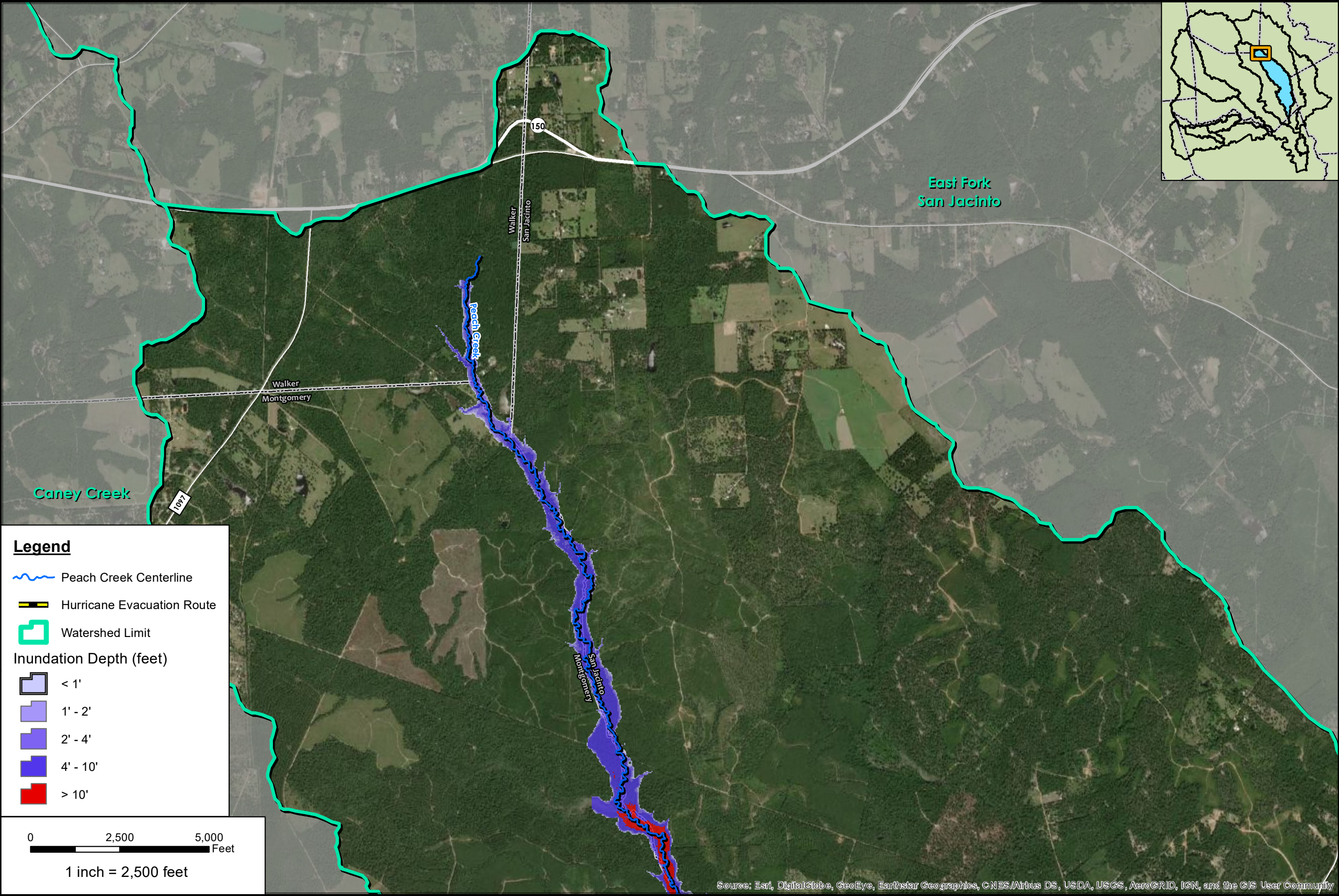
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO		33465
DATUM & COORDINATE SYSTEM		NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP PEACH CREEK		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP GPC - E		

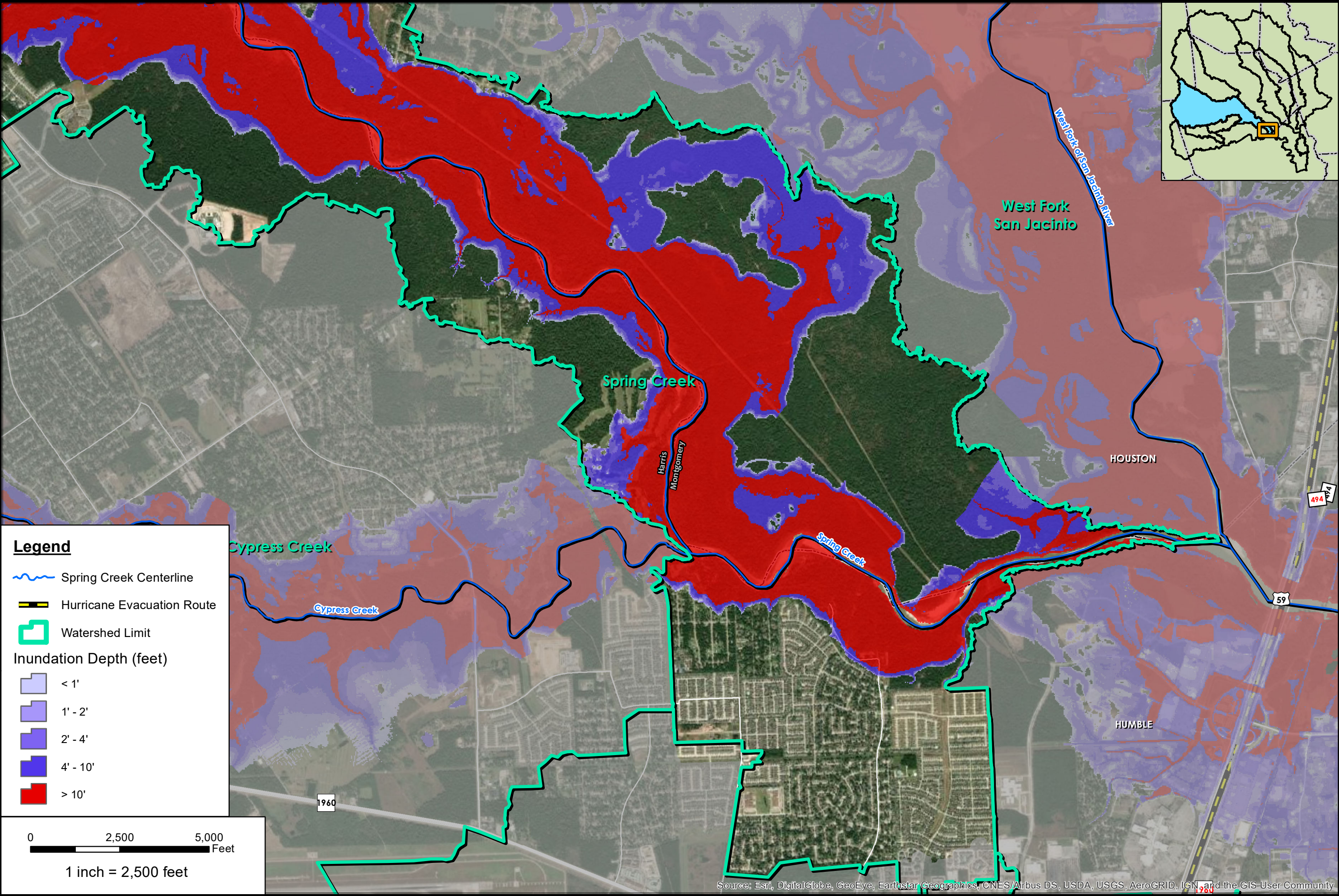


	PROJECT AVO	33465
	DATUM & COORDINATE SYSTEM NAD 1983 StatePlane Texas Central FIPS 4203 Feet	
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP PEACH CREEK		
		
APPENDIX J.2		
MAP GPC - F		

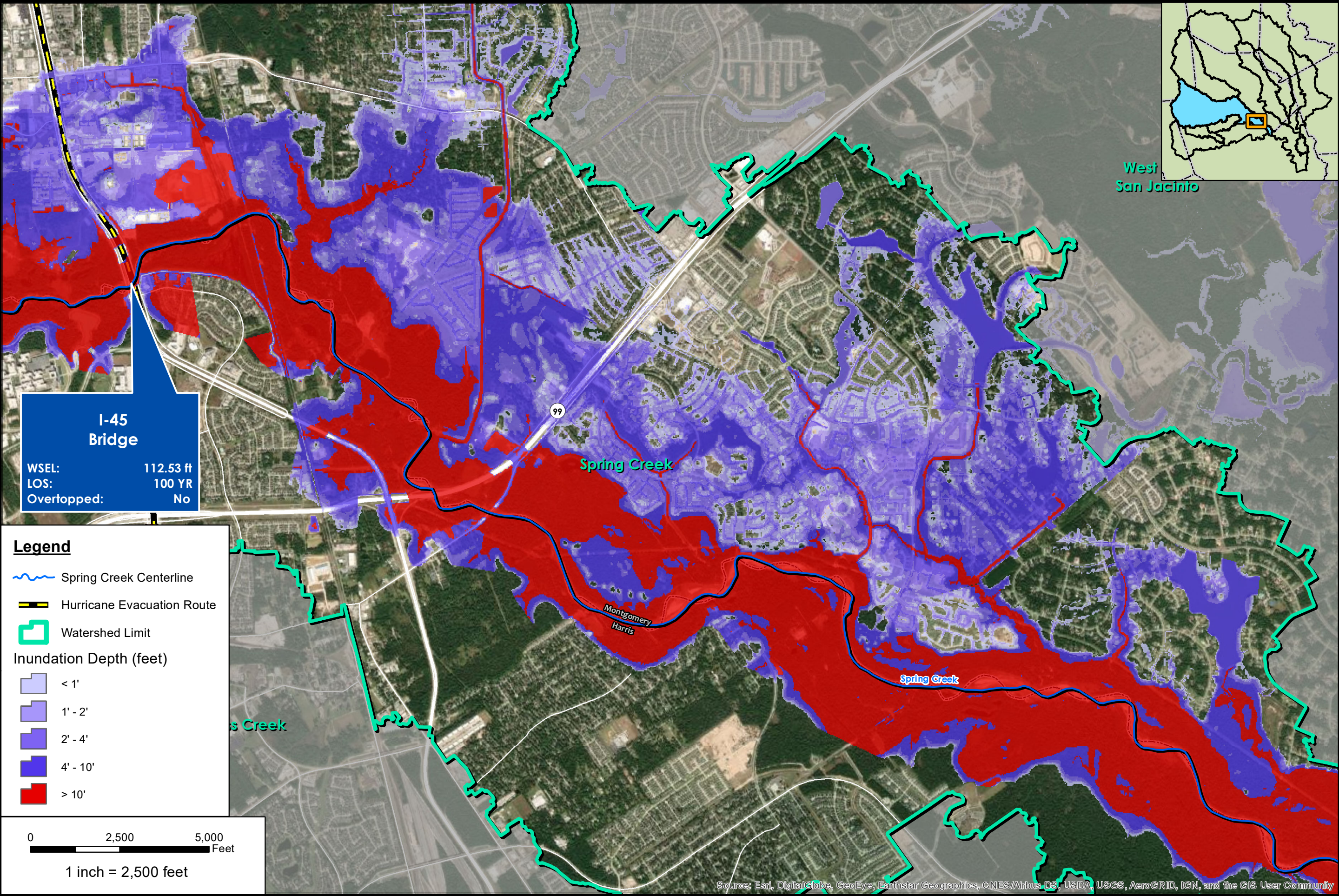
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



PROJECT AVO		33465	
HARRIS COUNTY FLOOD CONTROL DISTRICT		DATUM & COORDINATE SYSTEM	
San Jacinto Regional Watershed Master Drainage Plan		NAD 1983 StatePlane Texas Central FIPS 4203 Feet	
100YR EXISTING CONDITIONS MAP PEACH CREEK			
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		APPENDIX J.2	
		MAP GPC - G	



PROJECT AVO 33465	
DATUM & COORDINATE SYSTEM NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS	
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP SPRING CREEK	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP J100 - A	



I-45 Bridge

WSEL: 112.53 ft
LOS: 100 YR
Overtopped: No

- Legend**
- Spring Creek Centerline
 - Hurricane Evacuation Route
 - Watershed Limit
- Inundation Depth (feet)**
- < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

West
San Jacinto

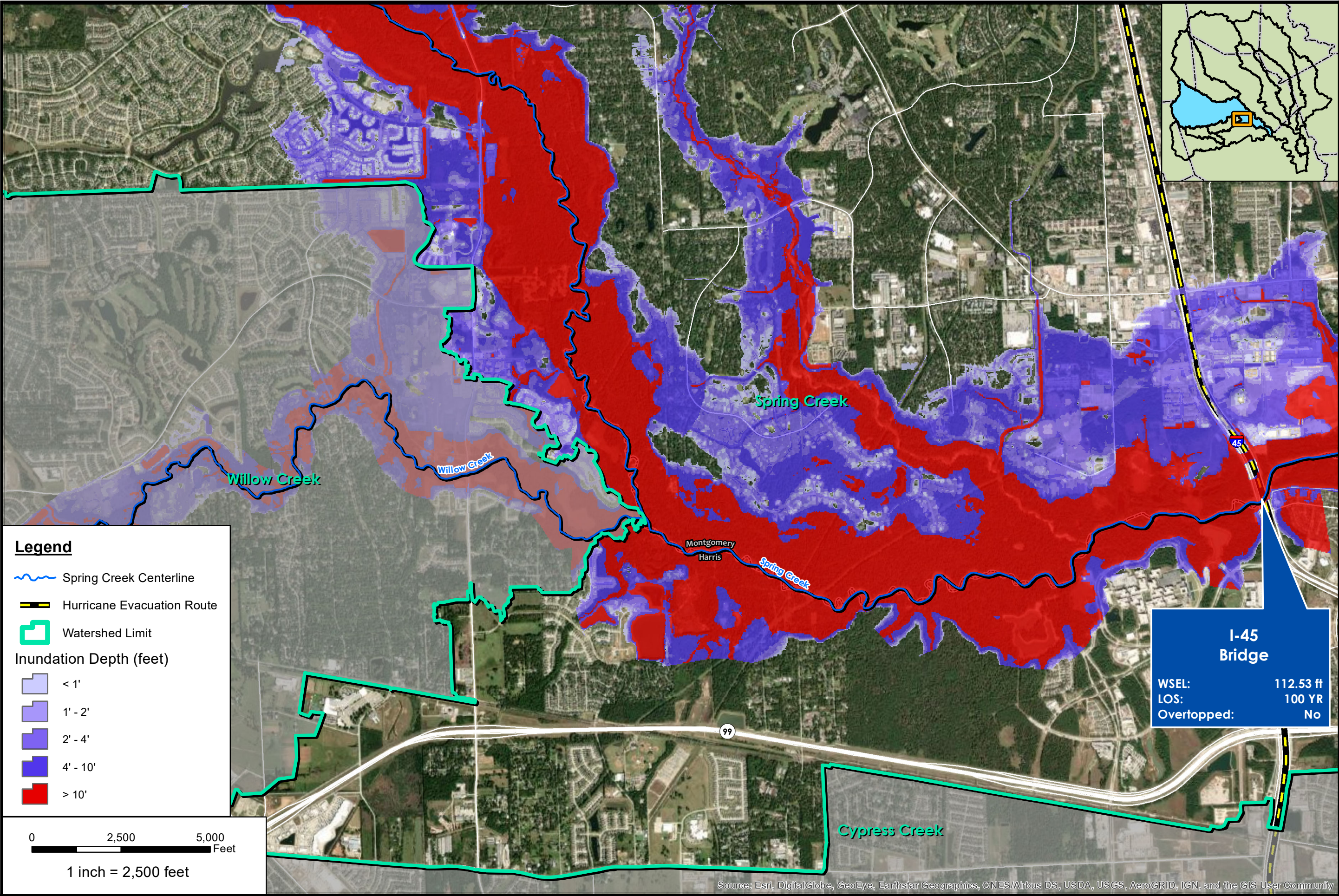
Spring Creek

Montgomery
Harris

Spring Creek

PROJECT AVO 33465	
DATUM & COORDINATE SYSTEM NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS	
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP SPRING CREEK	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP J100 - B	

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

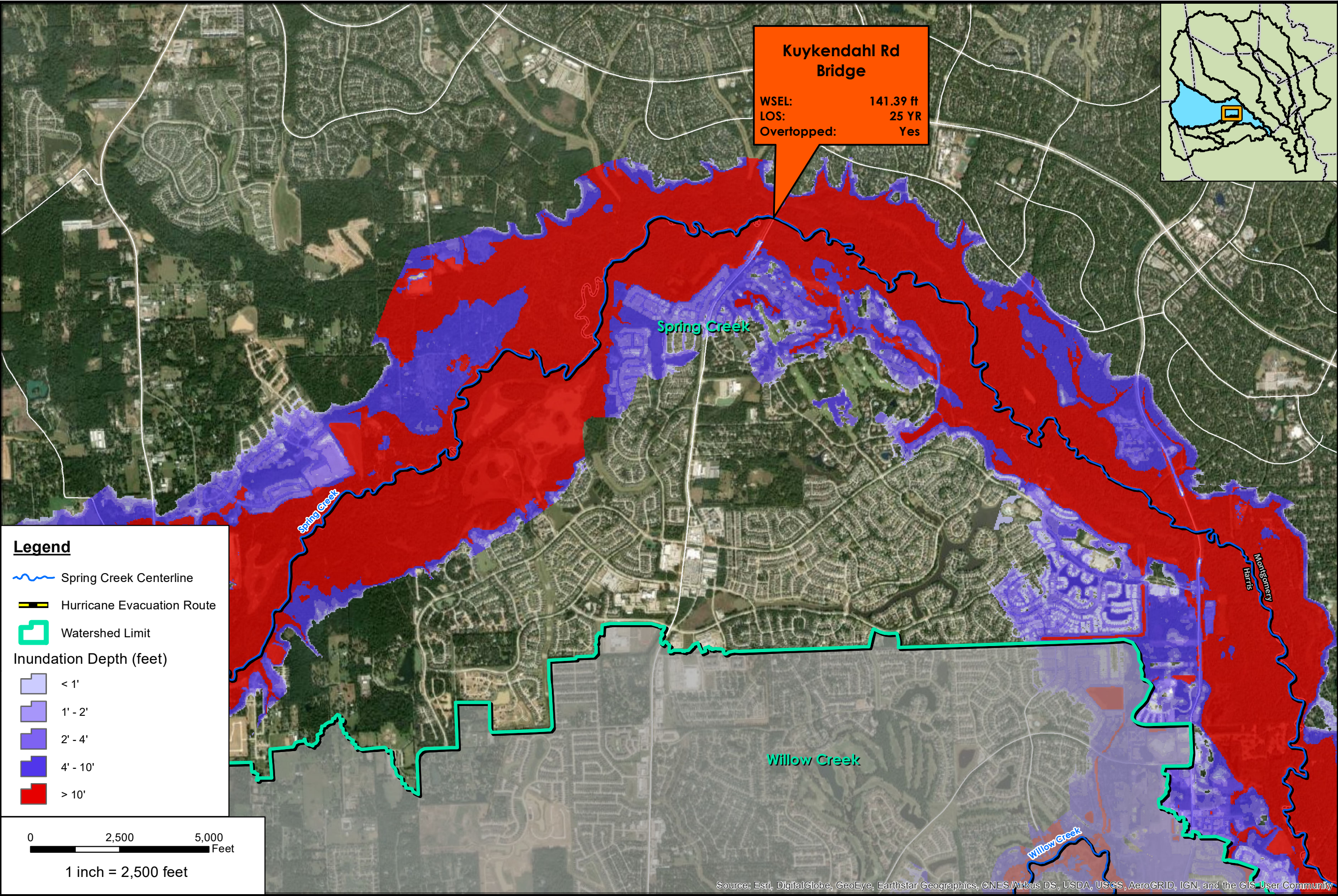
- Spring Creek Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO		33465
DATUM & COORDINATE SYSTEM		NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP SPRING CREEK		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP J100 - C		



Legend

- Spring Creek Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)**
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000 Feet

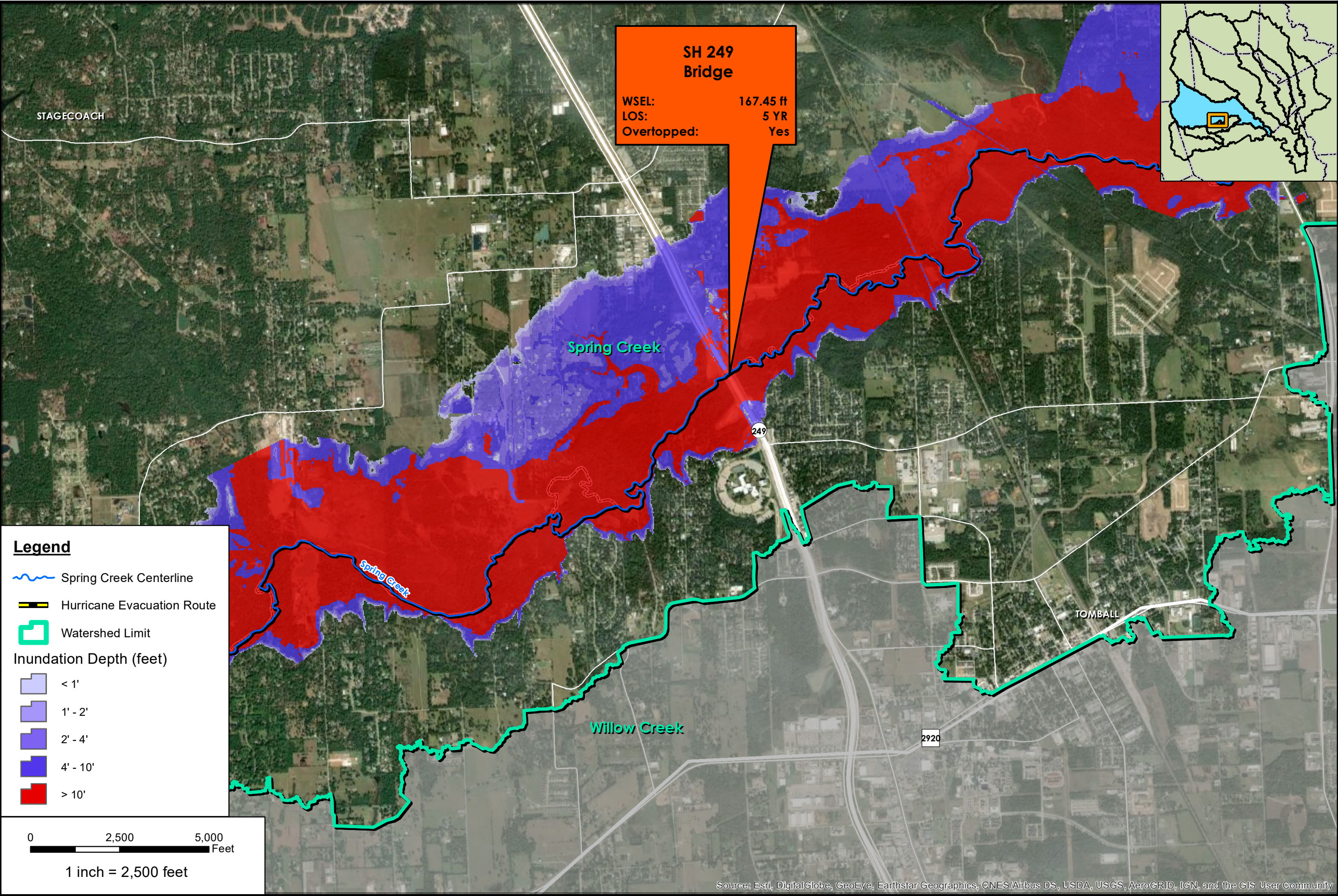
1 inch = 2,500 feet

Kuykendahl Rd Bridge
WSEL: 141.39 ft
LOS: 25 YR
Overtopped: Yes



PROJECT AVO		33465	
HARRIS COUNTY FLOOD CONTROL DISTRICT		DATUM & COORDINATE SYSTEM	
San Jacinto Regional Watershed Master Drainage Plan		NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS	
100YR EXISTING CONDITIONS MAP SPRING CREEK			
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN			
APPENDIX J.2			
MAP J100 - D			

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



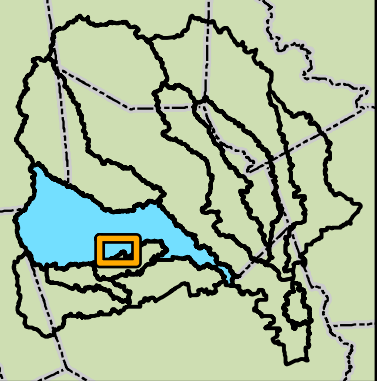
Legend

- Spring Creek Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

**SH 249
Bridge**
WSEL: 167.45 ft
LOS: 5 YR
Overtopped: Yes



PROJECT AVO

33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS

HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

100YR EXISTING CONDITIONS MAP | SPRING CREEK

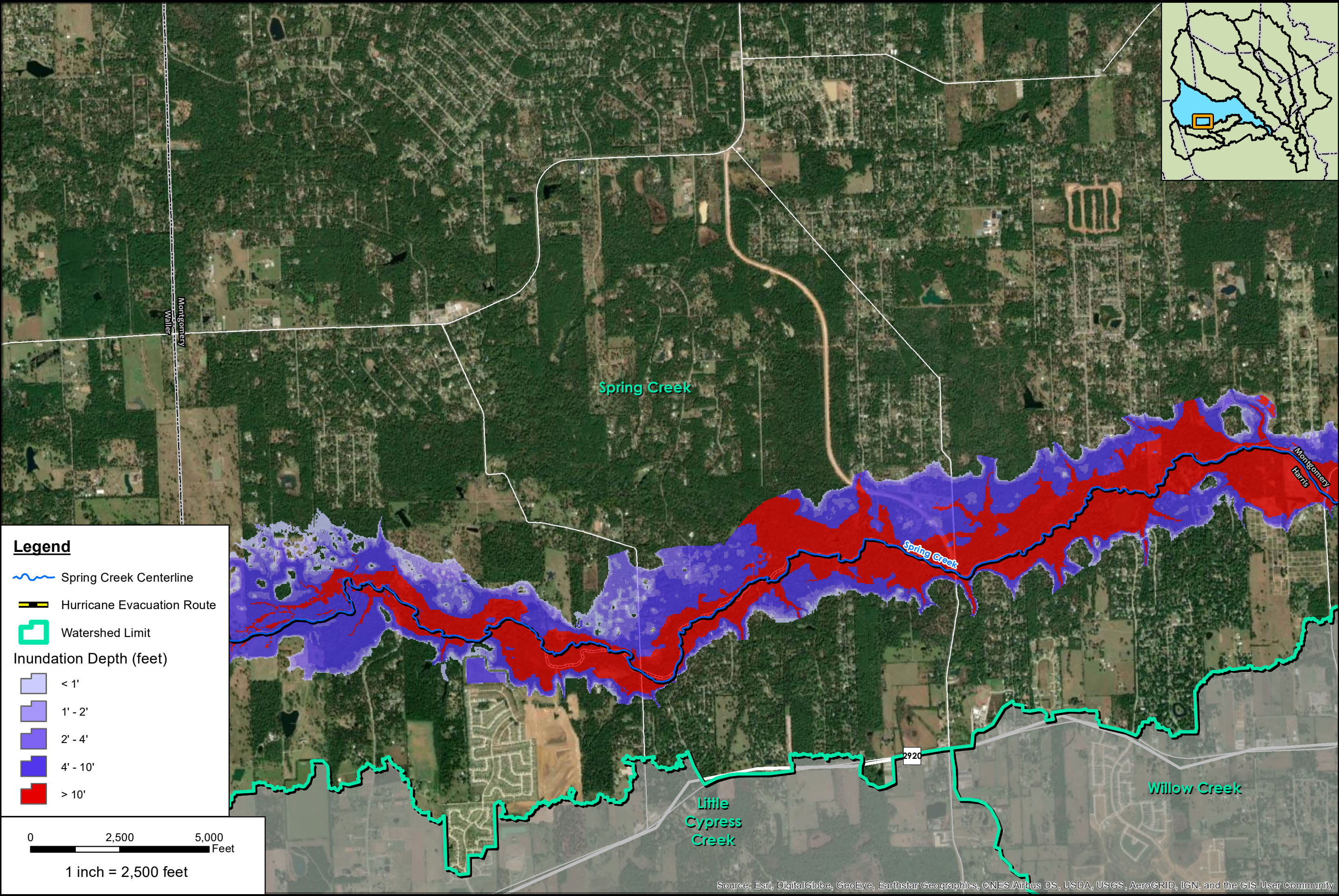
SAN JACINTO

REGIONAL WATERSHED
MASTER DRAINAGE PLAN









APPENDIX
J.2

MAP
J100 - E

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

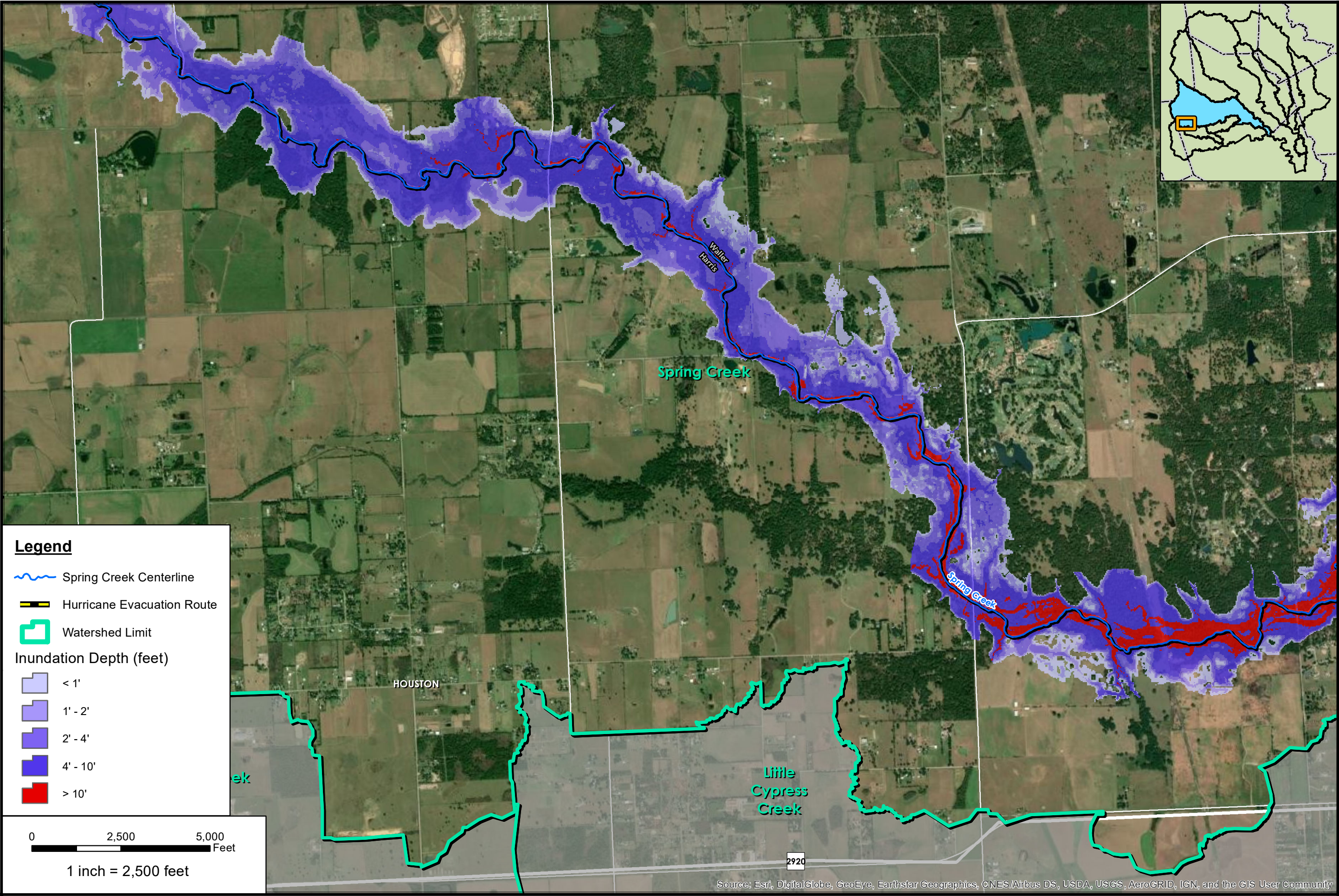
-  Spring Creek Centerline
-  Hurricane Evacuation Route
-  Watershed Limit
- Inundation Depth (feet)
 -  < 1'
 -  1' - 2'
 -  2' - 4'
 -  4' - 10'
 -  > 10'

0 2,500 5,000
Feet

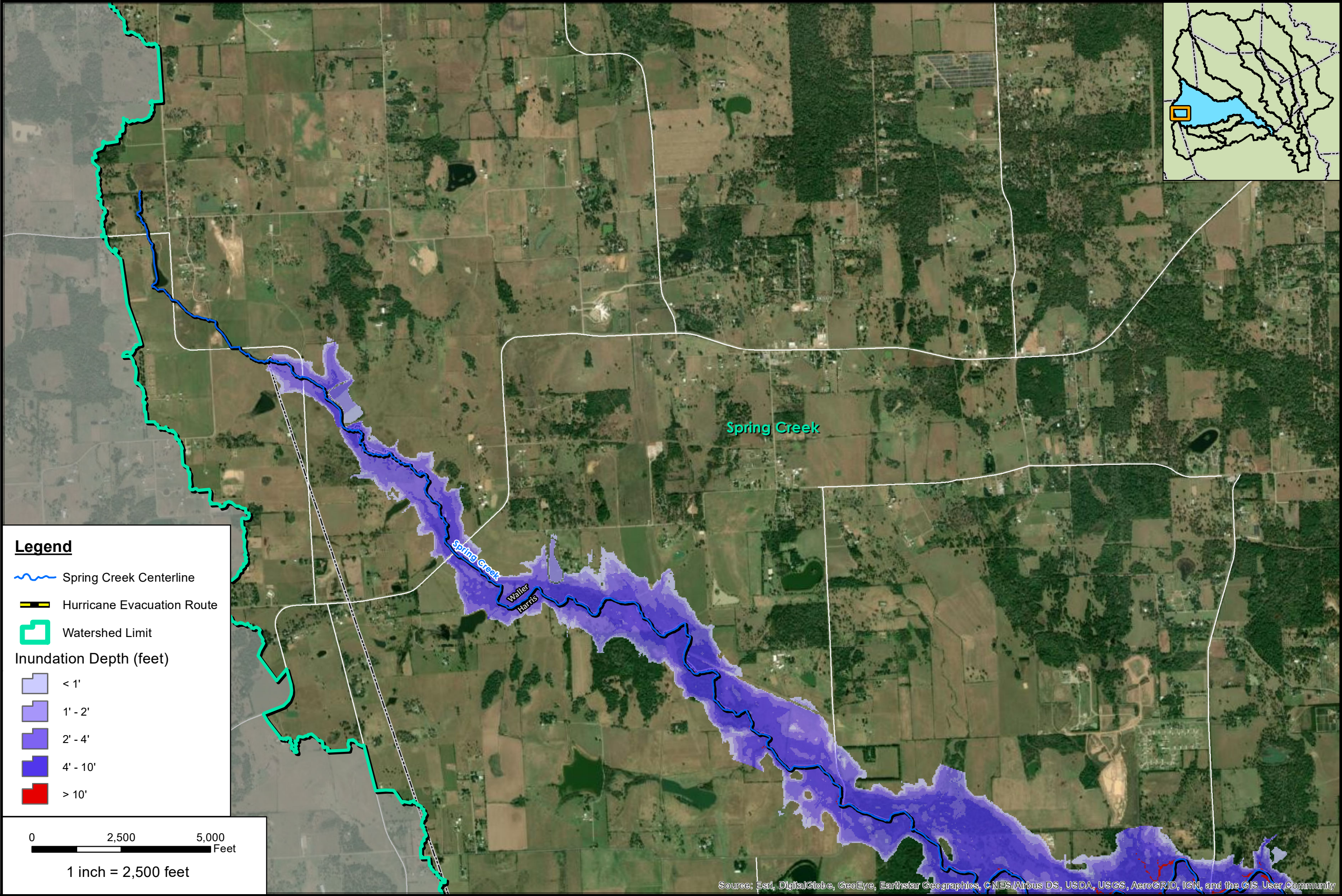
1 inch = 2,500 feet


PROJECT AVO		33465
HARRIS COUNTY FLOOD CONTROL DISTRICT		DATUM & COORDINATE SYSTEM
San Jacinto Regional Watershed Master Drainage Plan		NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS
100YR EXISTING CONDITIONS MAP SPRING CREEK		
APPENDIX J.2		
MAP J100 - F		

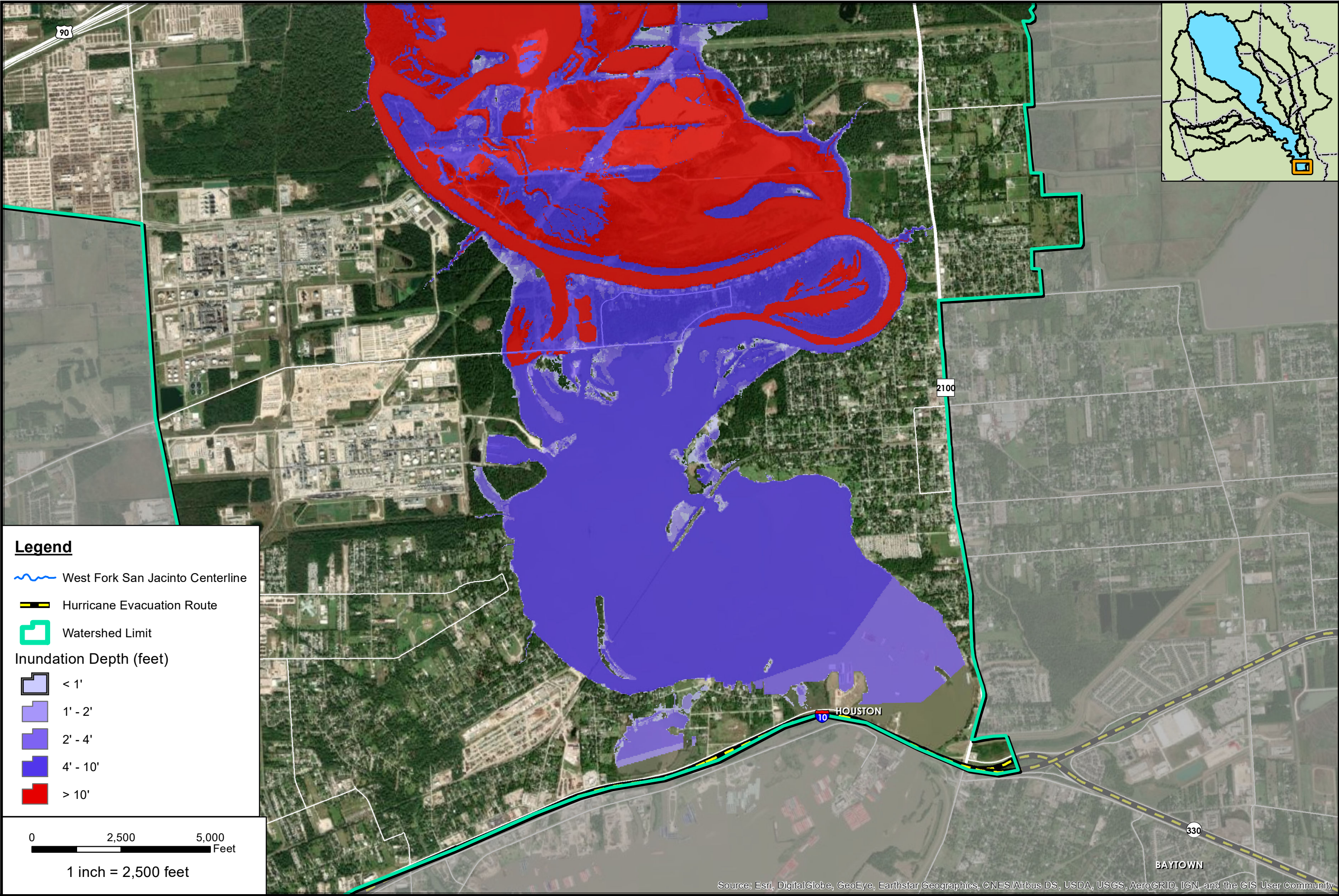
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



	PROJECT AVO	33465
	DATUM & COORDINATE SYSTEM NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS	
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP SPRING CREEK		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP J100 - G		



		PROJECT AVO 33465
HARRIS COUNTY FLOOD CONTROL DISTRICT San Jacinto Regional Watershed Master Drainage Plan		DATUM & COORDINATE SYSTEM <small>NAD 1983 2011 StatePlane Texas South Central FIPS 4204.FUS</small>
100YR EXISTING CONDITIONS MAP SPRING CREEK		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		APPENDIX J.2 MAP J100 - H



Legend

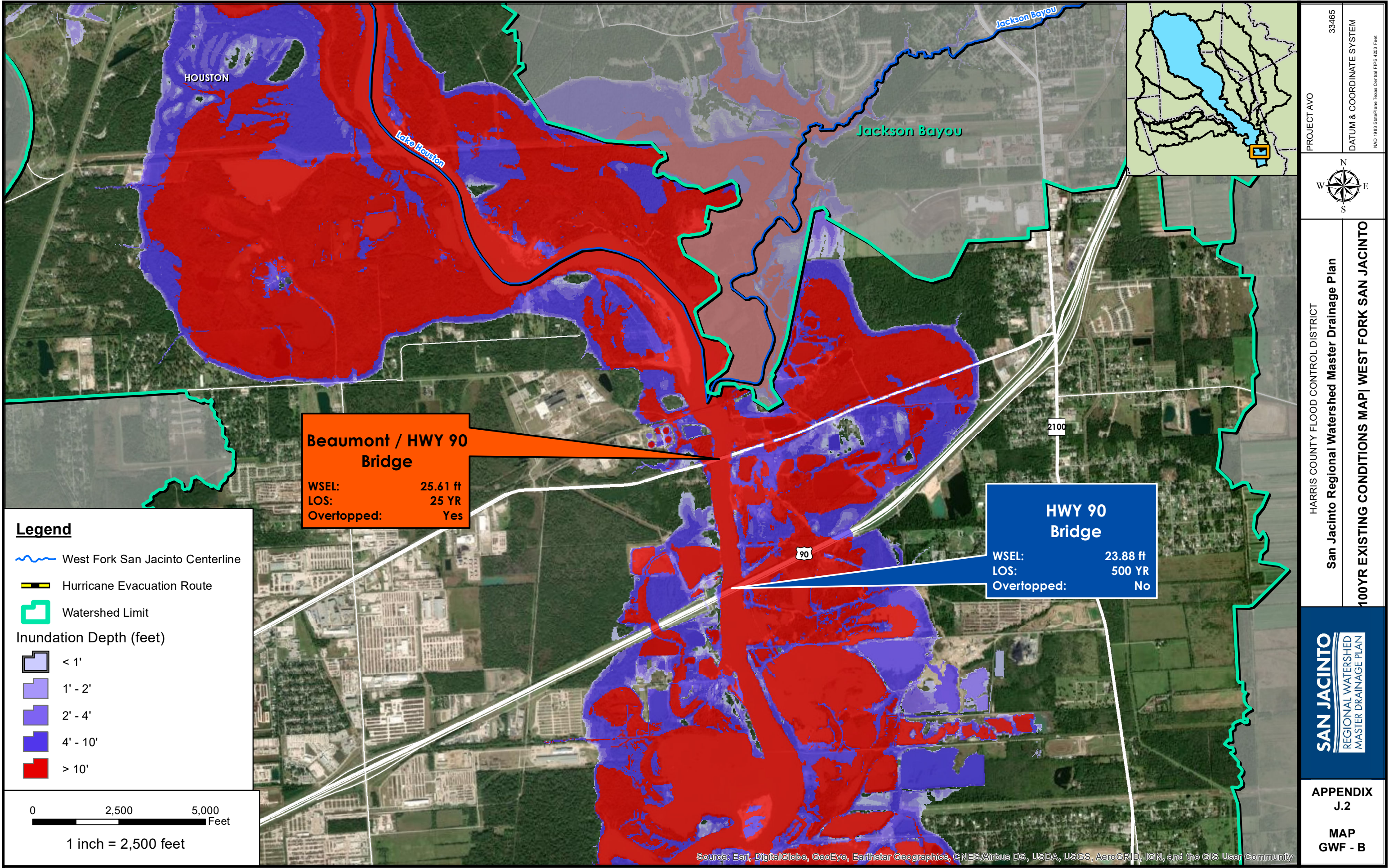
- West Fork San Jacinto Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)**
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

PROJECT AVO 33465	
DATUM & COORDINATE SYSTEM NAD 1983 StatePlane Texas Central FIPS 4203 Feet	
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP WEST FORK SAN JACINTO	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP GWF - A	

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



PROJECT AVO
33465

DATUM & COORDINATE SYSTEM
NAD 1983 StatePlane Texas Central FIPS 4203 Feet

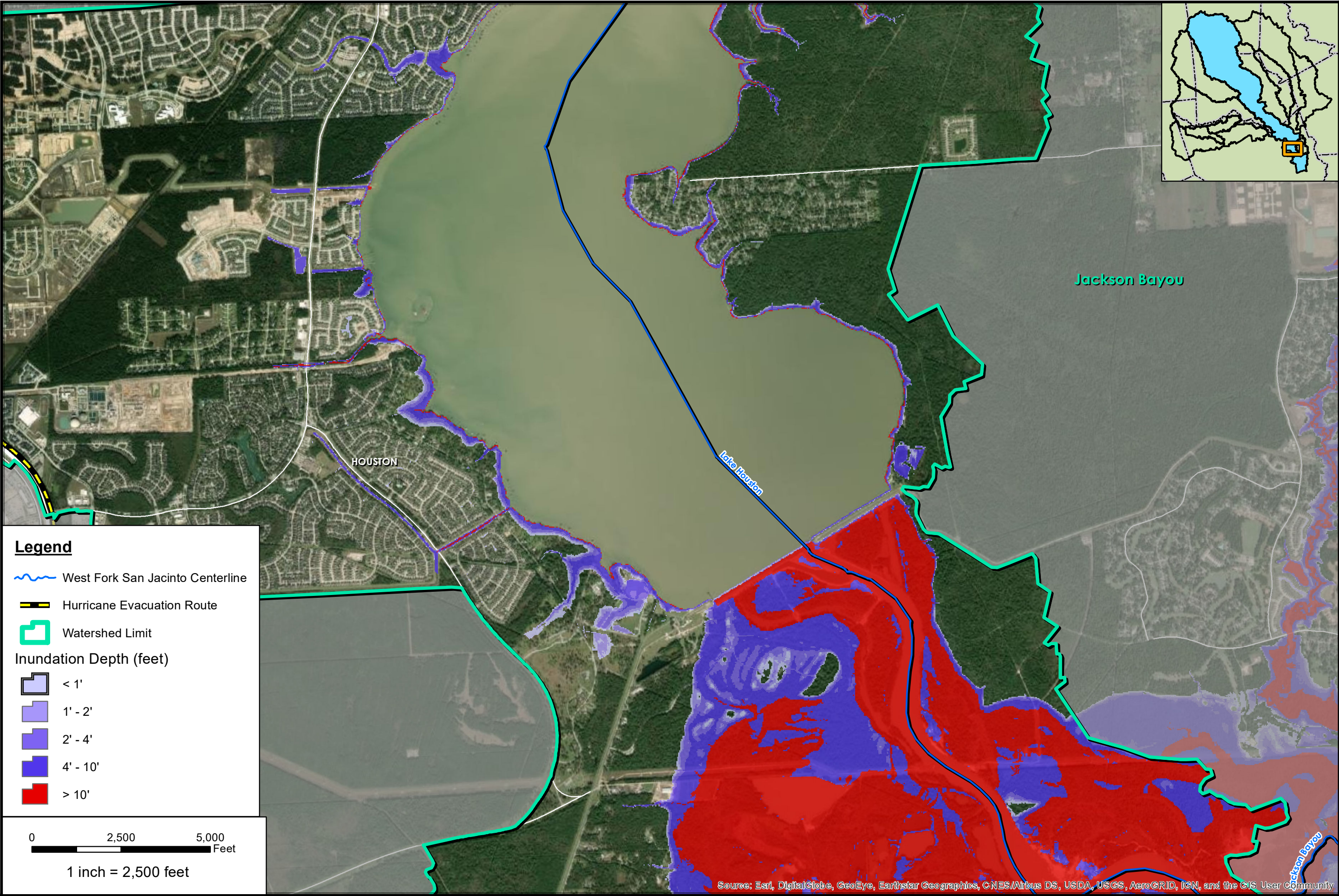
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

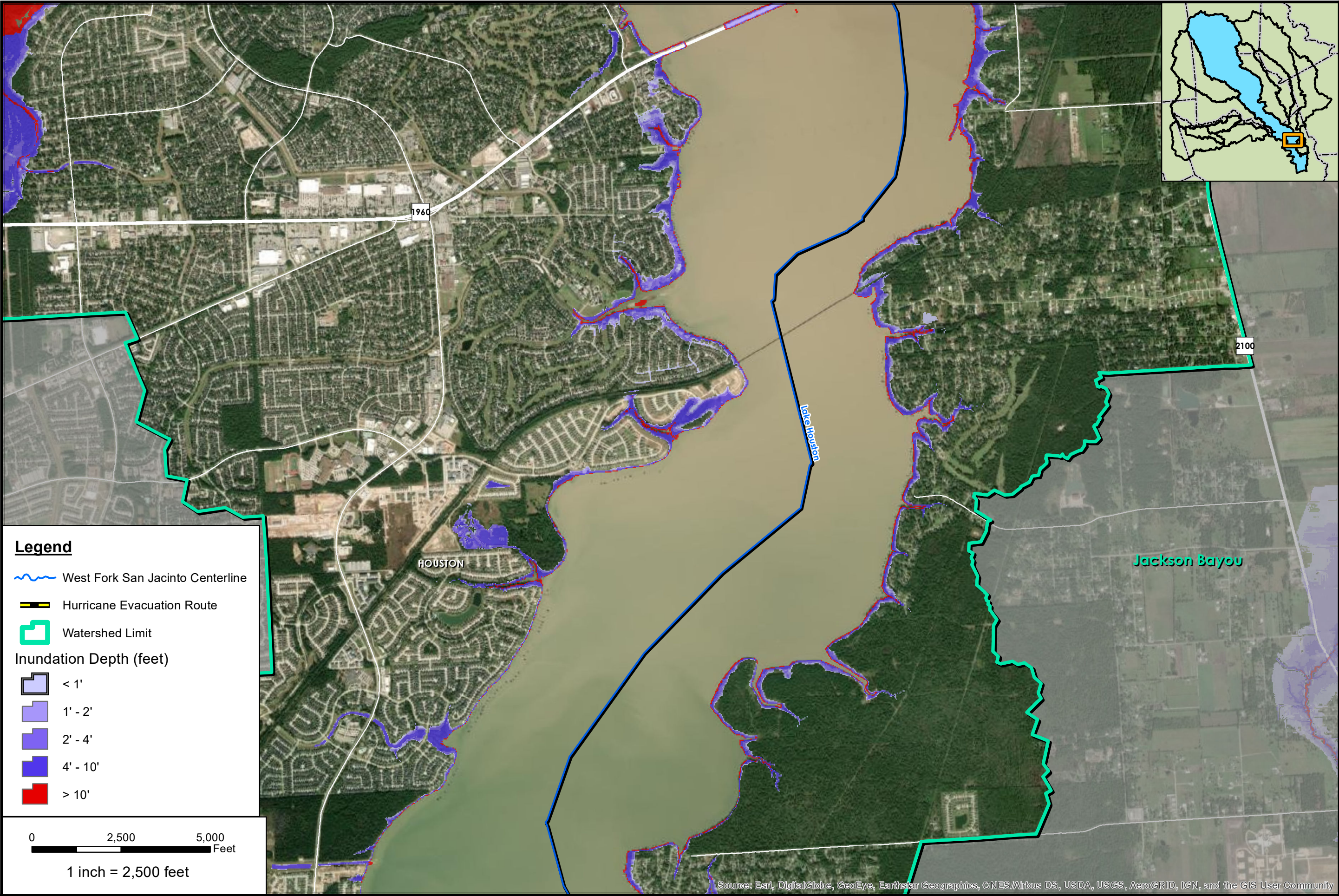
100YR EXISTING CONDITIONS MAP| WEST FORK SAN JACINTO

SAN JACINTO
REGIONAL WATERSHED
MASTER DRAINAGE PLAN

APPENDIX
J.2
MAP
GWF - B



PROJECT AVO		33465
DATUM & COORDINATE SYSTEM		NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP WEST FORK SAN JACINTO		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP GWF - C		



Legend

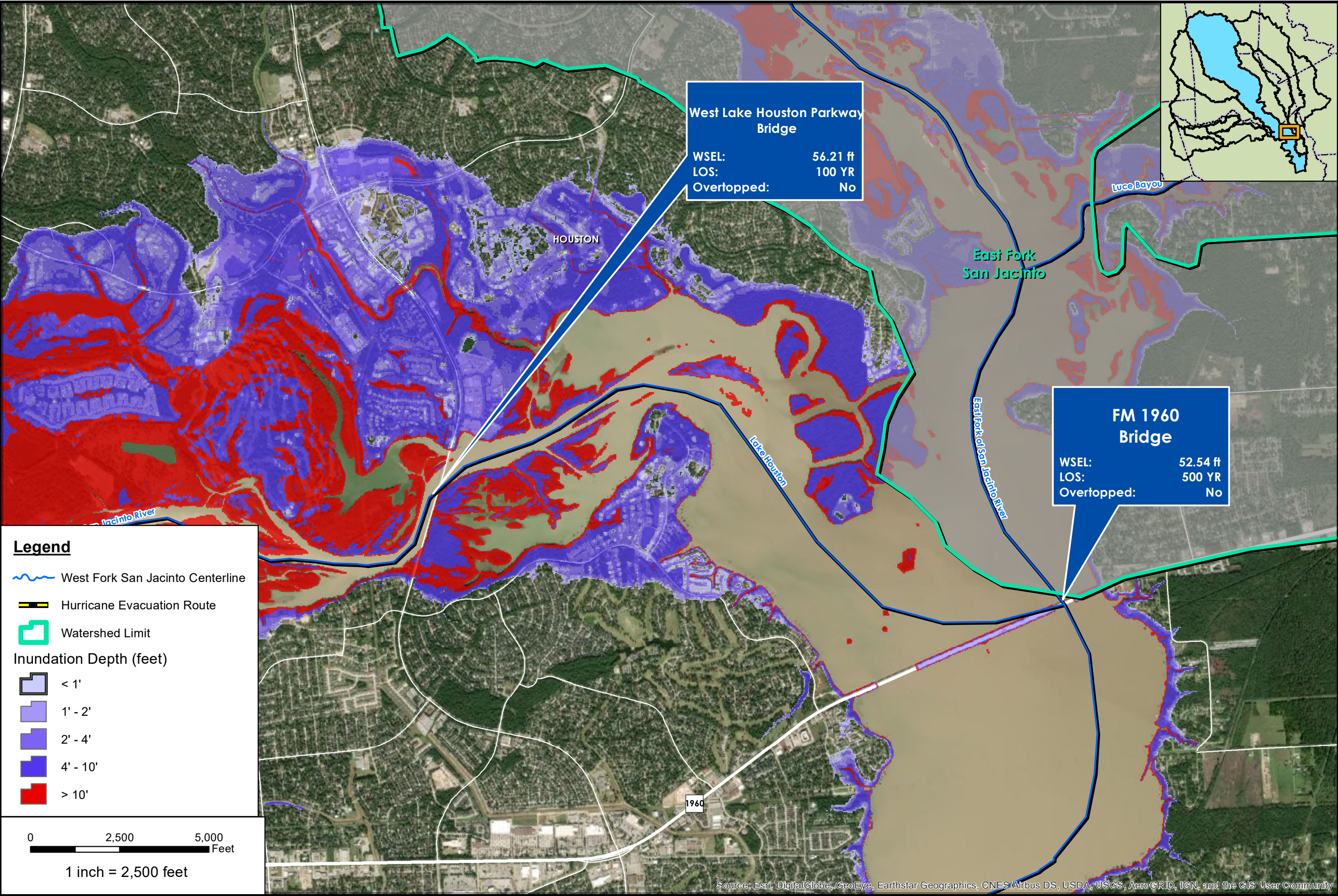
- West Fork San Jacinto Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)**
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

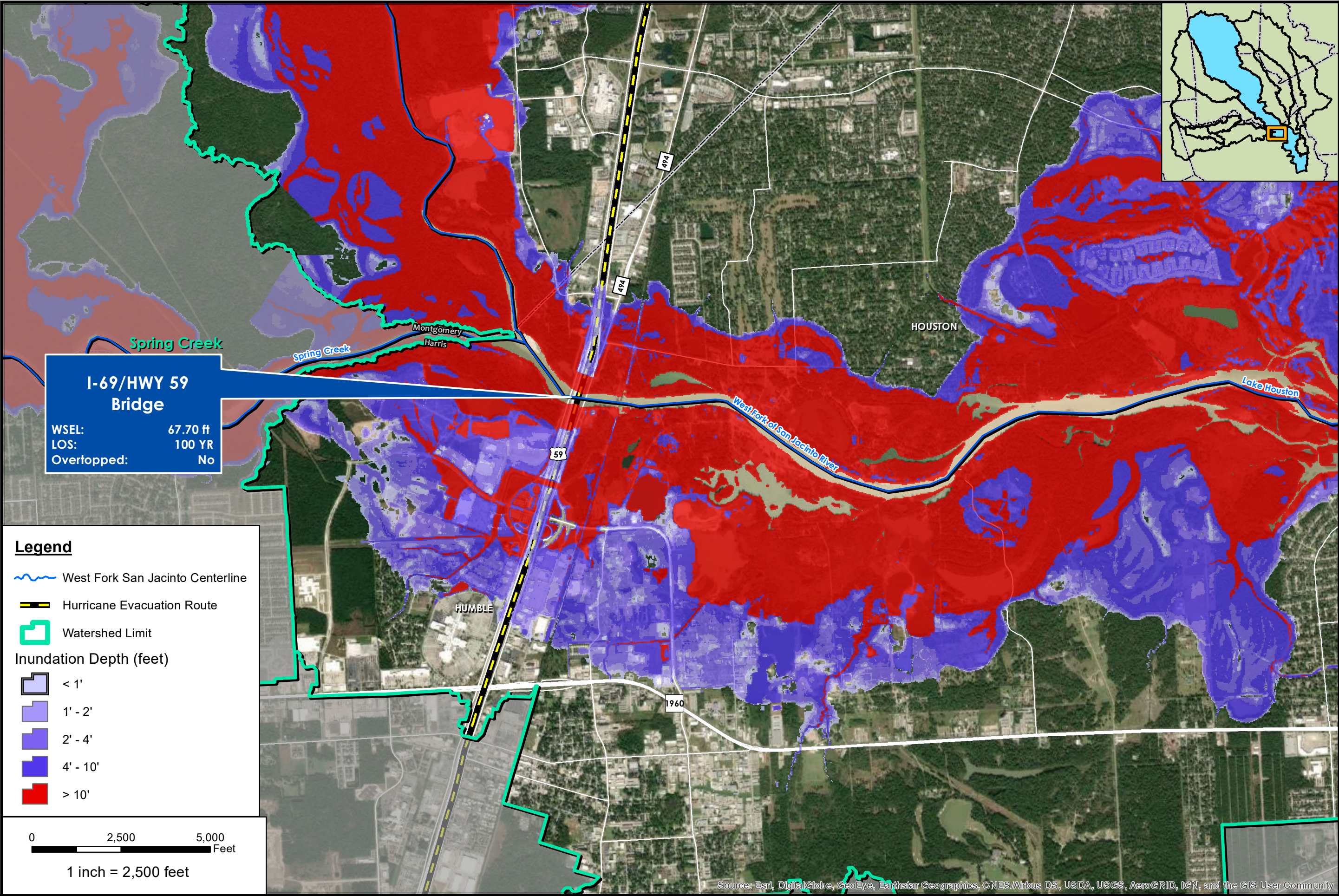
1 inch = 2,500 feet

PROJECT AVO	33465
	DATUM & COORDINATE SYSTEM NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP WEST FORK SAN JACINTO	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP GWF - D	

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



PROJECT AVO		33465
DATUM & COORDINATE SYSTEM		NAD 1983 StatePlane Texas Central FIPS 4203 Feet
		
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP WEST FORK SAN JACINTO		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP GWF - E		



**I-69/Hwy 59
Bridge**

WSEL:	67.70 ft
LOS:	100 YR
Overtopped:	No

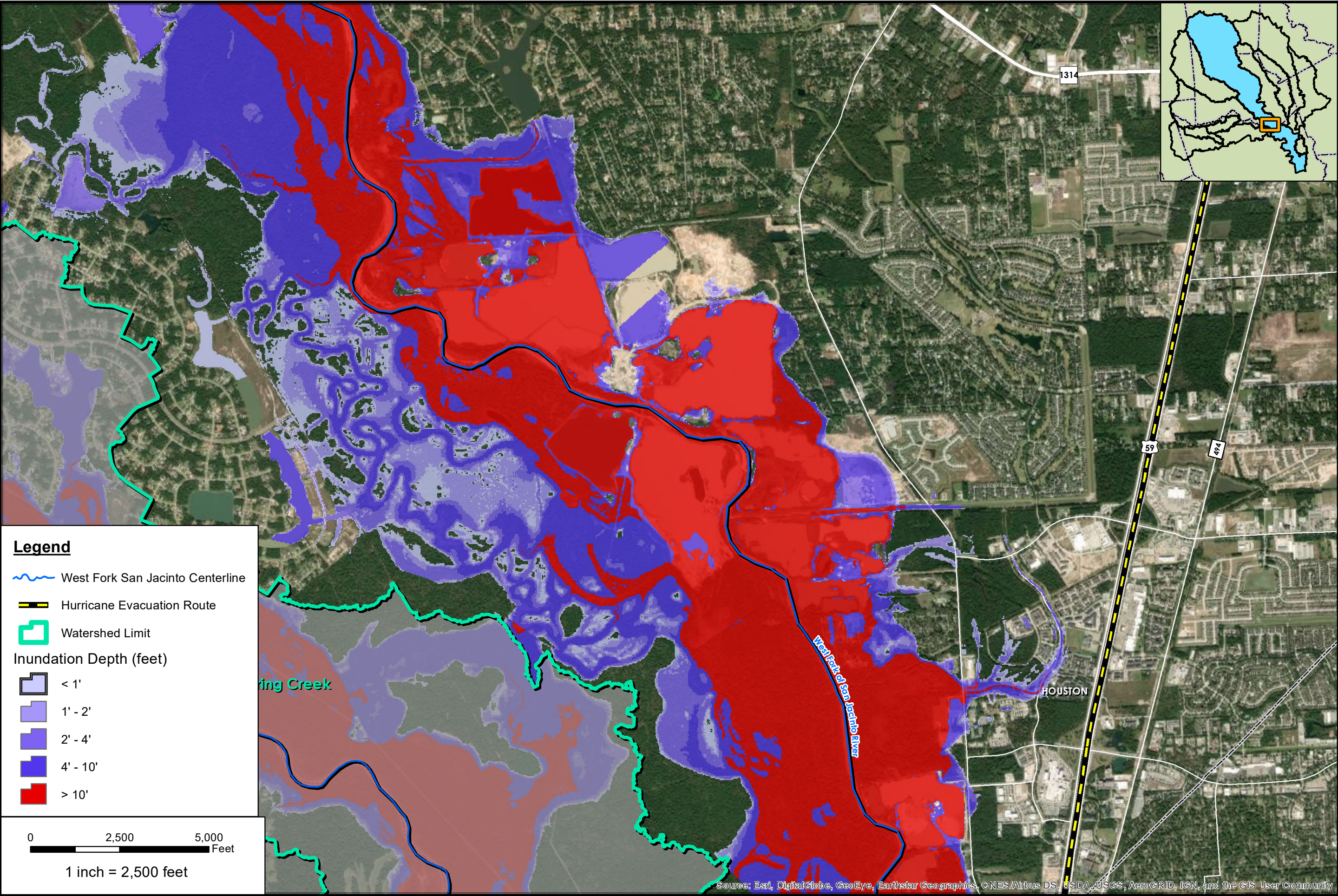
- Legend**
- West Fork San Jacinto Centerline
 - Hurricane Evacuation Route
 - Watershed Limit
- Inundation Depth (feet)**
- < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO	33465
	DATUM & COORDINATE SYSTEM NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT	
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100YR EXISTING CONDITIONS MAP WEST FORK SAN JACINTO	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
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MAP GWF - F	



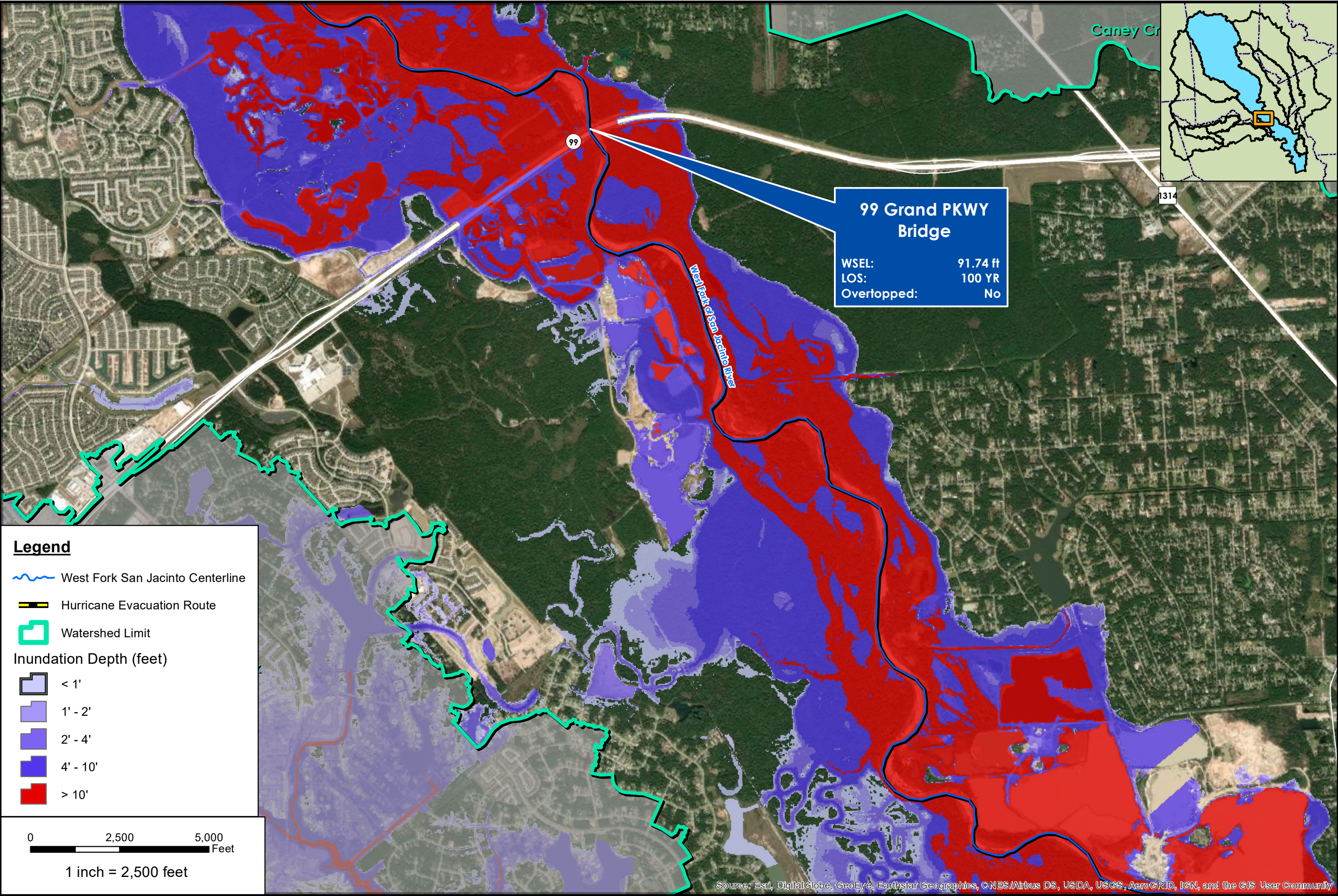
Legend

- West Fork San Jacinto Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)**
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

PROJECT AVO		33465
DATUM & COORDINATE SYSTEM		NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP WEST FORK SAN JACINTO		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP GWF - G		



**99 Grand PKWY
Bridge**

WSEL: 91.74 ft
LOS: 100 YR
Overtopped: No

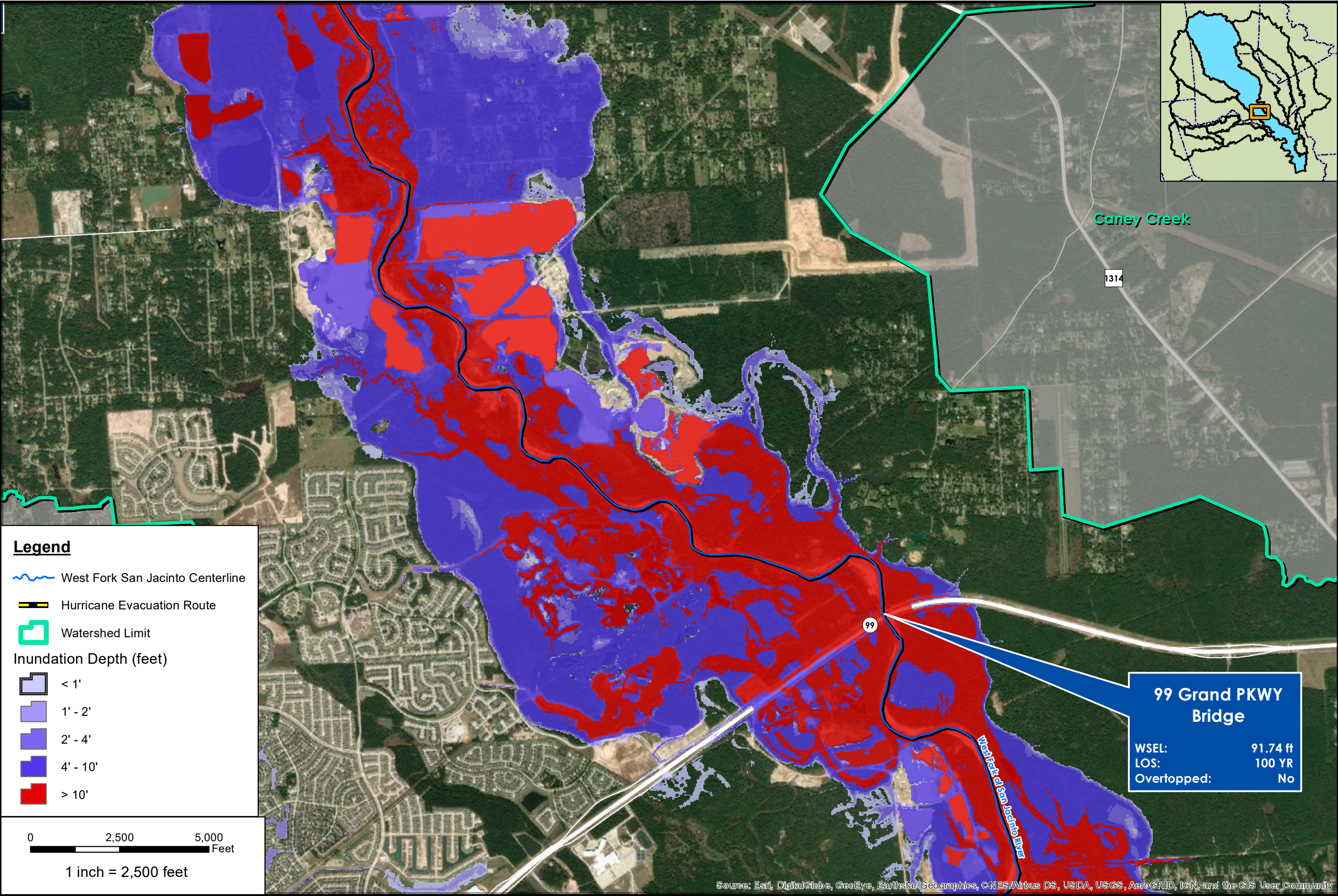
- Legend**
- West Fork San Jacinto Centerline
 - Hurricane Evacuation Route
 - Watershed Limit
 - Inundation Depth (feet)
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO	33465
	DATUM & COORDINATE SYSTEM NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP WEST FORK SAN JACINTO	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP GWF - H	



Legend

- West Fork San Jacinto Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

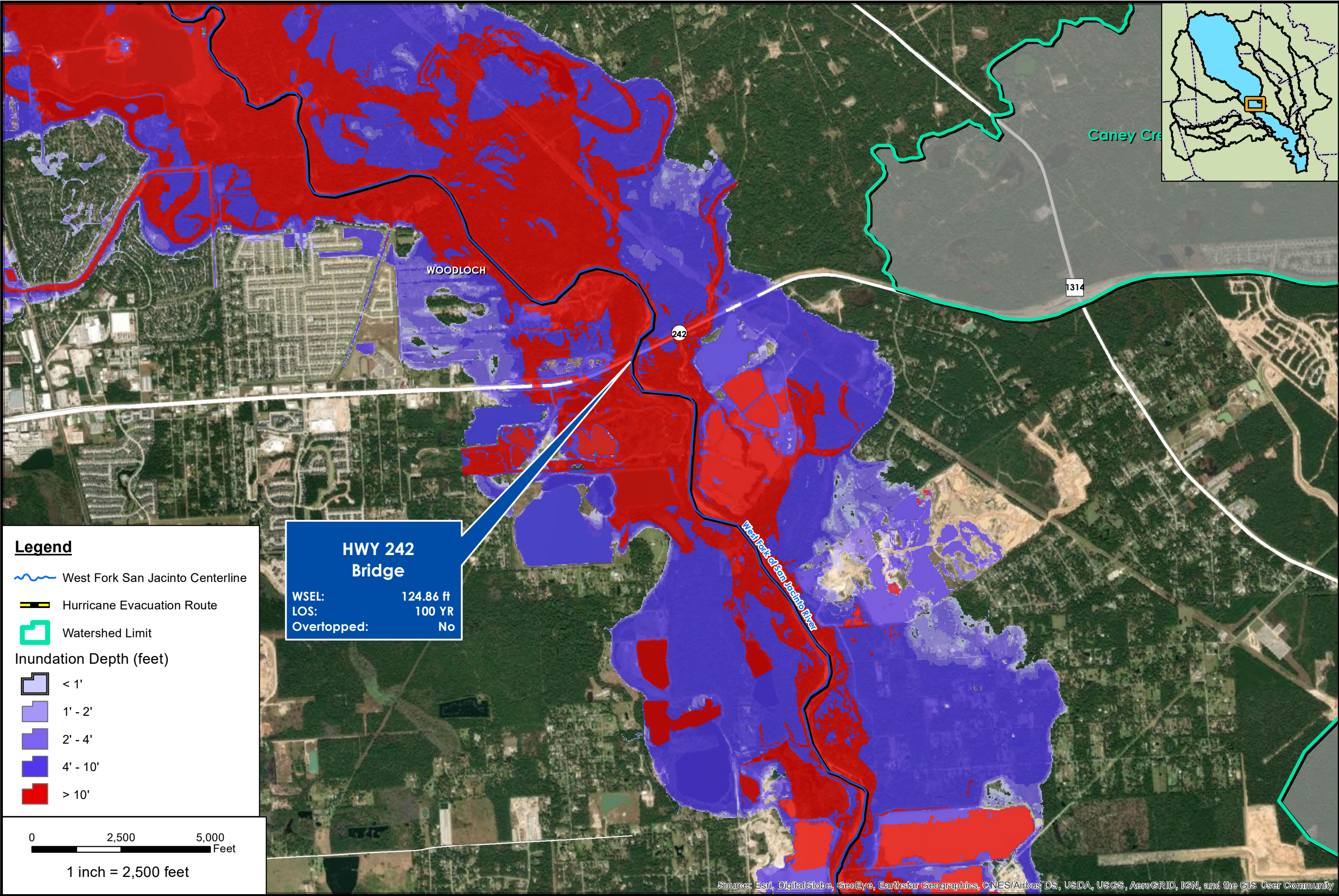
0 2,500 5,000 Feet

1 inch = 2,500 feet

99 Grand PKWY Bridge

WSEL: 91.74 ft
LOS: 100 YR
Overtopped: No

PROJECT AVO		33465
DATUM & COORDINATE SYSTEM		NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP WEST FORK SAN JACINTO		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP GWF - I		



Legend

- West Fork San Jacinto Centerline
- Hurricane Evacuation Route
- Watershed Limit

Inundation Depth (feet)

- < 1'
- 1' - 2'
- 2' - 4'
- 4' - 10'
- > 10'

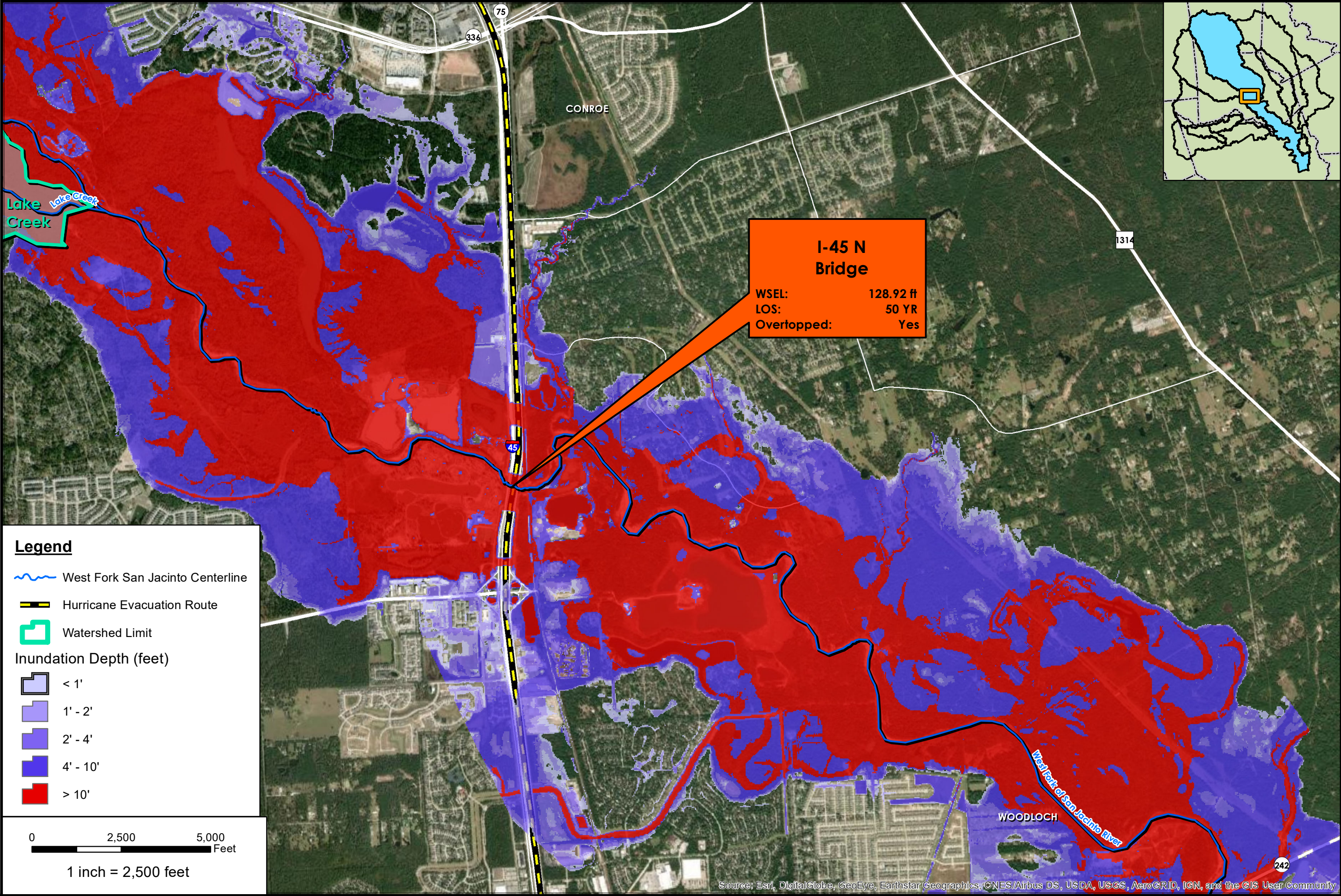
0 2,500 5,000
Feet

1 inch = 2,500 feet

**HWY 242
Bridge**

WSEL: 124.86 ft
LOS: 100 YR
Overtopped: No

PROJECT AVO	33465
	DATUM & COORDINATE SYSTEM NAD 1983 StatePlane Texas Central FIPS 4203 Feet
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP WEST FORK SAN JACINTO	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP GWF - J	



Legend

- West Fork San Jacinto Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000 Feet

1 inch = 2,500 feet



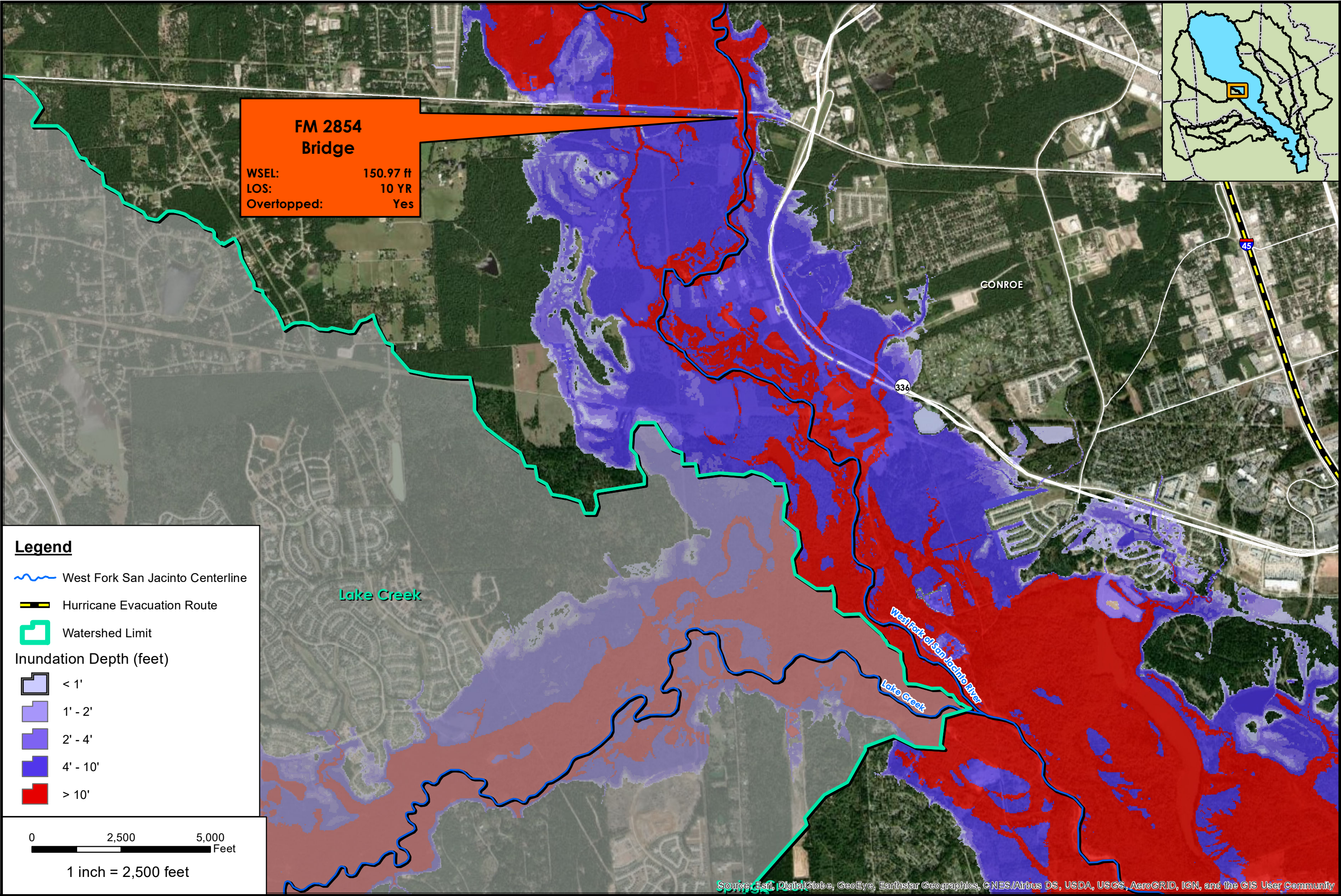
PROJECT AVO	33465
DATUM & COORDINATE SYSTEM	NAD 1983 StatePlane Texas Central FIPS 4203 Feet



HARRIS COUNTY FLOOD CONTROL DISTRICT
San Jacinto Regional Watershed Master Drainage Plan
100YR EXISTING CONDITIONS MAP WEST FORK SAN JACINTO

SAN JACINTO
REGIONAL WATERSHED MASTER DRAINAGE PLAN

APPENDIX J.2
MAP GWF - K



**FM 2854
Bridge**

WSEL: 150.97 ft
LOS: 10 YR
Overtopped: Yes

Legend

West Fork San Jacinto Centerline

Hurricane Evacuation Route

Watershed Limit

Inundation Depth (feet)

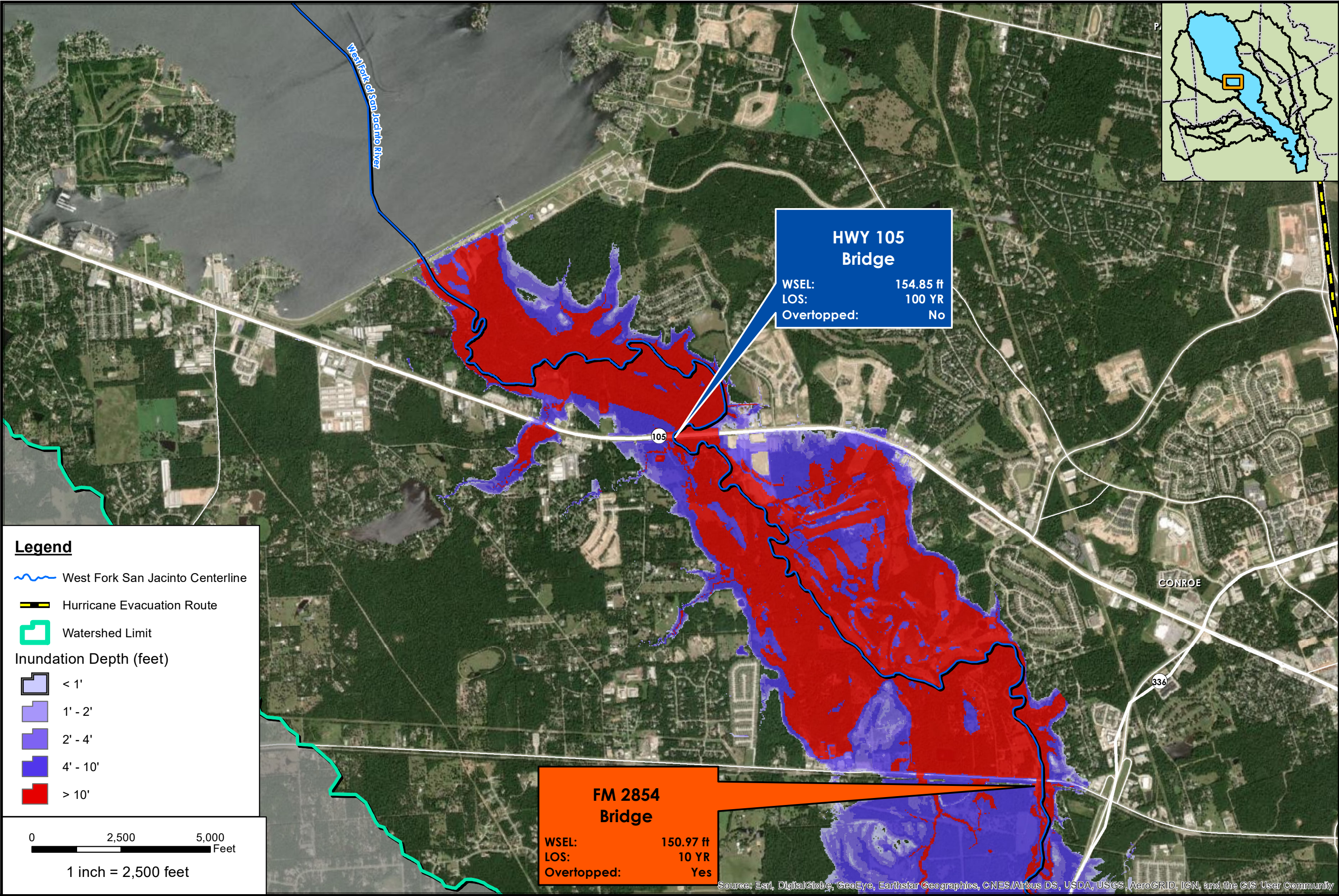
- < 1'
- 1' - 2'
- 2' - 4'
- 4' - 10'
- > 10'

0 2,500 5,000
Feet

1 inch = 2,500 feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO	33465
DATUM & COORDINATE SYSTEM	
NAD 1983 StatePlane Texas Central FIPS 4203 Feet	
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP WEST FORK SAN JACINTO	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP GWF - L	



Legend

West Fork San Jacinto Centerline

Hurricane Evacuation Route

Watershed Limit

Inundation Depth (feet)

- < 1'
- 1' - 2'
- 2' - 4'
- 4' - 10'
- > 10'

0 2,500 5,000 Feet

1 inch = 2,500 feet

**HWY 105
Bridge**

WSEL: 154.85 ft
LOS: 100 YR
Overtopped: No

**FM 2854
Bridge**

WSEL: 150.97 ft
LOS: 10 YR
Overtopped: Yes

PROJECT AVO

33465

DATUM & COORDINATE SYSTEM

NAD 1983 StatePlane Texas Central FIPS 4203 Feet

HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

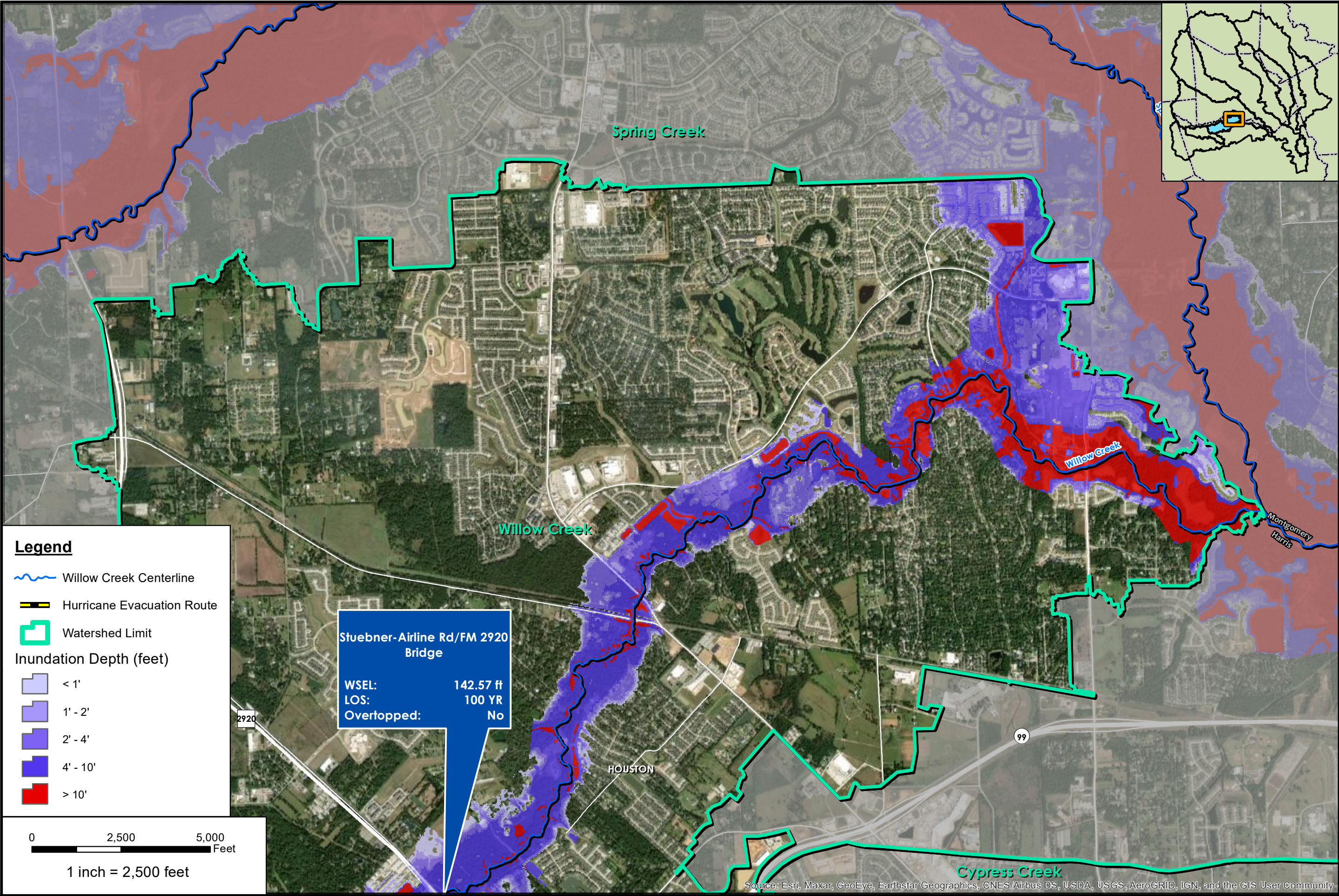
100YR EXISTING CONDITIONS MAP| WEST FORK SAN JACINTO

SAN JACINTO

REGIONAL WATERSHED
MASTER DRAINAGE PLAN

APPENDIX
J.2

MAP
GWF - M



Legend

- Willow Creek Centerline
- Hurricane Evacuation Route
- Watershed Limit
- Inundation Depth (feet)
 - < 1'
 - 1' - 2'
 - 2' - 4'
 - 4' - 10'
 - > 10'

0 2,500 5,000 Feet

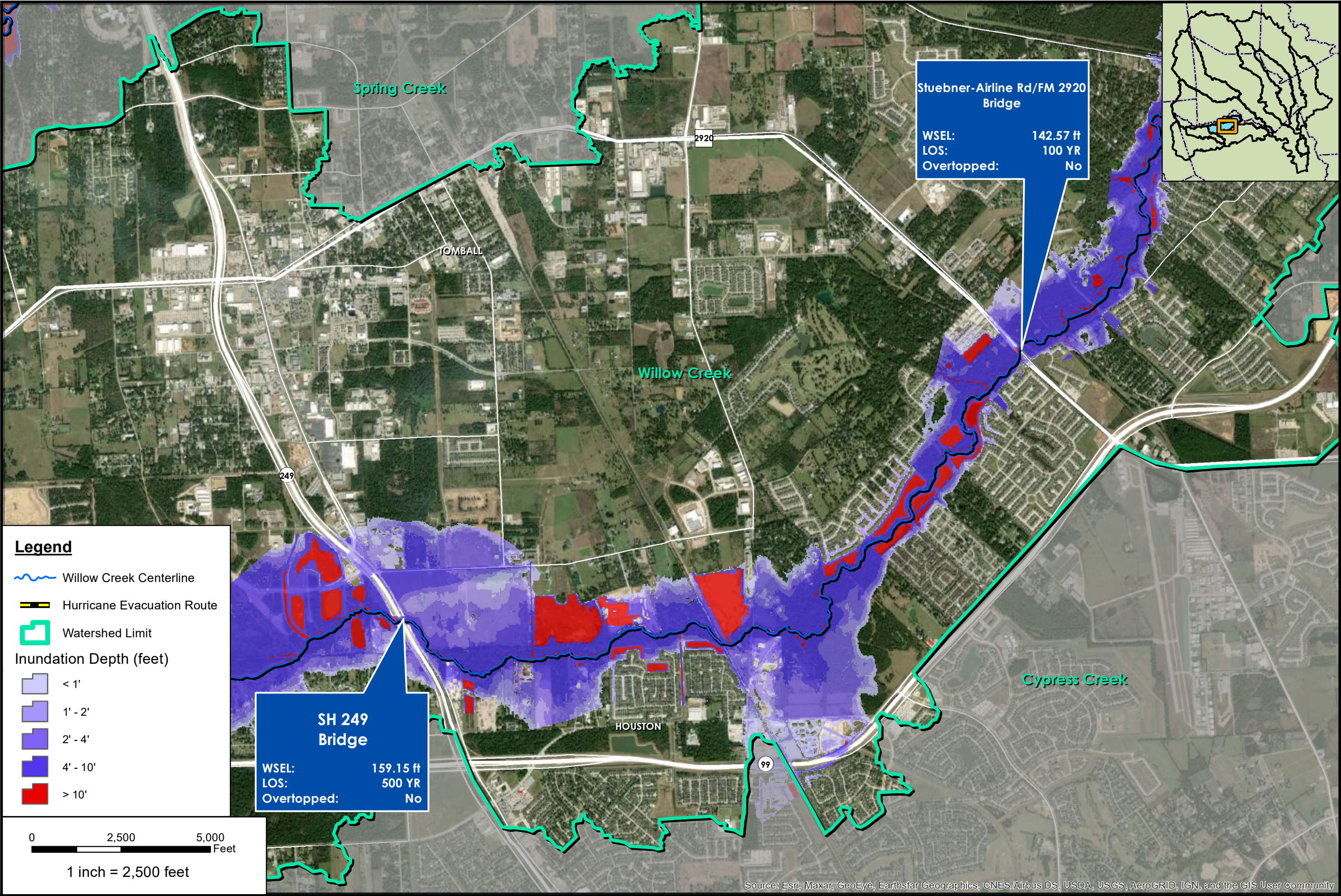
1 inch = 2,500 feet

Stuebner-Airline Rd/FM 2920 Bridge

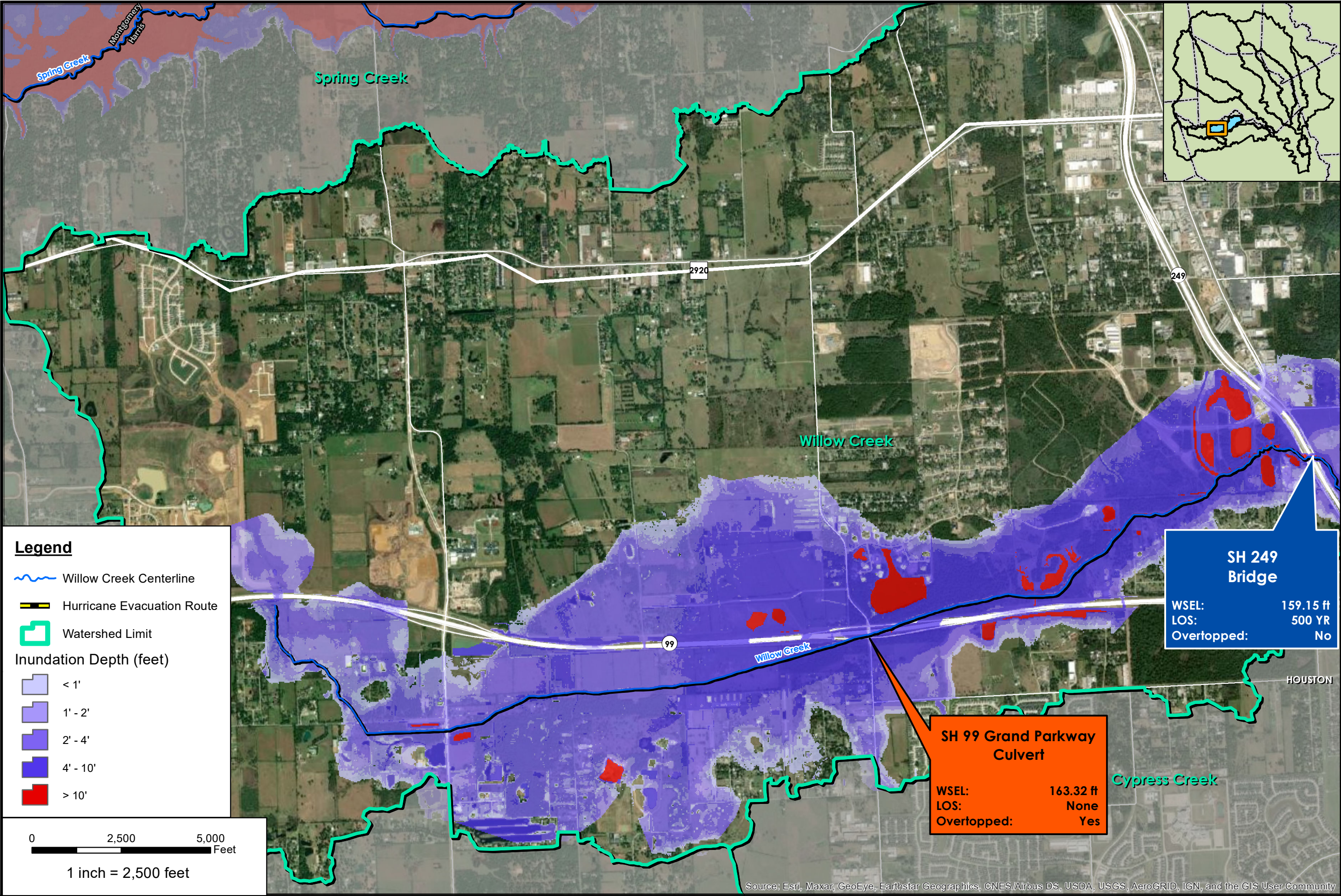
WSEL: 142.57 ft
LOS: 100 YR
Overtopped: No

PROJECT AVO		33465
DATUM & COORDINATE SYSTEM		NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS
HARRIS COUNTY FLOOD CONTROL DISTRICT		
San Jacinto Regional Watershed Master Drainage Plan		
100YR EXISTING CONDITIONS MAP WILLOW CREEK		
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN		
APPENDIX J.2		
MAP M100 - A		

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



PROJECT AVO 33465	
DATUM & COORDINATE SYSTEM NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS	
HARRIS COUNTY FLOOD CONTROL DISTRICT	
San Jacinto Regional Watershed Master Drainage Plan	
100YR EXISTING CONDITIONS MAP WILLOW CREEK	
SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN	
APPENDIX J.2	
MAP M100 - B	



PROJECT AVO
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DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas South Central FIPS 4204 FUS

HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

100YR EXISTING CONDITIONS MAP | WILLOW CREEK

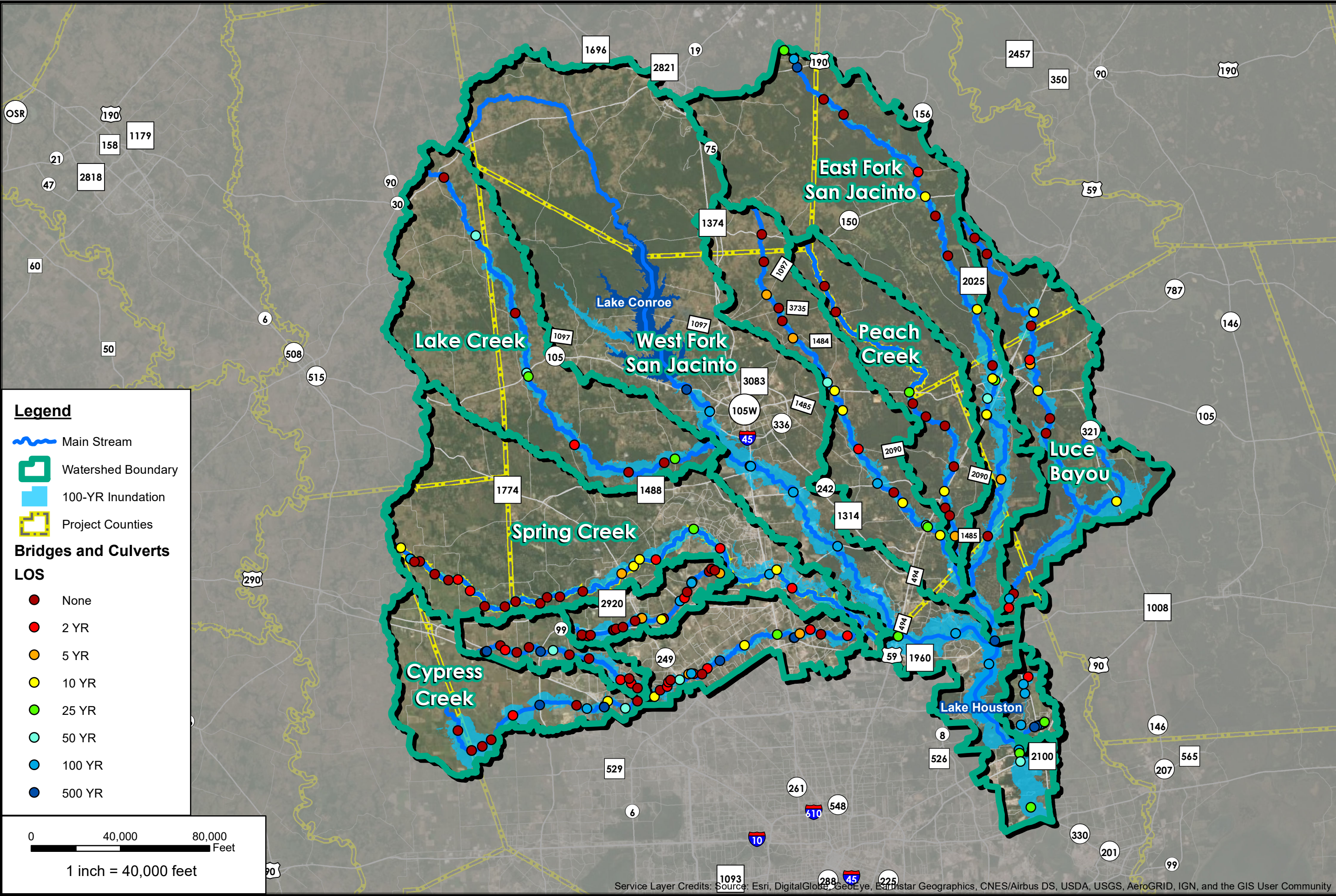
SAN JACINTO
REGIONAL WATERSHED
MASTER DRAINAGE PLAN

APPENDIX
J.2

MAP
M100 - C

Appendix J.3

Roadway Level of Service



Legend

- Main Stream
- Watershed Boundary
- 100-YR Inundation
- Project Counties

Bridges and Culverts

LOS

- None
- 2 YR
- 5 YR
- 10 YR
- 25 YR
- 50 YR
- 100 YR
- 500 YR

0 40,000 80,000 Feet

1 inch = 40,000 feet

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO

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HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

DATE & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas Central FIPS 4203 PLUS

N

W

E

S

SAN JACINTO

REGIONAL WATERSHED

MASTER DRAINAGE PLAN

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J.3

MAP

INDEX



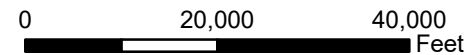
Legend

- Main Stream
- Watershed Boundary
- 100-YR Inundation
- Project Counties

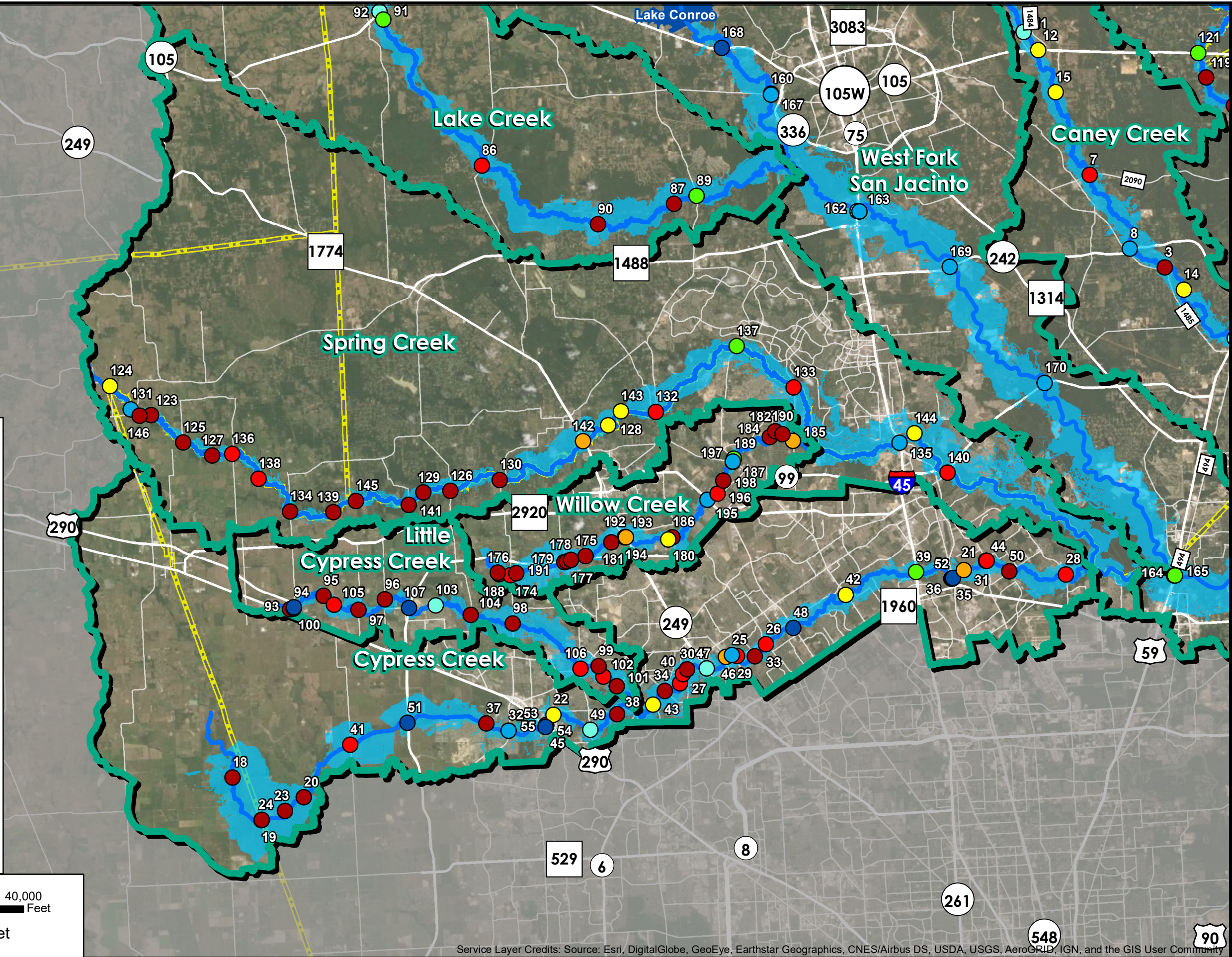
Bridges and Culverts

LOS

- None
- 2 YR
- 5 YR
- 10 YR
- 25 YR
- 50 YR
- 100 YR
- 500 YR



1 inch = 20,000 feet



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO

33465

DATUM & COORDINATE SYSTEM

NAD 1983 2011 StatePlane Texas Central FIPS 4203 PLUS

HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

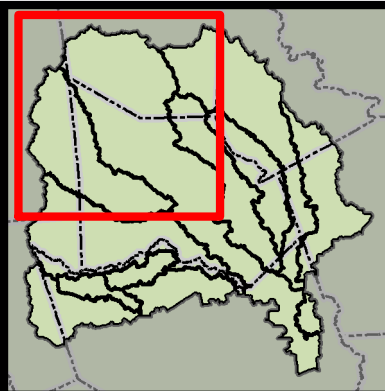
LEVEL OF SERVICE MAP | SW QUADRANT

SAN JACINTO

REGIONAL WATERSHED
MASTER DRAINAGE PLAN

APPENDIX
J.3

MAP
A



Legend

- Main Stream
- Watershed Boundary
- 100-YR Inundation
- Project Counties

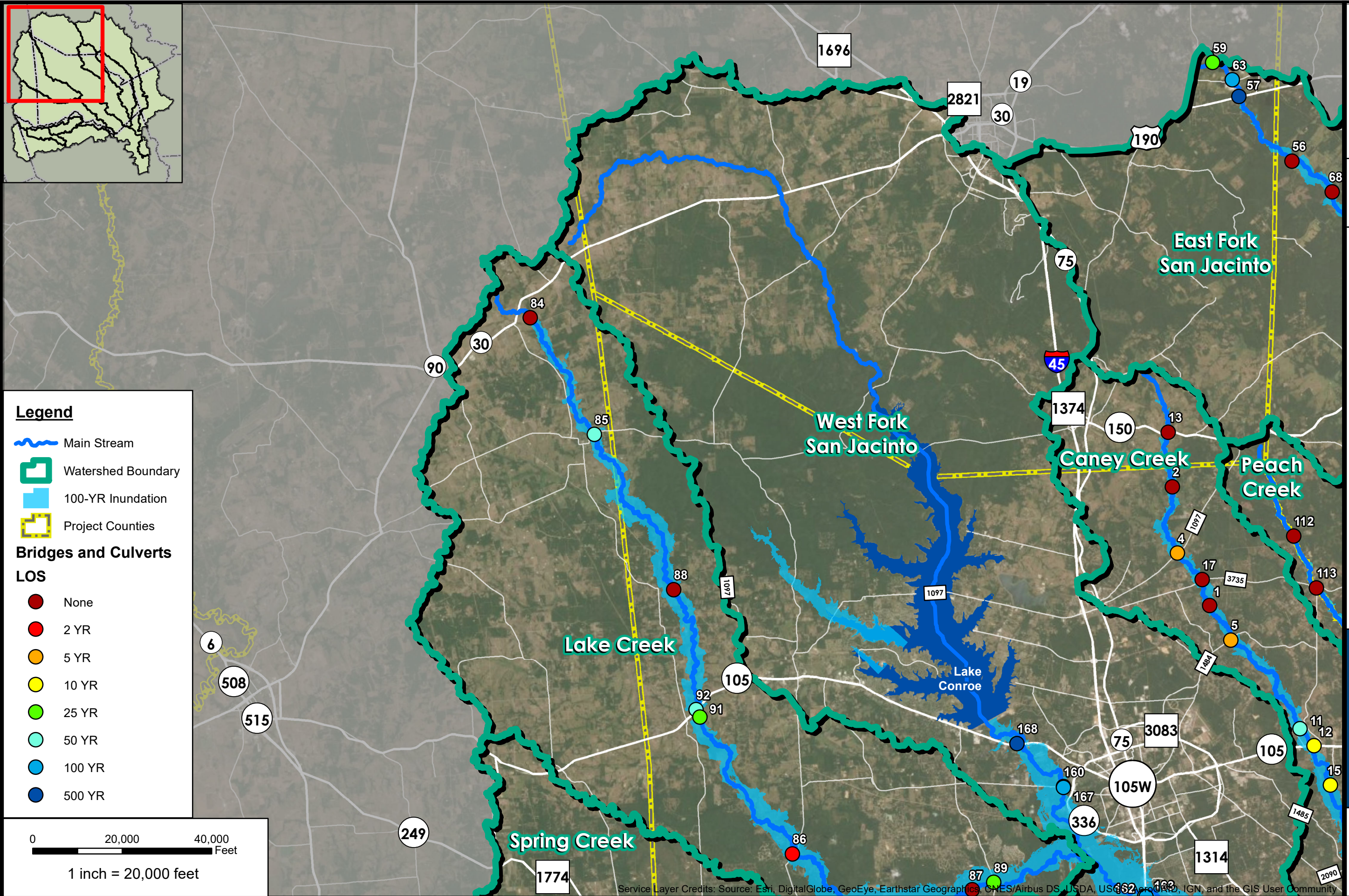
Bridges and Culverts

LOS

- None
- 2 YR
- 5 YR
- 10 YR
- 25 YR
- 50 YR
- 100 YR
- 500 YR

0 20,000 40,000 Feet

1 inch = 20,000 feet



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT AVO
33465

DATUM & COORDINATE SYSTEM
NAD 1983 2011 StatePlane Texas Central FIPS 4203 PLUS

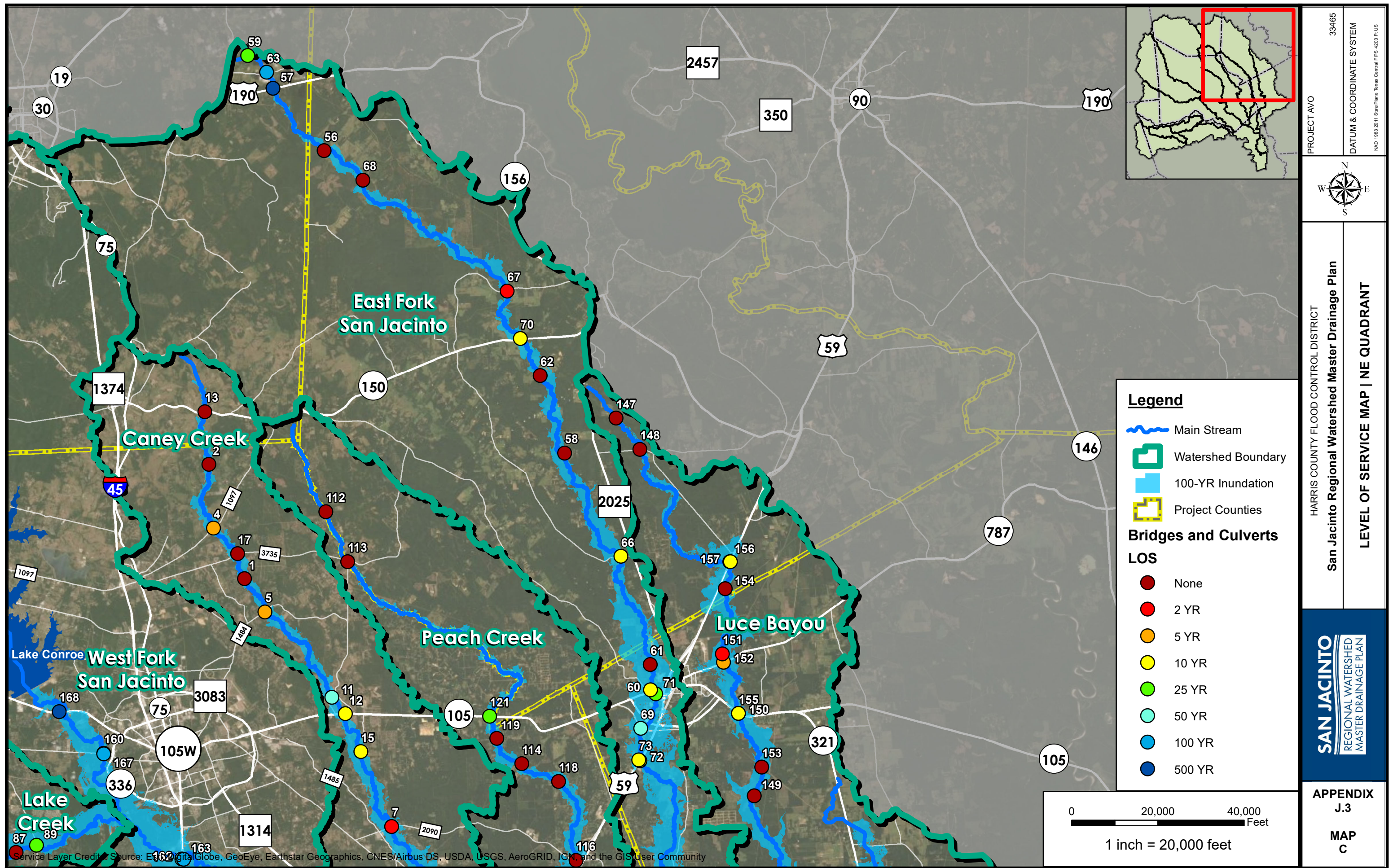
HARRIS COUNTY FLOOD CONTROL DISTRICT

San Jacinto Regional Watershed Master Drainage Plan

LEVEL OF SERVICE MAP | NW QUADRANT

SAN JACINTO
REGIONAL WATERSHED
MASTER DRAINAGE PLAN

APPENDIX
J.3
MAP
B



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

**Caney Creek
Roadway Crossing Level of Service**

Other Flood Hazard Mitigation Actions
Appendix J.3

* The Crossing ID corresponds to the number on the attached map

† The level of service (LOS) indicates the greatest storm that can pass without overtopping

Crossing ID *	Watershed	Road Name	Road Type	Crossing Type	Level of Service †
1	CANEY CREEK (G103-80-03)	ROYAL BRIDGE	County/City Rd	Culvert	< 2 YR
2	CANEY CREEK (G103-80-03)	BILNOSKI RD	County/City Rd	Bridge	< 2 YR
3	CANEY CREEK (G103-80-03)	FIRETOWER RD	County/City Rd	Bridge	< 2 YR
4	CANEY CREEK (G103-80-03)	FM 1485	Farm-to-Market	Bridge	5 YR
5	CANEY CREEK (G103-80-03)	FM-1097	Farm-to-Market	Bridge	5 YR
6	CANEY CREEK (G103-80-03)	FM1484	Farm-to-Market	Bridge	10 YR
7	CANEY CREEK (G103-80-03)	FM-2090	Farm-to-Market	Bridge	2 YR
8	CANEY CREEK (G103-80-03)	I-69	Highway	Bridge	100 YR
9	CANEY CREEK (G103-80-03)	LOOP 494	Interstate	Bridge	50 YR
10	CANEY CREEK (G103-80-03)	MILLMAC RD	Highway	Bridge	< 2 YR
11	CANEY CREEK (G103-80-03)	SH-105	County/City Rd	Bridge	50 YR
12	CANEY CREEK (G103-80-03)	SH-242	Highway	Bridge	10 YR
13	CANEY CREEK (G103-80-03)	SYCAMORE LANE	Highway	Bridge	< 2 YR
14	CANEY CREEK (G103-80-03)	TIMBER ROCK RAILROAD	County/City Rd	Bridge	10 YR
15	CANEY CREEK (G103-80-03)	TX-150	Railroad	Bridge	10 YR
16	CANEY CREEK (G103-80-03)	UNION PACIFIC RAILROAD	Railroad	Bridge	25 YR
17	CANEY CREEK (G103-80-03)	WILLIS COUNTY LINE RD	County/City Rd	Bridge	< 2 YR

**Cypress Creek
Roadway Crossing Level of Service**

Other Flood Hazard Mitigation Actions
Appendix J.3

* The Crossing ID corresponds to the number on the attached map. † The level of service (LOS) indicates the greatest storm that can pass without overtopp

Crossing ID *	Watershed	Road Name	Road Type	Crossing Type	Level of Service †
18	CYPRESS CREEK (K100-00-00)	HERBERT RD	County/City Rd	Culvert	< 2 YR
19	CYPRESS CREEK (K100-00-00)	PRIVATE RD 1270' US X103	Private Rd	Culvert	< 2 YR
20	CYPRESS CREEK (K100-00-00)	SHARP RD	County/City Rd	Culvert	< 2 YR
21	CYPRESS CREEK (K100-00-00)	ALDINE WESTFIELD RD	County/City Rd	Bridge	2 YR
22	CYPRESS CREEK (K100-00-00)	BARKER CYPRESS RD	County/City Rd	Bridge	10 YR
23	CYPRESS CREEK (K100-00-00)	BRIDGE	Private Rd	Bridge	< 2 YR
24	CYPRESS CREEK (K100-00-00)	BRIDGE	Private Rd	Bridge	< 2 YR
25	CYPRESS CREEK (K100-00-00)	BURLINGTON NORTHERN RAILROAD	Railroad	Bridge	100 YR
26	CYPRESS CREEK (K100-00-00)	CHAMPION FOREST DR	County/City Rd	Bridge	2 YR
27	CYPRESS CREEK (K100-00-00)	CYPRESSWOOD DR	County/City Rd	Bridge	2 YR
28	CYPRESS CREEK (K100-00-00)	CYPRESSWOOD DR	County/City Rd	Bridge	2 YR
29	CYPRESS CREEK (K100-00-00)	CYPRESSWOOD DR	County/City Rd	Bridge	2 YR
30	CYPRESS CREEK (K100-00-00)	FOOT BRIDGE	Private Rd	Bridge	< 2 YR
31	CYPRESS CREEK (K100-00-00)	FOOT BRIDGE	Private Rd	Bridge	5 YR
32	CYPRESS CREEK (K100-00-00)	FRY RD	County/City Rd	Bridge	100 YR
33	CYPRESS CREEK (K100-00-00)	GOLF CART BRIDGE	Private Rd	Bridge	< 2 YR
34	CYPRESS CREEK (K100-00-00)	GRANT RD	County/City Rd	Bridge	< 2 YR
35	CYPRESS CREEK (K100-00-00)	HARDY TOLL ROAD NORTH BOUND	Highway	Bridge	100 YR
36	CYPRESS CREEK (K100-00-00)	HARDY TOLL ROAD SOUTH BOUND	Highway	Bridge	100 YR
37	CYPRESS CREEK (K100-00-00)	HOUSE AND HAHL RD	County/City Rd	Bridge	< 2 YR
38	CYPRESS CREEK (K100-00-00)	HUFFMEISTER RD	County/City Rd	Bridge	< 2 YR
39	CYPRESS CREEK (K100-00-00)	I-45	Interstate	Bridge	25 YR
40	CYPRESS CREEK (K100-00-00)	JONES RD	County/City Rd	Bridge	2 YR
41	CYPRESS CREEK (K100-00-00)	KATY HOCKLEY RD	County/City Rd	Bridge	2 YR
42	CYPRESS CREEK (K100-00-00)	KUYKENDAHL RD	County/City Rd	Bridge	10 YR
43	CYPRESS CREEK (K100-00-00)	N ELDRIDGE PKWY	County/City Rd	Bridge	10 YR
44	CYPRESS CREEK (K100-00-00)	PIPELINE	County/City Rd	Bridge	2 YR
45	CYPRESS CREEK (K100-00-00)	RAILROAD 130' US OF 290	Railroad	Bridge	500 YR
46	CYPRESS CREEK (K100-00-00)	SCHROEDER RD	County/City Rd	Bridge	5 YR
47	CYPRESS CREEK (K100-00-00)	SH-249	Highway	Bridge	50 YR
48	CYPRESS CREEK (K100-00-00)	STUEBNER AIRLINE RD	County/City Rd	Bridge	500 YR
49	CYPRESS CREEK (K100-00-00)	TELGE RD	County/City Rd	Bridge	50 YR
50	CYPRESS CREEK (K100-00-00)	TREASCHWIG RD	County/City Rd	Bridge	< 2 YR
51	CYPRESS CREEK (K100-00-00)	TX-99 GRAND PKWY	Highway	Bridge	500 YR
52	CYPRESS CREEK (K100-00-00)	UNION PACIFIC RAILROAD	Railroad	Bridge	500 YR
53	CYPRESS CREEK (K100-00-00)	US 290	Highway	Bridge	100 YR
54	CYPRESS CREEK (K100-00-00)	US 290 EB ACCESS RD/WEIR	County/City Rd	Bridge	50 YR
55	CYPRESS CREEK (K100-00-00)	US 290 WB ACCESS RD	County/City Rd	Bridge	< 2 YR

**East Fork San Jacinto River
Roadway Crossing Level of Service**

Other Flood Hazard Mitigation Actions
Appendix J.3

* The Crossing ID corresponds to the number on the attached map

† The level of service (LOS) indicates the greatest storm that can pass without overtopping

Crossing ID *	Watershed	Road Name	Road Type	Crossing Type	Level of Service †
56	EAST FORK OF SAN JACINTO RIVE	GUINEA RD	County/City Rd	Culvert	< 2 YR
57	EAST FORK OF SAN JACINTO RIVE	HWY-190	Highway	Culvert	500 YR
58	EAST FORK OF SAN JACINTO RIVE	LOWER VANN RD	County/City Rd	Culvert	< 2 YR
59	EAST FORK OF SAN JACINTO RIVE	OLD CHAPEL RD	County/City Rd	Culvert	25 YR
60	EAST FORK OF SAN JACINTO RIVE	BNSF RAILROAD	Railroad	Bridge	10 YR
61	EAST FORK OF SAN JACINTO RIVE	COLD SPRINGS OIL FIELD RD/S BU	County/City Rd	Bridge	< 2 YR
62	EAST FORK OF SAN JACINTO RIVE	CO-RD 388/BRIDGE RD	County/City Rd	Bridge	< 2 YR
63	EAST FORK OF SAN JACINTO RIVE	DODGE OAKHURST RD	County/City Rd	Bridge	100 YR
64	EAST FORK OF SAN JACINTO RIVE	FM-1485	Farm-to-Market	Bridge	< 2 YR
65	EAST FORK OF SAN JACINTO RIVE	FM-2090	Farm-to-Market	Bridge	5 YR
66	EAST FORK OF SAN JACINTO RIVE	FM-945	Farm-to-Market	Bridge	10 YR
67	EAST FORK OF SAN JACINTO RIVE	FM-945/RR-2	Farm-to-Market	Bridge	2 YR
68	EAST FORK OF SAN JACINTO RIVE	JENKINS RD	County/City Rd	Bridge	< 2 YR
69	EAST FORK OF SAN JACINTO RIVE	SH-105	Highway	Bridge	50 YR
70	EAST FORK OF SAN JACINTO RIVE	SH-150/FM-1375	Highway	Bridge	10 YR
71	EAST FORK OF SAN JACINTO RIVE	TX-105 BUSINESS/W SOUTHLINE S	Highway	Bridge	25 YR
72	EAST FORK OF SAN JACINTO RIVE	UNION PACIFIC RAILROAD	Railroad	Bridge	10 YR
73	EAST FORK OF SAN JACINTO RIVE	US-59	Highway	Bridge	10 YR

Jackson Bayou - Gum Gully
Roadway Crossing Level of Service

Other Flood Hazard Mitigation Actions
Appendix J.3

* The Crossing ID corresponds to the number on the attached map

† The level of service (LOS) indicates the greatest storm that can pass without overtopping

Crossing ID *	Watershed	Road Name	Road Type	Crossing Type	Level of Service †
74	GUM GULLY (R102-00-00)	DIAMONDHEAD BLVD	County/City Rd	Bridge	100 YR
75	GUM GULLY (R102-00-00)	FM 2100	Farm-to-Market	Bridge	100 YR
76	GUM GULLY (R102-00-00)	FOLEY RD	County/City Rd	Bridge	100 YR
77	GUM GULLY (R102-00-00)	STROKER RD	County/City Rd	Bridge	2 YR
78	JACKSON BAYOU (R100-00-00)	MILLER WILSON RD	County/City Rd	Culvert	100 YR
79	JACKSON BAYOU (R100-00-00)	N. MAIN ST/FM 2100	Farm-to-Market	Culvert	500 YR
80	JACKSON BAYOU (R100-00-00)	PECAN ST	County/City Rd	Bridge	100 YR
81	JACKSON BAYOU (R100-00-00)	PRIVATE ROAD	Private Rd	Bridge	25 YR
82	JACKSON BAYOU (R100-00-00)	RUNNEBURG RD	County/City Rd	Bridge	100 YR
83	JACKSON BAYOU (R100-00-00)	SPRC RR CROSSING	Railroad	Bridge	500 YR

**Lake Creek
Roadway Crossing Level of Service**

Other Flood Hazard Mitigation Actions
Appendix J.3

* The Crossing ID corresponds to the number on the attached map

† The level of service (LOS) indicates the greatest storm that can pass without overtopping

Crossing ID *	Watershed	Road Name	Road Type	Crossing Type	Level of Service †
84	LAKE CREEK (GLC-00-00)	CO-RD 233	County/City Rd	Bridge	< 2 YR
85	LAKE CREEK (GLC-00-00)	FM-149	Farm-to-Market	Bridge	50 YR
86	LAKE CREEK (GLC-00-00)	FM-149	Farm-to-Market	Bridge	2 YR
87	LAKE CREEK (GLC-00-00)	HONEA EGYPT RD	County/City Rd	Bridge	< 2 YR
88	LAKE CREEK (GLC-00-00)	JOHNSON RD	County/City Rd	Bridge	< 2 YR
89	LAKE CREEK (GLC-00-00)	SENDERA RANCH DR	County/City Rd	Bridge	25 YR
90	LAKE CREEK (GLC-00-00)	SUPERIOR RD	County/City Rd	Bridge	< 2 YR
91	LAKE CREEK (GLC-00-00)	TIMBER ROCK RAILROAD/OLD MON	Railroad	Bridge	25 YR
92	LAKE CREEK (GLC-00-00)	TX-105	Highway	Bridge	50 YR

**Little Cypress Creek
Roadway Crossing Level of Service**

Other Flood Hazard Mitigation Actions
Appendix J.3

* The Crossing ID corresponds to the number on the attached map

† The level of service (LOS) indicates the greatest storm that can pass without overtopping

Crossing ID *	Watershed	Road Name	Road Type	Crossing Type	Level of Service †
93	LITTLE CYPRESS CREEK (L100-00-0)	HEGAR RD	County/City Rd	Culvert	< 2 YR
94	LITTLE CYPRESS CREEK (L100-00-0)	US 290	Highway	Culvert	500 YR
95	LITTLE CYPRESS CREEK (L100-00-0)	BAUER HOCKLEY RD	County/City Rd	Bridge	< 2 YR
96	LITTLE CYPRESS CREEK (L100-00-0)	BAUER RD	County/City Rd	Bridge	< 2 YR
97	LITTLE CYPRESS CREEK (L100-00-0)	BECKER RD	County/City Rd	Bridge	< 2 YR
98	LITTLE CYPRESS CREEK (L100-00-0)	CYPRESS ROSEHILL RD	County/City Rd	Bridge	< 2 YR
99	LITTLE CYPRESS CREEK (L100-00-0)	GOLF COURSE BRIDGE US LONGW	Private Rd	Bridge	< 2 YR
100	LITTLE CYPRESS CREEK (L100-00-0)	GRIMES RD/BAUER HOCKLEY RD	County/City Rd	Bridge	< 2 YR
101	LITTLE CYPRESS CREEK (L100-00-0)	KLUGE RD	County/City Rd	Bridge	< 2 YR
102	LITTLE CYPRESS CREEK (L100-00-0)	LONGWOOD TRACE	County/City Rd	Bridge	2 YR
103	LITTLE CYPRESS CREEK (L100-00-0)	MASON RD	County/City Rd	Bridge	50 YR
104	LITTLE CYPRESS CREEK (L100-00-0)	MUESCHKE RD	County/City Rd	Bridge	< 2 YR
105	LITTLE CYPRESS CREEK (L100-00-0)	ROBERTS RD	County/City Rd	Bridge	2 YR
106	LITTLE CYPRESS CREEK (L100-00-0)	TELGE RD/SPRING CYPRESS RD	County/City Rd	Bridge	2 YR
107	LITTLE CYPRESS CREEK (L100-00-0)	TX-99 GRAND PKWY	Highway	Bridge	500 YR

**Luce Bayou - Tarkington Bayou
Roadway Crossing Level of Service**

Other Flood Hazard Mitigation Actions
Appendix J.3

* The Crossing ID corresponds to the number on the attached map

† The level of service (LOS) indicates the greatest storm that can pass without overtopping

Crossing ID *	Watershed	Road Name	Road Type	Crossing Type	Level of Service †
108	LUCE BAYOU (S100-00-00)	DOVERBROOK RD	County/City Rd	Bridge	< 2 YR
109	LUCE BAYOU (S100-00-00)	FM- 2100/CROSBY HUFFMAN RD	Farm-to-Market	Bridge	100 YR
110	LUCE BAYOU (S100-00-00)	HUFFMAN NEW CANEY RD/HUFFMAN	County/City Rd	Bridge	2 YR
111	LUCE BAYOU (S100-00-00)	SH-321	Highway	Bridge	10 YR
147	TARKINGTON BAYOU (STB-00-00)	BIG CREEK SCENIC RD/FSR-221	County/City Rd	Culvert	< 2 YR
148	TARKINGTON BAYOU (STB-00-00)	FM-2666	Farm-to-Market	Culvert	< 2 YR
149	TARKINGTON BAYOU (STB-00-00)	PRIVATE ROAD	Private Rd	Culvert	< 2 YR
150	TARKINGTON BAYOU (STB-00-00)	TX-321/SH-105/E HOUSTON ST CUL	Highway	Culvert	10 YR
151	TARKINGTON BAYOU (STB-00-00)	BNSF RAILROAD	Railroad	Bridge	2 YR
152	TARKINGTON BAYOU (STB-00-00)	FM-787	Farm-to-Market	Bridge	5 YR
153	TARKINGTON BAYOU (STB-00-00)	GULF RD/ CO-RD 331	County/City Rd	Bridge	< 2 YR
154	TARKINGTON BAYOU (STB-00-00)	PRIVATE ROAD	Private Rd	Bridge	< 2 YR
155	TARKINGTON BAYOU (STB-00-00)	TX-321/SH-105/E HOUSTON ST	Highway	Bridge	10 YR
156	TARKINGTON BAYOU (STB-00-00)	UNION PACIFIC RAILROAD	Railroad	Bridge	10 YR
157	TARKINGTON BAYOU (STB-00-00)	US-59	Highway	Bridge	2 YR

**Peach Creek
Roadway Crossing Level of Service**

Other Flood Hazard Mitigation Actions
Appendix J.3

* The Crossing ID corresponds to the number on the attached map

† The level of service (LOS) indicates the greatest storm that can pass without overtopping

Crossing ID *	Watershed	Road Name	Road Type	Crossing Type	Level of Service †
112	PEACH CREEK (GPC-00-00)	TANYARD RD	County/City Rd	Culvert	< 2 YR
113	PEACH CREEK (GPC-00-00)	BROWDER TAYLOR RD	County/City Rd	Bridge	< 2 YR
114	PEACH CREEK (GPC-00-00)	FAULKNER RD	County/City Rd	Bridge	< 2 YR
115	PEACH CREEK (GPC-00-00)	FM-1485/TX-99 GRAND PKWY	Farm-to-Market	Bridge	5 YR
116	PEACH CREEK (GPC-00-00)	FM-2090	Farm-to-Market	Bridge	< 2 YR
117	PEACH CREEK (GPC-00-00)	I-69	Interstate	Bridge	10 YR
118	PEACH CREEK (GPC-00-00)	MORGAN CEMETERY RD	County/City Rd	Bridge	< 2 YR
119	PEACH CREEK (GPC-00-00)	OLD TX 105/WALKER DR	County/City Rd	Bridge	< 2 YR
120	PEACH CREEK (GPC-00-00)	ROMAN FOREST BLVD	County/City Rd	Bridge	< 2 YR
121	PEACH CREEK (GPC-00-00)	SH-105	Highway	Bridge	25 YR
122	PEACH CREEK (GPC-00-00)	WOODBANCH RD	County/City Rd	Bridge	< 2 YR

**Spring Creek
Roadway Crossing Level of Service**

Other Flood Hazard Mitigation Actions
Appendix J.3

* The Crossing ID corresponds to the number on the attached map

† The level of service (LOS) indicates the greatest storm that can pass without overtopping

Crossing ID *	Watershed	Road Name	Road Type	Crossing Type	Level of Service †
123	SPRING CREEK (J100-00-00)	ACCESS CONC. BRDG 2ND DS FM	Private Rd	Culvert	< 2 YR
124	SPRING CREEK (J100-00-00)	FM-1736	Farm-to-Market	Culvert	10 YR
125	SPRING CREEK (J100-00-00)	MAYER/FIELDS STORE RD	County/City Rd	Culvert	< 2 YR
126	SPRING CREEK (J100-00-00)	SANDERS CEMETERY RD / MUESC	County/City Rd	Culvert	< 2 YR
127	SPRING CREEK (J100-00-00)	ACCESS METAL BRIDGE US KICKA	Private Rd	Bridge	< 2 YR
128	SPRING CREEK (J100-00-00)	BURLINGTON NORTHERN RAILROA	Railroad	Bridge	10 YR
129	SPRING CREEK (J100-00-00)	CARDINAL DR	County/City Rd	Bridge	< 2 YR
130	SPRING CREEK (J100-00-00)	CYPRESS ROSEHILL RD/ CO-RD 29	County/City Rd	Bridge	< 2 YR
131	SPRING CREEK (J100-00-00)	FM-1488	Farm-to-Market	Bridge	100 YR
132	SPRING CREEK (J100-00-00)	FM-2978	Farm-to-Market	Bridge	2 YR
133	SPRING CREEK (J100-00-00)	GOSLING RD	County/City Rd	Bridge	2 YR
134	SPRING CREEK (J100-00-00)	HEGAR RD	County/City Rd	Bridge	< 2 YR
135	SPRING CREEK (J100-00-00)	I-45	Interstate	Bridge	100 YR
136	SPRING CREEK (J100-00-00)	KICKAPOO RD	County/City Rd	Bridge	2 YR
137	SPRING CREEK (J100-00-00)	KUYKENDAHL RD	County/City Rd	Bridge	25 YR
138	SPRING CREEK (J100-00-00)	MARGERSTADT RD	County/City Rd	Bridge	2 YR
139	SPRING CREEK (J100-00-00)	MURRELL RD	County/City Rd	Bridge	< 2 YR
140	SPRING CREEK (J100-00-00)	RILEY FUZZEL RD	County/City Rd	Bridge	2 YR
141	SPRING CREEK (J100-00-00)	ROBERTS CEMETERY RD	County/City Rd	Bridge	< 2 YR
142	SPRING CREEK (J100-00-00)	TOMBALL PARKWAY SH-249	Highway	Bridge	5 YR
143	SPRING CREEK (J100-00-00)	UNION PACIFIC RAILROAD	Railroad	Bridge	10 YR
144	SPRING CREEK (J100-00-00)	UNION PACIFIC RAILROAD	Railroad	Bridge	10 YR
145	SPRING CREEK (J100-00-00)	WD BRDG	Private Rd	Bridge	< 2 YR
146	SPRING CREEK (J100-00-00)	WOOD BRIDGE ACCESS DS FM1488	Private Rd	Bridge	< 2 YR

**West Fork San Jacinto River
Roadway Crossing Level of Service**

Other Flood Hazard Mitigation Actions
Appendix J.3

* The Crossing ID corresponds to the number on the attached map

† The level of service (LOS) indicates the greatest storm that can pass without overtopping

Crossing ID *	Watershed	Road Name	Road Type	Crossing Type	Level of Service †
158	WEST FORK OF SAN JACINTO RIVER	BEAUMONT HWY/ BUS HWY 90	Highway	Bridge	25 YR
159	WEST FORK OF SAN JACINTO RIVER	FM-1960	Farm-to-Market	Bridge	500 YR
160	WEST FORK OF SAN JACINTO RIVER	FM-2854	Farm-to-Market	Bridge	10 YR
161	WEST FORK OF SAN JACINTO RIVER	HWY 90	Highway	Bridge	500 YR
162	WEST FORK OF SAN JACINTO RIVER	I-45	Highway	Bridge	50 YR
163	WEST FORK OF SAN JACINTO RIVER	I-45 RAILROAD	Interstate	Bridge	50 YR
164	WEST FORK OF SAN JACINTO RIVER	I-69	Railroad	Bridge	100 YR
165	WEST FORK OF SAN JACINTO RIVER	SOUTHERN PACIFIC RAILROAD	Interstate	Bridge	25 YR
166	WEST FORK OF SAN JACINTO RIVER	SOUTHERN PACIFIC RAILROAD	Railroad	Bridge	25 YR
167	WEST FORK OF SAN JACINTO RIVER	TIMBER ROCK RAILROAD	Railroad	Bridge	100 YR
168	WEST FORK OF SAN JACINTO RIVER	TX-105	Railroad	Bridge	100 YR
169	WEST FORK OF SAN JACINTO RIVER	TX-242	Highway	Bridge	100 YR
170	WEST FORK OF SAN JACINTO RIVER	TX-99 GRAND PKWY	Highway	Bridge	100 YR
171	WEST FORK OF SAN JACINTO RIVER	UNION PACIFIC RAILROAD	Railroad	Bridge	100 YR
172	WEST FORK OF SAN JACINTO RIVER	UNION PACIFIC RAILROAD	Railroad	Bridge	25 YR
173	WEST FORK OF SAN JACINTO RIVER	W LAKE HOUSTON PKWY	County/City Rd	Bridge	100 YR

**Willow Creek
Roadway Crossing Level of Service**

Other Flood Hazard Mitigation Actions
Appendix J.3

* The Crossing ID corresponds to the number on the attached map

† The level of service (LOS) indicates the greatest storm that can pass without overtopping

Crossing ID *	Watershed	Road Name	Road Type	Crossing Type	Level of Service †
174	WILLOW CREEK (M100-00-00)	CYPRESS ROSEHILL RD	County/City Rd	Culvert	2 YR
175	WILLOW CREEK (M100-00-00)	PASTURE BRIDGE 2 M100-XS40	Private Rd	Culvert	< 2 YR
176	WILLOW CREEK (M100-00-00)	PRIVATE ACCESS US JUERGEN	Private Rd	Culvert	< 2 YR
177	WILLOW CREEK (M100-00-00)	TELGE RD	County/City Rd	Culvert	< 2 YR
178	WILLOW CREEK (M100-00-00)	TX-99 GRAND PKWY NORTH BOUN	County/City Rd	Culvert	< 2 YR
179	WILLOW CREEK (M100-00-00)	TX-99 GRAND PKWY SOUTH BOUN	County/City Rd	Culvert	< 2 YR
180	WILLOW CREEK (M100-00-00)	BURLINGTON NORTHERN RAILROA	Railroad	Bridge	10 YR
181	WILLOW CREEK (M100-00-00)	FOOT BRIDGE	Private Rd	Bridge	< 2 YR
182	WILLOW CREEK (M100-00-00)	GOLF CART BRIDGE	Private Rd	Bridge	< 2 YR
183	WILLOW CREEK (M100-00-00)	GOLF CART BRIDGE	Private Rd	Bridge	< 2 YR
184	WILLOW CREEK (M100-00-00)	GOLF CART BRIDGE DS KUYKENDA	Private Rd	Bridge	< 2 YR
185	WILLOW CREEK (M100-00-00)	GOSLING RD	County/City Rd	Bridge	5 YR
186	WILLOW CREEK (M100-00-00)	HUFSMITH KOHRVILLE RD	County/City Rd	Bridge	< 2 YR
187	WILLOW CREEK (M100-00-00)	HUFSMITH KUYKENDAHL RD	County/City Rd	Bridge	50 YR
188	WILLOW CREEK (M100-00-00)	JUERGEN RD	County/City Rd	Bridge	< 2 YR
189	WILLOW CREEK (M100-00-00)	KUYKENDAHL RD	County/City Rd	Bridge	25 YR
190	WILLOW CREEK (M100-00-00)	NORTHCREST DR	County/City Rd	Bridge	10 YR
191	WILLOW CREEK (M100-00-00)	SCHROEDER LN	County/City Rd	Bridge	< 2 YR
192	WILLOW CREEK (M100-00-00)	SH-249 MAINLANES	Highway	Bridge	500 YR
193	WILLOW CREEK (M100-00-00)	SH-249 NORTH BOUND FRONTAGE	County/City Rd	Bridge	5 YR
194	WILLOW CREEK (M100-00-00)	SH-249 SOUTH BOUND FRONTAGE	County/City Rd	Bridge	10 YR
195	WILLOW CREEK (M100-00-00)	STUEBNER-AIRLINE/FM-2920	Farm-to-Market	Bridge	100 YR
196	WILLOW CREEK (M100-00-00)	TUWA DR	County/City Rd	Bridge	2 YR
197	WILLOW CREEK (M100-00-00)	UNION PACIFIC RAILROAD	Railroad	Bridge	100 YR
198	WILLOW CREEK (M100-00-00)	WWTP BRIDGE	Private Rd	Bridge	< 2 YR