PREPARED BY

Mead & Hunt

Initial Study Report

# Infrastructure Report

## Pensacola Hydroelectric Project
## Project No. 1494

September 30, 2021

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# Executive Summary

Mead & Hunt, Inc. (Mead & Hunt) is assisting Grand River Dam Authority (GRDA, Licensee) in the relicensing of the Pensacola Hydroelectric Project (Project), which is regulated by the Federal Energy Regulatory Commission (FERC, Commission). Flood control operations at the Project are regulated by the United States Army Corps of Engineers (USACE).

The Commission recommended an Infrastructure Study (Study) to determine a range of inflow conditions for which hydraulic model results (separate study) show Project operations may influence the frequency or depth of flooding. Specifically, the Commission requested maps and tables identifying the frequency and depth of flooding for each item of infrastructure.

Mead & Hunt developed a hydraulic model of the area upstream of the Project along with a range of starting reservoir elevations. Inflow events representing a range of flood frequency were used for the Study. Hydraulic results were extracted at infrastructure locations. Infrastructure locations were mapped, and tabular data of inundation depth were developed. The difference in depth between different starting reservoir elevations was also tabulated.

Only 6% of the infrastructure locations studied experience an appreciable increase in maximum inundation depth due to a starting reservoir elevation increase from 742 feet to 745 feet. All appreciable increases in maximum inundation depth occur during high-flow conditions when the USACE controls the flood control operations under the Flood Control Act of 1944, except when the time of maximum inundation depth is solely a function of inflow event arrival time and not reservoir elevation. Therefore, no additional adverse impacts exist due to Project operation.

# List of Abbreviations and Terms

| | |
|---|---|
| Commission | Federal Energy Regulatory Commission |
| DHS | Department of Homeland Security |
| EPA | Environmental Protection Agency |
| FAA | Federal Aviation Administration |
| FEMA | Federal Emergency Management Agency |
| FERC | Federal Energy Regulatory Commission |
| FRS | Facility Registry Service |
| FSA | Farm Service Agency |
| GIS | Geographic Information Systems |
| GNIS | Geographic Names Information System |
| Grand Lake | Grand Lake O' the Cherokees |
| GRDA | Grand River Dam Authority |
| HEC | Hydrologic Engineering Center |
| HIFLD | Homeland Infrastructure Foundation Level Database |
| ISR | Initial Study Report |
| Kerr Dam | Robert S. Kerr Dam |
| Licensee | Grand River Dam Authority |
| MESTA | Mayes Emergency Service Trust Authority |
| NAIP | National Agricultural Imagery Program |
| NAVD88 | North American Vertical Datum of 1988 |
| NGVD29 | National Geodetic Vertical Datum of 1929 |
| ODOT | Oklahoma Department of Transportation |
| PD | Pensacola Datum |
| Project | Pensacola Hydroelectric Project |
| PSP | Proposed Study Plan |
| RAS | River Analysis System |
| RM | River Mile |
| RSP | Revised Study Plan |
| SPD | Study Plan Determination |
| Study | Infrastructure Study |
| USACE | United States Army Corps of Engineers |
| USGS | United States Geological Survey |

# 1. Introduction and Background

## 1.1 Project Description

The Pensacola Hydroelectric Project is owned and operated by GRDA and regulated by the FERC, except that flood control operations at the Project are dictated and regulated by USACE under the authority of Section 7 of the 1944 Flood Control Act. In addition, section 7612 (c) of the National Defense Authorization Act (NDAA) of Fiscal Year 2020 states that "The Secretary [of the Army] shall have exclusive jurisdiction and responsibility for management of the flood pool for flood control operations at Grand Lake O' the Cherokees" (116th Congress, 2019).

The Pensacola Dam is located in Mayes County, Oklahoma on the Grand-Neosho River. Pensacola Dam impounds Grand Lake O' the Cherokees (Grand Lake). Construction of Pensacola Dam was completed in 1940. Downstream of Pensacola Dam, GRDA also owns and operates the Robert S. Kerr Dam (Kerr Dam) also known as the Markham Ferry Hydroelectric Project. Kerr Dam is also in Mayes County and impounds Lake Hudson, also known as Markham Ferry Reservoir. Flood control operations at both Pensacola Dam and Kerr Dam are regulated by USACE.

## 1.2 Vertical Datums

Data sources for this Study use a variety of vertical datums. Unless otherwise noted, data are presented in the Pensacola Datum (PD). To convert from PD to the National Geodetic Vertical Datum of 1929 (NGVD29), add 1.07 feet. To convert from NGVD29 to the North American Vertical Datum of 1988 (NAVD88), add 0.33 feet. **Figure 1**; displays datum transformations and conversions (Hunter, Trevisan, Villa, & Smith, 2020).

## 1.3 Study Plan Proposals and Determination

GRDA is currently relicensing the Project. The timeline of study plan proposals and determination is as follows:

1. On April 27, 2018, GRDA filed its Proposed Study Plan (PSP) to address hydrologic and hydraulic modeling in support of its intent to relicense the Project.
2. On September 24, 2018, GRDA filed its Revised Study Plan (RSP).
3. On November 8, 2018, the FERC issued its Study Plan Determination (SPD) for the Project.
4. On January 23, 2020, the FERC issued an Order on the Request for Clarification and Rehearing, which clarified the timeline for certain milestones applicable to the relicensing study plan.

The PSP and RSP did not include an infrastructure study. The SPD recommended the following strategy for assessing infrastructure impacts (FERC, 2018):

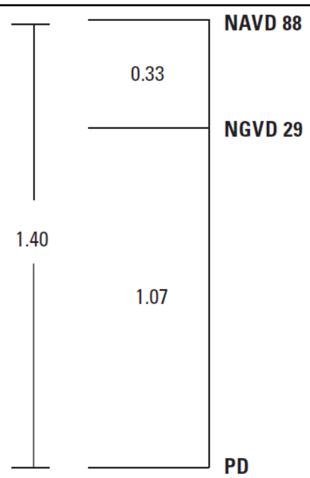
1. In consultation with the stakeholders, determine a list of infrastructure types to be included in the recommended infrastructure study. At a minimum, the list should include bridges, roads, structures, and other public amenities (e.g., recreation facilities) that have the potential to be flooded under all operating scenarios (e.g., by both the USACE-directed flood control operations and GRDA's Project operations).

2. Using output from the H&H modeling study, determine the range of inflow conditions for which model results show that Project operations for hydropower and other purposes under the Federal

Power Act in combination with USACE directed flood control operations are likely to have an effect on the frequency or depth of flooding. Based on the infrastructure identified in step 1, provide maps and tables identifying the frequency and depth of flooding for each item of infrastructure under existing operations, as defined above, and for the range of inflow conditions where such operations may have an effect on flooding.

3. Provide additional maps and tabular information based on any alternative operating scenarios proposed or developed through consultation, as required in the H&H study.

The Study's purpose is to analyze the impact, if any, of Project operations on inundation of critical infrastructure such as bridges, roads, water systems, electric transmission, and information and communication technology.




| | Elevations, in feet | | |
|---|---|---|---|
| | NAVD 88 | NGVD 29 | PD |
| Conservation pool | 743.40 | 743.07 | 742.00 |
| Top of the dam | 758.40 | 758.07 | 757.00 |

*Figure 1. Datum transformations and conversions.*
*Source: (Hunter, Trevisan, Villa, & Smith, 2020).*

## 2. Study Objectives and Schedule

Preliminary work for the Study occurred during the first study season. This report details the results of work performed in the first study season. **Table 1** provides major tasks identified for each study season.

*Table 1. Infrastructure study schedule and tasks.*

| STUDY SEASON | MAJOR TASKS |
| --- | --- |
| 1 | • Develop list of infrastructure types.<br>• Begin developing Geographic Information Systems (GIS) tools to extract flooding characteristics from simulation results.<br>• Consult with stakeholders to update list of infrastructure types.<br>• Map infrastructure locations.<br>• Determine a range of inflow conditions for which modeling results show that Project operations are likely to have an effect on frequency and depth of flooding.<br>• Use GIS tools to process modeling results to determine frequency and depth of flooding at mapped infrastructure locations.<br>• Prepare maps and tabular data as part of analysis.<br>• Develop an Initial Study Report (ISR). |
| 2 | • Stakeholder comments on the ISR are addressed. |

## 3. Study Area

The Study area encompasses areas where Project operations are likely to influence the frequency or depth of flooding upstream of the Project. Infrastructure locations potentially impacted by Project operations are displayed in **Figure 2**.

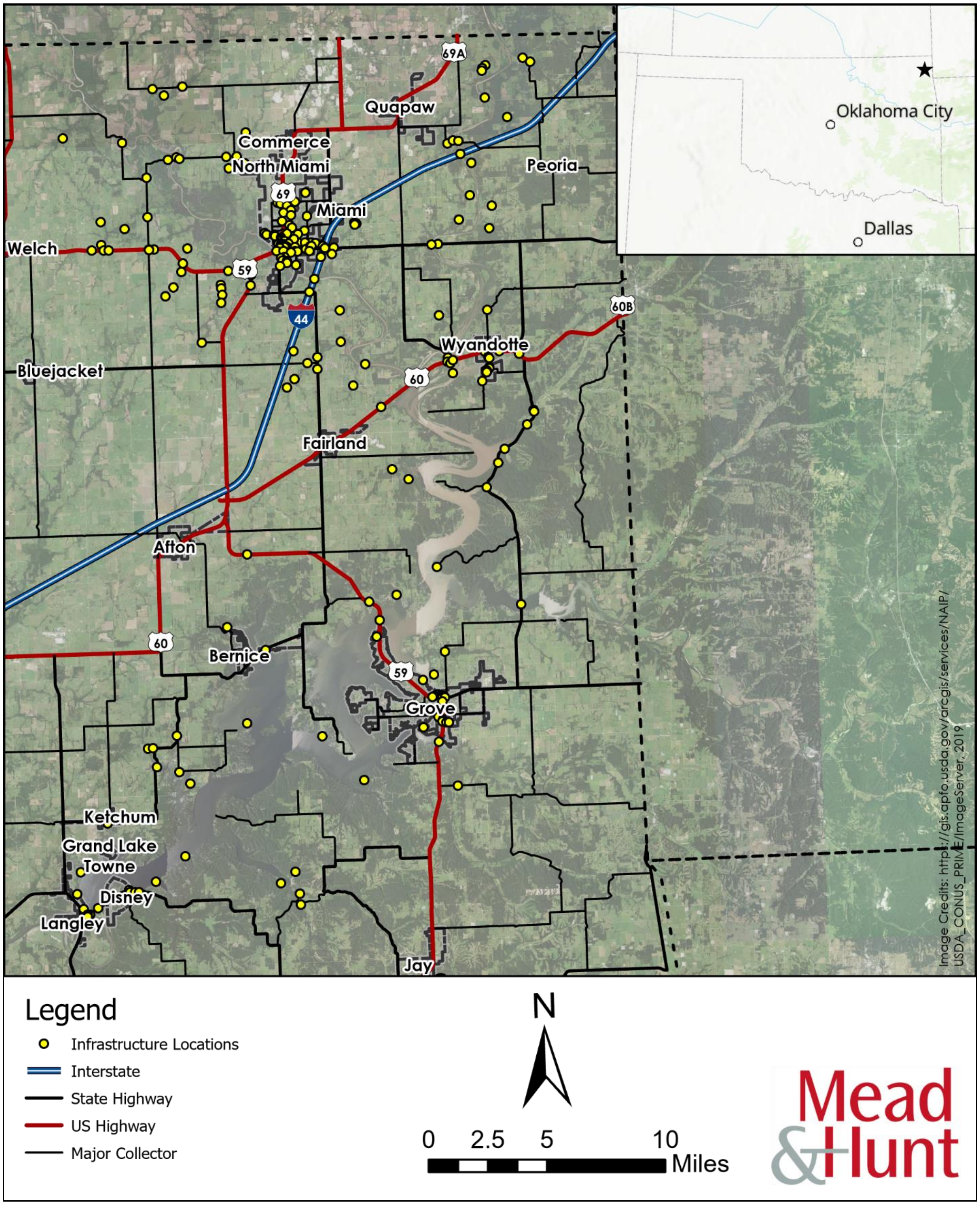



*Figure 2. Infrastructure study area.*

# 4. Methodology

Mead & Hunt defined a list of infrastructure types, gathered and mapped locations, consulted with stakeholders to refine the initial infrastructure list, and extracted inundation characteristics from simulation results. Historic inflows were examined to determine a range of conditions for which modeling results show Project operations potentially influence frequency and depth of flooding at the infrastructure locations. Maps showing the extent of inundation for multiple inflow events and starting reservoir elevations were developed. Tabular data for depth of inundation at each infrastructure location were developed for each simulated scenario.

## 4.1 Infrastructure Types and Data Sources

Infrastructure for the purposes of this Study is defined as facilities or structures that should be given consideration when there is potential for inundation due to Project operations. The Federal Emergency Management Agency (FEMA) includes hospitals, fire stations, police stations, and schools as examples of critical facilities (FEMA, 2020). The Department of Homeland Security (DHS) considers elements of transportation, clean water, and electricity to be of vital importance and identifies bridges and tunnels, energy infrastructure, and drinking water as key infrastructure elements (DHS, 2021).

The SPD (Federal Energy Regulatory Commission, 2018) states that:

> Characterizing existing infrastructure that could be affected under flood conditions would help staff analyze the broad effect of project operation (including operation during flood conditions) on land uses, including uses related to infrastructure or municipal recreation areas.

An initial list of potential infrastructure types was developed based on examples cited above and the availability of location information from accessible data sources. These data sources include Oklahoma state sources and U.S. government sources such as the United States Geological Survey (USGS), Environmental Protection Agency (EPA), and DHS.

Mead & Hunt compiled infrastructure locations from available data sources. The primary data source for GIS features and location information was Oklahoma Digital Data Online (Oklahoma Geographic Information Council, 2021). Features obtained from this source were supplemented with data obtained from the USGS Geographic Names Information System (GNIS), EPA's Facility Registry Service (FRS), Federal Aviation Administration (FAA), and Homeland Infrastructure Foundation Level Database (HIFLD). **Table 2** presents the list of infrastructure types, features, and sources of data.

The location accuracy and original source data of these features may vary based on the data provider. Many locations were likely compiled from earlier sources of data and made available for download. Locations were cross-checked with independent mapping sources such as Google maps and county online mapping where available. Features were adjusted based on these independent sources as needed, and no ground-truthing was performed. Given multiple data sources for some of the infrastructure types, a review for duplicate features was completed and duplicates were removed.

*Table 2. List of infrastructure types and data sources.*

| INFRASTRUCTURE TYPE | FEATURES | DATA SOURCE |
|---|---|---|
| Airports/Heliports | FAA public use airports | https://www.faa.gov/airports/airport_safety/airportdata_5010/ |
| Bridges | ODOT[1] On-system bridges | Oklahoma Digital Data Online (https://okmaps.org/OGI/search.aspx) |
| | ODOT Off-system bridges | Oklahoma Digital Data Online (https://okmaps.org/OGI/search.aspx) |
| Medical/Hospitals | Hospitals and Clinics | Oklahoma Digital Data Online (https://okmaps.org/OGI/search.aspx); USGS GNIS (https://www.usgs.gov/core-science-systems/ngp/board-on-geographic-names/download-gnis-data) |
| Law Enforcement | Police, State, Sheriff's, Patrol | Oklahoma Digital Data Online (https://okmaps.org/OGI/search.aspx) |
| Fire Stations | Fire Stations | Oklahoma Digital Data Online (https://okmaps.org/OGI/search.aspx); USGS GNIS (https://www.usgs.gov/core-science-systems/ngp/board-on-geographic-names/download-gnis-data) |
| Education/Schools | Public Schools | Oklahoma Digital Data Online (https://okmaps.org/OGI/search.aspx); USGS GNIS (https://www.usgs.gov/core-science-systems/ngp/board-on-geographic-names/download-gnis-data) |
| Recreation/Public Use Areas | Parks, Fairgrounds | Oklahoma Digital Data Online (https://okmaps.org/OGI/search.aspx); USGS GNIS (https://www.usgs.gov/core-science-systems/ngp/board-on-geographic-names/download-gnis-data) |
| Waste and Water Treatment | Plants | EPA's FRS (https://www.epa.gov/frs) |
| Power supply | Power plants, Substations, Electric Transmission Lines | Homeland Infrastructure Foundation Level Database (HIFLD) (https://gii.dhs.gov/HIFLD); U.S. Energy Information Administration |
| FM Transmission Towers | | HIFLD (https://gii.dhs.gov/HIFLD) |
| Cell towers | | HIFLD (https://gii.dhs.gov/HIFLD) |

*1 Oklahoma Department of Transportation*

## 4.2 Consultation with Stakeholders

### 4.2.1 Emergency Management Agencies

To refine and supplement the list of infrastructure, local emergency management agencies were contacted and given the opportunity to provide information on and/or the location of infrastructure features of concern to their jurisdictions. These contacts included county, city, and tribal emergency management entities, as well as the State of Oklahoma and USACE, Tulsa District Office.

Additional infrastructure locations identified through coordination with emergency management entities were added to the facilities GIS data layer. The list of entities contacted is provided in **Table 3**.

*Table 3. Emergency management agencies contacted.*

| AGENCY |
|---|
| Miami Emergency Management |
| Ottawa County Emergency Management |
| Quapaw Tribe |
| Wyandotte Emergency Management |
| Delaware County Emergency Management |
| Grove Emergency Management |
| Seneca Cayuga Nation Emergency Management |
| Craig County Emergency Management |
| Vinita Emergency Management |
| Mayes Emergency Service Trust Authority (MESTA) |
| State of Oklahoma Risk Management |
| USACE Tulsa Office |

A sample request email to emergency management agencies and the record of correspondence is included in **Appendix A**. Contact with each agency was initiated through email followed by a phone contact if there was no response to the initial email. A list of the agencies contacted is included in **Appendix B**.

### 4.2.2 Tribal Consultation

A certified return-receipt letter was sent for tribal consultation soliciting information on and/or the location of infrastructure features of concern to their jurisdictions on November 25, 2020. Additional certified letters were sent if no receipt was returned from the initial letter, followed by a phone call if the second receipt was not returned. A sample request letter is included in **Appendix C**. The list of entities to which a certified letter was sent is included in **Appendix D**.

## 4.3 Modeling Scenarios

Mead & Hunt developed a hydraulic model of the area upstream of the Project, using the USACE Hydrologic Engineering Center (HEC) River Analysis System (RAS) software. A separate report on the Hydrologic and Hydraulic Modeling Study is filed concurrently with this Study report. For more information on development of the HEC-RAS model and the simulations used in the Study, see the H&H Modeling Study: Upstream Hydraulic Model Report (Mead & Hunt, 2021).

For the Study, three inflow events were used in combination with two starting reservoir elevations. Each simulation included a historical inflow event with a modified reservoir starting elevation. What residents experienced in real life when the historical events took place, regarding maximum inundation depth, only occurred when USACE took control of Project operations pursuant to its exclusive jurisdiction under the Flood Control Act of 1944, except when the time of maximum inundation depth was solely a function of inflow event arrival time and not reservoir elevation[1]. Similarly, the maximum inundation depths reported in this study for the various inflow events and reservoir starting elevations only occur when the reservoir elevation is above 745 feet PD, in which circumstance the USACE would control Project operations,

[1] For more information on how inflow events impact maximum water surface elevations and maximum inundation extents, see the Hydraulic and Hydraulic Modeling: Upstream Hydraulic Model Initial Study Report.

except when the time of maximum inundation depth is solely a function of inflow event arrival time and not reservoir elevation.

The starting elevations of 742 ft PD and 745 ft PD were selected for these simulations and analysis because they represent the maximum and minimum elevations of the conservation pool. The resulting six simulations are:

1. September 1993 event, starting reservoir elevation of 742 ft PD
2. September 1993 event, starting reservoir elevation of 745 ft PD
3. July 2007 event, starting reservoir elevation of 742 ft PD
4. July 2007 event, starting reservoir elevation of 745 ft PD
5. December 2015 event, starting reservoir elevation of 742 ft PD
6. December 2015 event, starting reservoir elevation of 745 ft PD

The inflow events represent a variety of flood frequencies at the Project. The September 1993 event is estimated to have a recurrence interval of 21 years. The July 2007 event is estimated to have a recurrence interval of 4 years. The December 2015 event is estimated to have a recurrence interval of 15 years. Correlating a recurrence interval at each infrastructure location is not feasible because flow at each location is unique based on its position in the watershed. However, recurrence intervals at the Project can be considered when reviewing inundation depths and the criticality of each infrastructure location. For more information on recurrence intervals, see the H&H Modeling Study: Upstream Hydraulic Model Report (Mead & Hunt, 2021).

## 4.4 GIS Data Extraction

Infrastructure locations are represented as point locations in the GIS data. GIS processing tools were used to extract water depth values at specific point locations from hydraulic modeling results. Esri's Spatial Analyst software tools in ArcMap 10.8 were used to extract data from hydraulic simulations (Esri, 2021).

For each of the six simulations used in the Study, maximum water depth values were extracted at each infrastructure location. The water depth values are compiled in tabular format for each infrastructure location and are presented along with the maps as described below.

## 4.5 Mapping and Tabular Data

### 4.5.1 Purpose of Maps

The infrastructure maps provided in **Appendix E** show which infrastructure locations may be impacted under different hydraulic conditions. The infrastructure locations and simulated inundation areas are displayed on the maps.

Base map information such as roads, municipal boundaries, and county boundaries were also collected to provide reference. The 2019 aerial images displayed on the maps are provided by the U.S. Department of Agriculture's Farm Service Agency (FSA) National Agricultural Imagery Program (NAIP) (U.S. Department of Agriculture, 2021).

### 4.5.2 Map Description

A series of 37 maps at a scale of 1:24,000 (1 inch = 2000 ft) cover the upstream modeling area. This scale is sufficient for less developed areas. Three map series are included in **Appendix E**, one map set for each simulated inflow event: September 1993, July 2007, and December 2015. The simulated inundation at both starting reservoir elevations (742 ft PD and 745 ft PD) is displayed on each map set.

Each 1:24,000-scale map sheet is divided further into four 1:12,000-scale map sheets for developed areas requiring more detail to present the infrastructure locations in relation to the modeled inundation area. Five 1:12,000-scale map sheets are provided for the Miami, OK area which has the largest concentration of infrastructure locations in the study area.

An overview map provided in **Appendix E** details the 1:24,000 scale and 1:12,000 scale map sheet index, provides the infrastructure point legend, and describes the inundation scenario symbology used on each map sheet.

#### 4.5.3 Tabular Data

Tabular data presented in **Appendix F** lists maximum water depths for all six simulated scenarios at each infrastructure location. Tabular data is also provided for the difference in maximum water depth for starting reservoir elevations of 742 ft PD and 745 ft PD. The tables provide a description of the infrastructure type and list the map sheet where the infrastructure feature is located. Maximum water depths and differences in maximum depth are reported to the nearest tenth of a foot.

# 5. Study Results

Each map set presents the results of a simulated inundation and its effects on existing infrastructure during Project operations. Each map set represents a specific inflow event at two different starting reservoir elevations: 742 ft PD and 745 ft PD.

The purpose of the Study is to analyze the impact Project operations could have on infrastructure. First, difference in inundation area was analyzed. **Table 4** presents the difference in inundation area due to the difference in starting reservoir elevation. The total increase in inundation area due to a starting reservoir elevation of 745 ft PD – 3 feet higher than a starting reservoir elevation of 742 ft PD – is less than 1 percent for all simulated events.

*Table 4. Difference in inundation area due to difference in starting reservoir elevation.*

| Event | Difference in Inundation Area |
|---|---|
| September 1993 | 0.3 % |
| July 2007 | 0.1 % |
| December 2015 | 0.6 % |

Second, the difference in inundation depth was analyzed. Infrastructure locations with differences in depth greater than 0.1 feet were divided into three classes for discussion:

1. Class 1 differences range from greater than 0.1 feet up to 0.3 feet.
2. Class 2 differences range from 0.3 feet up to 0.5 feet.
3. Class 3 differences are greater than or equal to 0.5 feet.

Infrastructure locations meeting these criteria were placed in a class based on the greatest difference in depth for the three events.

## 5.1 Class 1 differences

**Table 5** lists infrastructure locations with Class 1 differences, which include the following:

- ID 57 is a bridge over Tar Creek. The bridge is on Rockdale Boulevard in the left overbank[2] of the Neosho River at River Mile (RM) 134.0.
- ID 94 is Lion Taylor Park in Miami, OK. It is in the left overbank of the Neosho River at RM 134.5.
- ID 97 is a bridge over Little Elm Creek. The bridge is on S 580 Road in the left overbank of the Neosho River at RM 133.0. The location is approximately 0.5 miles downstream of Interstate 44 (Will Rogers Turnpike).
- ID 103 is the south side of Riverview Park in Miami, OK. It is in the left overbank of the Neosho River at RM 135.2, slightly downstream of the Highway 125 Bridge.

[2] In hydraulic modeling terms, left and right sides of the river are based on the downstream direction. If you are floating down the river in a boat and you look to your left, that is the left bank of the river.

*Table 5. Infrastructure locations with Class 1 differences.*

| Infrastructure ID | Map Panel | Location | Difference in Depth (ft) | | |
|---|---|---|---|---|---|
| | | | Sept. 1993 event | July 2007 event | Dec. 2015 event |
| 57 | B4, B4-3 | Rockdale Blvd Bridge | 0.2 | 0.1 | 0.0 |
| 94 | B4, B4-3 | Lion Taylor Park | 0.2 | 0.1 | 0.0 |
| 97 | B4, B4-4 | Little Elm Creek Bridge | 0.2 | 0.1 | 0.2 |
| 103 | B4, B4-3 | Riverview Park South | 0.1 | 0.1 | 0.2 |

## 5.2 Class 2 differences

**Table 6** lists infrastructure locations with Class 2 differences, which include the following:

- ID 127 is a bridge over Hudson Creek. The bridge is on S 580 Road in the right overbank of the Neosho River at RM 128.0.
- ID 150 is Wyandotte High School in Wyandotte, OK. It is in the left overbank of the Neosho River at RM 122.0, slightly downstream of the BN Railroad bridge.

*Table 6. Infrastructure locations with Class 2 differences.*

| Infrastructure ID | Map Panel | Location | Difference in Depth (ft) | | |
|---|---|---|---|---|---|
| | | | Sept. 1993 event | July 2007 event | Dec. 2015 event |
| 127 | C4 | Hudson Creek Bridge | 0.1 | 0.4 | 0.3 |
| 150 | C6 | Wyandotte High School | 0.1 | 0.4 | 0.3 |

## 5.3 Class 3 differences

**Table 7** lists infrastructure locations with Class 3 differences. All locations with Class 3 differences are at or below the confluence of the Spring and Neosho Rivers, or along the Spring River.

- ID 139 is the Twin Bridges State Park at the confluence of the Neosho and Spring Rivers, along the left bank of the Neosho River at RM 122.5.
- ID 140 is a bridge over Shawnee Branch. The bridge is on S 645 Road in the left overbank of the Spring River at RM 3.0.
- ID 166 is a bridge over Fly Creek. The bridge is on E 262 Road in the right overbank of Grand Lake at RM 90.0.
- ID 167 is Bernice State Park, off E Highway 85A in the right overbank of Grand Lake at RM 90.0.
- ID 175 is the Cherokee Seaplane Base in Red Arrow, OK. It is in the right overbank of Grand Lake at RM 89.0.
- ID 181 is the Wolf Creek Park and Boat Ramp near Grove, OK. It is along the left edge of Grand Lake at RM 102.5, just upstream of Sailboat Bridge.
- ID 185 is Grove Springs Park in Grove, OK. It is in the left overbank of Grand Lake at RM 102.5, just upstream of Sailboat Bridge.
- ID 206 is Bacon’s Heliport. It is along the left edge of Grand Lake at RM 82.8.

*Table 7. Infrastructure locations with Class 3 differences.*

| Infrastructure ID | Map Panel | Location | Difference in Depth (ft) | | |
|---|---|---|---|---|---|
| | | | Sept. 1993 event | July 2007 event | Dec. 2015 event |
| 139 | C5 | Twin Bridges State Park | 0.1 | 0.7 | 0.4 |
| 140 | C6 | Shawnee Branch Bridge | 0.1 | 0.7 | 0.2 |
| 166 | E3 | Fly Creek Bridge | 0.0 | 0.0 | 0.5 |
| 167 | E3 | Bernice State Park | 0.0 | 0.1 | 0.5 |
| 175 | F3 | Cherokee Seaplane Base | 0.0 | 0.1 | 0.5 |
| 181 | F5 | Wolf Creek Park | -0.1 | 0.0 | 0.5 |
| 185 | F5 | Grove Springs Park | 0.0 | 0.1 | 0.5 |
| 206 | G3 | Bacon’s Heliport | 0.0 | 0.1 | 0.5 |

# 6. Discussion of Results

Locations where difference in maximum depth between different starting reservoir elevations is 0.1 feet or less have not been described in this study because they are not appreciable for the purpose of studying impacts on infrastructure.

Only 14 out of 228 infrastructure locations (6% of locations) studied show an appreciable increase in inundation depth if the starting reservoir elevation is 742 feet as compared to 745 feet. Of the fourteen infrastructure locations, four are categorized as Class 1 differences, two are classified as a Class 2 difference, and eight are categorized as Class 3 differences.

For a given infrastructure location, the event that causes the largest difference in depth is discussed first, followed by discussion of difference in depth for the other two events. For example, if the differences in depth for the September 1993 event, June 2007 event, and December 2015 event are 0.1, 0.5, and 0.2 feet, respectively, the July 2007 event is discussed first, followed by a discussion of the September 1993 and December 2015 events.

## 6.1 Class 1 differences

Class 1 differences range from greater than 0.1 feet up to 0.3 feet in this study. Class 1 differences are located at Rockdale Boulevard Bridge, Lion Taylor Park, Little Elm Creek Bridge, and the south side of Riverview Park in Miami.

### 6.1.1 Rockdale Boulevard Bridge (ID 57)

Rockdale Boulevard Bridge on Tar Creek is initially inundated by 1.3 feet of water for the September 1993 event if the starting reservoir elevation is 742 feet. Inundation depth increases to 1.5 feet if the starting reservoir elevation is 745 feet. The September 1993 event inundation, displayed in **Figure 3**, extends well beyond the bridge. The bridge is unusable regardless of starting reservoir elevation.


*Figure 3. September 1993 event inundation extents at Rockdale Boulevard Bridge (ID 57).*

For the July 2007 event, the depth is 6.7 feet if the starting reservoir elevation is 742 feet; the depth increases by 0.1 feet if the starting reservoir elevation is 745 feet. The bridge will be impassible in either scenario. For the December 2015 event, the bridge is not inundated for either reservoir starting elevation. For all three events, increasing the starting reservoir elevation from 742 feet to 745 feet does not result in additional loss of infrastructure use at this location.

### 6.1.2 Lion Taylor Park (ID 94)

Lion Taylor Park is initially inundated by 0.3 feet of water for the September 1993 event if the starting reservoir elevation is 742 feet. Inundation depth increases to 0.5 feet if the starting reservoir elevation is 745 feet. While the maximum depths are relatively shallow, the park is mostly inundated for either starting reservoir elevation, as displayed in **Figure 4**. Increasing the reservoir elevation to 745 feet at the start of the event does not result in any additional loss of infrastructure use at this location.

For the July 2007 event, the depth is 5.8 feet if the starting reservoir elevation is 742 feet; the depth increases by 0.1 feet if the starting elevation is 745 feet. The park is completely inundated in either scenario. For the December 2015 event, the park is not inundated for either reservoir starting elevation. For all three events, increasing the starting reservoir elevation from 742 feet to 745 feet does not result in additional loss of infrastructure use at this location.

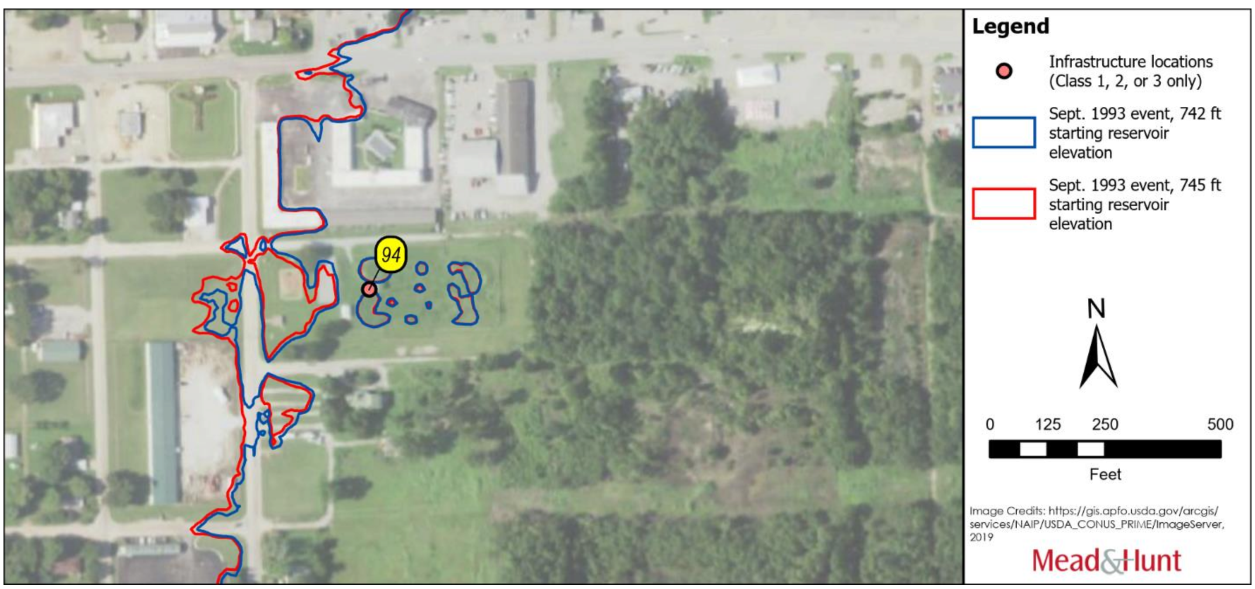



*Figure 4. September 1993 event inundation extents at Lion Taylor Park (ID 94).*

### 6.1.3 Little Elm Creek Bridge (ID 97)

Little Elm Creek Bridge is inundated by 5.2 feet of water for the December 2015 event if the starting reservoir elevation is 742 feet. Inundation depth increases to 5.4 feet if the starting reservoir elevation is 745 feet. The bridge is unusable regardless of the starting reservoir elevation.

For the September 1993 event and the July 2007 event, the bridge is inundated by 10.1 feet of water and 15.1 feet of water respectively for a starting elevation of 742 feet; the depths increase by 0.2 feet and 0.1 feet respectively if the starting reservoir elevation is 745 feet. The initial inundation makes any increased depth resulting from a starting reservoir elevation of 745 feet negligible for all three events and does not result in any additional loss of use of the infrastructure at this location.

### 6.1.4 Riverview Park South (ID 103)

At the south side of Riverview Park, for the December 2015 event, the park is initially inundated by 8.0 feet of water if the starting reservoir elevation is 742 feet. Inundation depth increases to 8.2 feet if the starting reservoir elevation is 745 feet. **Figure 5** displays the inundation extent for the December 2015 event.


*Figure 5. December 2015 event inundation at Riverview Park South (ID 103).*

For the September 1993 event and the July 2007 event, the park is inundated by 13.8 feet of water and 18.9 feet of water respectively if the starting reservoir elevation is 742 feet; both depths increase by 0.1 feet if the starting reservoir elevation is 745 feet. For all three events, the initial inundation means that any increased depth resulting from a starting reservoir elevation of 745 feet does not result in any additional loss of infrastructure use at this location.

## 6.2 Class 2 differences

Class 2 differences range from 0.3 feet up to 0.5 feet in this study. Class 2 differences are located at Hudson Creek Bridge and Wyandotte High School.

### 6.2.1 Hudson Creek Bridge (ID 127)

Hudson Creek Bridge is initially unusable and is inundated by 17.9 feet of water for the July 2007 event if the starting reservoir elevation is 742 feet, which increases to an inundation of 18.3 feet if the starting reservoir elevation is 745 feet. For the September 1993 event and the December 2015 event, the bridge is unusable and inundated by 15.0 feet of water and 12.4 feet of water respectively if the starting reservoir elevation is 742 feet; the depths increase by 0.1 feet and 0.3 feet respectively if the starting reservoir elevation is 745 feet. For all three events, the initial inundation means that any increased depth resulting from a starting reservoir elevation of 745 feet does not result in any additional loss of infrastructure use at this location.

### 6.2.2 Wyandotte High School (ID 150)

Wyandotte High School is initially inundated by 0.6 feet of water for the July 2007 event if the starting reservoir elevation is 742 feet. Inundation depth increases to 1.0 feet if the starting reservoir elevation is 745 feet. For the September 1993 event and the December 2015 event the grounds are inundated by 2.2

feet of water and 2.1 feet of water respectively if the starting reservoir elevation is 742 feet; the depths increase by 0.1 feet and 0.3 feet respectively if the starting reservoir elevation is 745 feet.

The Wyandotte School property is protected by an embankment. As displayed in **Figure 6**, there is a break in inundation due to the embankment and the inundation polygon that includes the school is disconnected from the main inundation polygon. This is a limitation of the study data and indicates that the school should not be inundated if the higher elevation of the embankment prevents overland flow from entering the school property.

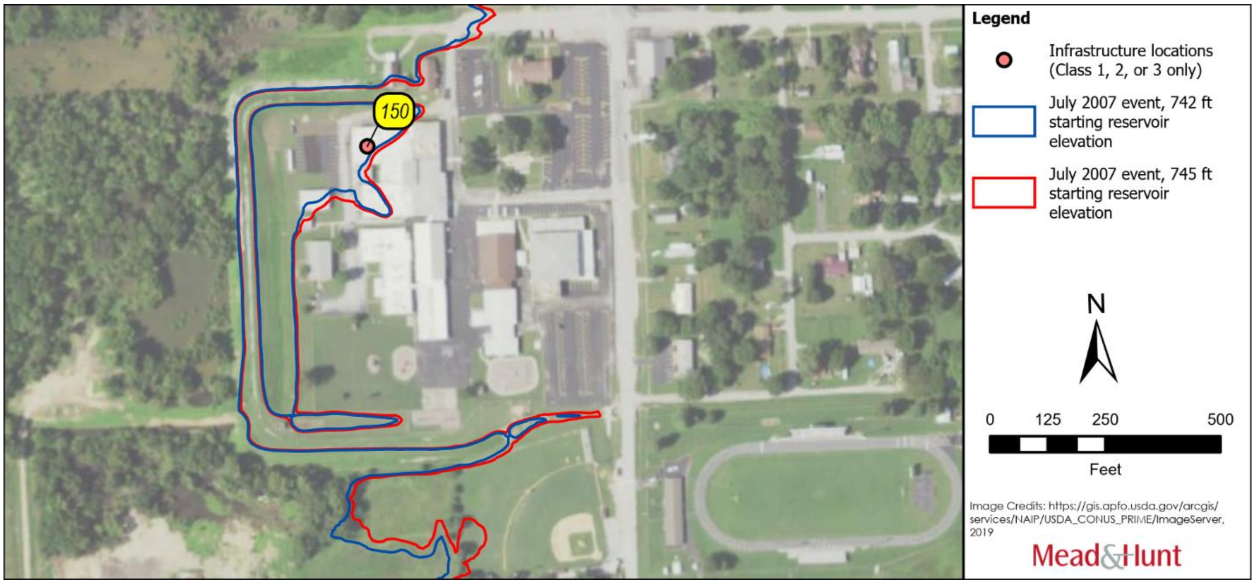



*Figure 6. July 2007 event inundation at Wyandotte High School (ID 150).*

## 6.3 Class 3 differences

Class 3 differences are differences greater than or equal to 0.5 feet in this study. Class 3 differences are located at Twin Bridges State Park, Shawnee Branch Bridge, Fly Creek Bridge, Bernice State Park, Cherokee Seaplane Base, Wolf Creek Park, Grove Springs Park, and Bacon's Heliport.

### 6.3.1 Twin Bridges State Park (ID 139)

Twin Bridges State Park is initially inundated by 7.8 feet of water for the July 2007 event if the starting reservoir elevation is 742 feet. All amenities other than part of the parking area are unusable. Inundation depth increases to 8.5 feet if the starting reservoir elevation is 745 feet. Inundation from the July 2007 event is displayed in **Figure 7**.

For the September 1993 event and the December 2015 event, the park is inundated by 12.4 feet of water and 10.0 feet of water respectively if the starting reservoir elevation is 742 feet; the depths increase by 0.1 feet and 0.4 feet respectively if the starting reservoir elevation is 745 feet. For all three events, the initial inundation means that any increased depth resulting from a starting reservoir elevation of 745 feet does not result in any additional loss of infrastructure use at this location.


*Figure 7. July 2007 event inundation at Twin Bridges State Park (ID 139).*

### 6.3.2 Shawnee Branch Bridge (ID 140)

The Shawnee Branch Bridge is initially unusable and is inundated by 2.4 feet of water for the July 2007 event if the starting reservoir elevation is 742 feet. Inundation depth increases to 3.1 feet of inundation if the starting reservoir elevation is 745 feet. The Shawnee Branch Bridge is already unusable for the July 2007 event regardless of the starting reservoir elevation of the reservoir.

For the September 1993 event and the December 2015 event, the bridge is inundated by 10.5 feet and 6.3 feet respectively if the starting reservoir elevation is 742 feet; the depths increase by 0.1 feet and 0.2 feet respectively if the starting reservoir elevation is 745 feet. For all three events, the initial inundation means that any increased depth resulting from a starting reservoir elevation of 745 feet does not result in any additional loss of infrastructure use at this location.

### 6.3.3 Fly Creek Bridge (ID 166)

The Fly Creek Bridge is initially unusable and is inundated by 3.1 feet of water for the December 2015 event if the starting reservoir elevation is 742 feet. Inundation depth increases to 3.6 feet if the starting reservoir elevation is 745 feet.

For the September 1993 event and the July 2007 event, the bridge is unusable and inundated by 3.7 feet of water and 3.0 feet of water respectively for a starting elevation of 742 feet; the depth does not increase for either event if the starting reservoir elevation is 745 feet. For all three events, the initial inundation means that any increased depth resulting from a starting reservoir elevation of 745 feet does not result in any additional loss of infrastructure use at this location.

### 6.3.4 Bernice State Park (ID 167)

Bernice State Park is initially unusable and is inundated by 2.4 feet of water for the December 2015 event if the starting reservoir elevation is 742 feet. Inundation depth increases to 2.9 feet if the starting reservoir elevation is 745 feet. Inundation from the December 2015 event is displayed in **Figure 8**.


*Figure 8. December 2015 event inundation at Bernice State Park (ID 167).*

For the September 1993 event and the July 2007 event, the grounds are inundated by 3.0 feet of water and 2.3 feet of water respectively for a starting elevation of 742 feet; the depths increase by 0.0 feet and 0.1 feet respectively if the starting reservoir elevation is 745 feet. For all three events, the initial inundation means that any increased depth resulting from a starting reservoir elevation of 745 feet does not result in any additional loss of infrastructure use at this location.

#### 6.3.5 Cherokee Seaplane Base (ID 175)

Cherokee Seaplane Base is initially inundated by 3.0 feet of water for the December 2015 event if the starting reservoir elevation is 742 feet. Inundation depth increases to 3.5 feet if the starting reservoir elevation is 745 feet. Inundation from the December 2015 event is displayed in **Figure 9**.


*Figure 9. December 2015 event inundation at Cherokee Seaplane Base (ID 175).*

For the September 1993 event and the July 2007 event, the base is inundated by 3.6 feet of water and 2.9 feet of water respectively if the starting elevation is 742 feet; the depths increase by 0.0 feet and 0.1

feet respectively if the starting reservoir elevation is 745 feet. For all three events, the initial inundation means that any increased depth resulting from a starting reservoir elevation of 745 feet does not result in any additional loss of infrastructure use at this location.

### 6.3.6 Wolf Creek Park (ID 181)

Wolf Creek Park is initially inundated by 5.1 feet of water for the December 2015 event if the starting reservoir elevation is 742 feet. Inundation depth increases to 5.6 feet if the starting reservoir elevation is 745 feet. Inundation from the December 2015 event is displayed in **Figure 10**.

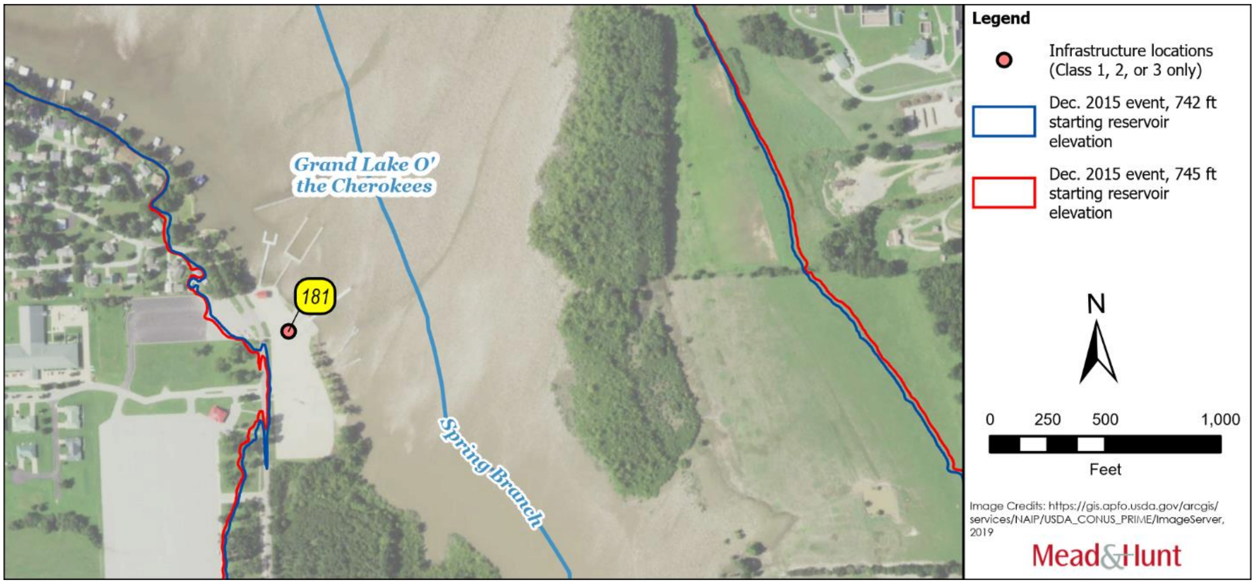



*Figure 10. December 2015 event inundation at Wolf Creek Park (ID 181).*

For the September 1993 event and the July 2007 event, the base is inundated by 5.7 feet of water and 5.0 feet of water respectively for a starting elevation of 742 feet; the depth does not increase for either event if the starting reservoir elevation is 745 feet. For all three events, the initial inundation means that any increased depth resulting from a starting reservoir elevation of 745 feet does not result in any additional loss of infrastructure use at this location.

### 6.3.7 Grove Springs Park (ID 185)

Grove Springs Park is initially inundated by 5.1 feet of water for the December 2015 event if the starting reservoir elevation is 742 feet. Inundation depth increases to 5.6 feet if the starting reservoir elevation is 745 feet. Inundation from the December 2015 event is displayed in **Figure 11**.

For the September 1993 event and the July 2007 event the park is inundated by 5.6 feet of water and 4.9 feet of water respectively for a starting elevation of 742 feet; the depths increase by 0.0 feet and 0.1 feet respectively if the starting reservoir elevation is 745 feet. For all three events, the initial inundation means that any increased depth resulting from a starting reservoir elevation of 745 feet does not result in any additional loss of infrastructure use at this location.

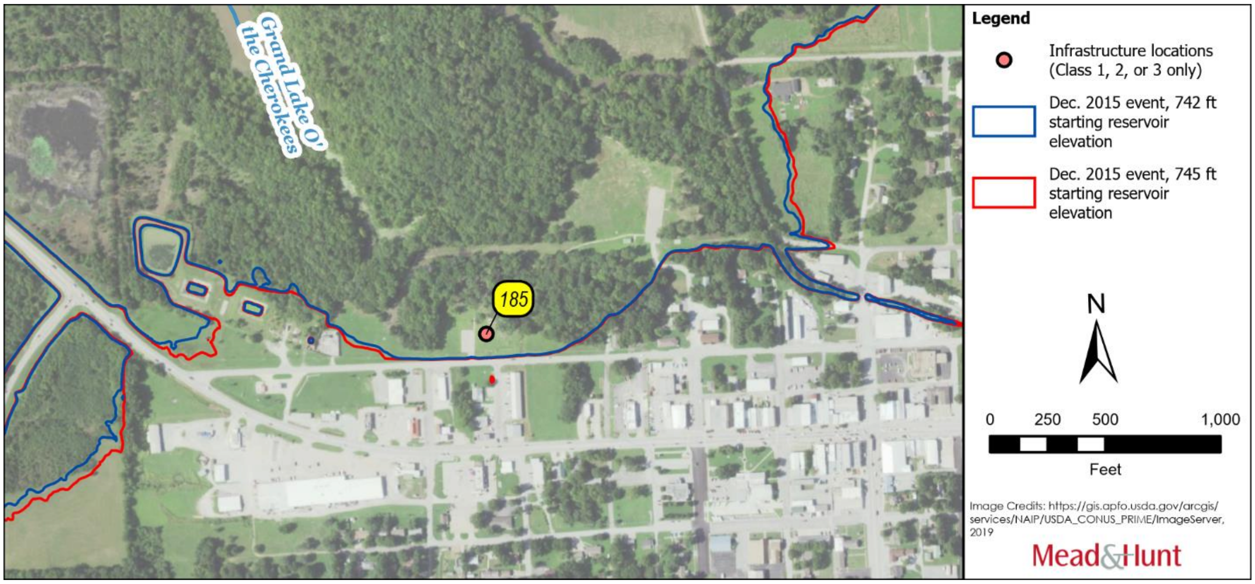



*Figure 11. December 2015 event inundation at Grove Springs Park (ID 185).*

### 6.3.8 Bacon's Heliport (ID 206)

Bacon's Heliport is a floating structure. However, if it were not a floating structure it would be initially inundated by 33.3 feet of water for the December 2015 event if the starting reservoir elevation is 742 feet. Inundation depth would increase to 33.8 feet if the starting reservoir elevation is 745 feet. Inundation from the December 2015 event is displayed in **Figure 12**.

For the September 1993 event and the July 2007 event, the depth would be 33.9 feet of water and 33.2 feet of water respectively for a starting elevation of 742 feet; the depths would increase by 0.0 and 0.1 feet respectively if the starting reservoir elevation is 745 feet. If the heliport was not a floating structure, the initial inundation would mean that any increased depth resulting from a starting reservoir elevation of 745 feet would not result in any additional loss of infrastructure use at this location.

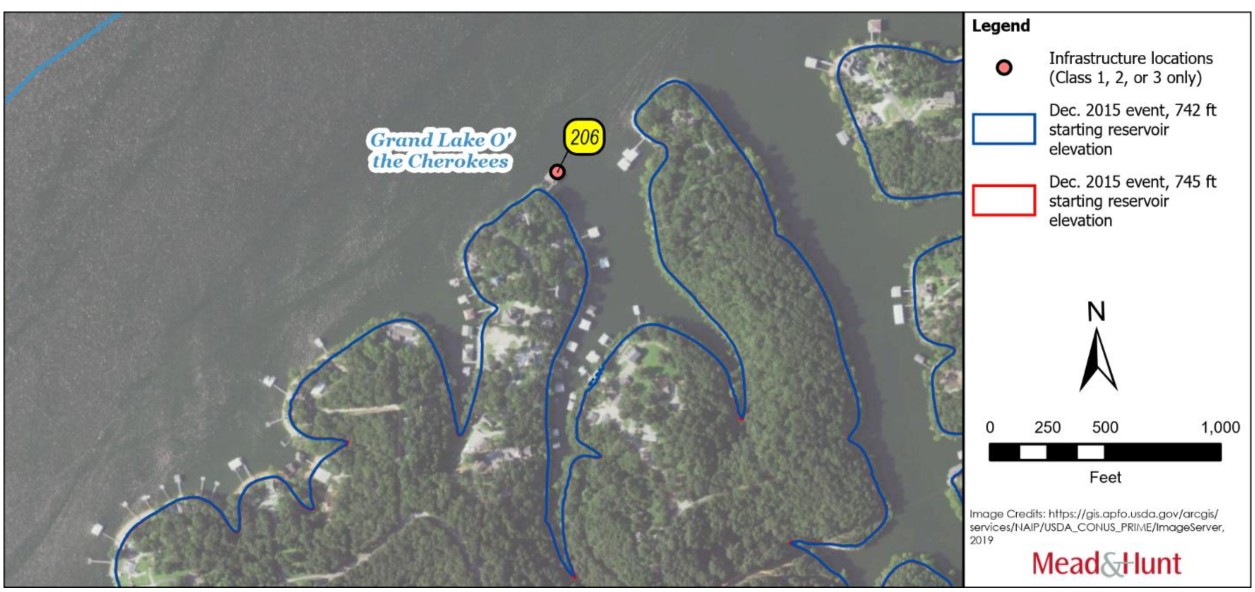



*Figure 12. December 2015 event inundation at Bacon's Heliport (ID 206).*

# 7. Conclusions

Only 6% of the infrastructure locations studied experience an appreciable increase in maximum inundation depth due to a starting reservoir elevation increase from 742 feet to 745 feet. All appreciable increases in maximum inundation depth occur during high-flow conditions when the USACE controls the flood control operations under the Flood Control Act of 1944, except when the time of maximum inundation depth is solely a function of inflow event arrival time and not reservoir elevation. Therefore, no additional adverse impacts exist due to Project operation.

# 8. References

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# APPENDIX A:
# SAMPLE EMAIL TO LOCAL EMERGENCY MANAGEMENT AGENCIES

## Brauna Hartzell

**From:** Jesse Piotrowski
**Sent:** Thursday, June 18, 2020 3:44 PM
**To:** tanderson@miamiokla.net
**Cc:** Shawn Puzen
**Subject:** Grand Lake Infrastructure Study

**Categories:** Important, Filed by Newforma

Mr. Anderson,

Mead & Hunt is performing a study at the direction of the Federal Energy Regulatory Commission (FERC) in support of the Grand River Dam Authority's intent to relicense the Pensacola Hydroelectric Project. The study is an effort to identify if hydrologic events could potentially have an effect on the frequency or depth of flooding for critical infrastructure such as:

1. Bridges and roads
2. Structures (fire stations, hospitals, substations, schools, wastewater treatment plants, etc.)
3. Public amenities (e.g. parks)

We have already compiled publicly available data sources such as shelters, airports, bridges, churches, fire stations, hospitals, law enforcement facilities, parks, power plants, substations, schools, wastewater treatment facilities, and water treatment facilities.

We are respectfully requesting your assistance in helping us identify any additional critical infrastructure that will not be included in the above datasets that could be affected by Pensacola Dam operations. To help you answer our question above, please answer the following questions to yourself:

1. Do you maintain a list of infrastructure that could potentially be affected by Pensacola Dam operations?
2. Do you have an emergency response plan?
3. Do you have a list of critical road intersections or road segments that are necessary for emergency response?

Answering the above questions may help you identify additional critical information that could assist with the study.

We greatly appreciate your assistance in this matter. If you would like, we can set up a teleconference to discuss our request. Please direct all responses to jesse.piotrowski@meadhunt.com. We would like to complete the identification of critical infrastructure by July 20, 2020.

Thank you in advance for your time and effort,
Jesse Piotrowski

**JESSE PIOTROWSKI**, PE, CFM
ENGINEER, WATER
Mead & Hunt
Direct: 608-443-0434 | Transfer Files
meadhunt.com | LinkedIn | Twitter | Facebook | Instagram

# APPENDIX B:
# LIST OF EMERGENCY MANAGEMENT AGENCIES CONTACTED

# Oklahoma Emergency Management Directory

| Ottawa | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Jurisdiction** | **Director** | **Address** | **City** | **St** | **ZIP** | **W-Phone** | **Email** |
| Miami Emergency Mgmt | Thomas Anderson | 129 5th Ave NW | Miami | OK | 74354 | 918-541-2302 | tanderson@miamiokla.net |
| Ottawa County Emergency Mgmt | Chad Holcomb | 123 East Central Suite 1 | Miami | OK | 74354 | 918-961-1676 | ottawacountyem@gmail.com |
| Quapaw Tribe | Jeff Reeves | P.O. Box 200 | Quapaw | OK | 74344 | 918-675-4200 | picherchief1@yahoo.com |
| | Randy Jackson | | | | | 918-533-4359 | jjackson@quapawnation.com |
| Wyandotte Emergency Mgmt | Leon Crow | P.O. Box 240 | Wyandotte | OK | 74370 | 918-542-1853 | leoncrow@yahoo.com |

| Delaware | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Jurisdiction** | **Director** | **Address** | **City** | **St** | **ZIP** | **W-Phone** | **Email** |
| Delaware County Emergency Mgmt | Travis Beesley | P.O. Box 309 | Jay | OK | 74342 | 918-353-2041 | delawarecountyem@yahoo.com |
| Grove Emergency Management | Frank Close | 104 West 3rd Street | Grove | OK | 74344 | 918-787-4357 | fclose@cityofgroveok.gov |
| | Main line (City Hall) | | | | | 918-786-6107 | |
| | Calvin Igney | | | | | 918-290-1975 (cell) | cigney@cityofgroveok.gov |
| | Russ Schmidt (GIS) | | | | | 918-964-3002 (cell) | rschmidt@cityofgroveok.gov |
| Seneca Cayuga Nation Emergency | Chris Arnold | P.O. Box 453220 | Grove | OK | 74345 | 918-787-9272 | carnold@sctribe.com |

| Craig County | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Jurisdiction** | **Director** | **Address** | **City** | **St** | **ZIP** | **W-Phone** | **Email** |
| Craig Co Emergency Mgmt | Morris Bluejacket | 210 W Delaware Suite 1 | Vinita | OK | 74301 | 918-323-0055 | craigco.em1@gmail.com |
| Vinita Emergency Mgmt | Morris Bluejacket | 210 W Delaware Suite 1 | Vinita | OK | 74301 | 918-323-0055 | craigco.em1@gmail.com |

| Mayes County | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Jurisdiction** | **Director** | **Address** | **City** | **St** | **ZIP** | **W-Phone** | **Email** |
| Mayes County Emergency Mgmt | Johnny Janzen | 1 Court Pl Suite 140 | Pryor | OK | 74361 | 918-825-4650 | mayescountyem@yahoo.com |
| Pryor Emergency Mgmt | Johnny Janzen | 12 North Rowe Street | Pryor | OK | 74361 | 918-825-4650 | mayescountyem@yahoo.com |

# GRDA Contact List

| Agency | | | | Phone | Email |
|---|---|---|---|---|---|
| Mayes Emergency Service Trust Authority (MESTA) | | | | 918-825-1155 | info@mestaems.org |
| Oklahoma Department of Civil Emergency Management (OCEM) | | | | 800-800-2481 (24-hours) | |
| | | | | 405-521-2481 (main) | |
| | | | | 405-833-3159 (Allison) | allison.whitsitt@oem.ok.gov |
| State of Oklahoma Risk Management | | | | 405-521-4999 (main) | |
| Gene Lidyard, Administrator | | | | | |
| Janet Morrow | | | | 405-521-6051 | |
| U.S. Army Corps of Engineers (USACE) Tulsa Office: Kerri Parks Stark | | | | 918-669-7431 | kerri.stark@usace.army.mil |

# APPENDIX C:
# SAMPLE CERTIFIED LETTER

Mead & Hunt

November 25, 2020

Chief Nelson Harjo
Alabama-Quassarte Tribal Town
PO Box 187
Wetumka, OK 74883

Subject: Grand Lake Infrastructure Study

Dear Chief Nelson Harjo:

Mead & Hunt is performing a study at the direction of the Federal Energy Regulatory Commission (FERC) in support of the Grand River Dam Authority's intent to relicense the Pensacola Hydroelectric Project. The study is an effort to identify if hydrologic events could potentially have an effect on the frequency or depth of flooding for critical infrastructure such as:

1. Bridges and roads
2. Structures (fire stations, hospitals, substations, schools, wastewater treatment plants, etc.)
3. Public amenities (e.g. parks)

We have already compiled publicly available data sources such as shelters, airports, bridges, churches, fire stations, hospitals, law enforcement facilities, parks, power plants, substations, schools, wastewater treatment facilities, and water treatment facilities.

We are respectfully requesting your assistance in helping us identify any additional critical infrastructure that may not be available in publicly available data sources, but which could be affected by Pensacola Dam operations. To help you consider whether you may be aware of any such critical infrastructure, please consider the following questions:

1. Do you maintain a list of infrastructure that could potentially be affected by Pensacola Dam operations?
2. Do you have an emergency response plan?
3. Do you have a list of critical road intersections or road segments that are necessary for emergency response?

If you are aware of any critical infrastructure that could be affected by Pensacola Dam operations, please send a description of the infrastructure and locational information, so that we can include it in our study.

We greatly appreciate your assistance in this matter. If you would like, we can set up a teleconference to discuss our request. Please direct all responses to shawn.puzen@meadhunt.com. We would like to complete the identification of critical infrastructure by January 8, 2020.

Thank you in advance for your time and effort,

Sincerely,

MEAD & HUNT, Inc.

Shawn Puzen
FERC Hydropower Relicensing and Compliance

# APPENDIX D:
# MAILING LIST FOR CERTIFIED LETTERS

## Socioeconomic Study Distribution List Tribal Organizations

| Organization | Name | Address | City | St | ZIP | Phone | Email |
|---|---|---|---|---|---|---|---|
| Alabama-Quassarte Tribal Town | Chief Nelson Harjo | PO Box 187 | Wetumka | OK | 74883 | | |
| Apache Tribe of Oklahoma | Chairman Bobby Komardley | 511 E Colorado | Anadarko | OK | 73005 | | |
| Caddo Nation | Derek Hill | PO Box 487 | Binger | OK | 73009 | | dhill@caddonation.org |
| Caddo Nation of Oklahoma | Chairman Tamara Francis-Fourkiller | PO Box 487 | Binger | OK | 73009 | | caddochair.cn@gmail.com |
| Cherokee Nation | Chief Chuck Hoskins | PO Box 948 | Tahlequah | OK | 74465 | | |
| Cherokee Nation | Elizabeth Toombs | PO Box 948 | Tahlequah | OK | 74465 | | elizabeth-toombs@cherokee.org |
| Delaware Nation | Deborah Dotson | PO Box 825 | Anadarko | OK | 73005 | | ddotson@delawarenation.com |
| Delaware Tribe of Indians | Chief Chester Brooks | 170 NE Barbara | Bartlesville | OK | 74006 | | cbrooks@delawaretribe.org |
| Eastern Shawnee Tribe of Oklahoma | Chief Glenna J. Wallace | 70500 E 128 Road | Wyandotte | OK | 74370 | | gjwallace@estoo.net |
| Inter-Tribal Council Inc. | | 21 N S Eight Tribe Trail, Suite C | Miami | OK | 74354 | | |
| Iowa Tribe of Oklahoma | Chairman Bobby Walkup | 335588 E 750 Road | Perkins | OK | 74059 | | |
| Jacobson Law Group (Counsel for Miami Nation) | Joe Halloran | 180 East 5th Street, Suite 940 | St. Paul | MN | 55101 | | jhalloran@thejacobsonlawgroup.com |
| Kiowa Tribe Office of Historic Preservation | Kellie Lewis | PO Box 369 | Carnegie | OK | 73015 | | kellie@tribaladminservices.org |
| Little Traverse Bay Bands of Odawa Indians | Regina Gasco-Bentley | 7500 Odawa Circle | Harbor Springs | MI | 49740 | | |
| Miami Tribe of Oklahoma | Chief Douglas G. Lankford | PO Box 1326 | Miami | OK | 74354 | | dlankford@miamination.com |
| Modoc Tribe of Oklahoma | Chief Bill Follis | 515 G Street SE | Miami | OK | 74354 | | modoctribe@cableone.net |
| Muscogee (Creek) Nation | Chief James Floyd | PO Box 580 | Okmulgee | OK | 74447 | | jfloyd@mcn-nsn.gov |
| Osage Nation | Chief Geoffrey Standing Bear | 627 Grandview Avenue | Pawhuska | OK | 74056 | | |
| Osage Nation Historic Preservation Office | James Munkres | 627 Grandview Avenue | Pawhuska | OK | 74056 | | jmunkres@osagenation-nsn.gov |
| Osage Nation Historic Preservation Office | Andrea Hunter | 627 Grandview Avenue | Pawhuska | OK | 74056 | | ahunter@osagenation-nsn.gov |
| Otoe-Missouria Tribe of Indians | Chairman John Shotton | 8151 Hwy 177 | Red Rock | OK | 74651 | | jshotton@omtribe.org |
| Ottawa Tribe of Oklahoma | Chief Ethel Cook | PO Box 110 | Miami | OK | 74354 | | cethel.oto@gmail.com |
| Ottawa Tribe of Oklahoma | Rhonda Hayworth | PO Box 110 | Miami | OK | 74355 | | rhonda.oto@gmail.com |
| Peoria Tribe of Oklahoma | Chief Craig Harper | 118 South Eight Tribes Trail | Miami | OK | 74354 | 918-540-2535 | chiefharper@peoriatribe.com |
| Quapaw Tribe of Oklahoma | Chairman John Berrey | PO Box 765 | Quapaw | OK | 74363 | | |
| Quapaw Tribe of Oklahoma | Everett Bandy | PO Box 765 | Quapaw | OK | 74363 | | ebandy@quapatribe.com |
| Sac and Fox Nation of Oklahoma | Chief Kay Rhoads | 920963 S Hwy 99, Building A | Stroud | OK | 74079 | | |
| Seneca-Cayuga Nation | Chief William Fisher | PO Box 453220 | Grove | OK | 74345-3220 | | wfisher@sctribe.com |
| Shawnee Tribe of Oklahoma | Chief Ron Sparkman | PO Box 189 | Miami | OK | 74354 | | rondede1@gmail.com |
| | Office | 29 S. Hwy 69A | Miami | OK | 74354 | 918-542-2441 x101 | agnes@shawnee-tribe.com |
| Tonkawa Tribe of Oklahoma | President Russel Martin | 1 Rush Buffalo Road | Tonkawa | OK | 74653 | 580-628-2561 | |
| United Keetoowah Band of Cherokees | Chief Joe Bunch | PO Box 746 | Tahlequah | OK | 74465 | | |
| Wichita and Affiliated Tribes | President Terri Parton | PO Box 729 | Anadarko | OK | 735005 | | terri.parton@wichitatribe.com |
| Wyandotte Nation | Norman Hildebrand, Jr. | 64700 East Highway 60 | Wyandotte | OK | 74370 | | nhildebrand@wyandotte-nation.org |
| Wyandotte Tribe of Oklahoma | Chief Billy Friend | 64700 East Highway 60 | Wyandotte | OK | 74370 | | bfriend@wyandotte-nation.org |

# APPENDIX E:
# INFRASTRUCTURE MAPS

*Note: This appendix is included as a separate set of PDF files.*

# APPENDIX F:
# TABULAR DATA SHEETS

# PENSACOLA DAM

GRAND RIVER DAM AUTHORITY

INFRASTRUCTURE DEPTH DATA SHEET

| Infrastructure ID | Map Panel | Location | Ground Elevation (ft, NGVD29) | Depth (ft), Sept. 1993 event | | Depth (ft), July 2007 event | | Depth (ft), December 2015 | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 742 ft PD starting WSEL | 745 ft PD starting WSEL | 742 ft PD starting WSEL | 745 ft PD starting WSEL | 742 ft PD starting WSEL | 745 ft PD starting WSEL |
| 1 | A1 | Bridge,Off-sys | 783.9 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2 | A2 | Church | 790.3 | n/a | n/a | n/a | n/a | n/a | n/a |
| 3 | A2 | Bridge,Off-sys | 784.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 4 | A2 | Bridge,Off-sys | 773.5 | 2.3 | 2.3 | 5.1 | 5.1 | 0.3 | 0.3 |
| 5 | A3 | Bridge,Off-sys | 783.7 | n/a | n/a | n/a | n/a | n/a | n/a |
| 6 | A3 | Bridge,Off-sys | 784.9 | n/a | n/a | n/a | n/a | n/a | n/a |
| 7 | A5 | Bridge,Off-sys | 770.8 | 19.7 | 19.7 | n/a | n/a | 14.9 | 14.9 |
| 8 | A6 | Bridge,Off-sys | 798.0 | 7.4 | 7.4 | n/a | n/a | 2.5 | 2.5 |
| 9 | A6 | Bridge,Off-sys | 788.8 | 15.2 | 15.2 | n/a | n/a | 9.8 | 9.8 |
| 10 | A6 | Bridge,Off-sys | 797.1 | 8.3 | 8.3 | n/a | n/a | 3.4 | 3.4 |
| 11 | A6 | Bridge,Off-sys | 782.4 | 21.2 | 21.2 | n/a | n/a | 15.7 | 15.7 |
| 12 | A6 | Bridge,Off-sys | 781.3 | 22.0 | 22.0 | n/a | n/a | 16.6 | 16.6 |
| 13 | A6 | Park | 777.1 | 23.2 | 23.2 | n/a | n/a | 17.8 | 17.8 |
| 14 | A6 | Bridge,Off-sys | 801.9 | n/a | n/a | n/a | n/a | n/a | n/a |
| 15 | A6 | Bridge,Off-sys | 796.0 | n/a | n/a | n/a | n/a | n/a | n/a |
| 16 | A6 | Bridge,Off-sys | 780.5 | 11.2 | 11.2 | n/a | n/a | 5.9 | 5.9 |
| 17 | B2 | Bridge,Off-sys | 767.6 | 5.0 | 5.0 | 9.1 | 9.1 | 1.3 | 1.3 |
| 18 | B2 | Bridge,Off-sys | 766.9 | 5.5 | 5.5 | 9.8 | 9.8 | 2.1 | 2.1 |
| 19 | B2 | Bridge,Off-sys | 771.8 | n/a | n/a | 4.5 | 4.5 | n/a | n/a |
| 20 | B2 | Bridge,Off-sys | 787.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 21 | B2 | Bridge,Off-sys | 782.7 | n/a | n/a | n/a | n/a | n/a | n/a |
| 22 | B2 | Bridge,Off-sys | 786.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 23 | B2 | Bridge,On-sys | 797.9 | n/a | n/a | n/a | n/a | n/a | n/a |
| 24 | B2 | Bridge,On-sys | 791.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 25 | B2 | Bridge,On-sys | 796.4 | n/a | n/a | n/a | n/a | n/a | n/a |
| 26 | B2 | Bridge,On-sys | 780.8 | n/a | n/a | n/a | n/a | n/a | n/a |
| 27 | B2 | School | 789.0 | n/a | n/a | n/a | n/a | n/a | n/a |
| 28 | B2 | Church | 789.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 29 | B3 | Bridge,Off-sys | 774.9 | n/a | n/a | 1.9 | 2.0 | n/a | n/a |
| 30 | B3 | Bridge,Off-sys | 779.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 31 | B3 | Bridge,Off-sys | 780.9 | n/a | n/a | n/a | n/a | n/a | n/a |

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# PENSACOLA DAM

GRAND RIVER DAM AUTHORITY

INFRASTRUCTURE DEPTH DATA SHEET

| Infrastructure ID | Map Panel | Location | Ground Elevation (ft, NGVD29) | Depth (ft), Sept. 1993 event | | Depth (ft), July 2007 event | | Depth (ft), December 2015 | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 742 ft PD starting WSEL | 745 ft PD starting WSEL | 742 ft PD starting WSEL | 745 ft PD starting WSEL | 742 ft PD starting WSEL | 745 ft PD starting WSEL |
| 32 | B3 | Bridge,Off-sys | 768.9 | 3.7 | 3.7 | 7.8 | 7.9 | 0.2 | 0.2 |
| 33 | B3 | Bridge,Off-sys | 794.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 34 | B3 | Bridge,Off-sys | 776.0 | n/a | n/a | n/a | n/a | n/a | n/a |
| 35 | B3, B3-4 | Church | 781.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 36 | B3 | Bridge,Off-sys | 765.4 | 5.3 | 5.4 | 10.1 | 10.2 | n/a | n/a |
| 37 | B3 | Bridge,On-sys | 779.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 38 | B3, B3-4 | Bridge,On-sys | 765.3 | 5.3 | 5.3 | 10.1 | 10.2 | n/a | n/a |
| 39 | B4, B4-1 | Park | 790.4 | n/a | n/a | n/a | n/a | n/a | n/a |
| 40 | B4, B4-1 | Shelter - Evac Only | 782.8 | n/a | n/a | n/a | n/a | n/a | n/a |
| 41 | B4, B4-1 | Church | 789.8 | n/a | n/a | n/a | n/a | n/a | n/a |
| 42 | B4, B4-1 | Church | 794.0 | n/a | n/a | n/a | n/a | n/a | n/a |
| 43 | B4, B4-1 | Bridge,Off-sys | 783.0 | n/a | n/a | n/a | n/a | n/a | n/a |
| 44 | B4, B4-1 | Bridge,Off-sys | 789.3 | n/a | n/a | n/a | n/a | n/a | n/a |
| 45 | B4, B4-1 | Church | 789.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 46 | B4, B4-1 | School | 782.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 47 | B4, B4-3 | Park | 771.4 | 2.6 | 2.6 | 1.5 | 1.6 | 0.6 | 0.6 |
| 48 | B4, B4-3 | Bridge,On-sys | 780.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 49 | B4, B4-3 | Bridge,Off-sys | 770.8 | 1.9 | 1.9 | 2.2 | 2.3 | 0.1 | 0.1 |
| 50 | B4, B4-3 | Bridge,Off-sys | 777.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 51 | B4, B4-3 | Fire Station | 789.5 | n/a | n/a | n/a | n/a | n/a | n/a |
| 52 | B4, B4-4 | Church | 789.0 | n/a | n/a | n/a | n/a | n/a | n/a |
| 53 | B4, B4-3 | Church | 779.9 | n/a | n/a | n/a | n/a | n/a | n/a |
| 54 | B4, B4-4 | Bridge,Off-sys | 784.8 | n/a | n/a | n/a | n/a | n/a | n/a |
| 55 | B4, B4-4 | Bridge,Off-sys | 786.3 | n/a | n/a | n/a | n/a | n/a | n/a |
| 56 | B4, B4-3 | Cell Tower | 771.0 | n/a | n/a | 2.0 | 2.1 | n/a | n/a |
| 57 | B4, B4-3 | Bridge,Off-sys | 766.2 | 1.3 | 1.5 | 6.7 | 6.8 | n/a | n/a |
| 58 | B4, B4-3 | Cell Tower | 788.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 59 | B4, B4-3 | Church | 780.0 | n/a | n/a | n/a | n/a | n/a | n/a |
| 60 | B4, B4-3 | Church | 795.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 61 | B4, B4-3 | School | 797.4 | n/a | n/a | n/a | n/a | n/a | n/a |
| 62 | B4, B4-3 | Church | 797.0 | n/a | n/a | n/a | n/a | n/a | n/a |

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# PENSACOLA DAM

GRAND RIVER DAM AUTHORITY

INFRASTRUCTURE DEPTH DATA SHEET

| Infrastructure ID | Map Panel | Location | Ground Elevation (ft, NGVD29) | Depth (ft), Sept. 1993 event | | Depth (ft), July 2007 event | | Depth (ft), December 2015 | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 742 ft PD starting WSEL | 745 ft PD starting WSEL | 742 ft PD starting WSEL | 745 ft PD starting WSEL | 742 ft PD starting WSEL | 745 ft PD starting WSEL |
| 63 | B4, B4-3 | Church | 793.8 | n/a | n/a | n/a | n/a | n/a | n/a |
| 64 | B4, B4-3 | School | 769.7 | n/a | n/a | 3.2 | 3.3 | n/a | n/a |
| 65 | B4, B4-3 | Law Enforcement | 776.0 | n/a | n/a | n/a | n/a | n/a | n/a |
| 66 | B4, B4-3 | School | 782.3 | n/a | n/a | n/a | n/a | n/a | n/a |
| 67 | B4, B4-3 | Church | 787.3 | n/a | n/a | n/a | n/a | n/a | n/a |
| 68 | B4, B4-3 | Church | 794.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 70 | B4, B4-3 | Church | 785.9 | n/a | n/a | n/a | n/a | n/a | n/a |
| 71 | B4, B4-3 | School | 785.9 | n/a | n/a | n/a | n/a | n/a | n/a |
| 72 | B4, B4-3 | Church | 788.4 | n/a | n/a | n/a | n/a | n/a | n/a |
| 73 | B4, B4-3 | Bridge,Off-sys | 772.5 | n/a | n/a | 0.5 | 0.6 | n/a | n/a |
| 74 | B4, B4-3 | Church | 786.3 | n/a | n/a | n/a | n/a | n/a | n/a |
| 75 | B4, B4-3 | Church | 792.3 | n/a | n/a | n/a | n/a | n/a | n/a |
| 76 | B4, B4-3 | Shelter - Evac Only | 795.5 | n/a | n/a | n/a | n/a | n/a | n/a |
| 77 | B4, B4-4 | School | 789.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 78 | B4, B4-3 | Church | 795.0 | n/a | n/a | n/a | n/a | n/a | n/a |
| 79 | B4, B4-3 | Church | 793.0 | n/a | n/a | n/a | n/a | n/a | n/a |
| 80 | B4, B4-3 | Hospital | 789.5 | n/a | n/a | n/a | n/a | n/a | n/a |
| 81 | B4, B4-3 | Hospital | 790.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 82 | B4, B4-3 | Church | 792.9 | n/a | n/a | n/a | n/a | n/a | n/a |
| 83 | B4, B4-4 | Law Enforcement | 784.3 | n/a | n/a | n/a | n/a | n/a | n/a |
| 84 | B4, B4-3 | Church | 775.3 | n/a | n/a | n/a | n/a | n/a | n/a |
| 85 | B4, B4-3 | Airport | 785.8 | n/a | n/a | n/a | n/a | n/a | n/a |
| 86 | B4, B4-4 | Bridge,On-sys | 767.0 | n/a | n/a | 4.8 | 4.9 | n/a | n/a |
| 87 | B4, B4-4 | Bridge,On-sys | 809.6 | n/a | n/a | n/a | n/a | n/a | n/a |
| 88 | B4, B4-3 | Bridge,On-sys | 765.4 | 2.2 | 2.3 | 7.6 | 7.7 | n/a | n/a |
| 89 | B4, B4-3 | Shelter - Evac Only | 782.0 | n/a | n/a | n/a | n/a | n/a | n/a |
| 90 | B4, B4-3 | Church | 781.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 91 | B4, B4-3 | Bridge,On-sys | 783.3 | n/a | n/a | n/a | n/a | n/a | n/a |
| 92 | B4, B4-3 | School | 781.6 | n/a | n/a | n/a | n/a | n/a | n/a |
| 93 | B4, B4-3 | School | 770.9 | n/a | n/a | 2.8 | 2.9 | n/a | n/a |
| 94 | B4, B4-3 | Park | 767.2 | 0.3 | 0.5 | 5.8 | 5.9 | n/a | n/a |

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# PENSACOLA DAM

GRAND RIVER DAM AUTHORITY

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|---|---|---|---|---|---|---|---|---|---|
| | | | | 742 ft PD starting WSEL | 745 ft PD starting WSEL | 742 ft PD starting WSEL | 745 ft PD starting WSEL | 742 ft PD starting WSEL | 745 ft PD starting WSEL |
| 95 | B4, B4-3 | Substation | 775.4 | n/a | n/a | n/a | n/a | n/a | n/a |
| 96 | B4, B4-3 | Substation | 778.5 | n/a | n/a | n/a | n/a | n/a | n/a |
| 97 | B4, B4-4 | Bridge,Off-sys | 756.6 | 10.1 | 10.3 | 15.1 | 15.2 | 5.2 | 5.4 |
| 98 | B4, B4-3 | Fire Station | 772.6 | n/a | n/a | 1.6 | 1.7 | n/a | n/a |
| 99 | B4, B4-3 | Bridge,RR | 772.7 | n/a | n/a | 1.6 | 1.7 | n/a | n/a |
| 100 | B4, B4-4 | Bridge,On-sys | 802.6 | n/a | n/a | n/a | n/a | n/a | n/a |
| 101 | B4, B4-3 | Bridge,On-sys | 777.5 | n/a | n/a | n/a | n/a | n/a | n/a |
| 102 | B4, B4-3 | Park | 761.8 | 7.2 | 7.3 | 12.3 | 12.3 | 1.4 | 1.5 |
| 103 | B4, B4-3 | Park | 755.2 | 13.8 | 13.9 | 18.9 | 19.0 | 8.0 | 8.2 |
| 104 | B4, B4-3 | Wastewater Treatment | 774.6 | n/a | n/a | n/a | n/a | n/a | n/a |
| 105 | B4, B4-3 | Park | 760.6 | 8.4 | 8.5 | 13.5 | 13.6 | 2.6 | 2.7 |
| 106 | B5 | Bridge,On-sys | 777.4 | n/a | n/a | n/a | n/a | n/a | n/a |
| 107 | B5 | Bridge,On-sys | 807.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 108 | B6 | Bridge,On-sys | 809.8 | n/a | n/a | n/a | n/a | n/a | n/a |
| 109 | B6 | Bridge,Off-sys | 782.2 | 1.8 | 1.8 | n/a | n/a | n/a | n/a |
| 110 | B6 | Bridge,Off-sys | 779.4 | 0.9 | 0.9 | n/a | n/a | n/a | n/a |
| 111 | B6 | Bridge,Off-sys | 774.2 | 5.3 | 5.3 | n/a | n/a | 3.1 | 3.1 |
| 112 | B6 | Bridge,Off-sys | 769.7 | 8.4 | 8.4 | n/a | n/a | 6.6 | 6.6 |
| 113 | B6 | Bridge,Off-sys | 774.9 | 3.1 | 3.1 | n/a | n/a | 1.3 | 1.3 |
| 114 | C2 | Bridge,Off-sys | 787.3 | n/a | n/a | n/a | n/a | n/a | n/a |
| 115 | C3 | Bridge,Off-sys | 773.2 | n/a | n/a | 2.3 | 2.3 | n/a | n/a |
| 116 | C3 | Bridge,On-sys | 810.4 | n/a | n/a | n/a | n/a | n/a | n/a |
| 117 | C3 | Bridge,Off-sys | 764.3 | 6.2 | 6.3 | 11.0 | 11.1 | 0.1 | 0.2 |
| 118 | C3 | Bridge,Off-sys | 779.5 | n/a | n/a | n/a | n/a | n/a | n/a |
| 119 | C3 | Bridge,On-sys | 790.3 | n/a | n/a | n/a | n/a | n/a | n/a |
| 120 | C3 | Bridge,Off-sys | 766.8 | 3.7 | 3.8 | 8.6 | 8.6 | n/a | n/a |
| 121 | C3 | Bridge,Off-sys | 771.7 | n/a | n/a | 3.6 | 3.7 | n/a | n/a |
| 122 | C3 | Bridge,Off-sys | 775.5 | n/a | n/a | n/a | n/a | n/a | n/a |
| 123 | C3 | Bridge,Off-sys | 793.0 | n/a | n/a | n/a | n/a | n/a | n/a |
| 124 | C4 | Bridge,On-sys | 785.8 | n/a | n/a | n/a | n/a | n/a | n/a |
| 125 | C4, C4-1 | Bridge,On-sys | 811.6 | n/a | n/a | n/a | n/a | n/a | n/a |

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## PENSACOLA DAM

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| Infrastructure ID | Map Panel | Location | Ground Elevation (ft, NGVD29) | Depth (ft), Sept. 1993 event | | Depth (ft), July 2007 event | | Depth (ft), December 2015 | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 742 ft PD starting WSEL | 745 ft PD starting WSEL | 742 ft PD starting WSEL | 745 ft PD starting WSEL | 742 ft PD starting WSEL | 745 ft PD starting WSEL |
| 126 | C4 | Bridge,Off-sys | 773.7 | n/a | n/a | n/a | n/a | n/a | n/a |
| 127 | C4 | Bridge,Off-sys | 747.7 | 15.0 | 15.1 | 17.9 | 18.3 | 12.4 | 12.7 |
| 128 | C4 | Bridge,Off-sys | 776.9 | n/a | n/a | n/a | n/a | n/a | n/a |
| 129 | C4 | Bridge,On-sys | 766.4 | n/a | n/a | n/a | n/a | n/a | n/a |
| 130 | C4 | Bridge,Off-sys | 772.0 | n/a | n/a | n/a | n/a | n/a | n/a |
| 131 | C4 | Church | 794.7 | n/a | n/a | n/a | n/a | n/a | n/a |
| 132 | C4 | Bridge,Off-sys | 773.4 | n/a | n/a | n/a | n/a | n/a | n/a |
| 133 | C4 | Bridge,Off-sys | 776.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 134 | C4 | Bridge,Off-sys | 770.8 | n/a | n/a | n/a | n/a | n/a | n/a |
| 135 | C5 | Bridge,Off-sys | 781.5 | n/a | n/a | n/a | n/a | n/a | n/a |
| 136 | C5 | Park | 807.9 | n/a | n/a | n/a | n/a | n/a | n/a |
| 137 | C5 | Bridge,Off-sys | 767.4 | n/a | n/a | n/a | n/a | n/a | n/a |
| 138 | C5 | Bridge,On-sys | 766.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 139 | C5 | Park | 749.5 | 12.4 | 12.5 | 7.8 | 8.5 | 10.0 | 10.4 |
| 140 | C6 | Bridge,Off-sys | 754.9 | 10.5 | 10.6 | 2.4 | 3.1 | 6.3 | 6.5 |
| 141 | C6 | Law Enforcement | 774.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 142 | C6 | Bridge,On-sys | 779.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 143 | C6 | Bridge,On-sys | 764.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 144 | C6 | Bridge,On-sys | 796.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 145 | C6 | School | 785.7 | n/a | n/a | n/a | n/a | n/a | n/a |
| 146 | C6 | Bridge,Off-sys | 764.6 | n/a | n/a | n/a | n/a | n/a | n/a |
| 147 | C6 | Bridge,On-sys | 766.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 148 | C6 | Fire Station | 762.7 | n/a | n/a | n/a | n/a | n/a | n/a |
| 149 | C6 | Church | 760.9 | n/a | n/a | n/a | n/a | n/a | n/a |
| 150 | C6 | School | 756.0 | 2.2 | 2.3 | 0.6 | 1.0 | 2.1 | 2.4 |
| 151 | C6 | School | 760.6 | n/a | n/a | n/a | n/a | n/a | n/a |
| 152 | C6 | Shelter - Both | 762.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 153 | C6 | School | 760.6 | n/a | n/a | n/a | n/a | n/a | n/a |
| 154 | C6 | Bridge,RR | 760.0 | n/a | n/a | n/a | n/a | n/a | n/a |
| 155 | C6 | Wastewater Treatment | 778.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 156 | D5 | Bridge,On-sys | 775.6 | n/a | n/a | n/a | n/a | n/a | n/a |

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**PENSACOLA DAM**

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|---|---|---|---|---|---|---|---|---|---|
| | | | | 742 ft PD starting WSEL | 745 ft PD starting WSEL | 742 ft PD starting WSEL | 745 ft PD starting WSEL | 742 ft PD starting WSEL | 745 ft PD starting WSEL |
| 157 | D5 | Bridge,Off-sys | 770.7 | n/a | n/a | n/a | n/a | n/a | n/a |
| 158 | D5 | Bridge,Off-sys | 764.8 | n/a | n/a | n/a | n/a | n/a | n/a |
| 159 | D6 | Bridge,On-sys | 775.3 | n/a | n/a | n/a | n/a | n/a | n/a |
| 160 | D6 | Bridge,On-sys | 771.5 | n/a | n/a | n/a | n/a | n/a | n/a |
| 161 | D6 | Bridge,On-sys | 774.8 | n/a | n/a | n/a | n/a | n/a | n/a |
| 162 | D6 | Bridge,On-sys | 764.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 163 | D6 | Bridge,On-sys | 765.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 164 | D6 | Bridge,On-sys | 769.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 165 | E3 | Bridge,On-sys | 774.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 166 | E3 | Bridge,Off-sys | 752.3 | 3.7 | 3.7 | 3.0 | 3.0 | 3.1 | 3.6 |
| 167 | E3 | Park | 753.0 | 3.0 | 3.0 | 2.3 | 2.4 | 2.4 | 2.9 |
| 168 | E5 | Fire Station | 771.8 | n/a | n/a | n/a | n/a | n/a | n/a |
| 169 | E5 | Bridge,Off-sys | 758.0 | n/a | n/a | n/a | n/a | n/a | n/a |
| 170 | E5 | Substation | 767.6 | n/a | n/a | n/a | n/a | n/a | n/a |
| 171 | E5 | Bridge,On-sys | 805.4 | n/a | n/a | n/a | n/a | n/a | n/a |
| 172 | E5 | Church | 767.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 173 | E6 | Bridge,On-sys | 773.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 174 | F3 | Bridge,On-sys | 757.4 | n/a | n/a | n/a | n/a | n/a | n/a |
| 175 | F3 | Airport | 752.4 | 3.6 | 3.6 | 2.9 | 3.0 | 3.0 | 3.5 |
| 176 | F3 | Fire Station | 767.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 177 | F3 | Airport | 771.5 | n/a | n/a | n/a | n/a | n/a | n/a |
| 178 | F4 | Airport | 760.8 | n/a | n/a | n/a | n/a | n/a | n/a |
| 179 | F5 | Bridge,Off-sys | 769.3 | n/a | n/a | n/a | n/a | n/a | n/a |
| 180 | F5 | Wastewater Treatment | 799.5 | n/a | n/a | n/a | n/a | n/a | n/a |
| 181 | F5 | Park | 750.4 | 5.7 | 5.6 | 5.0 | 5.0 | 5.1 | 5.6 |
| 182 | F5 | Church | 759.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 183 | F5 | Bridge,Off-sys | 760.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 184 | F5 | Church | 761.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 185 | F5 | Park | 750.4 | 5.6 | 5.6 | 4.9 | 5.0 | 5.1 | 5.6 |
| 186 | F5 | Fire Station | 762.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 187 | F5 | Bridge,Off-sys | 762.0 | n/a | n/a | n/a | n/a | n/a | n/a |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | 742 ft PD starting WSEL | 745 ft PD starting WSEL | 742 ft PD starting WSEL | 745 ft PD starting WSEL | 742 ft PD starting WSEL | 745 ft PD starting WSEL |
| 188 | F5 | Church | 760.8 | n/a | n/a | n/a | n/a | n/a | n/a |
| 189 | F5 | Church | 776.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 190 | F5 | Law Enforcement | 773.9 | n/a | n/a | n/a | n/a | n/a | n/a |
| 191 | F5 | Bridge,On-sys | 767.4 | n/a | n/a | n/a | n/a | n/a | n/a |
| 192 | F5 | Shelter - Both | 784.6 | n/a | n/a | n/a | n/a | n/a | n/a |
| 193 | F5 | Shelter - Both | 837.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 194 | F5 | Water Treatment | 772.4 | n/a | n/a | n/a | n/a | n/a | n/a |
| 195 | F5 | Bridge,On-sys | 768.8 | n/a | n/a | n/a | n/a | n/a | n/a |
| 196 | F5 | Shelter - Evac Only | 769.0 | n/a | n/a | n/a | n/a | n/a | n/a |
| 197 | F5 | Bridge,Off-sys | 771.9 | n/a | n/a | n/a | n/a | n/a | n/a |
| 198 | F5 | Bridge,Off-sys | 770.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 199 | F5 | Park | 813.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 200 | F5 | Bridge,On-sys | 770.7 | n/a | n/a | n/a | n/a | n/a | n/a |
| 201 | G2 | Bridge,Off-sys | 758.9 | n/a | n/a | n/a | n/a | n/a | n/a |
| 202 | G2 | Bridge,Off-sys | 768.0 | n/a | n/a | n/a | n/a | n/a | n/a |
| 203 | G2 | Bridge,On-sys | 757.9 | n/a | n/a | n/a | n/a | n/a | n/a |
| 204 | G2 | Shelter - Evac Only | 762.8 | n/a | n/a | n/a | n/a | n/a | n/a |
| 205 | G3 | Fire Station | 799.5 | n/a | n/a | n/a | n/a | n/a | n/a |
| 206 | G3 | Airport | 722.1 | 33.9 | 33.9 | 33.2 | 33.3 | 33.3 | 33.8 |
| 207 | G4 | Bridge,Off-sys | 764.6 | n/a | n/a | n/a | n/a | n/a | n/a |
| 208 | G4 | Bridge,Off-sys | 762.7 | n/a | n/a | n/a | n/a | n/a | n/a |
| 209 | G4 | Church | 768.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 210 | G5 | Airport | 916.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 211 | G6 | Bridge,Off-sys | 758.7 | n/a | n/a | n/a | n/a | n/a | n/a |
| 212 | H1 | Park | 807.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 213 | H2 | Airport | 0.0 | n/a | n/a | n/a | n/a | n/a | n/a |
| 214 | H2 | Airport | 772.1 | n/a | n/a | n/a | n/a | n/a | n/a |
| 215 | H2 | Park | 768.4 | n/a | n/a | n/a | n/a | n/a | n/a |
| 216 | H2 | Bridge,On-sys | 742.5 | n/a | n/a | n/a | n/a | n/a | n/a |
| 217 | H2 | Bridge,On-sys | 742.5 | n/a | n/a | n/a | n/a | n/a | n/a |
| 218 | H2 | Fire Station | 0.0 | n/a | n/a | n/a | n/a | n/a | n/a |

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# PENSACOLA DAM

GRAND RIVER DAM AUTHORITY

INFRASTRUCTURE DEPTH DATA SHEET

| Infrastructure ID | Map Panel | Location | Ground Elevation (ft, NGVD29) | Depth (ft), Sept. 1993 event | | Depth (ft), July 2007 event | | Depth (ft), December 2015 | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 742 ft PD starting WSEL | 745 ft PD starting WSEL | 742 ft PD starting WSEL | 745 ft PD starting WSEL | 742 ft PD starting WSEL | 745 ft PD starting WSEL |
| 219 | H2 | Park | 770.8 | n/a | n/a | n/a | n/a | n/a | n/a |
| 220 | H2 | Fire Station | 787.6 | n/a | n/a | n/a | n/a | n/a | n/a |
| 221 | H2 | Law Enforcement | 787.6 | n/a | n/a | n/a | n/a | n/a | n/a |
| 222 | H2 | Law Enforcement | 800.4 | n/a | n/a | n/a | n/a | n/a | n/a |
| 223 | H2 | Bridge,On-sys | 757.4 | n/a | n/a | n/a | n/a | n/a | n/a |
| 224 | H2 | Substation | 765.7 | n/a | n/a | n/a | n/a | n/a | n/a |
| 225 | H2 | Power Plant | 719.2 | n/a | n/a | n/a | n/a | n/a | n/a |
| 226 | H2 | Substation | 784.7 | n/a | n/a | n/a | n/a | n/a | n/a |
| 227 | H2 | Substation | 779.4 | n/a | n/a | n/a | n/a | n/a | n/a |
| 228 | H4 | Bridge,Off-sys | 759.6 | n/a | n/a | n/a | n/a | n/a | n/a |

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# PENSACOLA DAM

GRAND RIVER DAM AUTHORITY

INFRASTRUCTURE DIFFERENCE IN DEPTH DATA SHEET

| Infrastructure ID | Map Panel | Location | Ground Elevation | Difference in depth (ft), September 1993 event | Difference in depth (ft), July 2007 event | Difference in depth (ft), December 2015 event |
|---|---|---|---|---|---|---|
| 1 | A1 | Bridge,Off-sys | 783.9 | n/a | n/a | n/a |
| 2 | A2 | Church | 790.3 | n/a | n/a | n/a |
| 3 | A2 | Bridge,Off-sys | 784.1 | n/a | n/a | n/a |
| 4 | A2 | Bridge,Off-sys | 773.5 | 0.0 | 0.0 | 0.0 |
| 5 | A3 | Bridge,Off-sys | 783.7 | n/a | n/a | n/a |
| 6 | A3 | Bridge,Off-sys | 784.9 | n/a | n/a | n/a |
| 7 | A5 | Bridge,Off-sys | 770.8 | 0.0 | n/a | 0.0 |
| 8 | A6 | Bridge,Off-sys | 798.0 | 0.0 | n/a | 0.0 |
| 9 | A6 | Bridge,Off-sys | 788.8 | 0.0 | n/a | 0.0 |
| 10 | A6 | Bridge,Off-sys | 797.1 | 0.0 | n/a | 0.0 |
| 11 | A6 | Bridge,Off-sys | 782.4 | 0.0 | n/a | 0.0 |
| 12 | A6 | Bridge,Off-sys | 781.3 | 0.0 | n/a | 0.0 |
| 13 | A6 | Park | 777.1 | 0.0 | n/a | 0.0 |
| 14 | A6 | Bridge,Off-sys | 801.9 | n/a | n/a | n/a |
| 15 | A6 | Bridge,Off-sys | 796.0 | n/a | n/a | n/a |
| 16 | A6 | Bridge,Off-sys | 780.5 | 0.0 | n/a | 0.0 |
| 17 | B2 | Bridge,Off-sys | 767.6 | 0.0 | 0.0 | 0.0 |
| 18 | B2 | Bridge,Off-sys | 766.9 | 0.0 | 0.0 | 0.0 |
| 19 | B2 | Bridge,Off-sys | 771.8 | n/a | 0.0 | n/a |
| 20 | B2 | Bridge,Off-sys | 787.1 | n/a | n/a | n/a |
| 21 | B2 | Bridge,Off-sys | 782.7 | n/a | n/a | n/a |
| 22 | B2 | Bridge,Off-sys | 786.2 | n/a | n/a | n/a |
| 23 | B2 | Bridge,On-sys | 797.9 | n/a | n/a | n/a |
| 24 | B2 | Bridge,On-sys | 791.2 | n/a | n/a | n/a |
| 25 | B2 | Bridge,On-sys | 796.4 | n/a | n/a | n/a |
| 26 | B2 | Bridge,On-sys | 780.8 | n/a | n/a | n/a |
| 27 | B2 | School | 789.0 | n/a | n/a | n/a |
| 28 | B2 | Church | 789.1 | n/a | n/a | n/a |
| 29 | B3 | Bridge,Off-sys | 774.9 | n/a | 0.1 | n/a |
| 30 | B3 | Bridge,Off-sys | 779.2 | n/a | n/a | n/a |
| 31 | B3 | Bridge,Off-sys | 780.9 | n/a | n/a | n/a |
| 32 | B3 | Bridge,Off-sys | 768.9 | 0.0 | 0.1 | 0.0 |

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# PENSACOLA DAM

GRAND RIVER DAM AUTHORITY

INFRASTRUCTURE DIFFERENCE IN DEPTH DATA SHEET

| Infrastructure ID | Map Panel | Location | Ground Elevation | Difference in depth (ft), September 1993 event | Difference in depth (ft), July 2007 event | Difference in depth (ft), December 2015 event |
|---|---|---|---|---|---|---|
| 33 | B3 | Bridge,Off-sys | 794.1 | n/a | n/a | n/a |
| 34 | B3 | Bridge,Off-sys | 776.0 | n/a | n/a | n/a |
| 35 | B3, B3-4 | Church | 781.1 | n/a | n/a | n/a |
| 36 | B3 | Bridge,Off-sys | 765.4 | 0.1 | 0.1 | n/a |
| 37 | B3 | Bridge,On-sys | 779.2 | n/a | n/a | n/a |
| 38 | B3, B3-4 | Bridge,On-sys | 765.3 | 0.0 | 0.1 | n/a |
| 39 | B4, B4-1 | Park | 790.4 | n/a | n/a | n/a |
| 40 | B4, B4-1 | Shelter - Evac Only | 782.8 | n/a | n/a | n/a |
| 41 | B4, B4-1 | Church | 789.8 | n/a | n/a | n/a |
| 42 | B4, B4-1 | Church | 794.0 | n/a | n/a | n/a |
| 43 | B4, B4-1 | Bridge,Off-sys | 783.0 | n/a | n/a | n/a |
| 44 | B4, B4-1 | Bridge,Off-sys | 789.3 | n/a | n/a | n/a |
| 45 | B4, B4-1 | Church | 789.1 | n/a | n/a | n/a |
| 46 | B4, B4-1 | School | 782.1 | n/a | n/a | n/a |
| 47 | B4, B4-3 | Park | 771.4 | 0.0 | 0.1 | 0.0 |
| 48 | B4, B4-3 | Bridge,On-sys | 780.1 | n/a | n/a | n/a |
| 49 | B4, B4-3 | Bridge,Off-sys | 770.8 | 0.0 | 0.1 | 0.0 |
| 50 | B4, B4-3 | Bridge,Off-sys | 777.2 | n/a | n/a | n/a |
| 51 | B4, B4-3 | Fire Station | 789.5 | n/a | n/a | n/a |
| 52 | B4, B4-4 | Church | 789.0 | n/a | n/a | n/a |
| 53 | B4, B4-3 | Church | 779.9 | n/a | n/a | n/a |
| 54 | B4, B4-4 | Bridge,Off-sys | 784.8 | n/a | n/a | n/a |
| 55 | B4, B4-4 | Bridge,Off-sys | 786.3 | n/a | n/a | n/a |
| 56 | B4, B4-3 | Cell Tower | 771.0 | n/a | 0.1 | n/a |
| 57 | B4, B4-3 | Bridge,Off-sys | 766.2 | 0.2 | 0.1 | n/a |
| 58 | B4, B4-3 | Cell Tower | 788.2 | n/a | n/a | n/a |
| 59 | B4, B4-3 | Church | 780.0 | n/a | n/a | n/a |
| 60 | B4, B4-3 | Church | 795.1 | n/a | n/a | n/a |
| 61 | B4, B4-3 | School | 797.4 | n/a | n/a | n/a |
| 62 | B4, B4-3 | Church | 797.0 | n/a | n/a | n/a |
| 63 | B4, B4-3 | Church | 793.8 | n/a | n/a | n/a |
| 64 | B4, B4-3 | School | 769.7 | n/a | 0.1 | n/a |

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# PENSACOLA DAM

GRAND RIVER DAM AUTHORITY

INFRASTRUCTURE DIFFERENCE IN DEPTH DATA SHEET

| Infrastructure ID | Map Panel | Location | Ground Elevation | Difference in depth (ft), September 1993 event | Difference in depth (ft), July 2007 event | Difference in depth (ft), December 2015 event |
|---|---|---|---|---|---|---|
| 65 | B4, B4-3 | Law Enforcement | 776.0 | n/a | n/a | n/a |
| 66 | B4, B4-3 | School | 782.3 | n/a | n/a | n/a |
| 67 | B4, B4-3 | Church | 787.3 | n/a | n/a | n/a |
| 68 | B4, B4-3 | Church | 794.1 | n/a | n/a | n/a |
| 70 | B4, B4-3 | Church | 785.9 | n/a | n/a | n/a |
| 71 | B4, B4-3 | School | 785.9 | n/a | n/a | n/a |
| 72 | B4, B4-3 | Church | 788.4 | n/a | n/a | n/a |
| 73 | B4, B4-3 | Bridge,Off-sys | 772.5 | n/a | 0.1 | n/a |
| 74 | B4, B4-3 | Church | 786.3 | n/a | n/a | n/a |
| 75 | B4, B4-3 | Church | 792.3 | n/a | n/a | n/a |
| 76 | B4, B4-3 | Shelter - Evac Only | 795.5 | n/a | n/a | n/a |
| 77 | B4, B4-4 | School | 789.2 | n/a | n/a | n/a |
| 78 | B4, B4-3 | Church | 795.0 | n/a | n/a | n/a |
| 79 | B4, B4-3 | Church | 793.0 | n/a | n/a | n/a |
| 80 | B4, B4-3 | Hospital | 789.5 | n/a | n/a | n/a |
| 81 | B4, B4-3 | Hospital | 790.2 | n/a | n/a | n/a |
| 82 | B4, B4-3 | Church | 792.9 | n/a | n/a | n/a |
| 83 | B4, B4-4 | Law Enforcement | 784.3 | n/a | n/a | n/a |
| 84 | B4, B4-3 | Church | 775.3 | n/a | n/a | n/a |
| 85 | B4, B4-3 | Airport | 785.8 | n/a | n/a | n/a |
| 86 | B4, B4-4 | Bridge,On-sys | 767.0 | n/a | 0.1 | n/a |
| 87 | B4, B4-4 | Bridge,On-sys | 809.6 | n/a | n/a | n/a |
| 88 | B4, B4-3 | Bridge,On-sys | 765.4 | 0.1 | 0.1 | n/a |
| 89 | B4, B4-3 | Shelter - Evac Only | 782.0 | n/a | n/a | n/a |
| 90 | B4, B4-3 | Church | 781.2 | n/a | n/a | n/a |
| 91 | B4, B4-3 | Bridge,On-sys | 783.3 | n/a | n/a | n/a |
| 92 | B4, B4-3 | School | 781.6 | n/a | n/a | n/a |
| 93 | B4, B4-3 | School | 770.9 | n/a | 0.1 | n/a |
| 94 | B4, B4-3 | Park | 767.2 | 0.2 | 0.1 | n/a |
| 95 | B4, B4-3 | Substation | 775.4 | n/a | n/a | n/a |
| 96 | B4, B4-3 | Substation | 778.5 | n/a | n/a | n/a |
| 97 | B4, B4-4 | Bridge,Off-sys | 756.6 | 0.2 | 0.1 | 0.2 |

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# PENSACOLA DAM

GRAND RIVER DAM AUTHORITY

INFRASTRUCTURE DIFFERENCE IN DEPTH DATA SHEET

| Infrastructure ID | Map Panel | Location | Ground Elevation | Difference in depth (ft), September 1993 event | Difference in depth (ft), July 2007 event | Difference in depth (ft), December 2015 event |
|---|---|---|---|---|---|---|
| 98 | B4, B4-3 | Fire Station | 772.6 | n/a | 0.1 | n/a |
| 99 | B4, B4-3 | Bridge,RR | 772.7 | n/a | 0.1 | n/a |
| 100 | B4, B4-4 | Bridge,On-sys | 802.6 | n/a | n/a | n/a |
| 101 | B4, B4-3 | Bridge,On-sys | 777.5 | n/a | n/a | n/a |
| 102 | B4, B4-3 | Park | 761.8 | 0.1 | 0.0 | 0.1 |
| 103 | B4, B4-3 | Park | 755.2 | 0.1 | 0.1 | 0.2 |
| 104 | B4, B4-3 | Wastewater Treatment | 774.6 | n/a | n/a | n/a |
| 105 | B4, B4-3 | Park | 760.6 | 0.1 | 0.1 | 0.1 |
| 106 | B5 | Bridge,On-sys | 777.4 | n/a | n/a | n/a |
| 107 | B5 | Bridge,On-sys | 807.2 | n/a | n/a | n/a |
| 108 | B6 | Bridge,On-sys | 809.8 | n/a | n/a | n/a |
| 109 | B6 | Bridge,Off-sys | 782.2 | 0.0 | n/a | n/a |
| 110 | B6 | Bridge,Off-sys | 779.4 | 0.0 | n/a | n/a |
| 111 | B6 | Bridge,Off-sys | 774.2 | 0.0 | n/a | 0.0 |
| 112 | B6 | Bridge,Off-sys | 769.7 | 0.0 | n/a | 0.0 |
| 113 | B6 | Bridge,Off-sys | 774.9 | 0.0 | n/a | 0.0 |
| 114 | C2 | Bridge,Off-sys | 787.3 | n/a | n/a | n/a |
| 115 | C3 | Bridge,Off-sys | 773.2 | n/a | 0.0 | n/a |
| 116 | C3 | Bridge,On-sys | 810.4 | n/a | n/a | n/a |
| 117 | C3 | Bridge,Off-sys | 764.3 | 0.1 | 0.1 | 0.1 |
| 118 | C3 | Bridge,Off-sys | 779.5 | n/a | n/a | n/a |
| 119 | C3 | Bridge,On-sys | 790.3 | n/a | n/a | n/a |
| 120 | C3 | Bridge,Off-sys | 766.8 | 0.1 | 0.0 | n/a |
| 121 | C3 | Bridge,Off-sys | 771.7 | n/a | 0.1 | n/a |
| 122 | C3 | Bridge,Off-sys | 775.5 | n/a | n/a | n/a |
| 123 | C3 | Bridge,Off-sys | 793.0 | n/a | n/a | n/a |
| 124 | C4 | Bridge,On-sys | 785.8 | n/a | n/a | n/a |
| 125 | C4, C4-1 | Bridge,On-sys | 811.6 | n/a | n/a | n/a |
| 126 | C4 | Bridge,Off-sys | 773.7 | n/a | n/a | n/a |
| 127 | C4 | Bridge,Off-sys | 747.7 | 0.1 | 0.4 | 0.3 |
| 128 | C4 | Bridge,Off-sys | 776.9 | n/a | n/a | n/a |
| 129 | C4 | Bridge,On-sys | 766.4 | n/a | n/a | n/a |

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# PENSACOLA DAM

GRAND RIVER DAM AUTHORITY

INFRASTRUCTURE DIFFERENCE IN DEPTH DATA SHEET

| Infrastructure ID | Map Panel | Location | Ground Elevation | Difference in depth (ft), September 1993 event | Difference in depth (ft), July 2007 event | Difference in depth (ft), December 2015 event |
|---|---|---|---|---|---|---|
| 130 | C4 | Bridge,Off-sys | 772.0 | n/a | n/a | n/a |
| 131 | C4 | Church | 794.7 | n/a | n/a | n/a |
| 132 | C4 | Bridge,Off-sys | 773.4 | n/a | n/a | n/a |
| 133 | C4 | Bridge,Off-sys | 776.1 | n/a | n/a | n/a |
| 134 | C4 | Bridge,Off-sys | 770.8 | n/a | n/a | n/a |
| 135 | C5 | Bridge,Off-sys | 781.5 | n/a | n/a | n/a |
| 136 | C5 | Park | 807.9 | n/a | n/a | n/a |
| 137 | C5 | Bridge,Off-sys | 767.4 | n/a | n/a | n/a |
| 138 | C5 | Bridge,On-sys | 766.1 | n/a | n/a | n/a |
| 139 | C5 | Park | 749.5 | 0.1 | 0.7 | 0.4 |
| 140 | C6 | Bridge,Off-sys | 754.9 | 0.1 | 0.7 | 0.2 |
| 141 | C6 | Law Enforcement | 774.2 | n/a | n/a | n/a |
| 142 | C6 | Bridge,On-sys | 779.2 | n/a | n/a | n/a |
| 143 | C6 | Bridge,On-sys | 764.1 | n/a | n/a | n/a |
| 144 | C6 | Bridge,On-sys | 796.1 | n/a | n/a | n/a |
| 145 | C6 | School | 785.7 | n/a | n/a | n/a |
| 146 | C6 | Bridge,Off-sys | 764.6 | n/a | n/a | n/a |
| 147 | C6 | Bridge,On-sys | 766.1 | n/a | n/a | n/a |
| 148 | C6 | Fire Station | 762.7 | n/a | n/a | n/a |
| 149 | C6 | Church | 760.9 | n/a | n/a | n/a |
| 150 | C6 | School | 756.0 | 0.1 | 0.4 | 0.3 |
| 151 | C6 | School | 760.6 | n/a | n/a | n/a |
| 152 | C6 | Shelter - Both | 762.1 | n/a | n/a | n/a |
| 153 | C6 | School | 760.6 | n/a | n/a | n/a |
| 154 | C6 | Bridge,RR | 760.0 | n/a | n/a | n/a |
| 155 | C6 | Wastewater Treatment | 778.1 | n/a | n/a | n/a |
| 156 | D5 | Bridge,On-sys | 775.6 | n/a | n/a | n/a |
| 157 | D5 | Bridge,Off-sys | 770.7 | n/a | n/a | n/a |
| 158 | D5 | Bridge,Off-sys | 764.8 | n/a | n/a | n/a |
| 159 | D6 | Bridge,On-sys | 775.3 | n/a | n/a | n/a |
| 160 | D6 | Bridge,On-sys | 771.5 | n/a | n/a | n/a |
| 161 | D6 | Bridge,On-sys | 774.8 | n/a | n/a | n/a |

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# PENSACOLA DAM

GRAND RIVER DAM AUTHORITY

INFRASTRUCTURE DIFFERENCE IN DEPTH DATA SHEET

| Infrastructure ID | Map Panel | Location | Ground Elevation | Difference in depth (ft), September 1993 event | Difference in depth (ft), July 2007 event | Difference in depth (ft), December 2015 event |
|---|---|---|---|---|---|---|
| 162 | D6 | Bridge,On-sys | 764.2 | n/a | n/a | n/a |
| 163 | D6 | Bridge,On-sys | 765.2 | n/a | n/a | n/a |
| 164 | D6 | Bridge,On-sys | 769.1 | n/a | n/a | n/a |
| 165 | E3 | Bridge,On-sys | 774.2 | n/a | n/a | n/a |
| 166 | E3 | Bridge,Off-sys | 752.3 | 0.0 | 0.0 | 0.5 |
| 167 | E3 | Park | 753.0 | 0.0 | 0.1 | 0.5 |
| 168 | E5 | Fire Station | 771.8 | n/a | n/a | n/a |
| 169 | E5 | Bridge,Off-sys | 758.0 | n/a | n/a | n/a |
| 170 | E5 | Substation | 767.6 | n/a | n/a | n/a |
| 171 | E5 | Bridge,On-sys | 805.4 | n/a | n/a | n/a |
| 172 | E5 | Church | 767.2 | n/a | n/a | n/a |
| 173 | E6 | Bridge,On-sys | 773.2 | n/a | n/a | n/a |
| 174 | F3 | Bridge,On-sys | 757.4 | n/a | n/a | n/a |
| 175 | F3 | Airport | 752.4 | 0.0 | 0.1 | 0.5 |
| 176 | F3 | Fire Station | 767.1 | n/a | n/a | n/a |
| 177 | F3 | Airport | 771.5 | n/a | n/a | n/a |
| 178 | F4 | Airport | 760.8 | n/a | n/a | n/a |
| 179 | F5 | Bridge,Off-sys | 769.3 | n/a | n/a | n/a |
| 180 | F5 | Wastewater Treatment | 799.5 | n/a | n/a | n/a |
| 181 | F5 | Park | 750.4 | -0.1 | 0.0 | 0.5 |
| 182 | F5 | Church | 759.2 | n/a | n/a | n/a |
| 183 | F5 | Bridge,Off-sys | 760.2 | n/a | n/a | n/a |
| 184 | F5 | Church | 761.1 | n/a | n/a | n/a |
| 185 | F5 | Park | 750.4 | 0.0 | 0.1 | 0.5 |
| 186 | F5 | Fire Station | 762.1 | n/a | n/a | n/a |
| 187 | F5 | Bridge,Off-sys | 762.0 | n/a | n/a | n/a |
| 188 | F5 | Church | 760.8 | n/a | n/a | n/a |
| 189 | F5 | Church | 776.1 | n/a | n/a | n/a |
| 190 | F5 | Law Enforcement | 773.9 | n/a | n/a | n/a |
| 191 | F5 | Bridge,On-sys | 767.4 | n/a | n/a | n/a |
| 192 | F5 | Shelter - Both | 784.6 | n/a | n/a | n/a |
| 193 | F5 | Shelter - Both | 837.2 | n/a | n/a | n/a |

Note that flow at each location is unique based its position in the watershed.

Note that "n/a" indicates that location was not within the inundation boundary for that event.

# PENSACOLA DAM

GRAND RIVER DAM AUTHORITY

INFRASTRUCTURE DIFFERENCE IN DEPTH DATA SHEET

| Infrastructure ID | Map Panel | Location | Ground Elevation | Difference in depth (ft), September 1993 event | Difference in depth (ft), July 2007 event | Difference in depth (ft), December 2015 event |
|---|---|---|---|---|---|---|
| 194 | F5 | Water Treatment | 772.4 | n/a | n/a | n/a |
| 195 | F5 | Bridge,On-sys | 768.8 | n/a | n/a | n/a |
| 196 | F5 | Shelter - Evac Only | 769.0 | n/a | n/a | n/a |
| 197 | F5 | Bridge,Off-sys | 771.9 | n/a | n/a | n/a |
| 198 | F5 | Bridge,Off-sys | 770.2 | n/a | n/a | n/a |
| 199 | F5 | Park | 813.2 | n/a | n/a | n/a |
| 200 | F5 | Bridge,On-sys | 770.7 | n/a | n/a | n/a |
| 201 | G2 | Bridge,Off-sys | 758.9 | n/a | n/a | n/a |
| 202 | G2 | Bridge,Off-sys | 768.0 | n/a | n/a | n/a |
| 203 | G2 | Bridge,On-sys | 757.9 | n/a | n/a | n/a |
| 204 | G2 | Shelter - Evac Only | 762.8 | n/a | n/a | n/a |
| 205 | G3 | Fire Station | 799.5 | n/a | n/a | n/a |
| 206 | G3 | Airport | 722.1 | 0.0 | 0.1 | 0.5 |
| 207 | G4 | Bridge,Off-sys | 764.6 | n/a | n/a | n/a |
| 208 | G4 | Bridge,Off-sys | 762.7 | n/a | n/a | n/a |
| 209 | G4 | Church | 768.2 | n/a | n/a | n/a |
| 210 | G5 | Airport | 916.1 | n/a | n/a | n/a |
| 211 | G6 | Bridge,Off-sys | 758.7 | n/a | n/a | n/a |
| 212 | H1 | Park | 807.2 | n/a | n/a | n/a |
| 213 | H2 | Airport | 0.0 | n/a | n/a | n/a |
| 214 | H2 | Airport | 772.1 | n/a | n/a | n/a |
| 215 | H2 | Park | 768.4 | n/a | n/a | n/a |
| 216 | H2 | Bridge,On-sys | 742.5 | n/a | n/a | n/a |
| 217 | H2 | Bridge,On-sys | 742.5 | n/a | n/a | n/a |
| 218 | H2 | Fire Station | 0.0 | n/a | n/a | n/a |
| 219 | H2 | Park | 770.8 | n/a | n/a | n/a |
| 220 | H2 | Fire Station | 787.6 | n/a | n/a | n/a |
| 221 | H2 | Law Enforcement | 787.6 | n/a | n/a | n/a |
| 222 | H2 | Law Enforcement | 800.4 | n/a | n/a | n/a |
| 223 | H2 | Bridge,On-sys | 757.4 | n/a | n/a | n/a |
| 224 | H2 | Substation | 765.7 | n/a | n/a | n/a |
| 225 | H2 | Power Plant | 719.2 | n/a | n/a | n/a |

Note that flow at each location is unique based its position in the watershed.

Note that "n/a" indicates that location was not within the inundation boundary for that event.

| Infrastructure ID | Map Panel | Location | Ground Elevation | Difference in depth (ft), September 1993 event | Difference in depth (ft), July 2007 event | Difference in depth (ft), December 2015 event |
|---|---|---|---|---|---|---|
| 226 | H2 | Substation | 784.7 | n/a | n/a | n/a |
| 227 | H2 | Substation | 779.4 | n/a | n/a | n/a |
| 228 | H4 | Bridge,Off-sys | 759.6 | n/a | n/a | n/a |

Note that flow at each location is unique based its position in the watershed.
Note that "n/a" indicates that location was not within the inundation boundary for that event.