Three Rivers Southeast Arkansas Study

Appendix C: Civil Engineering

THREE RIVERS SOUTHEAST ARKANSAS

Introduction

The Three Rivers Southeast Arkansas Feasibility Study (Three Rivers Study) is being conducted by the U. S. Army Corps of Engineers (USACE) to recommend modifications to the McClellan-Kerr Arkansas River Navigation System (MKARNS) that would provide long-term sustainable navigation and promote the continued safe and reliable economic use of the MKARNS.

Study Authority

Section 216, Flood Control Act of 1970 (Public Law 91-611) authorizes a feasibility study due to examine significantly changed physical and economic conditions in the Three Rivers study area. The study will evaluate and recommend modifications for long-term sustainable navigation on the MKARNS.

Study Purpose

There is a risk of a breach of the existing Soil Cement Structure near the entrance channel to the MKARNS on the White River. During high water events, Mississippi backwater can create significant head differentials between the Arkansas and White rivers. The existing Soil Cement Structure in the isthmus between the Arkansas and White rivers is subject to damaging overtopping, flanking and seepage flows that could result in a catastrophic breach and failure of the system. The uninhibited development of a breach, or cutoff, has the potential to create navigation hazards, increase the need for dredging, and adversely impact an estimated 200 acres of bottomland hardwood forest in the isthmus.

Based on the Section 216 authority, the study is investigating alternatives that would minimize the risk of cut off development, including reducing the cost of maintence associated with preventing cutoff development, while minimizing impacts to the surrounding ecosystem.

Non-Federal Sponsor

The Arkansas Waterways Commission is the non-federal sponsor for the Three Rivers Southeast Arkansas Study. An amended feasibility cost-sharing agreement was executed in June 2015.

Recommended Plan

The recommended plan consists of a newly constructed 2.5-mile long containment structure at an elevation of 157 feet above mean sea level (ft msl) that would begin on natural high ground just south and west of the existing Melinda Structure located on the south side of Owens Lake. It would continue east and cross the Melinda head cut south of the existing Melinda Structure. From there, it would head northeast and connect to the existing Soil Cement Structure north of Jim Smith Lake. It continues to follow the existing Soil Cement Structure alignment terminating at the existing Historic Closure Structure. The recommended plan also includes a relief opening at the Historic Cutoff to an elevation 145 ft msl regardless of the width. In addition, the existing Melinda Structure would be demolished in place and the debris would be pushed into the deep scour hole at the top of the head cut. Finally, adding an opening in the existing Owens Lake Structure between Owens Lake and the White River would prevent water from backing up into Owens Lake, which would impact the bottomland hardwood forest. The opening would be designed to allow fish passage into Owens Lake.

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1. GENERAL

The project area being studied consists of a region where the White River, Arkansas River, Mississippi River and the McClellan-Kerr Arkansas River Navigation System (MKARNS) all interact during flood events to cause it to be a very dynamic area. When the Mississippi River is at flood stage it backs up the White River and eventually reaches a level where the White River’s flow cannot stay within the banks. When this occurs it flows overland towards the Arkansas River, causing erosion to occur on a massive scale. Over time multiple headcuts have formed and were ultimately closed by the Corps of Engineers before significant damage could occur. The Owens Lake Structure, The La Grues Lake Structure, the Melinda Structure, the Historic Cutoff Structure, the Jim Smith Structure and the Soil Cement Structure are just some of the facilities that USACE has built over the years in an attempt to control where and how water flows within the area. On a less frequent basis the Arkansas River can also flow towards the White River when it is experiencing a flooding condition. If the White River were to create a new channel to the Arkansas River, navigation utilizing the MKARNS would be disrupted. This is especially true of the barge shipping industry that uses the MKARNS to ship billions of dollars of commodities. The H&H Appendix discusses further how a breach in the study area would disrupt navigation.

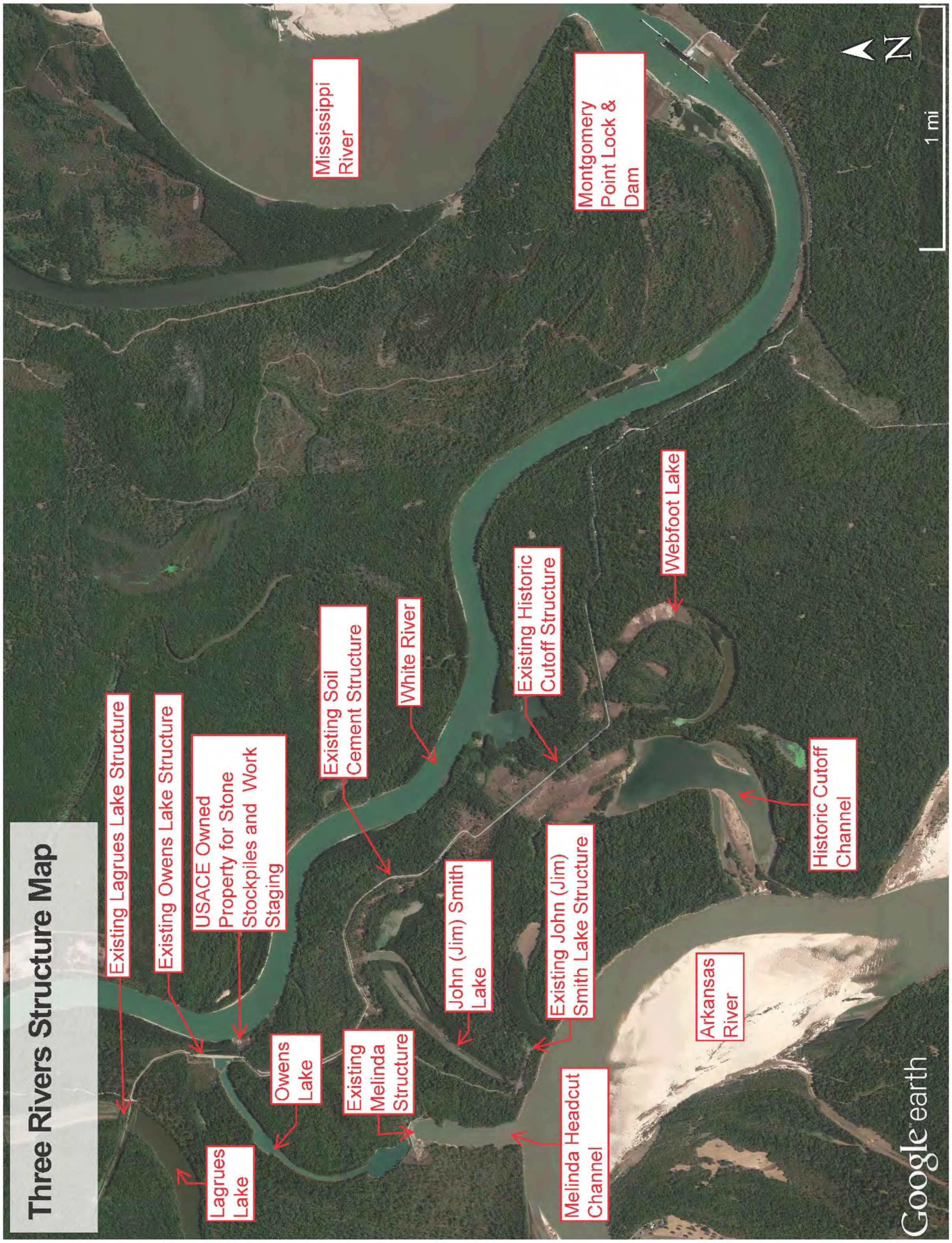
The goals for this project are to reduce the potential risk of a catastrophic breach, to ensure that navigation can continue on the MKARNS and that environmental impact is limited. The means for achieving each of these goals is to reduce the damaging velocity heads which are causing the erosive forces creating new channels between the White River and the Arkansas River. This in turn will prevent disruption of river navigation and prevent destruction of the surrounding woodland areas. In order to do this, construction of various structures will need to be completed.

The engineering designs to follow were prepared to provide structures that are resilient enough to withstand the hydraulic forces that the Three Rivers system is capable of producing. Should the structures require any maintenance or repairs, they can be easily performed with conventional construction equipment and the various stone materials required.

All the proposed structures will be hardened utilizing stone that has been delivered to the project site by the Sponsors shippers, utilizing the MKARNS.

On the next page is the Three Rivers Structure Map. It will provide the reader of this document the location of the existing structures located within the project area that will be impacted by the proposed projects to be discussed later in the Engineering Appendix.

THREE RIVERS STRUCTURE MAP



2. HYDROLOGY AND HYDRAULICS (H&H)

H&H personnel performed numerous computer models to come up with the Alternatives that have been designed for this appendix. The complete H&H analysis is covered in a separate appendix and will provide a full explanation of the modeling that was performed.

The team investigated climate change impacts per "Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects" was issued in Engineering and Construction Bulletin (ECB) 2014-10. The proposed construction improvements are located at an elevation greater than 100 feet above Mean Sea Level and will not be impacted by sea level change. Change in climate is not expected to significantly alter the hydrologic analysis for the region and as a result was not specifically modeled for in the project. No climate change impacts have been included in the study.

3. SURVEYING, MAPPING AND OTHER GEOSPATIAL DATA REQUIREMENTS

Where available, LIDAR and hydrographic topographic data were used in the preparation of the designs described in this section. It should be noted that the available LIDAR data was limited in some areas due to high water conditions at the time the LIDAR data was obtained. During the Preconstruction, Engineering and Design (PED) phase, a comprehensive topographic and hydrographic survey will be required in order to develop the formal plans and specifications for construction. This proposed survey will identify topographic features, boundary lines, easements, structures, roads and utility lines, etc.

The available LIDAR and hydrographic topographic data was used within the Bentley INROADS software program to create 3D surface models of the proposed structures. The 3D surface and structure models were used to develop quantities used in the preparation of the cost estimates. These surfaces can create contour data as a byproduct of the computation process but contours are not needed to create quantities, the volume quantities were obtained from comparing the existing and proposed surfaces. The data used provided a realistic basis for the quantities used in the cost estimates.

The existing LIDAR topographic data was obtained in 2014 and used the horizontal datum of NAD83 and vertical datum of NAVD88. The hydrographic data was obtained in 2011. However, no information is available as to how the hydrographic data was obtained or which horizontal and vertical datums were used.

4. GEOTECHNICAL

Sufficient geotechnical information is known about the areas where the proposed structures are to be located. The construction of the stone containment structure will be done by placement of the stone within a 2 foot keyway excavation and filling to the required grade. Based upon visual observation of excavated and eroded areas, the soils under the stone containment structure consist of silty-clay topsoil overlaying sandy materials. These soils have proven to be very stable when flooded and during construction activities. Prior to Preconstruction, Engineering and Design (PED) work, it is recommended that a thorough subsurface exploration must be performed along the proposed route of the Stone Containment Structure to verify the soil types present. Laboratory testing on the soils should include grain size and uniformity of the materials. This information will be required in order to confirm the keyway design at the Melinda Headcut Channel, confirm the 2-foot excavation depth along the length of the stone containment structure and determine if a granular or geotextile fabric filter is required.

The existing Historic Cutoff structure as its name implies, is a structure that was built to close the natural cutoff or bypass that allowed water to flow between the White River and the Arkansas River during a flood event. See the “Three Rivers Structure Map” above for the location of the Historic Cutoff Structure. It is a manmade structure and was constructed utilizing dredged material from the White River. The composition of the dredged material was generally sandy with some clays and silts included. This was visually witnessed during its placement by USACE personnel. As such we do not believe that formal geotechnical testing was required for the lowered Historic Cutoff structures design alternatives identified in this study. The associated geotechnical cost was therefore saved.

Prior to Preconstruction, Engineering and Design (PED) work, it is recommended that a thorough subsurface exploration be performed in the Historic Cutoff to confirm the presence of the sandy soils and for the sheet pile design. Borings should also be taken in the previous sinkhole locations. Laboratory testing on the soils should include grain size and uniformity of the materials. These testing results shall be used to look at maximum foreseeable head differential conditions on both the Arkansas and White River sides of the historic cutoff and look at the average and vertical hydraulic gradients considering the grain size and uniformity of the material in order to evaluate the potential for piping. Finite element modeling could be performed to better optimize the design of the sheet piling.

Stone material for the project’s various construction activities is readily available from multiple quarries and can be barged directly to a USACE owned staging area adjacent to the Owens Lake Structure.

Additional Geotechnical information for the project area, including earthquake information, can be found in the draft “Arkansas-White River Cutoff Study” dated November 2007.

5. ENVIRONMENTAL ENGINEERING

The Three Rivers Study revealed some ancillary environmental benefits. They include the reduction in the isthmus velocities that promote erosion, preservation of the bottom land hardwood forest’s hydrologic condition and re-connection of the Owens Lake oxbow that had been severed by the existing Melinda Structure. The existing Melinda Structure is located two-thirds of the way between the White River and Arkansas River and separates Owens Lake from the Melinda Headcut Channel. The existing Melinda Structure is constructed mainly of a soil cement mixture, with subsequent repairs utilizing concrete. The demolition of the existing Melinda Structure and the disposal of the debris in the 90 foot deep hole in the channel to the south of the structure will create a roughened bottom habit that will be beneficial for fish. See paragraph 6.1.2C for additional information. No other specific environmental features have been included in this study. For further background information see Appendix B – Hydrologic and Hydraulic Analysis and Appendix D - Environmental.

During the study’s preliminary design process, we considered using dredged materials from the MKARNS for portions of the containment structure. However, a design that would be considered resilient enough for the rivers hydraulic flows was not identified. This decision was reinforced by the damage that occurred to the Jim (John) Smith Structure in February of 2005. The structure was built with a geotube core overlain with soil and vegetation. See Figure 1-13 in the “Arkansas-White River Cutoff Study”, dated November 2007. It was therefore decided to utilize natural quarried stone for the containment structure. Stone is readily available for the project, it is durable and can be quickly modified or repaired if the need should occur.

6. CIVIL DESIGN

6.1.1 No Action Plan

Other than normal Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) requirements, the No Action Plan does not have any planned major changes to the existing structures maintaining the navigation system. Since 2014, two sinkholes have formed in the existing Historic Cutoff structure and were repaired. To ensure that the structure does not fail in the future, some form of remediation is required. While there may be other methods, this study only considered two methods for remediating future sinkhole issues. The first is to continue filling the sinkholes with a mixture of earth and stone as they occur, with the potential risk for a damaging breach still present. This is the method currently being used by USACE Operations personal for sinkhole repairs. The second method and the one recommended for this feasibility study is the installation of a sheet pile cutoff wall. The wall would be 5625 feet long and extend from an elevation of 170 at the top of the sheet pile wall to an elevation of 100 at the bottom. The alignment for the sheet piling will follow the top of the existing Historic Cutoff Structure and be located at least 30 feet from the existing soil cement structure located on its top. This will be done to avoid the existing overhead power line and underground fiber optic cable that runs on either side of the soil cement structure. We consider the use of sheet piling to be a conservative and the most realistic method for repairing the sinkholes. For the No Action Plan, the final decision as to the type of repair method to be utilized for the sinkholes will require additional geotechnical study in the future. This falls within the Operation, Maintenance, Repair, Replacement & Rehabilitation (O,M,R,R&R) requirements for the existing Historic Cutoff Structure.

In addition, the draft "Arkansas-White River Cutoff Study", dated November 2007 outlined additional structures that were to be constructed in the future as required to maintain the navigation system.

6.1.2 Alternative 1 – Stone Containment Structure at Elevation 157 and Re-opening of the Historic Cutoff (Tentatively Selected Plan (TSP))

This alternative is the Tentatively Selected Plan (TSP) and consists of four major elements:

A. The construction of a Stone Containment Structure at an elevation of 157 feet above sea level. The proposed alignment is shown on sheet C-101 and its centerline geometry has been included in Attachment A. The structure between stations 93+00 and 103+00 at the Melinda Headcut Channel will be constructed of Little Rock District, Grade B stone, all other areas of the structure will be constructed of Little Rock District, Grade C stone. The stone gradations are included in Attachment B. The structure will have a 20 foot wide top, with 1:5 side slopes and will be keyed 2 feet into the existing ground surface, which has an elevation ranging from 157 at the ends to 146 at the Historic Cutoff Channel. A keyway will be required on both sides of the Historic Cutoff Channel. The preliminary design is shown on sheet C-501, detail B. Upon completion of the geotechnical study; the depth of the 2-foot keyed excavation, the sizing of the keyway at the Melinda Headcut Channel and whether a granular or geotextile fabric filter will be required under the stone containment structure will need to be verified.

Numerous alternative design materials were considered for the Containment Structure but only stone was determined to have the resiliency and ease of repair necessary for flowing water. See the table of alternative designs considered and not used. Although the all soil cement structure would be resilient, it was removed from consideration because the cost of repairs are high as USACE has experienced in the past. Due to the remote location of the site, the use of stone provides the most hydraulically resilient structure, with the easiest ability to be maintained or repaired.

Alternative Designs Considered & Not Used	Resiliency
1 Ton retaining wall block core, 1:10 sand slopes & stone cap	No
Stone core w/1:1.5 slopes, 1:10 sand slopes & stone cap	No
Precast concrete core wall, 1:10 sand slopes & stone cap	No
Poured concrete wall core, 1:10 sand slopes & stone cap	No
Soil cement core, 1:10 sand slopes & stone cap	No
Soil cement structure in its entirety.	Yes
Sheet pile core, 1:10 sand slopes & stone cap	No

B. The existing soil cement/concrete Owens Lake Structure will be revised to include a flow equalization structure consisting of a precast concrete bridge unit with no wing walls similar to Forterra's "CrownSpan Precast Bridge Unit". See the Forterra sample design in Attachment D. (Note: there are other precast concrete bridge manufacturers that can build a bridge similar to Forterra's. Use of Forterra's bridge in this study is only for exhibition purposes and does not constitute endorsement.) The inclusion of the bridge will allow for flow between the White River and Owens Lake to allow the water levels to equalize at the same time without the damaging erosive forces which occur when water flows over the Owens Lake Structure. The bridge shall have the following nominal dimensions, a rise of 5 feet and a span of 30 feet. It is assumed that the existing soil cement structure has sufficient bearing capacity to be utilized for the bridge’s foundation. However during the Preconstruction, Engineering & Design (PED) phase of the project, it is recommended that additional testing be performed to verify this assumption. Should the testing determine that there is insufficient bearing capacity, then a footing system will be required to support the bridge. The cost of the footing system has been included in the cost estimate for Alternative 1. After installation of the bridge, backfilling of the surrounding trench will be done with concrete to restore the structural integrity of the Owens Lake Structure. A 12 inch thick non-reinforced concrete slab shall cap the bridge. The means for anchoring the new concrete to the existing Owens Lake Structure and the bridge will need to be designed during the PED phase of the project. Design consideration should also be made for preventing water movement between the contact surfaces between the existing soil cement and new concrete and the new concrete and the precast concrete bridge. See sheet C-103 for the structures location.

C. The existing Melinda Structure will be demolished. The structure is made up of a combination of soil cement and concrete, with rip-rap on each side of the structure. Material disposal will be by pushing the soil cement/concrete and rip-rap debris into the adjacent scour hole located to the south of the structure which is about 90 feet in depth. The removal of the existing Melinda Structure will allow for a uniform rise in water levels in Owens Lake and the Melinda Channel headcut without the risk of damage caused by high head differential flows over the Melinda Structure.

D. The Historic Cutoff structure will be lowered to a final top of stone elevation of 145. See sheets C-502 and C-504. The proposed alignment is shown on sheet C-102 and its centerline geometry has been included in Attachment A. For purposes of this feasibility study a 1000 foot wide opening is being used with 1:10 side slopes. During the Preconstruction, Engineering & Design (PED) phase of the project, the opening width will be optimized by the Hydrology & Hydraulics section (H&H). The materials excavated from the Historic Cutoff structure will be placed southwesterly of the proposed opening to create a new backwater embankment that is not directly impacted by the river flows. The excavated area will be protected by a 7 foot layer of R7400 on top of a 1 foot layer of R90 stone and an underlying geotextile. At both the inlet and outlet ends of the channel a 30 foot wide by 20 foot deep stone toe protection trench will be installed and filled with R7400 stone running the full width of the channel and up the 1:10 side slope for 100 feet. Both the R7400 and R90 stone gradations are from the Vicksburg District. The R7400 and R90 gradations are shown in Attachment B. An existing underground powerline and an existing underground fiber optic line are located in the project area and will need to be relocated as part of the New Historic Cutoff construction. Across the excavated area a 24 foot wide by 2 foot thick layer of concrete shall be placed with a top elevation of 145 and maximum 1:10 end slopes as the road transitions to match the existing road. This road will allow for continued access to the Montgomery Point Lock and Dam located 3-miles east of the Historic Cutoff. Underneath the northern half of the road, steel sheet piling shall be installed with a top elevation under the channel of 144 and a bottom elevation of 110 for a length of 2200 feet. Outside of the channel, the top elevation of the sheet piling shall follow the road slope to a final elevation of 170. All disturbed areas will be seeded with a flood resistant, deep rooting seed mixture suitable for growing in sandy conditions. During the Preconstruction, Engineering & Design (PED) phase, a geotechnical study should be performed to determine the best way to control sinkhole issues.

6.1.3 Alternative 2 – Multiple Openings

There will be three structures constructed as part of the Multiple Openings alternative and two existing structures will be modified. See sheets C-104 and C-105.

A. The Historic Cutoff structure will be lowered to a final top of stone elevation of 135. For purposes of this feasibility study a 2500 foot wide opening is being used with 1:10 side slopes. The materials excavated from the Historic Cutoff structure will be placed southwesterly and southerly of the proposed opening. The final disposal location would need to be determined during the PED phase due to a lack of topographic information to the south of the structure. The excavated area will be protected by a 7 foot layer of R7400 stone on top of a 1 foot layer of R90 stone and an underlying geotextile. At both the inlet and outlet ends of the channel a 30 foot wide by 20 foot deep stone toe protection trench will be installed and filled with R7400 stone running the full width of the channel and up the 1:10 side slope for 100 feet. Both the R7400 and R90 stone gradations are from the Vicksburg District. The R7400 and R90 gradations are shown in Attachment B. An existing underground powerline and an existing underground fiber optic line are located in the project area and will need to be relocated as part of the New Historic Cutoff construction. Across the excavated area a 24 foot wide by 2 foot thick layer of concrete shall be placed with a top elevation of 145 and maximum 1:10 end slopes as the road transitions to match the existing road. This road will allow for continued access to the Montgomery Point Lock and Dam located 3-miles east of the Historic Cutoff. Underneath the northern half of the road, steel sheet piling shall be installed with a top elevation under the channel of 134 and a bottom elevation of 110 for a length of 2600 feet. All disturbed areas will be seeded with a flood resistant, deep rooting seed mixture suitable for growing in sandy conditions. During the Preliminary, Engineering and Design (PED) phase, a geotechnical study should be performed to determine the best way to control sinkholes issues.

B. The existing soil cement/concrete Owens Lake Structure is at an elevation of 145. As part of the multiple openings alternative, the structure would be reconstructed by removing a 400 foot section of the soil cement/concrete until the weir is at an elevation of 132. Both ends of the weir would be constructed with a minimum 1:10 slope to allow for vehicular traffic to utilize the structure. For purposes of this report it was assumed that the demolished materials would be repurposed for erosion protection on the Owens Lake side (west side) of the structure.

C. A new 350 foot long stone structure will be constructed in Owens Lake halfway between the Owens Lake Structure and the Melinda Structure. It shall be constructed entirely of stone with a finished elevation of 135. The basic design shall follow the “New Owens Lake Stone Structure” shown in Details “E” and “F” on sheet C-501, Attachment A. Both ends of the structure shall incorporate 100 foot long stone keyways in each embankment to protect against flanking. A new 1975 foot long by 30 foot wide access road will need to be cleared of trees and stumps to provide access to the site. No aggregate surfacing is proposed at this time.

D. The existing Melinda Structure is at an elevation of 142 and was constructed originally with soil cement, with repairs being made using concrete. As part of the multiple openings alternative, the structure would be reconstructed by removing a 900 foot section of the soil cement/concrete until the weir is at an elevation of 132. Both ends of the weir would be constructed with a minimum 1:10 slope to allow for vehicular traffic to utilize the structure. For purposes of this report it was assumed that the demolished materials would be repurposed for erosion protection on the Melinda Headcut channel side (south side) of the structure.

E. A new 600 foot long stone structure will be constructed south of the Melinda Structure near the entrance to the Arkansas River. It shall be constructed entirely of stone with a finished elevation of 129. The basic design shall follow the “New Melinda Stone Structure” shown in Details “E” and “F” on sheet C-501, Attachment A. Both ends of the structure shall incorporate 200 foot long stone keyways in each embankment to protect against flanking. A new 600 foot long by 30 foot wide access road and 100 foot by 110 foot staging area will need to be cleared of trees and stumps to provide access to the site. No aggregate surfacing is proposed at this time.

6.1.4 Environmental Alternatives

Four environmental alternatives were considered to provide fish passage for La Grues Lake and Owens Lake. Preliminary designs and cost estimates were prepared for them, but were not included in this study. USACE was unable to find a Sponsor for the environmental alternatives, therefore the alternative was dropped from further consideration in the feasibility study.

A. The existing road crossing at the north end of La Grues Lake will have a flow equalization structure consisting of a reinforced concrete arch bridge span with no wing walls similar to Contech’s Con/Span O-Series. See the attached Contech sample design in Attachment D. (Note: there are other precast concrete arch bridge manufacturers that can build an arch bridge similar to Contech’s. Use of Contech’s arch bridge in this study is only for exhibition purposes and does not constitute endorsement.) The inclusion of the arch will allow for flow between the White River and La Grues Lake to allow for the passage of fish between them for longer periods of time. The arch bridge shall have the following nominal dimensions, a rise of 6 feet and a span of 30 feet. The arch will need to be placed upon a concrete footing system set upon piling due to the soft soils anticipated. After installation of the arch, backfilling of the surrounding trench will be done using existing onsite soils and capped by a 12 inch aggregate surface course to restore the road to its existing condition. As part of the construction, the existing buried fiber optic cable will need to be relocated. We believe 300 feet of cable will be impacted. Electric power is overhead in this area and should not be impacted.

B. The existing soil cement/concrete Owens Lake Structure, located at the westerly end of Owens Lake, will be revised to include a flow equalization structure consisting of a reinforced concrete arch bridge span with no wing walls similar to Contech's Con/Span O-Series. See the attached Contech sample design in Attachment D. (Note: there are other precast concrete arch bridge manufacturers that can build an arch bridge similar to Contech's. Use of Contech's arch bridge in this study is only for exhibition purposes and does not constitute endorsement.) The inclusion of the arch will allow for flow between the White River and Owens Lake to allow for the passage of fish between them for longer periods of time. The arch bridge shall have the following nominal dimensions, a rise of 6 feet and a span of 30 feet. The arch will be placed upon the existing soil cement which will act as the footing system. After installation of the arch, backfilling of the surrounding trench will be done with concrete to restore the structural integrity of the Owens Lake Structure. No utilities are expected to be impacted.

C. The existing soil cement containment structure at the easterly end of Owens Lake will be revised to include a flow equalization structure consisting of a reinforced concrete arch bridge span with no wing walls similar to Contech's Con/Span O-Series. See the attached Contech sample design in Attachment D. (Note: there are other precast concrete arch bridge manufacturers that can build an arch bridge similar to Contech's. Use of Contech's arch bridge in this study is only for exhibition purposes and does not constitute endorsement.)The inclusion of the arch will allow for flow between the White River and Owens Lake to allow for the passage of fish between them for longer periods of time. The arch bridge shall have the following nominal dimensions, a rise of 6 feet and a span of 30 feet and will need to be placed upon a concrete footing system. After installation of the arch, backfilling of the surrounding trench will be done with concrete to restore the structural integrity of the existing soil cement containment structure. As part of the construction, both the existing fiber optic cable and underground powerline will need to be relocated. We believe 300 feet of fiber optic cable and potentially up to 2400 feet of underground power will be impacted.

   Running parallel to the soil cement structure is a gravel road used by logging trucks. This gravel road lies within property currently owned by

USACE. Due to elevation differences, the north end of the arch will need to be excavated to allow for water to pass thru easier. This area includes the gravel road which will need to be lowered and restored. Restoration will be by the placement of a 200 foot long, 30 foot wide and 2 foot thick concrete road crossing. In order to control erosion, Class B stone will be placed within the excavated area as needed.

D. The existing La Grues Lake soil cement/rip-rap structure will be demolished in its entirety. The rip-rap that has been placed on-top of the easterly end of the structure, will be removed and stockpiled for future use within the USACE property on the east end of the structure. Where practical, the soil cement shall be broken up and stockpiled adjacent to the rip-rap, otherwise it will be disposed of within the lake and used for bank protection. Where required, sand will be brought in to fill any large voids and to allow for natural revegetation. Disturbed areas will be revegetated upon completion. No utilities are expected to be impacted.

7. STRUCTURAL REQUIREMENTS

The existing Historic Cutoff has been experiencing small sinkholes during high head conditions that could cause a path for subsurface flows to breach the structure. To combat this risk, a steel sheet pile wall system will need to be designed for the No Action Alternative and Alternatives 1 and 2. For the No Action Alternative the top of the sheet pile will be at an elevation of 170 and the bottom at an elevation of 100. The total length of sheet pile to be installed for the No Action Alternative is 5625 feet. For Alternative 1 the top of the sheet pile within the channel will be at an elevation of 144 and the bottom at an elevation of 110. In addition, the top elevation of the sheet pile will follow a 1:10 slope as it gets further from the channel, until it reaches an existing ground level of approximately 170. Total length of sheet pile to be installed for Alternative 1 is 2200 feet. For Alternative 2 the top of the sheet pile within the channel will be at an elevation of 134 and the bottom at an elevation of 110. Total length of sheet pile to be installed for Alternative 2 is 2600 feet. For purposes of this feasibility study, an uncoated 27-inch wide steel sheet pile with a profile section of PZ26 was utilized.

Alternative 1 calls for a bridge supported by a footing system to be installed through the Owens Lake Structure which is made up of a combination of soil cement and concrete in approximately 1 foot layers. In order for this to happen the structural integrity of the existing structure will need to be evaluated. Should the existing structure have sufficient bearing capacity, there is the chance the footing system may not need to be installed and the cost thereto saved.

8. ELECTRICAL AND MECHANICAL REQUIREMENTS

There are no mechanical features in this project.

For both Alternatives 1 and 2, an above ground electrical power line, owned and operated by C&L Electric Cooperative Corporation, has one two-pole system within the Historic Cutoff area to be excavated. These poles will need to be replaced with longer ones to account for the lower ground elevation and to keep the electric connections above the water level. The impacted length of wiring serving the area is approximately 4800 feet long. Design and construction of the electrical modifications would be performed by C&L Electric Cooperative Corporation with USACE reimbursing them for their work.

In addition, USACE owns an underground fiber optic communication cable serving the Montgomery Point Lock & Dam runs thru this same area and must be lowered after the excavation has been completed. Consideration should be given for the installation of the fiber optic cable within a minimum 4 inch PVC conduit installed adjacent to the sheet piling to provide protection from future damage. The anticipated length of fiber optic cable to be relocated is 2500 feet for Alternative 1 and 3000 feet for Alternative 2.

Electrical taking notes and drawings for the fiber optic cable show the general locations installed and are provided in Attachment D.

9. HAZARDOUS AND TOXIC MATERIALS

There will be no hazardous or toxic materials utilized in this project, nor are any expected to be encountered during its construction. A formal Hazardous, Toxic and Radioactive Waste (HTRW) survey is therefore not proposed for this project.

10. CONSTRUCTION PROCEDURES AND WATER CONTROL PLAN

As the Arkansas, White and Mississippi Rivers experience flood events, they will cause the cessation of all construction activities in the Three Rivers Study area. This is especially true for the placement of the geotextile fabric at the Historic Cutoff which cannot be placed underwater. Careful planning and monitoring of river and weather conditions will be required in order for the construction equipment and associated manpower to be evacuated to higher ground prior to a flood event. Due to the volume of water moving through the study area during a flood event, a physical water control plan for the construction site is therefore not feasible. However, localized erosion control measures should be implemented for the construction at the Historic Cutoff.

The construction schedule for the project should take into account mobilization and demobilization of construction equipment and personnel during flood events.

11. INITIAL RESERVOIR FILLING AND SURVEILLANCE PLAN

There are no reservoirs within the project area that would require a Reservoir Filling and Surveillance Plan.

12. FLOOD EMERGENCY PLANS FOR AREAS DOWNSTREAM AND UPSTREAM OF CORPS DAMS

There are no dams within the project area that would require a Flood Emergency Plan.

13. ENVIRONMENTAL OBJECTIVE AND REQUIREMENTS

The intent of the study's construction activities is to reduce the flood waters erosive forces which could potentially cause the White and Arkansas Rivers to merge. To accomplish this, Alternative 1 (the TSP) will require the installation of three new structures and the abandonment of one existing structure. Only the new Stone Containment Structure will require additional real estate. This real estate will be limited to the footprint covered by the structure and approximately 20 feet either side for future maintenance access. The other structures will be constructed within property owned by the Government or within the existing river floodways. The preliminary civil design described in Section 6 will become the basis for the final design.

14. RESERVOIR CLEANING

None required.

15. OPERATION AND MAINTENANCE

The project does not require physical operation of any of the features to be implemented. They are totally passive in nature and have no moving parts. As flooding occurs in the Three Rivers area, some stone will be shifted due to the force of the flood waters. In addition, vegetative debris could potentially begin to block the Owens Lake Equalization Structure. The expected maintenance required to maintain these structures would include the replacement of stone in areas where the thickness has been reduced, repair of damaged sections of the existing soil cement structure and the removal of the vegetative debris blocking the Owens Lake Equalization Structure. All these repairs can be accomplished with the use of backhoes to place the stone and trucks to haul it.

16. ACCESS ROADS

Access to Alternative 1's project areas will use the existing roads and structures serving the Three Rivers Study area. The existing roads consist of aggregate stabilized surfaces capable of handling heavy equipment loads. Recently these roads have been used for hauling timber, concrete and stone for structure repairs. Although not recommended for use, the surface of the existing structures consist of soil cement or concrete.

Only Alternative 2 requires additional access roads to be provided. They will be 30 feet wide, located within a 60 foot wide permanent easement and will not have an aggregate surface course. Clearing and grubbing of vegetation will be required in order to utilize the access roads. It is intended that the construction equipment blade and compact them so they are smooth and stable, in order to allow the off road trucks to deliver the stone for the two structures construction. Upon completion they would be reshaped and seeded.

It should be noted that portions of the existing access road will become inundated when the White River exceeds elevation 140. Also, there are weight restrictions on the existing soil cement structure and the Wild Goose Bayou Bridge. A low water crossing will be required adjacent to the Wild Goose Bayou Bridge for vehicles that exceed the bridge's weight restrictions.

During the Preconstruction, Engineering and Design (PED) phase, the access roads should be re-evaluated to verify that no improvements are required since the preparation of this study. The Contractor will be required to maintain all new and existing access roads used during the projects construction.

Access to the project area will also be available from the White River, especially for the delivery of stone materials.

17. CORROSION MITIGATION

The only metallic item in the project that could be subject to corrosion, is the steel sheet piling. The Historic Cutoff was built with sandy soils obtained from the dredging operations on the White River. These sandy soils allow for better aeration and faster evaporation, but the aeration could also cause the floods wet and dry cycles to increase the rusting/corrosion process on the steel sheet piling. With the presently defined conditions at the site, significant corrosion is not expected to impact the steel sheet piling. However, during Preliminary Engineering Design (PED) phase, a water and soil analysis should be performed to determine the "normal" groundwater level, resistivity and pH at the site. Other material options that could be considered if the water and soil analysis indicates corrosivity to the steel sheet piling, include the use of corrosion resistant piling such as vinyl or Core Ten weathering steel, concrete or slurry cutoff walls, various soil mixing techniques or the use of a cathodic protection system for the steel sheet piling.

18. PROJECT SECURITY

No project security is required, since the location of the construction is very remote and does not involve Government facilities that would require security to be present. During construction, the Contractor will be responsible for the protection of his equipment and personnel.

19. COST ESTIMATES

Cost estimates were prepared for the various alternatives and are included in Appendix F – "Cost Estimate".

20. SCHEDULE FOR DESIGN AND CONSTRUCTION

The schedule for the tentatively selected plan is located within Appendix F – "Cost Estimate".

21. SPECIAL STUDIES

None required.

22. PLATES, FIGURES AND DRAWINGS

Plates, Figures and Drawings have been included in Attachment A of the "Engineering Appendix". They include: plan views of the Stone Containment Structure and the Historic Cutoff channel, typical cross sections of the containment structure, Historic Cutoff and the Owens lake Equalization Structure.

23. DATA MANAGEMENT

During the feasibility study, electronic data was compiled and maintained in project folders for each discipline involved on the server. This data is backed up regularly by USACE's data manager (ACE-IT). The project's information will be available for the next phase of the project.

24. USE OF METRIC SYSTEM MEASUREMENTS

The Sponsor has not specifically requested that the project be designed in English units. However, the river mapping system and property surveys were all done originally in English units. Converting these survey drawings from English to Metric would have created additional work effort and potential translation errors which could affect the design team's efforts resulting in delays to the schedule and additional costs to prepare the study.

25. REPORT ON DESIGN AND CONSTRUCTION DEFICIENCIES IN THE DALE BUMPERS WHITE RIVER NATIONAL WILDLIFE REFUGE, ARKANSAS

During the Alternatives Milestone Meeting held on December 15, 2015, the project team was requested to review the report "Correct Design and Construction Deficiencies of Mitigation Structures", dated April 1991 for the Dale Bumpers White River National Wildlife Refuge. On October 11, 2016 a site visit was made to review the problems that said report had identified. The inspection report is located within Attachment C of the "Engineering Appendix". The Army Corps of Engineers completed the required mitigation structures per the agreement for the construction of the MKARNS channel. The same agreement passed the responsibility for operation and maintenance of the mitigation structures to the US Fish and Wildlife Service (USFWS). At the time of the inspection, no design or construction deficiencies were identified. The issues the USFWS was experiencing at the refuge were the result of facilities meeting their useful life or were impacted by water movement between the green tree reservoirs or flooding from the river. The responsibility for correcting the damages associated with the age of the structure's materials and the river is therefore the responsibility of the USFWS.

ATTACHMENT A

Plates, Figures and Drawings

US Army Corps of Engineers®

THREE RIVERS STUDY

MCCLELLAN-KERR ARKANSAS RIVER NAVIGATION SYSTEM (MKARNS)

WHITE RIVER

ARKANSAS COUNTY, ARKANSAS

Solicitation:

Contract:

US Army Corps of Engineers® Little Rock District

MARK	DESCRIPTION	TRACKING NO	ACTION	DATE
	REVISED FEBRUARY 2018			

Designed by: NPG
Drawn by: NPG
Reviewed by: GCW
Date: OCTOBER 2016
Solicitation No.:
Contract No.:

US ARMY CORPS OF ENGINEERS
LITTLE ROCK DISTRICT
LITTLE ROCK, ARKANSAS

Submitted by:

Chief, General Engineering Section

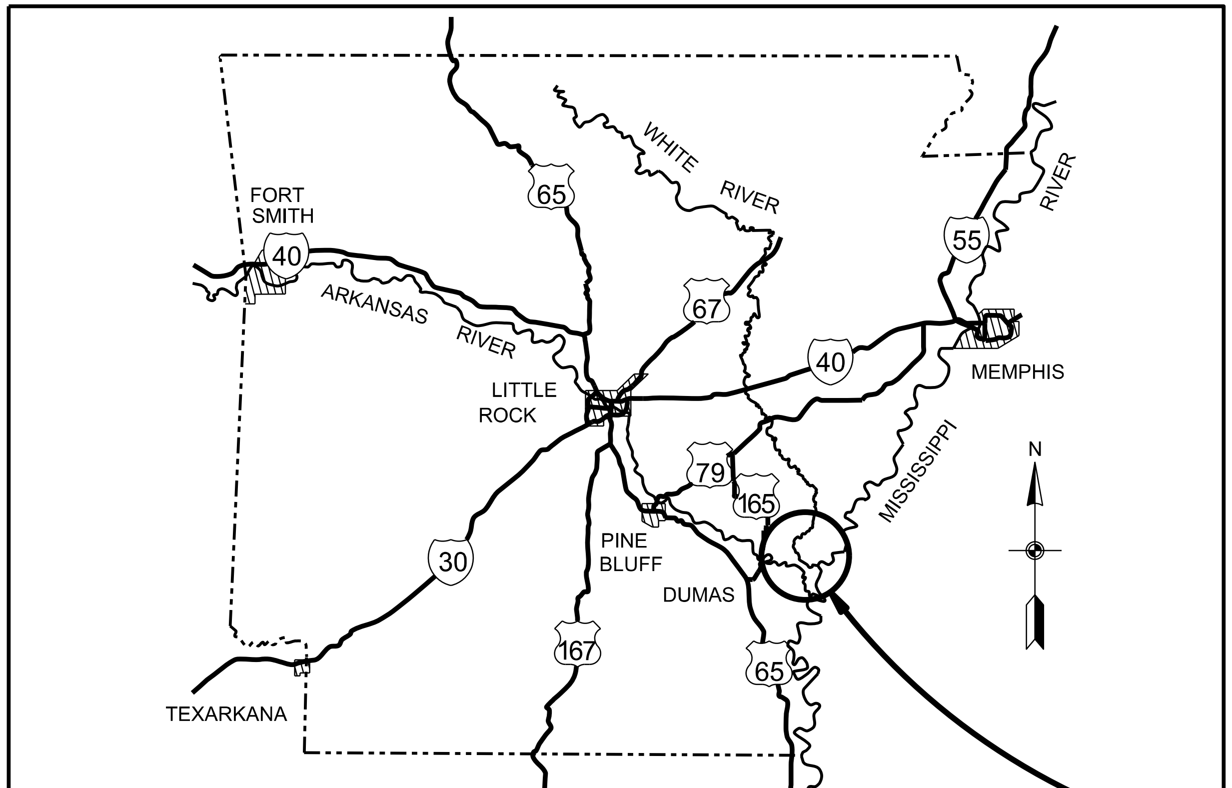
MCCLELLAN-KERR ARKANSAS RIVER NAVIGATION SYSTEM
WHITE RIVER
ARKANSAS COUNTY, ARKANSAS

THREE RIVERS STUDY
COVER SHEET

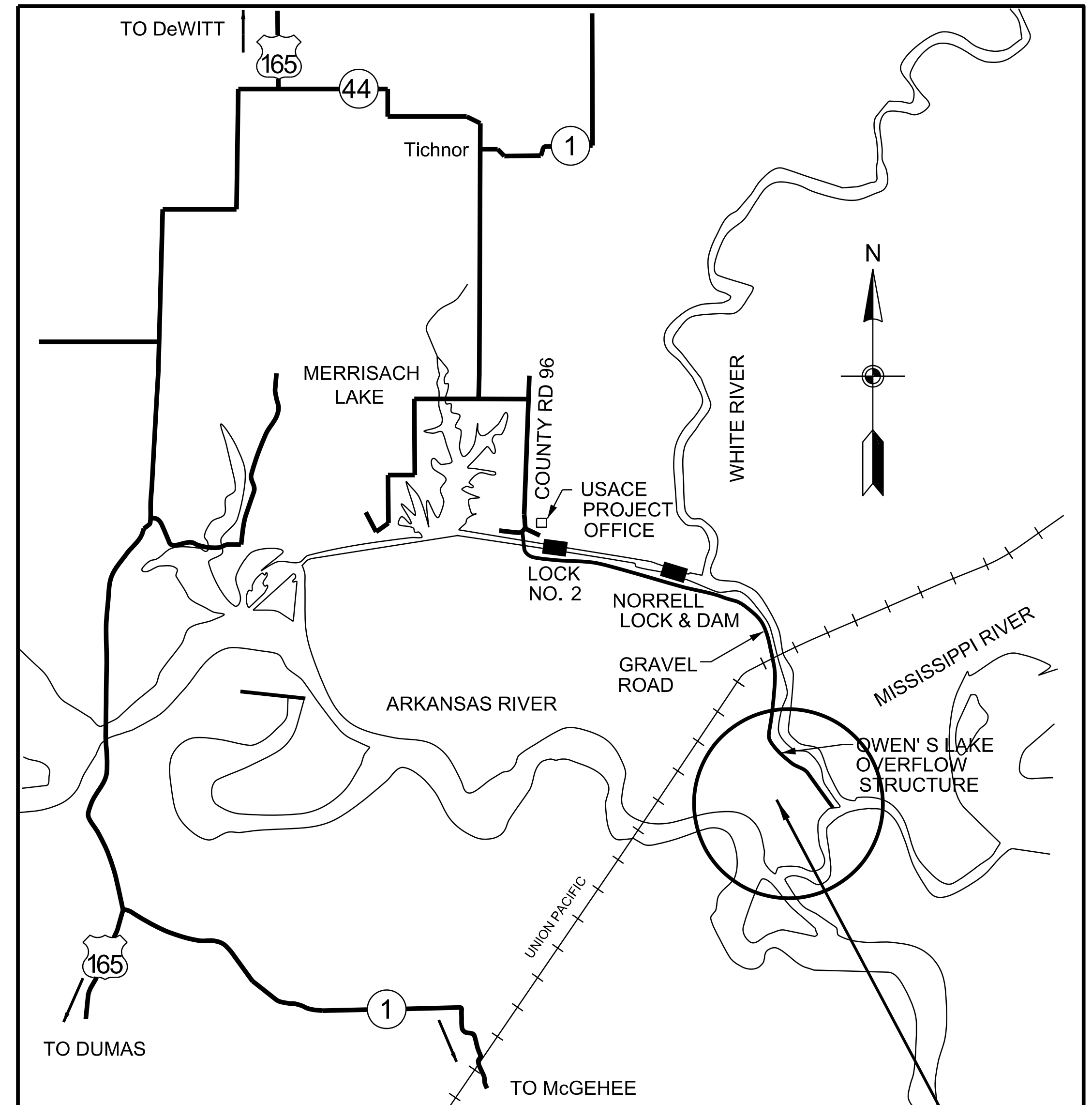
Drawing Code/ Serial No.
XXXXX-XXX/ XXXX

Drawing Ref. No.
G-001

$$$$$USERNAME$$$$$
$$$$$$$$$$$$$DGN$SPEC$$$$$$$$$$$$$$$
$$$$$SYTIME$$$$$



PROJECT VICINITY MAP
NTS



PROJECT LOCATION MAP
NTS

SHEET INDEX		
DRAWING CODE:	SHEET NO.	TITLE
	G-001	COVER SHEET
	G-002	PROJECT LOCATION AND VICINITY MAP-INDEX
	C-001	PROJECT LOCATION
	C-101	ALTERNATIVE 1 STONE STRUCTURE
	C-102	ALTERNATIVE 1 HISTORIC CUTOFF STRUCTURE
	C-103	ALTERNATIVE 1 OWENS LAKE EQUALIZATION STRUCTURE
	C-104	ALTERNATIVE 2 HISTORIC CUTOFF STRUCTURE
	C-105	ALTERNATIVE 2 MULTIPLE OPENING STRUCTURES
	C-501	DETAILS
	C-502	ALTERNATIVE 1 HISTORIC CUTOFF PROFILES
	C-503	ALTERNATIVE 2 HISTORIC CUTOFF PROFILES
	C-504	ALTERNATIVE 1 HISTORIC CUTOFF SECTIONS
	C-505	ALTERNATIVE 2 HISTORIC CUTOFF SECTIONS

NOTE: THESE DRAWINGS ARE LOCATED IN THE FOLLOWING FOLDER LOCATION:

\swl-netapp2.swl.ds.usace.army.mil\Shared\ENG Shared\DESIGN\PROJECTS\CIVIL WORKS CORPS\Three Rivers Study\Design Alternatives\InRoads

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Little Rock District

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Date: OCTOBER 2016
Solicitation No.:
Contract No.:

US ARMY CORPS OF ENGINEERS
LITTLE ROCK DISTRICT
LITTLE ROCK, ARKANSAS

Submitted by:
Chief, General Engineering Section

MCCLELLAN-KERR ARKANSAS RIVER NAVIGATION SYSTEM
WHITE RIVER
ARKANSAS COUNTY, ARKANSAS

THREE RIVERS STUDY
PROJECT LOCATION
AND VICINITY MAP-INDEX

Drawing Code/
Serial No.
XXXXX-XXX/ 20XX

Drawing Ref. No.
G-002

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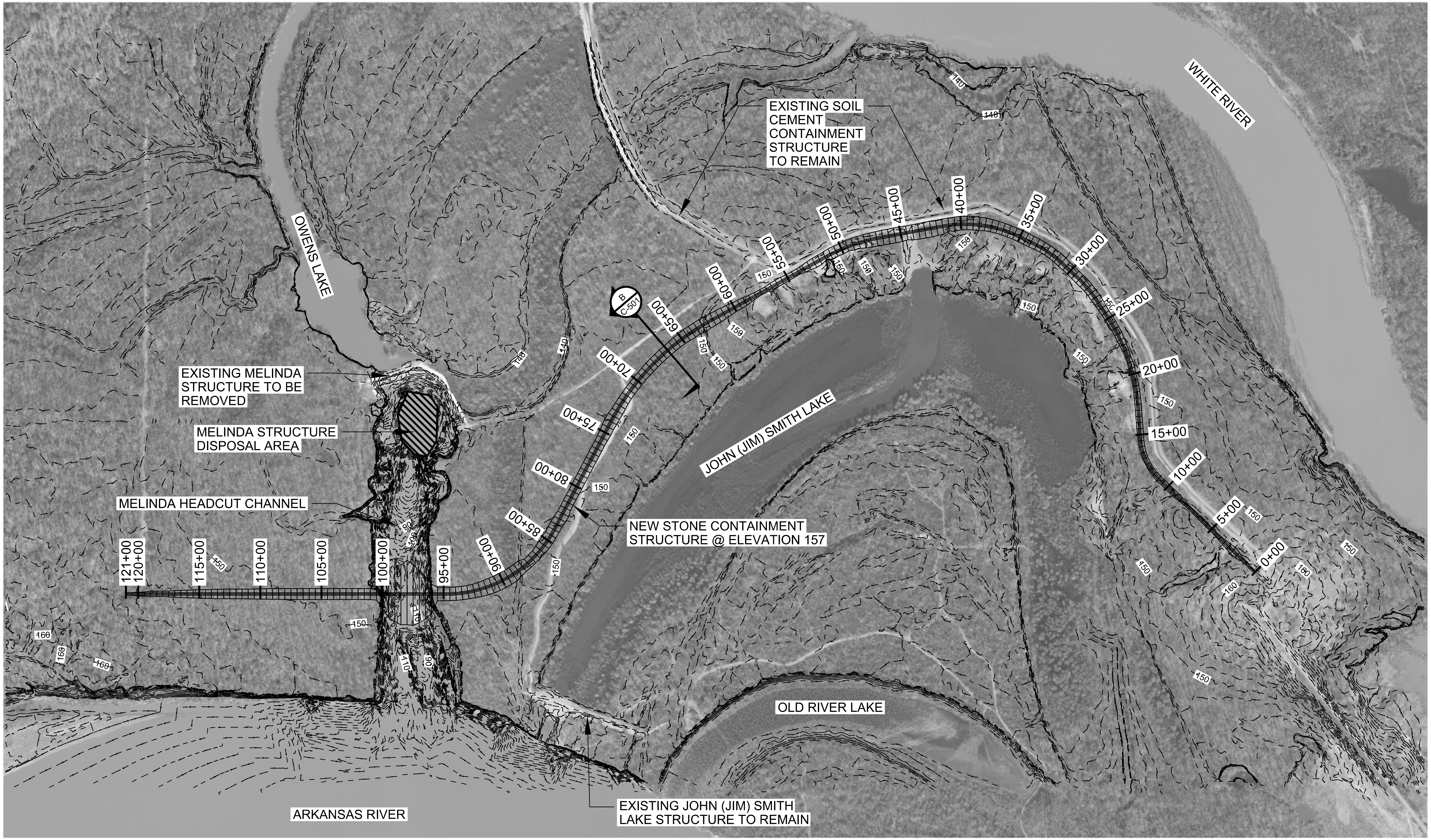

A C-101 C-101 SITE PLAN SCALE: 1" = 400'

STONE CONTAINMENT STRUCTURE - ALTERNATIVE 1

0 400' 800'

N

US Army Corps of Engineers® Little Rock District

REVISED FEBRUARY 2018

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Designed by: NPG

Date: OCTOBER 2016

Drawn by: AAC

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LITTLE ROCK DISTRICT
LITTLE ROCK, ARKANSAS

Submitted by:

Chief, General Engineering Section

MCCLELLAN-KERR ARKANSAS RIVER NAVIGATION SYSTEM
WHITE RIVER
ARKANSAS COUNTY, ARKANSAS

THREE RIVERS STUDY
ALTERNATIVE 1
STONE STRUCTURE

Drawing Code/ Serial No.
XXXXX-XXX/ xxx

Drawing Ref. No.
C-101

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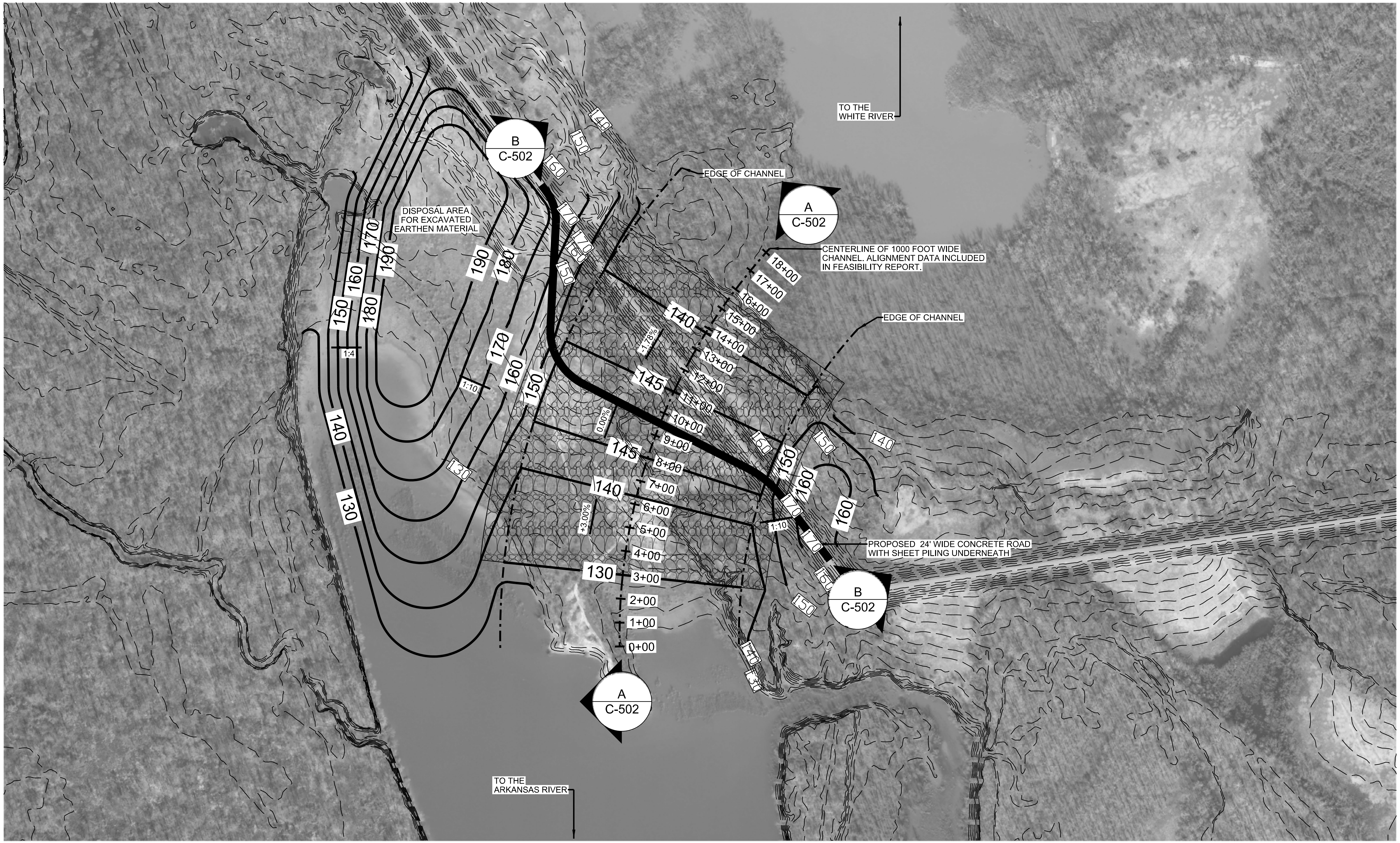
$$$$$$$$$$$$$$$DGNSSPEC$$$$$$$$$$$$$$$$

$$$$$SYTIME$$$$$



A
C-102 | C-102

SITE PLAN

SCALE: 1" = 200'

HISTORIC CUTOFF STRUCTURE - ALTERNATIVE 1

N

EXISTING CONTOURS
(2 FOOT INTERVAL)

PROPOSED CONTOURS
(5 OR 10 FOOT INTERVAL
AS NOTED)

US Army Corps
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Little Rock District

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US ARMY CORPS OF ENGINEERS
LITTLE ROCK DISTRICT
LITTLE ROCK, ARKANSAS

Submitted by:

Chief, General Engineering Section

MCCLELLAN-KERR ARKANSAS RIVER NAVIGATION SYSTEM
WHITE RIVER
ARKANSAS COUNTY, ARKANSAS

THREE RIVERS STUDY
ALTERNATIVE 1
HISTORIC CUTOFF STRUCTURE

Drawing Code/
Serial No.
XXXXX-XXX/ 140

Drawing Ref. No.
C-102

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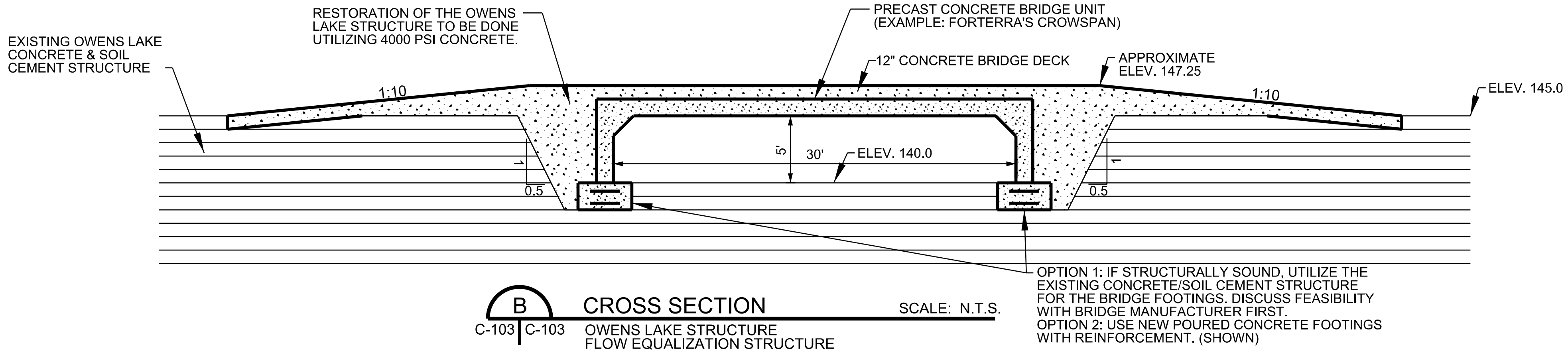
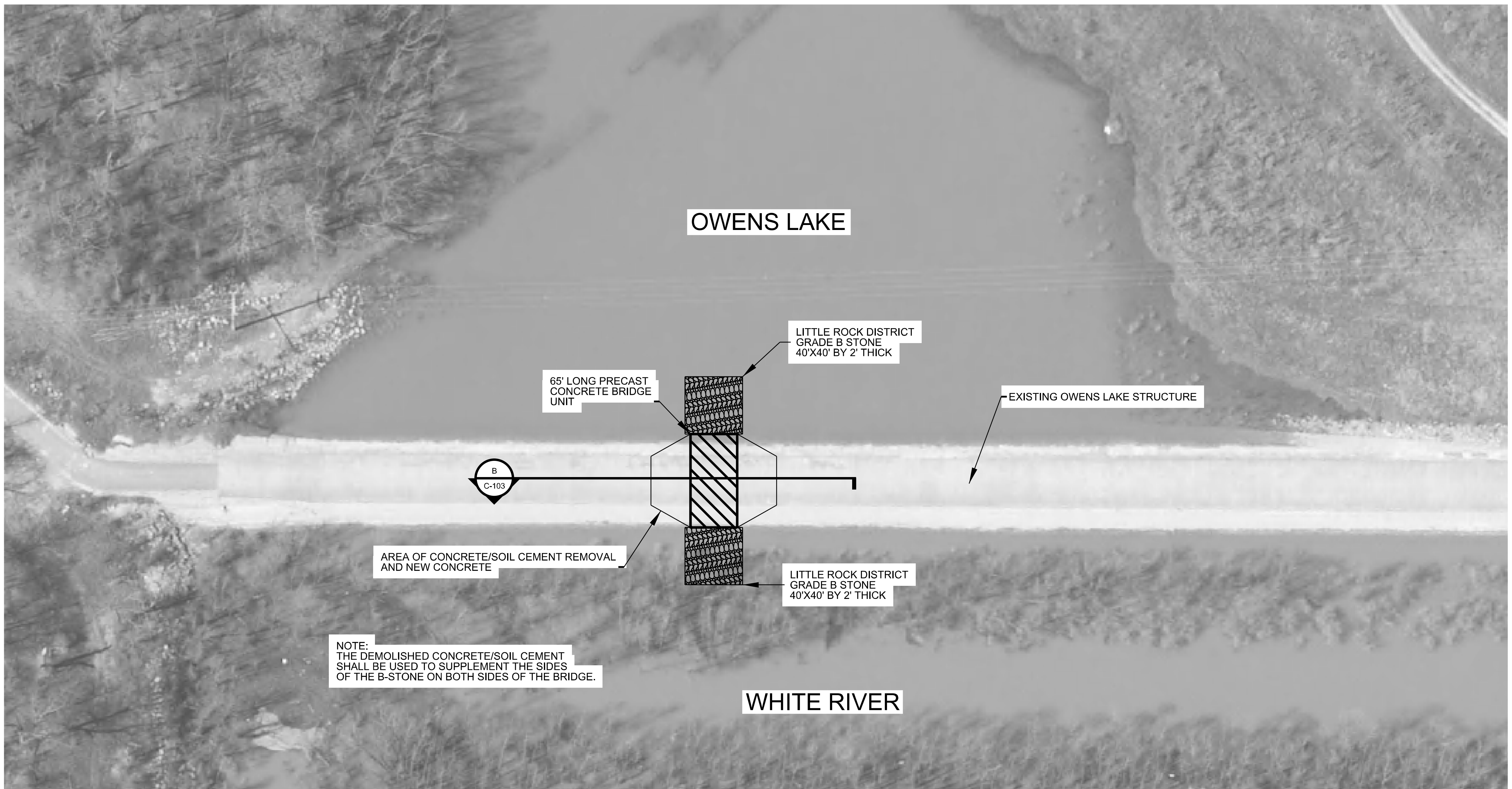


B — CROSS SECTION — SCALE: N.T.S.
C-103 | C-103
OWENS LAKE STRUCTURE
FLOW EQUALIZATION STRUCTURE



A — SITE PLAN — SCALE: 1" = 20'
C-103 | C-103
OWENS LAKE STRUCTURE FLOW EQUALIZATION
ALTERNATIVE 1

N

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Little Rock District

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Drawn by: NPG
Reviewed by: NHB
Date: OCTOBER 2016
Solicitation No.:
Contract No.:

US ARMY CORPS OF ENGINEERS
LITTLE ROCK DISTRICT
LITTLE ROCK, ARKANSAS

Submitted by:
Chief, General Engineering Section

MCCLELLAN-KERR ARKANSAS RIVER NAVIGATION SYSTEM
WHITE RIVER
ARKANSAS COUNTY, ARKANSAS

THREE RIVERS STUDY
ALTERNATIVE 1
OWENS LAKE EQUALIZATION STRUCTURE

Drawing Code/ Serial No.
XXXXX-XXX/ 140

Drawing Ref. No.
C-103

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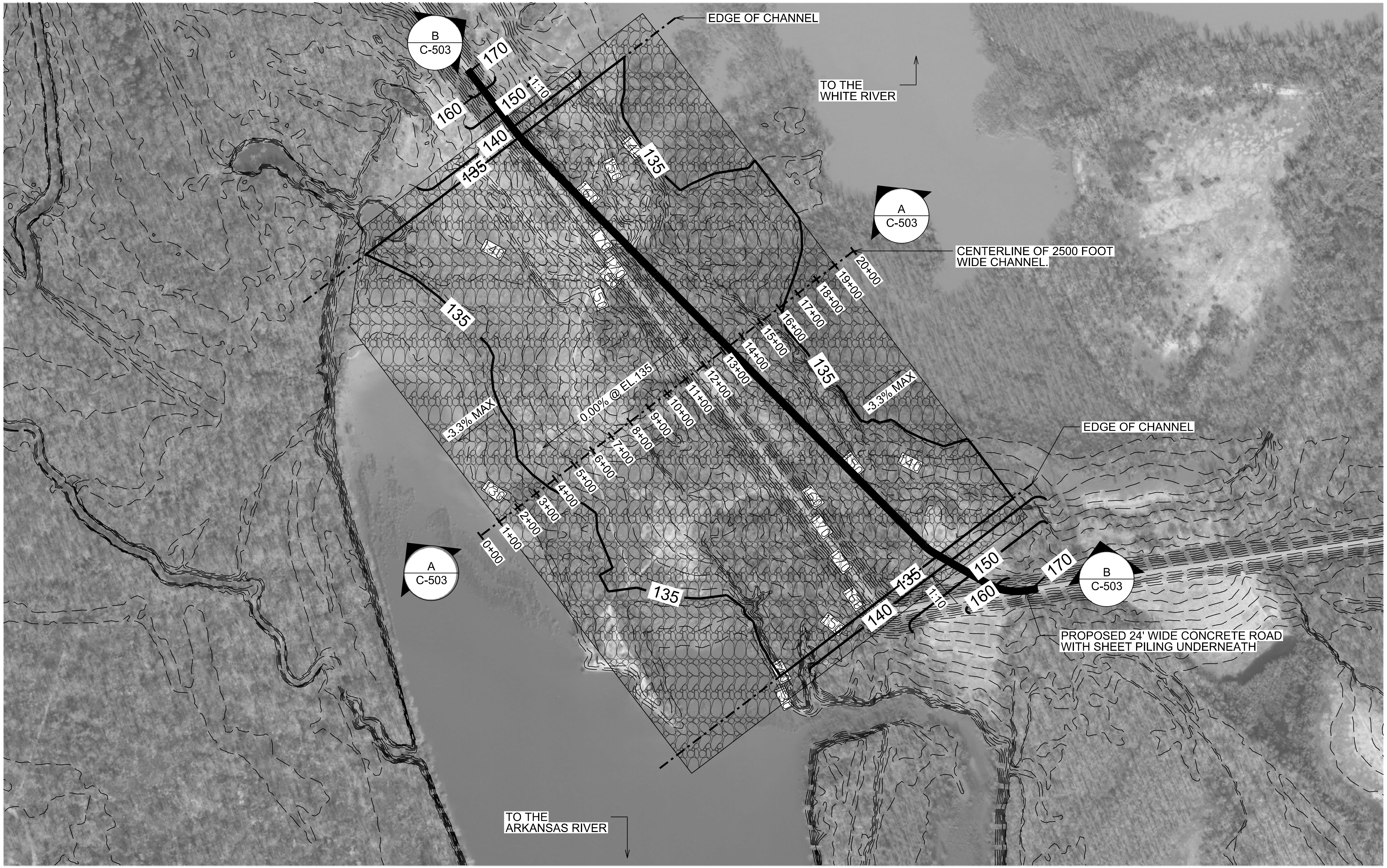

A SITE PLAN SCALE: 1" = 200'
C-102 | C-102 HISTORIC CUTOFF STRUCTURE - ALTERNATIVE 2

N

EXISTING CONTOURS
(2 FOOT INTERVAL)

PROPOSED CONTOURS
(5 OR 10 FOOT INTERVAL AS NOTED)

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Reviewed by: GCW	Contract No.:	

Submitted by:
Chief, General Engineering Section

ALTERNATIVE 2
HISTORIC CUTOFF STRUCTURE

XXXXX-XXX/

Drawing Ref. No.
C-104

$$$$$USERNAME$$$$$
$$$$$$$$$$$$$DGNSPEC$$$$$$$$$$$$$$$
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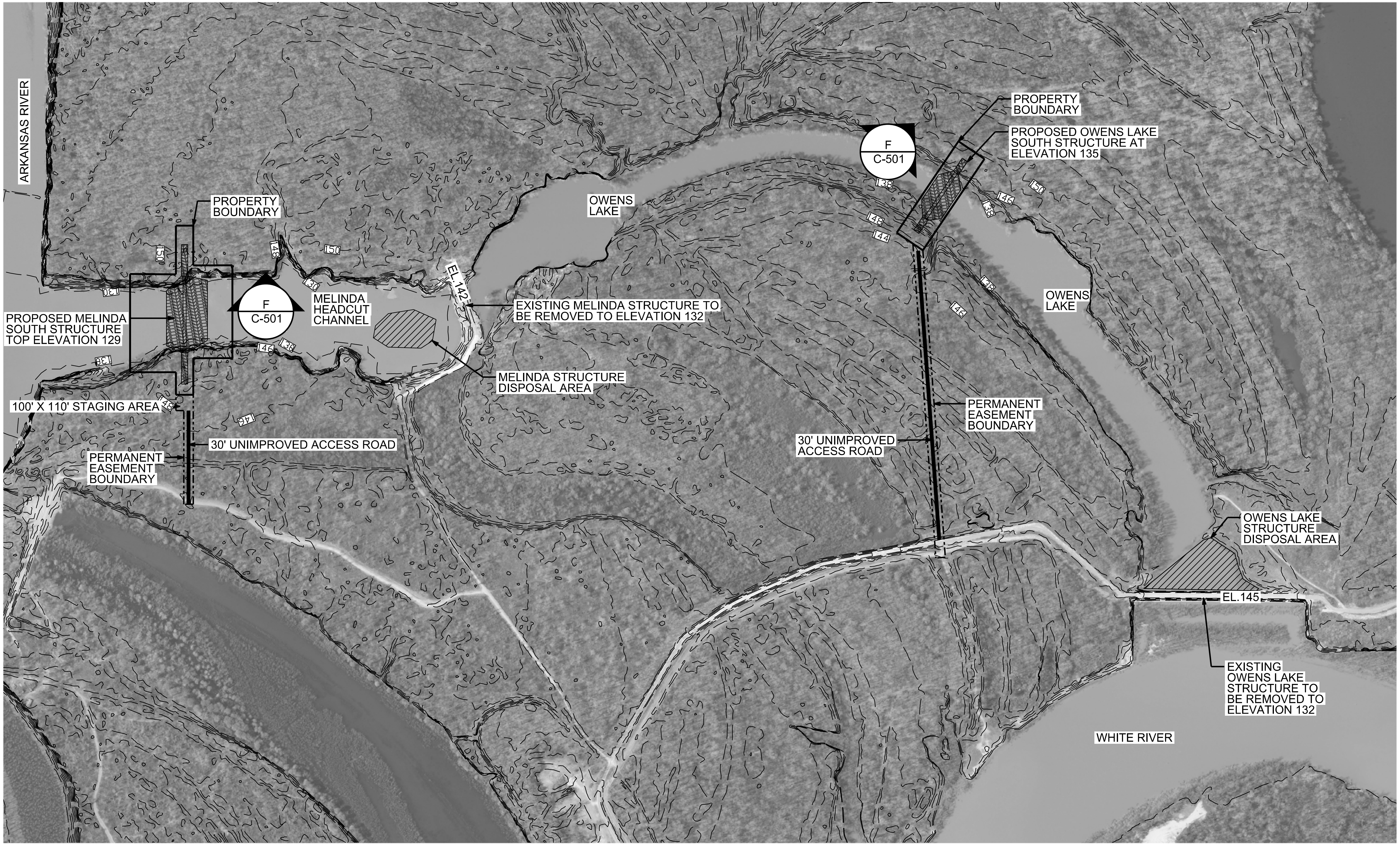

A
C-105

SITE PLAN
STRUCTURE IMPROVEMENTS
ALTERNATIVE 2

SCALE: 1" = 300'

N

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LITTLE ROCK DISTRICT
LITTLE ROCK, ARKANSAS

Submitted by:
Chief, General Engineering Section

MCCLELLAN-KERR ARKANSAS RIVER NAVIGATION SYSTEM
WHITE RIVER
ARKANSAS COUNTY, ARKANSAS

THREE RIVERS STUDY
ALTERNATIVE 2
MULTIPLE OPENING STRUCTURES

Drawing Code/
Serial No.
XXXXX-XXX/

Drawing Ref. No.
C-105

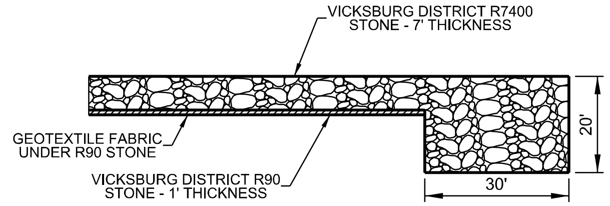
$$$$$USERNAME$$$$$
$$$$$$$$$$$$$$$DGNSPEC$$$$$$$$$$$$$$$
$$$$$SYTIME$$$$$

NOTES:

1. GRADE B STONE TO BE USED FROM 93+00 TO 103+00 ACROSS THE MELINDA HEADCUT CHANNEL. ALL OTHER AREAS ARE TO BE GRADE C STONE.

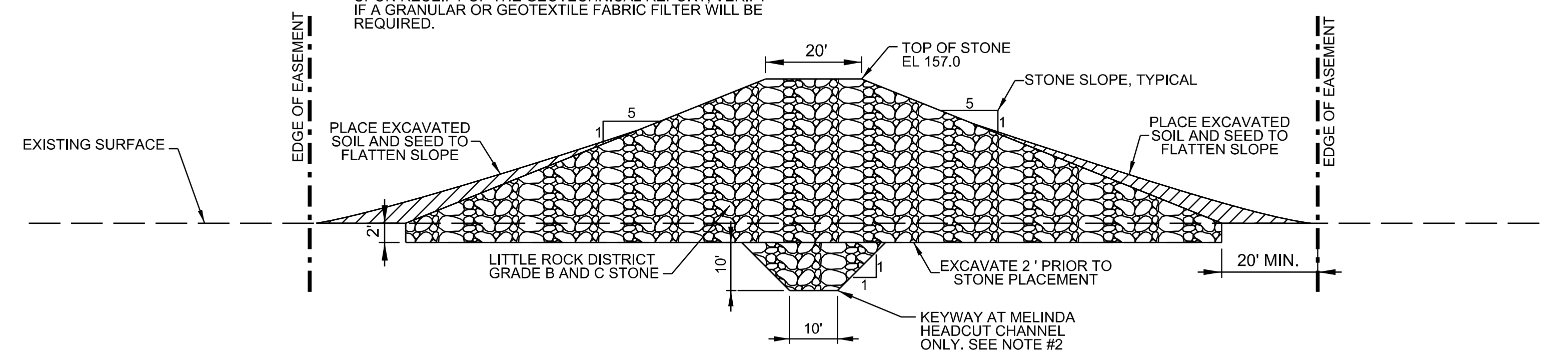
2. THE KEYWAY AT THE MELINDA HEADCUT CHANNEL IS TO BE INSTALLED IN THE AREA OF STATIONS 93+50 TO 96+00 AND 100+00 TO 102+50. THE KEYWAY DESIGN IS TO BE CONSIDERED PRELIMINARY UNTIL RECEIPT OF THE GEOTECHNICAL REPORT AND VERIFICATION IS MADE.

3. THE STONE CONTAINMENT STRUCTURE CURRENTLY DOES NOT HAVE A FILTER COMPONENT IN ITS DESIGN TO PREVENT MIGRATION OF GRANULAR MATERIALS AS WATER FLOWS THROUGH THESE POROUS STRUCTURES. UPON RECEIPT OF THE GEOTECHNICAL REPORT, VERIFY IF A GRANULAR OR GEOTEXTILE FABRIC FILTER WILL BE REQUIRED.



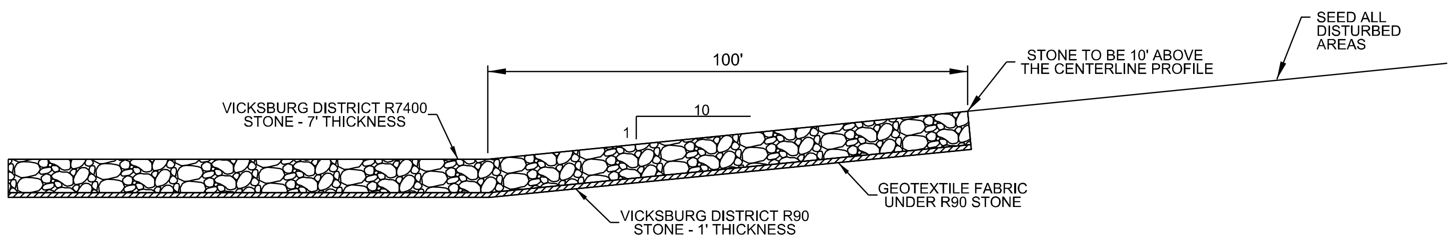
A C-504 C-505 **CHANNEL & CHANNEL END DETAIL** SCALE: N.T.S.

HISTORIC CUTOFF STRUCTURE
ALTERNATIVES 1 & 2



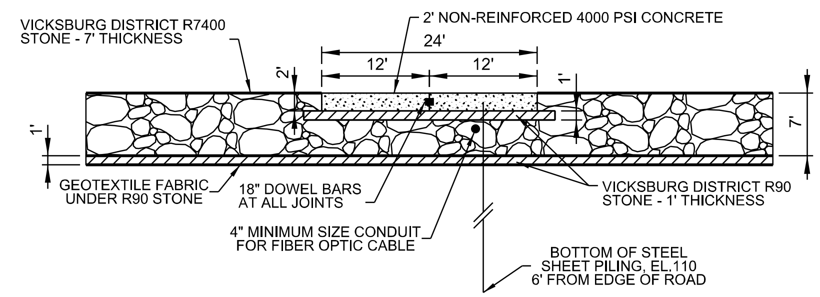
B C-101 **CROSS SECTION** SCALE: N.T.S.

STONE CONTAINMENT STRUCTURE
ALTERNATIVE 1



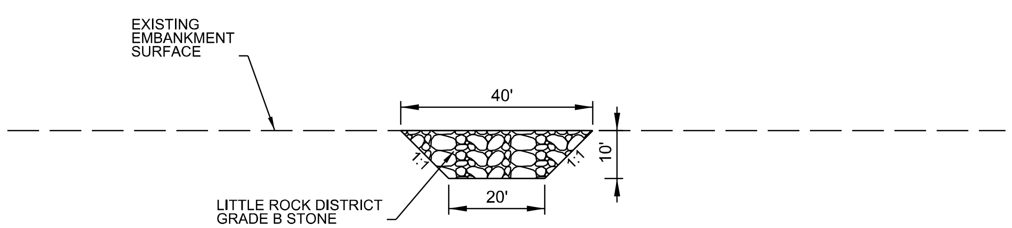
C C-504 C-505 **CHANNEL SIDE DETAIL** SCALE: N.T.S.

HISTORIC CUTOFF STRUCTURE
ALTERNATIVES 1 & 2



D C-504 C-505 **CONCRETE ROAD & PILING** SCALE: N.T.S.

HISTORIC CUTOFF STRUCTURE
ALTERNATIVES 1 & 2

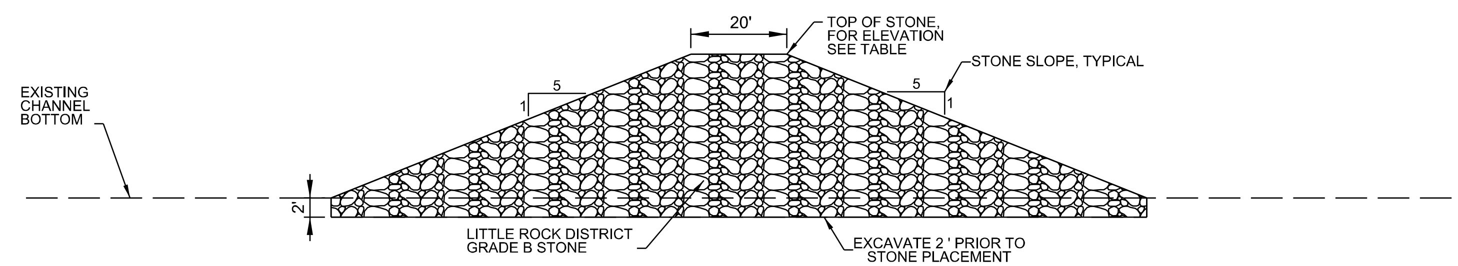


NOTE:
KEYWAYS ARE TO BE INSTALLED ON BOTH ENDS OF THE STRUCTURE, STARTING AT THE TOE OF THE EMBANKMENT AND EXTENDING FOR THE KEYWAY LENGTH LISTED.

STRUCTURE	KEYWAY LENGTH
NEW OWENS LAKE	150 FEET
NEW MELINDA	250 FEET

E C-105 **CROSS SECTION - KEYWAY** SCALE: N.T.S.

NEW OWENS LAKE STONE STRUCTURE &
NEW MELINDA STONE STRUCTURE
ALTERNATIVE 2



STRUCTURE	TOP OF STONE ELEVATION	APPROXIMATE STONE HEIGHT
NEW OWENS LAKE	135	15 FEET
NEW MELINDA	129	25 FEET

F C-105 **CROSS SECTION** SCALE: N.T.S.

NEW OWENS LAKE STONE STRUCTURE &
NEW MELINDA STONE STRUCTURE
ALTERNATIVE 2

US Army Corps of Engineers®
Little Rock District

MARK	DESCRIPTION	TRACKING NO	ACTION	DATE
	REVISED FEBRUARY 2018			
	REVISED MARCH 2018			

$$$$$USERNAME$$$$$

Designed by: NPG
Drawn by: NPG
Reviewed by: GCW
Date: OCTOBER 2016
Solicitation No.:
Contract No.:

US ARMY CORPS OF ENGINEERS
LITTLE ROCK DISTRICT
LITTLE ROCK, ARKANSAS

Submitted by:

Chief, General Engineering Section

$$$$$$$$$$$$$DGN$SPEC$$$$$$$$$$$$$$$

MCCLELLAN-KERR ARKANSAS RIVER NAVIGATION SYSTEM
WHITE RIVER
ARKANSAS COUNTY, ARKANSAS

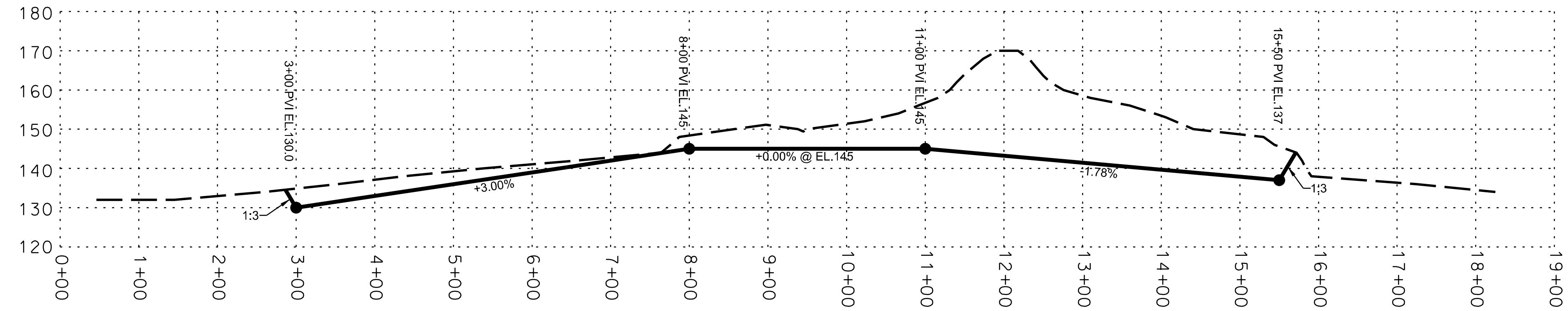
THREE RIVERS STUDY

DETAILS

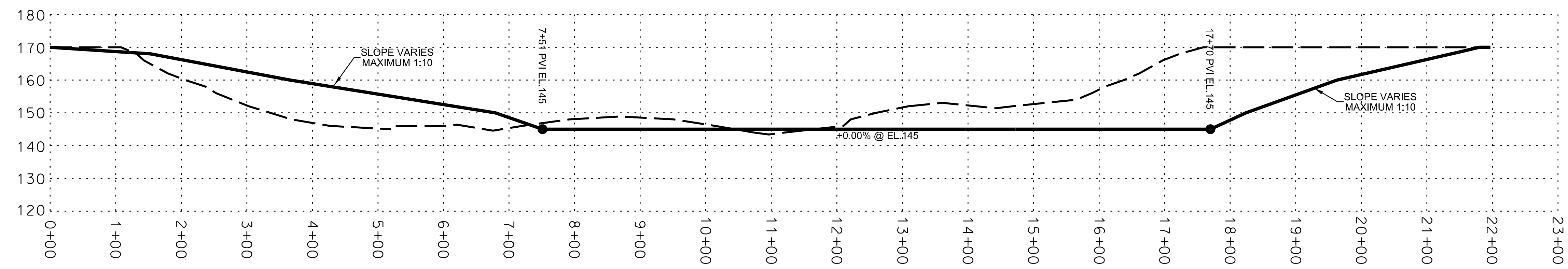
$$$$$SYTIME$$$$$

Drawing Code/ Serial No.
XXXXX-XXX/ 140

Drawing Ref. No.
C-501



A C-102 CHANNEL CENTERLINE PROFILE SCALE: 1"=100' HOR. & 1"=20' VERT.
HISTORIC CUTOFF STRUCTURE - ALTERNATIVE 1



B C-102 ROAD PROFILE SCALE: 1"=100' HOR. & 1"=20' VERT.
HISTORIC CUTOFF STRUCTURE - ALTERNATIVE 1

US Army Corps of Engineers
Little Rock District

REVISED FEBRUARY 2018

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Contract No.:

US ARMY CORPS OF ENGINEERS
LITTLE ROCK DISTRICT
LITTLE ROCK, ARKANSAS

Submitted by:
Chief, General Engineering Section

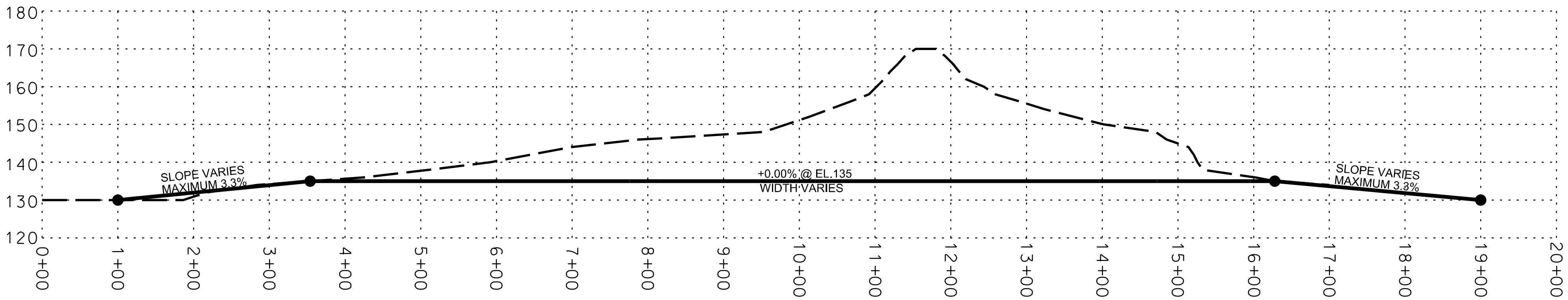
MCCLELLAN-KERR ARKANSAS RIVER NAVIGATION SYSTEM
WHITE RIVER
ARKANSAS COUNTY, ARKANSAS

THREE RIVERS STUDY
ALTERNATIVE 1
HISTORIC CUTOFF PROFILES

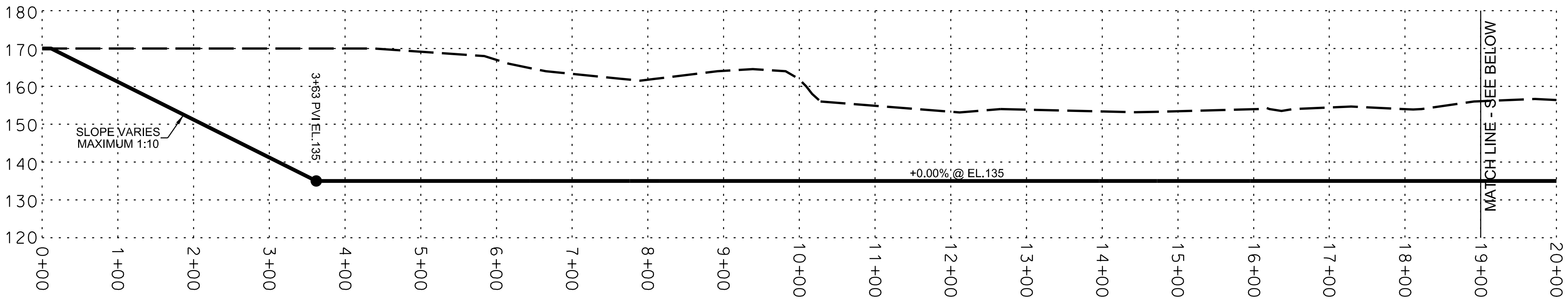
Drawing Code/
Serial No.
XXXXX-XXX/ 140

Drawing Ref. No.
C-502

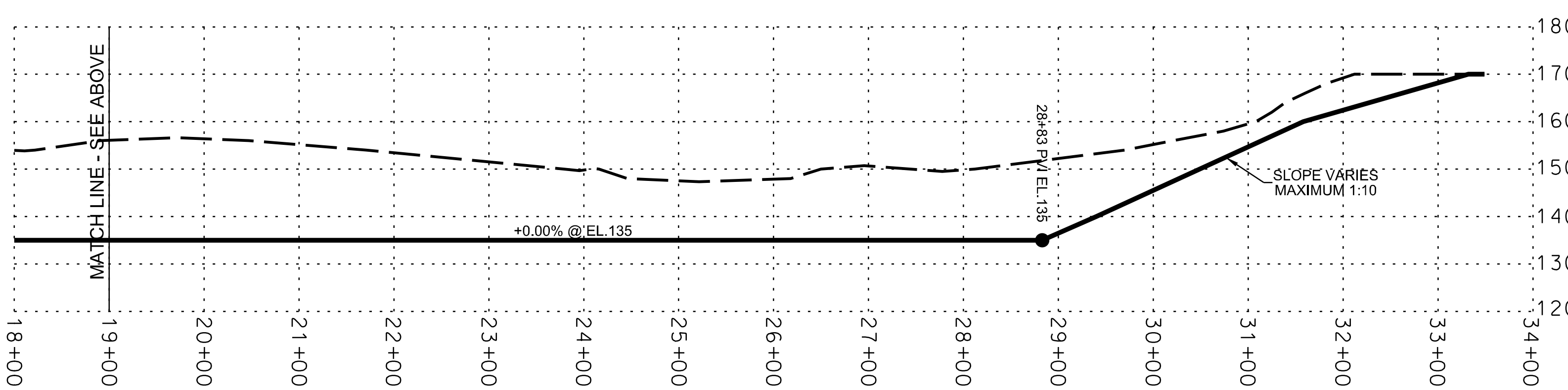
$$$$$USERNAME$$$$$
$$$$$$$$$$$$$$$$DGN$$SPEC$$$$$$$$$$$$$$$$$
$$$$$$SYTIME$$$$$$



A C-104 **CHANNEL CENTERLINE PROFILE** SCALE: 1"=100' HOR. & 1"=20' VERT.
HISTORIC CUTOFF STRUCTURE - ALTERNATIVE 2



B C-104 **ROAD PROFILE (WEST SIDE)** SCALE: 1"=100' HOR. & 1"=20' VERT.
HISTORIC CUTOFF STRUCTURE - ALTERNATIVE 2



B C-104 **ROAD PROFILE (EAST SIDE)** SCALE: 1"=100' HOR. & 1"=20' VERT.
HISTORIC CUTOFF STRUCTURE - ALTERNATIVE 2

US Army Corps of Engineers®
Little Rock District

REVISED FEBRUARY 2018

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Reviewed by: GCW
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US ARMY CORPS OF ENGINEERS
LITTLE ROCK DISTRICT
LITTLE ROCK, ARKANSAS

Submitted by:
Chief, General Engineering Section

MCCLELLAN-KERR ARKANSAS RIVER NAVIGATION SYSTEM
WHITE RIVER
ARKANSAS COUNTY, ARKANSAS

THREE RIVERS STUDY
ALTERNATIVE 2
HISTORIC CUTOFF PROFILES

Drawing Code/ Serial No.
XXXXX-XXX/ 140

Drawing Ref. No.
C-503

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$$$$$$$$$$$DGNSPEC$$$$$$$$$$$$$
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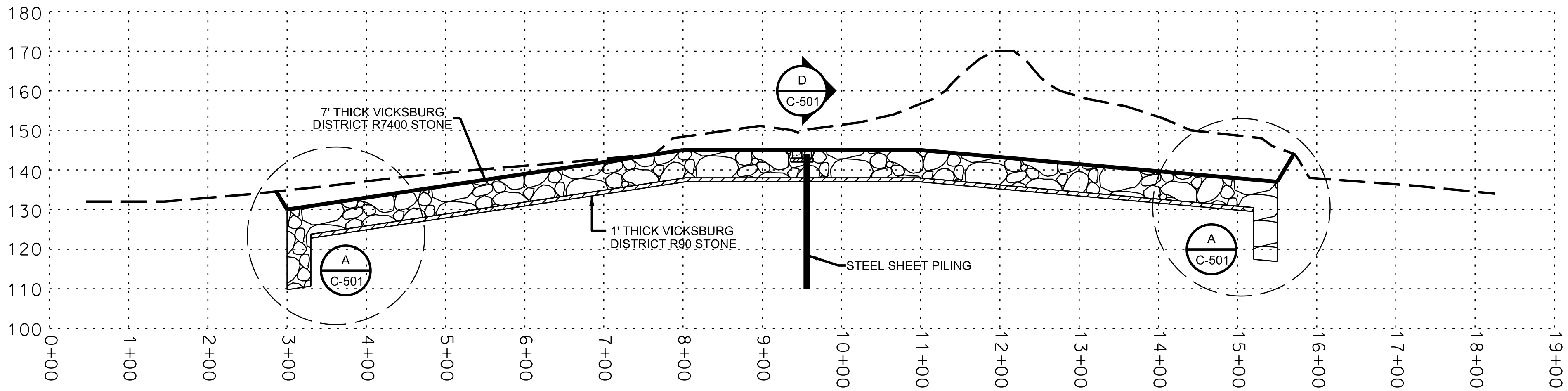
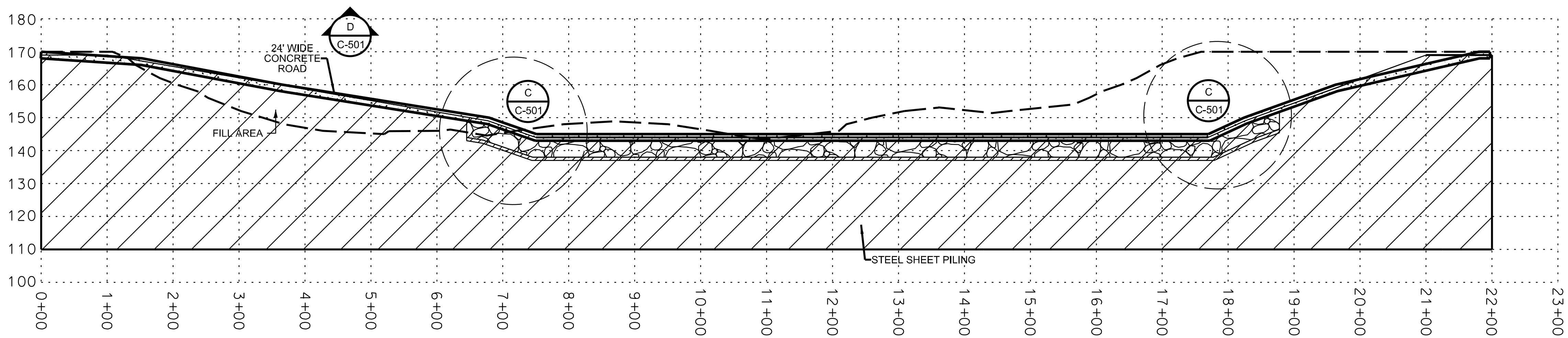


A C-102 **CHANNEL CENTERLINE SECTION** SCALE: 1"=100' HOR. & 1"=20' VERT.

HISTORIC CUTOFF STRUCTURE - ALTERNATIVE 1



B C-102 **ROAD SECTION** SCALE: 1"=100' HOR. & 1"=20' VERT.

HISTORIC CUTOFF STRUCTURE - ALTERNATIVE 1

US Army Corps of Engineers®
Little Rock District

REVISED FEBRUARY 2018

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US ARMY CORPS OF ENGINEERS
LITTLE ROCK DISTRICT
LITTLE ROCK, ARKANSAS

Submitted by:
Chief, General Engineering Section

MCCLELLAN-KERR ARKANSAS RIVER NAVIGATION SYSTEM
WHITE RIVER
ARKANSAS COUNTY, ARKANSAS

THREE RIVERS STUDY
ALTERNATIVE 1
HISTORIC CUTOFF SECTIONS

Drawing Code/ Serial No.
XXXXX-XXX/ 140

Drawing Ref. No.
C-504

$$$$$USERNAME$$$$$
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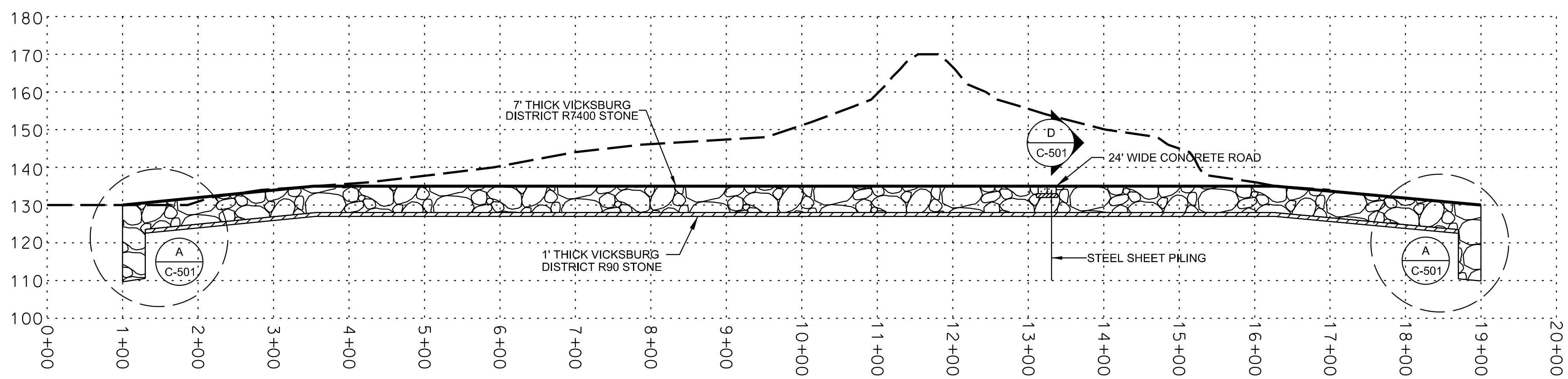
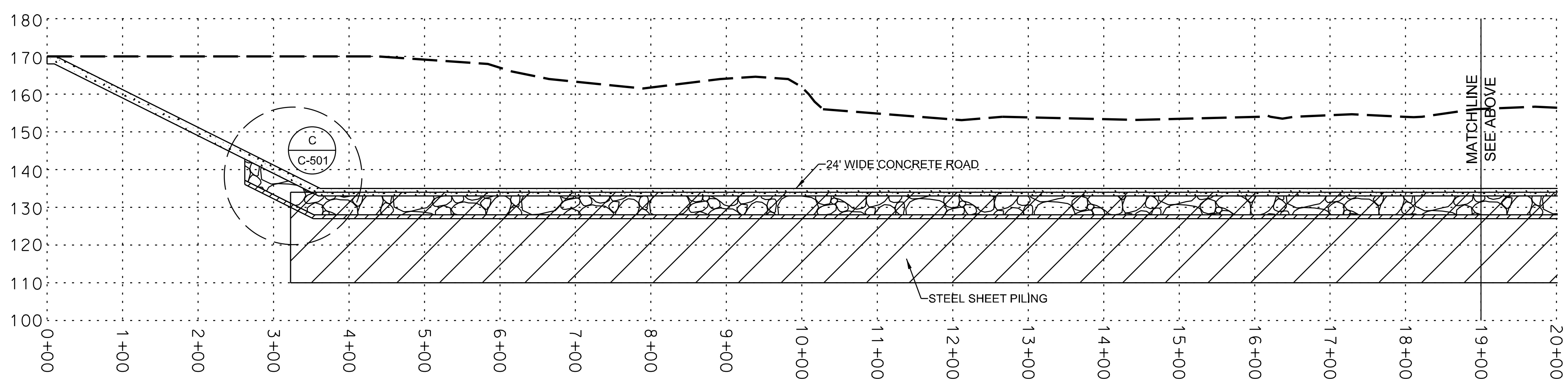


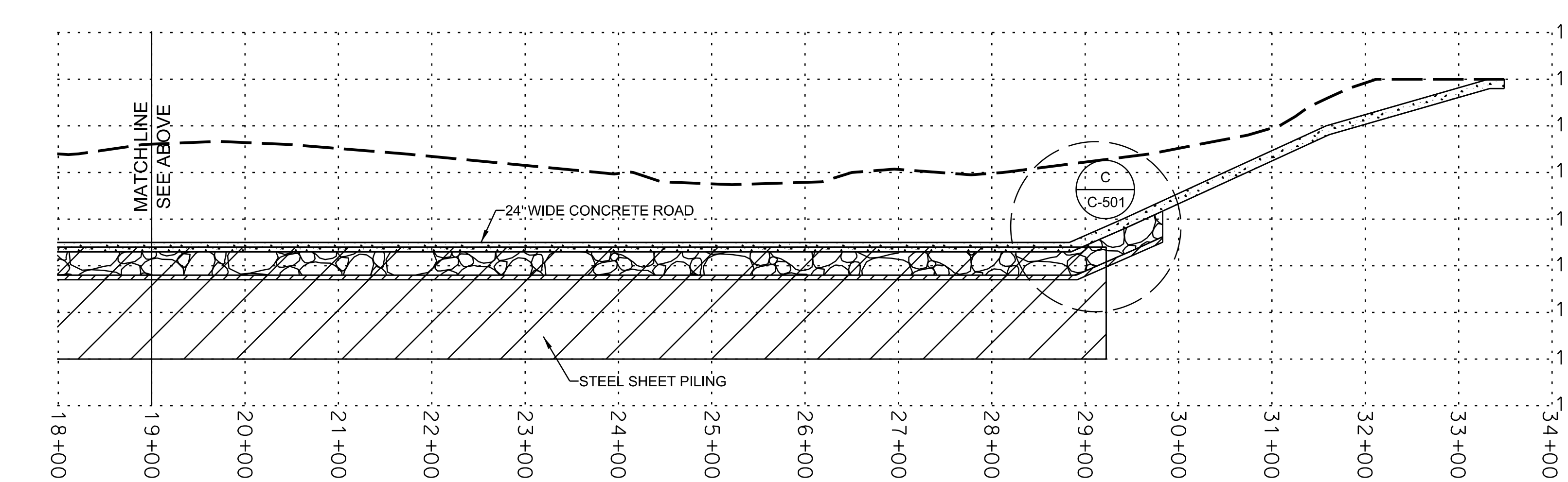
A / C-104 **CHANNEL CENTERLINE SECTION** SCALE: 1"=100' HOR. & 1"=20' VERT.

HISTORIC CUTOFF STRUCTURE - ALTERNATIVE 2



B / C-104 **ROAD SECTION (WEST SIDE)** SCALE: 1"=100' HOR. & 1"=20' VERT.

HISTORIC CUTOFF STRUCTURE - ALTERNATIVE 2



B / C-104 **ROAD SECTION (EAST SIDE)** SCALE: 1"=100' HOR. & 1"=20' VERT.

HISTORIC CUTOFF STRUCTURE - ALTERNATIVE 2

US Army Corps of Engineers®
Little Rock District

REVISED FEBRUARY 2018

MARK | DESCRIPTION | TRACKING NO | ACTION | DATE

Designed by: NPG | Date: OCTOBER 2016
Drawn by: NPG | Solicitation No.:
Reviewed by: GCW | Contract No.:

US ARMY CORPS OF ENGINEERS
LITTLE ROCK DISTRICT
LITTLE ROCK, ARKANSAS

Submitted by:
Chief, General Engineering Section

MCCLELLAN-KERR ARKANSAS RIVER NAVIGATION SYSTEM
WHITE RIVER
ARKANSAS COUNTY, ARKANSAS

THREE RIVERS STUDY
ALTERNATIVE 2
HISTORIC CUTOFF SECTIONS

Drawing Code/ Serial No.
XXXXX-XXX/ 140

Drawing Ref. No.
C-505

$$$$$USERNAME$$$$$ $$$$$$$$$$$$DGNSPEC$$$$$$$$$$$$$ $$$$$SYTIME$$$$$

ALTERNATIVE 1 - STONE CONTAINMENT

STRUCTURE @ ELEVATION 157

Horizontal Alignment Review Report

Report Created: 1/23/2018
Time: 1:25pm

Project: Model

Description:

File Name: \\swl-netapp2.swl.ds.usace.army.mil\Shared\ENG Shared\DESIGN\PROJECTS\CIVIL WORKS CORPS\Three Rivers Study\Design Alternatives\InRoads\InRoads Working File (2D).dgn

Last Revised: 1/23/2018 13:23:42

Note: All units in this report are in feet unless specified otherwise.

Alignment Name: Unnamed

Alignment Description: **Stone Containment Structure**

Alignment Style:

		Station	Northing	Easting
Element: Linear				
POB	( )	0+00.00	1784992.211	1571669.100
PC	( )	10+97.85	1785757.041	1570881.506
Tangential Direction:		N 45°50'24.5" W		
Tangential Length:		1097.85		
Element: Circular				
PC	( )	10+97.85	1785757.041	1570881.506
PI	( )	12+86.87	1785888.726	1570745.901
CC	( )		1786115.740	1571229.837
PT	( )	14+59.28	1786077.185	1570731.326
Radius:		500.00		
Delta:		41°25'03.6" Right		
Degree of Curvature (Arc):		11°27'33.0"		
Length:		361.44		

Tangent:		189.02		
Chord:		353.62		
Middle Ordinate:		32.31		
External:		34.54		
Tangent Direction:		N 45°50'24.5" W		
Radial Direction:		N 44°09'35.5" E		
Chord Direction:		N 25°07'52.7" W		
Radial Direction:		N 85°34'39.1" E		
Tangent Direction:		N 4°25'20.9" W		
Element: Linear				
PT	( )	14+59.28	1786077.185	1570731.326
PC	( )	17+46.17	1786363.220	1570709.204
Tangential Direction:		N 4°25'20.9" W		
Tangential Length:		286.89		
Element: Circular				
PC	( )	17+46.17	1786363.220	1570709.204
PI	( )	21+21.80	1786737.731	1570680.239
CC	( )		1786247.555	1569213.670
PT	( )	24+82.29	1787054.392	1570478.191
Radius:		1500.00		
Delta:		28°07'03.9"	Left	
Degree of Curvature (Arc):		3°49'11.0"		
Length:		736.12		
Tangent:		375.63		
Chord:		728.76		
Middle Ordinate:		44.93		
External:		46.32		
Tangent Direction:		N 4°25'20.9" W		
Radial Direction:		N 85°34'39.1" E		
Chord Direction:		N 18°28'52.8" W		
Radial Direction:		N 57°27'35.2" E		
Tangent Direction:		N 32°32'24.8" W		
Element: Linear				
PT	( )	24+82.29	1787054.392	1570478.191
PC	( )	26+62.99	1787206.718	1570380.998
Tangential Direction:		N 32°32'24.8" W		
Tangential Length:		180.69		
Element: Circular				
PC	( )	26+62.99	1787206.718	1570380.998

PI	( )	27+90.46	1787314.179	1570312.432
CC	( )		1786668.827	1569537.984
PT	( )	29+16.56	1787401.002	1570219.100
Radius:		1000.00		
Delta:		14°31'43.9"	Left	
Degree of Curvature (Arc):		5°43'46.5"		
Length:		253.58		
Tangent:		127.47		
Chord:		252.90		
Middle Ordinate:		8.03		
External:		8.09		
Tangent Direction:		N 32°32'24.8" W		
Radial Direction:		N 57°27'35.2" E		
Chord Direction:		N 39°48'16.8" W		
Radial Direction:		N 42°55'51.3" E		
Tangent Direction:		N 47°04'08.7" W		

Element: Linear

PT	( )	29+16.56	1787401.002	1570219.100
PC	( )	30+89.76	1787518.972	1570092.287
Tangential Direction:		N 47°04'08.7" W		
Tangential Length:		173.20		

Element: Circular

PC	( )	30+89.76	1787518.972	1570092.287
PI	( )	32+43.68	1787623.810	1569979.590
CC	( )		1786786.796	1569411.171
PT	( )	33+95.21	1787689.905	1569840.582
Radius:		1000.00		
Delta:		17°30'02.7"	Left	
Degree of Curvature (Arc):		5°43'46.5"		
Length:		305.45		
Tangent:		153.92		
Chord:		304.26		
Middle Ordinate:		11.64		
External:		11.78		
Tangent Direction:		N 47°04'08.7" W		
Radial Direction:		N 42°55'51.3" E		
Chord Direction:		N 55°49'10.1" W		
Radial Direction:		N 25°25'48.6" E		
Tangent Direction:		N 64°34'11.4" W		

Element: Linear				
PT	( )	33+95.21	1787689.905	1569840.582
PC	( )	35+20.36	1787743.648	1569727.554
Tangential Direction:		N 64°34'11.4" W		
Tangential Length:		125.15		
Element: Circular				
PC	( )	35+20.36	1787743.648	1569727.554
PI	( )	38+42.76	1787882.086	1569436.399
CC	( )		1786840.538	1569298.144
PT	( )	41+44.11	1787824.399	1569119.209
Radius:		1000.00		
Delta:		35°44'16.3"	Left	
Degree of Curvature (Arc):		5°43'46.5"		
Length:		623.74		
Tangent:		322.39		
Chord:		613.68		
Middle Ordinate:		48.24		
External:		50.68		
Tangent Direction:		N 64°34'11.4" W		
Radial Direction:		N 25°25'48.6" E		
Chord Direction:		N 82°26'19.6" W		
Radial Direction:		N 10°18'27.7" W		
Tangent Direction:		S 79°41'32.3" W		
Element: Linear				
PT	( )	41+44.11	1787824.399	1569119.209
PC	( )	46+65.85	1787731.041	1568605.885
Tangential Direction:		S 79°41'32.3" W		
Tangential Length:		521.74		
Element: Circular				
PC	( )	46+65.85	1787731.041	1568605.885
PI	( )	49+12.73	1787686.865	1568362.986
CC	( )		1786255.250	1568874.287
PT	( )	51+55.23	1787567.172	1568147.059
Radius:		1500.00		
Delta:		18°41'34.5"	Left	
Degree of Curvature (Arc):		3°49'11.0"		
Length:		489.38		
Tangent:		246.88		
Chord:		487.21		

Middle Ordinate:		19.91		
External:		20.18		
Tangent Direction:		S 79°41'32.3" W		
Radial Direction:		N 10°18'27.7" W		
Chord Direction:		S 70°20'45.1" W		
Radial Direction:		N 29°00'02.2" W		
Tangent Direction:		S 60°59'57.8" W		
Element: Linear				
PT	( )	51+55.23	1787567.172	1568147.059
PC	( )	62+41.12	1787040.711	1567197.323
Tangential Direction:		S 60°59'57.8" W		
Tangential Length:		1085.89		
Element: Circular				
PC	( )	62+41.12	1787040.711	1567197.323
PI	( )	68+39.33	1786750.686	1566674.116
CC	( )		1785291.482	1568166.960
PT	( )	74+03.67	1786221.006	1566396.089
Radius:		2000.00		
Delta:		33°18'16.5" Left		
Degree of Curvature (Arc):		2°51'53.2"		
Length:		1162.55		
Tangent:		598.21		
Chord:		1146.25		
Middle Ordinate:		83.88		
External:		87.55		
Tangent Direction:		S 60°59'57.8" W		
Radial Direction:		N 29°00'02.2" W		
Chord Direction:		S 44°20'49.6" W		
Radial Direction:		N 62°18'18.7" W		
Tangent Direction:		S 27°41'41.3" W		
Element: Linear				
PT	( )	74+03.67	1786221.006	1566396.089
PC	( )	83+88.84	1785348.698	1565938.218
Tangential Direction:		S 27°41'41.3" W		
Tangential Length:		985.17		
Element: Circular				
PC	( )	83+88.84	1785348.698	1565938.218
PI	( )	89+93.33	1784813.460	1565657.273
CC	( )		1785813.460	1565052.782

PT	( )	94+76.27	1784813.460	1565052.782
Radius:		1000.00		
Delta:		62°18'18.7" Right		
Degree of Curvature (Arc):		5°43'46.5"		
Length:		1087.43		
Tangent:		604.49		
Chord:		1034.64		
Middle Ordinate:		144.21		
External:		168.51		
Tangent Direction:		S 27°41'41.3" W		
Radial Direction:		N 62°18'18.7" W		
Chord Direction:		S 58°50'50.7" W		
Radial Direction:		N 0°00'00.0" E		
Tangent Direction:		N 90°00'00.0" W		

Element: Linear

PT	( )	94+76.27	1784813.460	1565052.782
POE	( )	121+00.00	1784813.460	1562429.056
Tangential Direction:		N 90°00'00.0" W		
Tangential Length:		2623.73		

ALTERNATIVE 1 - HISTORIC CUTOFF STRUCTURE

Horizontal Alignment Review Report

Report Created: 12/7/2017
Time: 11:37am

Project: Model

Description:

File Name: \\swl-netapp2.swl.ds.usace.army.mil\Shared\ENG Shared\DESIGN\PROJECTS\CIVIL WORKS CORPS\Three Rivers Study\Design Alternatives\InRoads\InRoads Working File (2D).dgn

Last Revised: 12/7/2017 11:18:34

Note: All units in this report are in feet unless specified otherwise.

Alignment Name: GeomCL
Alignment Description: Historic Cutoff – Alternative 1
Alignment Style: Geom_Centerline

		Station	Northing	Easting
Element: Circular				
PC	( )	0+00.00	1781178.295	1573169.792
PI	( )	9+58.88	1782136.995	1573151.125
CC	( )		1781225.015	1575569.337
PT	( )	18+24.50	1782844.620	1573798.213
Radius:		2400.00		
Delta:		43°33'24.5" Right		
Degree of Curvature (Arc):		2°23'14.4"		
Length:		1824.50		
Tangent:		958.88		
Chord:		1780.89		
Middle Ordinate:		171.30		
External:		184.46		
Tangent Direction:		N 1°06'55.5" W		
Radial Direction:		N 88°53'04.5" E		
Chord Direction:		N 20°39'46.7" E		
Radial Direction:		S 47°33'31.1" E		
Tangent Direction:		N 42°26'28.9" E		

ALTERNATIVE 1 - HISTORIC CUTOFF STRUCTURE

Vertical Alignment Review Report

Report Created: 12/7/2017
Time: 11:42am

Project: Model

Description:

File Name: \\swl-netapp2.swl.ds.usace.army.mil\Shared\ENG Shared\DESIGN\PROJECTS\CIVIL WORKS CORPS\Three Rivers Study\Design Alternatives\InRoads\InRoads Working File (2D).dgn

Last Revised: 12/7/2017 11:39:04

Note: All units in this report are in feet unless specified otherwise.

Horizontal Alignment: GeomCL
Horizontal Description: Historic Cutoff –Alternative 1
Horizontal Style: Geom_Centerline

Vertical Alignment: Unnamed
Vertical Description:
Vertical Style:

	Station	Elevation
Element: Linear		
POB	3+00.00	130.0
PVI	8+00.00	145.0
Tangent Grade:	3.00%	
Tangent Length:	500.00	
Element: Linear		
PVI	8+00.00	145.0
PVI	11+00.00	145.0
Tangent Grade:	0.00%	
Tangent Length:	300.00	
Element: Linear		
PVI	11+00.00	145.0
POE	15+50.00	137.0
Tangent Grade:	-1.78%	
Tangent Length:	450.00	

ALTERNATIVE 2 - HISTORIC CUTOFF STRUCTURE

Horizontal Alignment Review Report

Report Created: 1/19/2018
Time: 12:31pm

Project: Model

Description:

File Name: \\swl-netapp2.swl.ds.usace.army.mil\Shared\ENG Shared\DESIGN\PROJECTS\CIVIL WORKS CORPS\Three Rivers Study\Design Alternatives\InRoads\InRoads Working File (2D).dgn

Last Revised: 1/19/2018 12:28:38

Note: All units in this report are in feet unless specified otherwise.

Alignment Name: Historic Cutoff – Alternative 2
Alignment Description: Channel Centerline
Alignment Style:

		Station	Northing	Easting
Element: Linear				
POB	( )	0+00.00	1781727.733	1572440.033
POE	( )	20+00.00	1782942.066	1574029.182
Tangential Direction:		N 52°36'54.4" E		
Tangential Length:		2000.00		

ALTERNATIVE 2 - HISTORIC CUTOFF STRUCTURE

Vertical Alignment Review Report

Report Created: 1/19/2018

Project: Model
Description:
File Name:
Last Revised:
Note: All units in this report are in feet unless specified otherwise.

Horizontal Alignment: Unnamed
Horizontal Description: Historic Cutoff – Alternative 2
Horizontal Style:

Vertical Alignment: Unnamed
Vertical Description: Historic Cutoff – Alternative 2
Vertical Style: Channel Centerline

		Station	**Elevation**
Element: Linear			
	POB	Varies	Varies
	PVI	Varies	135.0
	Tangent Grade:	3.30% Max	
	Tangent Length:	Varies	
Element: Linear			
	PVI	Varies	135.0
	PVI	Varies	135.0
	Tangent Grade:	0.00%	
	Tangent Length:	Varies	
Element: Linear			
	PVI	Varies	135.0
	POE	Varies	Varies
	Tangent Grade:	-3.30% Max	
	Tangent Length:	Varies	

The stationing for all POB's, PVI's and POE's varies. It is the intent for the PVI to be at elevation 135 and match the existing contour location. The POB's and POE's shall be at the approximate toe of the existing slopes. Tangent Lengths and Tangent Grades (except between PVI's) will vary as a result.

THREE RIVERS STUDY

PRECONSTRUCTION, ENGINEERING & DESIGN (PED)

March 2018

The following tasks should be looked at further during the PED phase.

1. Prepare Hydrographic and Topographic survey for the project areas. Insufficient hydrographic and topographic information was available when the feasibility study was prepared.

2. Obtain soil borings for the Historic Cutoff Structure.
    a. The subsurface investigation program should be sufficiently robust to adequately characterize the foundation under this structure in order to design and optimize the sheet piling and under seepage controls.
    b. Determine the failure mechanism for the sinkholes currently being experienced.
    c. In lieu of steel sheet piling, determine alternative methods for correcting the sinkhole issue. (Note: the feasibility report used a conservative and costly approach that sheet piling was required. Hopefully further study during PED can result in the elimination of the sheet piling from the project.)
    d. A water and soil analysis should be performed to determine the “normal” groundwater level, resistivity and pH at the site. (IE: corrosivity study to determine if steel sheet piling can be used.)

3. Determine the appropriate means to combat corrosion of the “steel sheet pile wall system”. This could include material changes or different construction techniques. See the feasibility study’s Engineering Appendix C, Paragraph 17 for further discussion.

4. Owens Lake Structure:
    a. Provide design for anchoring the new concrete to the existing soil cement structure and the new concrete bridge deck to the precast concrete bridge unit. (IE: keyways, rebar anchors and bonding agents, etc.) Of major design concern is the new concrete bridge deck delaminating from the precast concrete bridge during a flood event. (Note: this type of failure previously occurred with the soil cement at the existing Melinda Structure.)
    b. Design consideration should also be made for preventing water movement between the contact surfaces such as the existing soil cement and new concrete and the new concrete and the precast concrete bridge. (IE: examples would be to use keyways and Hydrophilic (swelling) waterstops, etc.)

5. The Owens Lake Structure currently has an invert elevation of 140. Discuss with H&H, Environmental and the USFWS the benefits of lowering the invert to elevation 135. This would keep the top elevation of the Owens Lake Structure at the same level as currently exists.

    a. Elevation 140 is the current elevation in which water exchanges with the Arkansas River, but due to leakage through both the Melinda and Owen's Lake structures, the water surface elevation in Owen's Lake may closely mimic the water surface elevation in either the Arkansas or White Rivers. H&H expects the new containment structure at elevation 157 to "leak" like the existing Melinda structure since its design consists of rock without a clay or impermeable core.

       Placing 3 staff gages around Owens Lake will help determine the final design elevation of the Owens structure for PED. One in Owens lake, one in the White River immediately north of the Owens Lake Structure and one in the Arkansas River immediately south of the Melinda Structure.

       The water surface elevation data from the three staff gages can be supplied to fishery biologists to maximize spawning, fish passage, and other habitat benefits. It is believed that this will be a minimal level of effort once water surface elevation data is acquired. But currently, this data does not exist.

    b. The questions to be addressed are as follows:

        i. Does the invert elevation of the structure change the hydrology of the area significantly? (IE: is the area wetter or drier)

        ii. Does the lower invert elevation offset any changes in hydrology by allowing greater fish movement through the structure?

        iii. How does the hydrology affect the bottomland hardwood trees?

    c. If the invert can be lowered to elevation 135, consider changing the structure type back to a 65 foot long, 6’x30’ reinforced concrete arch bridge, with no wing walls similar to Contech’s Con/Span O-Series. See the attached Contech sample design in Attachment D.

6. Determine if 20 foot temporary easements are required on both sides of the Stone Containment Structure or can construction occur within the proposed right of way? The question to be answered is how much room is required for the placement of the stone and the excavated material on the slopes?

7. The excavated material under the Stone Containment Structure could be used as topsoil at the Historic Cutoff. Using the excavated material as topsoil will affect the answer for question 6 above.

8. Can the demolished material from the Melinda Structure be used for the core of the Stone Containment Structure as it crosses the Melinda Headcut? This could result in a possible cost savings because the stone materials for the crossing would not need to be acquired, nor additional easements.

9. The channel area south of the Historic Cutoff Structure should be looked at further. Does it require additional armoring of the embankments to prevent erosion or should additional real estate be purchased to prevent the possibility of damage claims. This discussion needs to be coordinated with Real Estate and H&H.

10. A careful evaluation of construction phasing for the Historic Cutoff Structure must be considered to prevent failure during a flood event. Do not excavate everything to final grade at one time! (Example Phasing: 1. Excavate and armour the slopes entering and exciting the structure. Decide how much length must be done before moving to step 2? 2. Excavate the plateau area to elevation 137 for a reasonable length that can be armoured before a flood event. 3. Install sheet piling. 4. Install stone to final grade. Progressively move across the width of the channel.)

11. Work with the Cost Engineers to look at the long term OMRRR costs of the projects structures in order to get a better cost estimate.

12. In order to protect the fiber optic cable to Montgomery Point L&D and insure its continued operation in a flood event, H&H wants to replace the existing damaged culverts at the north end of Lagrues Lake as they enter the White River. Utilize a 60-inch diameter polypropolene pipe (manufacturer ADS) at the location approximately 750 feet north of the abandoned railroad bridge. This type and size of pipe has been utilized by the USFWS at other locations along this road. Coordinate the invert elevation with the USFWS. They may want the pipe invert as low as possible to allow for fish passage over a longer time period.

13. For the Historic Cutoff Structure, H&H is coordinating with USACE’s Engineer Research and Development Center (ERDC) to have a Ship Tow Simulation performed prior to commencement of the PED phase of the project. The simulation will be used to insure that there are no dangerous cross currents from the White River into the Historic Cutoff Channel and to optimize the width of the Historic Cutoff Structure, which is currently set at 1000 feet.

14. For the Stone Containment Structure as it crosses the Melinda Headcut Channel, verify that the preliminary keyway design shown on plan Sheet C-501, Detail F is required. If required, verify that the keyway size and length is correct. After the Geotechnical analysis is completed, determine if a granular or geotextile filter is required to prevent the migration of fine granular materials thru the keyway and under the Stone Containment Structure for its full length.

ATTACHMENT B

Rock Gradation for the Proposed Weir through the Historic Cutoff Containment Structure

Three Rivers:

Rock Gradation for the Proposed Weir through the Historic Cutoff Structure

Table of Contents

Table of Figures

1 Rock Gradation for the Proposed Weir through the Historic Cutoff Structure

1.1 Summary

Final rock size falls in the USACE standard R7400 gradation.

1.2 Maximum Discharges

Calibrated HEC RAS output hydrographs from the Spring 2011 flood event was used to develop maximum discharges for the 500 foot and 1,000 foot proposed openings in the Historic Cutoff Structure.

Maximum Discharge for 500 foot opening: 82,000 cfs

Maximum Discharge for 1000 foot opening: 120,000 cfs

1.3 D_{50} Calculations

Seven methods or equations were used to calculate the D_{50} based on depth average flow velocity, depth of flow, unit discharge, bed slope, and other equation specific factors for rock shape, turbulence, etc as required for each equation. The seven results were averaged to come up with a D50 of 31.7 inches for the 500 foot opening with a 1V:20H bed slope and a factor of safety of 1.2.

Table 1: D_{50} for 7 methods, 500 foot opening

500 Foot Opening			
Method	1V:10H D50 (inches)	1V:20H D50 (inches)	Factor of Safety
Rock Spillway 2	56.9	41.1	1.2
Rock Spillway 3	37.0	29.7	1.2
NRCS Rock chute	48.4	27.9	1.2
ARS Rock chute	48.6	27.9	1.2
Method 1	29.3	29.3	1.2
Abt and Johnson	40.4	30.0	1.2
US Burea of Rec	36.1	36.1	1.2
Average:	42.4	31.7	1.2

Next, an excel program based on Design of Rock Chutes was used calculate the D_{50} for both the 500 foot and 1000 foot opening. The program took into consideration the hydraulic parameters mentioned in the previous 7 equations and the physical orientation and geometry of the weir such as the upstream and downstream channel slopes, width, Manning’s n-values, and headwater and tailwater elevations.

The 500 foot opening resulted in a larger D50 than the 1000 foot opening and so was used to determine the rock gradation for the weir through the Historic Cutoff Structure. Rock sizes of 30 inches and 33 inches were both used to develop gradation curves.

Table 2: D50 Based on Design of Rock Chutes

(Version WI-July-2010, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998

Opening Size	1V:10H D_{50} (inches)	1V:15H D_{50} (inches)	1V:20H D_{50} (inches)	Factor of Safety
500	46.4	33.5	26.7	1.2
1000	40.5	29.3	23.3	1.2

1.4 Gradation Curve

The D_{50} was then used to calculate the average D_{100}, D_{80}, D_{50}, and D_{10} using the table below.

Bank Protection 15 - 19

weigh 3000 pounds. Table 15-4 can be used to develop the gradation limits of any riprap class. D_{50} and W_{50} are the equivalent spherical diameter and weight of the median stone size.

Table 15-4: Riprap Gradation Limits

Stone Size (feet)	Stone Weight (lbs)	Percent of Gradation Smaller Than
$1.44D_{50}$ to $1.71D_{50}$	$3W_{50}$ to $5W_{50}$	100
$1.26D_{50}$ to $1.40D_{50}$	$2W_{50}$ to $2.75W_{50}$	80
$1.00D_{50}$ to $1.14D_{50}$	W_{50} to $1.5\ W_{50}$	50
$0.46D_{50}$ to $0.58D_{50}$	$0.1W_{50}$ to $0.2W_{50}$	10

Equivalent weights were calculated using two methods with a specific gravity of 2.6. The first method was to take the average volume of a sphere and a cube the second method was taken out of EM 110-2-1601. See Figure 1: Equivalent Weight: EM 1110-2-1601: 1994

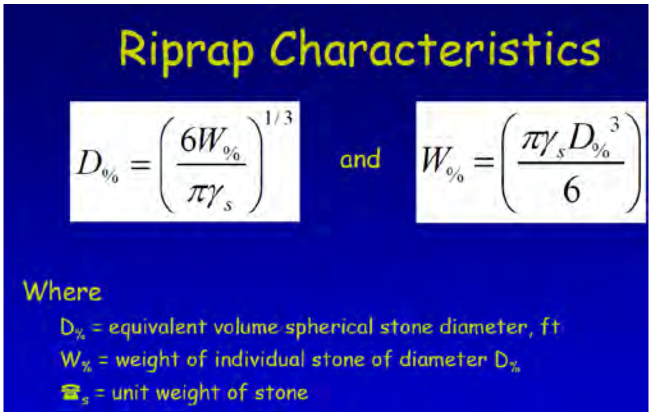


Figure 1: Equivalent Weight: EM 1110-2-1601: 1994

Gradation curves were developed for both the D_{50} = 30 inches and D_{50} = 33 inches. See Table 3 and Table 4

Table 3: Gradation D_{50} = 30 inches

D_{50} =	30.00	inches
Average Weight (lbs): Specific Gravity 2.6		
Stone Size	Weight Between sphere and cube	Weight: EM 1110-2-1601
D100	7710	5297
D80	4580	3147
D50	2396	1646
D10	282	194

Table 4: Gradation D_{50} = 33 inches

D_{50} =	33.00	inches
Average Weight (lbs): Specific Gravity 2.6		
Stone Size	Weight Between sphere and cube	Weight: EM 1110-2-1601
D100	10262	7051
D80	6096	4189
D50	3189	2191
D10	376	258

1.5 Plotting on Gradation curve

Both gradations were plotted against the standard R7400 gradation. See Figure 2 and Figure 3 for plotting results.

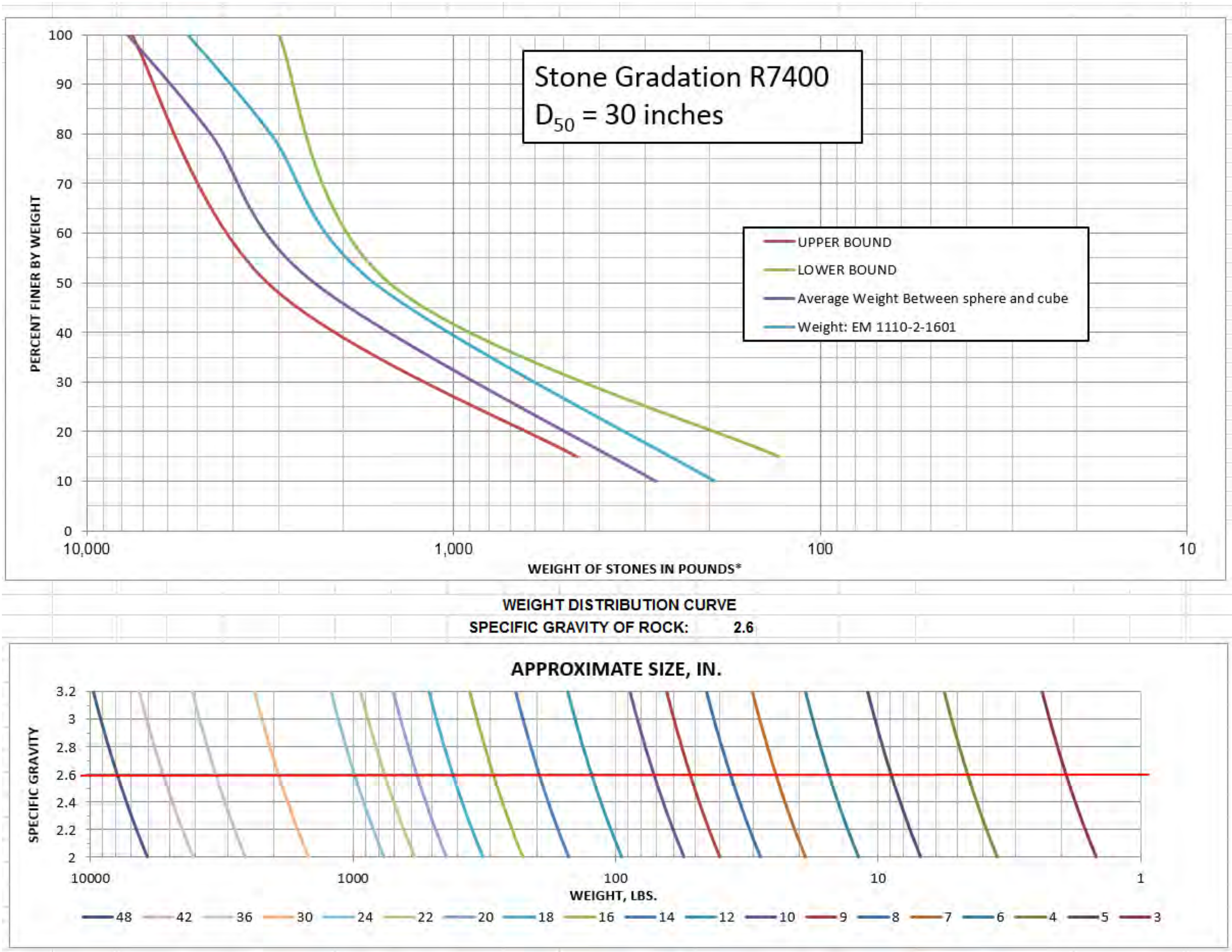


Figure 2: Gradation D_{50}=30 inches

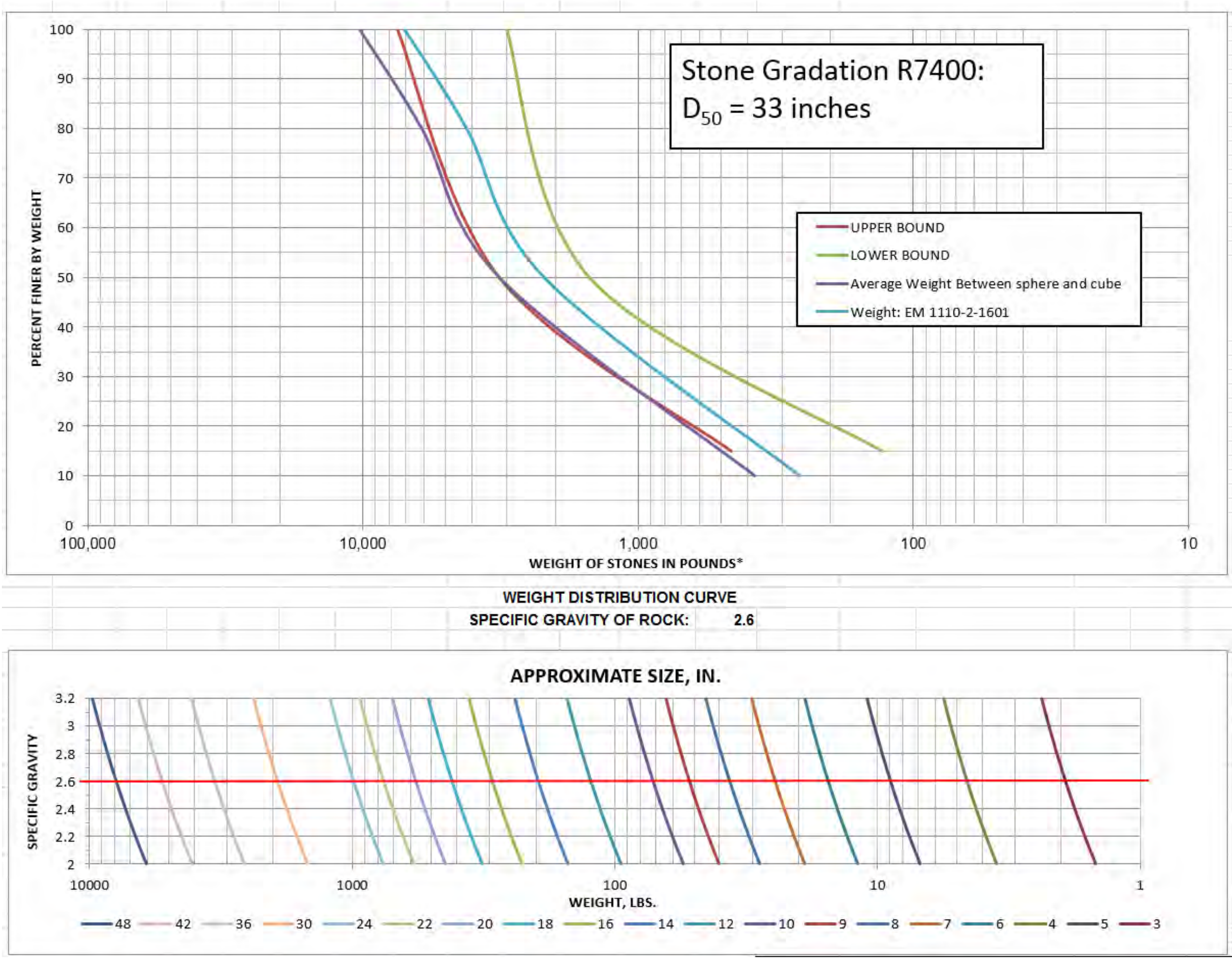
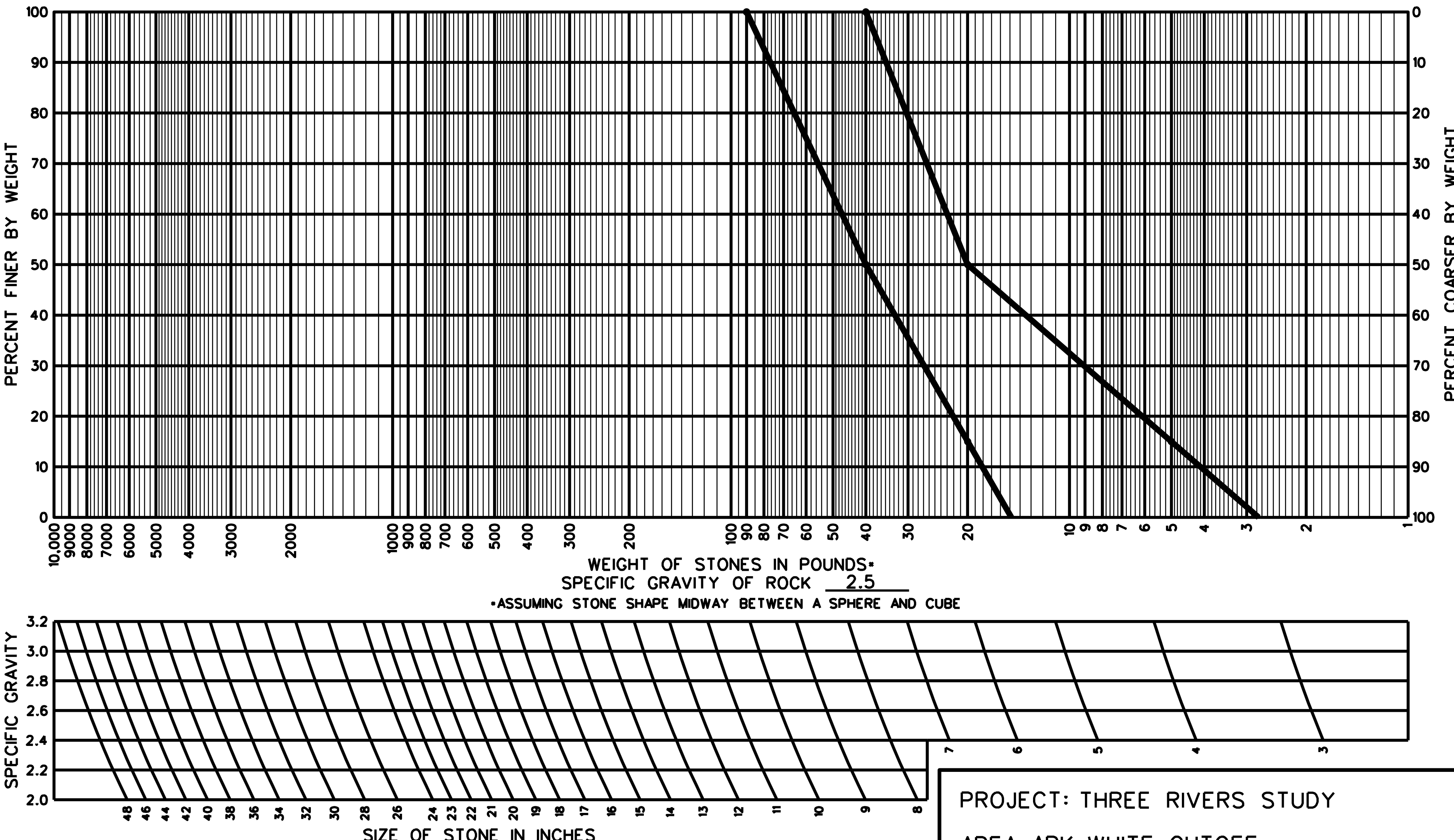


Figure 3: Gradation D_{50}=33 inches



R90 STANDARD RIPRAP

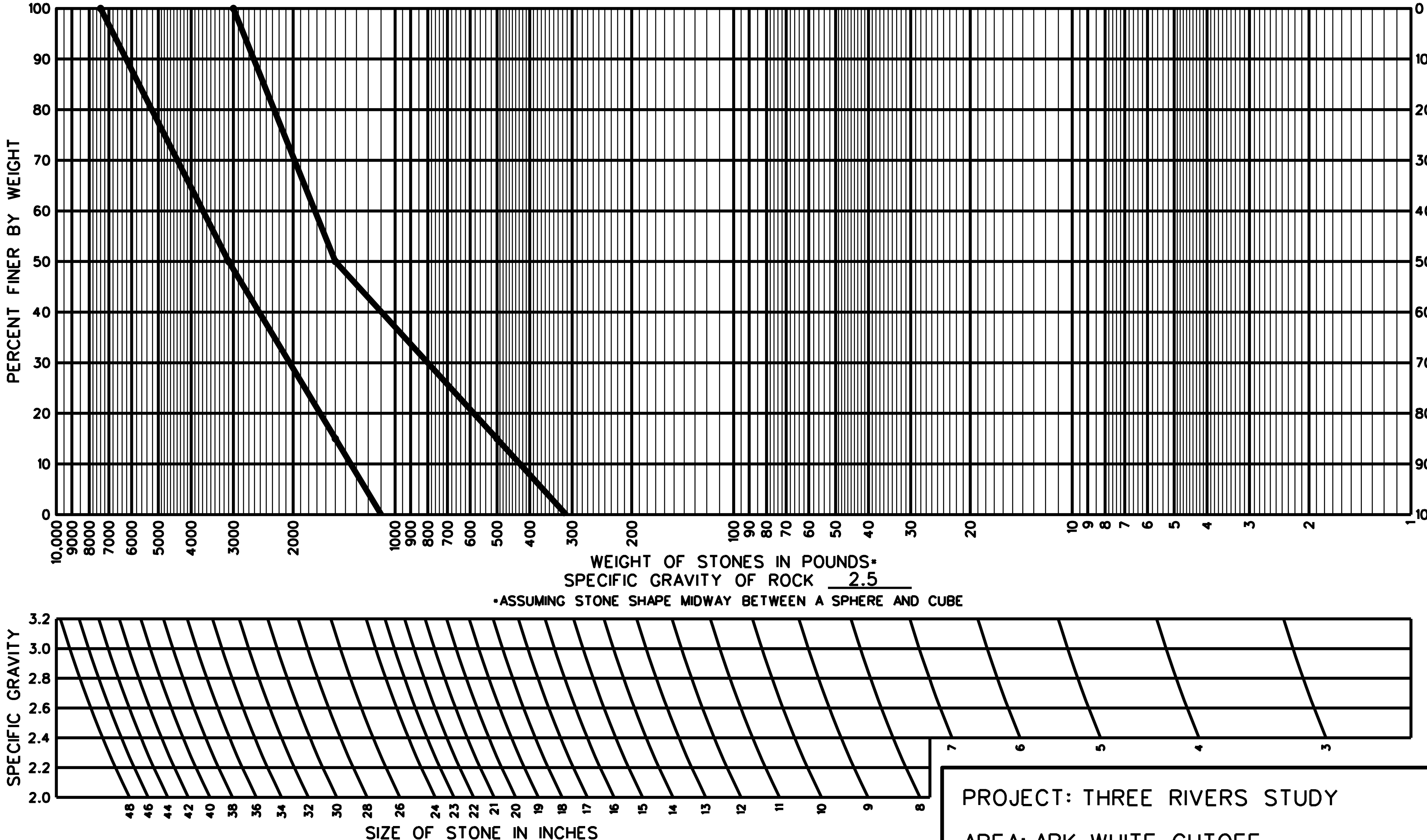
PROJECT: THREE RIVERS STUDY

AREA: ARK-WHITE CUTOFF
ARKANSAS COUNTY, AR

DATE: NOVEMBER 2016

GRADATION CURVES

ENG FORM 4055



R7400 STANDARD RIPRAP

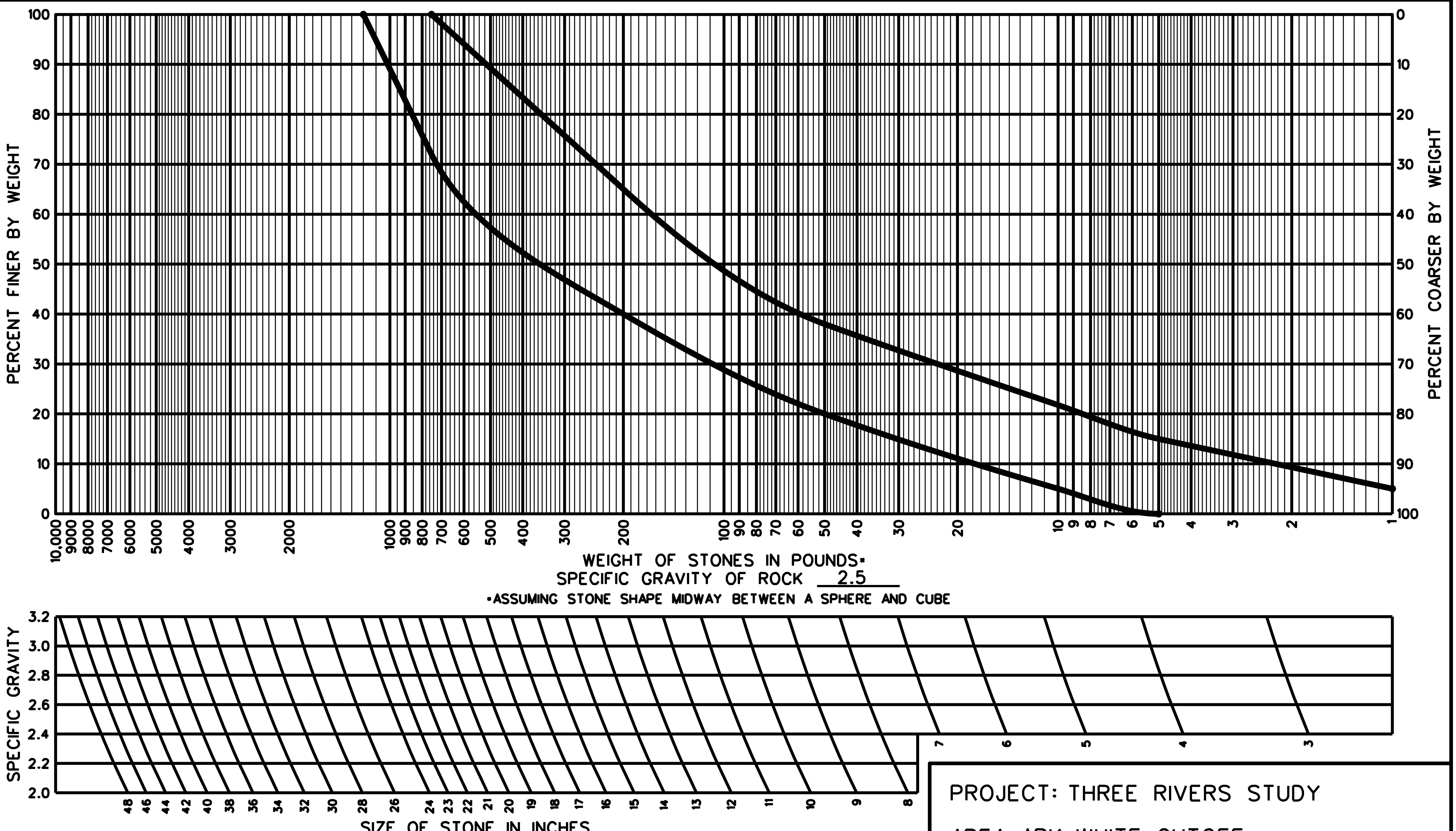
PROJECT: THREE RIVERS STUDY

AREA: ARK-WHITE CUTOFF
ARKANSAS COUNTY, AR

DATE: NOVEMBER 2016

GRADATION CURVES

ENG FORM 4055



GRADED STONE B RIPRAP

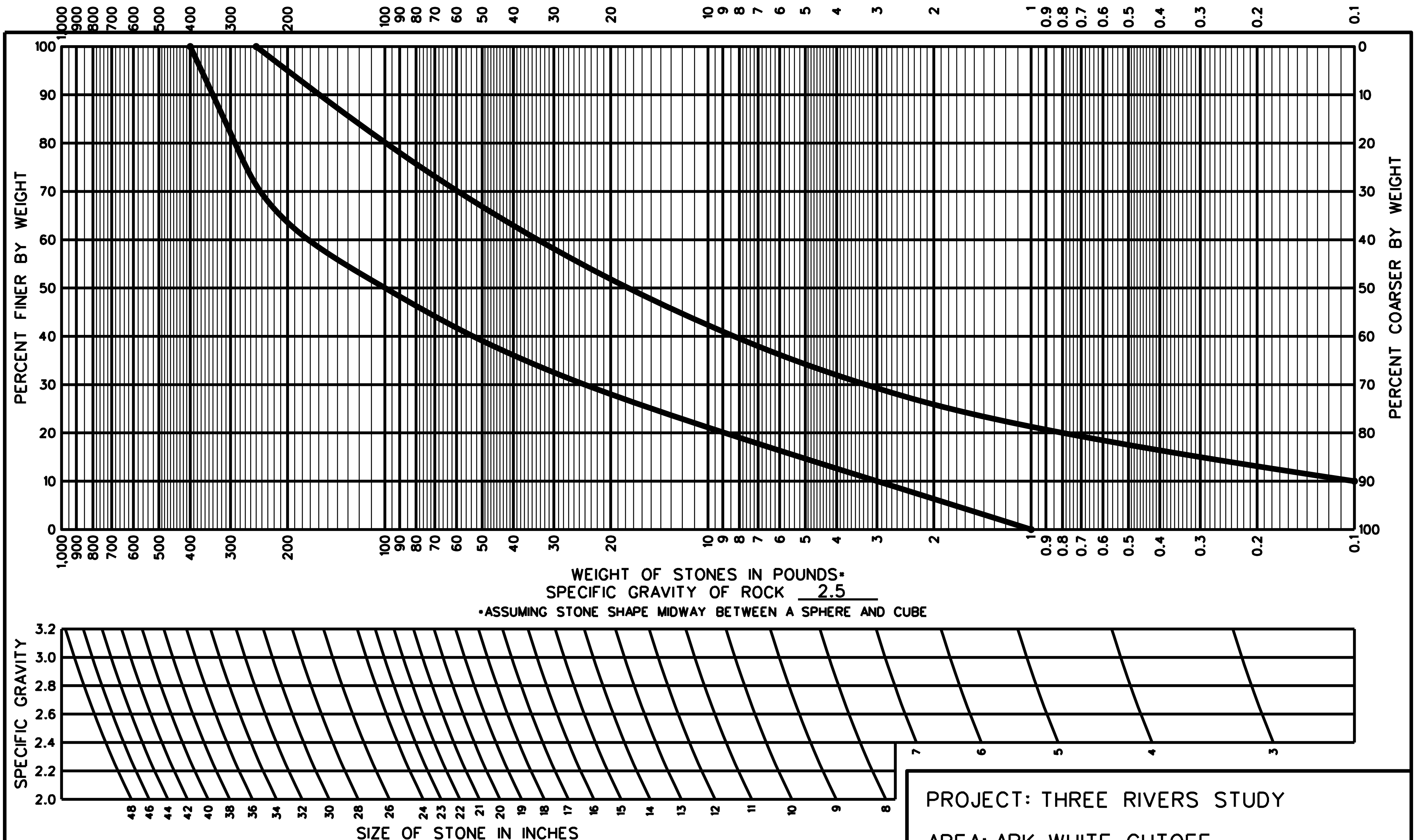
PROJECT: THREE RIVERS STUDY

AREA: ARK-WHITE CUTOFF
ARKANSAS COUNTY, AR

DATE: NOVEMBER 2016

GRADATION CURVES

ENG FORM 4055



GRADED STONE C RIPRAP

PROJECT: THREE RIVERS STUDY

AREA: ARK-WHITE CUTOFF
ARKANSAS COUNTY, AR

DATE: NOVEMBER 2016

GRADATION CURVES

ENG FORM 4055

ATTACHMENT C

Report on Design and Construction Deficiencies in the Dale Bumpers White River National Wildlife Refuge, Arkansas

DEPARTMENT OF THE ARMY
LITTLE ROCK DISTRICT, CORPS OF ENGINEERS
P.O. BOX 867
LITTLE ROCK, ARKANSAS 72203-0867
www.swl.usace.army.mil

Reply to
Attention of:

CESWL-EC-DG October 11, 2016

MEMORANDUM FOR RECORD

SUBJECT: Site Visit to Inspect MKARNS Construction Deficiencies of Mitigation Structures
Dale Bumpers White River National Wildlife Refuge (WRNWR), Arkansas

On this date a site visit was made to the WRNWR, specifically that area located north of the MKARNS channel and west of the White River. Present during the site visit were the USACE employees Norman Gartner, David "Craig" Hillburn and Cherrie-Lee Phillp and US Fish and Wildlife Service (USFWS) employees Charles "Bo" Sloan, Arthur "Jay" Hitchcock, and Jason Phillips. The Letter Report entitled "Correct Design and Construction Deficiencies of Mitigation Structures" dated April 1991 identified the mitigation structures that were to be corrected. This report is included for reference at the rear of this memorandum. It should be noted that since the 1991 report was completed, USACE has not performed any corrective action to these structures. During the December 15, 2015, Alternatives Milestone Meeting (AMM), USACE Headquarters requested that this report be revisited and the mitigation structures be re-inspected to see if additional damage has occurred. Below are the results of the site visit to the damaged mitigation structures and to other areas within the WRNWR that the USFWS requested to be looked at. Specific locations area identified on the attached Location Map.

Mitigation Deficiencies from 1991 Report

Area 1

A. Twin 60 inch Sluice Gate Control Structure.
The north slide gate has been replaced by Ducks Unlimited under contract with the USFWS. A "Hydrogate", Model IB5, with a 4:1 lift ratio was used to replace the original sluice gate. See Figure 1.

The south slide gate is still the original one installed. It has been partially disassembled and is currently inoperable. See Figures 2 and 3. In addition, the gate's guide brackets are not anchored to the concrete wall due to corrosion of the existing anchor bolts. See Figure 4. An attempt to re-anchor the guide brackets was never completed.

For the south slide gate, the concrete is pitted and at some locations adjacent to the stop log channels has broken away. In addition, the steel guide channels for the stop logs has corroded and is partially missing. See Figure 5. Vegetative and earthen debris has partially blocked the use of the gates. See Figures 5 and 6.

The settlement and resulting cracking identified in the above referenced report was not immediately visible during this inspection.

Recommendation: The south slide gate should be repaired or replaced to restore its operability. Where missing, the steel guide channel and concrete should be repaired. Both slide gates should be re-anchored to the concrete wall. All vegetative and earthen debris should be removed to insure successful operation of the entire structure as designed.

B. 36 inch CMP Culvert
The 36 inch CMP culvert located north of the sluice gate was replaced by Ducks Unlimited in 2003 under contract with the USFWS. The pipe is now a 5 foot diameter steel pipe with a sluice gate.

Recommendation: No further action is required.

C. 36 inch CMP Culvert (Not part of original deficiencies.)
The 36 inch CMP culvert located 4780 feet east of the sluice gate has been lined with a ½ inch polyethylene liner that was pulled thru the pipe with no other work being performed on the pipe. The installation of the liner was done by slicing slits in the end to facilitate pulling it thru the CMP. The liner was not pulled all the way thru the pipe so the slits still remain inside the pipe. The ends of the pipe seem to have a direct connection to the ground surface because some settlement has occurred on the surface, possibly due to soil migration into the pipe. The upstream end also has sediment deposition which should be removed. Who installed the liner is unknown.

Recommendation: With the exception of the end areas, the liner does seem to be functioning, however USACE's preferred method of repair would have been to use the SnapTite liner system and grout the annular space that remains to restore the pipes structural integrity and prevent soil intrusion. The USFWS should periodically inspect the liner to insure further failure has not occurred. Other than removal of the sediment deposit at the upstream end of the pipe, no further action is recommended.

D. 36 inch CMP Culvert (Not part of original deficiencies.)
The 36 inch CMP culvert located 5440 feet east of the sluice gate has been lined with a ½ inch polyethylene liner that was pulled thru the pipe with no other work being performed on the pipe. The installation of the liner was done by slicing slits in the end to facilitate pulling it thru the CMP. The liner was not pulled all the way thru the pipe and remains inside the pipe. The liners ends also have poor adhesion at the top. See Figure 7. The upstream end of the pipe seems to have a direct connection to the ground level because some settlement has occurred on the surface, possibly due to soil migration into the pipe. The upstream end also has sediment deposition which should be removed. See Figure 8. Who installed the liner is unknown.

Recommendation: With the exception of the end areas, the liner does seem to be functioning, however USACE's preferred method of repair would have been to use the SnapTite liner system and grout the annular space that remains to restore the pipes structural integrity and prevent soil intrusion. The USFWS should periodically inspect the liner to insure further failure has not occurred. Other than removal of the sediment deposit at the upstream end of the pipe, no further action is recommended.

Area 2

This area was not inspected because the Deficiencies Report identified that there was "No economical justifiable repair to recommend".

Area 3

The 36" CMP was not visible during this site visit. It can only be assumed that it has been filled in or removed as previously recommended in the Deficiencies Report. The levee in this area was also in good structural shape.

Recommendation: No further action is required.

Area 4

As mentioned in the Deficiencies Report the culvert has been replaced by the USFWS with a 36" CMP. The outlet looked like it had been armored with a combination of stone and concrete. See Figure 9. The existing levee looked in good shape and did not appear to require widening or additional stone protection. The drainage from the culvert does not go directly to the river but turns southerly and follows an old channel between the levee and the river. This channel has experienced some erosion in localized areas that are not very big. The USFWS has indicated that the sluice gate and culvert are not currently being used and that their preference would be to block them. These issues appear to fall within the Operation and Maintenance obligations of the USFWS.

Recommendation: No further action is required.

New Erosion Area (Not part of original deficiencies.)

Approximately 6250 feet north of Area 4, the White River's embankment is within 50 feet of Levee A. At the time of the inspection, it was impossible to tell how active the river erosion process is in the area. Aerial photos reviewed back to 1994 on Google Earth did not show a very active erosion process. It is therefore impossible to determine if the levee is in imminent risk or whether the river will move away from this area.

Recommendation: Perform annual inspections of this area to determine if the river is continuing to erode the embankment. To do this establish fixed points to measure from towards the river and create a database to determine how fast the erosion is occurring. If erosion is determined to be a problem, approximately 3000 feet of stone bank protection may be required to protect the embankment area. The final design of any stone bank protection required would be determined in the future.

Area 5

The White River has destroyed approximately 1300 feet of Levee "A" used as mitigation for the MKARNS project. The USFWS has built a new levee west of the White River. Starting approximately 8200 feet east of Area 1 and extending north until it intersects with Levee "A". Constructing this new levee was the recommendation in the Deficiencies Report. This new levee has removed approximately 175 acres of land from the "green tree reservoir" that the levee was to create for mitigation. Since this new levee has been constructed, the need for restoring the destroyed portion of Levee "A" is uncertain. In addition, a 60 inch CMP culvert located 8150 feet east of Area 1's sluice gate, has been constructed by Ducks Unlimited under contract with the USFWS.

Recommendation: No further action is required.

Dry Lake Structure (Not part of original deficiencies.)

During the site visit the USFWS requested that the Dry Lake Gate Structure be looked at. Figures 10 – 16 provide representative views of the structure. A visual inspection indicated the structure was in good shape. Some minor repairs are required. They include rehabilitating and adding a protective coating to the trash racks to repair the holes which have appeared over time. The second would be to replace the missing covers over the grating. See Figure 14. The structures outlet pipe is served by two CMP of unknown size. No physical damage was witnessed, but due to their age it is believed they are approaching their useful life and should be considered for lining sometime in the near future.

Conclusion

Per the 1964 permit, a copy of which is included in the attached deficiency report, USACE was to design and construct the mitigation structures while the USFWS was to operate and maintain them. At the time of the inspection, no design or construction deficiencies were identified. In addition, the problems being experienced by the USFWS appear to be normal maintenance issues. Many of the issues the USFWS is experiencing are the result of facilities meeting their useful life or were physically impacted by water movement between the green tree reservoirs or flooding from the river. The responsibility for correcting the damages associated with the age of the structure's materials and the river is therefore the responsibility of the USFWS.

There were 41 photos taken of the different areas and placed in the following folder: "L:\ENG Shared\DESIGN\PROJECTS\CIVIL WORKS CORPS\Three Rivers Study\Photos\MKARNS Deficiencies". Representative photos of various items found have been attached as figures at the rear of this report.

Norman Gartner, P.E.
USACE General Engineering Section
CESWL-EC-DG


Figure 1 - Area 1, New Gate Mechanism installed by USFWS in 2003.

Figure 2 - Area 1, Existing Gate Mechanism (Note that it has been disassembled.)

Figure 3 - Area 1, Existing Gate Mechanism (Note that it has been disassembled.)

Figure 4 - Area 1 - Existing southern slide gate. Note that the anchor bolts are not connected.

Figure 5 - Area 1, Debris and missing guide frame and concrete spalling. North side of the southern 60” concrete pipes inlet.


Figure 6 - Area 1, Debris and guide frame. South side of the southern 60” concrete pipes inlet.

Figure 7 - Existing 36" CMP, 5440 feet east of Area 1. Typical liner installation. Note the poor liner adhesion at the pipes entrance.

Figure 8 - Existing 36" CMP inlet 5440 feet east of Area 1. Typical guide installation. Note sediment on upstream side.


Figure 9 – Area 4, Outlet end of 36” CMP replaced by the USFWS.


Figure 10 - Dry Lake Structure. (Not part of original mitigation deficiencies.)


Figure 11 - Dry Lake Structure. (Not part of original mitigation deficiencies.)

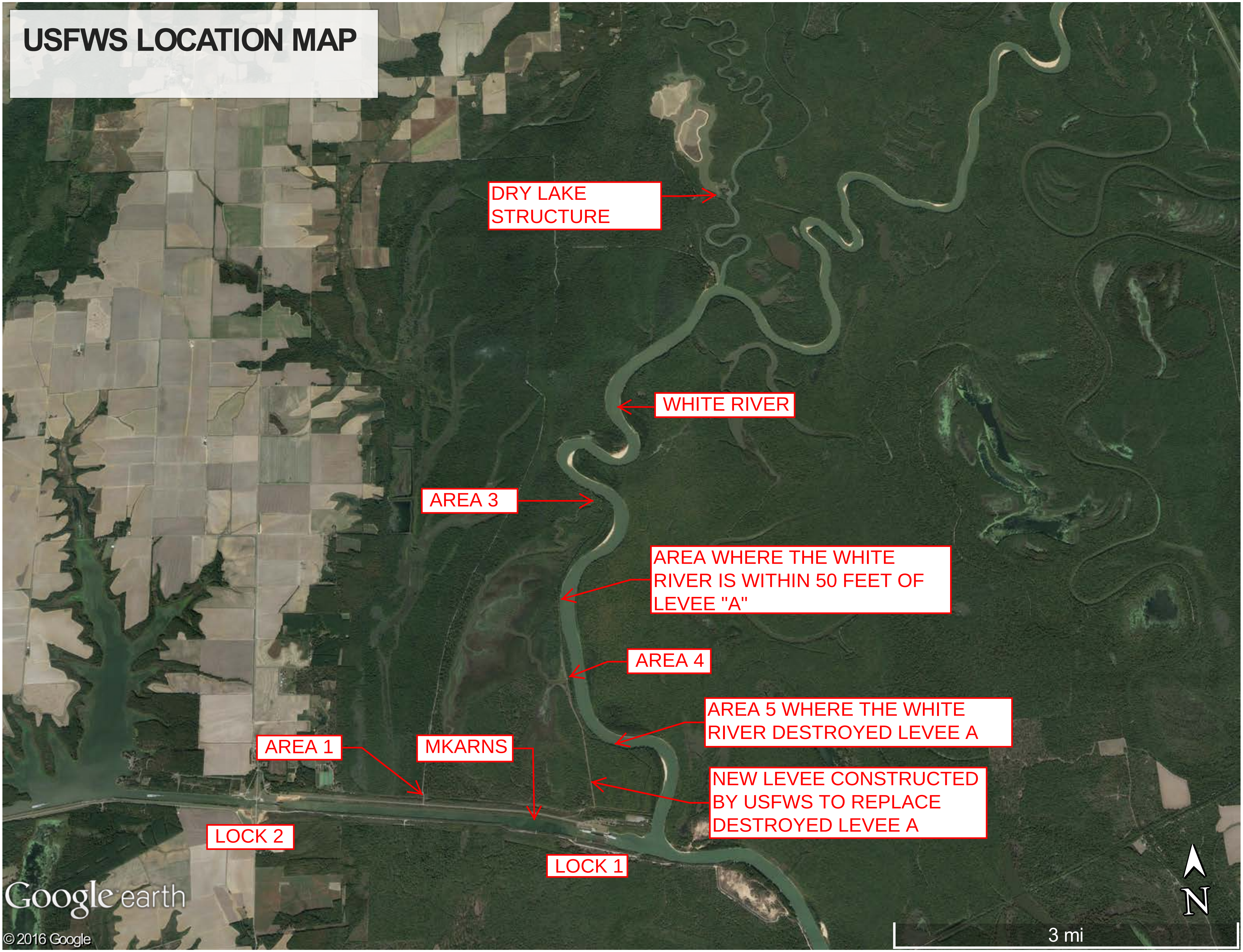

Figure 12 - Dry Lake Structure. (Not part of original mitigation deficiencies.)


Figure 13 - Dry Lake Structure. (Not part of original mitigation deficiencies.)


Figure 14 - Dry Lake Structure. (Not part of original mitigation deficiencies.)


Figure 15 - Dry Lake Structure. (Not part of original mitigation deficiencies.)

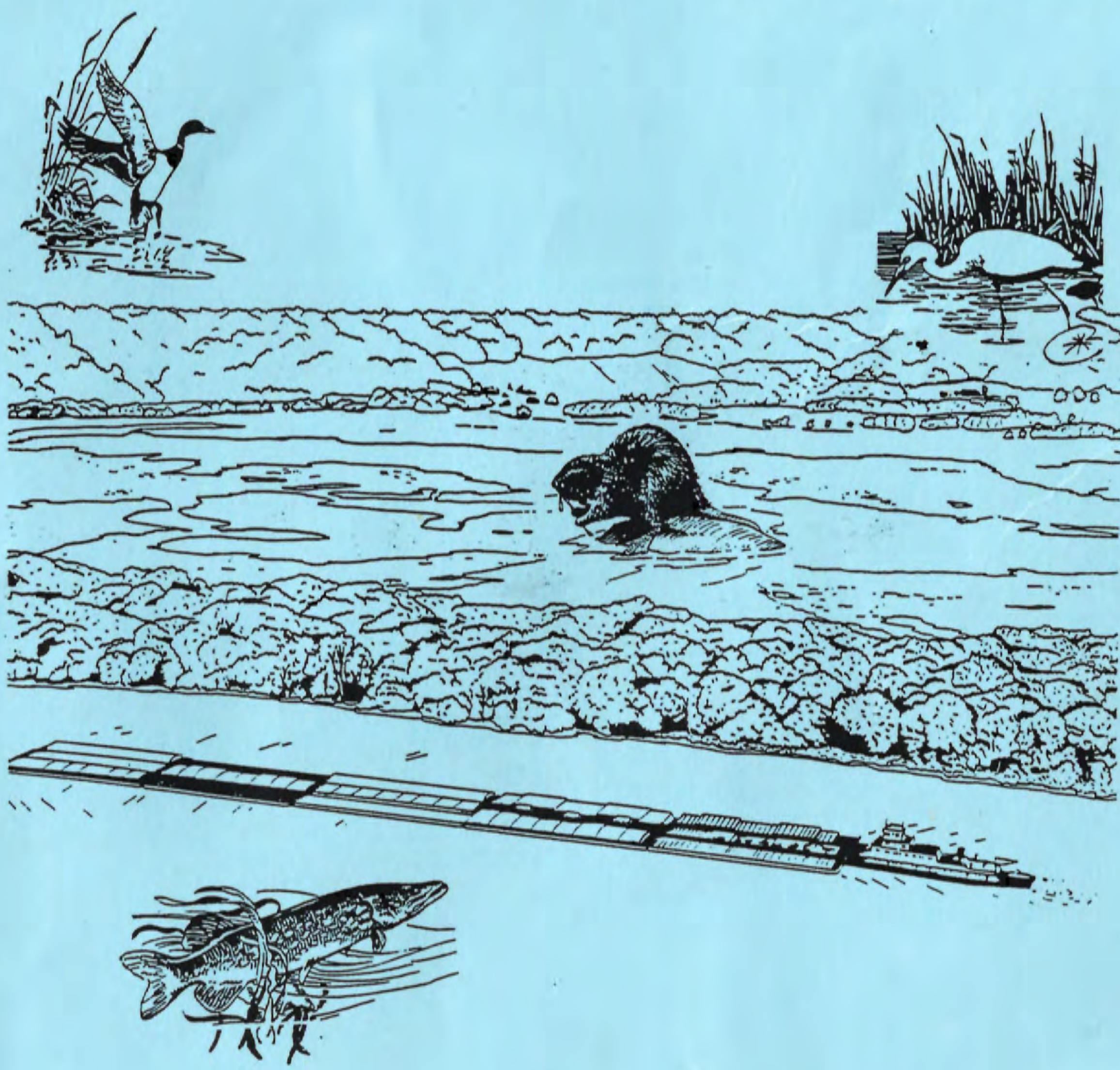
Figure 16 - Dry Lake Structure Outlet. (Not part of original mitigation deficiencies.)


USFWS LOCATION MAP
DRY LAKE STRUCTURE
WHITE RIVER
AREA 3
AREA WHERE THE WHITE RIVER IS WITHIN 50 FEET OF LEVEE "A"
AREA 4
AREA 5 WHERE THE WHITE RIVER DESTROYED LEVEE A
AREA 1
MKARNS
NEW LEVEE CONSTRUCTED BY USFWS TO REPLACE DESTROYED LEVEE A
LOCK 2
LOCK 1
Google earth
© 2016 Google
N
3 mi

US Army Corps of Engineers
Little Rock District

WHITE RIVER NATIONAL WILDLIFE REFUGE, ARKANSAS

CORRECT DESIGN AND CONSTRUCTION DEFICIENCIES OF MITIGATION STRUCTURES



LETTER REPORT
APRIL 1991

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LIST OF APPENDICES

Letter Report
Rehabilitation of Deteriorating Structures
White River National Wildlife Refuge

1. Background. Construction of the Arkansas Post Canal as a part of the McClellan-Kerr Arkansas River Navigation System was started during the early 1960's. A portion of the canal was constructed through the White River National Wildlife Refuge, which is managed by the U.S. Fish and Wildlife Service (hereinafter referred to as "the Service"). Under the terms of a permit with the Service dated 2 January 1964 (Appendix A), the Corps was required to construct a containment levee system with gate structures (Plates 1-4) as mitigation measures.

2. Description of Original Project. The project consists of a system of levees that form three shallow greentree reservoirs with nine drainage structures providing water management. The purpose of the project was to develop and manage waterfowl resources on approximately 2,540 acres of refuge lands located north of the Arkansas Post Canal. The project was provided as mitigation for the loss of canal right-of-way (534 acres) and the "loss" of 568 acres of refuge land that was isolated south of the canal.

3. Description and History of Deficiencies. Areas 1-5 in this report correspond with those in previous correspondence and memorandums for record and are shown on Plate 2. Appendix B provides a detailed chronological listing of project problems and deficiencies.

A. Structural Deficiencies. Design and construction deficiencies in Area 1 were cited in a 1989 district memorandum as reasons for the following problems:

(1) Settlement of the 60" twin sluice gate structure in Levee B has caused cracking of the headwall. Poor concrete contributed to spalling at the gate support bracket. These problems caused the binding of one gate and breaking of its gate support bracket anchor bolt in 1984.

(2) The 36" slide gate located about 100 feet north of the twin 60" structure has failed. The gate reportedly "popped off" and has been missing since 1978.

B. Hydraulic Deficiencies. Levee A has been partially destroyed by the action of White River headcutting in Areas 3, 4, and 5 reportedly due to channelization of the White River below the Arkansas Post Canal. In 1967 the Service requested that the Corps take immediate measures to provide bank stabilization for those portions of the River subject to greatly increased erosion. This was not done.

(1) Area 2: Although this area has experienced significant erosion by the White River, the Service has indicated that it would not be feasible to perform all repairs that would be required.

(2) Area 3: A portion of the original section of Levee A in Area 3 and the 36" gate structure were lost due to the action of bank caving and was later rebuilt by the Service some distance inland from the White River. The new levee and gate structure became damaged by the action of floodwaters overtopping the sheet pile headwalls and eroding behind the sheet piles. This erosion was subsequently arrested by the installation of sheet pile wingwalls and stone slope protection. Although the gate structure was saved, the levee crown had eroded from 10 feet to approximately 5 feet in width, preventing occasional vehicle travel along the levee by the Service for inspections. (The Service has requested that a 100-foot section of levee in this area be reconstructed to the full 10-foot crown width and that slope protection be provided to extend longevity. Additionally, the Service no longer has a need to operate the 36" gate structure, and requests that it be removed from the levee or that the 36" corrugated metal pipe (cmp) be plugged with concrete.

(3) Area 4: The Service installed two concrete spillways in 1981 and placed rip rap along the levee for erosion protection. The Service also replaced a deteriorated 36" cmp gate structure with an 18" concrete pipe. The Service requests that stone protection be placed on the slopes around each end of the 18" pipe to prevent additional erosion.

(4) Area 5: The Service has estimated the loss of approximately 900 feet of Levee A due to the action of the White River. This has eliminated the Levee A road connecting with Wild Goose Landing. To keep from losing all of the use of Reservoir A, the Service installed a new section of levee with gate structure in a slough inland from the White River. The Service requests that the levee be rebuilt farther inland, perhaps utilizing this Service section of levee. The estimated length is 1,500 lineal feet.

4. <u>History of Repairs by Local Interests</u>. It appears that the Service has adequately attempted to maintain the subject structures since they were constructed.

A. Service memo, 27 April 1987, stated that "In the ensuing 20 years since construction, the Service has performed operation and maintenance (O&M) for all the completed mitigation features. The O&M activities to date have consisted primarily of adding gravel to the levees, minor repair of the levees or access roads, and other similar actions. ".... the costs of these activities .... represent a sizeable portion of the annual budget of White River NWR."

B. On 8 February 1991, the refuge manager stated that since the completion of the mitigation structures, the Service had expended over $50,000 on maintenance.

5. <u>History of Project Alterations by Local Interests Since Project Completion</u>.

A. The Service had to replace the deteriorated 36" cmp in Area 1. The existing pipe and downstream headwall were both removed. As an economy measure, rip rap protection was provided in lieu of replacing the headwall.

B. When Levee A at Prosperous Bayou (Area 3) was lost, the Service moved inland to build a new temporary levee and protected it and the rebuilt gate structure with sheet pile headwalls. Later, after the levee became eroded, the Service placed rip rap on the White River face of the levee.

C. After the original 36" cmp gate structure in Area 4 had deteriorated, the Service, due to fiscal restraints, replaced it with an unregulated 18" concrete pipe placed higher up near the top of the levee.

D. After Levee A in Area 5 was lost, the Service constructed a temporary levee and gate structure inland in the southernmost slough.

6. <u>Proposed Corrective Measures</u>. The proposed methods of correcting design and construction deficiencies are shown on Plates 2 through 4. The corrective measures are described below:

A. Area 1: Bring the existing sluice gates and slide gate to operable condition as described below and as shown.

(1) Repair 60" sluice gate: Remove and reinstall floorstand; adjust existing guides; clean and paint two 60" gates, stems and floorstands; and, clean concrete on top of wall and patch spalls with grout.

(2) Repair 36" slide gate: Install complete 36" slide gate on existing structure.

B. Area 2: None.

C. Area 3: Abandon the existing gate structure (plug with concrete), restore the levee crown width, and provide stone slope protection as shown.

(1) Widen a 100-foot length of levee along the same alignment to original width, that is, with a 10-foot crown width and specified side slopes. Provide quarry run stone on the slopes to resist erosion.

(2) Since the gate structure and culvert are no longer used for reservoir A level control, the culvert will be plugged with concrete and abandoned in place.

D. Area 4: Provide erosion protection along the levee and beyond each end of the 18" pipe in Levee A. See Plate 4.

E. Area 5: Construct a 1,500-foot section of Levee A farther inland from the White River as shown on Plates 2 and 4.

7. Alternative Corrective Measures Considered.

A. Area 3: Abandon existing gate structure, culvert, and sheet pile headwalls. Alternatives considered included:

(1) Seal both ends of pipe with a metal plate. This would leave a potential failure zone in the embankment and was therefore considered unacceptable.

(2) Remove the gate structure and culvert from the embankment and rebuild the levee. This was considered to be too expensive.

(3) Plug the culvert with concrete and abandon in place. This alternate was selected as being the most economical satisfactory fix.

B. Areas 1,2,4 & 5: No practical alternatives were identified for consideration.

8. Estimated Cost of Corrective Measures. The estimated cost for all repairs at Areas 1,3,4, and 5 is $261,393, including $29,650 for E&D and $16,200 for Supervision and Administration. See Cost Estimate Summary, Appendix C.

9. Justification. Rehabilitation of Corps constructed levees and structural features is desirable for the following reasons: (1) To correct design deficiencies, (2) to correct construction deficiencies, and (3) to fully comply with the original permit signed with the Service. These items are more fully described below:

A. Area 1: The 60" sluice gate and 36" slide gate were identified as having design and construction deficiencies. These items should be expected to have a reasonable usable life, which has not been the case. The Service has had to expend considerable effort to be able to even marginally operate the structures by using stop logs or sand bags. These features have been unusable for many years and the Service has not been able to perform needed repairs having spent considerable funds on maintaining the levees. The sense of urgency should come from the Corps in a effort to mitigate damage to our reputation as experts in the fields of water resource facility design, management, and construction.

B. Area 3: Abandon the existing gate structure as requested by the Service. Rebuild the eroded section of the levee to a 10 foot crown width and rip rap the White River face of the structure at Prosperous Bayou. A comparison of trip reports (87,88 and 90) and discussion with Service personnel emphasizes the urgency of the situation. The levees have deteriorated at an increasing rate that threatens the structural integrity of Levee A. The gate structure is in danger of being destroyed and with it goes the use of Reservoir A. This breach would provide access for White River flows down Prosperous Bayou. This would destroy Service ability to regulate and control water to the wildlife refuge and lead to increased erosion and destruction of wildlife and lands. Of greater concern to the Corps would be the frequent torrents of water that could flow down Prosperous Bayou toward the Arkansas Post Canal levee. This could lead to future expensive maintenance problems for the Corps.

C. Area 4: Provide stone protection at the 18" cmp that was installed by the Service, located near the top of Levee A. Although this culvert was installed by the Service, it was a replacement for a (deteriorated) 36" cmp originally installed by the Corps. Accordingly, it is reasonable to expect the Corps to provide adequate stone protection (as desired by the Service) or for the Corps to provide a new 36" gate structure. Since the lower cost fix is acceptable to the Service, we should expeditiously complete this rehabilitation.

D. Area 5: Construct a new 1,500 foot section of levee inland from the White River to replace that previously eroded. To comply with the permit with the Service, these mitigation structures were supposed to last as long as the Arkansas Post Canal, subject only to normal maintenance. The Service has provided adequate maintenance; however, the original facilities have not provided the required useful life.

E. Legal Obligations: The failure of the mitigation features to fulfill our legal agreements with the Fish and Wildlife Service also makes the Corps technically out of legal compliance with the Fish and Wildlife Coordination Act and the National Environmental Policy Act. Without rehabilitation, one could advance a good position that the Corps is violating these laws and, should litigations ensue, the Corps would be exposed to unfavorable publicity especially since the problems are directly related to design and construction issues. It is, therefore, in the Nation's best interest to accomplish this work now.

G. ER 1165-2-119: In applying the guidelines contained in ER 1165-2-119, it is important to note that the mitigation features were to operate for the life of the navigation project that traverses through the refuge. Compared with the adjacent navigation features, it is obvious that the failure of mitigation features is attributable to a combination of design and construction deficiencies. Application of ER 1165-2-119 criteria is as follows:

(1) The project does not function according to the agreements and intended purposes, nor are the features viable or operational.

(2) The conditions and mitigation requirements have not changed. The features are essential to fulfill the authorized project purposes and various environmental laws.

(3) Rehabilitation would bring the project into compliance with authorized purposes.

(4) Rehabilitation costs associated with existing features are significantly less and incrementally justified compared with alternative measures that would be required.

(5) Maintenance of the mitigation features is not the cause of failure. The Service keeps national wildlife refuges (such as the White River National Wildlife Refuge) well maintained and operational because of the high waterfowl usage. Since major rehabilitation of project features is now required, the costs greatly exceed the maintenance budget of the White River National Wildlife Refuge.

10. Cost Sharing. Not applicable. Under terms of the permit signed by the Corps and the Service, the levees and structural features that were constructed by the Corps were in payment for use of Service (Government) lands. There was no cost sharing per se. Instead, the Corps was required to mitigate damages to the wildlife refuge caused by the construction of the Arkansas Post Canal. There was no first cost for the Service, which was required only to provide future normal maintenance. Since the Corps did not fully construct the levees, roads, and other features in accordance with normal Corps design and construction standards and since the Corps did not comply with the terms of the permit, it is unreasonable to expect the Service to share in major rehabilitation costs.

11. Environmental Considerations:

A. Introduction.

(1) The White River National Wildlife Refuge was established in the 1930's as a waterfowl refuge. The 139 channel scar lakes on the 115,000 acre refuge have furnished good sport and commercial fishing from the beginning. In the 1960's the refuge was opened to deer hunting for the first time and has been open yearly since. Squirrel hunting has always been opened for the first few days of squirrel season. Duck hunting in limited areas is now permitted for half-days, three days a week, during the state waterfowl season.

(2) When the McClellan-Kerr Navigation System was constructed, the preferred route for the Arkansas Post Canal linking the Arkansas and White Rivers for navigation purposes was across the south end of the refuge. In exchange for the right-of-way across the land belonging to the Department of Interior, the Corps constructed three green-tree reservoirs, complete with levees and water control structures, to facilitate waterfowl management on the refuge. The Service agreed to operate and maintain the reservoirs after construction.

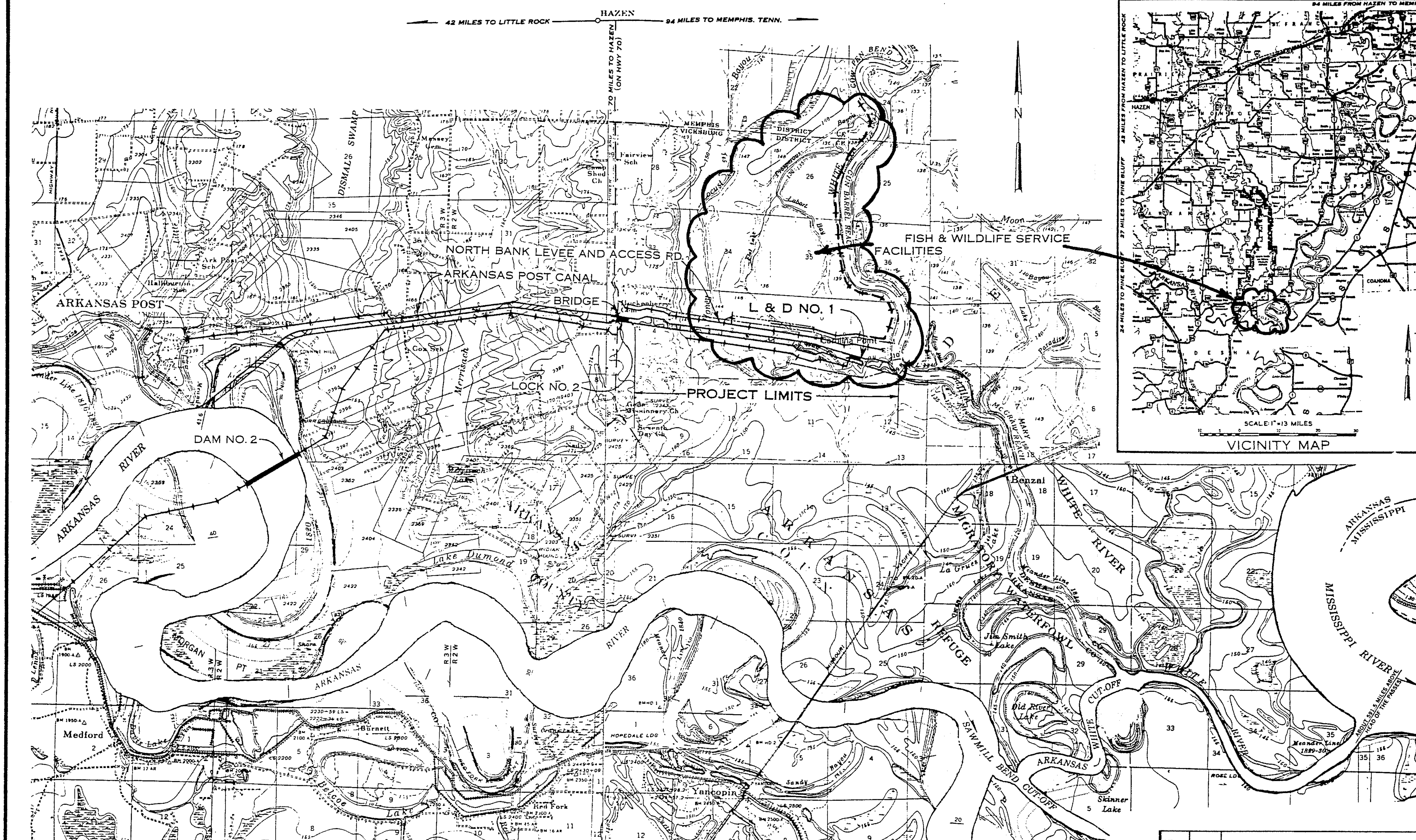
(3) However, damage has occurred to one of the levees constructed by the Corps; damage that exceeds the expectation of ordinary maintenance. The concrete water-control structures have also shown damage which could not have been prevented by maintenance. As a result, the Corps has agreed to repair the structures and gates, and to restore the levee destroyed by erosion from the White River.

B. Environmental Resources. The natural resources of the project area (Plates 1 and 2) are many and varied, and of considerable significance regionally. The green-tree reservoirs furnish excellent fishing, particularly in the springtime. In the fall, they furnish resting and feeding areas for all migratory waterfowl. The migrating eagles use the snags in the reservoirs for perching and watching for prey. Alligators are seen frequently in the sloughs and bayous encompassed by the reservoirs. Deer and turkey are common to abundant in the area. Furbearers such as beaver, muskrat, skunk, river otter, raccoon, and coyote are resident to the area. Occasionally seen are black bears, year 'round residents of the refuge. Over 200 species of song birds have been identified as residents and/or visitors to the area. In short, the area abounds with terrestrial and aquatic species of wildlife, and contributes to the area by providing hunting, fishing, birdwatching, wildlife photography, sightseeing, camping, and other opportunities.

C. Cultural Resources. There are no recorded archeological sites in the immediate project area according to the records of the Arkansas Archeological Survey. A shipwreck located in the White River channel, upstream of the project area, should not be affected. Numerous archeological sites of the late prehistoric and early historic period are located in the surrounding area but they should not be affected by the project. Telephone coordination with the Arkansas State Historic Preservation Officer (SHPO) was conducted on 10 April 1991. The SHPO requested that all new borrow areas of areas to be impacted by levee construction should be surveyed for cultural resources. Archeological fieldwork has been delayed by high water levels in the project area.

D. Environmental Compliance. Draft versions of the Environmental Assessment, Finding of No Significant Impact (FONSI), and Section 404 (b) (1) Evaluation Report are virtually complete, but are not included in this report. A Section 404 Joint Public Notice (for the new levee section only) will be submitted at a later date in accordance with regulations. A Section 106 coordination letter will be sent to the Arkansas State Historic Preservation Officer (SHPO) following a reconnaissance of the 1500 foot levee replacement in Area 5, which will occur after the White River recedes.

12. Recommendations. Recommend that this report be approved as a basis for funding the design and rehabilitation of project features described herein. Additionally recommend that construction funds in the amount of $261,393 be included in the FY93 Construction General Budget for this purpose.



LEGEND

- LOCK
- NAVIGATION DAM
- BRIDGE
- LEVEE
- DRAINAGE DITCH
- CANAL
- SURGE & PASSING AREA

SCALE 1:40,000

4,000 0 4,000 8,000 12,000 FEET

DATUM IS MEAN SEA LEVEL
CONTOUR INTERVAL 5 FEET

RIVER MILES ARE BASED ON 1943 SURVEY
BANK LINES BASED ON 1960 AERIAL PHOTOGRAPHS
DRAWING COMPILED FROM COMPOSITE OF QUADRANGLE MAPS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
LITTLE ROCK DISTRICT, CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

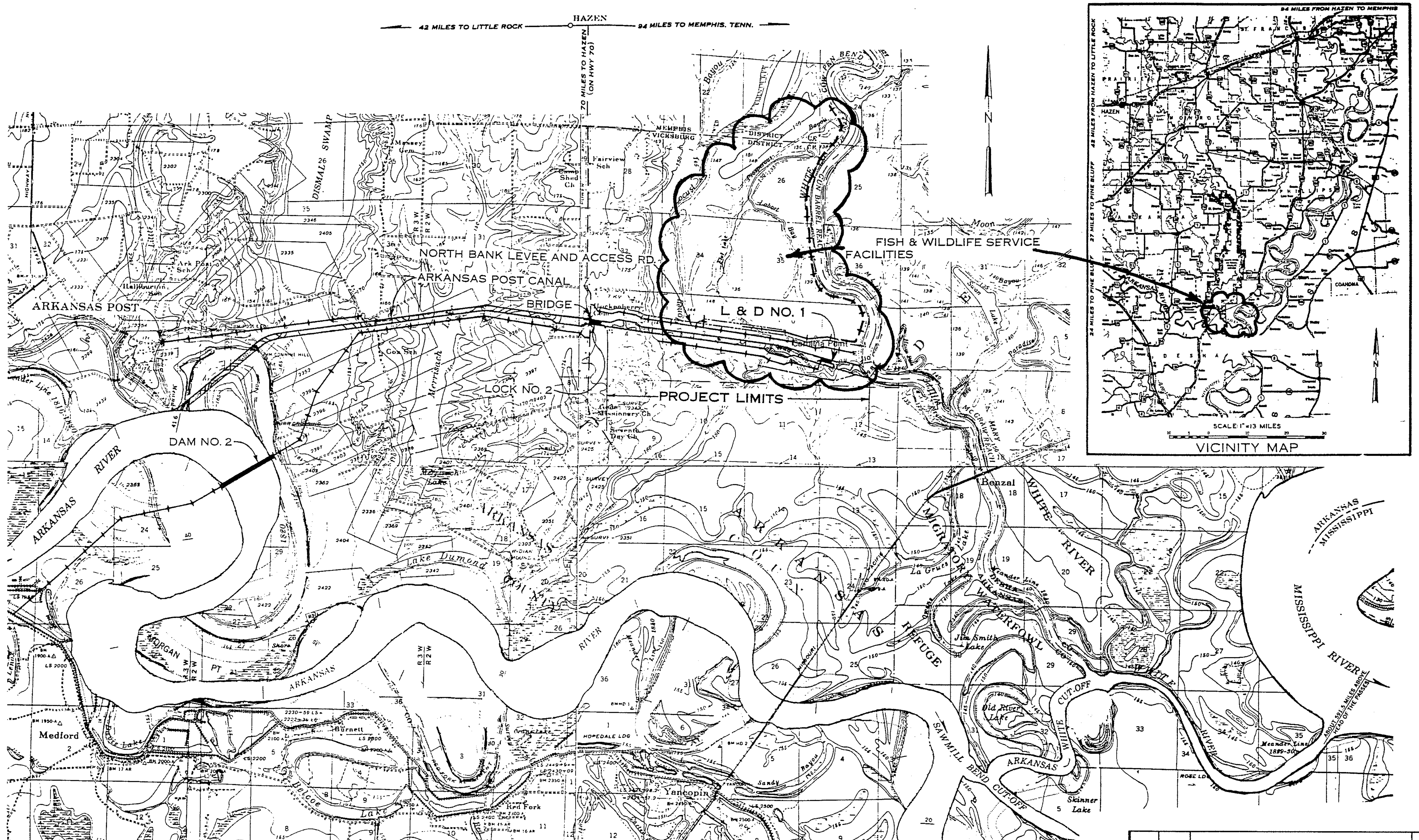
DESIGNED BY: MKB — WHITE RIVER AND TRIBUTARIES — ARKANSAS RIVER, ARKANSAS
DRAWN BY: MKB
CHECKED BY: XXX

ARKANSAS POST CANAL
WHITE RIVER NATIONAL WILDLIFE REFUGE
PROJECT LOCATION

SUBMITTED BY:
ENGINEER

SCALE: AS SHOWN — MARCH 1991 — INV. SERIAL NO.
DRAWING NUMBER — SHEET 1 OF 4 — PLATE I

VALUE ENGINEERING WILL INCREASE YOUR PROFIT



LEGEND

- LOCK
- NAVIGATION DAM
- BRIDGE
- LEVEE
- DRAINAGE DITCH
- CANAL
- SURGE & PASSING AREA

SCALE 1:40,000

4,000 0 4,000 8,000 12,000 FEET

DATUM IS MEAN SEA LEVEL

CONTOUR INTERVAL 5 FEET

RIVER MILES ARE BASED ON 1943 SURVEY

BANK LINES BASED ON 1960 AERIAL PHOTOGRAPHS

DRAWING COMPILED FROM COMPOSITE OF QUADRANGLE MAPS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
LITTLE ROCK DISTRICT, CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

WHITE RIVER AND TRIBUTARIES — ARKANSAS RIVER, ARKANSAS

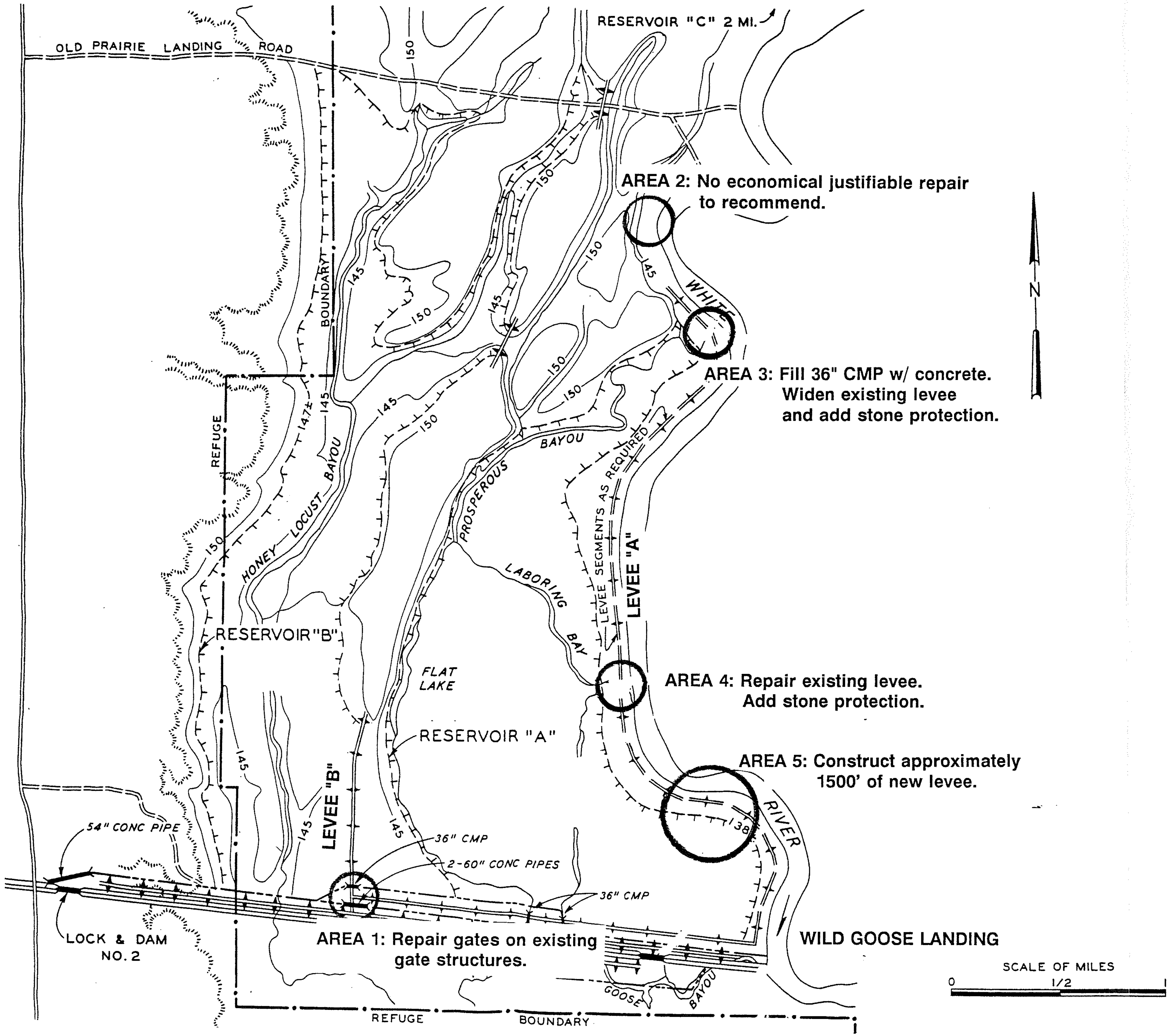
DESIGNED BY: MKB
DRAWN BY: MKB
CHECKED BY: XXX
SUBMITTED BY:
ENGINEER

ARKANSAS POST CANAL
WHITE RIVER NATIONAL WILDLIFE REFUGE
PROJECT LOCATION

SCALE: AS SHOWN — MARCH 1991 — INV. SERIAL NO.

DRAWING NUMBER

SHEET 1 OF 4 — PLATE I



REVISION	DATE	DESCRIPTION	BY

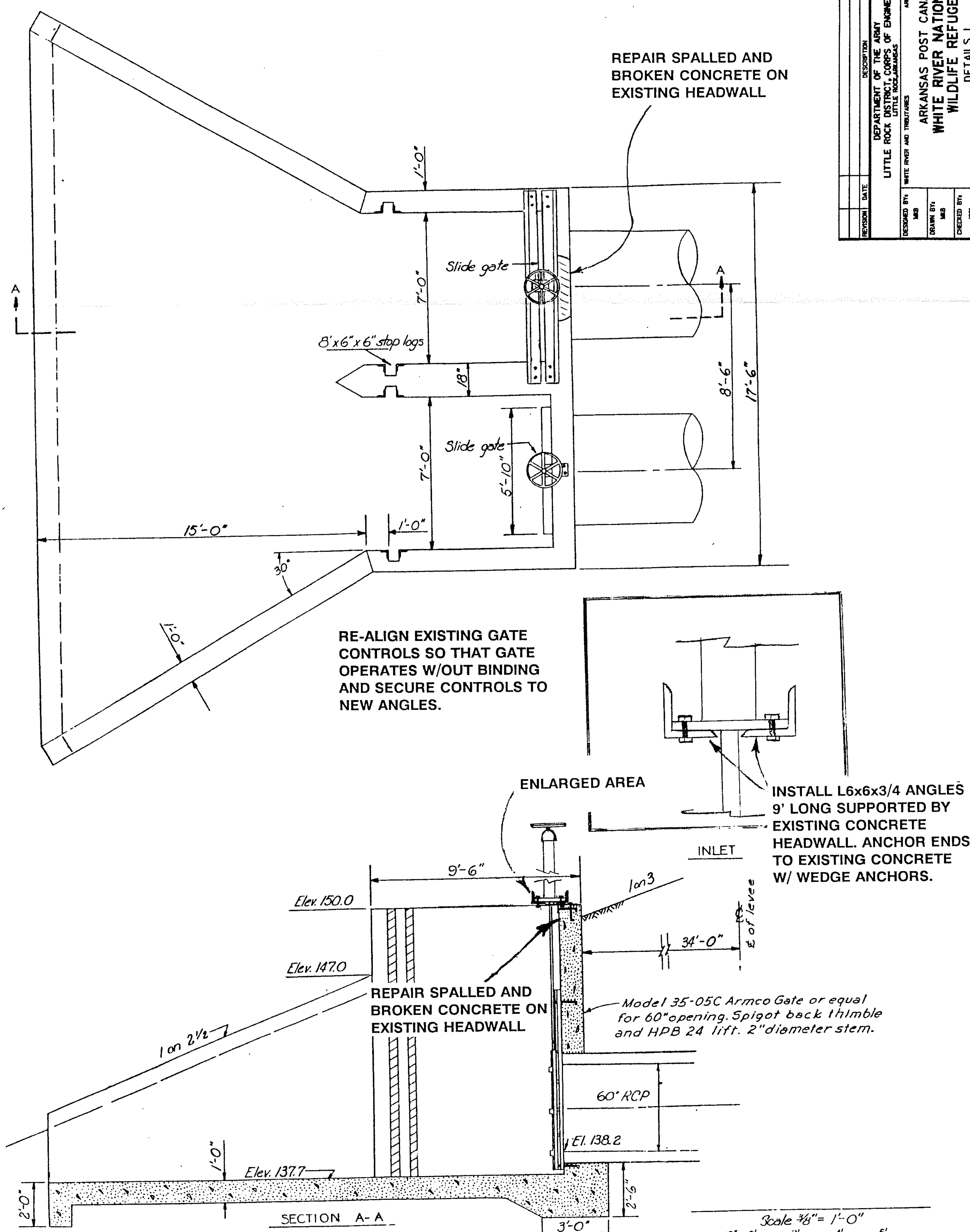
DEPARTMENT OF THE ARMY
LITTLE ROCK DISTRICT, CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

DESIGNED BY: MKB
DRAWN BY: MKB
CHECKED BY: XXX
SUBMITTED BY:
ENGINEER

WHITE RIVER AND TRIBUTARIES — ARKANSAS RIVER, ARKANSAS

ARKANSAS POST CANAL
WHITE RIVER NATIONAL
WILDLIFE REFUGE
SUMMARY

SCALE: AS SHOWN
MARCH 1991
INV. SERIAL NO.
DRAWING NUMBER
SHEET 2 OF 4
PLATE 2



AREA 1 - 60" SLUICE GATES

REVISION	DATE	DESCRIPTION	BY

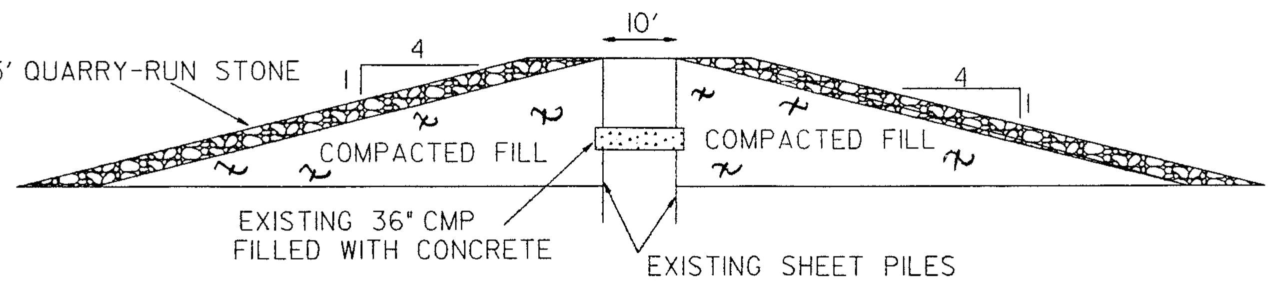
DEPARTMENT OF THE ARMY
LITTLE ROCK DISTRICT, CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

DESIGNED BY: MJB
DRAWN BY: MJB
CHECKED BY: XXX
SUBMITTED BY:
ENGINEER

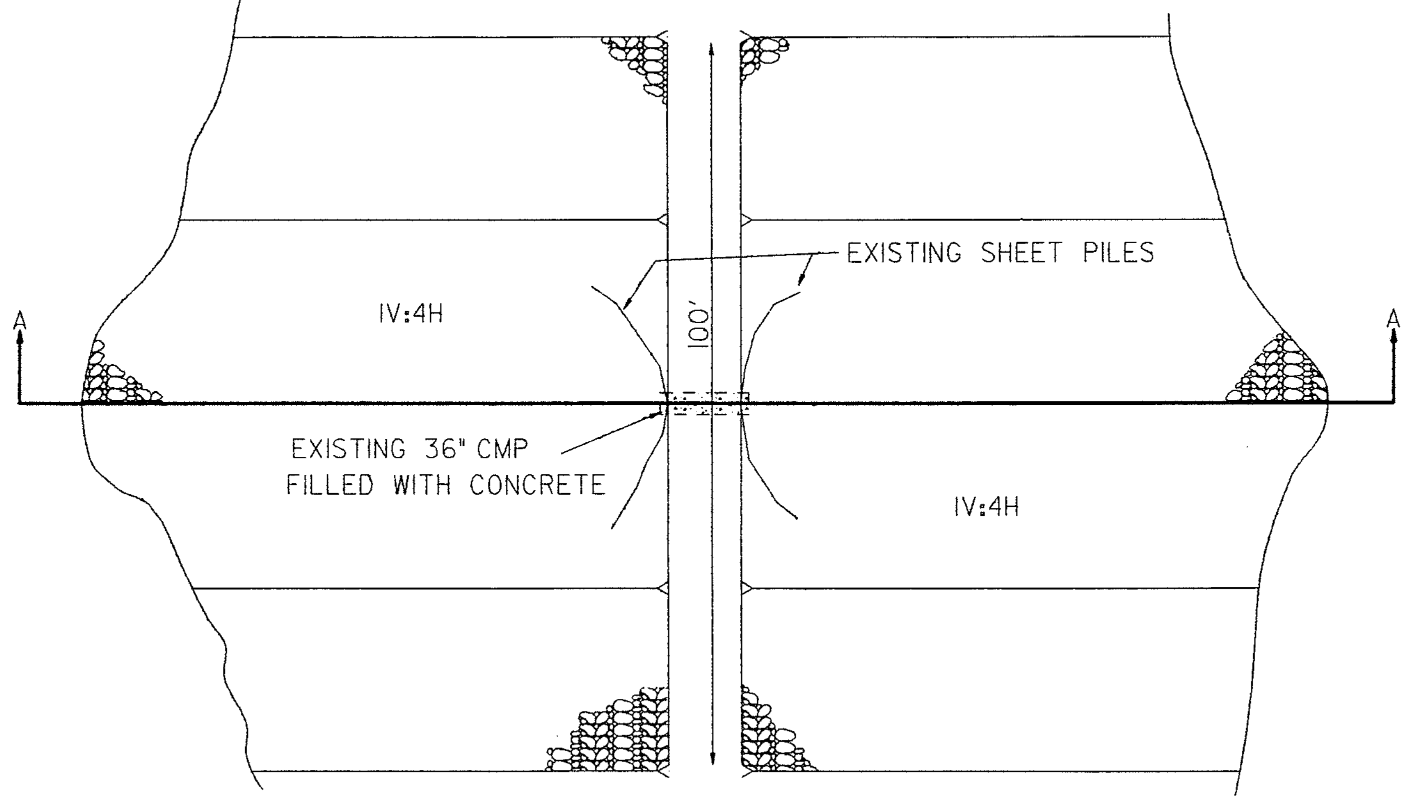
WHITE RIVER AND TRIBUTARIES — ARKANSAS RIVER, ARKANSAS

ARKANSAS POST CANAL
WHITE RIVER NATIONAL WILDLIFE REFUGE
DETAILS I

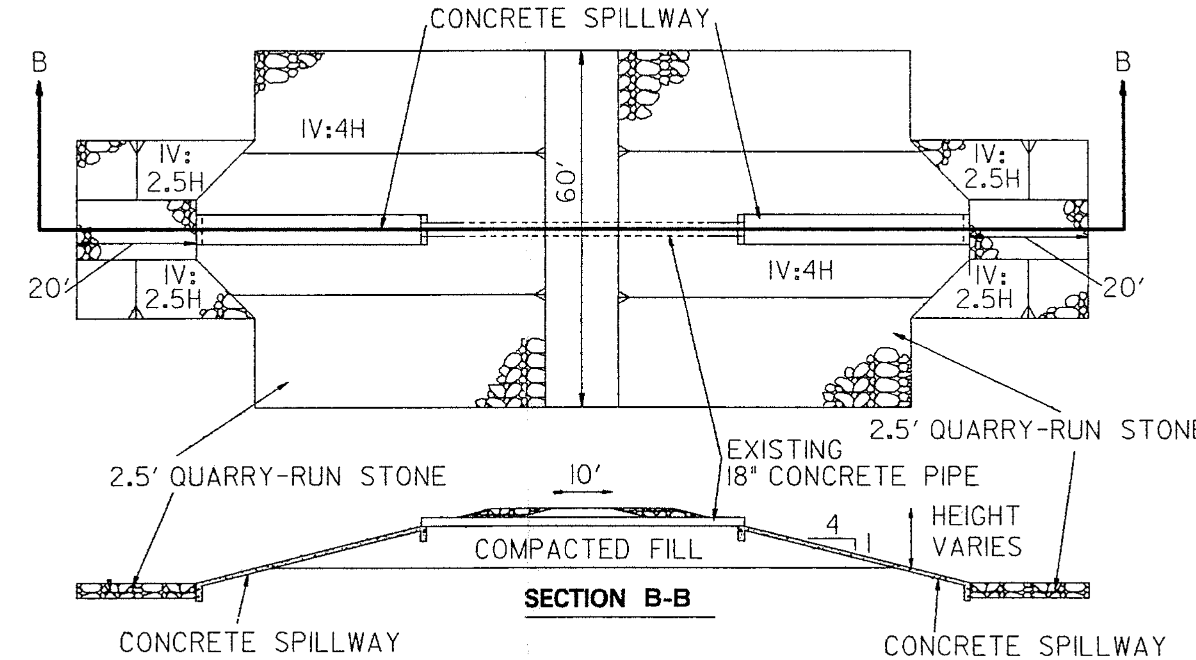
SCALE: AS SHOWN
MARCH 1991
INV. SERIAL NO.
DRAWING NUMBER
SHEET 3 OF 4
PLATE 3



SECTION A-A
SCALE: 0 10 20

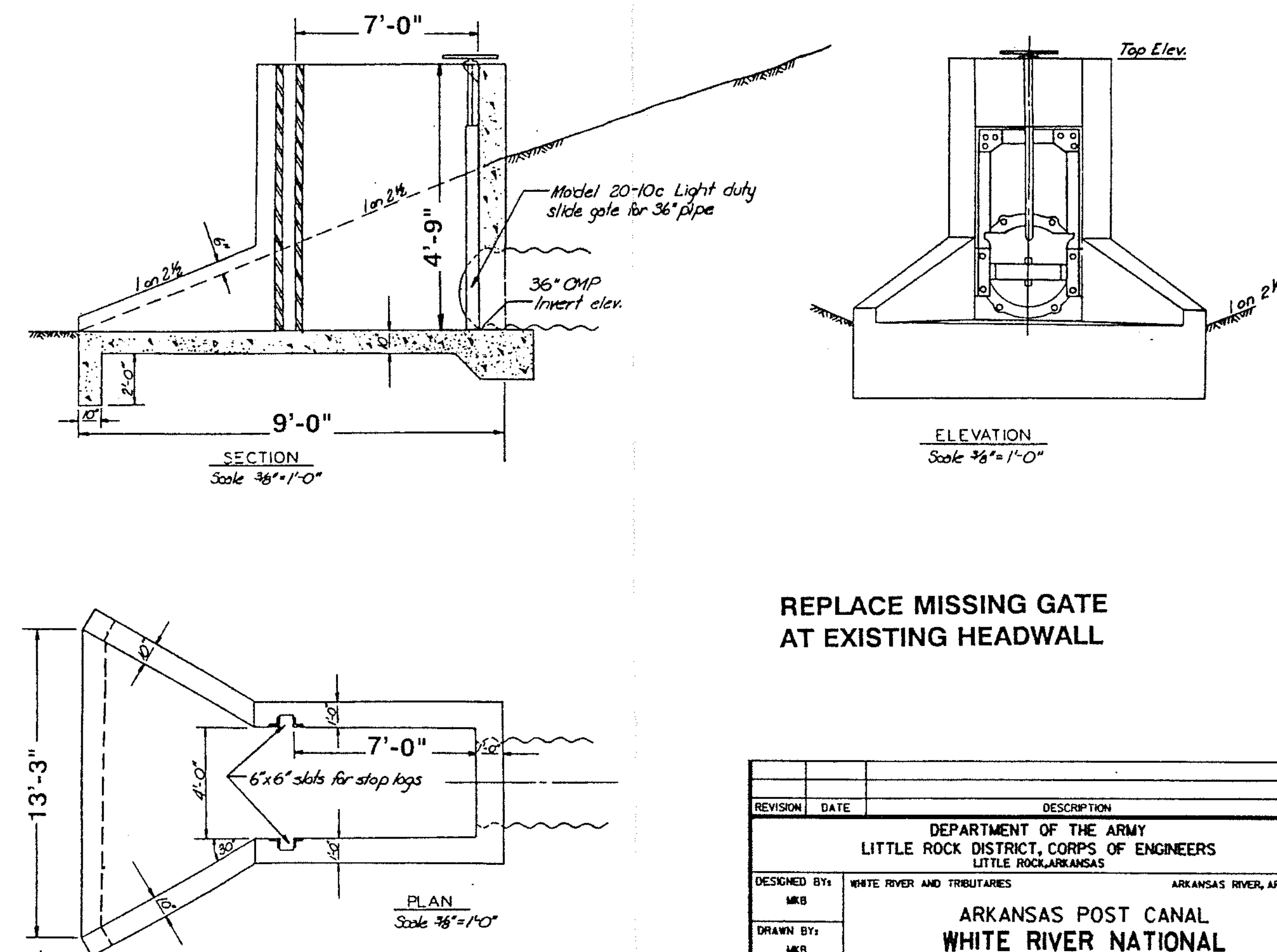


AREA 3 – LEVEE REPAIR
SCALE: 0 10 20



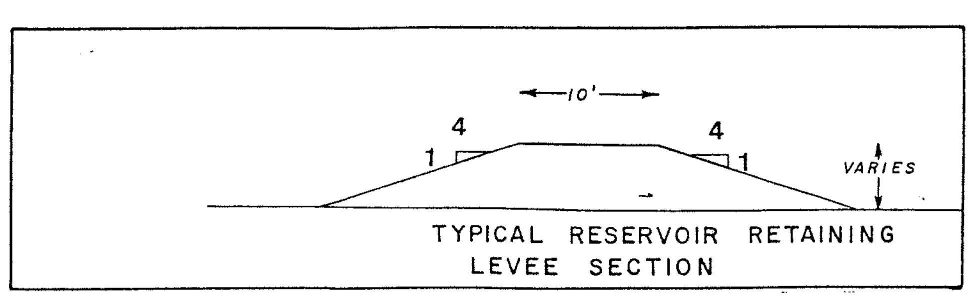
SECTION B-B

AREA 4 – LEVEE REPAIR
SCALE: 0 10 20



AREA 1 - 36" SLIDE GATE

REPLACE MISSING GATE AT EXISTING HEADWALL



AREA 5 - NEW LEVEE

NOTE: BORROW MATERIAL WILL BE AVAILABLE ON SITE AS DIRECTED BY THE USFW. NO EXCAVATION MAY OCCUR W/IN 50' OF LEVEE TOE OR TO A DEPTH GREATER THAN 5'

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
LITTLE ROCK DISTRICT, CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

DESIGNED BY: MKB
DRAWN BY: MKB
CHECKED BY: XXX
SUBMITTED BY:
ENGINEER

WHITE RIVER AND TRIBUTARIES — ARKANSAS RIVER, ARKANSAS

ARKANSAS POST CANAL
WHITE RIVER NATIONAL
WILDLIFE REFUGE
DETAILS 2

SCALE: AS SHOWN — MARCH 1991
INV. SERIAL NO.
DRAWING NUMBER
SHEET 4 OF 4 — PLATE 4

PERMIT
TO THE
UNITED STATES CORPS OF ENGINEERS, DEPARTMENT OF THE ARMY
TO USE AND OCCUPY PROPERTY IN THE
WHITE RIVER NATIONAL WILDLIFE REFUGE, ARKANSAS

WHEREAS, the United States Bureau of Sport Fisheries and Wildlife and its predecessor agencies, herein referred to as the "Bureau", has acquired certain lands in fee title as the White River National Wildlife Refuge, Arkansas, for the benefit and protection of migratory birds and other forms of wildlife, and

WHEREAS, pursuant to the Rivers and Harbors Act of July 24, 1946, as amended, the U. S. Corps of Engineers, herein referred to as the "Corps", has been authorized to construct, maintain and operate the Arkansas River Navigation Canal Project, and

WHEREAS, the Corps, in connection with the Arkansas River Multiple-Purpose Project, proposes to locate and construct on the Refuge a portion of the navigation canal and Lock and Dam No. 1;

NOW, THEREFORE, to further the aims and purposes of the Arkansas River Multiple-Purpose Project, the Corps is hereby granted a permit to use and occupy 545 acres of Refuge land upon which it may construct, maintain, and operate said navigation canal and Lock and Dam No. 1, upon which it may locate a public access area as heretofore agreed, and upon which additional recreational or other facilities may be located in future years on mutual agreement of the Bureau and Corps. This permit to remain in effect for as long as these facilities are maintained and operated for purposes authorized in the above act. The area covered by this permit, which is for an indefinite period, is described below and shown in blue on attached map, Exhibit "A", which is made a part hereof.

DESCRIPTION - PARCEL "A" - 545.00 Acres

A tract of land situated in the county of Arkansas, State of Arkansas, being a part of Sections 1, 2, and 3, Township 8 South, Range 2 West of the Fifth Principal Meridian, and being more particularly described as follows:

Beginning at a point on the west line of said Section 3, which is 1,040 feet north of the west quarter corner thereof, being on the west boundary line of the White River National Wildlife Refuge and being 610 feet north of Station 164+20 on

HCP /

APPENDIX A

the centerline of the Navigation Canal; thence southeasterly 2,120 feet to a point which is 635 feet north of Station 143+00; thence southeasterly 2,000 feet to a point which is 645 feet north of Station 123+00; thence southeasterly 750 feet to a point which is 645 feet north of Station 115+50; thence southeasterly 450 feet to a point which is 660 feet north of Station 111+00; thence southeasterly 2,400 feet to a point which is 660 feet north of Station 87+00; thence southeasterly 1,780 feet to a point which is 650 feet north of Station 70+20; thence northeasterly 1,130 feet to a point which is 1,125 feet north of Station 59+85; thence southeasterly 2,775 feet, more or less, to a point on the ordinary high-water line, right bank of White River, which is 1,325 feet north of Station 32+00; thence southerly along the meanders of said ordinary high-water line to its intersection with a line extended southerly and perpendicular to Station 13+00; thence southwesterly along said line extended from Station 13+00 to its intersection with the south line of said Section 1; thence westerly along said south line 910 feet to a point on the southerly right-of-way line for said Navigation Canal, which is 800 feet south of Station 22+80; thence along said right-of-way line as follows north 74° 22' west 1,500 feet to a point; thence south 83° 50' west 1,080 feet to a point, said point being 1,200 feet south of Station 46+50; thence north 74° 22' west 5,210 feet to a point; thence north 07° 23' east 320 feet to a point which is 700 feet south of Station 100+00; thence north 82° 37' west 6,300 feet to a point on the west line of said Section 3; thence, departing from said right-of-way line, north along said section line 1,310 feet to the point of beginning, and containing 545.00 acres, more or less.

Also, to facilitate construction work, the Corps is permitted, for a period not to exceed five years after execution of this permit, to use and occupy an additional 80 acres of Refuge Land, as shown in red on map Exhibit "A" and described below:

DESCRIPTION - PARCEL "B" - 80.00 Acres

A tract of land situated in the county of Arkansas, State of Arkansas, being a part of Sections 1, 2, and 3, Township 8 South, Range 2 West of the Fifth Principal Meridian, and being more particularly described as follows:

Beginning at a point on the west line of said Section 3, which is 1,040 feet north of the west quarter corner thereof, being on the west boundary line of the White River National Wildlife Refuge and being 610 feet north of Station 164+20 on the centerline of the Navigation Canal; thence southeasterly 2,120 feet to a point which is 635 feet north of Station 143+00 on said centerline; thence southeasterly 2,000 feet to a point which is 645 feet north of Station 123+00 on said centerline; thence southeasterly 750 feet to a point which is 645 feet north of Station 115+50; thence southeasterly 450 feet to a point which is 660 feet north of Station 111+00; thence southeasterly 2,400 feet to a point which is 660 feet north of Station 87+00; thence southeasterly 1,780 feet to a point which is 650 feet north of Station 70+20; thence northeasterly 1,130 feet to a point which is 1,125 feet north of Station 59+85; thence southeasterly 2,775 feet, more or less, to a point on the ordinary high-water line, right bank of White River, which is 1,325 feet north of Station 32+00; thence northerly along the meanders of said ordinary high-water line 275 feet to a point which is 1,600 feet north of Station 33+00; thence northwesterly 2,725 feet to a point which is 1,360 feet north of Station 60+00; thence southwesterly 1,130 feet to a point which is 900 feet north of Station 70+35; thence northwesterly 1,785 feet to a point which is 900 feet north of Station 87+00; thence north 50 feet to a point which is 950 feet north of said Station 87+00; thence northwesterly 5,600 feet to a point which is 950 feet north of Station 143+00; thence south 150 feet to a point which is 800 feet north of said Station 143+00; thence northwesterly 2,140 feet to a point on the west line of said Section 3, which is 800 feet north of Station 164+40; thence south along said west line 190 feet to the point of beginning, and containing 80.00 acres, more or less.

In consideration of this permit granted by the Bureau, the Corps as a part of project costs agrees:

1. To construct necessary levees and control structures to create Reservoirs A and B on Refuge land immediately north of the navigation canal for management by the Bureau in their waterfowl program. Construction items for these two reservoirs are to include:

   a. Controllable inlet and diversion from Pool No. 2 designed to supply water at a rate of 150 c.f.s. for gravity delivery to White River National Wildlife Refuge.

b. Diversion Ditch "A" designed to convey water supply from inlet structure to the interceptor drainage ditch.

c. Interceptor Drainage Ditch, a project feature comprised of sections "B" and "C", designed to convey waters from the 28.1 square mile drainage area of Honey Locust Bayou to White River and also water supply for wildlife purposes.

d. Control Structure in Interceptor Drainage Ditch between sections "B" and "C" designed to impound Reservoir "B" and also to divert water into Reservoir "A". Access roadway from project retaining levee would be incorporated in this structure. The section of the structure in the drainage ditch should have stoplog spillway sections for controlled upstream impoundment to elevation 148 feet m.s.l. in Reservoir "B". Structure openings should be of adequate size to provide prompt evacuation of storm drainage. Maximum length of ponding of storm runoff shall be four days.

e. Diversion Ditch "D" designed to convey water from the main control structure to Reservoir "A".

f. Levee section separating Reservoir "A" on the south end from the interceptor drainage ditch. It would be constructed to about elevation 141 feet.

g. Two water-control structures in south retaining levee at crossings of Wild Goose Bayou.

h. Intermittent levee sections along bank of White River to about elevation 141 feet m.s.l. for Impounding Reservoir "A".

i. A stoplog water-control structure in the levee section constructed across the mouth of Laboring Bay.

j. A water-control structure in the levee section to be constructed across Paradise Bayou.

k. Levee sections separating Reservoirs "A" and "B". This levee would extend north from the main control structure and would be constructed to about elevation 150 feet m.s.l. Total length would be about 22,780 feet.

The Fish and Wildlife Plan, which includes the location and layout of the above construction features, is shown on attached Exhibit "B", and is made a part hereof.

2. To operate and maintain a water diversion structure at Lock No. 2; to permit the Bureau to withdraw from pool at said lock sufficient water to properly manage Reservoirs A and B. The total annual diversion is estimated to be approximately 10,000 acre feet of water, which, if necessary, may be diverted to Reservoirs A and B within a 30-day period. The diversion is to be coordinated with the navigation locking requirements which will be given first priority.

3. To close the public access area at Lock and Dam No. 1 between November 1 and March 15 of any year if requested to do so by the Regional Director, Bureau of Sport Fisheries and Wildlife.

4. To use and occupy the area without cost or expense to the Bureau.

5. To maintain the area in good condition and repair.

6. To protect the property from fire and vandalism. Also, it shall make and enforce such rules and regulations as are necessary, within its legal authority, to exercise the privileges granted in this permit.

7. To report to the Bureau any interference with or damage to any refuge property described herein arising from the exercise of privileges herein granted, and further, that it will correct any such interference or damage to the satisfaction of the Regional Director, Bureau of Sport Fisheries and Wildlife.

8. That the Bureau, its employees, agents, and assigns may at all times have full rights of access to and through said area for any work whatever involving Bureau operations or wildlife management and protection.

9. That in granting this permit the intent of the Bureau is to convey to the Corps only those rights necessary to (1) operate, use, and maintain the navigation canal, (2) operate, use and maintain Lock and Dam No. 1, and (3) operate, use, and maintain the public access area at Lock and Dam No. 1. All other rights, and especially those relating to fish and wildlife, are reserved to the Bureau.

In connection with the operation and maintenance of fish and wildlife features of the project, as provided herein and shown on Exhibit "B", the Corps and Bureau mutually agree that:

10. The Corps shall operate and maintain the water diversion structure at Lock No. 2.

11. The Bureau shall operate and maintain all other structures, ditches and levees incident to the management of Reservoirs A and B.

12. In the event water is needed for the proper management of Reservoirs A and B, and the Corps is unable to provide the necessary operating service, the Bureau may on a temporary emergency basis operate all water control structures leading to Reservoirs A and B--including those at Lock No. 2, after obtaining assurance from the District Engineer or his authorized representative that the Corps is unable to provide the necessary operating service at the time requested.

13. Any signs constructed by the permittee involving public access, recreation, or both, shall give full recognition to the United States Fish and Wildlife Service on the cooperative nature of the land development.

OCT 1 1963
(Date)

Regional Director, Bureau of Sport Fisheries and Wildlife

2 January 1964
(Date)

CHARLES D. MAYNARD Colonel, CE
District Engineer, U. S. Army Engineer District, Little Rock

Record cy of Permit
Drawing file Historical
in Real Estate Files

HISTORY OF PROJECT DEFICIENCIES
White River National Wildlife Refuge
(McClellan-Kerr Arkansas River Navigation System)

1. On 29 August 1967, the Service provided a letter of inspection and acceptance of the mitigation features which noted that current velocity along the White River had increased significantly due to channelization on the lower White River below the Arkansas Post Canal. The resulting erosion had endangered Levee A, which was constructed by the Corps in connection with other mitigation measures on the refuge. The Corps was requested to take immediate steps to provide bank stabilization for those portions of the White River subject to this greatly increased erosion. (This requested work was not accomplished by the Corps.)

2. Reference: Fish and Wildlife Service Memo, 23 April 1987.

A. Areas 3,4 & 5 (See Encl 2, Plate 2): "In at least two places, on the right descending bank of the White River in the vicinity of RM 13.5 (Area 3) and between miles 10 to 12 (Areas 4 & 5), there is considerable danger of the complete loss of Levee A due to headcutting during high river flow. Only through temporary repairs has the Service prevented the headcut near mile 13.5 from dewatering the Levee A greentree impoundment."

B. Area 1: "An additional problem exists at the southern end of "Levee B" where two separate water control structures were constructed. The larger of the two structures consists of two separate pipes and drop gates; the smaller is only one pipe and drop gate. At the present time, apparently due to settling and cracking, the concrete wall on the larger structure is broken and one of the drop gates cannot be raised to dewater the Levee B impoundment. The dropgate on the smaller structure has broken off and an improvised stop log system is utilized. Although functional, this improvised system is not nearly so efficient as the original drop gate and requires extensive time and labor to operate and maintain."

3. Reference: Fish and Wildlife Service Memo, 20 May 1988. "The Fish and Wildlife Service is becoming increasingly concerned over the deteriorating condition of Greentree reservoir levees A, B, and C and the associated water control structures. .....the levees and pipe/drop structures will require <u>major rehabilitation</u>."

4. CESWL-PL-A (CESWL-PL/2 Aug 88) 2nd End stated, "We find that the project has not fulfilled the needs for which it was conceived and constructed. This failure to fulfill the needs is due to design and construction shortcomings in providing the

water control structures. The failure of the levee is due to normal occurrences. We also find that the ordinary maintenance by the US Fish and Wildlife Service has been adequate."

5. A CESWL-ED-DP trip report dated 8 December 1988 described the following results of an 18 November 1988 District inspection:

A. Area 1 contains two gate structures which pass water through Levee B. The first structure consists of 2-60" concrete pipes with concrete headwalls, stop logs and slide gates. The north gate is inoperable. Apparently the contraction and expansion of the soils in the area has shifted the structure to the point where the gate shaft is binding and prevents operation of the gate. Concrete has broken and/or spalled off of the headwall around the gate support bracket and an anchor bolt is broken. The anchor bolt broke in 1984 and the sliding gate shaft was in a bind for several years before 1984. After the anchor bolt broke, it could no longer be lowered, so they have used stop logs since. The second structure on Levee B is approximately 100 feet north of the first structure. It consists of 1-36" CMP with concrete headwalls, stop logs and a slide gate. The slide gate on the structure has been missing since at least 1978.

B. "Area 2 is vastly different that the 1967 quad map shows. Levee A in this area in completely gone as is the access road that the Service used to maintain all of Levee A. It appears the White River has meandered inland 400± causing extensive bank caving as it progressed. Currently at high river stages the White River is developing a channel and entering into Prosperous Bayou.......... If this continues, it could prove disastrous for the refuge and navigation on the White River."

C. Area 3. "The original structure consisted of 1-36" CMP with concrete headwalls and stop logs. That structure and parts of Levee A were lost due to bank caving. When this was lost, the use of reservoir A was also lost. The Service moved inland and constructed a new levee section to plug the hole and a gate structure so Reservoir A could be put back into service. The sheet pile headwalls were installed to protect the levee and gate structures from erosion. Flood waters currently overtop the levee and are causing erosion from behind the sheet piles. The result is a distressed condition on the levee slope with a potential for a breach. Currently the road across the structure in only 5 feet wide making it almost impassible."

D. "Area 4 was not visited on this trip. The Service poured two concrete spillways in 1981 through Levee A north and south of Area 4 and placed rip-rap along the levee for protection. This was done to reduce the severe headcutting of Levee A during high water."

E. Levee A presently ends at Area 5. There is no longer a connection road along Levee A to Wild Goose landing because a large section of the levee had been eroded away."

6. Reference: CESWD-PL-R Memorandum, 5 July 1988.

A. ".... it appears that the FWS refuge people may have a very reasonable request for the Corps to repair the mitigation features."

B. It appears that the Corps "made structural and design changes in the mitigation features without consulting FWS. Additionally, it looks like we (Corps) underestimated the altered flow velocities and subsequent under designed the mitigation features."

7. Reference: CESWL-ED-DG Memorandum, 18 September 1989.

A. Area 1: "It is our belief that the failure of the two gates, one 60" sluice gate and one 36" slide gate, is due to design and construction deficiencies. The concrete has spalled at the support bracket on the 60" sluice gate apparently due to poor concrete. The 36" slide gate has popped off."

B. Area 3: The large lengths of levee A that have caved into the White River have done so as a normal occurrence. These levees have not been lost as a result of lack of maintenance by the service. In fact, the Service has done a lot of work in repairing and maintaining the levees. When the levee at Prosperous Bayou (Area 3) was lost, the Service moved inland to build a new levee and protected the levee and gate structure with sheet pile headwalls. This structure is now in danger of being lost and with it goes the use of Reservoir A. This breach would provide access for White River flows down Prosperous Bayou."

C. Area 4: The Service has replaced a blow-out and added some rip-rap in this area.

D. "Recommendation: As a replacement to the Wildlife Service, we recommend that the Corps repair the above gates, fill and rip-rap the White River face of the structure at Prosperous Bayou. It is in the Corps' best interest to do the work in exchange for Wildlife Service lands that are used for dredge disposal on the lower White River."

8. Reference: CESWL-PL-R Memorandum For Record, 8 February 1991.

A. Area 1 - Verified inoperable condition of the north 60" sluice gate. The 36" slide gate was inoperable. Flow was controlled by use of a stop log. A Service representative stated that they had replaced the deteriorated 36" pipe through Levee B the previous summer.

B. Area 2 - This area had been severely eroded by the White River. No additional work was requested since it was not constructed by the Corps.

C. Area 3 - Verified condition of the eroded levee.

D. Area 4 - Examined an area where the Service had inserted an 18" pipe near the top of Levee A to speed drainage of Reservoir A.

E. Area 5 - The Service representative indicated that approximately 900 feet of Levee A had been washed out and he suggested that a new section of levee be constructed farther back from the river.

CESWL-ED-C

March
28 ~~APRIL~~ 1991

MENORANDUM FOR: Chief, Planning Division, Project Reports Br.
Attn: Terry Daniel

SUBJECT: Request for Revised Cost Estimate, Reconnaissance Report to Correct Design and Construction Deficiencies at the White River National Refuge, Arkansas

The revised cost estimate is inclosed. It includes the scope of as outlined in the memorandum dated 28 March 1991 (subject as above) provided to us by the Ch, Gen. Engr. Sec.

This estimate includes 7.85% for escalation and 25% contingincies on construction work. It also includes for the prime contractor 10% for FOOH, 5% for HOOH, 10% for profit and 1% for bond.

Billy G. Smith

Encl 1

BILLY G. SMITH P.E.
Chief, Cost Engineering Branch

Randall R. Montgomery P.E.
Cost Engr, Cost Engineering Branch

SUMMARY REPORTS SUMMARY PAGE

DETAILED ESTIMATE DETAIL PAGE

DETAILED ESTIMATE DETAIL PAGE

DETAILED ESTIMATE DETAIL PAGE

No Backup Reports...

*** END TABLE OF CONTENTS ***

WHITE RIVER NATIONAL WILDLIFE
REFUGE, REHABILITATION OF
DETERIORATING STRUCTURES,
RECONNAISSANCE REPORT

Designed By: LITTLE ROCK DIST CORP OF ENGR
Estimated By: COST ENGINEERING BRANCH

Prepared By: RANDY MONTGOMERY

Date: 03/21/91

This revised cost estimate is for "Reconnaissance Report to Correct Design and Construction Deficiencies at the White River National Refuge, Arkansas".

This estimate uses 10% for FOOH, 5% for HOOH, 10% for profit and 1% for bond charged to the prime contractor. Subcontractors were not used in the cost estimate.

An escalation of 7.85% and a 25% contingency was applied to this estimate.

This cost estimate is based on the following scope of work:

1. Repair 60 inch sluice gate:
   a. Clean and paint both 60 inch sluice gates.
   b. Adjust existing guides on bothe 60 inch sluice gates.
   c. On the 60" gate theat is inoperable raise the floorstand and support it on two 9 ft L6x6x3/4 spanning across the top of the concrete headwall. Anchor the steel angles into the concrete headwall with wedge anchors. Attach the floorstand support bracket to the angles with steel bolts or weld.
   d. Repair the broken and spalled concrete caused by the cantilevered support bracket with grout.

2. Replace 36 inch slide gate:
   a. Install new 36 inch slide gate on existing structure.

3. Eliminate existing gate structure and repair 100 lf of levee:
   a. Plug existing 36" CMP with 2 ft of concrete on each end. Use 3.14 cy of concrete.
   b. Clear and grub 0.34 acres.
   c. Compact 2,625 cy of fill to 1V:4H sideslopes.
   d. Place 2,470 tons of quarry run stone 2 1/2 ft thick on both sides of the levee.
   e. Establish 0.02 acres of turf on the levee crown and all other disturbed areas lacking stone protection.

4. Laboring Bay - Repair 60 lf of existing levee and 18" CMP and add stone protection.
   a. Clear and grub 0.07 acres.
   b. Compact 150 cy of fill.
   c. Add 2 1/2 ft (530 tons) of quarry run stone protection on both sides of the levee and drainage channel.
   d. Place 3.06 cy of concrete and 165 sf of WWF in slab spillways.
   e. Establish 0.03 acres of turf on crown and all disturbed areas where stone protection is lacking.

5. Construct approx. 1,500 lf of levee with compacted fill using 1V:4H side slopes. This will replace an orig levee that was washed out.
   a. Clear and grub 1.44 acres.
   b. Place and compact 4,400 cy of fill.
   c. Establish 1.44 acres of turf.

** CONTRACTOR SETTINGS **

		AMOUNT	PCT	PCT S	RISK	DIFF	SIZE	PERIOD	INVEST	ASSIST	SUBCON
A PRIME CONTRACTOR											
PRIME CONTRACTOR OVERHEAD	P		10.00								
PRIME CONTRACTOR HOME OFFICE OVERHEAD	P		5.00								
PRIME CONTRATCTOR PROFIT	P		10.00								
PRIME CONTRACTOR BOND	P		1.00								

** PROJECT OWNER SUMMARY - LEVEL 1 **

		QUANTY UOM	CONTRACT	ESCALATN	CONTNGCY	TOTAL COST	UNIT
11	LEVEES AND FLOODWALLS		159,887	12,547	43,109	215,543	
30	ENGINEERING AND DESIGN		29,650	0	0	29,650	
31	SUPERVISION AND ADMINISTRATION		16,200	0	0	16,200	
	WHITE RIVER NATIONAL WILDLIFE		205,737	12,547	43,109	261,393	

	QUANTY	UOM	CONTRACT	ESCALATN	CONTNGCY	TOTAL COST	UNIT
11 LEVEES AND FLOODWALLS							
11.1 LEVEES							
11.1.1 MOBILIZATION AND DEMOBILIZATION							
11.1.1.1 LOAD AND UNLOAD EQUIPMENT TO BE							
LOAD AND UNLOAD EQUIPMENT TO BE	10.00	PCS	635	50	171	857	85.65
11.1.1.2 TRANSPORT EQUIPMENT (MOB & DEMOB							
TRANSPORT EQUIPMENT (MOB & DEMOB	80.00	HRS	4,715	370	1,271	6,357	79.46
11.1.1.3 MOB & DEMOB EQPMT TO BE DRIVEN,							
MOB & DEMOB EQPMT TO BE DRIVEN,	8.00	HRS	743	58	200	1,002	125.23
MOBILIZATION AND DEMOBILIZATION			6,094	478	1,643	8,215	
11.1.2 REPAIR 60" SLUICE GATES							
11.1.2.B METALS							
11.1.2.B.1 REMOVE EXISTING 60" SLUICE GATES							
REMOVE EXISTING 60" SLUICE GATES	2.00	EA	919	72	248	1,239	619.74
11.1.2.B.3 CLEAN AND PAINT GATE							
CLEAN AND PAINT GATE	2.00	EA	984	77	265	1,326	662.99
11.1.2.B.5 ADJUST EXISTING GATE GUIDES							
ADJUST EXISTING GATE GUIDES	2.00	EA	514	40	138	692	346.17

	QUANTY	UOM	CONTRACT	ESCALATN	CONTNGCY	TOTAL COST	UNIT
11.1.2.B.7 INSTALL 60" SLUICE GATE							
INSTALL 60" SLUICE GATE	2.00	EA	460	36	124	620	309.87
11.1.2.B.8 REPAIR SPALLED CONCRETE							
REPAIR SPALLED CONCRETE			98	8	26	132	
11.1.2.B.9 METAL WORK FOR IN-OPERABLE GATE							
METAL WORK FOR IN-OPERABLE GATE			672	53	181	906	
METALS			3,646	286	983	4,916	
REPAIR 60" SLUICE GATES			3,646	286	983	4,916	
11.1.3 REPLACE 36" SLIDE GATE							
11.1.3.B METAL WORK							
11.1.3.B.1 Rem Ext 36" Slide Gate & Framewk							
Rem Ext 36" Slide Gate & Framewk			927	73	250	1,249	
11.1.3.B.3 Install New 36" Slide Gate							
Install New 36" Slide Gate			5,888	462	1,587	7,937	
METAL WORK			6,815	535	1,837	9,187	
REPLACE 36" SLIDE GATE			6,815	535	1,837	9,187	
11.1.4 ELINMINATE GATE STR & REPR LEVEE							
11.1.4.B SITE WORK							

		QUANTY	UOM	CONTRACT	ESCALATN	CONTNGCY	TOTAL COST	UNIT
11.1.4.B.1	CLEAR AND GRUB							
	CLEAR AND GRUB			1,310	103	353	1,766	
11.1.4.B.2	EXC, PL, COMPACT & GRADE FILL							
11.1.4.B.2.1	EXCAVATE AND PLACE NEW FILL MAT	2625.00	CY	4,549	357	1,227	6,133	2.34
11.1.4.B.2.2	INSTALL GEOTEXTILE MATERIAL	3878.00	SY	8,762	688	2,362	11,811	3.05
11.1.4.B.2.3	SPREAD AND SHAPE TO GRADE	2625.00	CY	1,901	149	512	2,562	0.98
11.1.4.B.2.4	COMPACTION	2625.00	CY	1,231	97	332	1,659	0.63
11.1.4.B.2.5	CHECK GRADE	2625.00	CY	157	12	42	212	0.08
	EXC, PL, COMPACT & GRADE FILL	2625.00	CY	16,599	1,303	4,475	22,377	8.52
11.1.4.B.4	HAUL & DUMP RIPRAP ON WORK SITE							
	HAUL & DUMP RIPRAP ON WORK SITE	2470.00	TON	54,593	4,284	14,719	73,597	29.80
11.1.4.B.5	PLACE RIPRAP ON SLOPES							
	PLACE RIPRAP ON SLOPES	2470.00	TON	15,661	1,229	4,223	21,113	8.55
11.1.4.B.9	ESTABLISH TURF ON TOP OF LEVEE							
11.1.4.B.9.1	Replace Top Soil	17.00	CY	178	14	48	241	14.15
11.1.4.B.9.2	Till or Prepare Seedbed	871.00	SF	89	7	24	120	0.14
11.1.4.B.9.3	Seed and Fertilize	97.00	SY	16	1	4	21	0.22
	ESTABLISH TURF ON TOP OF LEVEE	871.00	SF	283	22	76	381	0.44
	SITE WORK			88,447	6,941	23,847	119,234	
11.1.4.C	CONCRETE							
11.1.4.C.1	PREPARE CULVERT TO RECEIVE CONC							
	PREPARE CULVERT TO RECEIVE CONC			72	6	19	97	

		QUANTY UOM	CONTRACT	ESCALATN	CONTNGCY	TOTAL COST	UNIT
11.1.4.C.3 PLACE CONC PLUG IN CULVERT							
	PLACE CONC PLUG IN CULVERT	3.14 CY	674	53	182	908	289.26
	CONCRETE		746	59	201	1,005	
11.1.4.E METALS							
11.1.4.E.1 REMOVE EXISTING GATE STRUCTURE							
	REMOVE EXISTING GATE STRUCTURE		460	36	124	620	
	METALS		460	36	124	620	
	ELINMINATE GATE STR & REPR LEVEE		89,652	7,036	24,172	120,860	
11.1.5 REPAIR 60' OF LEVEE & ADD RIPRAP							
11.1.5.B SITE WORK							
11.1.5.B.1 CLEAR AND GRUB							
	CLEAR AND GRUB		270	21	73	364	
11.1.5.B.3 EXC, PL, COMPACT & GRADE FILL							
11.1.5.B.3.1	EXCAVATE AND PLACE FILL MATERIAL	150.00 CY	260	20	70	350	2.34
11.1.5.B.3.2	INSTALL GEOTEXTILE MATERIAL	222.00 SY	526	41	142	709	3.19
11.1.5.B.3.3	SPREAD AND SHAPE TO GRADE	150.00 CY	109	9	29	146	0.98
11.1.5.B.3.4	COMPACTION	150.00 CY	70	6	19	95	0.63
11.1.5.B.3.5	CHECK GRADE	150.00 CY	9	1	2	12	0.08
	EXC, PL, COMPACT & GRADE FILL	150.00 CY	974	76	263	1,313	8.75
11.1.5.B.4 HAUL RIPRAP FROM QUARRY TO SITE							
	HAUL RIPRAP FROM QUARRY TO SITE	530.00 TON	11,714	919	3,158	15,792	29.80

		QUANTY UOM	CONTRACT	ESCALATN	CONTNGCY	TOTAL COST	UNIT
11.1.5.B.5	PLACE QUARRY RUN STONE						
	PLACE QUARRY RUN STONE	530.00 TON	3,360	264	906	4,530	8.55
11.1.5.B.7	ESTABLISH TURF ON LEVEE CROWN						
11.1.5.B.7.1	Replace Top Soil	24.00 CY	252	20	68	340	14.15
11.1.5.B.7.2	Prepare Seed Bed	1307.00 SF	134	10	36	180	0.14
11.1.5.B.7.3	Seeding and Fertilizer	145.00 SY	23	2	6	31	0.22
	ESTABLISH TURF ON LEVEE CROWN		409	32	110	551	
	SITE WORK		16,727	1,313	4,510	22,550	
11.1.5.C	CONCRETE SPILLWAY WORK						
11.1.5.C.1	PREPARE SURFACE AREA TO RECEIVE						
	PREPARE SURFACE AREA TO RECEIVE	350.00 SF	181	14	49	243	0.70
11.1.5.C.2	PLACE FORMS FOR CONCRETE SPILLWY						
	PLACE FORMS FOR CONCRETE SPILLWY	160.00 LF	148	12	40	199	1.25
11.1.5.C.3	PLACE WWF (W6 X 6) IN SPILLWAY						
	PLACE WWF (W6 X 6) IN SPILLWAY	350.00 SF	129	10	35	173	0.50
11.1.5.C.4	PLACE CONCRETE IN SPILLWAY						
	PLACE CONCRETE IN SPILLWAY	3.06 CY	357	28	96	481	157.19
11.1.5.C.5	FINISH CONCRETE IN SPILLWAY						
	FINISH CONCRETE IN SPILLWAY	350.00 SF	87	7	23	117	0.33

		QUANTY	UOM	CONTRACT	ESCALATN	CONTNGCY	TOTAL COST	UNIT
11.1.5.C.6	CURE CONCRETE IN SPILLWAY							
	CURE CONCRETE IN SPILLWAY	3.50	CSF	15	1	4	20	5.81
	CONCRETE SPILLWAY WORK	3.06	CY	916	72	247	1,235	403.48
	REPAIR 60' OF LEVEE & ADD RIPRAP			17,643	1,385	4,757	23,784	
11.1.6	CONST 1500 LF OF LEVEE							
11.1.6.B	CONST 1500 LF OF LEVEE							
11.1.6.B.1	CLEAR AND GRUB							
	CLEAR AND GRUB	1.44	ACR	5,548	435	1,496	7,479	5193.61
11.1.6.B.3	CONST 1500 LF OF LEVEE							
11.1.6.B.3.1	Exc, Haul & Place fill	4400.00	CY	7,625	598	2,056	10,280	2.34
11.1.6.B.3.2	Apply Geotextile Material	6500.00	SY	15,309	1,201	4,128	20,638	3.18
11.1.6.B.3.3	Spread, and Shape to Grade	4400.00	CY	3,186	250	859	4,295	0.98
11.1.6.B.3.4	Compaction	4400.00	CY	2,063	162	556	2,781	0.63
11.1.6.B.3.5	Check Grade	4400.00	CY	263	21	71	355	0.08
	CONST 1500 LF OF LEVEE			28,446	2,232	7,670	38,348	
11.1.6.B.5	ESTABLISH TURF							
11.1.6.B.5.1	Replace and Spread Top Soil	1162.00	CY	923	72	249	1,244	1.07
11.1.6.B.5.2	Prepare Seed Bed	62726	SF	172	14	46	232	0.00
11.1.6.B.5.3	Seeding and Fertilizing	6970.00	SY	948	74	256	1,278	0.18
	ESTABLISH TURF	1.44	ACR	2,043	160	551	2,755	1913.03
	CONST 1500 LF OF LEVEE			36,037	2,828	9,716	48,582	
	CONST 1500 LF OF LEVEE			36,037	2,828	9,716	48,582	
	LEVEES			159,887	12,547	43,109	215,543	
	LEVEES AND FLOODWALLS			159,887	12,547	43,109	215,543	

	QUANTY	UOM	CONTRACT	ESCALATN	CONTNGCY	TOTAL COST	UNIT
30 ENGINEERING AND DESIGN							
30.B ENGRG & DESIGN PRIOR TO 03-28-91							
30.B.2 ENGR SUPERVISION & REVIEW							
ENGR SUPERVISION & REVIEW	25.00	MHR	1,250	0	0	1,250	50.00
30.B.4 DESIGN BY THIS DISTRICT							
DESIGN BY THIS DISTRICT	200.00	MHR	10,000	0	0	10,000	50.00
30.B.7 RECONN & DETAIL PROJECT REPORTS							
RECONN & DETAIL PROJECT REPORTS	40.00	MRS	2,000	0	0	2,000	50.00
ENGRG & DESIGN PRIOR TO 03-28-91			13,250	0	0	13,250	
30.H PLANS AND SPECIFICATIONS							
30.H.L BIDABILITY, CONSTRUCTIBILITY AND							
BIDABILITY, CONSTRUCTIBILITY AND	40.00	MHR	2,000	0	0	2,000	50.00
PLANS AND SPECIFICATIONS			2,000	0	0	2,000	
30.J ENGINEERING DURING CONSTRUCTION							
30.J.1 AE CONTR AWARD/ADMINISTRATION							
AE CONTR AWARD/ADMINISTRATION	8.00	MHR	400	0	0	400	50.00
30.J.3 VALUE ENGRG CH PROPOSALS (VECP)							
VALUE ENGRG CH PROPOSALS (VECP)	8.00	MHR	400	0	0	400	50.00
30.J.5 PERIODIC INSPECTIONS							

	QUANTY	UOM	CONTRACT	ESCALATN	CONTNGCY	TOTAL COST	UNIT
PERIODIC INSPECTIONS	40.00	MHR	2,400	0	0	2,400	60.00
ENGINEERING DURING CONSTRUCTION			3,200	0	0	3,200	
30.M COST ENGINEERING							
COST ENGINEERING	80.00	MHR	4,000	0	0	4,000	50.00
30.N CONST & SUPPLY CONTR AWARD ACTV							
30.N.1 PREPARATION OF BID DOCUMENTS							
PREPARATION OF BID DOCUMENTS	16.00	MHR	800	0	0	800	50.00
30.N.2 CONTRACT NEGOTIATIONS							
CONTRACT NEGOTIATIONS	8.00	MHR	400	0	0	400	50.00
30.N.3 CONTRACTING OFFICE ACTIVITIES							
CONTRACTING OFFICE ACTIVITIES	24.00	MHR	1,200	0	0	1,200	50.00
CONST & SUPPLY CONTR AWARD ACTV			2,400	0	0	2,400	
30.T PED PHASE LCPM							
PED PHASE LCPM	96.00	MHR	4,800	0	0	4,800	50.00
ENGINEERING AND DESIGN			29,650	0	0	29,650	
31 SUPERVISION AND ADMINISTRATION							
31.B CONTRACT ADMINISTRATION							
31.B.1 PRE-AWARD ACTIVITIES							
PRE-AWARD ACTIVITIES			500	0	0	500	
31.B.5 PROGRESS AND COMPLETION REPORTS							

	QUANTY	UOM	CONTRACT	ESCALATN	CONTNGCY	TOTAL COST	UNIT
PROGRESS AND COMPLETION REPORTS			1,200	0	0	1,200	
CONTRACT ADMINISTRATION			1,700	0	0	1,700	
31.C BENCH MARKS AND BASELINES							
BENCH MARKS AND BASELINES			800	0	0	800	
31.D REVIEW OF SHOP DRAWINGS							
REVIEW OF SHOP DRAWINGS			1,700	0	0	1,700	
31.E INSPECTION AND QUALITY ASSURANCE							
31.E.1 SCHEDULE COMPLIANCE							
SCHEDULE COMPLIANCE			1,800	0	0	1,800	
31.E.2 COMPLIANCE SAMPLING AND TESTING							
COMPLIANCE SAMPLING AND TESTING			4,500	0	0	4,500	
INSPECTION AND QUALITY ASSURANCE			6,300	0	0	6,300	
31.F PROJECT OFFICE OPERATION							
PROJECT OFFICE OPERATION			3,200	0	0	3,200	
31.H CONTR INIT CLAIMS & LITIGATIONS							
CONTR INIT CLAIMS & LITIGATIONS			800	0	0	800	
31.T CONSTRUCTION PHASE LCPM							
CONSTRUCTION PHASE LCPM			1,700	0	0	1,700	
SUPERVISION AND ADMINISTRATION			16,200	0	0	16,200	
WHITE RIVER NATIONAL WILDLIFE			205,737	12,547	43,109	261,393	

** PROJECT DIRECT SUMMARY - LEVEL 1 **

	QUANTITY	UOM	CREW ID	OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST
11 LEVEES AND FLOODWALLS					4,089	45,667	68,854	45,366	159,887	
30 ENGINEERING AND DESIGN					56	29,250	400	0	29,650	
31 SUPERVISION AND ADMINISTRATI					305	15,250	685	265	16,200	
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WHITE RIVER NATIONAL WILDLIF					4,450	90,167	69,939	45,631	205,737	
ESCALATN									12,547	

SUBTOTAL									218,285	
CONTNGCY									43,109	

TOTAL INCL OWNER COSTS									261,393	

	QUANTITY UOM	CREW ID	OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST
11 LEVEES AND FLOODWALLS									
11.1 LEVEES									
11.1.1 MOBILIZATION AND DEMOBIL									
11.1.1.1 LOAD AND UNLOAD EQUIPM									
LOAD AND UNLOAD EQ	10.00 PCS			22	281	354	0	635	63.54
11.1.1.2 TRANSPORT EQUIPMENT (M									
TRANSPORT EQUIPMEN	80.00 HRS			80	851	3,864	0	4,715	58.94
11.1.1.3 MOB & DEMOB EQPMT TO B									
MOB & DEMOB EQPMT	8.00 HRS			32	321	422	0	743	92.89
MOBILIZATION AND D				134	1,453	4,641	0	6,094	
11.1.2 REPAIR 60" SLUICE GATES									
11.1.2.B METALS									
11.1.2.B.1 REMOVE EXISTING 60"									
REMOVE EXISTING 60	2.00 EA			32	392	528	0	919	459.71
11.1.2.B.3 CLEAN AND PAINT GATE									
CLEAN AND PAINT GA	2.00 EA			32	392	528	64	984	491.79
11.1.2.B.5 ADJUST EXISTING GATE									
ADJUST EXISTING GA	2.00 EA			32	392	122	0	514	256.78

	QUANTITY	UOM	CREW ID	OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST
11.1.2.B.7 INSTALL 60" SLUICE G										
INSTALL 60" SLUICE	2.00	EA			16	196	264	0	460	229.86
11.1.2.B.8 REPAIR SPALLED CONCR										
REPAIR SPALLED CON					4	49	17	32	98	
11.1.2.B.9 METAL WORK FOR IN-OP										
METAL WORK FOR IN-					16	196	82	394	672	
METALS					132	1,616	1,540	490	3,646	
REPAIR 60" SLUICE					132	1,616	1,540	490	3,646	
11.1.3 REPLACE 36" SLIDE GATE										
11.1.3.B METAL WORK										
11.1.3.B.1 Rem Ext 36" Slide Ga										
Rem Ext 36" Slide					32	395	532	0	927	
11.1.3.B.3 Install New 36" Slid										
Install New 36" Sl					16	196	264	5,428	5,888	
METAL WORK					48	591	796	5,428	6,815	
REPLACE 36" SLIDE					48	591	796	5,428	6,815	
11.1.4 ELINMINATE GATE STR & RE										
11.1.4.B SITE WORK										

		QUANTITY	UOM	CREW ID	OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST
11.1.4.B.1	CLEAR AND GRUB										
	CLEAR AND GRUB					31	350	960	0	1,310	
11.1.4.B.2	EXC, PL, COMPACT & G										
11.1.4.B.2.1	EXCAVATE AND PLACE	2625.00	CY			86	1,104	3,446	0	4,549	1.73
11.1.4.B.2.2	INSTALL GEOTEXTILE	3878.00	SY			4	42	11	8,708	8,762	2.26
11.1.4.B.2.3	SPREAD AND SHAPE T	2625.00	CY			48	729	1,172	0	1,901	0.72
11.1.4.B.2.4	COMPACTION	2625.00	CY			48	695	535	0	1,231	0.47
11.1.4.B.2.5	CHECK GRADE	2625.00	CY			10	100	57	0	157	0.06
	EXC, PL, COMPACT &	2625.00	CY			195	2,669	5,222	8,708	16,599	6.32
11.1.4.B.4	HAUL & DUMP RIPRAP O										
	HAUL & DUMP RIPRAP	2470.00	TON			1,213	12,899	29,967	11,727	54,593	22.10
11.1.4.B.5	PLACE RIPRAP ON SLOP										
	PLACE RIPRAP ON SL	2470.00	TON			1,115	11,970	3,691	0	15,661	6.34
11.1.4.B.9	ESTABLISH TURF ON TO										
11.1.4.B.9.1	Replace Top Soil	17.00	CY			16	151	28	0	178	10.49
11.1.4.B.9.2	Till or Prepare Se	871.00	SF			8	75	14	0	89	0.10
11.1.4.B.9.3	Seed and Fertilize	97.00	SY			1	5	1	10	16	0.16
	ESTABLISH TURF ON	871.00	SF			24	231	42	10	283	0.32
	SITE WORK					2,579	28,119	39,882	20,446	88,447	
11.1.4.C	CONCRETE										
11.1.4.C.1	PREPARE CULVERT TO R										
	PREPARE CULVERT TO					4	49	23	0	72	

		QUANTITY	UOM	CREW ID	OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST
11.1.4.C.3	PLACE CONC PLUG IN C										
	PLACE CONC PLUG IN	3.14	CY			25	308	145	222	674	214.57
	CONCRETE					29	357	168	222	746	
11.1.4.E	METALS										
11.1.4.E.1	REMOVE EXISTING GATE										
	REMOVE EXISTING GA					16	196	264	0	460	
	METALS					16	196	264	0	460	
	ELINMINATE GATE ST					2,624	28,671	40,314	20,667	89,652	
11.1.5	REPAIR 60' OF LEVEE & AD										
11.1.5.B	SITE WORK										
11.1.5.B.1	CLEAR AND GRUB										
	CLEAR AND GRUB					6	72	198	0	270	
11.1.5.B.3	EXC, PL, COMPACT & G										
11.1.5.B.3.1	EXCAVATE AND PLACE	150.00	CY			5	63	197	0	260	1.73
11.1.5.B.3.2	INSTALL GEOTEXTILE	222.00	SY			2	22	6	499	526	2.37
11.1.5.B.3.3	SPREAD AND SHAPE T	150.00	CY			3	42	67	0	109	0.72
11.1.5.B.3.4	COMPACTION	150.00	CY			3	40	31	0	70	0.47
11.1.5.B.3.5	CHECK GRADE	150.00	CY			1	6	3	0	9	0.06
	EXC, PL, COMPACT &	150.00	CY			13	172	304	499	974	6.49
11.1.5.B.4	HAUL RIPRAP FROM QUA										
	HAUL RIPRAP FROM Q	530.00	TON			260	2,768	6,430	2,516	11,714	22.10

		QUANTITY	UOM	CREW ID	OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST
11.1.5.B.5	PLACE QUARRY RUN STO										
	PLACE QUARRY RUN S	530.00	TON			239	2,569	792	0	3,360	6.34
11.1.5.B.7	ESTABLISH TURF ON LE										
11.1.5.B.7.1	Replace Top Soil	24.00	CY			23	213	39	0	252	10.49
11.1.5.B.7.2	Prepare Seed Bed	1307.00	SF			12	113	21	0	134	0.10
11.1.5.B.7.3	Seeding and Fertil	145.00	SY			1	7	1	15	23	0.16
	ESTABLISH TURF ON					35	333	61	15	409	
	SITE WORK					554	5,913	7,785	3,030	16,727	
11.1.5.C	CONCRETE SPILLWAY WORK										
11.1.5.C.1	PREPARE SURFACE AREA										
	PREPARE SURFACE AR	350.00	SF			17	161	20	0	181	0.52
11.1.5.C.2	PLACE FORMS FOR CONC										
	PLACE FORMS FOR CO	160.00	LF			4	52	9	87	148	0.92
11.1.5.C.3	PLACE WWF (W6 X 6) I										
	PLACE WWF (W6 X 6)	350.00	SF			4	49	12	67	129	0.37
11.1.5.C.4	PLACE CONCRETE IN SP										
	PLACE CONCRETE IN	3.06	CY			10	115	26	216	357	116.60
11.1.5.C.5	FINISH CONCRETE IN S										
	FINISH CONCRETE IN	350.00	SF			5	70	17	0	87	0.25

		QUANTITY	UOM	CREW ID	OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST
11.1.5.C.6	CURE CONCRETE IN SPI										
	CURE CONCRETE IN S	3.50	CSF			1	6	1	9	15	4.31
	CONCRETE SPILLWAY	3.06	CY			41	454	84	378	916	299.30
	REPAIR 60' OF LEVE					595	6,366	7,869	3,408	17,643	
11.1.6	CONST 1500 LF OF LEVEE										
11.1.6.B	CONST 1500 LF OF LEVEE										
11.1.6.B.1	CLEAR AND GRUB										
	CLEAR AND GRUB	1.44	ACR			131	1,483	4,065	0	5,548	3852.56
11.1.6.B.3	CONST 1500 LF OF LEV										
11.1.6.B.3.1	Exc, Haul & Place	4400.00	CY			144	1,850	5,776	0	7,625	1.73
11.1.6.B.3.2	Apply Geotextile M	6500.00	SY			59	559	153	14,596	15,309	2.36
11.1.6.B.3.3	Spread, and Shape	4400.00	CY			80	1,222	1,964	0	3,186	0.72
11.1.6.B.3.4	Compaction	4400.00	CY			80	1,165	897	0	2,063	0.47
11.1.6.B.3.5	Check Grade	4400.00	CY			16	168	96	0	263	0.06
	CONST 1500 LF OF L					379	4,963	8,887	14,596	28,446	
11.1.6.B.5	ESTABLISH TURF										
11.1.6.B.5.1	Replace and Spread	1162.00	CY			17	224	699	0	923	0.79
11.1.6.B.5.2	Prepare Seed Bed	62726.00	SF			14	150	22	0	172	0.00
11.1.6.B.5.3	Seeding and Fertil	6970.00	SY			14	150	22	776	948	0.14
	ESTABLISH TURF	1.44	ACR			46	524	743	776	2,043	1419.06
	CONST 1500 LF OF L					556	6,970	13,695	15,373	36,037	
	CONST 1500 LF OF L					556	6,970	13,695	15,373	36,037	
	LEVEES					4,089	45,667	68,854	45,366	159,887	
	LEVEES AND FLOODWA					4,089	45,667	68,854	45,366	159,887	

	QUANTITY	UOM	CREW ID	OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST
30 ENGINEERING AND DESIGN										
30.B ENGRG & DESIGN PRIOR TO 03										
30.B.2 ENGR SUPERVISION & REVIE										
ENGR SUPERVISION &	25.00	MHR			0	1,250	0	0	1,250	50.00
30.B.4 DESIGN BY THIS DISTRICT										
DESIGN BY THIS DIS	200.00	MHR			0	10,000	0	0	10,000	50.00
30.B.7 RECONN & DETAIL PROJECT										
RECONN & DETAIL PR	40.00	MRS			0	2,000	0	0	2,000	50.00
ENGRG & DESIGN PRI					0	13,250	0	0	13,250	
30.H PLANS AND SPECIFICATIONS										
30.H.L BIDABILITY, CONSTRUCTIBI										
BIDABILITY, CONSTR	40.00	MHR			0	2,000	0	0	2,000	50.00
PLANS AND SPECIFIC					0	2,000	0	0	2,000	
30.J ENGINEERING DURING CONSTRU										
30.J.1 AE CONTR AWARD/ADMINISTR										
AE CONTR AWARD/ADM	8.00	MHR			8	400	0	0	400	50.00
30.J.3 VALUE ENGRG CH PROPOSALS										
VALUE ENGRG CH PRO	8.00	MHR			8	400	0	0	400	50.00
30.J.5 PERIODIC INSPECTIONS										

	QUANTITY	UOM	CREW ID	OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST
PERIODIC INSPECTIO	40.00	MHR			40	2,000	400	0	2,400	60.00
ENGINEERING DURING					56	2,800	400	0	3,200	
30.M COST ENGINEERING										
COST ENGINEERING	80.00	MHR			0	4,000	0	0	4,000	50.00
30.N CONST & SUPPLY CONTR AWARD										
30.N.1 PREPARATION OF BID DOCUM										
PREPARATION OF BID	16.00	MHR			0	800	0	0	800	50.00
30.N.2 CONTRACT NEGOTIATIONS										
CONTRACT NEGOTIATI	8.00	MHR			0	400	0	0	400	50.00
30.N.3 CONTRACTING OFFICE ACTIV										
CONTRACTING OFFICE	24.00	MHR			0	1,200	0	0	1,200	50.00
CONST & SUPPLY CON					0	2,400	0	0	2,400	
30.T PED PHASE LCPM										
PED PHASE LCPM	96.00	MHR			0	4,800	0	0	4,800	50.00
ENGINEERING AND DE					56	29,250	400	0	29,650	
31 SUPERVISION AND ADMINISTRATI										
31.B CONTRACT ADMINISTRATION										
31.B.1 PRE-AWARD ACTIVITIES										
PRE-AWARD ACTIVITI					10	500	0	0	500	
31.B.5 PROGRESS AND COMPLETION										

	QUANTITY	UOM	CREW ID	OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST
PERIODIC INSPECTIO	40.00	MHR			40	2,000	400	0	2,400	60.00
ENGINEERING DURING					56	2,800	400	0	3,200	
30.M COST ENGINEERING										
COST ENGINEERING	80.00	MHR			0	4,000	0	0	4,000	50.00
30.N CONST & SUPPLY CONTR AWARD										
30.N.1 PREPARATION OF BID DOCUM										
PREPARATION OF BID	16.00	MHR			0	800	0	0	800	50.00
30.N.2 CONTRACT NEGOTIATIONS										
CONTRACT NEGOTIATI	8.00	MHR			0	400	0	0	400	50.00
30.N.3 CONTRACTING OFFICE ACTIV										
CONTRACTING OFFICE	24.00	MHR			0	1,200	0	0	1,200	50.00
CONST & SUPPLY CON					0	2,400	0	0	2,400	
30.T PED PHASE LCPM										
PED PHASE LCPM	96.00	MHR			0	4,800	0	0	4,800	50.00
ENGINEERING AND DE					56	29,250	400	0	29,650	
31 SUPERVISION AND ADMINISTRATI										
31.B CONTRACT ADMINISTRATION										
31.B.1 PRE-AWARD ACTIVITIES										
PRE-AWARD ACTIVITI					10	500	0	0	500	
31.B.5 PROGRESS AND COMPLETION										

	QUANTITY	UOM	CREW ID	OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST
PROGRESS AND COMPL					24	1,200	0	0	1,200	
CONTRACT ADMINISTR					34	1,700	0	0	1,700	
31.C BENCH MARKS AND BASELINES										
BENCH MARKS AND BA					15	750	35	15	800	
31.D REVIEW OF SHOP DRAWINGS										
REVIEW OF SHOP DRA					34	1,700	0	0	1,700	
31.E INSPECTION AND QUALITY ASS										
31.E.1 SCHEDULE COMPLIANCE										
SCHEDULE COMPLIANC					36	1,800	0	0	1,800	
31.E.2 COMPLIANCE SAMPLING AND										
COMPLIANCE SAMPLIN					80	4,000	450	50	4,500	
INSPECTION AND QUA					116	5,800	450	50	6,300	
31.F PROJECT OFFICE OPERATION										
PROJECT OFFICE OPE					56	2,800	200	200	3,200	
31.H CONTR INIT CLAIMS & LITIGA										
CONTR INIT CLAIMS					16	800	0	0	800	
31.T CONSTRUCTION PHASE LCPM										
CONSTRUCTION PHASE					34	1,700	0	0	1,700	
SUPERVISION AND AD					305	15,250	685	265	16,200	
WHITE RIVER NATION					4,450	90,167	69,939	45,631	205,737	

	QUANTITY	UOM	CREW ID	OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST
ESCALATN									12,547	
SUBTOTAL									218,285	
CONTNGCY									43,109	
TOTAL INCL OWNER COSTS									261,393	

	QUANTY UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
11. LEVEES AND FLOODWALLS								
A PRIME CONTRACTOR		124,600	12,460	6,853	14,391	1,583	159,887	
30. ENGINEERING AND DESIGN								
NOT IDENTIFIED								
31. SUPERVISION AND ADMINISTRATION								
NOT IDENTIFIED								

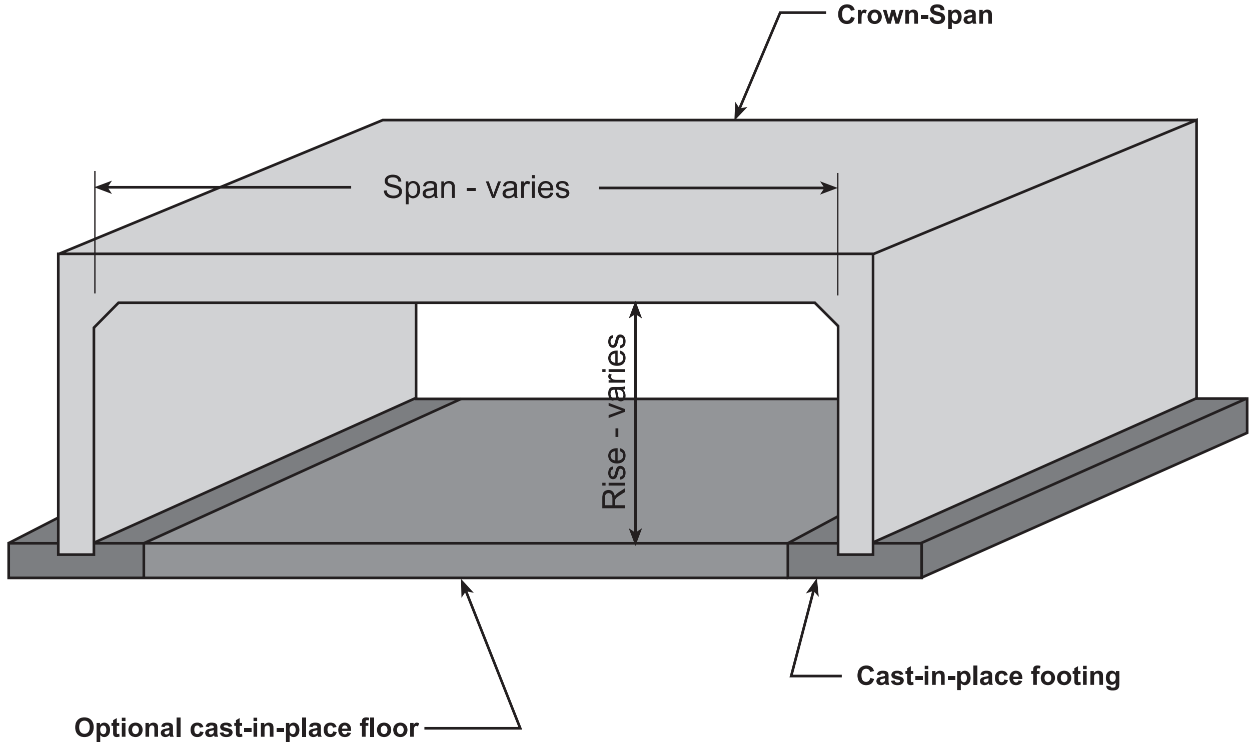
	QUANTY UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
11.1.4.B.2.1. EXCAVATE AND PLACE NEW FILL MAT								
A PRIME CONTRACTOR		3,545	355	195	409	45	4,549	
11.1.4.B.2.2. INSTALL GEOTEXTILE MATERIAL								
A PRIME CONTRACTOR		6,828	683	376	789	87	8,762	
11.1.4.B.2.3. SPREAD AND SHAPE TO GRADE								
A PRIME CONTRACTOR		1,481	148	81	171	19	1,901	
11.1.4.B.2.4. COMPACTION								
A PRIME CONTRACTOR		959	96	53	111	12	1,231	
11.1.4.B.2.5. CHECK GRADE								
A PRIME CONTRACTOR		122	12	7	14	2	157	
11.1.4.B.9.1. Replace Top Soil								
A PRIME CONTRACTOR		139	14	8	16	2	178	
11.1.4.B.9.2. Till or Prepare Seedbed								
A PRIME CONTRACTOR		69	7	4	8	1	89	
11.1.4.B.9.3. Seed and Fertilize								
A PRIME CONTRACTOR		12	1	1	1	0	16	
11.1.5.B.3.1. EXCAVATE AND PLACE FILL MATERIAL								
A PRIME CONTRACTOR		203	20	11	23	3	260	
11.1.5.B.3.2. INSTALL GEOTEXTILE MATERIAL								
A PRIME CONTRACTOR		410	41	23	47	5	526	
11.1.5.B.3.3. SPREAD AND SHAPE TO GRADE								
A PRIME CONTRACTOR		85	8	5	10	1	109	
11.1.5.B.3.4. COMPACTION								
A PRIME CONTRACTOR		55	5	3	6	1	70	
11.1.5.B.3.5. CHECK GRADE								
A PRIME CONTRACTOR		7	1	0	1	0	9	
11.1.5.B.7.1. Replace Top Soil								
A PRIME CONTRACTOR		196	20	11	23	2	252	
11.1.5.B.7.2. Prepare Seed Bed								
A PRIME CONTRACTOR		104	10	6	12	1	134	
11.1.5.B.7.3. Seeding and Fertilizer								
A PRIME CONTRACTOR		18	2	1	2	0	23	
11.1.6.B.3.1. Exc, Haul & Place fill								

	QUANTY UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
A PRIME CONTRACTOR		5,942	594	327	686	75	7,625	
11.1.6.B.3.2. Apply Geotextile Material								
A PRIME CONTRACTOR		11,930	1,193	656	1,378	152	15,309	
11.1.6.B.3.3. Spread, and Shape to Grade								
A PRIME CONTRACTOR		2,483	248	137	287	32	3,186	
11.1.6.B.3.4. Compaction								
A PRIME CONTRACTOR		1,607	161	88	186	20	2,063	
11.1.6.B.3.5. Check Grade								
A PRIME CONTRACTOR		205	21	11	24	3	263	
11.1.6.B.5.1. Replace and Spread Top Soil								
A PRIME CONTRACTOR		719	72	40	83	9	923	
11.1.6.B.5.2. Prepare Seed Bed								
A PRIME CONTRACTOR		134	13	7	15	2	172	
11.1.6.B.5.3. Seeding and Fertilizing								
A PRIME CONTRACTOR		739	74	41	85	9	948	

ATTACHMENT D

Referenced Drawings

Crown-Span



Forterra's Crown-Span units are rectangular three-sided reinforced concrete structures designed to be installed on cast-in-place concrete footings. Crown-Span units are produced with spans from 16 to 40 feet for prestressed units and 16 to 20 feet for non-prestressed. Risers are available up to 12 feet. Installations can be single or multiple cells. The units can be skewed up to 43 degrees to accommodate streambed alignment.

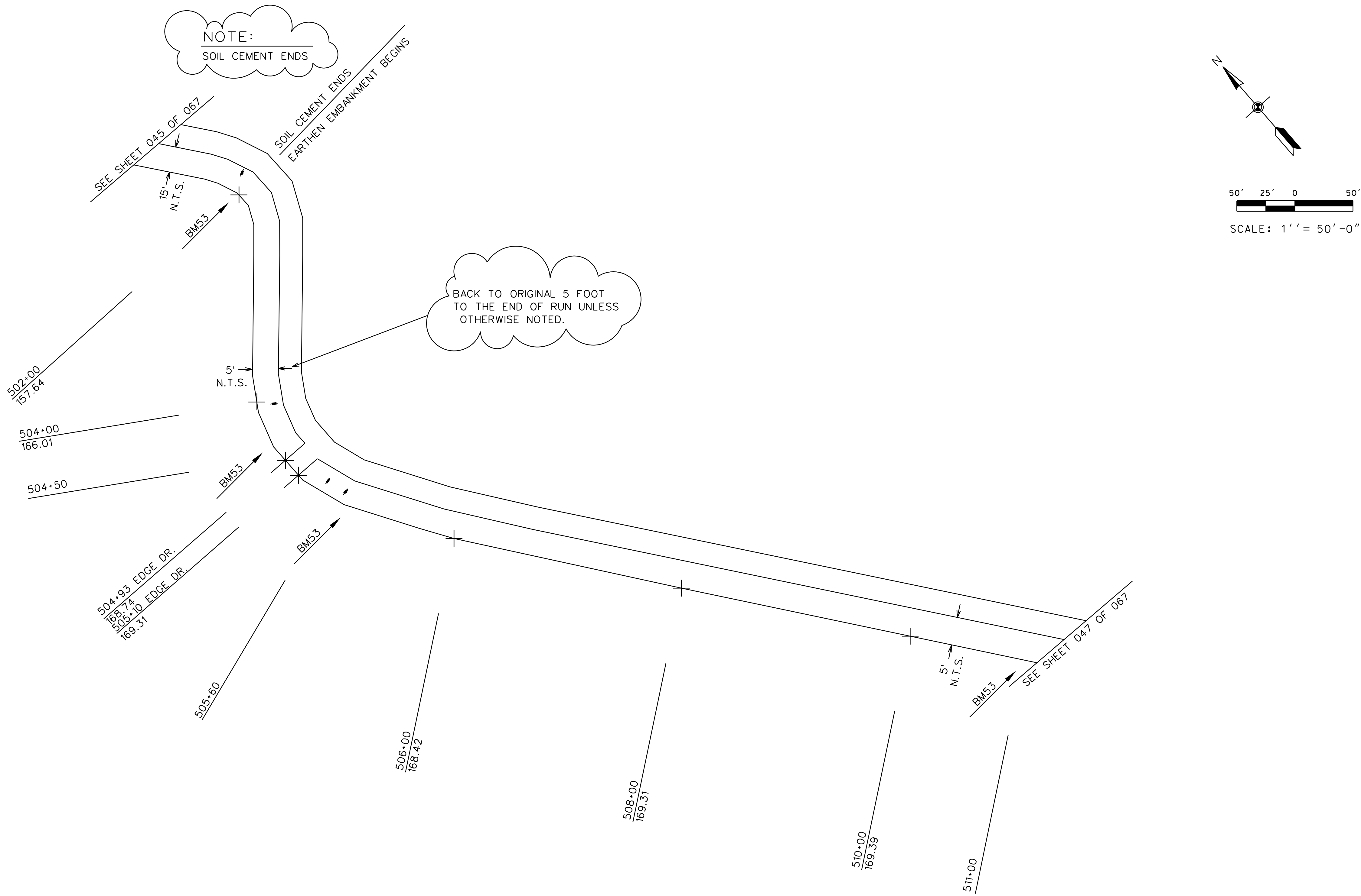
Crown-Span units are recommended where natural stream bottoms are desired, wetlands must be spanned, the span is longer than can be accommodated with a precast box culvert and when cost and time of construction are critical.

Forterra's engineers design the cast-in-place footings based on soil bearing data provided by the owner. The precast sections are designed for each specific application according to AASHTO2 Standard Specifications for Highway Bridges.

Typical applications include new or replacement highway bridges, storm drains, stormwater management structures, culverts, culvert extensions and utility or pedestrian tunnels.

Connections are provided for attaching guard rails, parapets and wing walls. Individual sections are typically eight feet long and are butted against adjacent units. The joints are sealed with an external wrapper.

Forterra's Crown-Span units have been used successfully for over a decade by state DOT's, municipalities and private developers.



CONTRACTOR TO LOCATE ALL BURIED
UTILITIES PRIOR TO CONSTRUCTION

POLE / PED * OR HAND-HOLE	POLE H / C	POLE OWN	BD	CABLE & WIRE	BG	BM	BHF	HBFO	HO	R	PF	PG	PM	W	SE	XX	XX	XZ	XX		REVISED BY/DATE
						53															
						4															
TOTAL						4															

US Army Corps of Engineers
Little Rock District

Symbol	Description	Date	Appr.

Date: NOV 2002
Solicitation No.: DACW03-03-B-0008
Contract No.:
Designed by: M&B
Drawn by: M&B
Reviewed by: M&B

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

MARTIN & BLACKWELL, LLC
TELECOMMUNICATIONS CONSULTANTS

Submitted by:
Chief, Mechanical/Electrical Section

MONTGOMERY POINT LOCK & DAM (MPLD)
DESHA & ARKANSAS COUNTIES, ARKANSAS
LOCK 2 TO MPLD FIBER OPTIC CABLE

STAKING SHEET 46 OF 67

Drawing Code/ Serial No.
10711-52/925

Drawing Ref. Number
V-046

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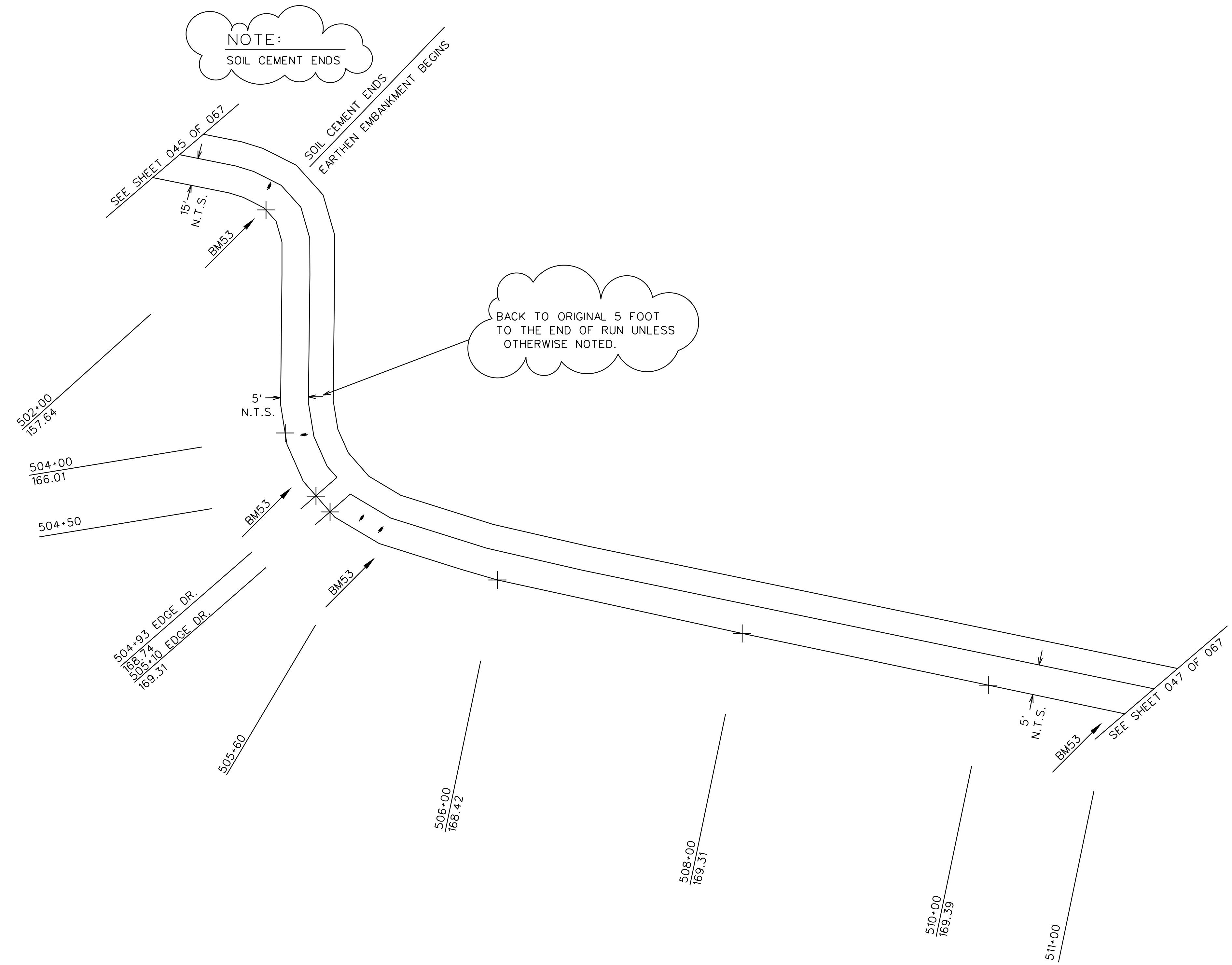

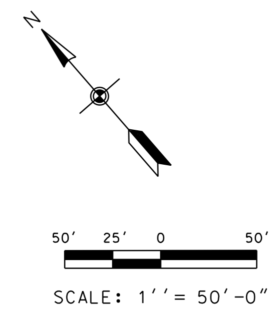

CONTRACTOR TO LOCATE ALL BURIED
UTILITIES PRIOR TO CONSTRUCTION

POLE / PED * OR HAND-HOLE	POLE H / C	POLE OWN	BD	CABLE & WIRE	BG	BM	BHF	HBFO	HO	R	PF	PG	PM	W	SE	XX	XX	XZ	XX	REVISED BY/DATE
						53														
						4														
TOTAL						4														

US Army Corps of Engineers
Little Rock District

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LOCK 2 TO MPLD FIBER OPTIC CABLE

STAKING SHEET 46 OF 67

Drawing Code/ Serial No.
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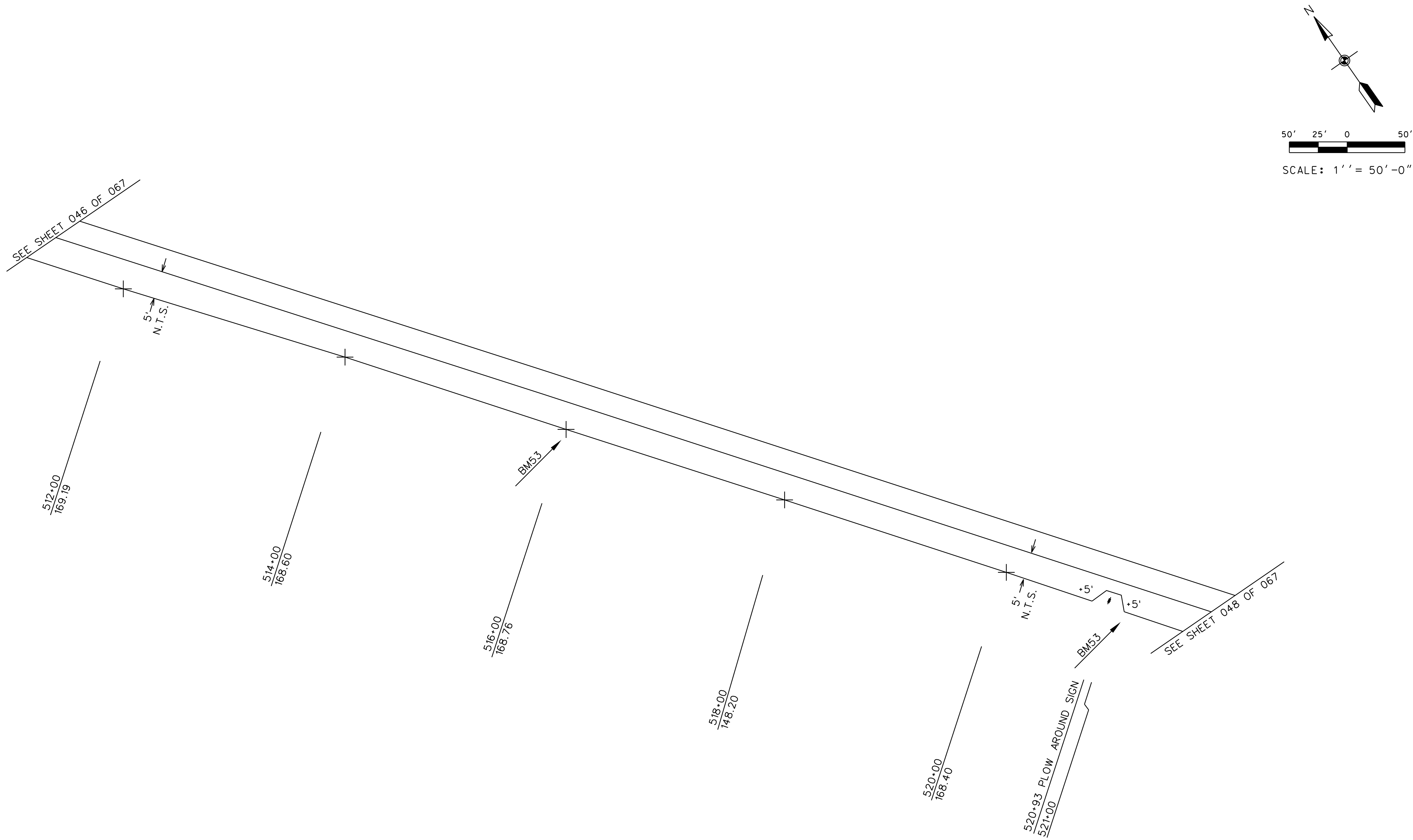
Drawing Ref. Number
V-046



CONTRACTOR TO LOCATE ALL BURIED UTILITIES PRIOR TO CONSTRUCTION

POLE / PED * OR HAND-HOLE	POLE H / C	POLE OWN	BD	CABLE & WIRE	BG	BM	BHF	HBFO	HO	R	PF	PG	PM	W	SE	XX	XX	XZ	XX		REVISED BY/DATE
						53															
						2															
TOTAL						2															

US Army Corps of Engineers
Little Rock District

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Date: NOV 2002
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Contract No.:
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Drawn by: M&B
Reviewed by: M&B

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

MARTIN & BLACKWELL, LLC
TELECOMMUNICATIONS CONSULTANTS

Submitted by:
Chief, Mechanical/Electrical Section

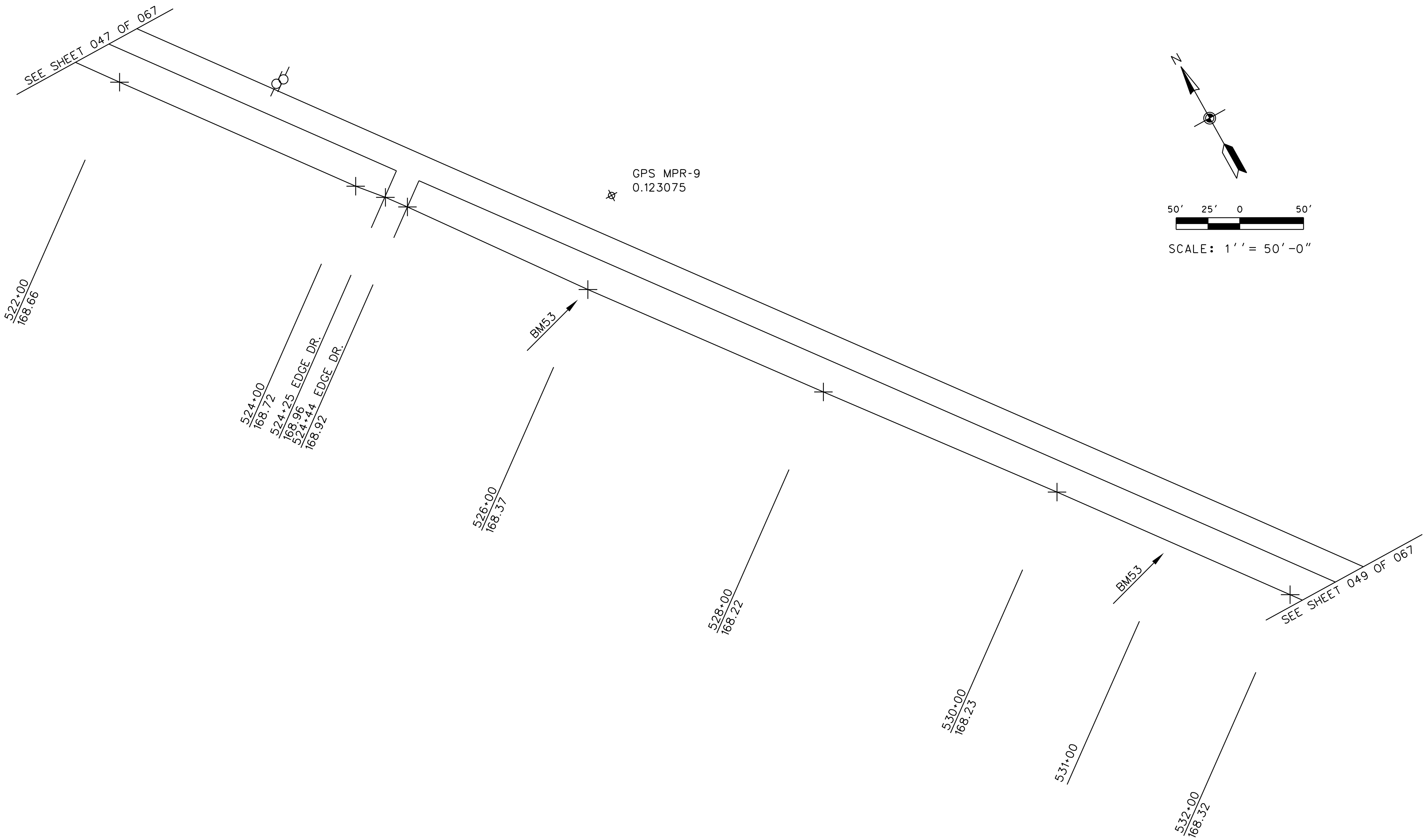
MONTGOMERY POINT LOCK & DAM (MPLD)
DESHA & ARKANSAS COUNTIES, ARKANSAS
LOCK 2 TO MPLD FIBER OPTIC CABLE

STAKING SHEET 47 OF 67

Drawing Code/ Serial No.
10711-52/926

Drawing Ref. Number
V-047

$$$$$USERNAME$$$$$ $$$$$$$$$$$$$DGN$SPEC$$$$$$$$$$$$$$$ $$$$$SYTIME$$$$$



CONTRACTOR TO LOCATE ALL BURIED UTILITIES PRIOR TO CONSTRUCTION

POLE / PED * OR HAND-HOLE	POLE (H / C)	POLE OWN	BD	CABLE & WIRE	BG	BM	BHF	HBFO	HO	R	PF	PG	PM	W	SE	XX	XX	XZ	XX		REVISED BY/DATE
						53															
						2															
TOTAL						2															

US Army Corps of Engineers
Little Rock District

Symbol	Description	Date	Appr.

Date: NOV 2002
Solicitation No.: DACW03-03-B-0008
Contract No.:
Designed by: M&B
Drawn by: M&B
Reviewed by: M&B

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

MARTIN & BLACKWELL, LLC
TELECOMMUNICATIONS CONSULTANTS

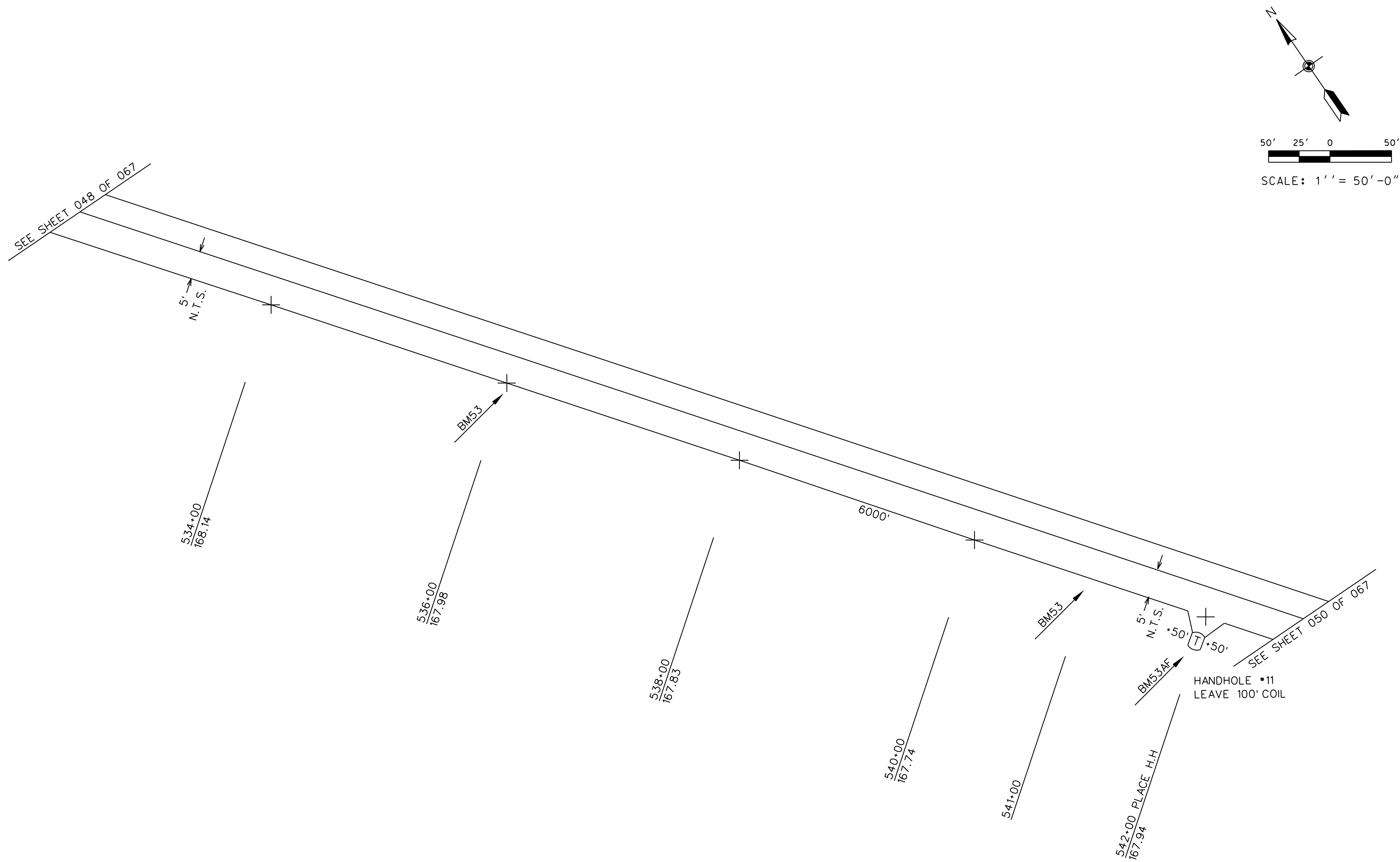
Submitted by:
Chief, Mechanical/Electrical Section

MONTGOMERY POINT LOCK & DAM (MPLD)
DESHA & ARKANSAS COUNTIES, ARKANSAS
LOCK 2 TO MPLD FIBER OPTIC CABLE

STAKING SHEET 48 OF 67

Drawing Code/ Serial No.
10711-52/927

Drawing Ref. Number
V-048



CONTRACTOR TO LOCATE ALL BURIED UTILITIES PRIOR TO CONSTRUCTION

POLE / PED # OR HAND-HOLE	POLE H / C	POLE OWN	BD	CABLE & WIRE	BG	BM 53	BM 2 (5/8) (8)	BM 53 AF	BHF (18x 24x 36)	HBFO (24)	HO	R	PF	PG	PM	W	SE	XX	XX	XZ	XX	REVISED BY/DATE
#11				BFO24 6000'		2	1	1	1	1												
TOTAL				6000'		2	1	1	1	1												

US Army Corps of Engineers
Little Rock District

Symbol	Description	Date	Appr.

Designed by: M&B	Date: NOV 2002
Drawn by: M&B	Solicitation No.: DACW03-03-B-0008
Reviewed by: M&B	Contract No.:

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

MARTIN & BLACKWELL, LLC
TELECOMMUNICATIONS CONSULTANTS

Submitted by:

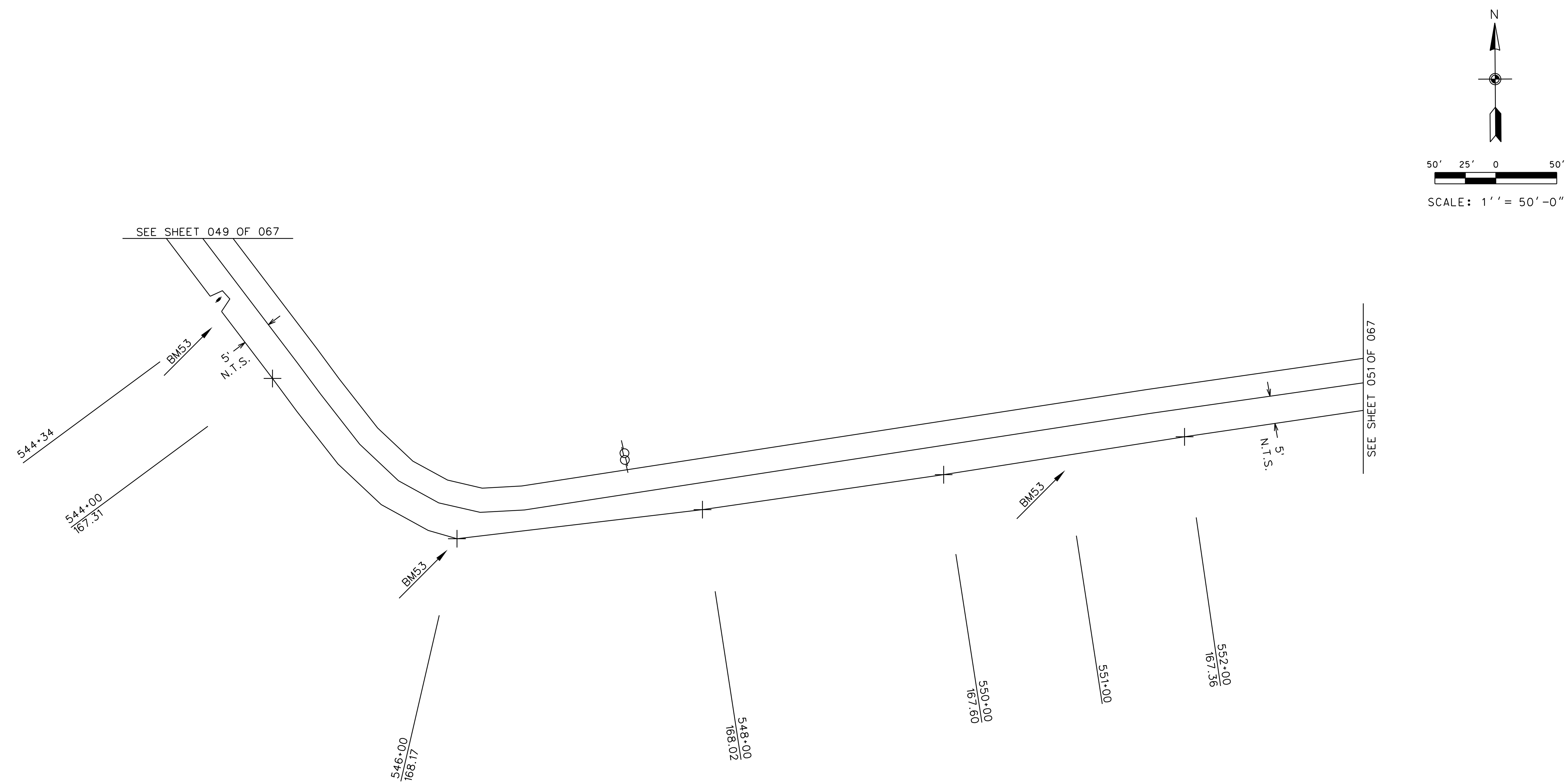
Chief, Mechanical/Electrical Section

MONTGOMERY POINT LOCK & DAM (MPLD)
DESHA & ARKANSAS COUNTIES, ARKANSAS
LOCK 2 TO MPLD FIBER OPTIC CABLE

STAKING SHEET 49 OF 67

Drawing Code/ Serial No.
10711-52/928

Drawing Ref. Number
V-049



CONTRACTOR TO LOCATE ALL BURIED UTILITIES PRIOR TO CONSTRUCTION

POLE / PED * OR HAND-HOLE	POLE H / C	POLE OWN	BD	CABLE & WIRE	BG	BM	BHF	HBFO	HO	R	PF	PG	PM	W	SE	XX	XX	XZ	XX	REVISED BY/DATE
						53														
						3														
TOTAL						3														

US Army Corps of Engineers
Little Rock District

Date: NOV 2002
Solicitation No.: DACW03-03-B-0008
Contract No.:
Designed by: M&B
Drawn by: M&B
Reviewed by: M&B

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

MARTIN & BLACKWELL, LLC
TELECOMMUNICATIONS CONSULTANTS

Submitted by:
Chief, Mechanical/Electrical Section

MONTGOMERY POINT LOCK & DAM (MPLD)
DESHA & ARKANSAS COUNTIES, ARKANSAS
LOCK 2 TO MPLD FIBER OPTIC CABLE

STAKING SHEET 50 OF 67

Drawing Code/ Serial No.
10711-52/929

Drawing Ref. Number
V-050

STAKING SHEET

NAME AR 21

PROJECT Montgomery Point

CONSTRUCTION
PRI. WIRE SIZE 350 KIND: MCM 25 KV DESIGN TENSION UG
PHASE 4Ø NO. WIRES 4 RULING SPAN: UG

RETIREMENT
PRI. WIRE SIZE ____ KIND: ____ PHASE ____ NO. WIRES ____

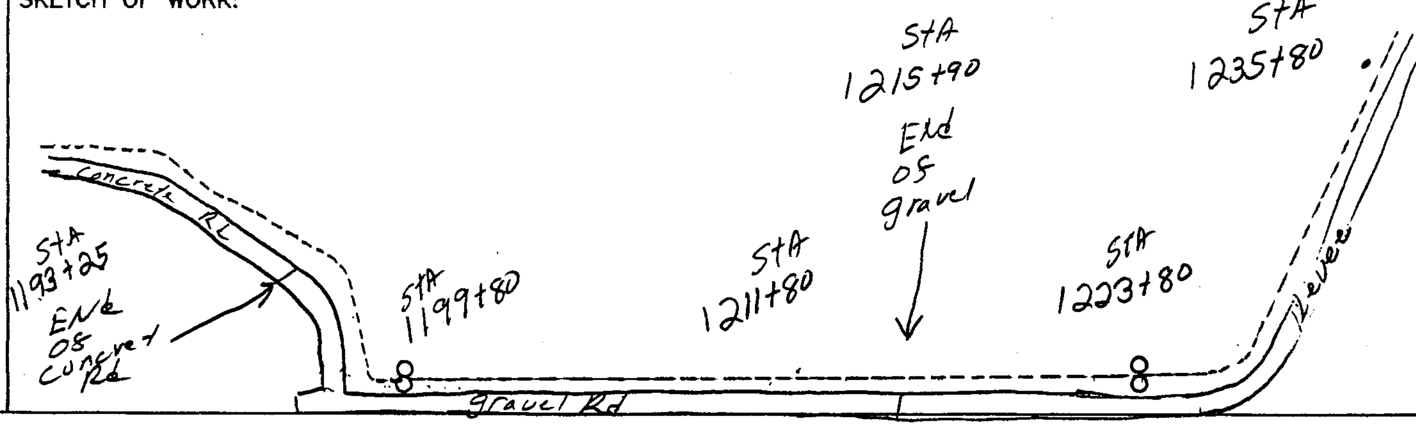
COUNTY Desha
TWP. ____ RG. ____ SEC. ____
MAP DETAIL NO. ____
WORK PLAN REFERENCE NO. ____

WOR
STA
CHE
REV
SHE

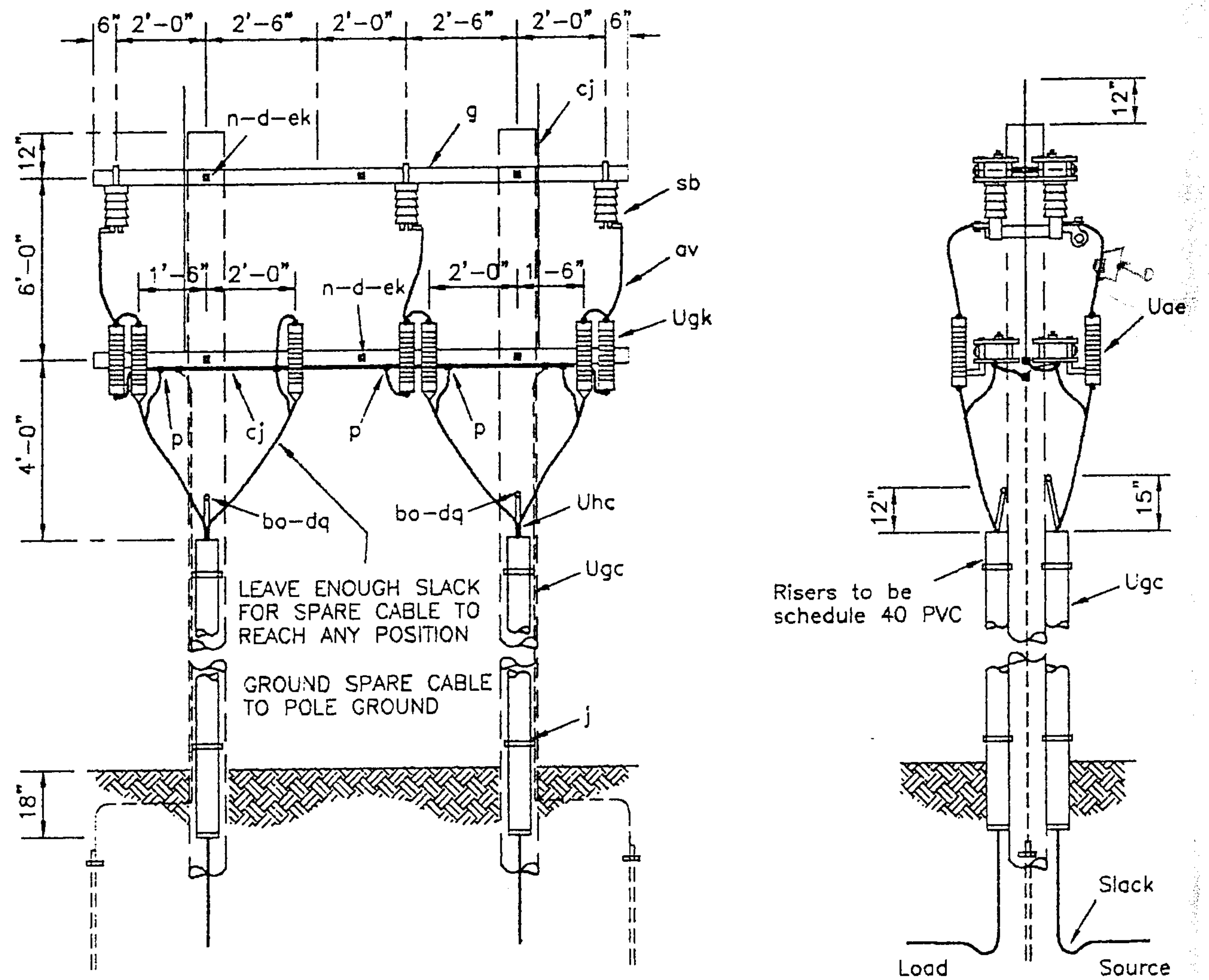
TYPE (EX) (LN,H) (NEW)	POLE NUMBER	SPAN	POLES H. & C.	PRI-UNIT O.H.	PRI-UNIT U.R.D.	R/W CLEARING	TRANS. "G"	TRANS. "UG"	GR.	GUY NO.	GUY UNIT	GUY LEAD	ANCHOR NO.	ANCHOR UNIT	SECONDARY O.H. SPAN UNDER-BUILD	SECONDARY O.H. SPAN SEC. ONLY	SECONDARY O.H. UNIT NO.	SECONDARY O.H. UNIT J. OR K.	SERVICE O.H. SPAN	SERVICE O.H. UNIT NO.	SERVICE O.H. UNIT J. OR K.	SECONDARY BURIED SPAN	SECONDARY BURIED UNIT NO.	SECONDARY BURIED UNIT "UK" OR "UM"	SEC. OR SER. WIRE SIZE
New	STA 1199+80	2400	2)45-2		UCH				2)-11																
New	STA 1211+80				UM6-6																				
New	STA 1223+80	2400	2)45-2		UCH				2)-11																
New	STA 1235+80				UM6-6																				

NOTES:

SKETCH OF WORK:



CONSTRUCT
PRI. O.H.
PRI. BURIE
SEC. O.H.
SEC. BURIE
RETIREMENT
PRI. O.H.
PRI. BURIE
SER. O.H.
SER. BURIE



NOTES:

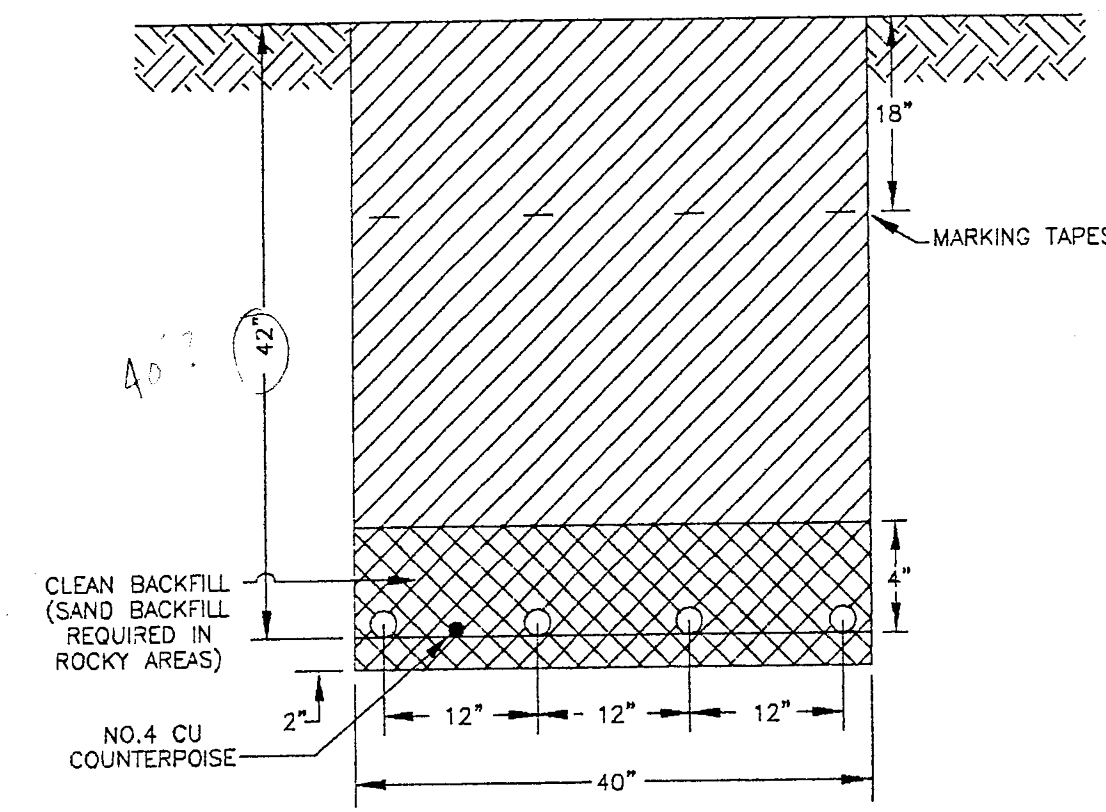
1. TOTAL ARRESTER LEAD LENGTH MUST BE UNDER 3'.
2. NO BENDS PERMITTED WITHIN 6" OF CABLE TERMINAL BASE.
3. ALLOW MINIMMUM CABLE SLACK OF 24" AT BOTTOM OF RISER.
4. ALL LIVE PARTS MUST HAVE AN 18 FOOT CLEARANCE ABOVE GROUND.
5. Clearance to grounded equipment or to expos primary cable to be no less than 15' above ground.

ITEM	NO.	MATERIAL	
d	16	Washer, square, 2 1/4", 13/16" hole	
g	4	Crossarm, 4 5/8" x 5 5/8" x 12'-0"	
i	14	Bolt, carriage, 1/2" x req'd length	
j		Screw, lag, as req'd	
n	6	Bolt, double arming, 5/8" x req'd. lgth.	
p		Connectors, as required	
bo	4	Shackle, anchor	
dg	4	Eye screw, or drive hook	
ek	16	Locknuts, 5/8"	

ITEM	NO.	MATERIAL
sb	3	Switch, disconnect and hardware
av		Jumpers, as required
cj		#4 HD copper, as required
Uce	6	Arrester
Ugc		Conduit, size & length as required
Ugk	8	Cable termination
Uhc	8	Cable support
---		Conduit straps, as req'd
---	12	Conduit, 2-hole pad and hardware

2-POLE 3-PHASE CABLE TERMINAL POLES WITH HOOK-OPERATED DISCONNECT SWITCHES

LEDBETTER, TOTH, & ASSOCIATES CONSULTING ENGINEERS	
DRAWN BY: PGP	DATE: 10-13-97
CHECKED BY: MAJ	FILE: MIS_324
APPROVED BY: MDB	No.: UCH



NOTE:

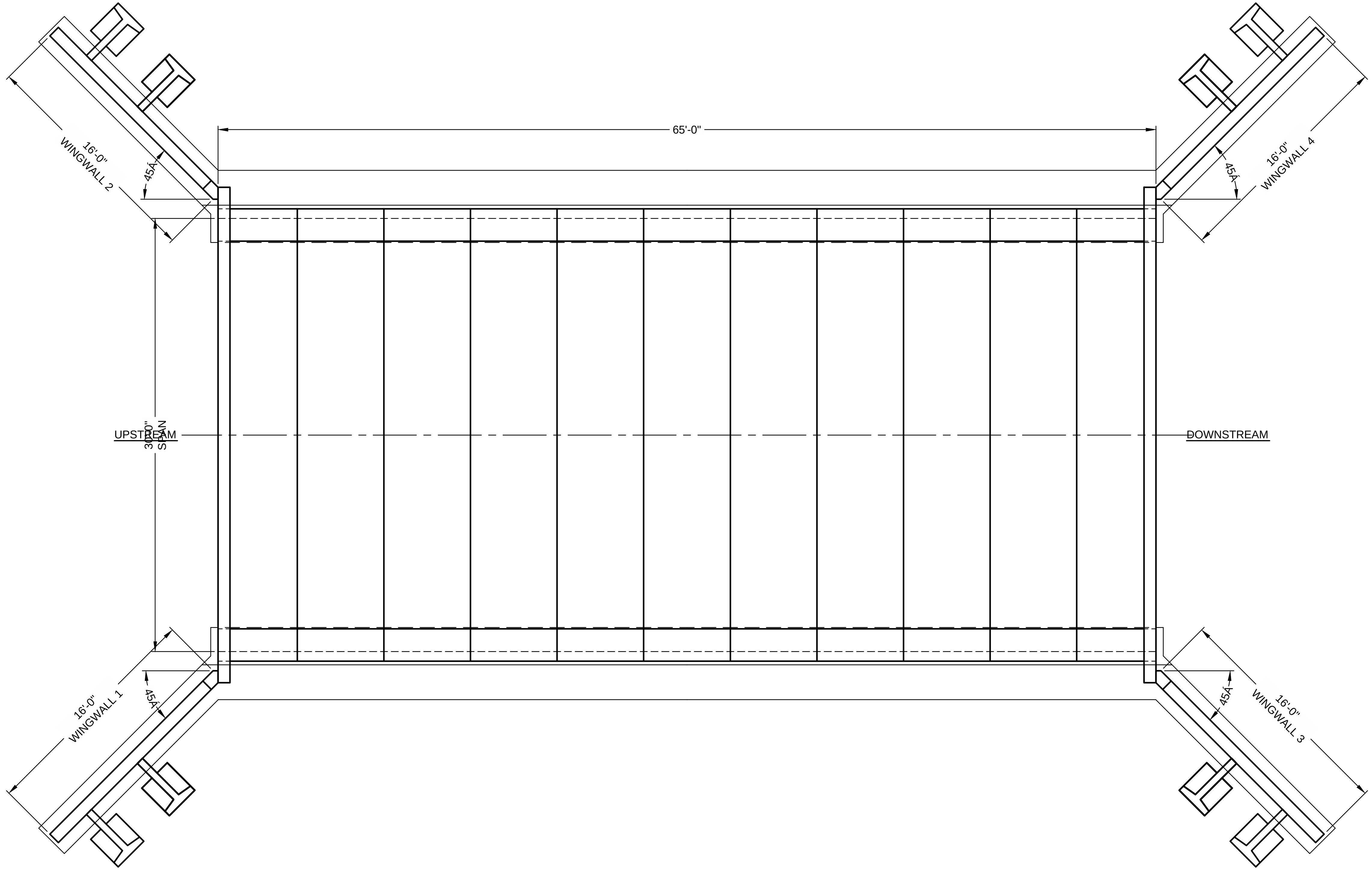
BACKFILL SHALL BE COMPACTED IN 8 INCH LIFTS.

LEGEND

- UNDISTRIBUTED EARTH
- SAND OR CLEAN SOIL
- COMPACTED BACKFILL UNLESS OTHERWISE SPECIFIED

TRENCHES FOR DIRECT BURIAL CABLES

LEDBETTER, TOTH, & ASSOCIATES CONSULTING ENGINEERS	
DRAWN BY: PGP	DATE: 10-13-97
CHECKED BY: MAJ	FILE: MIS_294
APPROVED BY: MDB	No.: UR2-1A



BRIDGE PLAN

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CON/SPAN O-SERIES

CONTECH DYOB DRAWING

Arkansas River and White River Crossings
CON/SPAN O-Series O530 30'-0" Span x 6'-5 3/8" Rise
1 Cell - 65' Long
Benzal, Arkansas

PROJECT No.:	SEQ. No.:	DATE:
212251		10/17/2017

DESIGNED:	DRAWN:
DYOB	DYOB
CHECKED:	APPROVED:
DYOB	DYOB

SHEET NO.: 1 OF 5

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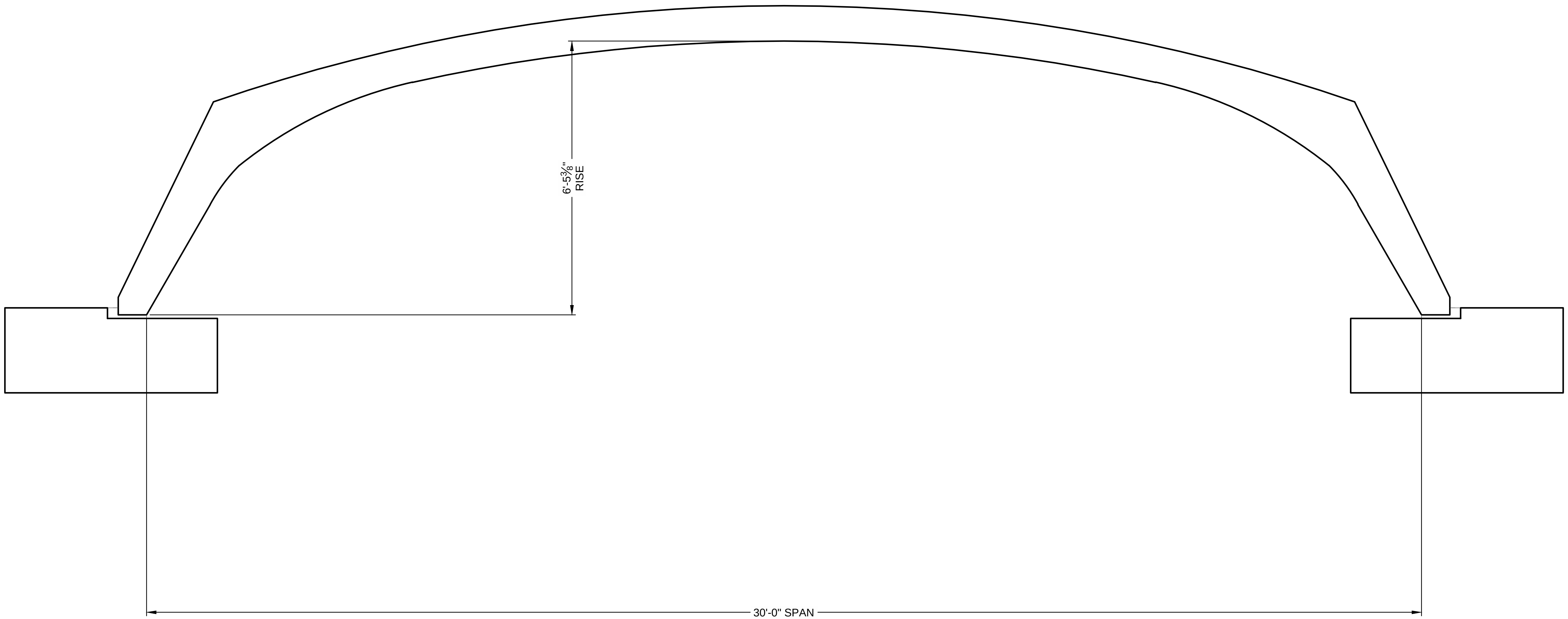

CROSS SECTION

CONTECH ENGINEERED SOLUTIONS LLC
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9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
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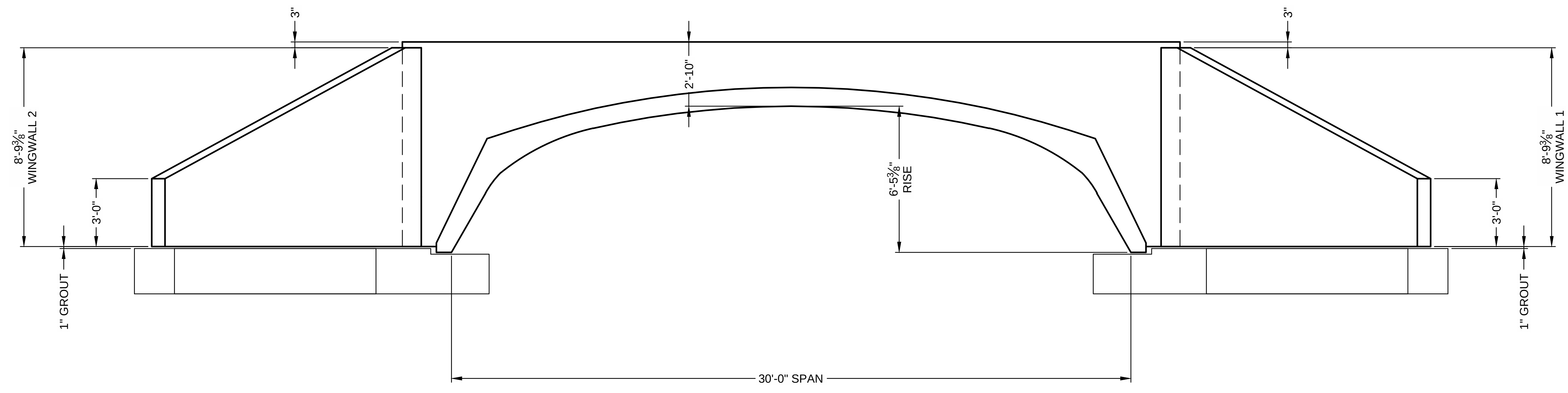
DESIGNED: DYOB	DRAWN: DYOB	
CHECKED: DYOB	APPROVED: DYOB	
SHEET NO.: 2 OF 5		



UPSTREAM END ELEVATION

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
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CON/SPAN O-SERIES
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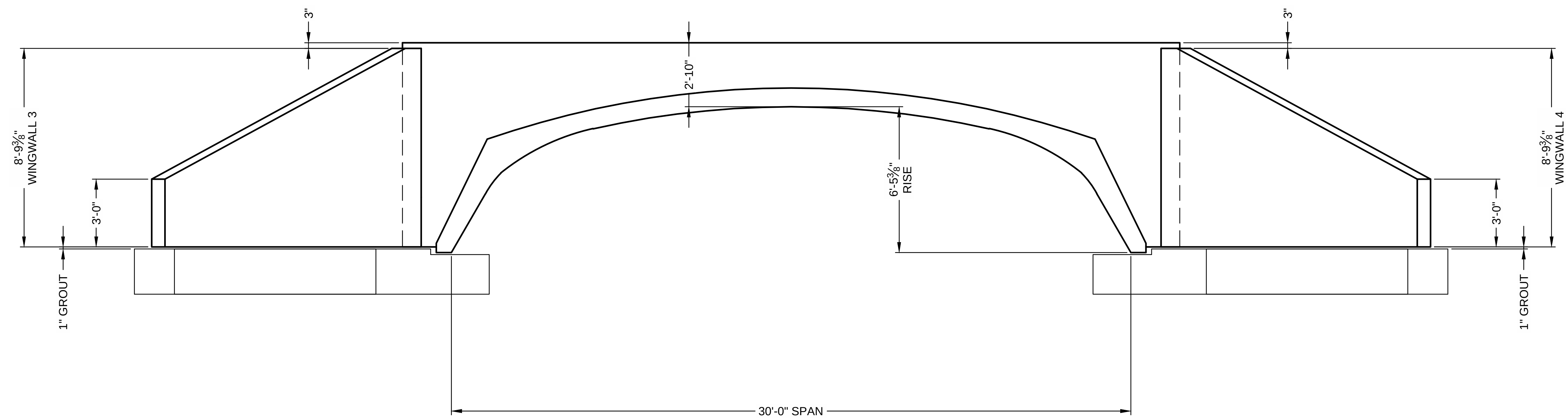
PROJECT No.: 212251	SEQ. No.:	DATE: 10/17/2017
DESIGNED: DYOB		DRAWN: DYOB
CHECKED: DYOB		APPROVED: DYOB
SHEET NO.: 3 OF 5		



DOWNSTREAM END ELEVATION

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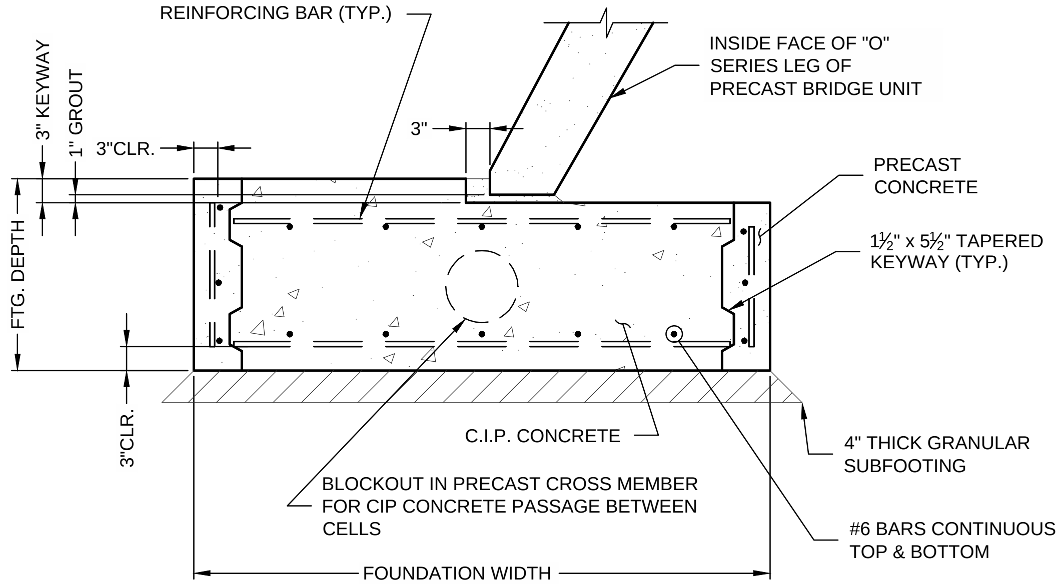
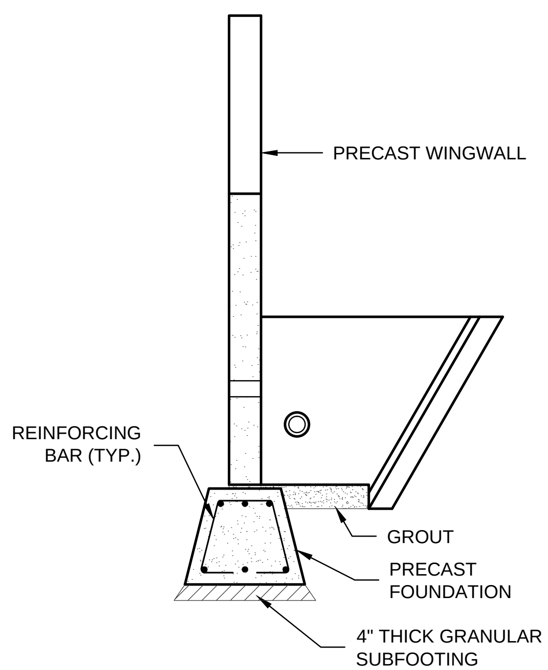
212251		10/17/2017
DESIGNED: DYOB		DRAWN: DYOB
CHECKED: DYOB		APPROVED: DYOB
SHEET NO.: 4 OF 5		

EXPRESS FOUNDATIONS

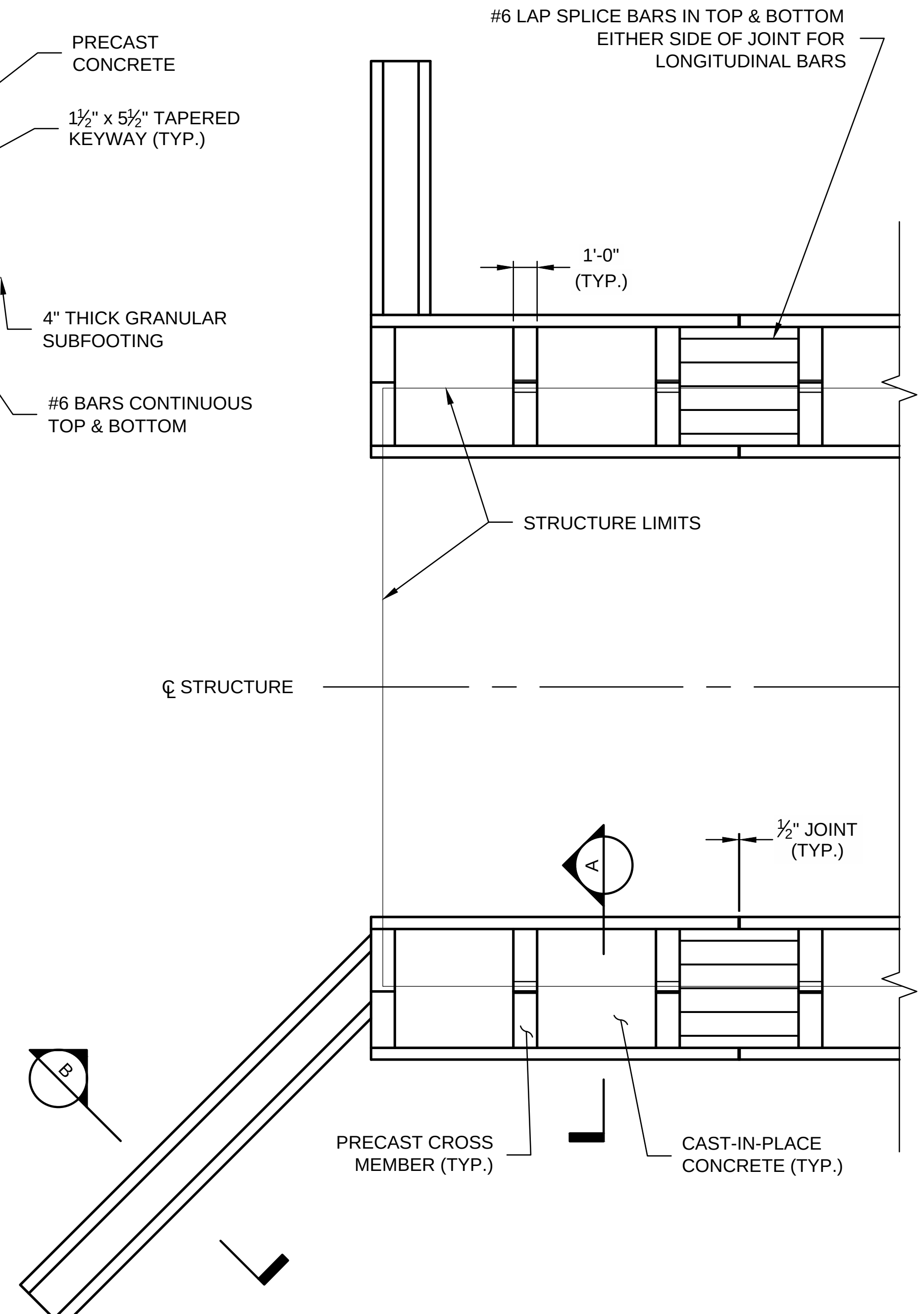
SAMPLE DRAWING ONLY



SECTION A
(NOT PROJECT SPECIFIC)



SECTION B
(NOT PROJECT SPECIFIC)



SAMPLE PARTIAL FOUNDATION PLAN
(NOT PROJECT SPECIFIC)

EXPRESS FOUNDATIONS

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PROJECT No.: 212251	SEQ. No.:	DATE: 10/17/2017
DESIGNED: DYOB		DRAWN: DYOB
CHECKED: DYOB		APPROVED: DYOB
SHEET NO.: 5 OF 5		

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