APPENDIX K

LOCALLY PREFERRED PLAN

- H & H Analysis for the LPP
- Economic Analysis for the LPP
- Civil Quantity calculations for the LPP
- Cost Engineering Items for the LPP
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    - MII Cost Estimate
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APPENDIX LPP

LOCALLY PREFERRED PLAN

HYDRAULICS, HYDROLOGY, and SEDIMENTATION

Lower Cache River, AR
Section 1135 Study for Restoration of Six Meanders
Locally Preferred Plan
December 2010

Background

In 2009 an 1135 study was completed that evaluated 5 meander restoration alternatives for the Lower Cache River, AR. The Project Management Plan for the study identified 6 meanders that the local sponsors deemed suitable for restoration. However, inclusion of all six meanders was not an implementable plan because costs far exceeded authorized 1135 funding levels and the local sponsors were unable to commit to funding the amount in excess of the 1135 authorizations.

The study team then formulated two lesser alternatives that restored only 4 (Meanders #1, #3, #5 and #6) and 3 (Meanders #1, #2, and #3) of the original 6 meanders. These were referred to as Alternative 2b and 2c, respectively. All plans were analyzed to insure that they would function as intended over the full 50-year project life. The intended function was to restore natural river behavior which would improve bio-diversity within the channel. This includes restoring flow velocities and flow durations as much as possible to pre-channelization conditions. One principal constraint for restoration studies permitted no construction within the meander channels beyond that required to remove existing earthen plugs at their upstream end.

Closure weir design utilized standard criteria for rock weirs and used dike design information taken from the Mississippi River Channel Improvement Program. Basic riprap requirements were determined from HEC-RAS velocity data and MVD standard riprap gradations. The focus of this project was environmental restoration and there were no public features that would be jeopardized in the event of structure failure. Experience with riprap training structures on the Mississippi River indicated that should failure occur, it would not be catastrophic with complete and immediate failure of the structure over its entire length. For this reason the study considered a matrix of possible solutions. Selection of the final weir configuration was to use a risk-based approach where the risk of failure, initial construction costs, and operation and maintenance costs were considered. Locations for proposed closure weirs were selected to insure that meander bankfull flow would be diverted back to the historic channels over the project life of 50 years.

Closure weir construction costs were based upon using a single, more robust anchor weir at the downstream most restoration site and a lesser weir configuration for the upstream sites. Restoring meanders 1, 5, and 6 required a single closure weir while two were required for meander 3. Meander 3 had a cross-ditch about mid-way of the reach that connected with the canal. The close proximity of the meander to the canal at the cross-ditch site significantly increased the likelihood that the restored meander would migrate toward the canal over the project life and would ultimately intersect the canal. Flow would then revert back to the canal

downstream of the cross-ditch and effectively sever the lower ½ to $^1/_3$ of the restored meander 3. Projections are that this could occur within the 50-year project life. Therefore, a viable USACE project required an additional closure weir across the canal just downstream of the cross-ditch. Weir 3A refers to the closure just downstream of where flow enters the restored meander channel and is analogous to Closure Weir #3 described in Table 2 of the main report. Weir 3B refers to the closure just downstream of the cross-ditch (See Figure 1) and is analogous to Closure Weir #4 described in Table 2 of the main report With use of two closure weirs for meander 3 the cross-ditch remained open to provide drainage from the canal segment between the adjacent closure structures.

Unfortunately, cost estimates for the USACE Alternatives 2b and 2c remained above the 1135 funding authorization.

General Plan Description

In order to establish a plan within allowable federal and local cost share funding for the 1135 authority, the local sponsors consulted with USACE about an alternate plan. The local sponsor stated that their intent is to pursue restoration of all 6 meanders. However, they wish to pursue other options—external to USACE--to execute construction efforts on some of the closure weirs. Because construction access is restricted to the Cache River canal, a specific construction sequence must be followed. Construction work must begin with the upstream closure structure and proceed sequentially downstream. For this reason, the local sponsors requested that the USACE 1135 authority be used to construct the upstream 3 meander restoration features. This would be meanders 1, 2, and 3. Restoration features for these meanders under the USACE project formulation included removal of 3 earthen plugs and construction of 4 closure weirs using riprap (Alternative 2c). Parametric cost estimates for this configuration remained beyond funding levels as defined under an 1135 project.

The USACE study team then considered possible ways to reduce project costs while achieving the environmental restoration objectives. The only way identified was to pursue construction under an approach where the USACE would partner to do initial construction for 3 weirs, 3 plug removals, and adding a plug within the cross-ditch (Figure 2). The need for the 4th closure weir would be monitored and reassessed as the canal and meander channels respond to the new flow regime. This approach considers local financial contributions under the 1135 cost share by recognizing the fact that costs above the federal contribution of $5M are 100% local costs. Specifically, the normal 75% federal plus 25% sponsor funding appear only sufficient to construct the 3 weirs and 3 plug removals. This means that the 4th closure weir would be a 100% local responsibility. The question then was whether a modified project could be considered viable for the 50-year project life under USACE guidelines. In other words, could the locals be permitted to delay construction of the 4th weir, at their expense, until such time as conditions warranted without jeopardizing viability of the USACE project.

With addition of a plug in the cross-ditch and limited bank armor within meander 3, hydraulic calculations show that a degree of flow control can be achieved to divert flow into meander 3—the two closures for meander 3 were at the same crest elevation so the degree of control would change only due to the difference in water surface elevations resulting from the slope of the

water surface between the two structures. Computed water surface profile slopes for this reach ranged between 0.0001 to 0.00004 depending on discharge. This slope converts to less than a 0.4 ft elevation difference (canal) between expected in-bank water levels at the upper end of meander 3. Without the recommended closure weir water levels at the upper end of meander 3 would be between 0 and 0.4 ft lower than with the weir for within bank discharges. For conditions where the closure weirs are submerged, there would be virtually no perceptible difference in water levels.

A lowering of 0.4 feet at the entrance to the restored meander 3 would affect the amount of flow diverted to the meander for a small percentage of flows. Except for seepage through the closure weir all discharges up to the crest of closure 3B (Figure 1) would be diverted into meander 3. For the increment of flow between this level and 0.4 feet higher would be proportionately split between the meander and the canal. With closure 3A in place, this full increment of flow would divert to the meander. For conditions where discharge exceeded the level required to overtop closure 3A, there would be no perceptible difference in flow distribution.

Unfortunately, the initial concept of the reduced plan remained above available funding. To further reduce project costs, the study team next evaluated project performance with closure weirs at a lower elevation than considered in the original 1135 alternatives. Weir crest elevations were decreased by 2 feet to elevations as shown in Table LPP-1.

Table LPP-1. Estimated Closure Elevations Associated with Locally Preferered Plan.

Closure Weir ID	Meander	Target Weir Elevation to Obtain Bankfull Flow in Meander Channel
1	M1	158.5
2	M2	157.75
~~3A (3)~~[1]	~~M3~~	~~158.0~~
3B (4)[2]	M3	158.0
CD1	Cross-Ditch	164.0
[1] Closure 3A (#3 in 1135 report) would not be constructed under 1135 authority but is shown for future reference by Sponsor [2]Closure 3B (#4 in 1135 report) would be constructed across the canal immediately downstream of the Cross-Ditch in Meander 3.		

The HEC-RAS model was modified to reflect the LPP configuration and weir elevations as shown in Figure 4. Model results confirmed that there was no impact to the Authorized Project flowline. Additionally, water surface profiles would be lower with the LPP than with USACE alternatives with closures. The decrease was due to using lower weir crest elevations. Lowering the closure crest elevations by two feet will affect the resulting flow distribution between the restored channels and the canal. The original elevations proposed for the closures were estimated from the discharge associated with a bankfull stage within the meander channels. There is some latitude in estimating the banfull stage and thus the bankfull discharge. Lowering the estimate slightly as would result with the lower closures should not have significant impacts

on the overall project function. Additional lowering of the closures was not recommended to ensure an appropriate balance between water and sediment discharge.

While more natural river conditions can certainly be restored to meander 3 with just closure 3B, there are some concerns with pursuing this plan. The primary concern is that adverse sedimentation patterns may develop near the entrance to the restored meander 3. All previous meanders were restored by using a closure near the upper end of the meander channels to provide a smooth flow transition between the canal and meander channels. This would help prevent excessive deposition from occurring within the canal or meander channel entrance. Without the presence of a closure to guide flow into the meander there will be more energy losses and sediment will deposit at the junction. With available data it is not possible to estimate the amount or location of these deposits. Past deposition trends within the canal have been limited in this area as evidenced by thalweg and cross-section area comparisons between the design section (circa 1973) and 2007 surveys. Should the deposition occur disproportionately in the meander entrance then flow may be diverted into downstream side channels that exit from the canal. Property along these channels is largely in private ownership.

Figure 1---Meander 3 showing Closures at 3A and 3B. Structure 3B is located immediately downstream of the Cross-Ditch that connects the canal and meander channel.

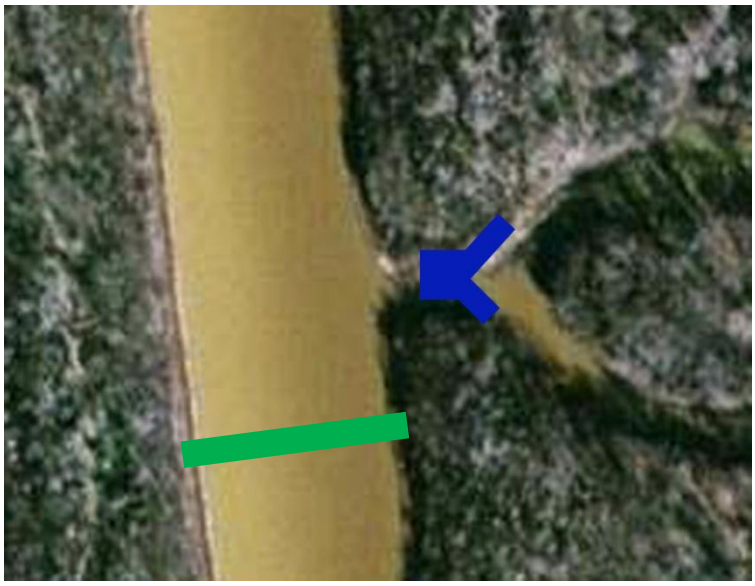


Figure 2---Cross-Ditch at Meander #3 showing proposed plug (Blue) with bank protection. Approximate location of Closure 3B is shown in Green.

Figure 3---Closure 3A being considered for construction using Adaptive Management/Phased construction (dashed Red Line).

Design Modifications to Closure Structures

It was not possible to achieve a balance between project function, structure performance, and costs for the Locally Preferred Plan without deviating from established USACE design criteria and guidelines. The consideration to deviate from established procedures was based on the fact that there are no known public facilities within or immediately downstream of the project reach and there would be no expected risk to human safety in the event of closure structure failure. There would be an increased level of risk to the sponsor for reduced factors of safety in structure design. Project cost estimates included additional operation and maintenance costs to account for some of this additional risk.

Risks associated with deviating from current design standards are described as follows.

1. Elimination of 2nd closure for meander #3
    a. Standard: EM 1110-2-1601 and 1110-2-4000 require consideration of sediment and water movement from system perspective. The 2nd weir for M3 is necessary to fulfill this requirement.
    b. Risk: **Without 2nd closure deposition patterns cannot be adequately predicted over the project life and deposition will occur at the meander/canal junction.** Deposition may negatively impact diversion of flow to meander and will result in accelerated accretion in the canal near the private boat ramp. **Worst case is that an additional structure will be required at local expense to mitigate adverse flow and deposition patterns to maintain project function under the Locally Preferred Plan. The Locally Preferred Plan does not provide the same level of service for a project life of 50 years as provided by alternatives considered during feasibility studies.**

2. Weir crest configuration
    a. Standard: Guidelines recommend riprap chute slopes be no steeper than 1V:20H downstream of weir crest. Flatter slopes are desirable. Past experience substantiates these recommendations. A minimum 10 ft. crown width is recommended for riprap being used for this project. The lowermost weir utilizes 1V:6H slopes for both upstream and downstream approaches. The upper two weirs utilize a MS River dike section with 1V:1.5H slopes for both upstream and downstream approaches. All three weirs use a 20 ft. crown width. Various combinations of weir slope were considered during alternative formulation to make allowances for the environmental restoration focus of this 1135 project.
    b. Risk: The steeper weir approach slopes increase the likelihood that stone movement will occur because the slope steepness directly affects the stability of the rock. The lower rock stability increases the probability that the weir crest will fail over time. The **greatest risk of failure is for upper two weirs** that have the

steeper 1V:1.5H slopes. The **lower most weir with 1V:6H slopes has elevated risk of failure** but the low gradient of the lower Cache coupled with backwater effects from the White are expected to reduce the time of exposure to critical flow conditions. The design includes additional riprap within the weir section to accommodate some stone launching. The **crown width was increased from 10 ft. to 20 ft. in all three weirs to mitigate risk by providing an additional volume** of stone within the weir core. The additional riprap volume also provides opportunity for reshaping efforts during future maintenance activities.

There are **no public facilities in the study reach and there is no anticipated threat to human life in the event of structure failure**. O&M costs were adjusted for each different weir configuration commensurate with the degree of departure from the guidelines: The **downstream most weir with 1V:6H slopes had significantly higher O&M costs over the "standard design" (roughly 10 times); the upper two weir O&M costs were 25 times that for the standard design**.

3. Riprap thickness increase for underwater placement
    a. Standard: EM 1110-2-1601 requires increase in embedment thickness for underwater placement. A factor of 1.5 (50% increase) is used to ensure proper layer thickness given uncertainties of grading and placing riprap under water (a layer thickness of 6 ft. becomes 9 ft.). Underwater placement for all riprap will be required under construction methods envisioned (due to accessibility issues). Design calculations identify R2200 riprap to provide adequate stability for expected flows. R2200 for highly turbulent flow requires a minimum blanket thickness of 54 inches for placement in the dry. R2200 placement thickness for **the upper two weirs does not provide** the required 50% increase in thickness for underwater placement. Riprap layer thickness for the upper weirs only provides a 33% increase. **The lower most weir includes** the 50% increase. Closely controlled specifications and inspection will be necessary to ensure that an acceptable layer thickness is provided during construction.
    b. Risk: Premature failure of the structure will result if riprap placement does not provide the minimum nominal thickness for underwater placement. Weirs without the required 50% increase will require additional O&M to maintain structure integrity and performance. Some increase in thickness is included but cost constraints prevent achieving the full 50% increase—Cost considerations only permitted a 33% increase. **Annual O&M costs for structures not providing the 50% increase were adjusted upward by 1/3** over O&M costs for the structure that had the full required thickness.

4. Riprap keys
    a. Standard: EM1110-2-1601; ETL 1110-2-120 and other guidance outline requirements to adequately terminate riprap at the upstream, downstream and bank limits. Keys provide additional launch stone that will adjust to scour where flow transitions between the riprap and natural material.
    b. Risk: The **lower most anchor weir includes** upstream and downstream keys per guidance. The **upper two weirs for the LPP do not include** keys. The lower weir will be under increased hydraulic stress from normal flow from the Cache and reverse flow from the White River. The upper two structures should have lower stresses due to backwater development as water levels increase. The risk without keys is that no additional stone is provided to self-launch as scour occurs. There is additional riprap included within the upper weir sections to cover scour from reverse flow, but downstream scour will begin to undermine the apron. **O&M costs are increased for structures without keys.**

The risk associated with potential deposition without closure 3A appears manageable under a phased construction approach (Figure 3). The local sponsor should be made aware that sediment removal and management for the adaptive management approach falls under their commitment to perform operation and maintenance as necessary to preserve project function and benefits. The best estimate for operation and maintenance costs associated with the phased construction approach would be equivalent to the cost of constructing and maintaining the closure structure at 3A as outlined in the main study report (Closure Weir #3 in Table 2 of Appendix D-2 of the Report).

Should the sponsors select the option for a phased construction of project features, they may choose to construct the closure weir as currently designed, or after observing system behavior, alter the design as necessary to prevent additional sedimentation at the upstream canal/meander junction.

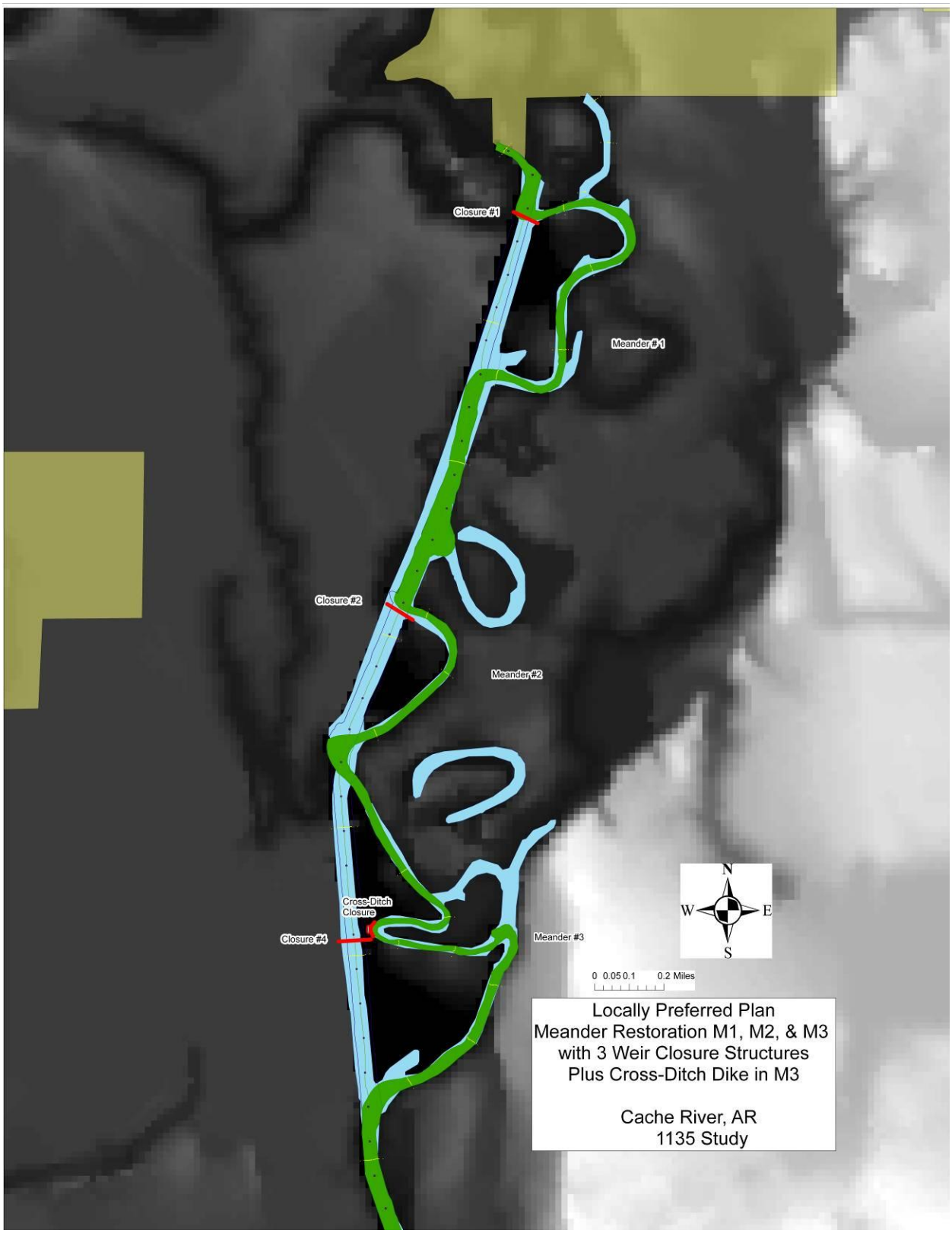


Figure 4. Locally Preferred Plan to restore meanders 1, 2, and 3. Cache River, AR.

HEC-RAS Output Locally Preferred Plan. Meander Restoration with Weir Closures: Meanders 1, 2, 3 Only Model—with Closures 1, 2, 4 at lower elevations that USACE Alternatives

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)
Meander #3	Main	120	I1000	1000	150.4	156.7
Meander #3	Main	120	I-AP	9211	150.4	167.8
Meander #3	Main	120	I0500	500	150.4	155.1
Meander #3	Main	120	I2000	1799	150.4	158.3
Meander #3	Main	120	I2500	1922	150.4	158.5
Meander #3	Main	120	I0200	200	150.4	153.7
Meander #3	Main	120	I-APbw	7446	150.4	172.3
Meander #3	Main	120	I3000	2104	150.4	158.7
Meander #3	Main	120	I7000	2803	150.4	159.8
Meander #3	Main	119	I1000	1000	150.4	156.7
Meander #3	Main	119	I-AP	9211	150.4	167.8
Meander #3	Main	119	I0500	500	150.4	155.1
Meander #3	Main	119	I2000	1799	150.4	158.2
Meander #3	Main	119	I2500	1922	150.4	158.5
Meander #3	Main	119	I0200	200	150.4	153.7
Meander #3	Main	119	I-APbw	7446	150.4	172.3
Meander #3	Main	119	I3000	2104	150.4	158.7
Meander #3	Main	119	I7000	2803	150.4	159.8
Meander #3	Main	118	I1000	1000	150.7	156.4
Meander #3	Main	118	I-AP	9211	150.7	167.8
Meander #3	Main	118	I0500	500	150.7	154.9
Meander #3	Main	118	I2000	1799	150.7	157.9
Meander #3	Main	118	I2500	1922	150.7	158.2
Meander #3	Main	118	I0200	200	150.7	153.6
Meander #3	Main	118	I-APbw	7446	150.7	172.3
Meander #3	Main	118	I3000	2104	150.7	158.4
Meander #3	Main	118	I7000	2803	150.7	159.6
Meander #3	Main	117	I1000	1000	150.4	155.6
Meander #3	Main	117	I-AP	9211	150.4	167.7
Meander #3	Main	117	I0500	500	150.4	154.2
Meander #3	Main	117	I2000	1799	150.4	157.1
Meander #3	Main	117	I2500	1922	150.4	157.3
Meander #3	Main	117	I0200	200	150.4	153.1
Meander #3	Main	117	I-APbw	7446	150.4	172.3
Meander #3	Main	117	I3000	2104	150.4	157.5

HEC-RAS Output Locally Preferred Plan. Meander Restoration with Weir Closures: Meanders 1, 2, 3 Only Model—with Closures 1, 2, 4 at lower elevations that USACE Alternatives

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)
Meander #3	Main	117	I7000	2803	150.4	159.3
Meander #3	Main	116	I1000	1000	149.7	154.3
Meander #3	Main	116	I-AP	9211	149.7	167.6
Meander #3	Main	116	I0500	500	149.7	153.2
Meander #3	Main	116	I2000	1799	149.7	155.7
Meander #3	Main	116	I2500	1922	149.7	156.1
Meander #3	Main	116	I0200	200	149.7	152.2
Meander #3	Main	116	I-APbw	7446	149.7	172.3
Meander #3	Main	116	I3000	2104	149.7	156.2
Meander #3	Main	116	I7000	2803	149.7	158.9
Meander #3	Main	115	I1000	1000	149.7	153.9
Meander #3	Main	115	I-AP	9211	149.7	167.6
Meander #3	Main	115	I0500	500	149.7	152.8
Meander #3	Main	115	I2000	1799	149.7	155.2
Meander #3	Main	115	I2500	1922	149.7	155.6
Meander #3	Main	115	I0200	200	149.7	151.9
Meander #3	Main	115	I-APbw	7446	149.7	172.3
Meander #3	Main	115	I3000	2104	149.7	155.8
Meander #3	Main	115	I7000	2803	149.7	158.7
Meander #3	Main	114	I1000	1000	149.6	151.5
Meander #3	Main	114	I-AP	9211	149.6	167.5
Meander #3	Main	114	I0500	500	149.6	150.9
Meander #3	Main	114	I2000	1799	149.6	154.1
Meander #3	Main	114	I2500	1922	149.6	154.9
Meander #3	Main	114	I0200	200	149.6	150.4
Meander #3	Main	114	I-APbw	7446	149.6	172.3
Meander #3	Main	114	I3000	2104	149.6	154.8
Meander #3	Main	114	I7000	2803	149.6	158.5
Meander #2	Reach	123	I1000	821	149.5	158.1
Meander #2	Reach	123	I-AP	13942	149.5	168.0
Meander #2	Reach	123	I0500	449	149.5	158.0
Meander #2	Reach	123	I2000	1431	149.5	158.5
Meander #2	Reach	123	I2500	1570	149.5	158.8
Meander #2	Reach	123	I0200	200	149.5	158.0

HEC-RAS Output Locally Preferred Plan. Meander Restoration with Weir Closures: Meanders 1, 2, 3 Only Model—with Closures 1, 2, 4 at lower elevations that USACE Alternatives

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)
Meander #2	Reach	123	I-APbw	15406	149.5	172.4
Meander #2	Reach	123	I3000	1778	149.5	159.0
Meander #2	Reach	123	I7000	3465	149.5	160.4
Meander #2	Reach	122	I1000	821	148.6	158.0
Meander #2	Reach	122	I-AP	13942	148.6	168.0
Meander #2	Reach	122	I0500	449	148.6	158.0
Meander #2	Reach	122	I2000	1431	148.6	158.4
Meander #2	Reach	122	I2500	1570	148.6	158.6
Meander #2	Reach	122	I0200	200	148.6	158.0
Meander #2	Reach	122	I-APbw	15406	148.6	172.3
Meander #2	Reach	122	I3000	1778	148.6	158.8
Meander #2	Reach	122	I7000	3465	148.6	160.2
Meander #2	Reach	121	I1000	821	149.7	158.0
Meander #2	Reach	121	I-AP	13942	149.7	167.9
Meander #2	Reach	121	I0500	449	149.7	158.0
Meander #2	Reach	121	I2000	1431	149.7	158.3
Meander #2	Reach	121	I2500	1570	149.7	158.6
Meander #2	Reach	121	I0200	200	149.7	158.0
Meander #2	Reach	121	I-APbw	15406	149.7	172.3
Meander #2	Reach	121	I3000	1778	149.7	158.8
Meander #2	Reach	121	I7000	3465	149.7	160.1
Meander #1	Reach	127	I1000	1000	151.4	158.4
Meander #1	Reach	127	I-AP	14075	151.4	168.5
Meander #1	Reach	127	I0500	500	151.4	158.1
Meander #1	Reach	127	I2000	1739	151.4	159.1
Meander #1	Reach	127	I2500	1977	151.4	159.4
Meander #1	Reach	127	I0200	200	151.4	158.0
Meander #1	Reach	127	I-APbw	15088	151.4	172.4
Meander #1	Reach	127	I3000	2178	151.4	159.7
Meander #1	Reach	127	I7000	3853	151.4	161.5
Meander #1	Reach	126	I1000	1000	150.8	158.2
Meander #1	Reach	126	I-AP	14075	150.8	168.4
Meander #1	Reach	126	I0500	500	150.8	158.1
Meander #1	Reach	126	I2000	1739	150.8	158.8

HEC-RAS Output Locally Preferred Plan. Meander Restoration with Weir Closures: Meanders 1, 2, 3 Only Model—with Closures 1, 2, 4 at lower elevations that USACE Alternatives

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)
Meander #1	Reach	126	I2500	1977	150.8	159.2
Meander #1	Reach	126	I0200	200	150.8	158.0
Meander #1	Reach	126	I-APbw	15088	150.8	172.4
Meander #1	Reach	126	I3000	2178	150.8	159.4
Meander #1	Reach	126	I7000	3853	150.8	161.3
Meander #1	Reach	125	I1000	1000	150.4	158.2
Meander #1	Reach	125	I-AP	14075	150.4	168.3
Meander #1	Reach	125	I0500	500	150.4	158.1
Meander #1	Reach	125	I2000	1739	150.4	158.7
Meander #1	Reach	125	I2500	1977	150.4	159.0
Meander #1	Reach	125	I0200	200	150.4	158.0
Meander #1	Reach	125	I-APbw	15088	150.4	172.4
Meander #1	Reach	125	I3000	2178	150.4	159.3
Meander #1	Reach	125	I7000	3853	150.4	161.2
Meander #1	Reach	124	I1000	1000	150.7	158.1
Meander #1	Reach	124	I-AP	14075	150.7	168.3
Meander #1	Reach	124	I0500	500	150.7	158.0
Meander #1	Reach	124	I2000	1739	150.7	158.6
Meander #1	Reach	124	I2500	1977	150.7	158.9
Meander #1	Reach	124	I0200	200	150.7	158.0
Meander #1	Reach	124	I-APbw	15088	150.7	172.4
Meander #1	Reach	124	I3000	2178	150.7	159.2
Meander #1	Reach	124	I7000	3853	150.7	161.0
Cache	Main	16	I1000	1000	147.2	158.6
Cache	Main	16	I-AP	30982	147.2	168.7
Cache	Main	16	I0500	500	147.2	158.5
Cache	Main	16	I2000	2000	147.2	159.2
Cache	Main	16	I2500	2500	147.2	159.6
Cache	Main	16	I0200	200	147.2	158.5
Cache	Main	16	I-APbw	30982	147.2	172.5
Cache	Main	16	I3000	3000	147.2	159.9
Cache	Main	16	I7000	7000	147.2	162.0
Cache	Main	15.9	I1000	1000	147.2	158.5
Cache	Main	15.9	I-AP	30982	147.2	168.4

HEC-RAS Output Locally Preferred Plan. Meander Restoration with Weir Closures: Meanders 1, 2, 3 Only Model—with Closures 1, 2, 4 at lower elevations that USACE Alternatives

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)
Cache	Main	15.9	I0500	500	147.2	158.5
Cache	Main	15.9	I2000	2000	147.2	159.1
Cache	Main	15.9	I2500	2500	147.2	159.4
Cache	Main	15.9	I0200	200	147.2	158.5
Cache	Main	15.9	I-APbw	30982	147.2	172.4
Cache	Main	15.9	I3000	3000	147.2	159.7
Cache	Main	15.9	I7000	7000	147.2	161.4
Cache	Reach_1	15	I1000	0	149.6	158.5
Cache	Reach_1	15	I-AP	16907	149.6	168.4
Cache	Reach_1	15	I0500	0	149.6	158.5
Cache	Reach_1	15	I2000	261	149.6	159.1
Cache	Reach_1	15	I2500	523	149.6	159.4
Cache	Reach_1	15	I0200	0	149.6	158.5
Cache	Reach_1	15	I-APbw	15894	149.6	172.4
Cache	Reach_1	15	I3000	822	149.6	159.7
Cache	Reach_1	15	I7000	3147	149.6	161.5
Cache	Reach_1	14.98	I1000	0	149.6	158.5
Cache	Reach_1	14.98	I-AP	16907	149.6	168.4
Cache	Reach_1	14.98	I0500	0	149.6	158.5
Cache	Reach_1	14.98	I2000	261	149.6	159.1
Cache	Reach_1	14.98	I2500	523	149.6	159.4
Cache	Reach_1	14.98	I0200	0	149.6	158.5
Cache	Reach_1	14.98	I-APbw	15894	149.6	172.4
Cache	Reach_1	14.98	I3000	822	149.6	159.7
Cache	Reach_1	14.98	I7000	3147	149.6	161.5
Cache	Reach_1	14.97	I1000	0	149.6	158.5
Cache	Reach_1	14.97	I-AP	16907	149.6	168.4
Cache	Reach_1	14.97	I0500	0	149.6	158.5
Cache	Reach_1	14.97	I2000	261	149.6	159.1
Cache	Reach_1	14.97	I2500	523	149.6	159.4
Cache	Reach_1	14.97	I0200	0	149.6	158.5
Cache	Reach_1	14.97	I-APbw	15894	149.6	172.4
Cache	Reach_1	14.97	I3000	822	149.6	159.7
Cache	Reach_1	14.97	I7000	3147	149.6	161.5

HEC-RAS Output Locally Preferred Plan. Meander Restoration with Weir Closures: Meanders 1, 2, 3 Only Model—with Closures 1, 2, 4 at lower elevations that USACE Alternatives

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)
Cache	Reach_1	14.965		Inl Struct		
Cache	Reach_1	14.96	I1000	0	149.6	158.1
Cache	Reach_1	14.96	I-AP	16907	149.6	168.4
Cache	Reach_1	14.96	I0500	0	149.6	158.0
Cache	Reach_1	14.96	I2000	261	149.6	158.6
Cache	Reach_1	14.96	I2500	523	149.6	159.0
Cache	Reach_1	14.96	I0200	0	149.6	158.0
Cache	Reach_1	14.96	I-APbw	15894	149.6	172.4
Cache	Reach_1	14.96	I3000	822	149.6	159.2
Cache	Reach_1	14.96	I7000	3147	149.6	161.2
Cache	Reach_1	14.95	I1000	0	149.6	158.1
Cache	Reach_1	14.95	I-AP	16907	149.6	168.4
Cache	Reach_1	14.95	I0500	0	149.6	158.0
Cache	Reach_1	14.95	I2000	261	149.6	158.6
Cache	Reach_1	14.95	I2500	523	149.6	159.0
Cache	Reach_1	14.95	I0200	0	149.6	158.0
Cache	Reach_1	14.95	I-APbw	15894	149.6	172.4
Cache	Reach_1	14.95	I3000	822	149.6	159.2
Cache	Reach_1	14.95	I7000	3147	149.6	161.2
Cache	Reach_1	14.9	I1000	0	149.6	158.1
Cache	Reach_1	14.9	I-AP	16907	149.6	168.3
Cache	Reach_1	14.9	I0500	0	149.6	158.0
Cache	Reach_1	14.9	I2000	261	149.6	158.6
Cache	Reach_1	14.9	I2500	523	149.6	159.0
Cache	Reach_1	14.9	I0200	0	149.6	158.0
Cache	Reach_1	14.9	I-APbw	15894	149.6	172.4
Cache	Reach_1	14.9	I3000	822	149.6	159.2
Cache	Reach_1	14.9	I7000	3147	149.6	161.1
Cache	Reach_2	14	I1000	1000	149.0	158.1
Cache	Reach_2	14	I-AP	30982	149.0	168.3
Cache	Reach_2	14	I0500	500	149.0	158.0
Cache	Reach_2	14	I2000	2000	149.0	158.6
Cache	Reach_2	14	I2500	2500	149.0	158.9
Cache	Reach_2	14	I0200	200	149.0	158.0

HEC-RAS Output Locally Preferred Plan. Meander Restoration with Weir Closures: Meanders 1, 2, 3 Only Model—with Closures 1, 2, 4 at lower elevations that USACE Alternatives

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)
Cache	Reach_2	14	I-APbw	30982	149.0	172.4
Cache	Reach_2	14	I3000	3000	149.0	159.2
Cache	Reach_2	14	I7000	7000	149.0	161.0
Cache	Reach_2	13.9	I1000	1000	149.0	158.1
Cache	Reach_2	13.9	I-AP	30982	149.0	168.0
Cache	Reach_2	13.9	I0500	500	149.0	158.0
Cache	Reach_2	13.9	I2000	2000	149.0	158.5
Cache	Reach_2	13.9	I2500	2500	149.0	158.8
Cache	Reach_2	13.9	I0200	200	149.0	158.0
Cache	Reach_2	13.9	I-APbw	30982	149.0	172.4
Cache	Reach_2	13.9	I3000	3000	149.0	159.0
Cache	Reach_2	13.9	I7000	7000	149.0	160.3
Cache	Reach_3	13	I1000	179	149.1	158.1
Cache	Reach_3	13	I-AP	17040	149.1	168.0
Cache	Reach_3	13	I0500	51	149.1	158.0
Cache	Reach_3	13	I2000	569	149.1	158.5
Cache	Reach_3	13	I2500	930	149.1	158.8
Cache	Reach_3	13	I0200	0	149.1	158.0
Cache	Reach_3	13	I-APbw	15576	149.1	172.4
Cache	Reach_3	13	I3000	1222	149.1	159.0
Cache	Reach_3	13	I7000	3535	149.1	160.4
Cache	Reach_3	12.99	I1000	179	149.1	158.1
Cache	Reach_3	12.99	I-AP	17040	149.1	168.0
Cache	Reach_3	12.99	I0500	51	149.1	158.0
Cache	Reach_3	12.99	I2000	569	149.1	158.5
Cache	Reach_3	12.99	I2500	930	149.1	158.8
Cache	Reach_3	12.99	I0200	0	149.1	158.0
Cache	Reach_3	12.99	I-APbw	15576	149.1	172.4
Cache	Reach_3	12.99	I3000	1222	149.1	159.0
Cache	Reach_3	12.99	I7000	3535	149.1	160.4
Cache	Reach_3	12.98	I1000	179	149.1	158.1
Cache	Reach_3	12.98	I-AP	17040	149.1	168.0
Cache	Reach_3	12.98	I0500	51	149.1	158.0
Cache	Reach_3	12.98	I2000	569	149.1	158.5

HEC-RAS Output Locally Preferred Plan. Meander Restoration with Weir Closures: Meanders 1, 2, 3 Only Model—with Closures 1, 2, 4 at lower elevations that USACE Alternatives

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)
Cache	Reach_3	12.98	I2500	930	149.1	158.8
Cache	Reach_3	12.98	I0200	0	149.1	158.0
Cache	Reach_3	12.98	I-APbw	15576	149.1	172.4
Cache	Reach_3	12.98	I3000	1222	149.1	159.0
Cache	Reach_3	12.98	I7000	3535	149.1	160.4
Cache	Reach_3	12.975		Inl Struct		
Cache	Reach_3	12.97	I1000	179	149.1	158.0
Cache	Reach_3	12.97	I-AP	17040	149.1	168.0
Cache	Reach_3	12.97	I0500	51	149.1	158.0
Cache	Reach_3	12.97	I2000	569	149.1	158.3
Cache	Reach_3	12.97	I2500	930	149.1	158.6
Cache	Reach_3	12.97	I0200	0	149.1	158.0
Cache	Reach_3	12.97	I-APbw	15576	149.1	172.3
Cache	Reach_3	12.97	I3000	1222	149.1	158.8
Cache	Reach_3	12.97	I7000	3535	149.1	160.2
Cache	Reach_3	12.96	I1000	179	149.1	158.0
Cache	Reach_3	12.96	I-AP	17040	149.1	168.0
Cache	Reach_3	12.96	I0500	51	149.1	158.0
Cache	Reach_3	12.96	I2000	569	149.1	158.3
Cache	Reach_3	12.96	I2500	930	149.1	158.6
Cache	Reach_3	12.96	I0200	0	149.1	158.0
Cache	Reach_3	12.96	I-APbw	15576	149.1	172.3
Cache	Reach_3	12.96	I3000	1222	149.1	158.8
Cache	Reach_3	12.96	I7000	3535	149.1	160.2
Cache	Reach_3	12.9	I1000	179	149.1	158.0
Cache	Reach_3	12.9	I-AP	17040	149.1	167.9
Cache	Reach_3	12.9	I0500	51	149.1	158.0
Cache	Reach_3	12.9	I2000	569	149.1	158.3
Cache	Reach_3	12.9	I2500	930	149.1	158.6
Cache	Reach_3	12.9	I0200	0	149.1	158.0
Cache	Reach_3	12.9	I-APbw	15576	149.1	172.3
Cache	Reach_3	12.9	I3000	1222	149.1	158.8
Cache	Reach_3	12.9	I7000	3535	149.1	160.1

HEC-RAS Output Locally Preferred Plan. Meander Restoration with Weir Closures: Meanders 1, 2, 3 Only Model—with Closures 1, 2, 4 at lower elevations that USACE Alternatives

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)
Cache	Reach_4	12.5	I1000	1000	149.1	158.0
Cache	Reach_4	12.5	I-AP	30982	149.1	167.9
Cache	Reach_4	12.5	I0500	500	149.1	158.0
Cache	Reach_4	12.5	I2000	2000	149.1	158.3
Cache	Reach_4	12.5	I2500	2500	149.1	158.6
Cache	Reach_4	12.5	I0200	200	149.1	158.0
Cache	Reach_4	12.5	I-APbw	30982	149.1	172.3
Cache	Reach_4	12.5	I3000	3000	149.1	158.8
Cache	Reach_4	12.5	I7000	7000	149.1	160.0
Cache	Reach_4	12.2	I1000	1000	149.1	158.0
Cache	Reach_4	12.2	I-AP	30982	149.1	167.8
Cache	Reach_4	12.2	I0500	500	149.1	158.0
Cache	Reach_4	12.2	I2000	2000	149.1	158.3
Cache	Reach_4	12.2	I2500	2500	149.1	158.5
Cache	Reach_4	12.2	I0200	200	149.1	158.0
Cache	Reach_4	12.2	I-APbw	30982	149.1	172.3
Cache	Reach_4	12.2	I3000	3000	149.1	158.7
Cache	Reach_4	12.2	I7000	7000	149.1	159.8
Cache	Reach_5	12	I1000	0	148.0	158.0
Cache	Reach_5	12	I-AP	21771	148.0	167.8
Cache	Reach_5	12	I0500	0	148.0	158.0
Cache	Reach_5	12	I2000	201	148.0	158.3
Cache	Reach_5	12	I2500	578	148.0	158.6
Cache	Reach_5	12	I0200	0	148.0	158.0
Cache	Reach_5	12	I-APbw	23536	148.0	172.3
Cache	Reach_5	12	I3000	896	148.0	158.7
Cache	Reach_5	12	I7000	4197	148.0	159.8
Cache	Reach_5	11.99	I1000	0	148.0	158.0
Cache	Reach_5	11.99	I-AP	21771	148.0	167.8
Cache	Reach_5	11.99	I0500	0	148.0	158.0
Cache	Reach_5	11.99	I2000	201	148.0	158.3
Cache	Reach_5	11.99	I2500	578	148.0	158.6
Cache	Reach_5	11.99	I0200	0	148.0	158.0
Cache	Reach_5	11.99	I-APbw	23536	148.0	172.3
Cache	Reach_5	11.99	I3000	896	148.0	158.7

HEC-RAS Output Locally Preferred Plan. Meander Restoration with Weir Closures: Meanders 1, 2, 3 Only Model—with Closures 1, 2, 4 at lower elevations that USACE Alternatives

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)
Cache	Reach_5	11.99	I7000	4197	148.0	159.8
Cache	Reach_5	11.98	I1000	0	148.0	158.0
Cache	Reach_5	11.98	I-AP	21771	148.0	167.8
Cache	Reach_5	11.98	I0500	0	148.0	158.0
Cache	Reach_5	11.98	I2000	201	148.0	158.3
Cache	Reach_5	11.98	I2500	578	148.0	158.6
Cache	Reach_5	11.98	I0200	0	148.0	158.0
Cache	Reach_5	11.98	I-APbw	23536	148.0	172.3
Cache	Reach_5	11.98	I3000	896	148.0	158.7
Cache	Reach_5	11.98	I7000	4197	148.0	159.8
Cache	Reach_5	11.975		Inl Struct		
Cache	Reach_5	11.97	I1000	0	148.0	151.7
Cache	Reach_5	11.97	I-AP	21771	148.0	167.8
Cache	Reach_5	11.97	I0500	0	148.0	149.7
Cache	Reach_5	11.97	I2000	201	148.0	154.3
Cache	Reach_5	11.97	I2500	578	148.0	155.0
Cache	Reach_5	11.97	I0200	0	148.0	148.1
Cache	Reach_5	11.97	I-APbw	23536	148.0	172.3
Cache	Reach_5	11.97	I3000	896	148.0	155.0
Cache	Reach_5	11.97	I7000	4197	148.0	158.7
Cache	Reach_5	11.96	I1000	0	148.0	151.7
Cache	Reach_5	11.96	I-AP	21771	148.0	167.8
Cache	Reach_5	11.96	I0500	0	148.0	149.7
Cache	Reach_5	11.96	I2000	201	148.0	154.3
Cache	Reach_5	11.96	I2500	578	148.0	155.0
Cache	Reach_5	11.96	I0200	0	148.0	148.1
Cache	Reach_5	11.96	I-APbw	23536	148.0	172.3
Cache	Reach_5	11.96	I3000	896	148.0	155.0
Cache	Reach_5	11.96	I7000	4197	148.0	158.7
Cache	Reach_5	11	I1000	0	147.6	151.7
Cache	Reach_5	11	I-AP	21771	147.6	167.5
Cache	Reach_5	11	I0500	0	147.6	149.7
Cache	Reach_5	11	I2000	201	147.6	154.3

HEC-RAS Output Locally Preferred Plan. Meander Restoration with Weir Closures: Meanders 1, 2, 3 Only Model—with Closures 1, 2, 4 at lower elevations that USACE Alternatives

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)
Cache	Reach_5	11	I2500	578	147.6	155.0
Cache	Reach_5	11	I0200	0	147.6	148.1
Cache	Reach_5	11	I-APbw	23536	147.6	172.3
Cache	Reach_5	11	I3000	896	147.6	155.0
Cache	Reach_5	11	I7000	4197	147.6	158.5
Cache	Reach_6	10	I1000	1000	145.0	151.6
Cache	Reach_6	10	I-AP	30982	145.0	167.3
Cache	Reach_6	10	I0500	500	145.0	149.7
Cache	Reach_6	10	I2000	2000	145.0	154.2
Cache	Reach_6	10	I2500	2500	145.0	154.9
Cache	Reach_6	10	I0200	200	145.0	148.1
Cache	Reach_6	10	I-APbw	30982	145.0	172.3
Cache	Reach_6	10	I3000	3000	145.0	154.9
Cache	Reach_6	10	I7000	7000	145.0	158.4
Cache	Reach_6	9	I1000	1000	143.8	151.5
Cache	Reach_6	9	I-AP	30982	143.8	166.6
Cache	Reach_6	9	I0500	500	143.8	149.5
Cache	Reach_6	9	I2000	2000	143.8	154.1
Cache	Reach_6	9	I2500	2500	143.8	154.8
Cache	Reach_6	9	I0200	200	143.8	148.0
Cache	Reach_6	9	I-APbw	30982	143.8	172.2
Cache	Reach_6	9	I3000	3000	143.8	154.7
Cache	Reach_6	9	I7000	7000	143.8	158.0
Cache	Reach_6	8	I1000	1000	143.8	151.4
Cache	Reach_6	8	I-AP	30982	143.8	165.8
Cache	Reach_6	8	I0500	500	143.8	149.5
Cache	Reach_6	8	I2000	2000	143.8	154.0
Cache	Reach_6	8	I2500	2500	143.8	154.7
Cache	Reach_6	8	I0200	200	143.8	147.9
Cache	Reach_6	8	I-APbw	30982	143.8	172.1
Cache	Reach_6	8	I3000	3000	143.8	154.6
Cache	Reach_6	8	I7000	7000	143.8	157.7
Cache	Reach_6	7	I1000	1000	144.4	151.4
Cache	Reach_6	7	I-AP	30982	144.4	165.4

HEC-RAS Output Locally Preferred Plan. Meander Restoration with Weir Closures: Meanders 1, 2, 3 Only Model—with Closures 1, 2, 4 at lower elevations that USACE Alternatives

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)
Cache	Reach_6	7	I0500	500	144.4	149.4
Cache	Reach_6	7	I2000	2000	144.4	154.0
Cache	Reach_6	7	I2500	2500	144.4	154.7
Cache	Reach_6	7	I0200	200	144.4	147.9
Cache	Reach_6	7	I-APbw	30982	144.4	172.1
Cache	Reach_6	7	I3000	3000	144.4	154.5
Cache	Reach_6	7	I7000	7000	144.4	157.6
Cache	Reach_6	6.7	I1000	100	143.8	151.4
Cache	Reach_6	6.7	I-AP	3098	143.8	165.8
Cache	Reach_6	6.7	I0500	50	143.8	149.4
Cache	Reach_6	6.7	I2000	200	143.8	154.0
Cache	Reach_6	6.7	I2500	250	143.8	154.7
Cache	Reach_6	6.7	I0200	20	143.8	147.9
Cache	Reach_6	6.7	I-APbw	3098	143.8	172.1
Cache	Reach_6	6.7	I3000	300	143.8	154.5
Cache	Reach_6	6.7	I7000	700	143.8	157.7
Cache	Reach_6	6.69	I1000	100	143.8	151.4
Cache	Reach_6	6.69	I-AP	3098	143.8	165.8
Cache	Reach_6	6.69	I0500	50	143.8	149.4
Cache	Reach_6	6.69	I2000	200	143.8	154.0
Cache	Reach_6	6.69	I2500	250	143.8	154.7
Cache	Reach_6	6.69	I0200	20	143.8	147.9
Cache	Reach_6	6.69	I-APbw	3098	143.8	172.1
Cache	Reach_6	6.69	I3000	300	143.8	154.5
Cache	Reach_6	6.69	I7000	700	143.8	157.7
Cache	Reach_6	6.68	I1000	100	143.8	151.4
Cache	Reach_6	6.68	I-AP	3098	143.8	165.8
Cache	Reach_6	6.68	I0500	50	143.8	149.4
Cache	Reach_6	6.68	I2000	200	143.8	154.0
Cache	Reach_6	6.68	I2500	250	143.8	154.7
Cache	Reach_6	6.68	I0200	20	143.8	147.9
Cache	Reach_6	6.68	I-APbw	3098	143.8	172.1
Cache	Reach_6	6.68	I3000	300	143.8	154.5
Cache	Reach_6	6.68	I7000	700	143.8	157.7

HEC-RAS Output Locally Preferred Plan. Meander Restoration with Weir Closures: Meanders 1, 2, 3 Only Model—with Closures 1, 2, 4 at lower elevations that USACE Alternatives

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)
Cache	Reach_6	6.67	I1000	100	143.8	151.4
Cache	Reach_6	6.67	I-AP	3098	143.8	165.8
Cache	Reach_6	6.67	I0500	50	143.8	149.4
Cache	Reach_6	6.67	I2000	200	143.8	154.0
Cache	Reach_6	6.67	I2500	250	143.8	154.7
Cache	Reach_6	6.67	I0200	20	143.8	147.9
Cache	Reach_6	6.67	I-APbw	3098	143.8	172.1
Cache	Reach_6	6.67	I3000	300	143.8	154.5
Cache	Reach_6	6.67	I7000	700	143.8	157.7
Cache	Reach_6	6.66	I1000	100	143.8	151.4
Cache	Reach_6	6.66	I-AP	3098	143.8	165.8
Cache	Reach_6	6.66	I0500	50	143.8	149.4
Cache	Reach_6	6.66	I2000	200	143.8	154.0
Cache	Reach_6	6.66	I2500	250	143.8	154.7
Cache	Reach_6	6.66	I0200	20	143.8	147.9
Cache	Reach_6	6.66	I-APbw	3098	143.8	172.1
Cache	Reach_6	6.66	I3000	300	143.8	154.5
Cache	Reach_6	6.66	I7000	700	143.8	157.7
Cache	Reach_6	6.55	I1000	100	143.8	151.4
Cache	Reach_6	6.55	I-AP	3098	143.8	165.8
Cache	Reach_6	6.55	I0500	50	143.8	149.4
Cache	Reach_6	6.55	I2000	200	143.8	154.0
Cache	Reach_6	6.55	I2500	250	143.8	154.7
Cache	Reach_6	6.55	I0200	20	143.8	147.9
Cache	Reach_6	6.55	I-APbw	3098	143.8	172.1
Cache	Reach_6	6.55	I3000	300	143.8	154.5
Cache	Reach_6	6.55	I7000	700	143.8	157.7
Cache	Reach_6	6.5	I1000	1000	143.8	151.4
Cache	Reach_6	6.5	I-AP	30982	143.8	165.2
Cache	Reach_6	6.5	I0500	500	143.8	149.4
Cache	Reach_6	6.5	I2000	2000	143.8	154.0
Cache	Reach_6	6.5	I2500	2500	143.8	154.6
Cache	Reach_6	6.5	I0200	200	143.8	147.9
Cache	Reach_6	6.5	I-APbw	30982	143.8	172.1
Cache	Reach_6	6.5	I3000	3000	143.8	154.5

HEC-RAS Output Locally Preferred Plan. Meander Restoration with Weir Closures: Meanders 1, 2, 3 Only Model—with Closures 1, 2, 4 at lower elevations that USACE Alternatives

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)
Cache	Reach_6	6.5	I7000	7000	143.8	157.6
Cache	Reach_6	6.4	I1000	1000	143.8	151.4
Cache	Reach_6	6.4	I-AP	30982	143.8	165.2
Cache	Reach_6	6.4	I0500	500	143.8	149.4
Cache	Reach_6	6.4	I2000	2000	143.8	154.0
Cache	Reach_6	6.4	I2500	2500	143.8	154.6
Cache	Reach_6	6.4	I0200	200	143.8	147.9
Cache	Reach_6	6.4	I-APbw	30982	143.8	172.1
Cache	Reach_6	6.4	I3000	3000	143.8	154.5
Cache	Reach_6	6.4	I7000	7000	143.8	157.6
Cache	Reach_6	5	I1000	100	144.4	151.4
Cache	Reach_6	5	I-AP	3098	144.4	165.5
Cache	Reach_6	5	I0500	50	144.4	149.4
Cache	Reach_6	5	I2000	200	144.4	154.0
Cache	Reach_6	5	I2500	250	144.4	154.6
Cache	Reach_6	5	I0200	20	144.4	147.9
Cache	Reach_6	5	I-APbw	3098	144.4	172.1
Cache	Reach_6	5	I3000	300	144.4	154.5
Cache	Reach_6	5	I7000	700	144.4	157.6
Cache	Reach_6	4.99	I1000	100	144.4	151.4
Cache	Reach_6	4.99	I-AP	3098	144.4	165.5
Cache	Reach_6	4.99	I0500	50	144.4	149.4
Cache	Reach_6	4.99	I2000	200	144.4	154.0
Cache	Reach_6	4.99	I2500	250	144.4	154.6
Cache	Reach_6	4.99	I0200	20	144.4	147.9
Cache	Reach_6	4.99	I-APbw	3098	144.4	172.1
Cache	Reach_6	4.99	I3000	300	144.4	154.5
Cache	Reach_6	4.99	I7000	700	144.4	157.6
Cache	Reach_6	4.98	I1000	100	144.4	151.4
Cache	Reach_6	4.98	I-AP	3098	144.4	165.5
Cache	Reach_6	4.98	I0500	50	144.4	149.4
Cache	Reach_6	4.98	I2000	200	144.4	154.0
Cache	Reach_6	4.98	I2500	250	144.4	154.6
Cache	Reach_6	4.98	I0200	20	144.4	147.9

HEC-RAS Output Locally Preferred Plan. Meander Restoration with Weir Closures: Meanders 1, 2, 3 Only Model—with Closures 1, 2, 4 at lower elevations that USACE Alternatives

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)
Cache	Reach_6	4.98	I-APbw	3098	144.4	172.1
Cache	Reach_6	4.98	I3000	300	144.4	154.5
Cache	Reach_6	4.98	I7000	700	144.4	157.6
Cache	Reach_6	4.97	I1000	100	144.4	151.4
Cache	Reach_6	4.97	I-AP	3098	144.4	165.5
Cache	Reach_6	4.97	I0500	50	144.4	149.4
Cache	Reach_6	4.97	I2000	200	144.4	154.0
Cache	Reach_6	4.97	I2500	250	144.4	154.6
Cache	Reach_6	4.97	I0200	20	144.4	147.9
Cache	Reach_6	4.97	I-APbw	3098	144.4	172.1
Cache	Reach_6	4.97	I3000	300	144.4	154.5
Cache	Reach_6	4.97	I7000	700	144.4	157.6
Cache	Reach_6	4.96	I1000	100	144.4	151.4
Cache	Reach_6	4.96	I-AP	3098	144.4	165.5
Cache	Reach_6	4.96	I0500	50	144.4	149.4
Cache	Reach_6	4.96	I2000	200	144.4	154.0
Cache	Reach_6	4.96	I2500	250	144.4	154.6
Cache	Reach_6	4.96	I0200	20	144.4	147.9
Cache	Reach_6	4.96	I-APbw	3098	144.4	172.1
Cache	Reach_6	4.96	I3000	300	144.4	154.5
Cache	Reach_6	4.96	I7000	700	144.4	157.6
Cache	Reach_6	4.5	I1000	100	144.4	151.4
Cache	Reach_6	4.5	I-AP	3098	144.4	165.5
Cache	Reach_6	4.5	I0500	50	144.4	149.4
Cache	Reach_6	4.5	I2000	200	144.4	154.0
Cache	Reach_6	4.5	I2500	250	144.4	154.6
Cache	Reach_6	4.5	I0200	20	144.4	147.9
Cache	Reach_6	4.5	I-APbw	3098	144.4	172.1
Cache	Reach_6	4.5	I3000	300	144.4	154.5
Cache	Reach_6	4.5	I7000	700	144.4	157.6
Cache	Reach_6	4	I1000	1000	144.7	151.4
Cache	Reach_6	4	I-AP	30982	144.7	165.4
Cache	Reach_6	4	I0500	500	144.7	149.4
Cache	Reach_6	4	I2000	2000	144.7	153.9

HEC-RAS Output Locally Preferred Plan. Meander Restoration with Weir Closures: Meanders 1, 2, 3 Only Model—with Closures 1, 2, 4 at lower elevations that USACE Alternatives

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)
Cache	Reach_6	4	I2500	2500	144.7	154.6
Cache	Reach_6	4	I0200	200	144.7	147.9
Cache	Reach_6	4	I-APbw	30982	144.7	172.1
Cache	Reach_6	4	I3000	3000	144.7	154.5
Cache	Reach_6	4	I7000	7000	144.7	157.6
Cache	Reach_6	3	I1000	1000	144.7	151.3
Cache	Reach_6	3	I-AP	30982	144.7	165.3
Cache	Reach_6	3	I0500	500	144.7	149.4
Cache	Reach_6	3	I2000	2000	144.7	153.9
Cache	Reach_6	3	I2500	2500	144.7	154.6
Cache	Reach_6	3	I0200	200	144.7	147.8
Cache	Reach_6	3	I-APbw	30982	144.7	172.1
Cache	Reach_6	3	I3000	3000	144.7	154.4
Cache	Reach_6	3	I7000	7000	144.7	157.5
Cache	Reach_6	2.5	I1000	100	144.7	151.3
Cache	Reach_6	2.5	I-AP	3098	144.7	165.3
Cache	Reach_6	2.5	I0500	50	144.7	149.4
Cache	Reach_6	2.5	I2000	200	144.7	153.9
Cache	Reach_6	2.5	I2500	250	144.7	154.6
Cache	Reach_6	2.5	I0200	20	144.7	147.8
Cache	Reach_6	2.5	I-APbw	3098	144.7	172.1
Cache	Reach_6	2.5	I3000	300	144.7	154.4
Cache	Reach_6	2.5	I7000	700	144.7	157.5
Cache	Reach_6	2.49	I1000	100	144.7	151.3
Cache	Reach_6	2.49	I-AP	3098	144.7	165.3
Cache	Reach_6	2.49	I0500	50	144.7	149.4
Cache	Reach_6	2.49	I2000	200	144.7	153.9
Cache	Reach_6	2.49	I2500	250	144.7	154.6
Cache	Reach_6	2.49	I0200	20	144.7	147.8
Cache	Reach_6	2.49	I-APbw	3098	144.7	172.1
Cache	Reach_6	2.49	I3000	300	144.7	154.4
Cache	Reach_6	2.49	I7000	700	144.7	157.5
Cache	Reach_6	2.48	I1000	100	144.7	151.3
Cache	Reach_6	2.48	I-AP	3098	144.7	165.3

HEC-RAS Output Locally Preferred Plan. Meander Restoration with Weir Closures: Meanders 1, 2, 3 Only Model—with Closures 1, 2, 4 at lower elevations that USACE Alternatives

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)
Cache	Reach_6	2.48	I0500	50	144.7	149.4
Cache	Reach_6	2.48	I2000	200	144.7	153.9
Cache	Reach_6	2.48	I2500	250	144.7	154.6
Cache	Reach_6	2.48	I0200	20	144.7	147.8
Cache	Reach_6	2.48	I-APbw	3098	144.7	172.1
Cache	Reach_6	2.48	I3000	300	144.7	154.4
Cache	Reach_6	2.48	I7000	700	144.7	157.5
Cache	Reach_6	2.47	I1000	100	144.7	151.3
Cache	Reach_6	2.47	I-AP	3098	144.7	165.3
Cache	Reach_6	2.47	I0500	50	144.7	149.4
Cache	Reach_6	2.47	I2000	200	144.7	153.9
Cache	Reach_6	2.47	I2500	250	144.7	154.6
Cache	Reach_6	2.47	I0200	20	144.7	147.8
Cache	Reach_6	2.47	I-APbw	3098	144.7	172.1
Cache	Reach_6	2.47	I3000	300	144.7	154.4
Cache	Reach_6	2.47	I7000	700	144.7	157.5
Cache	Reach_6	2.46	I1000	100	144.7	151.3
Cache	Reach_6	2.46	I-AP	3098	144.7	165.3
Cache	Reach_6	2.46	I0500	50	144.7	149.4
Cache	Reach_6	2.46	I2000	200	144.7	153.9
Cache	Reach_6	2.46	I2500	250	144.7	154.6
Cache	Reach_6	2.46	I0200	20	144.7	147.8
Cache	Reach_6	2.46	I-APbw	3098	144.7	172.1
Cache	Reach_6	2.46	I3000	300	144.7	154.4
Cache	Reach_6	2.46	I7000	700	144.7	157.5
Cache	Reach_6	2.1	I1000	100	144.7	151.3
Cache	Reach_6	2.1	I-AP	3098	144.7	165.3
Cache	Reach_6	2.1	I0500	50	144.7	149.4
Cache	Reach_6	2.1	I2000	200	144.7	153.9
Cache	Reach_6	2.1	I2500	250	144.7	154.6
Cache	Reach_6	2.1	I0200	20	144.7	147.8
Cache	Reach_6	2.1	I-APbw	3098	144.7	172.1
Cache	Reach_6	2.1	I3000	300	144.7	154.4
Cache	Reach_6	2.1	I7000	700	144.7	157.5

HEC-RAS Output Locally Preferred Plan. Meander Restoration with Weir Closures: Meanders 1, 2, 3 Only Model—with Closures 1, 2, 4 at lower elevations that USACE Alternatives

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)
Cache	Reach_6	2	I1000	1000	143.3	151.3
Cache	Reach_6	2	I-AP	30982	143.3	165.2
Cache	Reach_6	2	I0500	500	143.3	149.4
Cache	Reach_6	2	I2000	2000	143.3	153.9
Cache	Reach_6	2	I2500	2500	143.3	154.6
Cache	Reach_6	2	I0200	200	143.3	147.8
Cache	Reach_6	2	I-APbw	30982	143.3	172.1
Cache	Reach_6	2	I3000	3000	143.3	154.4
Cache	Reach_6	2	I7000	7000	143.3	157.4
Cache	Reach_6	1	I1000	1000	143.9	151.2
Cache	Reach_6	1	I-AP	30982	143.9	164.9
Cache	Reach_6	1	I0500	500	143.9	149.3
Cache	Reach_6	1	I2000	2000	143.9	153.8
Cache	Reach_6	1	I2500	2500	143.9	154.4
Cache	Reach_6	1	I0200	200	143.9	147.8
Cache	Reach_6	1	I-APbw	30982	143.9	172.0
Cache	Reach_6	1	I3000	3000	143.9	154.1
Cache	Reach_6	1	I7000	7000	143.9	157.0
Cache	Reach_6	0	I1000	1000	144.1	151.0
Cache	Reach_6	0	I-AP	30982	144.1	164.6
Cache	Reach_6	0	I0500	500	144.1	149.1
Cache	Reach_6	0	I2000	2000	144.1	153.6
Cache	Reach_6	0	I2500	2500	144.1	154.2
Cache	Reach_6	0	I0200	200	144.1	147.5
Cache	Reach_6	0	I-APbw	30982	144.1	172.0
Cache	Reach_6	0	I3000	3000	144.1	153.7
Cache	Reach_6	0	I7000	7000	144.1	156.6

APPENDIX K
Lower Cache River Ecosystem Restoration
Section 1135 DPR

Cost Effectiveness & Incremental Cost Analysis

Locally Preferred Plan:

Because of a constraint of funds, a decision was made to evaluate a project smaller than the NER Plan. The Locally Preferred Plan (LPP) is less in scope and cost than the NER Plan, and it meets the highest environmental outputs (Habitat Units) for the funds that are available.

A Cost Effectiveness Analysis was conducted for the LPP Scenarios to identify if the plans were Cost Effective as to average cost per habitat unit. The LPP Scenarios were not comparable to Alternative 2, because of the significant design and cost changes, plus the funding constraint that would eliminate Alternative 2 which is unimplementable from further analysis. This analysis assumed that the same net habitat unit benefits for unplugging each meander would remain the same for the LPP Scenarios. The only change would be the reduction in cost from changing the construction design. Table 1 shows that project construction cost for the smaller design is reduced; however, with this design deviation, OMRR&R costs and risk increase.

Combinable LPP management measures: Several possible combinations of management measures and scales were formulated for the LPP Scenarios. Each measure and scale was combined with the cost and output of each part being summed. As a result, each combination had an associated total cost and total output. Each possible combination was considered a Scenario/plan. Table 1 displays the 4 LPP Scenarios that were measured.

LPP Scenario/Plan:

No Action plan: No Federal action would be undertaken to restore the degraded conditions in the project area with the No Action plan.

LPP-1 (M 1 & 2): This scenario includes the removal of channel plugs in 2 meanders (1 & 2), and the building of 2 low water weirs in the main channel.

LPP-1 (M 1 & 3): This scenario includes the removal of channel plugs in 2 meanders (1 & 3), and the building of 3 low water weirs in the main channel, and adding 1 rock plug in meander 3. (Note: Meander 2 cannot be opened in the future after building

weirs at meander 3.)

LPP (M 1, 2 & 3): This scenario includes the removal of channel plugs in 3 meanders (1, 2 & 3), and the building of 4 low water weirs in the main channel, and adding 1 rock plug in meander 3. This is the plan that the sponsor requested in correspondence in November 2010.

LPP-1 (M 1, 2, 3 & 4): This scenario includes the removal of channel plugs in 4 meanders (1, 2, 3 & 4), and the building of 5 low water weirs in the main channel, and adding 1 rock plug in meander 3.

TABLE 1

LOWER CACHE RIVER ECOSYSTEM RESTORATION

AVERAGE ANNUAL TOTAL PROJECT COST FOR THE LPP SCENARIO & COST PER HABITAT UNIT

(November 2010 Price Level @ 4 1/8% Interest Rate)

Col. 1 Scenario (Meanders)	Col. 2 Project Construction First Cost	Col. 3 Average Annual Cost 1/	Col. 4 Annual OMRR&R Cost 2/	Col. 5 Average Annual Monitoring 3/	Col. 6 Average Annual Total Cost (Col. 3+4+5	Col. 7 Average Annual Net Restored Habitat Units	Col. 8 Average Annual Cost Per Habitat Unit (Col. 6/7)
No Action	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LPP-1 (M1&2)	$3,794,000	$180,000	$30,000	$3,000	$213,000	4,446	$47.91
LPP-1 (M1&3)	$4,289,000	$204,000	$30,000	$3,000	$237,000	6,240	$37.98
LPP (M1,2,3)	**$5,574,000**	**$265,000**	**$45,000**	**$3,000**	**$313,000**	**7,963**	**$39.31**
LPP+1 (M1,2,3,4)	$6,902,000	$335,000	$60,000	$3,000	$398,000	9,933	$40.07
NER 4/ Alt. 2a (M1,2,3,4,5&6)	$13,054,000	$634,000	$6,000	$3,000	$643,000	16,200	$39.69

1/ Project construction will take place over a 1-year period for LPP-1 & LPP, and a 2-year period for LPP+1. Average annual cost includes Interest During Construction (IDC). Common reference period is end of year.

2/ OMRR&R costs are for inspection, weir maintenance, and minor repairs at the 10 year intervals after construction.

3/ Performance monitoring of the project site will take place after construction.

4/ The NER plan is not actually comparable to the LPP scenarios, because of the smaller weir design, however, the NER is shown at the bottom of this table for informational purposes only.

Cost effectiveness analysis: A cost effective analysis was performed for the LPP Scenarios to determine if no other plan provided the same level of output for less cost and if no other plan provided more output for the same or less cost. This identifies the least-cost or best solution plan for a given amount (or range) of outputs. All four LPP Scenarios/plans were identified as being "cost effective" plans.

The LPP Scenarios provided relatively similar outputs with lower construction costs when decreasing the number of meanders that were being unplugged. Figure 1 shows that LPP-1 (M1&2) and LPP (M1,2,3) were cost effective plans, whereas LPP-1 (M1&3) and LPP+1 (M1,2,3,4) were cost effective plans and also determined to be "Best Buy" plans.

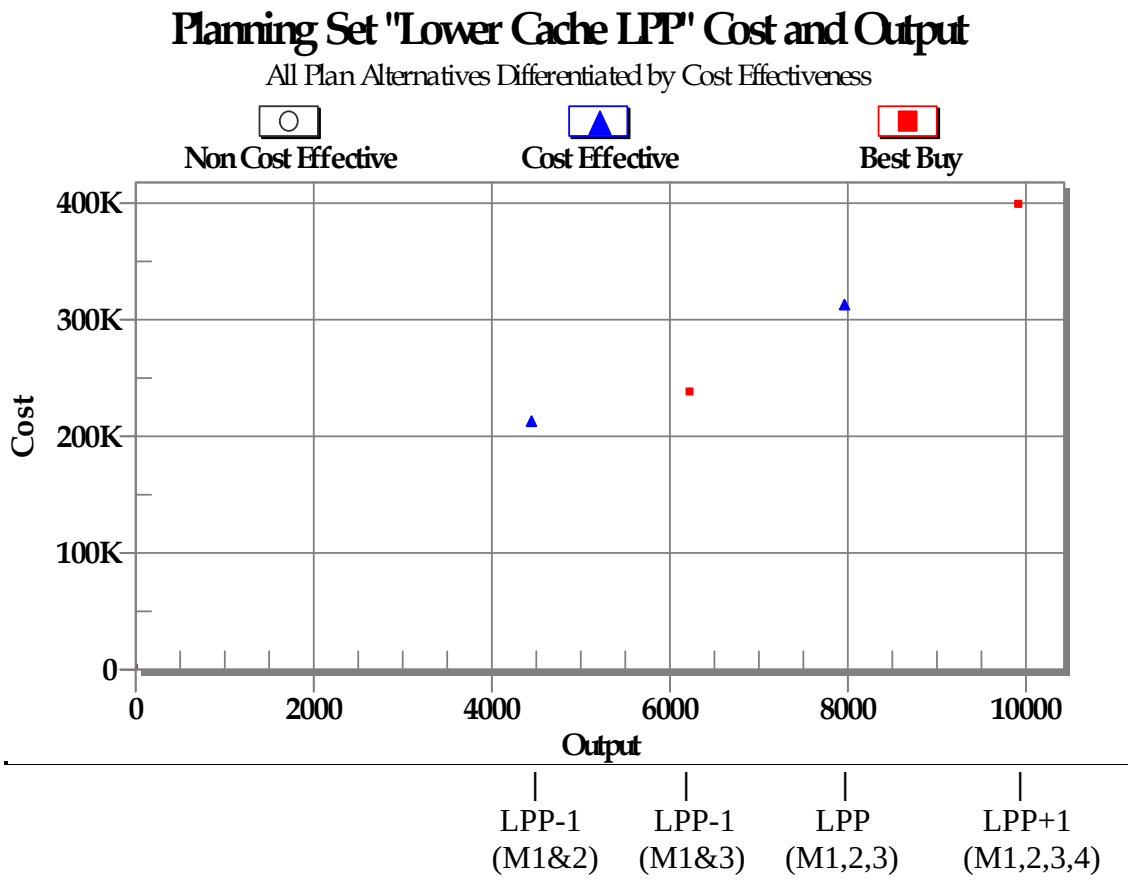
a. It should be noted that even though the LLP-1 (M1&3) is the first Best Buy plan, with an average cost of $37.98 per habitat unit, it is not exactly comparable to the other LPP plans in that by building weirs at meanders 1 and 3, this eliminates the possibility of opening meander 2 in the future. Therefore, the net benefits for meander 2 would be lost. The other LPP plans are connected to each other in meander order as a system. This is an acceptable plan and can be chosen by the decision makers if they decide to eliminate opening meander 2. Otherwise, this plan should be eliminated from consideration.

b. LPP+1 (M1,2,3,4) is the second Best Buy plan, however, the project costs to build this alternative is much higher (over $1.3 million) than the funds that are available. This plan is eliminated.

c. LPP (M1,2,3) is a cost effective plan with an average cost of $39.31 per habitat unit. Net benefits for unplugging only 3 of the 6 meanders are 7,963 average annual habitat units (AAHU). By unplugging the first 3 meanders located at the top of the Lower Cache River (Meanders 1, 2, and 3) as the first project design, the lower 3 meanders (Meanders 4, 5, and 6) could still be unplugged at a later date. This means that the potential restoration of habitat units from the lower 3 meanders could still be realized in the future. This is an acceptable plan and can be chosen by the decision makers.

d. LPP-1 (M1&2) is a cost effective plan with an average cost of $47.91 per habitat unit. However, it is not as cost effective as LPP (M1,2,3). This is an acceptable plan and can be chosen by the decision makers.

Figure 1



Recommended Plan:

After considering the economy, overall benefits, the cost limitation of the Section 1135 Program, and sponsor funding constraints; the LPP (M1,2,3) was selected as the recommended plan. This was based on the cost effectiveness analysis which showed that the average cost per habitat unit for the LPP (M1,2,3) was $39.31. The LPP (M1,2,3) was chosen as the recommended ecosystem restoration design plan to continue to the design stage. LPP (M1,2,3) provides the greatest restoration benefits for the funds that are available.

Locally Preferred Plan: Total first cost for the LPP (M1,2,3) is $5,574,000 at current (November 2010) price levels. Real estate cost is estimated to be $68,000 or 1.2% of the total. The bulk of the cost is for constructing the weirs and removing the plugs, which is estimated to be $4,735,000 or 84.9% of the total. The remaining $771,000 (13.8%) is for engineering & design, and supervision & administration. Only actual project construction costs were included in the total project first cost calculations for the Cost Effectiveness Analysis. Study costs are sunk costs and were not included as part of the total project costs for this analysis.

Average Annual Investment Costs: The first cost for the construction of the Locally Preferred Plan (M1,2,3) was estimated to be $5,574,000, with a total average annual investment cost of $265,000.

Annual Operation, Maintenance, and Replacement Costs: Total annual operation, maintenance, repair, rehabilitation, and replacement costs (OMRR&R) are estimated at $45,000 for the LPP (M1,2,3). OMRR&R costs are for inspection, weir maintenance, and major repairs at 10 year intervals.

Performance Monitoring Costs: Performance monitoring and inspection of the project site will take place after construction. The average annual equivalent costs are estimated at $3,000 for the LPP (M1,2,3).

Summary: The Locally Preferred Plan (M1,2,3) has net benefits of 7,963 average annual habitat units, and an average total cost of $313,000 for an average cost of $39.31 per habitat unit. Whereas the NER Plan, the average cost was $39.69 per habitat unit. The Locally Preferred Plan (M1,2,3) is a cost-effective plan that also maximizes ecosystem restoration benefits as compared to costs per habitat unit, for the funds that are available. There are no smaller scale plans that are comparable that produces potentially greater net benefits than the LPP (M1,2,3).

Items resulting in reduced quantities from changing the configuration of the weir (from ht = 8' to ht = 6')
12/8/2010

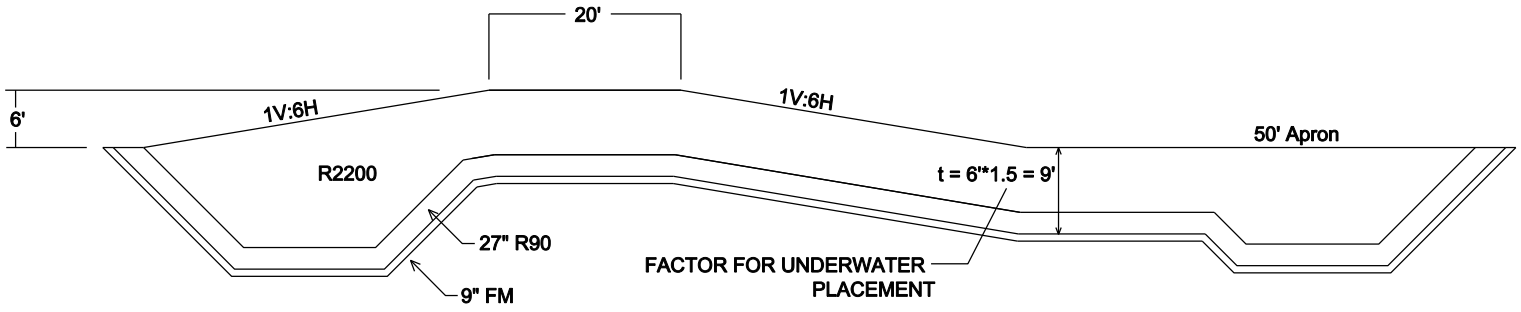
	Previous cy	Revised cy	cy Reduction
Weir 3 (downstream one - largest)			
R2200 in weir structure	20,350	11,132	9,218
R90 in weir structure	2,536	3,606	-1,070
FM in weir structure	1,268	1,243	25
R2200 along bank slopes of weir	3,016	2,361	655
Weirs 5 (dike configuration) --> these quantities are cumulative for both weirs			
R2200 in weir structure	16,602	10,858	5,744
R90 in weir structure	2,872	3,932	-1,060
FM in weir structure	1,436	1,508	-72
R2200 along bank slopes of weir	1,936	1,800	136
Meander Plug & Bank Protection			
R2200 in plug	3,335	0	3,335
R90 in plug & bank slopes	2,102	4,945	-2,843
FM in plug & bank slopes	1,051	460	591
			14,659 <---- Need to reduce quantity by atleast 14,374 cy √

NOTE: Need to cut quantity by approximately 21,500 TN material for cost savings
--> 14,374 cy material reduction required

Since the footprint of the weir structures decreased, the quantities and costs associated with the excavation, and clearing & turfing will also decrease. However, by decreasing the height and thickness of the weir, O&M costs slightly increase

Real estate costs will also slightly decrease

WEIR OPTION 3 W/KEY (1 LOCATION)
weir ht = 6', design t = 6'
multiply by factor of 1.5 for underwater placement



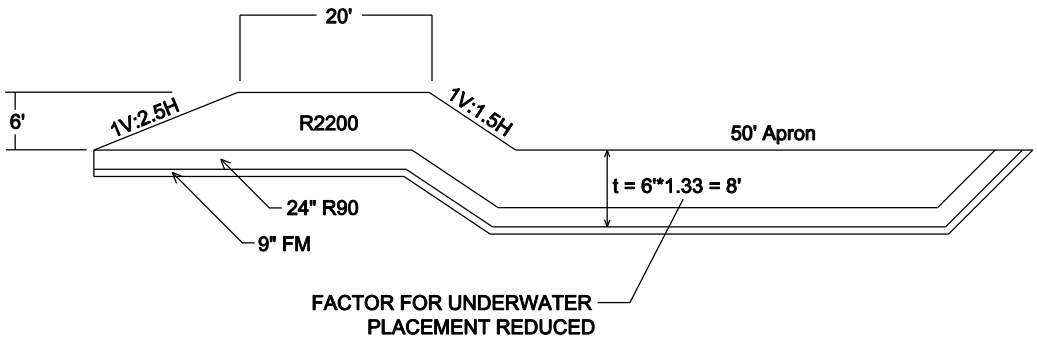
AREA R2200 = 1,093 sf
w = 275 ft
V R2200 = 11,132 cy

AREA R90 = 354 sf
w = 275 ft
V R90 = 3,606 cy

V FM = 1,243 cy

SCALE: 1"=20'

WEIR OPTION 5 W/O KEY (2 LOCATIONS)
t = 6'



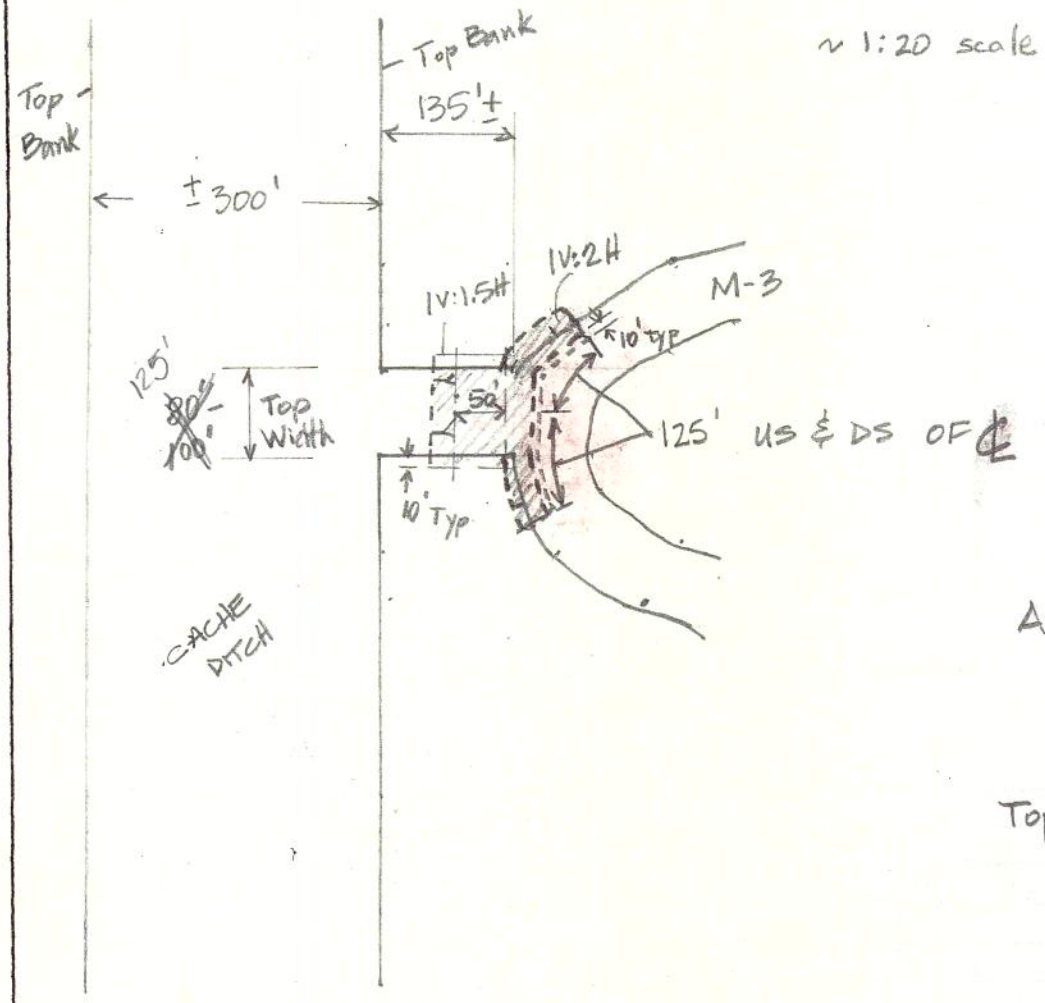
AREA R2200 = 533 sf
w = 275 ft
V R2200 = 5,429 cy

AREA R90 = 193 sf
w = 275 ft
V R90 = 1,966 cy

V FM = 754 cy

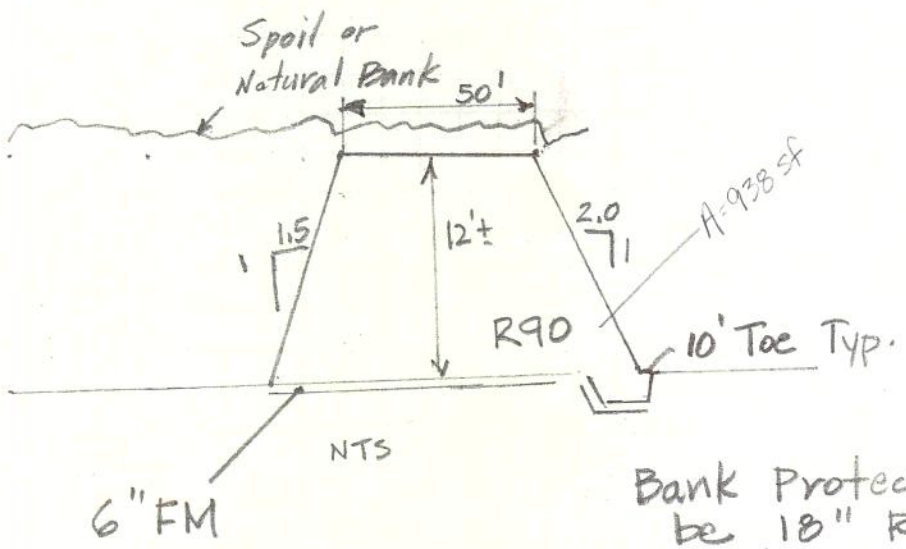
SCALE: 1"=20'

SUBJECT: L. CACHE #135 Rock Plug For Connector Channel M#3	COMPUTED BY: A. Gaines	DATE: 12/8/2010	FILE NO.
	CHECKED BY:	DATE:	SHEET NO.



ASSUME 1V:1.5H bank slope for connector ditch.

Top Widths scaled from aerial photo in ArcGIS.



Bank Protection to be 18" R90. Adjust Thickness using 1.5 factor for UW placement

WES FORM NO. 1253
REV OCT 1968

SUBJECT:	COMPUTED BY:	DATE:	FILE NO.
NOTE: All of the plug and slope prot will be R_{90}.	LEWIS	12/8/10	
	CHECKED BY:	DATE:	SHEET NO.

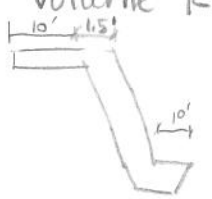
Volume Material for the Plug:

Volume of Plug R_{90} = $\frac{(938\ sf)(125\ ft)}{27}$ = 4345 cy

FM = (54)(125)/27 = 250 cy

Bank Protection Volumes (x 1.5 for underwater placement):

Volume R_{90} =



Area = 77 sf

L = 70' us + 70' ds = 140' (past each side of the plug limit)

V = 400 cy (1.5 U.P. FACTOR) = 600 cy

FM = (27 sf)(140 ft)/27 = 140 cy (1.5 U.P. FACTOR) = 210 cy

Totals for Plug:

R_{90} = 4345 + 600 = 4,945 cy [7,418 TN]

F.M. = 250 + 210 = 460 cy [690 TN]

APPENDIX LPP
COST ESTIMATES

C-01. PROJECT DESCRIPTION

This study was conducted under the authority of Section 1135 of the Water Resources Development Act of 1986, in response to a request from the Arkansas Game and Fish Commission and Ducks Unlimited. The lower seven miles of the Cache River was channelized in the early 1970's. Plugs were placed in the upstream openings of at least six meanders, thereby changing them from lotic to lentic in structure and function. The Cache River National Wildlife Refuge provides some riparian buffer in this area, which has afforded a level of protection from riverside development. Significant levels of sediment enter and are transported by the Cache River. The sediment originates from headcutting and erosion in its tributaries and unstable reaches of the river itself. The sediment either moves downstream into the White River below Clarendon, Arkansas or is deposited within choked reaches of the Cache River and adjacent floodplain.

The purpose of this study was to determine the feasibility of restoring riverine conditions to the meanders, thereby providing improvements to fish and wildlife habitat.

The proposed project encompasses a reach of the River located in Monroe County, Arkansas almost entirely within the boundaries of the Cache River National Wildlife Refuge. The reach of the Cache River under study begins approximately 1.5 miles north of Clarendon, Arkansas and ends approximately 8.5 miles north of Clarendon. The project area includes six river meanders that were plugged by the Cache River Basin Project in the early 1970's. This project diverted flow of the river into a straight channel dissecting the historic river configuration.

C-02. REFERENCES

References used in the development of the cost estimate and this section of the appendix, are as follows:

Cost Engineering Regulations:

ER 1110-1-1300	26 Mar 93	Engineering and Design Cost Engineering Policy
ER 1110-2-1302	15 Sep 08	Civil Works Cost Engineering
ETL 1110-2-573	30 Sep 08	Construction Cost Estimating Guide for CW

Planning/Design Regulations:

ER 1105-2-100	22 Apr 00	Planning Guidance Notebook
ER 1110-2-1150	31 Aug 99	E & D for Civil Works Projects
EC 1165-2-209	31 Jan 10	Civil Works Review Policy

C-03. ALTERNATIVE PLAN SELECTION

In order to compare the costs of the different options, parametric estimates were made on each of the options involving construction. These three total project cost estimates were

computed in a spreadsheet, and are shown in this appendix. The basis for parametric unit pricing used in the cost estimates was the detailed MII cost estimate built for the selected option. However, the costs of the selected plan were more than the sponsor could afford, so a 4th alternative was developed. This is called the Locally Preferred Plan (LPP) in the rest of this appendix. The M2 estimate was revised to reflect the LPP, in accordance with ER 1105-2-100, paragraph 4-3b(2)(a), page 4-6. "A detailed analysis and description of the NED, NER or Combined NED/NER plans, including a detailed final cost estimate for these plans, are not required and do not need to be documented in the feasibility report."

The comments column in the Cost Tables explains assumptions used in the costing. Quantities for excavation and rock were furnished by the Civil Design team member. Other quantities were computed by the cost engineer, using spreadsheets and the design data furnished.

C-04. LPP PLAN

The LPP is the selected plan, and consists of work on the following three meanders: 1, 2, and 3. This will involve the construction of three weirs in the Cache River, the removal of three plugs at the entrances to the meanders, and the construction of one rock cutoff. For another description of this plan, see the Main Report section entitled "Locally Preferred Plan". The low-flow weirs would direct water into the meanders during normal flows, but would not impede conveyance during flood events.

The existing plugs on the upstream ends of the meanders could be removed when the river stages are lower. Clearing for this and for the weir overbank protection could also be done during this time. When the river stages are higher, then the rock could be delivered and placed directly from the barges into the weirs. Since the Cache is only about 230' wide at the reach of river where this work is, the rock barge and work barge would both have to be parallel to the banks, side by side. Each barge is about 200' long by 40' wide. Since the dragline or hydraulic excavator would be on one end of the work barge, another machine (a Front-End Loader) would be needed to keep the rock supply close to the hydraulic excavator.

C-05. LPP ESTIMATE

The estimate on the chosen alternative, was done using M2 (version 3.01, build 2), and the latest versions of the Equipment Library and Cost Book (2007 version 2 region 3, and 2008 v3, respectively). A detailed estimate was prepared.

The M2 project library file was "LCR 20101216 LPP.mlp" and the total cost for the 06 account was $4,896,721 with contingencies. The M2 cost reports included in this appendix were those determined to be most applicable to the majority of users. They consist of the cost summaries down to, and including, the "fifth" level (bid item level). Detail task notes, production, and crew information are available at the "detail" level and contain valuable descriptions of exactly what is planned or envisioned by the study team and costs applied accordingly. This data should be followed and considered when

preparing final plans and specifications to insure that the authorized costs are not changed. Additional backup reports are available for review by hard copy or electronically from the Memphis District Design Branch, Cost Engineering and Relocations Unit.

C-06. CONTINGENCIES AND ESCALATION

Contingencies were applied to each cost account in the MII estimate and the parametric estimates used for alternative selection and averaged about 23.6%. The percentages used were judged to be appropriate considering the uncertainties at this stage of the design, and the lack of cross section data. This lack of data could affect the quantities, which would impact the estimate. Another source of risk is the White River and Cache River water levels, which could impact the ability to transport stone to build the weirs. Without barge transportation, roads would have to be constructed (to each weir site) that could support heavy trucks loaded with stone.

The construction costs estimated assume an average bidding and economic climate, care in designing to cost, prudent construction procedures, and contract timing that takes advantage of the construction season. The major driver for this estimate is the price of the stone used in the weirs. Average weather conditions were assumed. Unrestricted bidding will produce the best prices, and was assumed to be the method of procurement. If restricted bidding is used, (8-a contractors only, etc.), construction prices will be about 20% higher than those shown here.

The total project estimate is current as of the date shown on the Cost Tables. No escalation was applied at this time within the M2 estimate. Any future escalation in project costs will use EM 1110-2-1304, Civil Works Construction Cost Index System factors.

C-07. COST ACCOUNT NOTES.

01 Lands and Damages Feature - Real Estate Division provided information for this feature. See the real estate appendix for more details.

02 Relocations Feature - Information for this feature was provided by Relocations personnel in the Memphis District. No relocations needs were discovered, as most of this area is located in a wildlife refuge area.

06 Fish and Wildlife Facilities - Civil Design Section, Design Branch, furnished all quantities, except for some minor items such as clearing, tree planting, and turfing. Some additional quantity calculations performed by Cost Engineering are shown toward the end of this appendix. Work was broken down into typical bid items for this type of work, and unit prices from historical data were used as a check.

Riprap and Filter Material: A recent quote from a trusted supplier was used for the stone and delivery costs. Delivery is to be by barge from the Mississippi to the White and Cache Rivers.

The "detail" M2 printout notes and documentation should be consulted if further information and documentation is desired. The other engineering appendixes offer detailed descriptions which would only be duplicated if presented here.

One set of labor rates was used for this non-union, or "valley" state (AR). Rates from actual payroll records have been obtained from similar jobs and adjusted for inflation. These rates usually exceed the minimum 2010 Davis Bacon labor rates for Monroe County, Arkansas.

Production rates were extracted from Memphis District contract field reports, the Memphis District Cost Item data base, in-house calibrated production spreadsheet programs, various technical publications such as R.S. Means, and information from contractors, subcontractors and manufacturers. Production for draglines and excavators was calculated from a spreadsheet program based upon the Power Shovel Association method for dragline production and calibrated with Memphis District historic production data.

A total markup of about 24% was used for the Contractor's Overheads. This includes field office overhead, home office, profit, and bond (applied in that order). A typical earthwork general contractor has about 10% – 12% supervision and miscellaneous costs, but because the high rock prices increased the contract amount, 5% was used here. Home office percent was set at 7%. Profit was set at 9%, and bond was computed in the software, using the bond tables, which yielded .9%.

It was assumed that the work could be accomplished using one contract; however it is essential that the contract be awarded such that he can work during the winter/spring of the year, when river levels are highest, and most favorable for transporting rock on the White and Cache Rivers. The work would have to start upstream and move downstream, since the weirs would restrict rock barge traffic after they are constructed. The plug removals could be done if the river dropped for several days, since they don't require rock.

30 Planning, Engineering, and Design Feature - A percentage of the 06, Fish and Wildlife Facilities feature, was used to determine the total cost for this feature. A contingency of 15% was used.

31 Construction Management - A percentage of the 06, Fish and Wildlife Facilities feature, was used to determine the total cost for this feature. A contingency of 15% was used.

C-08. O&M COSTS.

The M2 estimate does not include O&M costs. These costs were based on a percent of the total construction first costs, and are shown in the O & M spreadsheets at the end of the project cost estimates for each alternative. These O & M costs are current construction costs and were converted to average annual costs in Table 1 of the Cost Effectiveness and Incremental Cost Analysis section of the Locally Preferred Plan Appendix. For the LPP, it was assumed that notches would be cut in the downstream weirs (the large one & 1 smaller one) to allow more stone to be added. This was due to the smaller weir design configuration in the LPP. The notches would be repaired after the contractor moves downstream as the work progresses. The frequency and the percent of stone required for repairs are also increased due to the smaller weir design configuration in the LPP.

C-09. CONSTRUCTION SCHEDULE.

A construction schedule was developed and is shown at the end of this appendix. The start date shown (this year) is not necessarily when construction will start, but was chosen to reflect the earliest time of year when a contract could be awarded. This is due to the necessity of high water levels to float the rock to the project site. Actual contract time could vary some, but the contractor will have some work to do that doesn't require rock, so he will have some flexibility in scheduling his work. The work should take about five months to complete, barring any unusually low river stages over a protracted length of time.

Corps of Engineers, Memphis District							
LOWER CACHE RIVER, Monroe Co, AR; Section 1135 Feasibility Study							
Prices as of Nov 2010; Preparation Date: 1/21/11							
LPP FOR 3 WEIRS, 3 PLUG REMOVALS, & 1 ROCK PLUG							
ITEM DESCRIPTION	**QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**	**CONTING.**	**TOTAL**	**COMMENT**
01 LANDS AND DAMAGES (w/ contin.)							
Lands and Damages	1	LS	$68,000	$68,000	$0	$68,000	Contingency included, 44 acres total
Mitigation Land (none required)	1	LS		$0	$0	$0	
Total 01				$68,000	$0	**$68,000**	
02 RELOCATIONS							(none required)
Roads & Bridges	1	LS		$0	$0	$0	
Utilities	1	LS	$0	$0	$0	$0	
Total 02				$0	$0	**$0**	
06 FISH & WILDLIFE FACILITIES							
Plug Removal	3	EA	$60,333	$181,000	$48,000	$229,000	Total for plug removals
Mob & Demob	1	LS	$51,700	$52,000	$13,000	$65,000	Includes environmental protection and assumes 1 work season
Clearing	18	AC	$1,400	$25,000	$6,000	$31,000	Medium-Heavy, pile and/or burn
Excavate Plug	19,800	CY	$4.45	$88,000	$26,000	$114,000	Spoil beside Cache River, Dragline & Dozer
Turfing	9	AC	$1,800	$16,000	$3,000	$19,000	Fertilize & Seed
Large Weir Construction	1	EA	$1,553,000	$1,553,000	$424,000	$1,977,000	Total for building southern-most weir
Excavation for Keys	21,170	CY	$4.45	$94,000	$24,000	$118,000	Spoil beside Cache River, Dragline & Dozer
Filter Material	2,750	TN	$39.75	$109,000	$30,000	$139,000	All Rock delivered by barge, placed by barge mounted equipment
Riprap R-90	7,180	TN	$41.05	$295,000	$81,000	$376,000	
Riprap R-2200	22,720	TN	$46.35	$1,053,000	$288,000	$1,341,000	
Tree Planting	1,600	EA	$1.55	$2,000	$1,000	$3,000	Four 200' rows on each bank beside weirs
Smaller Weir Construction	2	EA	$826,000	$1,652,000	$451,000	$2,103,000	Total for building all other weirs
Excavation for Keys	18,694	CY	$4.45	$83,000	$21,000	$104,000	Spoil beside Cache River, Dragline & Dozer
Filter Material	3,260	TN	$39.75	$130,000	$36,000	$166,000	All Rock delivered by barge, placed by barge mounted equipment
Riprap R-90	7,900	TN	$41.05	$324,000	$89,000	$413,000	
Riprap R-2200	23,940	TN	$46.35	$1,110,000	$304,000	$1,414,000	
Tree Planting	3,200	EA	$1.55	$5,000	$1,000	$6,000	Four 200' rows on each bank beside weirs
Rock Plug Construction	1	EA	$335,000	$335,000	$91,000	$426,000	Assumed R90 used instead of R2200
Excavation for Slope adjustment	200	CY	$4.45	$1,000	$0	$1,000	this is for bank protection
Filter Material	690	TN	$39.75	$27,000	$7,000	$34,000	
Riprap R-90	7,420	TN	$41.05	$305,000	$83,000	$388,000	
Riprap R-2200	0	TN	$46.35	$0	$0	$0	

Corps of Engineers, Memphis District							
LOWER CACHE RIVER, Monroe Co, AR; Section 1135 Feasibility Study							
Prices as of Nov 2010; Preparation Date: 1/21/11							
LPP FOR 3 WEIRS, 3 PLUG REMOVALS, & 1 ROCK PLUG							
ITEM DESCRIPTION	**QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**	**CONTING.**	**TOTAL**	**COMMENT**
Tree Planting	1,600	EA	$1.55	$2,000	$1,000	$3,000	
Total 06				$3,721,000	$1,014,000	**$4,735,000**	
30 PLANNING, E&D							"Quantity" for 06 is cost of construction in dollars
E&D for study costs	1	LS		$895,000	$0	$895,000	Cost to do study (most is sunk costs)
E&D for 02 relocations	0	DOL			$0	$0	Unit is Dollars
E&D for 06 Fish & Wildlife	3,721,000	DOL	10%	$372,000	$56,000	$428,000	"Unit Price" is Percent of construction
Total 30				$1,267,000	$56,000	**$1,323,000**	
31 CONSTRUCTION MANAGEMENT							"Quantity" for 06 is cost of construction in dollars
S&A for 02 relocations	0	DOL		$0	$0	$0	Unit is Dollars
S&A for 06 Fish & Wildlife	3,721,000	DOL	8%	$298,000	$45,000	$343,000	"Unit Price" is Percent of construction
Total 31				$298,000	$45,000	**$343,000**	
TOTAL PROJECT COSTS (Nov 2010)	1	LS		$5,354,000	$1,115,000	**$6,469,000**	
TOTAL PROJECT COSTS (Nov 2010)	1	LS	100.0%		20.8%	**$6,469,000**	

LOWER CACHE RIVER, Monroe Co, AR; Section 1135 Feasibility Study
OPERATION AND MAINTENANCE COSTS
Prices as of Nov 2010; Preparation Date: 1/21/11
LPP FOR 3 WEIRS, 3 PLUG REMOVALS, & 1 ROCK PLUG

PROJECT FEATURE	COMMENTS	INTER. YRS	ORIG. QTY.	UNIT	% OF ORIG.	O&M QTY	UNIT PRICE	COST per Occurrence	NO. OF OCCUR.	COST OVER LIFE
Weir Construction										
Mob/Demob		10	1	LS	100%	1	$60,000	$60,000	4	$240,000
Cut Notch & Replace Stone for rock barge passage		10	2,300	TN	100%	2,300	$6	$13,800	4	$55,200
Large Weir Construction										
Riprap R-2200		10	22,720	TN	10%	2,272	$60	$136,899	4	$547,597
Small Weir Construction & Rock Plug										
Riprap R-90	(for Rock Plug)	10	7,420	TN	20%	1,484	$60	$89,418	4	$357,674
Riprap R-2200		10	23,940	TN	20%	4,788	$60	$288,501	4	$1,154,004
Large weir is the southern-most weir and will be accessible by barge to bring in rock.										
Weirs US of the large weir will be accessible by temporarily notching the large weir.										
R90 in weirs is all under the R2200, and will not be subject to damage										
Rock is for replacing the damage after major events										
TOTAL COST FOR O&M OVER LIFE OF PROJECT ----->										$2,354,475

Project life, in years ----> 50

INTER. YRS: This is the interval in years that this task must be done.
ORIG. QTY. This is the original quantity for this item when it is constructed.
UNIT PRICE: This is the current price with contingencies and may be higher than the orighinal price since the maintenance contract will have smaller quantities.
All costs are in Nov 2010 dollars.
NO. OF OCCURRENCES: Number of times this task will happen. Assumes nothing is done in last year of project life.

Estimated by	Cost Engineering & Relocations Section
Designed by	Memphis District Corps of Engineers CEMVM
Prepared by	Richard Hurst
Preparation Date	1/3/2011
Effective Date of Pricing	1/3/2011
Estimated Construction Time	150 Days

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Library Properties i

Project Notes ii

Markup Properties iii

Owner Feature Sum 1

Alt 3W3P1C LOWER CACHE RIVER 1

01 Lands and Damages 1

06 Fish and Wildlife Facilities 1

30 Planning, Engineering and Design 1

31 Construction Management 1

Owner Summary 2

Alt 3W3P1C LOWER CACHE RIVER 2

01 Lands and Damages 2

1 Real Estate 2

06 Fish and Wildlife Facilities 2

0603 Wildlife Facilities & Sanctuary 2

1 Mob/Demob 2

1 Mobilization 2

2 Demobilization 2

3 Interim Moves 2

2 Plug Removal 2

2 Clearing 2

3 Excavation 2

4 Turfing 2

3 Weir Construction 2

1 Large Weir Construction 2

2 Small Weir Construction 2
4 Rock Plug Construction 2
1 Excavation for Keys 2
2 Filter Material 2
3 R90 Rock 2
5 Tree Planting 2
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Indirect Summary w/ Contractor OHs 3
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0603 Wildlife Facilities & Sanctuary 3
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1 Mobilization 3
2 Demobilization 3
3 Interim Moves 3
2 Plug Removal 3
2 Clearing 3
3 Excavation 3
4 Turfing 3

3 Weir Construction 3
1 Large Weir Construction 3
2 Small Weir Construction 3
4 Rock Plug Construction 3
1 Excavation for Keys 3
2 Filter Material 3
3 R90 Rock 3
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1 06 account 3
Direct Summary 4
Alt 3W3P1C LOWER CACHE RIVER 4
01 Lands and Damages 4
1 Real Estate 4
06 Fish and Wildlife Facilities 4
0603 Wildlife Facilities & Sanctuary 4
30 Planning, Engineering and Design 5
1 06 account 5
2 Cost of Study 5
31 Construction Management 5
1 06 account 5

Designed by
Memphis District Corps of Engineers CEMVM

Estimated by
Cost Engineering & Relocations Section

Prepared by
Richard Hurst

Design Document	Feasiblity Report
Document Date	1/3/2011
District	Memphis District
Contact	Richard Hurst
Budget Year	2011
UOM System	English

Direct Costs
LaborCost
EQCost
MatlCost
SubBidCost
Real Estate

Timeline/Currency

Preparation Date	1/3/2011
Escalation Date	1/3/2011
Eff. Pricing Date	1/3/2011
Estimated Duration	150 Day(s)
Currency	US dollars
Exchange Rate	1.000000

Costbook CB08EB: MII English Cost Book 2008

Labor LNS2009: Labor National - Seattle 2009
Note: - http://www.wdol.gov/ - The website for current up to date, Davis Bacon & Service (FOOH) Labor Rates!!!!! Fringes paid to the laborers are tax pay fr

Labor Rates
LaborCost1
LaborCost2
LaborCost3
LaborCost4

Equipment EP07R03: 2007 EP Region 3 ver2 Eq 2010 11 26
Note: rate of interest is 3.125% till Dec 31, 2010

03 SOUTHEAST

Sales Tax	7.40
Working Hours per Year	1,530
Labor Adjustment Factor	0.83
Cost of Money	3.13
Cost of Money Discount	25.00
Tire Recap Cost Factor	1.50
Tire Recap Wear Factor	1.80
Tire Repair Factor	0.15
Equipment Cost Factor	1.00
Standby Depreciation Factor	0.50

Fuel

Electricity	0.090
Gas	2.990
Diesel Off-Road	2.870
Diesel On-Road	3.390

Shipping Rates

Over 0 CWT	10.26
Over 240 CWT	9.59
Over 300 CWT	8.41
Over 400 CWT	7.64
Over 500 CWT	4.49
Over 700 CWT	4.36
Over 800 CWT	4.99

Date	Author	Note
11/27/2010	Richard H.	PROJECT DESCRIPTION: The Cache River is about 230' wide at the project location. The bottom elevation of the Cache starts out about 147, and then jumps up to El 148 below meander 3,outlet, then to 152 next to the middle of meander 1. This project consists of building Stone Weirs in the Cache River to divert low flows into a few old meanders, to help the habitat in those meanders. Earthen plugs must be removed from the US end of each meander first. In addtion to that, a rock plug will be constructed where 1 meander gets close to the Cache River, to prevent it from entering the Cache before it reaches the end of the meander. TIME RESTRICTIONS: This work has to be done during high river stages to allow the rock barges access on the Cache River. The stone deliver rate will determine the job time, as only about 1 barge/day (1000 tons) will make it up the Cache River. The job will probably last over 1 construcition season. LOCATION: This project is located in Monroe Co, AR, South of Hwy 70 and North of Hwy 79. The southernmost meander, #6, is about 2 miles North of Clarendon. The northernmost meander, #1, is about 6.8 miles North of Clarendon. Traveling by river: From Miss R. mile, 599, go 100 miles N on White River, @ mile 100, go N. on Cache River about 1.3 miles to meander 6 weir site, 2.6 miles to weir 4, 5 mile to weir 3, 5.6 to weir 2, and 6.8 to weir 1. BOND CLASS: Most civil works projects are class B (Drainage, etc.). STUDY REPORT NOTES: Weir Construction: See quantity spreadsheet provided in LPP Appendix. Excavation qty was from the last Civil Design worksheet provided. Quantity would actually be a little less, since the weir height was decreased. Filter material and riprap quantities were provided by Civil Design Section (see appendix K). When Civil Design reduced the weir design quantities, they only recomputed that part of the rock quantities that changed, not the entire quantity. Therefore, the Civil Design quantities shown in app K will not be the total rock quantities, but Civil Design furnished to Cost Engineering the revised tonnage totals, and they checked w/ what I had computed for the totals. Civil quantities for clearing and turfing may not include all quantities needed for construction of the work. Also, number of trees in estimate was based on a 1' spacing, which is a little more realistic than the 6" spacing suggested. This was discovered after several conversations w/ nurseries and tree planters and this spacing would yield a much higher survival rate. The AR sales tax rate is currently at 6%. A total rate of 7% was used here to account for any local taxes that may be imposed.

Direct Cost Markups	**Category**	**Method**
Sales Tax	TaxAdj	Running % on Selected Costs
MatlCost		

OT Dragline		Overtime		Overtime		
	Days/Week	*Hours/Shift*	*Shifts/Day*	*1st Shift*	*2nd Shift*	*3rd Shift*
Standard	*5.00*	*8.00*	*2.00*	*8.00*	*8.00*	*0.00*
Actual	*6.00*	*8.00*	*2.00*	*10.00*	*9.00*	*0.00*

Day	*OT Factor*	*Working*	*OT Percent*	*FCCM Percent*
Monday	*1.50*	*Yes*	*14.91*	*(64.91)*
Tuesday	*1.50*	*Yes*		
Wednesday	*1.50*	*Yes*		
Thursday	*1.50*	*Yes*		
Friday	*1.50*	*Yes*		
Saturday	*1.50*	*Yes*		
Sunday	*2.00*	*No*		

Overtime 6-10s		Overtime		Overtime		
	Days/Week	*Hours/Shift*	*Shifts/Day*	*1st Shift*	*2nd Shift*	*3rd Shift*
Standard	*5.00*	*8.00*	*1.00*	*8.00*	*0.00*	*0.00*
Actual	*5.00*	*8.00*	*1.00*	*10.00*	*0.00*	*0.00*

Day	*OT Factor*	*Working*	*OT Percent*	*FCCM Percent*
Monday	*1.50*	*Yes*	*16.67*	*(33.33)*
Tuesday	*1.50*	*Yes*		
Wednesday	*1.50*	*Yes*		
Thursday	*1.50*	*Yes*		
Friday	*1.50*	*Yes*		
Saturday	*1.50*	*Yes*		
Sunday	*2.00*	*No*		

Contractor Markups	**Category**	**Method**
SUP&MISC (Calculated) (Small Tools)	JOOH	% of Labor
SUP&MISC (Calculated)	JOOH	JOOH (Calculated)
JOOH (running%)	JOOH	Running %
HOME OFC (Running%)	HOOH	Running %
PROFIT (Running%)	Profit	Running %
BOND (Running%)	Bond	Bond Table
Class B, Tiered, 24 months, 1.00% Surcharge		

Contract Price	*Bond Rate*
500,000	*15.84*
2,000,000	*9.57*
2,500,000	*7.59*
2,500,000	*6.93*
100,000,000,000	*6.34*

Owner Markups	**Category**	**Method**
Escalation	Escalation	Running %
Contingency	Contingency	Running %

Description	Quantity	UOM	ContractCost	Contingency	Escalation	OwnerMarkup	ProjectCost
Owner Feature Sum			**5,369,835.21**	**1,262,948.73**	**0.00**	**1,262,948.73**	**6,632,783.94**
Alt 3W3P1C LOWER CACHE RIVER	**1.0000**	**LS**	**5,369,835.21**	**1,262,948.73**	**0.00**	**1,262,948.73**	**6,632,783.94**
01 Lands and Damages	**1.0000**	**LS**	**68,000.00**	**0.00**	**0.00**	**0.00**	**68,000.00**
06 Fish and Wildlife Facilities	**1.0000**	**LS**	**3,734,607.21**	**1,162,114.53**	**0.00**	**1,162,114.53**	**4,896,721.74**
30 Planning, Engineering and Design	**1.0000**	**LS**	**1,268,460.00**	**56,019.00**	**0.00**	**56,019.00**	**1,324,479.00**
31 Construction Management	**1.0000**	**LS**	**298,768.00**	**44,815.20**	**0.00**	**44,815.20**	**343,583.20**

Description	Quantity	UOM	ContractCost	Contingency	Escalation	OwnerMarkup	ProjectCost
Owner Summary			**5,369,835**	**1,262,949**	**0**	**1,262,949**	**6,632,784**
Alt 3W3P1C LOWER CACHE RIVER	**1**	**LS**	**5,369,835**	**1,262,949**	**0**	**1,262,949**	**6,632,784**
01 Lands and Damages	**1**	**LS**	**68,000**	**0**	**0**	**0**	**68,000**
1 Real Estate	**1**	**LS**	**68,000**	**0**	**0**	**0**	**68,000**
06 Fish and Wildlife Facilities	**1**	**LS**	**3,734,607**	**1,162,115**	**0**	**1,162,115**	**4,896,722**
0603 Wildlife Facilities & Sanctuary	**1**	**LS**	**3,734,607**	**1,162,115**	**0**	**1,162,115**	**4,896,722**
1 Mob/Demob	**1**	**LS**	**50,736**	**12,684**	**0**	**12,684**	**63,420**
			260.49				*325.62*
1 Mobilization	**108**	**MI**	**28,133**	**7,033**	**0**	**7,033**	**35,166**
			260.49				*325.62*
2 Demobilization	**54**	**MI**	**14,067**	**3,517**	**0**	**3,517**	**17,583**
			2,134.05				*2,667.56*
3 Interim Moves	**4**	**EA**	**8,536**	**2,134**	**0**	**2,134**	**10,670**
			43,426.22				*55,490.91*
2 Plug Removal	**3**	**EA**	**130,279**	**36,194**	**0**	**36,194**	**166,473**
			1,417.53				*1,771.91*
2 Clearing	**18**	**ACR**	**25,516**	**6,379**	**0**	**6,379**	**31,894**
			4.48				*5.82*
3 Excavation	**19,800**	**ECY**	**88,626**	**26,588**	**0**	**26,588**	**115,213**
			1,793.05				*2,151.66*
4 Turfing	**9**	**ACR**	**16,137**	**3,227**	**0**	**3,227**	**19,365**
			36.43				*47.83*
3 Weir Construction	**88,110**	**TON**	**3,209,631**	**1,004,976**	**0**	**1,004,976**	**4,214,606**
			47.65				*62.56*
1 Large Weir Construction	**32,650**	**TON**	**1,555,849**	**486,679**	**0**	**486,679**	**2,042,528**
			826,890.95				*1,086,039.10*
2 Small Weir Construction	**2**	**EA**	**1,653,782**	**518,296**	**0**	**518,296**	**2,172,078**
			42.41				*55.76*
4 Rock Plug Construction	**8,110**	**TON**	**343,962**	**108,261**	**0**	**108,261**	**452,223**
			4.55				*5.68*
1 Excavation for Keys	**2,000**	**ECY**	**9,093**	**2,273**	**0**	**2,273**	**11,367**
			39.78				*52.38*
2 Filter Material	**690**	**TON**	**27,445**	**8,700**	**0**	**8,700**	**36,145**
			41.10				*54.13*
3 R90 Rock	**7,420**	**TON**	**304,949**	**96,669**	**0**	**96,669**	**401,617**
			1.55				*1.93*
5 Tree Planting	**1,600**	**EA**	**2,475**	**619**	**0**	**619**	**3,094**
30 Planning, Engineering and Design	**1**	**LS**	**1,268,460**	**56,019**	**0**	**56,019**	**1,324,479**
			0.10				*0.12*
1 06 account	**3,734,600**	**EA**	**373,460**	**56,019**	**0**	**56,019**	**429,479**
2 Cost of Study	**1**	**LS**	**895,000**	**0**	**0**	**0**	**895,000**
31 Construction Management	**1**	**LS**	**298,768**	**44,815**	**0**	**44,815**	**343,583**
			0.08				*0.09*
1 06 account	**3,734,600**	**EA**	**298,768**	**44,815**	**0**	**44,815**	**343,583**

Description	Quantity	UOM	CostToPrime	JOOH_PRM	HOOH_PRM	Bond_PRM	ContractCost
Indirect Summary w/ Contractor OHs			3,020,093	151,005	221,977	36,156	5,369,835
Alt 3W3P1C LOWER CACHE RIVER	1	LS	3,020,093	151,005	221,977	36,156	5,369,835
01 Lands and Damages	1	LS	0	0	0	0	68,000
1 Real Estate	1	LS	0	0	0	0	68,000
06 Fish and Wildlife Facilities	1	LS	3,020,093	151,005	221,977	36,156	3,734,607
0603 Wildlife Facilities & Sanctuary	1	LS	3,020,093	151,005	221,977	36,156	3,734,607
1 Mob/Demob	1	LS	41,029	2,051	3,016	491	50,736
1 Mobilization	108	MI	22,751	1,138	1,672	272	28,133
2 Demobilization	54	MI	11,375	569	836	136	14,067
3 Interim Moves	4	EA	6,903	345	507	83	8,536
2 Plug Removal	3	EA	105,353	5,268	7,743	1,261	130,279
2 Clearing	18	ACR	20,634	1,032	1,517	247	25,516
3 Excavation	19,800	ECY	71,670	3,583	5,268	858	88,626
4 Turfing	9	ACR	13,050	653	959	156	16,137
3 Weir Construction	88,110	TON	2,595,556	129,778	190,773	31,074	3,209,631
1 Large Weir Construction	32,650	TON	1,258,180	62,909	92,476	15,063	1,555,849
2 Small Weir Construction	2	EA	1,337,376	66,869	98,297	16,011	1,653,782
4 Rock Plug Construction	8,110	TON	278,154	13,908	20,444	3,330	343,962
1 Excavation for Keys	2,000	ECY	7,354	368	540	88	9,093
2 Filter Material	690	TON	22,194	1,110	1,631	266	27,445
3 R90 Rock	7,420	TON	246,605	12,330	18,125	2,952	304,949
5 Tree Planting	1,600	EA	2,002	100	147	24	2,475
30 Planning, Engineering and Design	1	LS	0	0	0	0	1,268,460
1 06 account	3,734,600	EA	0	0	0	0	373,460
2 Cost of Study	1	LS	0	0	0	0	895,000
31 Construction Management	1	LS	0	0	0	0	298,768
1 06 account	3,734,600	EA	0	0	0	0	298,768

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectSubBid	CostToPrime
Direct Summary			**176,675**	**368,371**	**884,195**	**3,158,080**	**3,020,093**
Alt 3W3P1C LOWER CACHE RIVER	**1.00**	**LS**	**176,675**	**368,371**	**884,195**	**3,158,080**	**3,020,093**

(Note: This is the Locally Preferred Plan, and is less than the NER Plan. Acquisition strategy: It is anticipated that this will be an unrestricted construction solicitation due to the cost sharing requirements and the sponsor's. limited funds. Prime and subcontractor assignments: It is anticipated that 1 prime river-work contractor will do all the work. Subcontractor quotes were used for the price of the rock and transportation of the rock. Sources and dates of major cost quotes: Subcontract (transportation of rock) and material pricing for filter material and riprap were obtained from a well-established rock quarry. His name is not included in the M2 estimate, since his prices are considered proprietary and FOUO. Quote date was 11/19/2010. Construction phasing or sequencing: The removal of the plug at each meander will be done first, and then the weir will be constructed. Plug removals may be done at a lower river level, since no rock barges are required to do this, and several may be done sequentially if river levels prohibit rock delivery.)

01 Lands and Damages	**1.00**	**LS**	**0**	**0**	**0**	**0**	**0**
1 Real Estate	**1.00**	**LS**	**0**	**0**	**0**	**0**	**0**

(Note: This cost was furnished by Real Estate Division.)

06 Fish and Wildlife Facilities	**1.00**	**LS**	**176,675**	**368,371**	**884,195**	**1,590,852**	**3,020,093**
0603 Wildlife Facilities & Sanctuary	**1.00**	**LS**	**176,675**	**368,371**	**884,195**	**1,590,852**	**3,020,093**

(Note: This option assumed removing 3 plugs and constructing 3 weirs, and constructing a rock plug in the crossover @ the middle of meander 3.)

1 Mob/Demob	**1.00**	**LS**	**15,830**	**17,699**	**0**	**7,500**	**41,029**

(Note: Assumes 1 contract (1 mob), since rock is only about 75k tons. The commercial hauling costs covers any land-based equipment for clearing, excavation, etc. that may not be transported on the river. Even though land access is very limited, there is a possibility one of the sites may be accessible for some equipment. In either case, there will probably be some preparation cost for the equipment that is barge-mounted (for the initial mob and the interim mobs), and this money would cover that.)

			77.60	*86.76*	*0.00*	*46.30*	*210.65*
1 Mobilization	**108.00**	**MI**	**8,380**	**9,370**	**0**	**5,000**	**22,751**

(Note: Miles here assume 1 contracts (1 mob).)

			77.60	*86.76*	*0.00*	*46.30*	*210.65*
2 Demobilization	**54.00**	**MI**	**4,190**	**4,685**	**0**	**2,500**	**11,375**
			814.76	*911.00*	*0.00*	*0.00*	*1,725.76*
3 Interim Moves	**4.00**	**EA**	**3,259**	**3,644**	**0**	**0**	**6,903**

(Note: The time here is mainly for set-up & breakdown, since there is just 5 miles between the 7 weir sites.)

			10,442.09	*20,325.72*	*0.00*	*4,350.00*	*35,117.80*
2 Plug Removal	**3.00**	**EA**	**31,326**	**60,977**	**0**	**13,050**	**105,353**

(Note: Clearing quantity was estimated by using an average width/length for each plug site that included the plug area plus an area to dispose of the material removed and the clearing debris. Turfing acreage was calculated similarly, w/ the area of the meander subtracted. Production rates for excavation and clearing were based on cycle times from MVM historical data. Turfing was not actually a quote, as no types of grass were specified at this level of design, and this is a relatively small item in the estimate. Cost was based on MVM historical bid data.)

			358.75	*787.57*	*0.00*	*0.00*	*1,146.33*
2 Clearing	**18.00**	**ACR**	**6,458**	**14,176**	**0**	**0**	**20,634**
			1.26	*2.36*	*0.00*	*0.00*	*3.62*
3 Excavation	**19,800.00**	**ECY**	**24,869**	**46,801**	**0**	**0**	**71,670**

(Note: This is for 3 plugs @ 6600 cys/ea.)

			0.00	*0.00*	*0.00*	*1,450.00*	*1,450.00*
4 Turfing	**9.00**	**ACR**	**0**	**0**	**0**	**13,050**	**13,050**
			1.34	*3.00*	*9.20*	*15.92*	*29.46*
3 Weir Construction	**88,110.00**	**TON**	**118,165**	**264,222**	**810,744**	**1,402,425**	**2,595,556**

(Note: Clearing was included w/ the Plug Removal. This is to construct 3 weirs, 1 of which is the larger, downstream weir.. The lowermost weir would need to be keyed in with an embedded riprap thickness of 6 feet, a crown width of 20 feet, slopes of 1V:6H upstream and downstream, with a 50 foot downstream apron. 31. The weirs upstream of the lowermost weir would not need to be keyed in and would have embedded riprap thicknesses of 6 feet, a crown width of 20 feet, slopes of 1V:1.5H upstream and downstream, with a 50 foot downstream apron. See quantity spreadsheet provided in LPP Appendix. Excavation qty was from the last Civil Design worksheet provided. Quantity would actually be a little less, since the weir height was decreased. Filter material and riprap quantities were provided by Civil Design Section (see appendix K). When Civil Design reduced the weir design quantities, they only recomputed that part of the rock quantities that changed, not the entire quantity. Therefore, the Civil Design quantities shown in app K will not be the total rock quantities, but Civil Design furnished to Cost Engineering the revised tonnage totals, and they checked w/ what I had computed for the totals.)

			1.80	*4.04*	*12.00*	*20.70*	*38.54*
1 Large Weir Construction	**32,650.00**	**TON**	**58,758**	**131,889**	**391,679**	**675,855**	**1,258,180**

(Note: Clearing was included w/ the Plug Removal. This is to construct the larger, downstream weir.. The lowermost weir would need to be keyed in with an embedded riprap thickness of 6 feet, a crown width of 20 feet, slopes of 1V:6H upstream and downstream, with a 50 foot downstream apron.)

			1.23	*2.39*	*0.00*	*0.00*	*3.63*
1 Excavation for Keys	**21,170.00**	**ECY**	**26,140**	**50,611**	**0**	**0**	**76,751**

(Note: This is needed for the riprap embedment for the keys.)

			0.95	*2.49*	*8.03*	*20.70*	*32.17*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectSubBid	CostToPrime
2 Filter Material	**2,750.00**	**TON**	**2,615**	**6,846**	**22,069**	**56,925**	**88,454**
(Note: This is needed under the bigger rock.)							
			0.95	*2.49*	*9.10*	*20.70*	*33.24*
3 R90 Rock	**7,180.00**	**TON**	**6,827**	**17,874**	**65,302**	**148,626**	**238,629**
			0.95	*2.49*	*13.38*	*20.70*	*37.52*
4 R2200 Rock	**22,720.00**	**TON**	**21,603**	**56,558**	**303,880**	**470,304**	**852,345**
			0.98	*0.00*	*0.27*	*0.00*	*1.25*
5 Tree Planting	**1,600.00**	**EA**	**1,574**	**0**	**428**	**0**	**2,002**
(Note: This consists of planting 1 tree every LF of row. There are 4 rows, each 200 LF long, on each bank of each weir. This equals 1600 LF per weir.)							
			29,703.58	*66,166.78*	*209,532.75*	*363,285.00*	*668,688.11*
2 Small Weir Construction	**2.00**	**EA**	**59,407**	**132,334**	**419,066**	**726,570**	**1,337,376**
(Note: Clearing was included w/ the Plug Removal. This is to construct 2 weirs north of the larger weir. The weirs upstream of the lowermost weir would not need to be keyed in and would have embedded riprap thicknesses of 6 feet, a crown width of 20 feet, slopes of 1V:1.5H upstream and downstream, with a 50 foot downstream apron.)							
			1.22	*2.40*	*0.00*	*0.00*	*3.63*
1 Excavation for Keys	**18,700.00**	**ECY**	**22,886**	**44,957**	**0**	**0**	**67,843**
(Note: This is needed for the riprap embedment for the keys.)							
			0.95	*2.49*	*8.03*	*20.70*	*32.17*
2 Filter Material	**3,260.00**	**TON**	**3,100**	**8,115**	**26,162**	**67,482**	**104,858**
(Note: This is needed under the bigger rock.)							
			0.95	*2.49*	*9.10*	*20.70*	*33.24*
3 R90 Rock	**7,900.00**	**TON**	**7,511**	**19,666**	**71,851**	**163,530**	**262,558**
			0.95	*2.49*	*13.38*	*20.70*	*37.52*
4 R2200 Rock	**23,940.00**	**TON**	**22,763**	**59,595**	**320,198**	**495,558**	**898,113**
			0.98	*0.00*	*0.27*	*0.00*	*1.25*
5 Tree Planting	**3,200.00**	**EA**	**3,147**	**0**	**856**	**0**	**4,003**
(Note: This consists of planting 1 tree every LF of row. There are 4 rows, each 200 LF long, on each bank of each weir. This equals 1600 LF per weir.)							
			1.40	*3.14*	*9.06*	*20.70*	*34.30*
4 Rock Plug Construction	**8,110.00**	**TON**	**11,355**	**25,472**	**73,450**	**167,877**	**278,154**
(Note: Clearing was included w/ the Plug Removals. This is to construct a rock plug, to block meander 3 from going back into the Cache River at the crossover. Excavation quantities were not provided so quantity was based on a reduced volume used for the weirs. Subcontract (transportation of rock) and material pricing for filter material and riprap were obtained from a well-established rock quarry. His name is not included in the M2 estimate, since his prices are considered proprietary and FOUO. Quote date was 11/19/2010. Production rates for stone installation were based on cycle times from MVM historical data, and have relatively little influence on the price of this work.)							
			1.04	*2.64*	*0.00*	*0.00*	*3.68*
1 Excavation for Keys	**2,000.00**	**ECY**	**2,070**	**5,283**	**0**	**0**	**7,354**
(Note: This is needed for the riprap embedment for the keys on the overbank protection.)							
			0.95	*2.49*	*8.03*	*20.70*	*32.17*
2 Filter Material	**690.00**	**TON**	**656**	**1,718**	**5,537**	**14,283**	**22,194**
(Note: This is needed under the bigger rock.)							
			0.95	*2.49*	*9.10*	*20.70*	*33.24*
3 R90 Rock	**7,420.00**	**TON**	**7,055**	**18,471**	**67,485**	**153,594**	**246,605**
			0.98	*0.00*	*0.27*	*0.00*	*1.25*
5 Tree Planting	**1,600.00**	**EA**	**1,574**	**0**	**428**	**0**	**2,002**
(Note: This consists of planting 1 tree every LF of row. There are 4 rows, each 200 LF long, on each bank of each weir. This equals 1600 LF per weir.)							
			0.98	*0.00*	*0.27*	*0.00*	*1.25*
2 Trees	**1,600.00**	**EA**	**1,574**	**0**	**428**	**0**	**2,002**
30 Planning, Engineering and Design	**1.00**	**LS**	**0**	**0**	**0**	**1,268,460**	**0**
			0.00	*0.00*	*0.00*	*0.10*	*0.00*
1 06 account	**3,734,600.00**	**EA**	**0**	**0**	**0**	**373,460**	**0**
(Note: The quantity for this folder represents the cost of the 06 account, in dollars.)							
2 Cost of Study	**1.00**	**LS**	**0**	**0**	**0**	**895,000**	**0**
(Note: This was provided by the PM.)							
31 Construction Management	**1.00**	**LS**	**0**	**0**	**0**	**298,768**	**0**
			0.00	*0.00*	*0.00*	*0.08*	*0.00*
1 06 account	**3,734,600.00**	**EA**	**0**	**0**	**0**	**298,768**	**0**

LOWER CACHE RIVER, Monroe Co, AR; Section 1135 Feasibility Study
OPERATION AND MAINTENANCE COSTS
Prices as of Nov 2010; Preparation Date: 12/15/10
LPP FOR 3 WEIRS, 3 PLUG REMOVALS, & 1 ROCK PLUG

PROJECT FEATURE	COMMENTS	INTER. YRS	ORIG. QTY.	UNIT	% OF ORIG.	O&M QTY	UNIT PRICE	COST per Occurrence	NO. OF OCCUR.	COST OVER LIFE
Weir Construction										
Mob/Demob		10	1	LS	100%	1	$60,000	$60,000	4	$240,000
Cut Notch & Replace Stone for rock barge passage		10	2,300	TN	100%	2,300	$6	$13,800	4	$55,200
Large Weir Construction										
Riprap R-90	Replacing damage after major events	10	1,767	TN	10%	177	$53	$9,430	4	$37,718
Riprap R-2200		10	37,530	TN	10%	3,753	$60	$226,137	4	$904,548
Total	Assumes replacing rock									$942,266
Small Weir Construction & Rock Plug										
Riprap R-90	Replacing damage after major events	10	9,418	TN	20%	1,884	$53	$100,518	4	$402,073
Riprap R-2200		10	23,940	TN	20%	4,788	$60	$288,501	4	$1,154,004
Total										$1,556,077
Large weir is the southern-most weir and will be accessible by barge to bring in rock.										
Weirs US of the large weir will be accessible by temporarily notching the large weir.										
R90 original qty does not include portion under R2200.										
TOTAL COST FOR O&M OVER LIFE OF PROJECT ----->										$2,793,543

Project life, in years ----> 50

INTER. YRS: This is the interval in years that this task must be done.
ORIG. QTY. This is the original quantity for this item when it is constructed.
UNIT PRICE: This is the current price with contingencies and may be higher than the orighinal price since the maintenance contract will have smaller quantities.
All costs are in Nov 2010 dollars.
NO. OF OCCURRENCES: Number of times this task will happen. Assumes nothing is done in last year of project life.

FOR O&M on LPP ONLY:
Cut notches in big weir & 1 small weir, to allow material to get to sites.

Big Weir END AREA & VOLUME

Height	1V on ?H	1V on ?H	Top Width	Length	
3	6.00	6.00	20	100	
E. Area	Slope dis.	Base Width	Cys.	Cys/Ft	TONS
114	36	56	422	4.22	**633**

Move & then place back **1,267**

1 SMALLER Weir END AREA & VOLUME

Height	1V on ?H	1V on ?H	Top Width	Length	
3	2.50	5.00	20	100	
E. Area	Slope dis.	Base Width	Cys.	Cys/Ft	TONS
94	23	43	347	3.47	**521**

Move & then place back **1,042**

TOTAL **2,308**

ROCK IN WEIRS:

Revision for smaller Weir Design:

TYPICAL US WEIRS

FM	R90	R2200			was	is	was	is
				R2200	16,602	10,858	8,301	5,429
		5,429	CYs, Rock per weir	R90	2,872	3,932	1,436	1,966
		948	CYs, Bank, DS of apr	FM	1,436	1,508	718	754
754	1,966	900	CYs, Rock per weir	R2200	1,936	1,800	968	900
333	666	704	CYs, Bank key, @ weir crown					
1,087	2,632	7,981	CYs, Total Rock per weir					
1,631	**3,948**	**11,972**	Tons Rock per Weir				sq inches	sf
2	2	2	weirs			R2200	2.63	1052
2,174	5,264	15,962	CYs, Rock					
3,261	7,896	23,943	Tons Rock					

DS WEIR (Large)

FM	R90	R2200				was	is
					R2200	20,350	11,132
		11,132	CYs, Rock per weir		R90	2,536	3,606
		948	CYs, Bank, DS of apron		FM	1,268	1,243
1,243	3,606	2,361	CYs, Rock per weir		R2200	3,016	2,361
589	1,178	704	CYs, Bank key, @ weir crown				
1,832	4,784	15,145	CYs, Total Rock per weir				
1	1	1	weirs				
1,832	4,784	15,145	CYs, Rock				
2,748	**7,176**	**22,718**	Tons Rock	32,642			
				Totals			
6,009	**15,072**	**46,661**	**TOTAL TONS**	**67,742**			

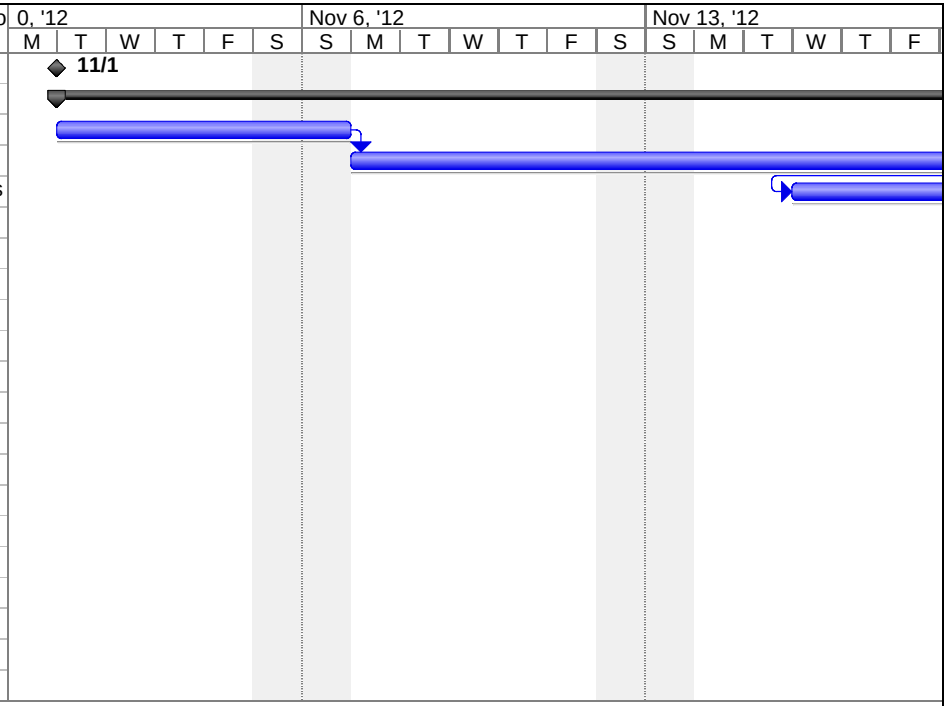
KEY EXCAVATION:

DS WEIR	19,128	**Cys for key**
	2,044	Cys of bank key
	21,172	Total
TYPICAL US WEIRS	1,362	Cys of bank key, per weir
	2	weirs
	2,724	CYs, Bank key
TYPICAL US WEIRS	7,985	Cys of key, per weir
	2	weirs
	15,970	CYs, key
	4,768	Overbank keys total
	35,098	keys total
	39,866	**Total Excavation for Weirs**
	9,347	**Cys of keys, per US weir**
	26400	for plugs
	66,266	TOTAL ALL EXC

2.5	cy bucket
20	swings/hr
50	production

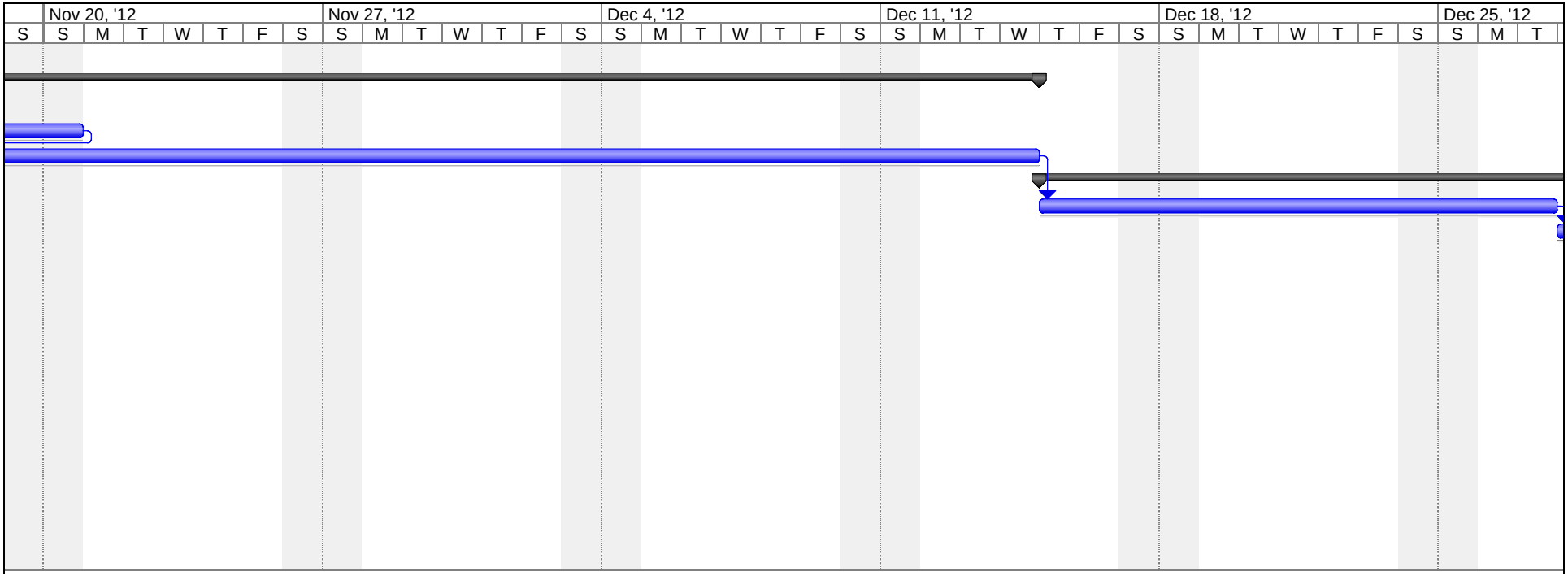
FM	R90	R2200		
3,260	7,900	23,940	TYPICAL US WEIRS	
2,750	7,180	22,720	DS WEIR (Large)	
690	7,420		Rock Plug	
6,700	22,500	46,660	**Total Rock, tons**	**75,860**

ID		Task Name	Duration	Start	Finish	Predecesso
1		**Issue NTP**	0 hrs	Tue 11/1/11	Tue 11/1/11	
2		**REMOVE PLUGS**	**380 hrs**	**Tue 11/1/11**	**Thu 12/15/11**	
3		mob + time to start + demc	50 hrs	Tue 11/1/11	Mon 11/7/11	
4		clear (plug & weirs)	120 hrs	Mon 11/7/11	Mon 11/21/11	3
5		excavate.(plug removal)	250 hrs	Wed 11/16/11	Thu 12/15/11	4FS-4 days
6		**SMALL WEIRS**	**305 hrs**	**Thu 12/15/11**	**Thu 1/19/12**	
7		Excavation for keys	110 hrs	Thu 12/15/11	Wed 12/28/11	5
8		Place FM	18 hrs	Wed 12/28/11	Thu 12/29/11	7
9		Place R90	44 hrs	Thu 12/29/11	Wed 1/4/12	8
10		Place R2200	133 hrs	Wed 1/4/12	Thu 1/19/12	9
11		**LARGE WEIR**	**333 hrs**	**Wed 1/25/12**	**Sat 3/3/12**	**16**
12		Excavation for weir keys	150 hrs	Wed 1/25/12	Sat 2/11/12	
13		Place FM	16 hrs	Sat 2/11/12	Tue 2/14/12	12
14		Place R90	40 hrs	Tue 2/14/12	Sat 2/18/12	13
15		Place R2200	127 hrs	Sat 2/18/12	Sat 3/3/12	14
16		**ROCK PLUG**	**50 hrs**	**Thu 1/19/12**	**Wed 1/25/12**	**6**
17		Place FM	5 hrs	Thu 1/19/12	Fri 1/20/12	
18		Place R90	45 hrs	Fri 1/20/12	Wed 1/25/12	17
19		**LAST OVERBANK WORK**	**70 hrs**	**Sat 3/3/12**	**Mon 3/12/12**	**11**
20		turfing	20 hrs	Sat 3/3/12	Tue 3/6/12	
21		Tree planting	50 hrs	Tue 3/6/12	Mon 3/12/12	20



Project: LCR Construction
Date: Fri 1/7/11

Task		Milestone		External Tasks	
Split		Summary		External Milestone	
Progress		Project Summary		Deadline	



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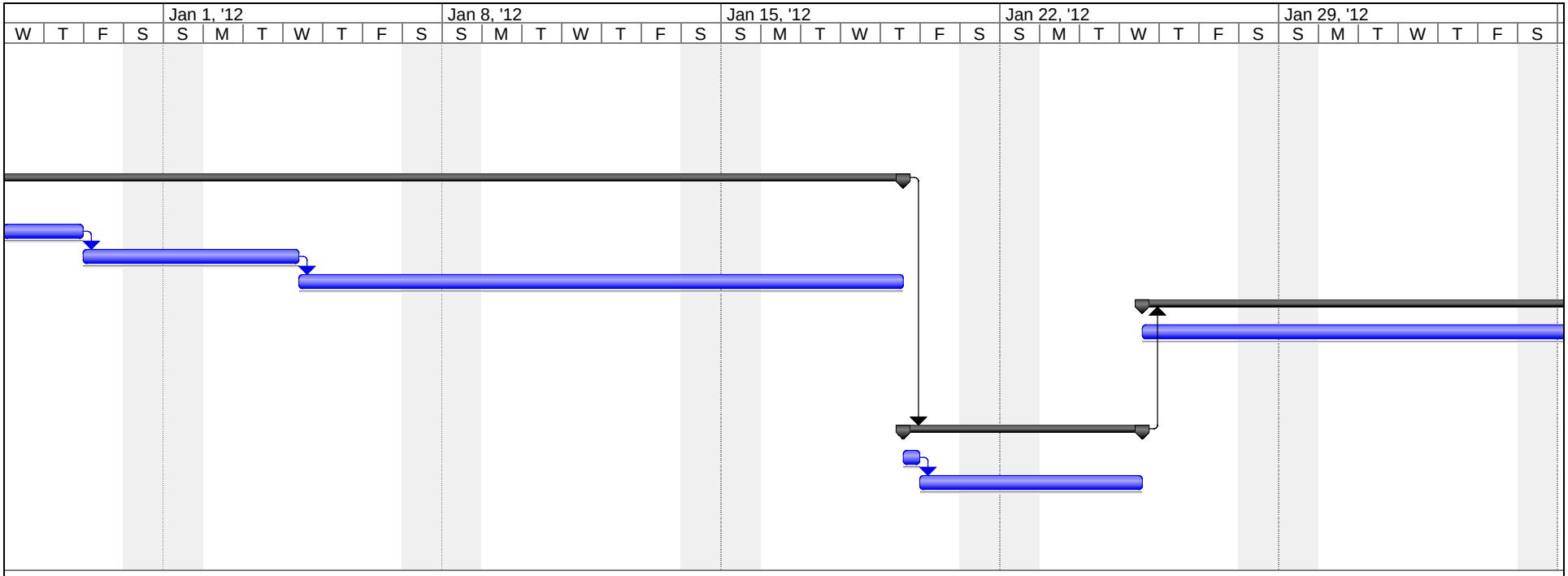

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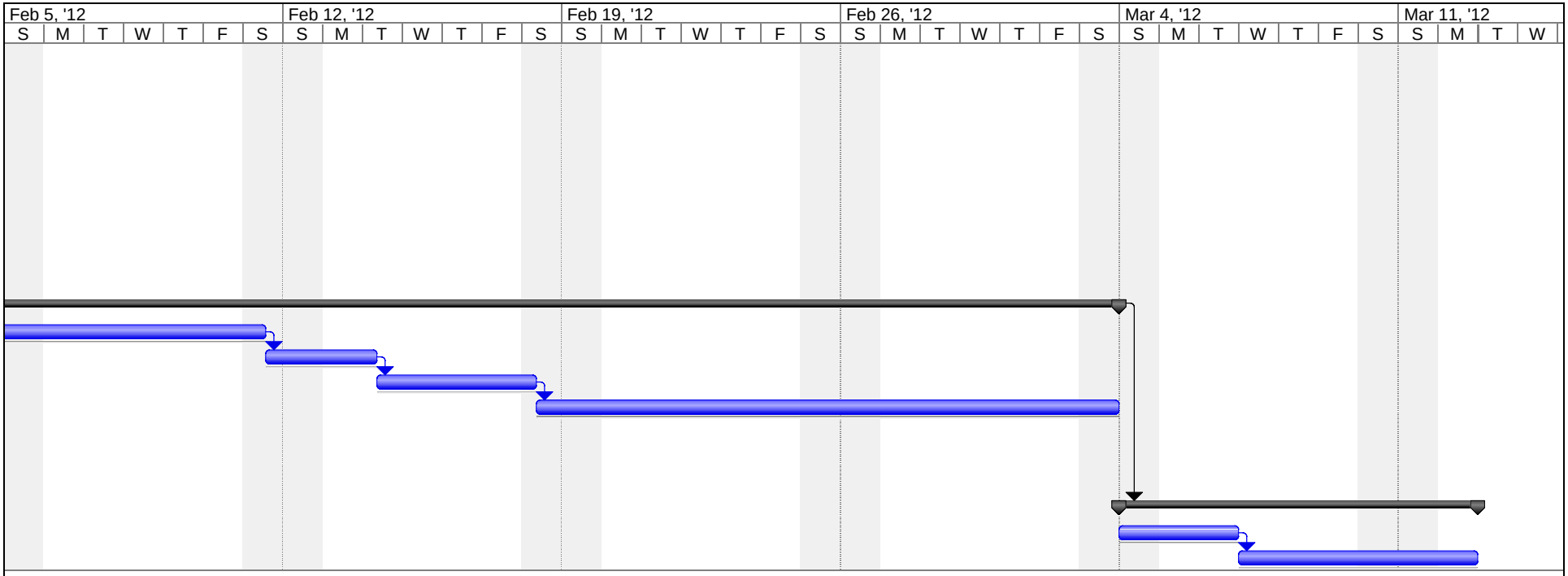

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