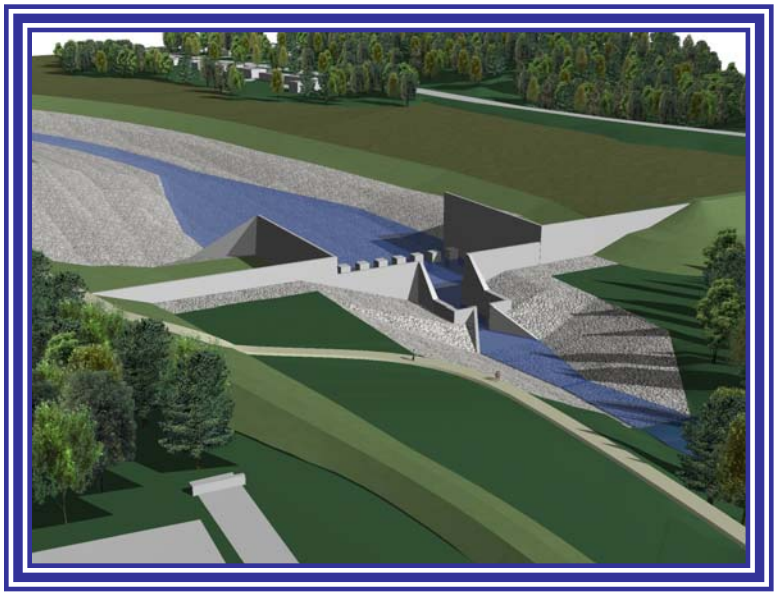

Value Engineering Study

Final Report

US Army Corps of Engineers, Kansas City District

Grade Control Structure – Blue River

January 2008

Strategic Value Solutions, Inc.

BLACK & VEATCH

Final

Value Engineering Study Report

for

Grade Control Structure, Blue River Channel

Kansas City, MO

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SECTION 1

EXECUTIVE SUMMARY

SECTION 1
EXECUTIVE SUMMARY

This report presents the results of a Value Study conducted by Strategic Value Solutions, Inc. (SVS) on the design of the Grade Control Structure, Blue River Channel project for the US Army Corps of Engineers, Kansas City District (USACE). The project was reviewed at 90 percent design completion.

The project design being reviewed was developed by HNTB (HNTB) in conjunction with USACE.

The Value Study included a four-day (32-hour) value methodology workshop that was conducted with a multidisciplinary team in Kansas City, MO on April 23 - 27, 2007.

PROJECT DESCRIPTION SUMMARY

This project includes construction of a grade control structure on the Blue River Channel between 58th and 59th Street. The grade control structure will accommodate a 30-year event as well as a 100-year and 500 year events. The project also includes construction of a berm around Byram's Ford Industrial Park.

SCOPE OF THE VALUE STUDY

This study is the only Value Study currently planned for this project. The scope of this Value Study encompasses:

- Grade Control Structure
- Trail Berm

VALUE STUDY TEAM

The team members that comprised this multidisciplinary Value Study Team are listed on the introductory pages of this report. All other participants of the study are provided in Appendix A.

In general, the Value Study Team members were independent of the project development team. This ensured maximum objectivity towards identifying alternative solutions.

VALUE METHODOLOGY

This Value Study used the international standard Value Methodology established by SAVE International, the Value Society. The Value Methodology (VM) uses a six-phase process executed in a workshop format with a multidisciplinary team. Value is expressed as the relationship between functions and resources where function is measured by the performance requirements of the customer and resources are measured in materials, labor, price, time, etc. required to accomplish that function. VM focuses on improving Value by identifying the most resource efficient way to reliably accomplish a function that meets the performance expectations of the customer.

With this process, the Value Team identifies the essential project functions and alternative ways to achieve those functions, and then selects the best alternatives to develop into workable solutions for value improvements.

Additional information about the Value Study processes used in the generation of the results presented is provided in Section 3 of this report.

Value Study Constraints

Often constraints or limits are imposed on the Value Study to define the boundaries between project aspects that the project stakeholders will consider changing and those that cannot be changed. These constraints may result from a variety of political, technical, schedule, or environmental causes. For this Value Study, no such constraints were placed on the team's ability to identify and pursue creative solutions for value improvements.

PROJECT COST ANALYSIS

The Value Team was provided a construction cost estimate as part of the project documentation. This estimate indicated an anticipated construction cost of $25,680,000 based on prices escalated to the mid-point of construction. The construction start is scheduled for 2007, with a 24-month construction duration.

As part of this workshop, the team prepared an independent estimate based on the quantities provided by HNTB and USACE. This estimate ensured that the Value Team was using reliable data for the basis of cost comparisons of alternative concepts. The Value Team's estimate indicated a construction cost of $40,270,000. Additionally, the team reviewed the estimate provided by USACE for any differences between the two estimates. The discrepancies between the Value Team's revised estimate and the Corps of Engineers' original cost estimate were reconciled between the Value Team's cost estimator and the Corps of Engineers' cost estimator.

The review concluded that:

- The unit cost provided to the Value Team is low based on the scope of the project

WORKSHOP RESULTS

The purpose of the workshop is to identify and develop alternative concepts that will improve the overall value of the project. In order to be successful at identifying alternatives, it is essential that the Value Team first understand the project objectives and the problems that must be solved. For this reason, the workshop began with presentations by USACE's project management to define the project objectives and to provide background information on the project. This was followed by a more detailed presentation of the project design by the project development team on how the design will accomplish the project's objectives. To give the Value Team a better perspective on the project the team participated in a site visit following the presentations.

This Information Phase of the workshop was followed by an in-depth analysis of the functional requirements of the project. A complete understanding of the basic functions that must be accomplished in order to successfully achieve the mission of the project is essential for the team to identify feasible alternatives to the current concept. From this Function Analysis Phase

of the workshop the team gained the following understanding about the basic functions of the project.

Using function analysis and Function Analysis System Technique (FAST) diagramming, the team defined the basic functions of this project as managing scour and managing headcutting. The key secondary function that supported these basic functions included controlling velocity. Analysis of the functions intended to be performed by the project helped the team focus on the mission of the project and, consequently, how to identify alternative concepts that would still meet the mission while exploring opportunities for value enhancement.

Analyzing the functions of this project gave the team the following key insights:

- The structure was designed to control velocity upstream to pre-project conditions which in turn aided in managing the headcutting at the battlefield location and managing scour along the riverbanks.

- Overbank scouring is not a concern. Undercutting the toe of the banks is the chief concern.

- The thickness of the structure slab was driven by the friction coefficient between the shale and the structure. To address the uncertainty with the friction at the shale-to-shale interface, a high safety factor was used.

With an understanding of the functional requirements, the Value Team transitioned to the Creative Phase of the workshop and brainstormed on all of the possible ways to accomplish each of those functions. The team generated 121 ideas for potential changes to the current design.

Based on the team members' professional judgment and input from USACE and HNTB representatives, 10 of these ideas were selected for developing into Value Alternatives.

Value Alternatives

Table 1-1, at the end of this section, includes a complete list of all the Value Alternatives developed. This table shows the number and title of each alternative as well as a summary of the cost savings. These savings include the capital or first cost savings as well as the present worth value of the savings associated with the long term owning and operating costs over the economic life of the project. The first cost savings and the present worth savings on operations and maintenance (O&M) sum to give the overall life cycle cost savings for each Value Alternative.

It should be noted that Value Studies are working sessions for the purpose of developing and recommending alternative approaches to the current design. As such, the results presented are of a conceptual nature and are not intended as a final design. Detailed feasibility assessment and final design development of any of the alternatives or suggestions presented herein, should they be accepted, remain the responsibility of USACE and HNTB.

Some alternatives presented in this report are variations of a common concept and others are alternatives to a specific aspect of the design. Thus, not necessarily all alternatives in this report can be implemented as selection of some may preclude or limit the use of others.

These potential savings do not reflect any costs for redesign, which must be considered. Moreover, the full benefit and impact of many of the alternatives goes beyond the cost savings to include improved project performance of required functions.

Optimum Combination of Alternatives

After completing the development of the Value Alternatives, the team reviewed the composite list of alternatives to identify what they believed to be the optimum combination of alternatives. This combination represents the best value solution for the project in the opinion of the Value Team. The review concluded that the maximum project benefits would be realized by combining the alternatives as shown in Table 1-2.

The team divided the Alternatives into three scenarios. The first scenario involves an alternative to the present concrete structure design. This alternative results in potential cost savings of $32,000,000 over the present design and includes construction of the downstream reach to the confluence with Brush Creek.

Should it be desired to construct the present design, the second scenario includes modifications to this design. This combination of alternative results in $12,738,000 potential cost savings:

The final alternative which is to modify the present design to meet the 30-year flood protection requirement, but allowing for expansion to increased levels of protection in the future, stands alone and provides a savings of $16 million over the present design.

Design Suggestions

In addition to the Value Alternatives, the team also identified three design suggestions. These are suggestions for changes or clarifications to the project documents that did not have an identifiable or quantifiable cost impact that could be determined within the scope of the workshop. The design suggestions from this study are included in Section 5 of this report.

Validation of Design

In the process of identifying recommendations for change, the value team evaluated all aspects of the design. In general, an absence of recommendations pursuant to certain portions of the project investigated can serve as a validation of the design for those portions of the project. If a portion of the project is investigated and no recommendation for change results from that investigation, then it can be assumed that the Value Team agrees with the design as originally presented. Through this process, many of the current design decisions proved to be appropriate to accomplish the required functions. Some of the more significant decisions that were validated through the scrutiny of the Value Study include:

- The increased shear is causing the headcutting exhibited at the Battlefield.
- The downstream improvements to the channel are causing the increased shear.
- It is appropriate to have a high factor of safety on the structure slab due to the uncertainty of the shale-to-shale interface.

Additional Benefits

A Value Study typically results in benefits beyond cost savings. These benefits are generated as a part of an alternative, design suggestion, or from an observation made by the team or one of the other participants during the workshop. Below are some of the benefits realized from this study, in addition to the cost savings discussed above.

- The team provided options to the proposed design that would meet KCMO's requirements and provide the protection required
- Alternatives were provided that allow opportunities to soften the structure
- The team clarified the O&M issues relative to the structure

IMPLEMENTATION RESULTS

The final phase of the VE process consisted of implementation decisions and actions by USACE and HNTB. On November 7, 2007, an implementation meeting was conducted in USACE's office in Kansas City.

This meeting was conducted to discuss each Value Alternative and design suggestion, answer questions, and decide what changes to make to the project. During the meeting, some ideas were accepted, others partially accepted or modified and some were rejected. The decisions and the rationale for these decisions are documented in Section 6, Implementation Decisions. These decisions are also summarized in Table 1-2, Summary of Implementation Decisions.

Accepted Savings

Estimated net savings from the Value Alternatives accepted by USACE for implementation are:

Capital Cost Savings	$ 2,605,000

Additional Savings

Implementing additional items that are still open, undecided or require further study by USACE and HNTB could add additional savings up to:

Capital Cost Savings	$ 42,350,000

Total Potential Savings

If these additional alternatives are determined to be acceptable, then the total savings from this Value Study would increase from the accepted savings stated above to:

Capital Cost Savings	$ 44,955,000

CONCLUSIONS

The workshop provides a new concept to the concrete grade control structure, as designed. The team was provided the latitude to use "outside the box" thinking, coming up with alternatives to manage the energy that hadn't previously been examined. The team generated alternatives that satisfied the Corps technical requirements, while meeting the City's needs for low

maintenance and desire to have a park-like setting. The alternative to eliminate the concrete grade control structure and install a series of rock structures appears feasible, but needs a better hydraulic analysis to confirm the anticipated velocities. Additionally, this study also provides several recommendations for optimizing the original concept should the District decide to move forward with the concrete grade control structure concept,

Table 1-1
Summary of Value Alternatives

Alt. No.	Description	Capital Cost Savings	Decision
MS-02	Replace GCS with series of grade control structures and bank protection to Brush Creek	$32,882,000	FS
S-01	Replace tie back walls with earth embankment	$5,462,000	R
S-02	Replace large concrete walls with MSE walls	$9,584,000	FS
S-03	Match stilling basin sidewall geometry/profile to hydraulic profile	$157,000	R
S-04	Eliminate downstream wingwalls	$1,113,000	A
S-10	Lower the entire structure with the ability to expand up to 500-year	$16,115,000	R
S-24	Stair step the foundations for the tie back walls	$580,000	A/M
G-12	Move the structure downstream to approximately Sta. 53+00; build in the dry	$584,000	A
G-18	Minimize fill and use existing channel for habitat	$328,000	A
C-18	Use a series of flat pipe runs and vertical drops instead of gutters	($116,000)	FS

A = Accepted A/M = Accepted with Modifications P = Partially Accepted
FS = Further Study Required R = Rejected

Summary of Design Suggestions

Alt. No.	Description	Decision
C-13	Provide early notice of material quantities to community	A
C-17	Use corrugated HDPE pipe instead of RCP	R
C-20	Use a separate contract to establish plantings	A

Table 1-2
Optimum Combination

	Idea No.	Idea Description	Capital Cost Savings	Adjustments Capital	After Combining Recommendations Capital Cost Savings	Comments
Option 1	MS-02	Replace GCS with series of grade control structures and bank protection	$32,882,000	$ -	$32,882,000	This recommendation stands on it's own if redesign of the structure is an option.
Option 2	S-01	Replace ties walls with earth embankment	$5,462,000	$ (5,000,000)	$462,000	Should redesign not be an option, these alternatives can be applied to the existing design.
	S-02	Replace large concrete walls with Mass walls	$9,584,000	$ -	$9,584,000	
	S-03	Match side wall geometry/profile to hydraulic profile	$157,000	$ -	$157,000	
	S-04	Eliminate downstream wing walls	$1,113,000	$ -	$1,113,000	
	S-24	Stair step the foundations for the tie back walls	$580,000	$ -	$580,000	
	G-12	Move structure downstream to approximately Sta 53+00; build in the dry	$584,000	$ -	$584,000	
	G-18	Minimize filling and use existing channel for habitat	$328,000	$ -	$328,000	
	C-08	Eliminate water stops in concrete joints	$47,000	$ -	$47,000	
	C-18	Use series of flat pipe runs and vertical drops instead of gutters	($116,000)	$ -	($116,000)	
Option 3	S-10	Lower the entire structure with ability to expand to 500-year	$16,115,000	$ -	$16,115,000	This alternative would not allow incorporation of the above alternatives.

SECTION 2

PROJECT DESCRIPTION

SECTION 2
PROJECT DESCRIPTION

The Blue River Channel Flood Protection Project is a continuing Federal project for flood damage reduction and other purposes along the Blue River Channel. The Blue River Basin Channel Project was authorized by the Flood Control Act of 1970 (P.L. 91-611, 91st Congress, 2nd Session). This project is located approximately 12 miles upstream of the confluence of Missouri River near 59th Street and the Blue River Channel in Kansas City, Missouri. .Improvements to the Blue River Channel began in 1983, when the first Contract was started on the Blue River Channel Project between the reach of the I-435 Bridge and the confluence of the Missouri River. Currently, the channel has been improved from the mouth to the confluence with Brush Creek. The limits of the project are 63rd Street.

The need for the Grade Control Structure resulted from the difference in the hydraulic gradeline between the improved channel and the unimproved channel. Additionally, the City of Kansas City, the Corps of Engineers, the Monnett Battle of Westport Fund Inc. and the Byram's Ford Industrial Park have agreed through Alternative Disputes Resolution that the flow of water through Byram's Ford will be restored to pre-project conditions.

HNTB has designed a reinforced concrete grade control structure on the Blue River Channel between 58th and 59th streets in Kansas City, Missouri to meet the above criteria. Low flows will enter the structure thought a 10-foot opening that extends from the channel flowline to the top of the upstream headwall. During high river stages, the upstream headwall acts as a 160-foot long weir. Crest elevations for the second and third stages of the weir are 18 and 38 feet, respectively, above the upstream channel flowline. Debris deflectors are located at the upstream entrance point at angles of 30-degrees to the channel flowline. The stilling basin is 7 feet deep and 160 feet long and contains ten 8 foot x 8 foot baffle blocks. The stilling basin sidewalls are 56.4 feet tall by 127.5 feet long and 7'-2" thick at the base of the wall. Access to the GCS is from the right bank of Blue River Channel.

The Grade Control Structure Basin's dimensions are 160-feet in width and extend downstream from the tieback walls 124-feet. The upstream tieback walls extend out from each side of the structure 152-feet. The basin floor thickness is 7.5 feet. There is a tie-back levee on the right back that extends out from the tie-back wall with fill area "A" downstream of the tie-back levee that fills the old channel loop and keeps flow from flanking the GCS on the right bank. On the left bank of the GCS, the Byram' s Ford Levee extends along the left bank of the GCS. The channel is constructed at a 160 feet width from the end sill wall of the GCS and extends160 feet downstream from the sill wall with both 24-inch and 18-inch thick riprap. The channel then transitions from 160-feet to 24 feet wide over 260 feet. The project continues with an improved channel for the next 696 feet where it transitions back to the original low-flow channel bottom width. There are two outfall structures in the channel; a 60-inch RCP on the right bank at station 51+55, and a 48-inch RCP on the left bank at station 49+64.

The extension of the existing 48-inch RCP is proposed northwest of the Grade Control Structure. This extension includes a 5 foot x 5 foot manhole on the landside of the berm, 48" RCP with concrete cradle under the berm and an outlet structure with flapgate on the riverside of the berm.

The 60-inch CMP extension is proposed northeast of the Grade control structure. The extension includes a 6-foot x 6-foot manhole, a 60-inch RCP extension and an outlet structure.

The project also includes a berm around the Byram's Ford Industrial Park as contemplated in the Alternative Dispute Resolution agreed upon by the City of Kansas City, USACE NWK, the Monnett Battle of Westport Fund, Inc. and the Byram's Ford Industrial Park Association on September 24.1992. The agreement is to provide protection from a flood event with expected frequency of once in 30 years. The ADR Agreement requires that the berm elevation is at 862 feet above mean sea level and 4 to 6 feet in height with 1 on 4 side slopes. The centerline runs generally eastward from the rail bed, crossing Manchester Trafficway, traversing just south of 60th Street and curves northward approximately 2000 feet east of the rail bed, west of the Building and tying into the planned berm (Alternate A) at approximately station 14+00. Manchester Trafficway appears to be the primary access to the industrial park.

Construction of the Grade Control Structure is currently planned to be completed in four phases. The stilling basin slab will be placed first during the low flow period (winter). The flow of the river will then be diverted around the structure while the remainder of the structure is built. Placement of the slab on the underlying shale layer is required to be placed in such a manner as to limit exposure of the shale layer to no more than 24 hours. Between the shale layer and the slab, six inches of lean concrete are to be placed to reduce the risk caused by this layer. The structure slab is to be 7.5 feet thick to overcome any sliding on the shale layer.

Three sumps are included in the stilling basin to be used for dewatering the stilling basin.

SECTION 3

VALUE STUDY PROCESS

SECTION 3
VALUE STUDY PROCESS

This section describes the process used to conduct this Value Study and the significant findings of the Value Team. This Value Study used the international standard Value Methodology established by SAVE International, the Value Society. The standard establishes the specific 6-Phase, sequential process, and the objectives of each of those phases, but does not standardize the specific activities in each phase.

Value Methodology (VM) is the general term that describes the structure and process for executing the Value Workshop. This systematic process was used with a multidisciplinary team to improve the value of the project through the analysis of functions and the identification of targets of opportunity for value improvement.

The **VM Job Plan** provides the structure for the activities associated with the Value Study. These activities are further organized into three major stages:

1. Pre-Workshop preparation
2. VM Workshop
3. Post-Workshop documentation and implementation

Figure 3-2 at the end of this section shows a diagram of the VM Job Plan used for this Value Study.

DEFINING VALUE

Within the context of VM, Value is commonly represented by the following relationship:

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

In this expression, functions are measured by the performance requirements of the customer, such as mission objectives, risk reduction, and quality improvements. Resources are measured in materials, labor, price, time, etc. required to accomplish the specific function. VM focuses on improving Value by identifying the most resource efficient way to reliably accomplish a function that meets the performance expectations of the customer.

It can be seen from this relationship that Value is improved or increased by:

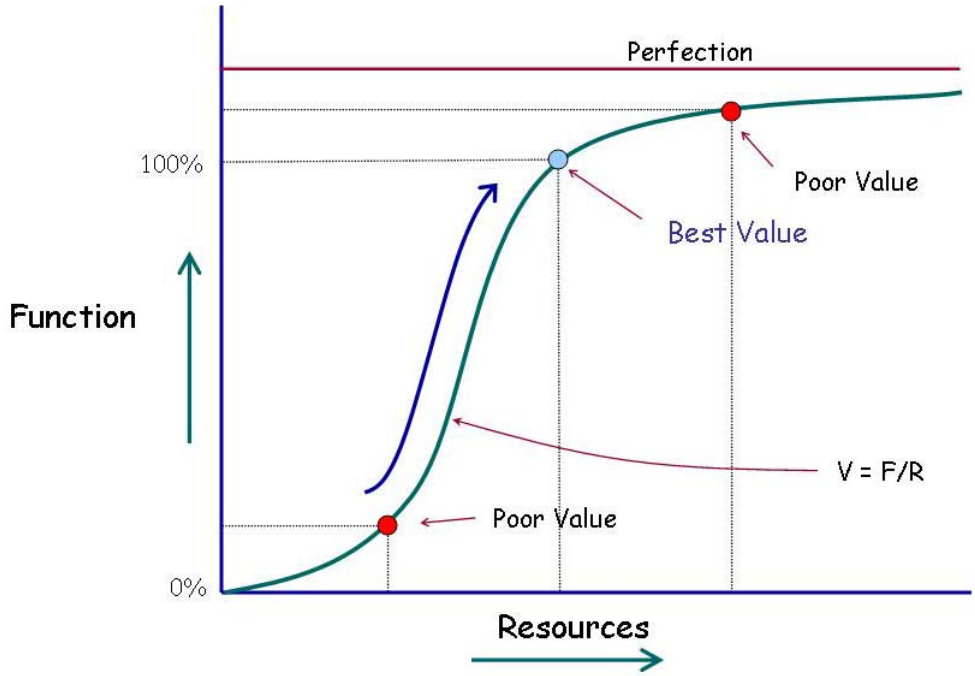
1. Increasing function without increasing resource consumption. Some increase in resources is acceptable as long as there is a greater increase in function performance.
2. Decreasing resources without decreasing function. Again, some decrease in function may be acceptable if the corresponding decrease in resources is significant enough.

Ideally, the Value Team looks for opportunities to increase function and concurrently decrease resource requirements. This will achieve the best value solution.

This Value concept is illustrated in the Figure 3-1, The Value Curve. This figure shows a hypothetical curve from plotting the value expression above. This curve will asymptotically approach perfection. The best value solution for a given project or project element will be found at the knee of the curve. At this point, the required function or functions have been achieved to 100% of the required level with a corresponding minimum resource commitment. To attempt to increase the function performance beyond this level will result in a resource consumption that has a higher worth than the marginal increase in function. This results in a poor value solution. Conversely, a poor value solution can also be the result of not achieving the function to 100% of the requirement. In this case, an incremental increase in resources delivers significant increase in function performance. The Value Methodology is used to identify the poor value decisions in a project and then develop alternative solutions to better align the project along this curve to achieve a best value solution.

Figure 3-1

The Value Curve



This understanding of how Value is affected by changes in function or resources provides the foundation for all SVS Value Studies. The following paragraphs describe the process we used to understand the functional requirements and how we identified value improvement alternatives.

PRE-WORKSHOP

Prior to the start of the workshop, the team was tasked with reviewing the most current documentation on the project development. This was done to familiarize them with the project design and to prepare them for asking questions of the project stakeholders during the project presentations at the beginning of the workshop. Much of the background information for this study was generated by HNTB. Other pre-workshop activities included:

- Coordinating workshop logistics and communicating those to the various participants
- Providing guidance to USACE and HNTB on presentation content for the project introduction
- Scheduling workshop participants and assigning tasks to ensure the team is prepared for the workshop
- Gathering necessary background information on the project and making sure project documentation is distributed to the team members

Materials furnished to the team by USACE and HNTB are listed in the Appendix.

VM WORKSHOP

The VM workshop was an intensive session during which the project design was analyzed to optimize the balance between functional requirements and resource commitments (primarily capital and O&M costs).

The VM Job Plan used by SVS includes the execution of the following phases during the workshop:

1. Information Phase
2. Function Analysis Phase
3. Creative Phase
4. Evaluation Phase
5. Development Phase
6. Presentation Phase

Information Phase

At the beginning of the workshop, it was important to understand the background of the project from which the design was developed. This background was provided in an oral overview by USACE and HNTB. The overview and subsequent project analysis provided information on the following topics:

- Rationale why this project is necessary

- Project objectives that have governed the proposed design
- Rationale for the proposed design configuration
- Explanation of design features, criteria, and assumptions
- Value Study constraints
- Project cost

The USACE project management presentation provided the team with an overview of the goals, issues, and expectations for the project. USACE and the Value Team also finalized the Value Study constraints. This was followed by HNTB's more detailed presentation on the project design and an explanation of the rationale behind key design level decisions. Further, this gave HNTB an opportunity to share their issues and concerns about the project from their perspective.

From these presentations, the Value Team noted the following key information:

- The hydraulic model needed correction due to the hydraulics of the weir
- The headcutting shear was being managed by controlling water elevation and velocity
- The berm protecting the Byram's Ford Industrial Area was required because of the structure. Without the structure, no berm was necessary.
- Hardesty Road is and will remain in the flood plain.

Site Visit

After the project presentations, representatives from the Value Team, USACE, and HNTB visited the project site. The purpose of the site visit was to give the team members a first-hand opportunity to see the physical features of the project site that influenced the design development.

From this site visit, the team made the following observations:

- The actual Ford has moved upstream approximately 150 feet due to historic headcutting
- A substantial amount of fill is required on the East side of the channel. Further, a substantial cut in the West side is required.

Project Cost Analysis

The Value Team was provided a construction cost estimate as part of the project documentation. This estimate indicated an anticipated construction cost of $25,680,000 based on prices escalated to the mid-point of construction. The construction start is scheduled for 2007 with a 24-month construction duration.

As a part of this workshop, the team prepared an independent construction cost estimate and compared it to the estimate provided by the Corps of Engineers. The review verified the reasonableness of the:

- estimated quantities
- estimated unit costs
- estimated contingencies
- mark-ups for overhead, profit, bonds, etc.
- overall project cost

This was done to ensure that the value team had reliable data to use as the basis for cost comparisons of alternatives.

The result of this review of the project cost estimate resulted in a recommended increase of the estimated project costs from $25,680,000 to $40,000,000. This is approximately a 60% increase over the cost estimate dated April 22, 2007, prepared by Corps of Engineers.

Review of the costs included comparison of unit prices to recently received prices for similar projects and to published unit price indices. Unit prices for unique project elements were compared to prices based on applicable crew compositions and production rates. Vendor quotations were obtained for unique and/or major equipment and compared to those in the project cost estimate. Adjustments were made where appropriate to bring unit prices and quantities into conformance with the current design documents and presentation information provided to the value team.

A complete review of all the estimate's supporting backup data was not attempted due to time limitations and availability of information; however, limited reviews were made of some quantities for the larger cost items within the estimate.

Function Analysis Phase

Function Analysis is the heart of the VM process and is the key activity that differentiates the VM process from other problem solving or improvement practices. During the Function Analysis Phase of the VM Job Plan, functions are identified that describe the expected outcomes of the project under study. Function Analysis also defines how those outcomes are expected to be accomplished by the design. These functions are described using a two-word, active verb and measurable noun pairing.

This identification and naming convention of project functions enables a more precise understanding by limiting the description of a function to an *active verb* that operates on a *measurable noun* to communicate what work an item or activity performs. This naming convention also helps multidisciplinary teams to build a shared understanding of the functional requirements of the project.

Function Determination

Defining functional requirements for the project allowed USACE to be sure that the facility, as designed, would fulfill the needed purposes. The entire project was analyzed to determine what functions are being accomplished by the current design. Required functions were retained. Some functions were not necessary to accomplish the mission of the project and thus became candidates for deletion.

During the Function Analysis Phase, the Value Team used various function analysis techniques to analyze the project. This analysis helped the team confirm its understanding of the overall project objectives and analyzed the functions of key project elements. The Value Team Leader led the team through an in-depth discussion of the possible functions of each key project element to clearly and precisely identify the purposes of each.

FAST Diagram

Function analysis was enhanced by using a graphical mapping tool known as the *Function Analysis System Technique* (FAST), which allows team members to understand how the functions of a project relate to each other. The resulting FAST Diagram allowed quick visualization of the logical relationship between project functions and the project as a whole. The FAST diagram is in the Function Analysis section of the Appendix.

The FAST Diagram is structured such that moving to the right of any function answers the question, “How are we accomplishing this function?” Moving to the left of any function answers the question, “Why are we accomplishing this function?” Elements that are vertically connected occur “When,” or as a consequence of, the function it is connected to on the horizontal path.

The diagram shows on the far left that the ultimate function or the mission that must be accomplished by this project is to protect battlefield and preserve channel. This is accomplished by managing scour, managing headcutting, and stabilizing the banks.

The functions between the two dashed lines, called Scope Lines, represent the functional elements of the project which are within the scope of the Value Study. The first column of functions (basic functions) within the left Scope Line represents the functions that must occur in order for this project to successfully accomplish its mission. The remaining functions (secondary or support functions) represent how the current design has chosen to accomplish those basic functions.

Function Findings

From the function analysis of this project, the team concluded that:

- The structure was designed to control velocity upstream to pre-project conditions which in turn aided in managing the headcutting at the battlefield location and managing scour along the riverbanks.

- Overbank scouring is not a concern. Undercutting the toe of the banks is the chief concern.

- The thickness of the structure slab was driven by the friction coefficient between the shale and the structure. To address the uncertainty with the friction at the shale-to-shale interface, a high safety factor was used.

In addition to identifying the essential project functions, this phase of the workshop also serves two other objectives:

1. The unification of the individual Value Team members into a synergistic, cohesive team, and

2. The stimulation of creative ideas prior to beginning the subsequent creative phase.

The function analysis worksheets are included in the Appendix.

Creative Phase

This step in the VM process involved generating ideas using creativity techniques. The team recorded all ideas regardless of their feasibility. In order to maximize the Value Team's creativity, evaluation of the ideas was not allowed during the creative phase. The team's effort was directed toward a large quantity of ideas. These ideas were later screened in the Evaluation Phase of the workshop.

The creative ideas generated by the team are included in the Appendix. The list also includes ratings for each idea based on the Evaluation Phase of the workshop. These lists should be carefully reviewed, as there may be other good ideas not developed by the team because of time constraints. These should be further evaluated or modified to gain the maximum benefit for the project.

Evaluation Phase

In this phase of the workshop, the team selected the ideas with the most merit for further development.

After an initial vote, the Value Team Leader assessed how many ideas could be developed into Value Alternatives within the remaining duration of the workshop. From this assessment, all ideas with a certain number of votes were selected for development. However, prior to the final selection, all of the ideas were revisited collectively by the Value Team to ensure that those selected by the voting process truly represented the best ideas for development. This gave the team the opportunity to down-rate some ideas and to up-rate other ideas based upon team discussion of the ideas.

The criteria used for selection were:

1. The inherent value, benefit and technical appropriateness of the idea

2. The expected magnitude of the potential cost savings

3. The potential for USACE and HNTB acceptance of the idea

Ideas were selected for development as Value Alternatives based on all three criteria.

Other ideas were selected for development as design suggestions based primarily on the first and third criteria rather than for cost savings. Some design suggestions may save costs, others may increase costs, and the cost impact of some could not be predicted adequately with information and time available to the team. Not all ideas were developed. This evaluation

process is designed to identify those ideas with the greatest potential for value improvement that can be developed into Value Alternatives within the time constraints of the workshop and the production capacity of the team.

The remaining ideas were eliminated from further consideration by the team; however, the ideas not developed should also be reviewed, as there may still be other good ideas not developed by the team because of time constraints or other factors. These could be further evaluated or modified to gain the maximum benefit for the project.

Development Phase

During the Development Phase of the workshop, each idea was expanded into a workable alternative to the original project concept. Development consisted of preparing a description of the value alternative, evaluating advantages and disadvantages, and making cost comparisons.

Each alternative is presented with a brief narrative to compare the original concept and the alternative concept. Sketches and brief calculations were also developed, if needed, to clarify and support the alternative. The value alternatives developed during the workshop are presented in Section 4 – Value Improvement Alternatives.

The Value Team Leader and, to the extent possible, other team members reviewed each alternative to improve completeness and accuracy.

Redesign costs are not included in the cost comparison of alternatives. The responsibility for determining these costs is between USACE and HNTB. Redesign costs, if any, should be addressed by HNTB in their response to USACE on the alternatives.

Presentation Phase

The last phase of this workshop was the presentation of the Value Alternatives. The presentation was made by the Value Team on April 26, 2007 to representatives of USACE's and HNTB's project team. The Value Team described each Value Alternative and the rationale that went into the development. This was followed by answering the audience's questions. The acceptability of the Value Alternatives was deferred pending USACE's and HNTB's review of our Preliminary Report.

POST-WORKSHOP

The Post-Workshop activities of this Value Study consisted of preparing the Value Study Reports and coordinating with USACE and HNTB to help them make decisions regarding the acceptance of the value alternatives.

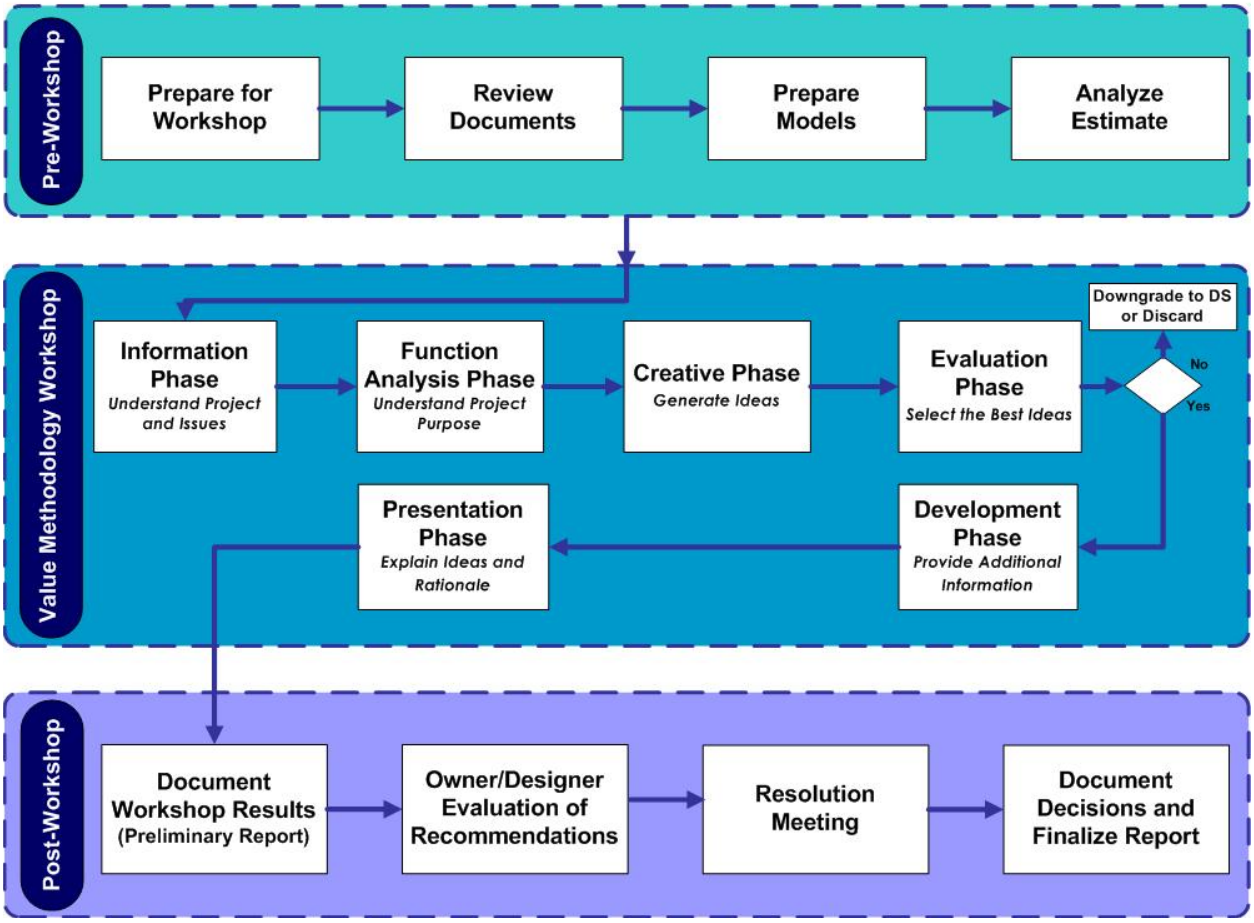
Shortly after the conclusion of the workshop, our Preliminary Report was submitted to USACE for review. The report was also provided to HNTB by USACE. Upon receipt of the report, representatives of USACE and HNTB analyzed each Value Alternative. HNTB provided a response to USACE, either recommending incorporation of the Value Alternative into the design or presenting reasons for rejection.

Upon completion of the review, a meeting was held between USACE, HNTB, and the Value Team Leader for resolution of any outstanding questions and for making decisions regarding

the appropriate implementation action for each Value Alternative and Design Suggestion. The results of that meeting are presented in Section 6 – Implementation Decisions.

This Final Value Study Report includes the Value Alternatives developed during the workshop and the subsequent implementation decisions.

FIGURE 3-2
VALUE ENGINEERING PROCESS DIAGRAM



SECTION 4

VALUE IMPROVEMENT ALTERNATIVES

SECTION 4
VALUE IMPROVEMENT ALTERNATIVES

The results of this Value Study represent the value improvement opportunities that can be realized on this project. They are presented as individual alternatives for specific changes to the current design.

Each alternative includes:

- a summary of the original concept
- a description of the alternative concept
- a brief narrative comparing the original design and the recommended change
- sketches, where appropriate, to further explain the alternative
- calculations, where appropriate, to support the technical adequacy of the alternative
- a capital cost comparison
- and a life cycle cost analysis, if appropriate

Cost was the primary resource that was compared to the functions being accomplished in the project. To ensure that costs were compatible within the Value Alternatives proposed by the team, the project cost estimate was used as the basis of cost.

ORGANIZATION OF ALTERNATIVES

The alternatives presented on the following pages are organized by project or functional categories, and then numerically within each of those categories. The divisions used to organize the alternatives are as follows:

MS – Manage Shear

S – Structure

G – Geometry

C – Construct

These designations have been used throughout the VE process to organize the ideas.

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Manage Shear

Value Alternative

Project: Grade Control Structure, Blue River Channel
Location: Kansas City, MO

Alternative No:
MS-02

Title:
Replace GCS with series of grade control structures and bank protection to Brush Creek

Description of Original Concept:

In the original concept, the GCS is the upstream terminus of the Blue River channel improvement project. The proposed structure is to cascade the flow in a controlled manner by dissipating energy within a concrete stilling basin, to reduce the flow downstream preventing erosion. The structure also controls the hydraulic conditions upstream in the Byram's Ford Battlefield area to limit erosion and damage in the area by maintaining flow depth and velocity to the pre-project conditions.

Description of Alternative Concept:

The alternative concept is to replace the GCS with a series of grade control structures, changing channel geometry and selected bank protection from 63rd Street to Brush Creek using applied fluvial geomorphology to mimic the natural methods for distributing and dissipating energy and use soil bioengineering and other bank strengthening methods to limit erosion and damage to the Byram's Ford Battlefield area. Incision and scour from lower flows is managed by rock grade controls placed where riffles and runs would normally occur in a natural channel. Banks are protected selectively using rock toe armor, vegetated stream banks and changed channel geometry. Scour from higher flows is managed by small internal floodplains predominantly on the inside of meanders, vegetated streambanks and floodplains and selected areas of toe armor.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☒ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☒ Decreased

Cost Savings Summary

First Cost Savings: $32,882,000

Advantages/Disadvantages

Alternative No.: MS-02

Advantages of Alternative Concept

- Distributes energy
- Only armors banks and bed at high stress points
- Preserves natural conditions
- Allows uninterrupted riparian corridor
- Completes the project from Brush Creek to 63rd Street

Disadvantages of Alternative Concept

- May have local limited damage
- Requires additional field work by specialty consultant
- Requires redesign of the project
- Requires design by specialty design consultant
- Extends the project schedule

Discussion

Alternative No.: MS-02

The thalwegs and banks of channels adjusts over time and develop a ratio of riffle spacing to channel forming width of approximately 2π. Riffles and runs form in the transitions between meander bends. Pools form in the meanders. The planform of a stream adjusts to match the rate of water and sediment traveling through the stream. Planform adjustment can be by meander advance, changes in meander amplitude or widening. The increased flow quantity and frequency, and the channelization of the lower Blue River has caused a series of scour events upstream of Brush Creek through atleast 63rd Street that are reflected in changes in planform and profile. The team performed a prelimianary fluvial geomorphic analysis based on aerial photographs from Google Earth, the results from HNTB's HEC-RAS analysis, information from project documents and personal experience in the Kansas City region. The purpose of the analysis was to gather preliminary design parameters and confirm assumptions. Preliminarily, there are a series of head cuts moving upstream from Brush Creek. The channel appears to be widening and meanders are increasing wavelength (flattening with a longer radius). The meander radius is approximately 400 to 250 feet, the channel width is approximately 50 to 60 feet. The resulting ratio of radius to width is approximately 3 to 6, the upper limit for a stable bed form. Where observable from aerial photographs, riffle spacing to channel width is approximately 7, the upper limit of the ratio.

Scouring and mass wasting were observed at a few places along the channel. Local landslides appear to be occurring in the meanders and are the dominant mechanism for changes in meander geometry. The slides appear to result from toe scour.

As with most stream instability problems, energy management is the central issue. Between the downstream channelization and increased flows with development, there is more energy in this stream reach than the boundaries can resist. Successful management requires both reducing the applied stress and increasing the boundary strength.

Reducing applied stress

The only driving force acting on the river is gravity moving water and sediment downstream and downslope. This force acts as applied shear on the boundary of the channel. This applied shear is lowered by managing the energy. Energy reduction is accomplished by streambed structures commonly referred to as grade controls. The grade controls locally harden the bed and flatten the hydraulic slope. Near-bank energy is also reduced by increasing the hydraulic roughness of the riverbanks by planting native riparian vegetation and by channel geometry. Hydraulic slope is also controlled for higher flows by excavating internal floodplains giving a larger cross section and thereby lowering the water surface profile. These methods should be used to limit the cumulative applied tractive shear to below the threshold for toe and bed erosion.

Discussion

Alternative No.: MS-02

Increasing boundary strength

Continuous strengthening of the banks is generally not economically feasible with hard armor but can be accomplished with the use of native riparian vegetation. Strengthening of the toe with armor rock or similar materials may be necessary at selected locations along the river.

Slopes are currently eroded and vary from exposed soil to a mixed quality of vegetation. Increasing the quality of the vegetation planting with native vegetation will decrease near-surface applied shear and strengthen the banks.

The team preliminarily recommends the installation of 19 grade controls, excavation of 3 internal floodplains and vegetating the banks through the reach.

The inside of meanders is currently being scoured to form internal floodplains as demonstrated in the Google Earth image near 54th Street.

Based on the teams experience and values published in the Kansas City Chapter of APWA Design Standard 5600, the critical shear for shale is 0.67 psf and soil is from 0.26 to 0.46 psf. The critical shear values must be adjusted to compare those values with the values calculated by HEC-RAS. In general, a value of critical shear of 0.26 psf is equivalent to a channel shear of 0.8 psf as calculated by HEC-RAS (value may vary with quality and frequency of cross-sections). Results from the Corps of Engineers HEC-RAS model modified by HNTB revealed existing channel shear stress in the range from 0.5 to 1.5 psf. The preliminary HEC-RAS results of channel shear for the proposed project range from 0.25 to 1 psf.

Sketch

Alternative No.: MS-02

☒ Original ☐ Alternative

Sketch

Alternative No.: MS-02

☒ Original ☐ Alternative

Sketch

Alternative No.: MS-02

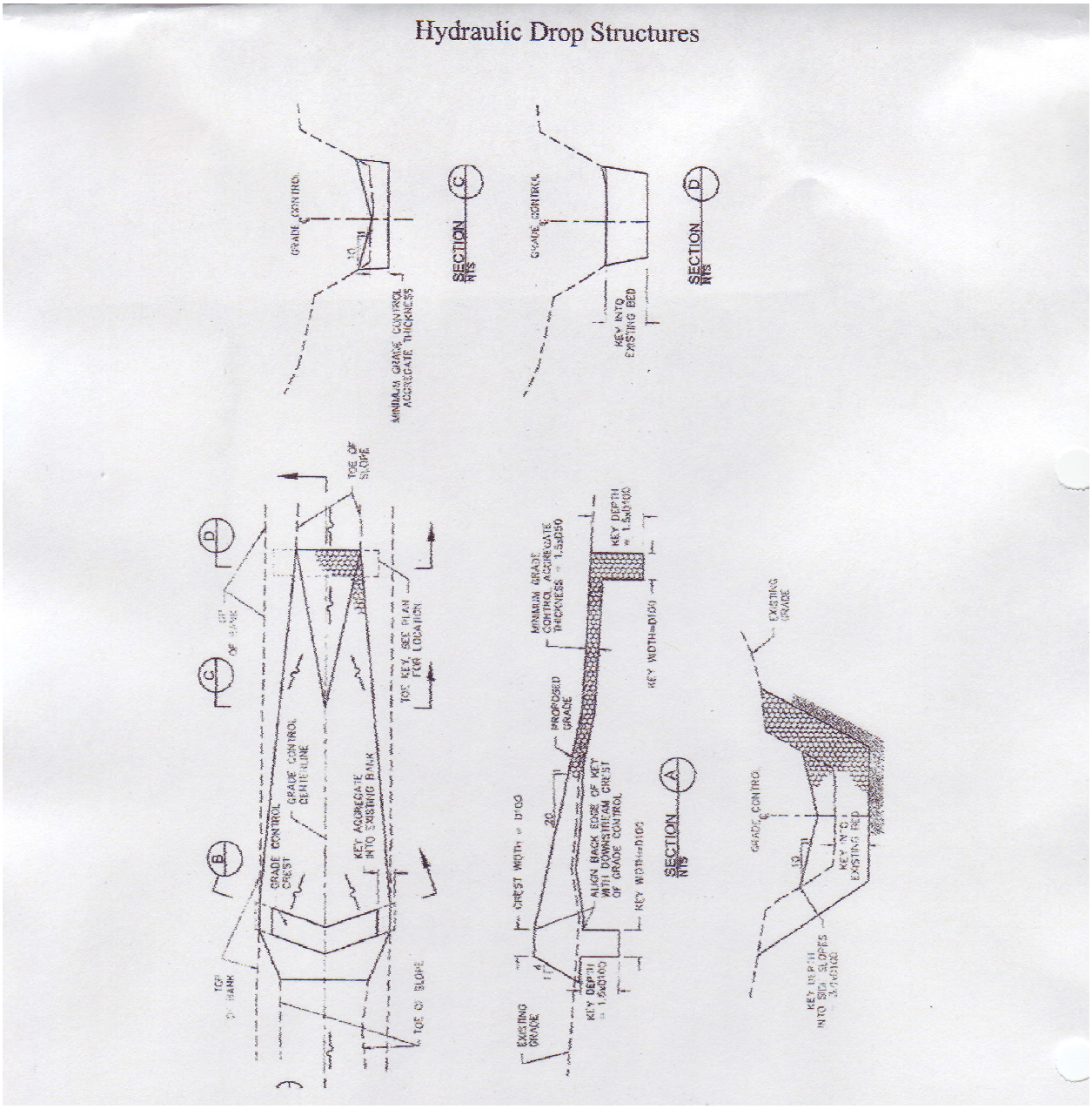
☒ Original ☐ Alternative

Completed channel work looking downstream from Coal Mine Road

Sketch

Alternative No.: MS-02

☐ Original ☒ Alternative



Sketch

Alternative No.: MS-02

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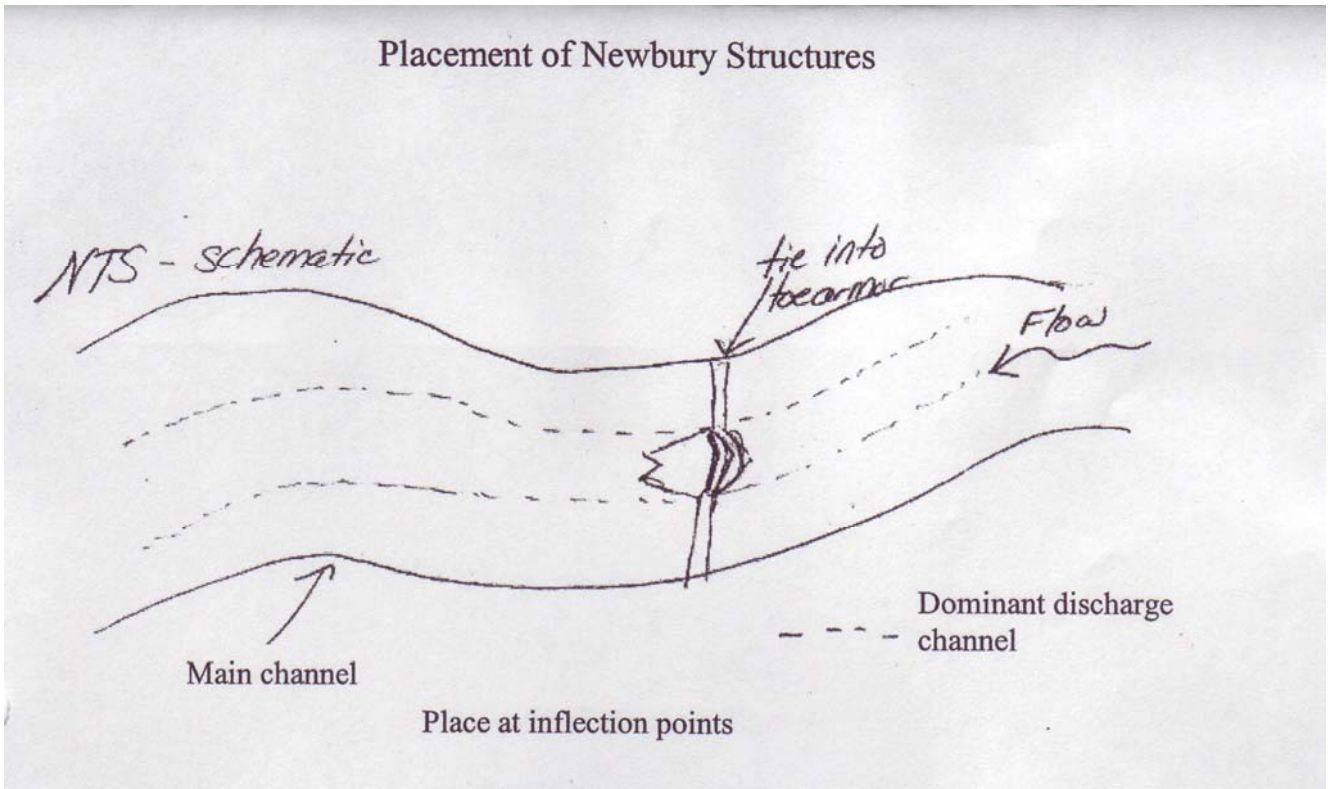
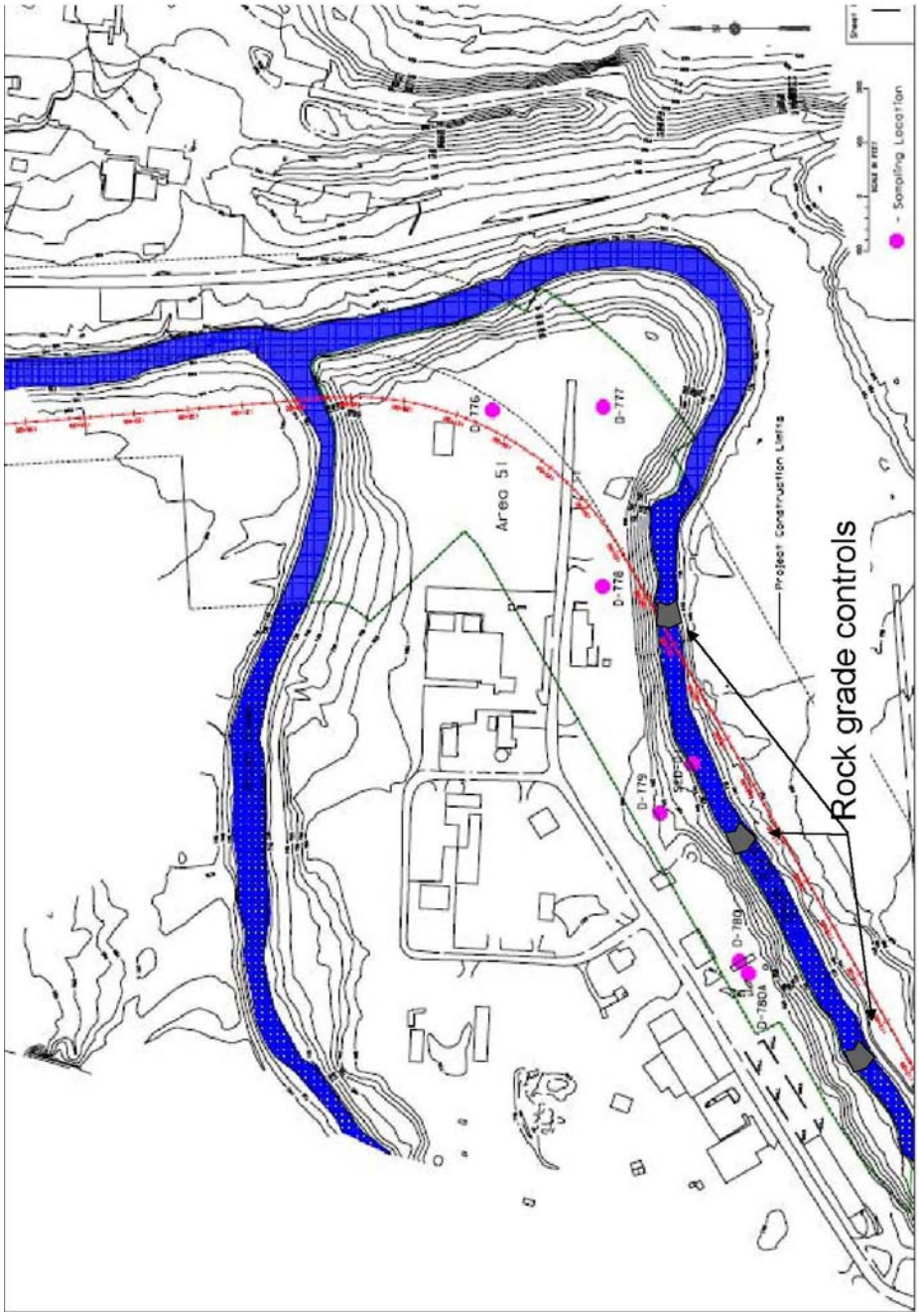


Sketch

Alternative No.: MS-02

☐ Original ☒ Alternative

The following indicate locations of proposed rock grade control structures.



Sketch

Alternative No.: MS-02

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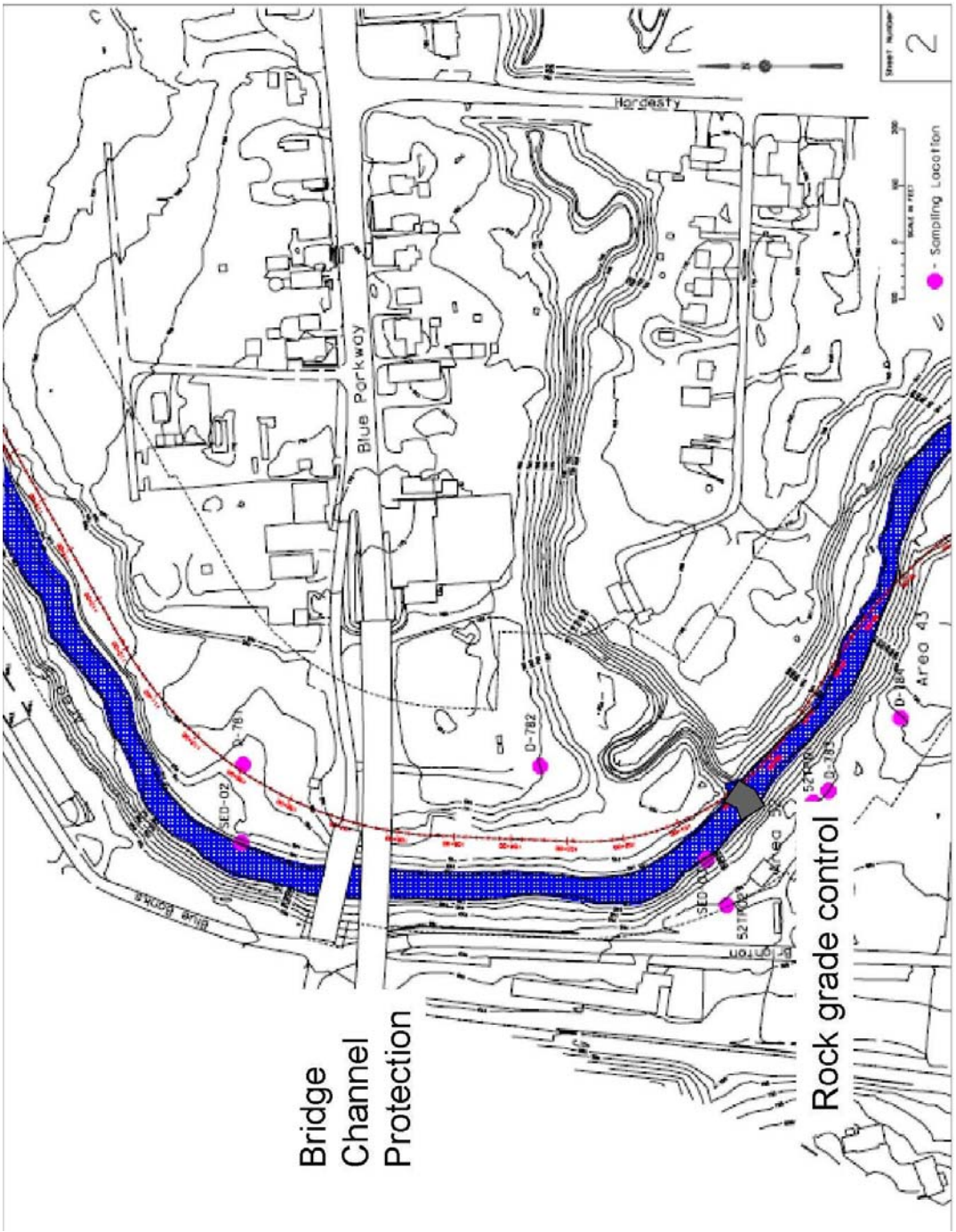

Sketch

Alternative No.: MS-02

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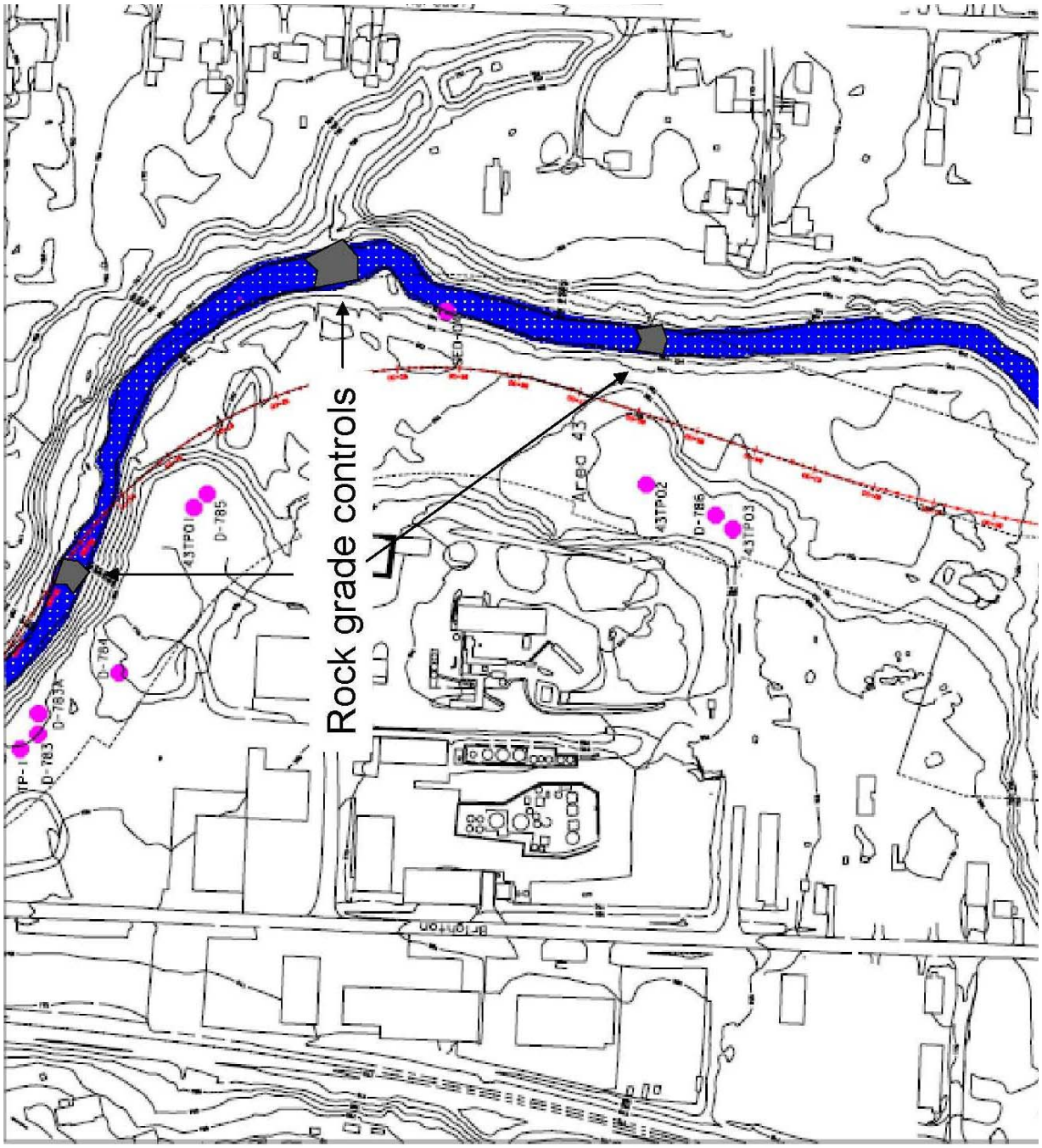

Sketch

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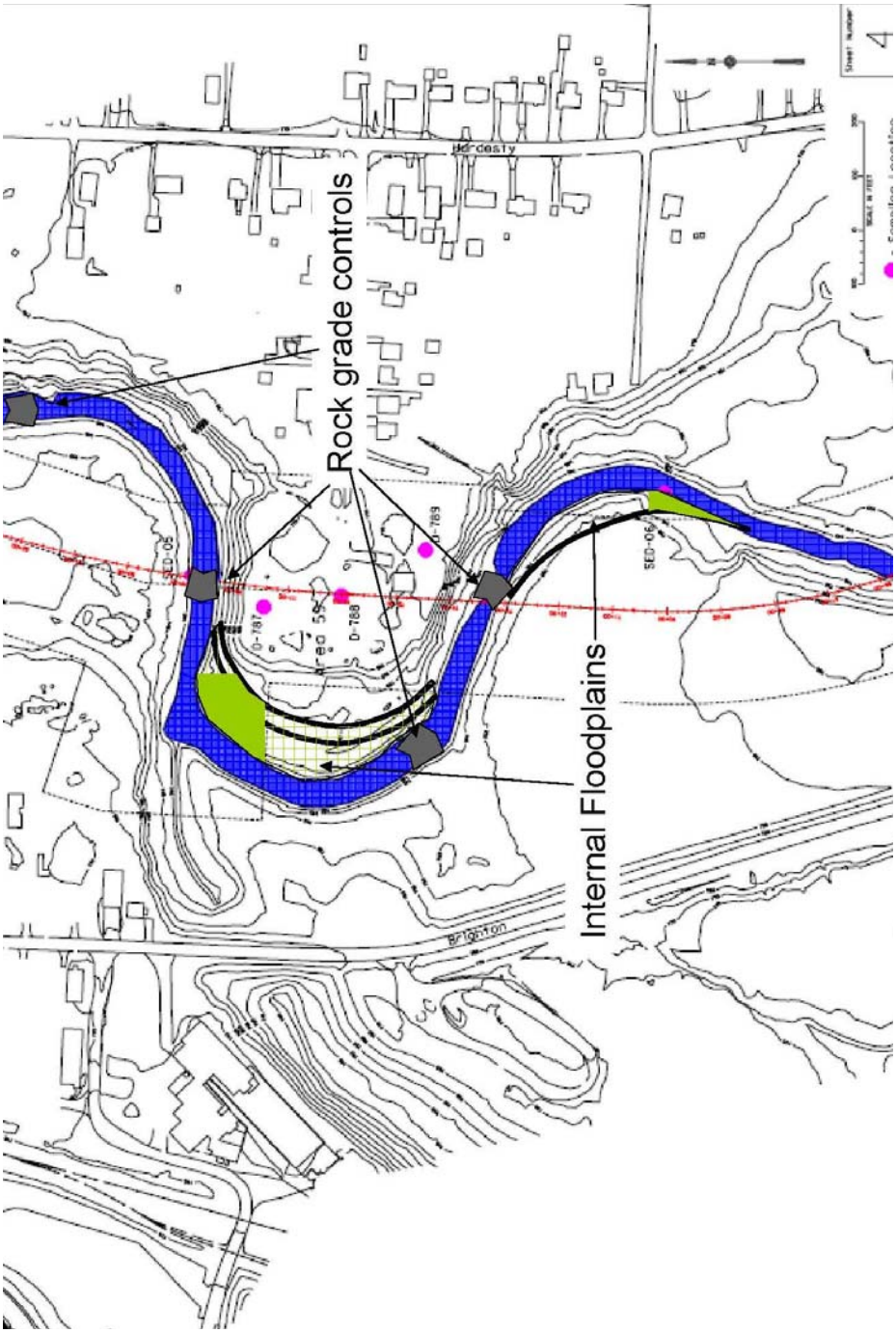
☐ Original ☒ Alternative



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Alternative No.: MS-02

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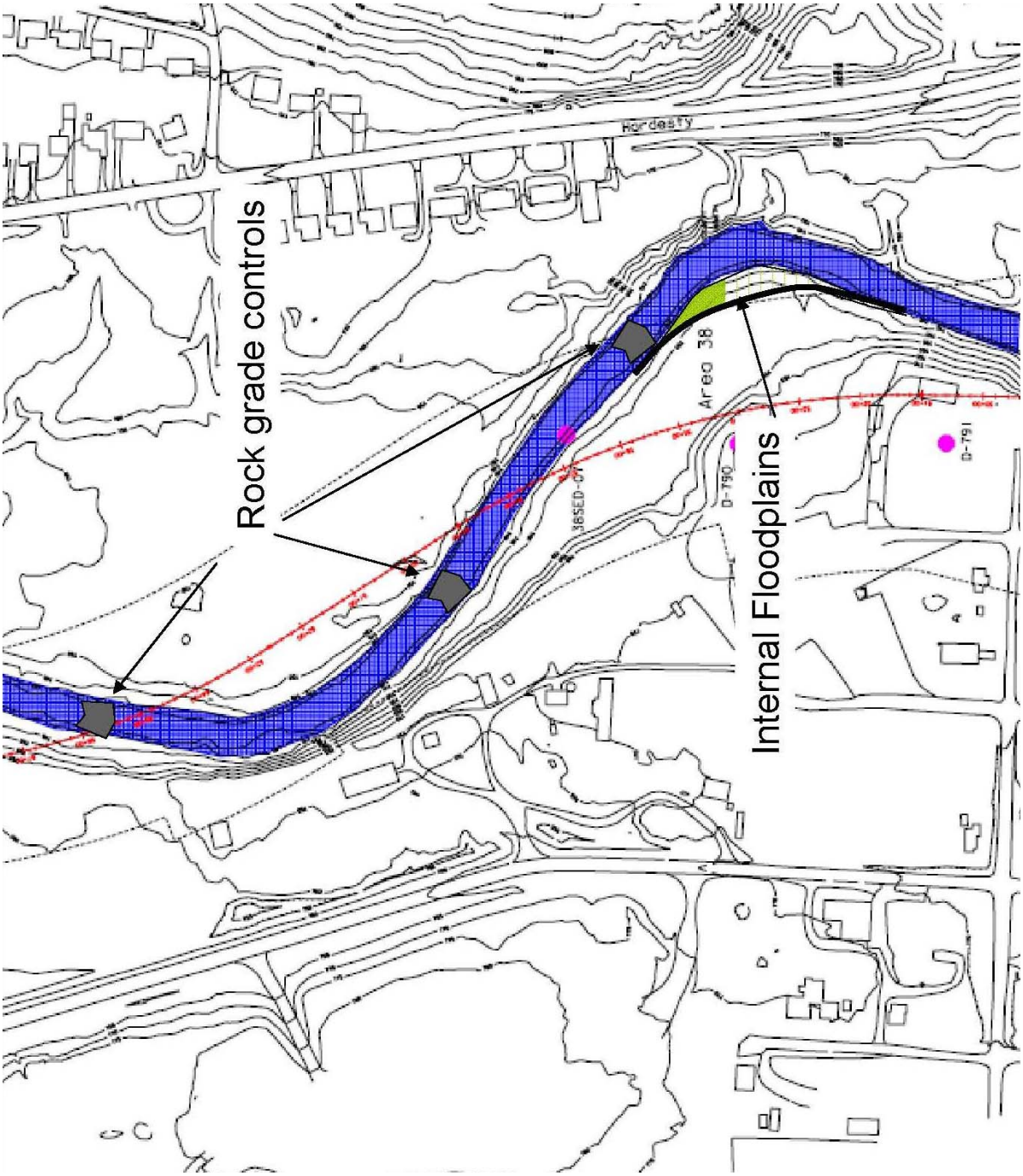

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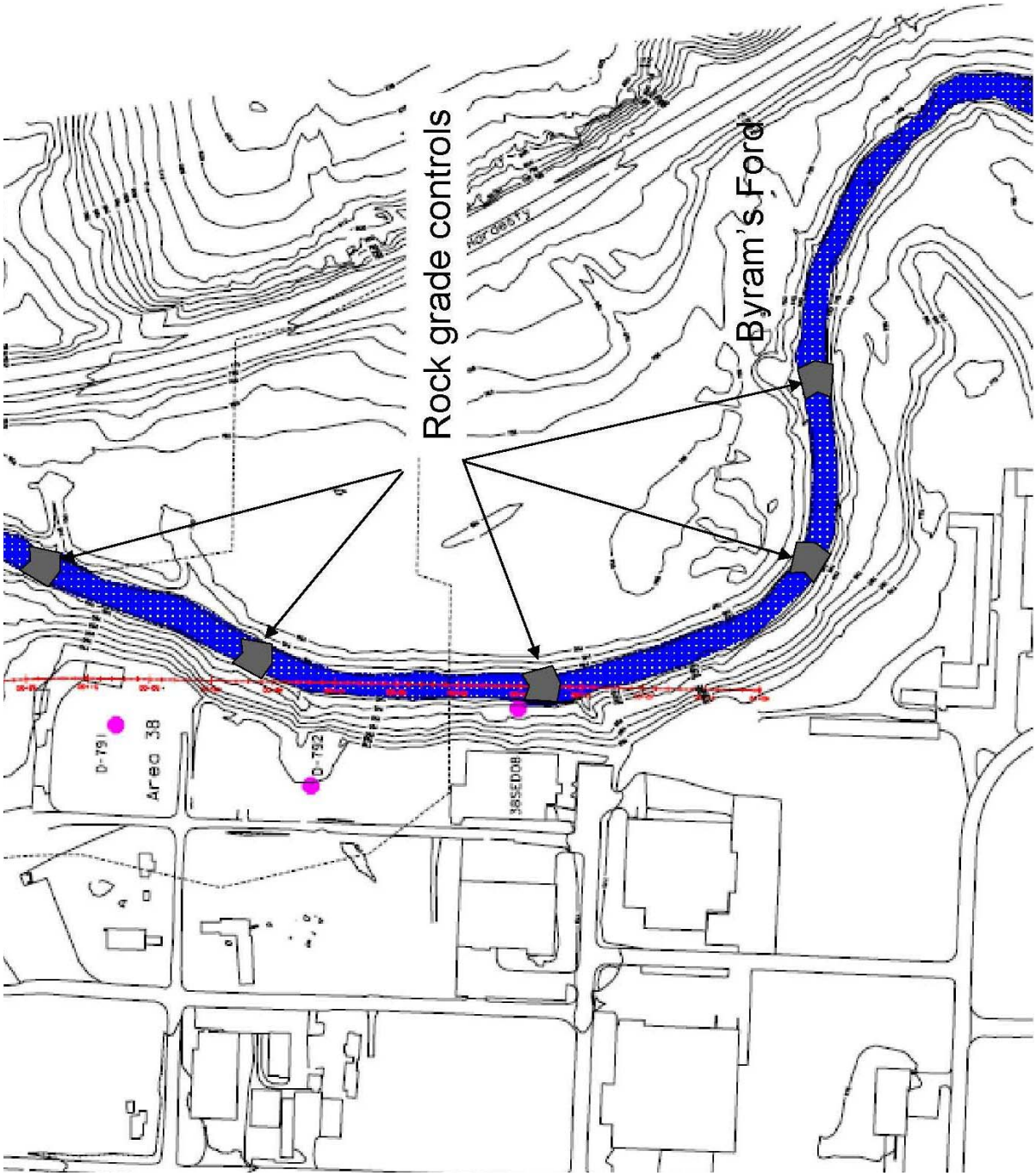
Alternative No.: MS-02

☐ Original ☒ Alternative



Sketch

Alternative No.: MS-02

☐ Original ☒ Alternative

An Example: Fee Fee Road Bridge Channel Design, Maryland Heights, MO

Sketch

Alternative No.: MS-02

☐ Original ☒ Alternative

Sketch

Alternative No.: MS-02

☐ Original ☒ Alternative

Construction Cost Estimate

Alternative No.: MS-02

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas.**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Blue River GCS	LS	$36,065,000	1	$36,065,000		
Excavation	cu yd	$12			110,000	$1,320,000
Grade Controls (Rock)	each	$50,000			19	$950,000
Brdge Stablization	LS	$75,000			1	$75,000
Waste Soil Off Site	cu yd	$4			110,000	$478,500
Stripping areas L & R Banks	LS	$200,000			1	$200,000
60" RCP	lin ft	$744			100	$74,400
Flap gate, 60"	each	$19,220			1	$19,220
Junction Box	LS	$56,203			1	$56,203
Outlet structure	LS	$25,172			1	$25,172
Channel protection	LS	$37,200			1	$37,200
Modification to exist at connection	LS	$43,400			1	$43,400
48" RCP	lin ft	$595			312	$185,640
Flap gate, 48"	each	$12,400			1	$12,400
Junction Box	LS	$37,200			1	$37,200
Outlet structure	LS	$31,000			1	$31,000
Channel protection	LS	$37,200			1	$37,200
Modification to exist at connection	LS	$43,400			1	$43,400
Access	each	$20,000			10	$200,000
Erosion & Sediment Control	LS	$500,000			1	$500,000
Planting	lin ft	$200			10,560	$2,112,000
Project Marked up cost	LS			$36,065,000		$6,437,935
Contingency	5.0%			$1,803,250		$321,897
SIOH	5.7%			$2,158,490		$385,310
TOTALS				$40,026,740		$7,145,142
NET SAVINGS						$32,881,598

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Structure

Value Alternative

Project: Grade Control Structure, Blue River Channel
Location: Kansas City, MO

Alternative No:
S-01

Title:
Replace tie back walls with earth embankment

Description of Original Concept:

The original concept is to use cast-in-place concrete walls to tie the grade control structure into the adjacent river banks.

Description of Alternative Concept:

The alternative concept is to use earth embankment in lieu of cast-in-place concrete walls to tie the grade control structure into the adjacent river banks.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☐ Increased
☒ Maintained	☐ Maintained
☐ Decreased	☒ Decreased

Cost Savings Summary

First Cost Savings: $ 5,462,000

Advantages/Disadvantages

Alternative No.: S-01

Advantages of Alternative Concept

- Provides the opportunity to use all excavated embankment material on site rather than going to an offsite disposal
- Reduces a large amount of cast-in-place concrete
- Reduces the long term maintenance
- Provides a more natural looking grade control structure

Disadvantages of Alternative Concept

- Requires additional landscaping and plantings

Discussion

Alternative No.: S-01

The tie walls for the grade control structure as planned are cast-in-place concrete that are very large. Not only are the walls costly to build but they present a long term maintenance problem for both the joints and graffiti exposure.

By using a earth embankment in lieu of the cast-in-place concrete for the tie walls all the excess excavated material is used on site. The material can be placed at less cost than the cast-in-place concrete and in less time thus providing a savings in both dollars and time.

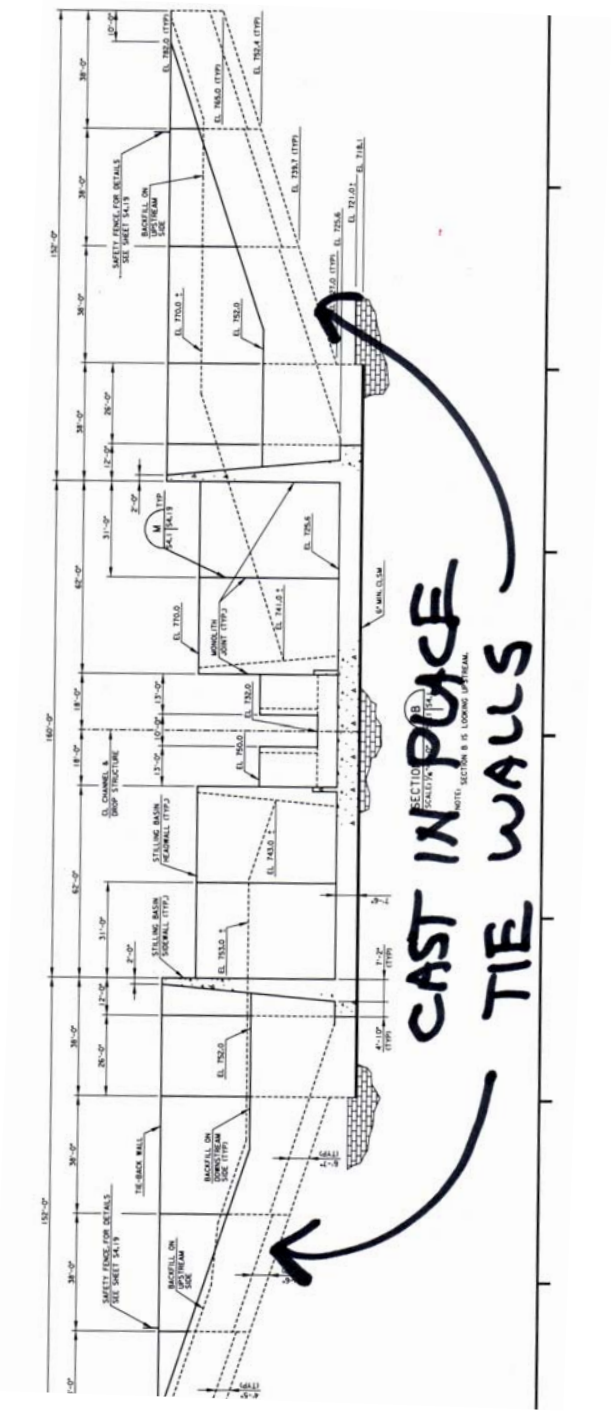
The earth embankment will not have the joint exposure as does the concrete and instead of having a large flat surface that will attract graffiti the embankment will blend into the surrounding area providing a natural landscape. This should be a lot more user friendly for the public and be pleasing for the Civil War round table.

Some engineering will be required to ensure the embankment has the shape and weight to control the various flood stages but this should not be a deal breaker.

Sketch

Alternative No.: S-01

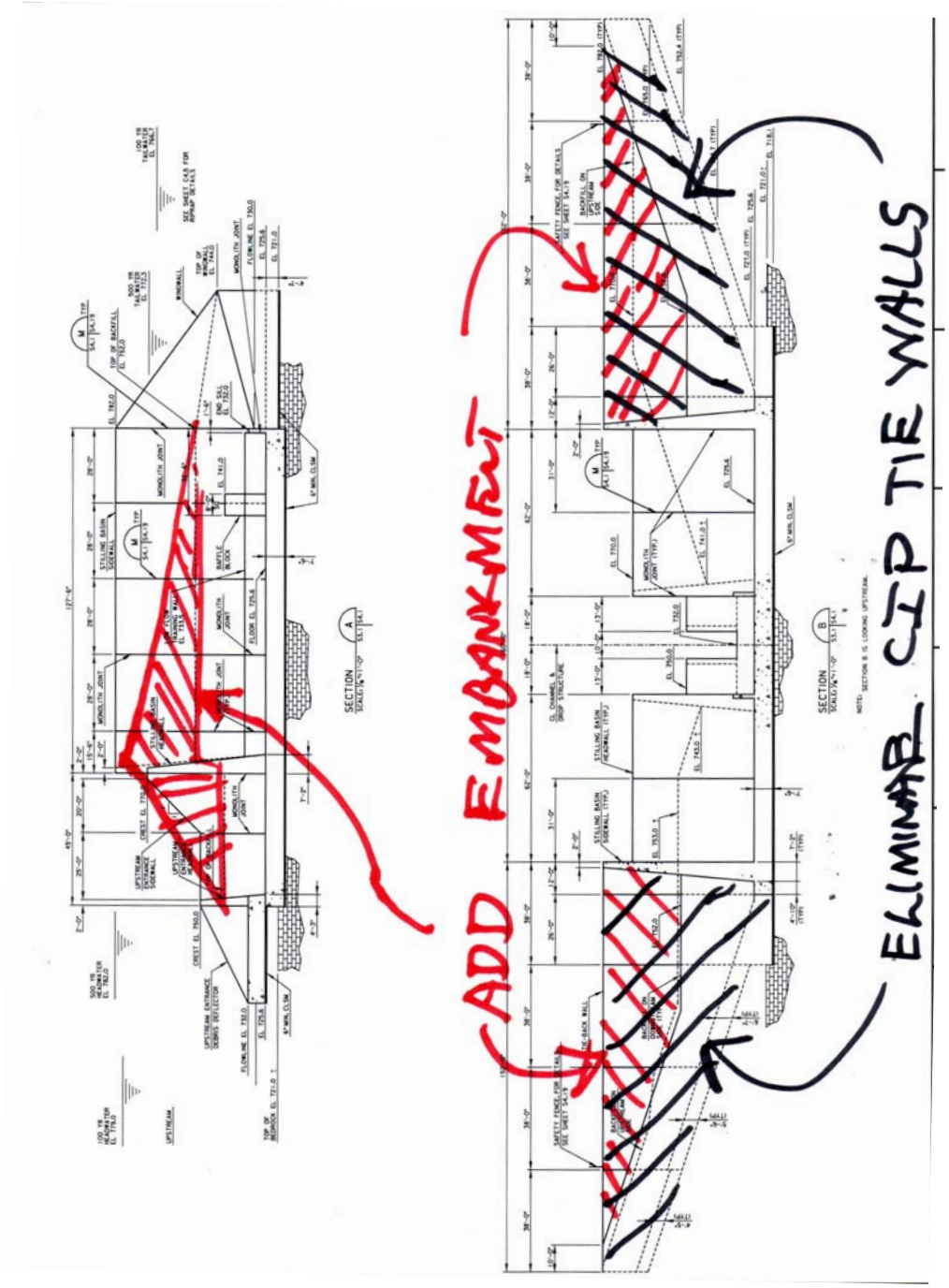
☒ Original ☐ Alternative



Sketch

Alternative No.: S-01

☐ Original ☒ Alternative



Calculations

Alternative No.: S-01

☒ Original ☐ Alternative

Cast-in-Place Tie Walls

Section	Footing	Wall
1	32,109	12,017
2	41,537	12,658
3	22,084	7,987
4	9,315	4,268
	105,045	36,930

Total 141,975 cf / 27 = 5,258 cy Mass Concrete

286 cy Lean Concrete

361 cy Rock Excavation

14,735 cy Common Excavation

Note: Quantities from HNTB take off

Calculations

Alternative No.: S-01

☐ Original ☒ Alternative

In Place Embankment

Right side upstream 782 – 752 = 30

(76 x 30 x 50)/27 = 4,222 cy

Right side downstream 782 – 752 = 30

(76 x 30 x 64)/27 = 5,404 cy

Left side upstream 782 – 770 =12

(76 x 12 x 50)/27 = 1,689 cy

Left side downstream 782 – 752 = 30

(76 x 30 x 64)/27 = 5,404 cy

Total

4,222 + 5,404 + 1,689 + 5,404 = 16,719 cy + 50% for slope tie-in = 25,079 cy

Construction Cost Estimate

Alternative No.: S-01

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas.**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Mass Concrete	cu yd	$922	5,258	$4,847,876		
Lean Concrete	cu yd	$245	286	$70,070		
Rock Excavation	cu yd	$55	361	$19,855		
Common Excavation	cu yd	$8.50	14,735	$125,248		
Common Excavation Haul Off	cu yd	$4.35	25,079	$109,094		
Additional in Place Embankments	cu yd	$10			25,079	$250,790
Project Marked Up Cost				$5,172,142		$250,790
Contingency	5.0%			$258,607		$12,540
SIOH	5.7%			$309,553		$15,010
TOTALS				$5,740,302		$278,339
NET SAVINGS						$5,461,963

Value Alternative

Project: Grade Control Structure, Blue River Channel
Location: Kansas City, MO

Alternative No:
S-02

Title:
Replace large concrete walls with MSE walls

Description of Original Concept:

The original concept is to use cast-in-place concrete for the large stilling basin walls and the large tie walls.

Description of Alternative Concept:

The alternative concept is to use MSE walls in lieu of the large cast-in-place concrete walls.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☐ Increased
☒ Maintained	☐ Maintained
☐ Decreased	☒ Decreased

Cost Savings Summary

First Cost Savings: $9,584,000

Advantages/Disadvantages

Alternative No.: S-02

Advantages of Alternative Concept

- Eliminates the need for large cast-in-place concrete walls under the Mass Concrete Specifications
- Will allow a thinner stilling basin base slab
- Will improve the schedule
- Adds opportunity for decorative art design

Disadvantages of Alternative Concept

- Requires selective backfill to be purchased
- Possible differential settlement
- Some staining will result from weeping

Discussion

Alternative No.: S-02

The original concept is to use cast-in-place concrete walls for both the stilling basin walls and the tie walls. The stilling basin walls are 57 ft in height which requires large footings and base widths to prevent over turning and resist vertical loads due to earth and water against the walls.

A large amount of time will be required in the schedule to form and place the concrete for these large walls. In addition the walls and footings are so large they will require Mass Concrete controls which add both time and dollars to the project.

By using MSE walls in lieu of the cast-in-place concrete walls the stilling basin slab thickness can be reduced. The walls can be constructed in concert with the earth embankment and will present an opportunity for art work and /or designs on the face of the wall. The MSE walls are also much faster to put in place than cast-in-place concrete walls thus lending themselves to improved schedule.

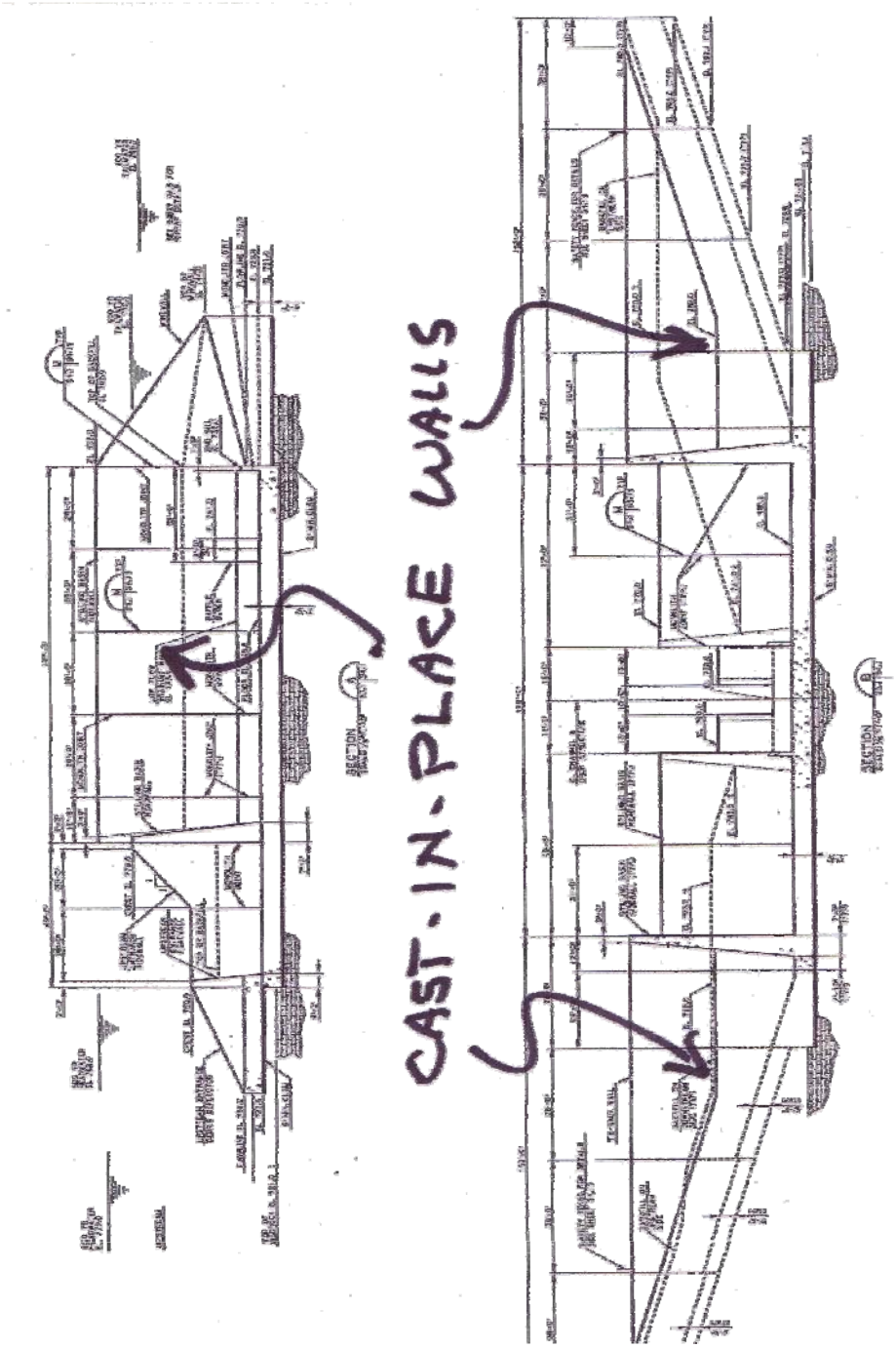
Caution must be used in the footing design to allow for differential settlement (Possible to stack on top of the stilling basin slab) and in the placement of the selective backfill for the strap integrity.

A colored or stained concrete can also be used to overcome the staining issue.

Sketch

Alternative No.: S-02

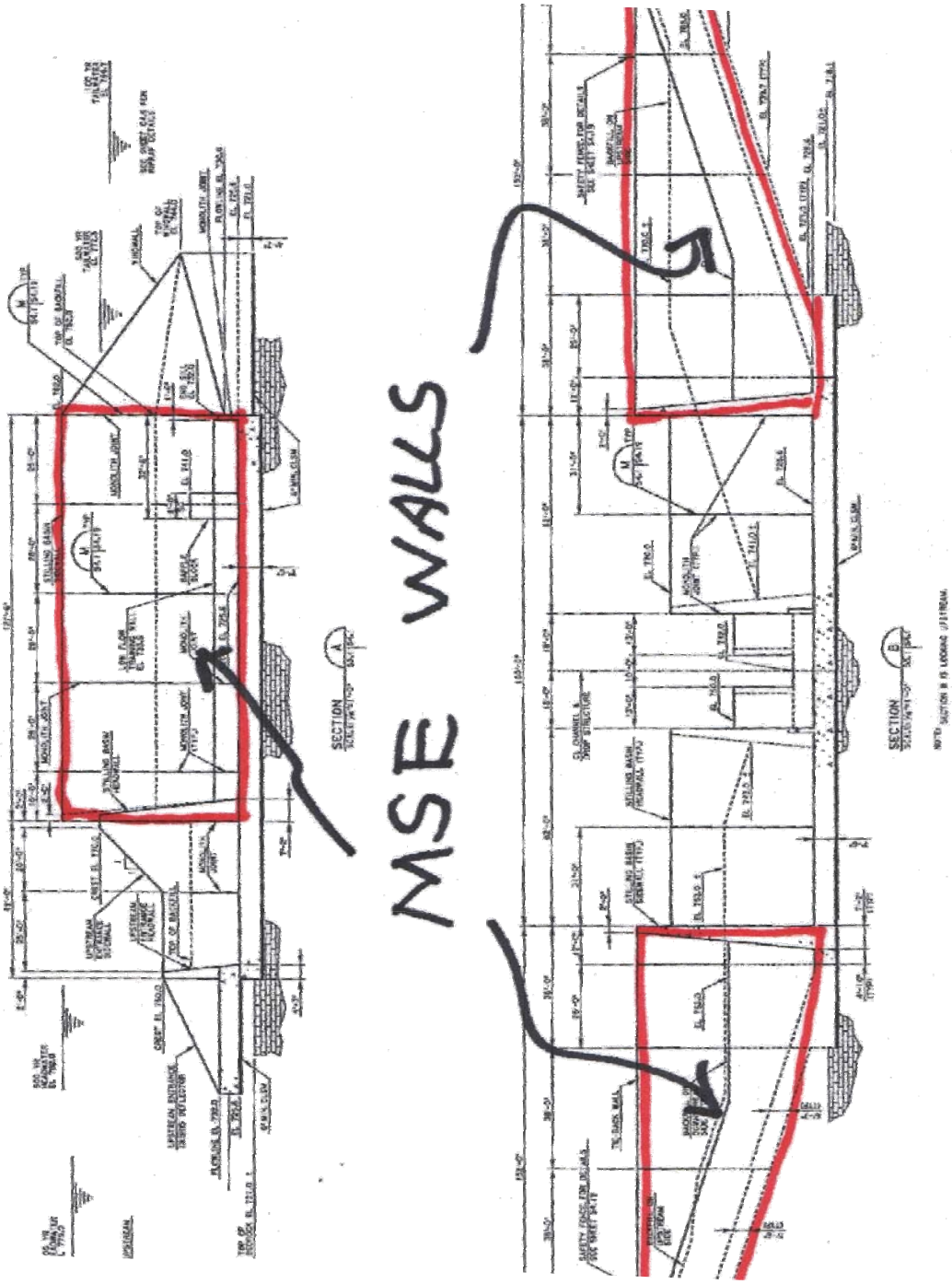
☒ Original ☐ Alternative



Sketch

Alternative No.: S-02

☐ Original ☒ Alternative



Calculations

Alternative No.: S-02

☒ Original ☐ Alternative

Cast-in-Place Tie Walls

Section	Footing	Wall
1	32,109	12,017
2	41,537	12,658
3	22,084	7,987
4	9,315	4,268
	105,045	36,930

Total 141,975 cf / 27 = 5,258 cy Mass Concrete

286 cy Lean Concrete

361 cy Rock Excavation

14,735 cy Common Excavation

Cast-in-Place Stilling Basin

Side Walls 64,110/27 = 2,374 cy

Slab (127.5 x 184 x 3)/27 = 2,607 cy

Note: Quantities from HNTB take off

Calculations

Alternative No. S-02

☐ Original ☒ Alternative

MSE Walls

Tie Walls

(38 x (55 +48.5+36+23.5)) x 2 = 12,388 sf

Stilling Basin Walls

127.5 x 56.4 x 2 = 14,382 sf

In Place Embankment

Right side downstream 782 – 752 = 30

(76 x 30 x 64)/27 = 5,404 cy

Left side downstream 782 – 752 = 30

(76 x 30 x 64)/27 = 5,404 cy

Total

5,404 + 5,404 = 10,808 cy + 50% for slope tie-in = 16,212 cy

Piling 14" Dia @ 15' c/c

(127.5 x 184)/225 = 104ea @ 30' = 3,120 lf

Construction Cost Estimate

Alternative No.: S-02

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas.**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Mass Concrete	cu yd	$992	10,239	$10,157,088		
Lean Concrete	cu yd	$245	786	$192,570		
Rock Excavation	cu yd	$55	361	$19,855		
Disposal	cu yd	$6	16,212	$97,272		
Schedule	months	$62,000	3	$186,000		
MSE Wall	sq ft	$65			26,770	$1,740,050
Embankment	cu yd	$10			16,212	$162,120
Piling	lin ft	$37			3,120	$115,440
Project Marked Up Cost				$10,652,785		$2,017,610
Contingency	5.0%			$532,639		$100,881
SIOH	5.7%			$637,569		$120,754
TOTALS				$11,822,993		$2,239,244
NET SAVINGS						$9,583,749

Value Alternative

Project: Grade Control Structure, Blue River Channel
Location: Kansas City, MO

Alternative No:
S-03

Title:
Match stilling basin sidewall geometry/profile to hydraulic profile

Description of Original Concept:

The top of the stilling basin sidewall is continuous along the length of the structure at EL 782, which is the elevation of the 500-year flood headwater. The elevation of the 500-year flood tailwater is EL 772.3.

The downstream wingwall slopes from the top of the stilling basin sidewall at EL 782 down to EL 744.0.

Description of Alternative Concept:

The alternative concept primarily involves more closely matching the top of the sidewall to the hydraulic profile within the stilling basin. EL 782 is not a requirement for the entire length of the structure.

Sloping the stilling basin sidewalls from EL 782 at the upstream end to EL 772.3 at the end of the stilling basin will reduce the volume of concrete in the stilling basin sidewalls. In addition, the wingwalls will start at EL 772.3 sloping to EL 744. This adds to the concrete volume reduction for this alternative.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☐ Increased
☒ Maintained	☐ Maintained
☐ Decreased	☒ Decreased

Cost Savings Summary

First Cost Savings:	$157,000

Advantages/Disadvantages

Advantages of Alternative Concept

- Reduces the volume of concrete required for the stilling basin sidewalls, and wingwalls, without adversely affecting the function or integrity of the structure.

Disadvantages of Alternative Concept

- None identified

Discussion

Alternative No.: S-03

The top of the stilling basin sidewall is continuous along the length of the structure at EL 782, which is the elevation of the 500-year flood headwater. The elevation of the 500-year flood tailwater is EL 772.3. The downstream wingwall, at an angle of 45 degrees from the structure, slopes from the top of the stilling basin sidewall at EL 782 down to EL 744 at the end of the wingwall.

This value alternative proposes that the profile of the sidewalls follow or more closely match the hydraulic profile. By observation, the 500-year flood profile will control. The 500-year headwater is at EL 782. The 500-year tailwater is at EL 772.3. The proposed sidewall profile will slope from EL 782 at the headwall down to EL 772.3 at the end of the stilling basin. Sloping the stilling basin sidewalls, paralleling the approximate hydraulic profile, will yield in a substantial reduction in concrete volume.

Likewise, the profile of the wingwalls at the end of the stilling basin can be reduced. Currently the wingwalls start at EL 782, sloping down to EL 744 at the end. With the proposed alternative, the wingwall profile can slope from EL 772.3 down to EL 744. This will also result in a reduction of concrete volume.

Altering the profile of the sidewalls and the wingwalls should have no effect on the hydraulic performance of the structure. Water flowing through the structure during a 500-year event will stay within the sidewalls.

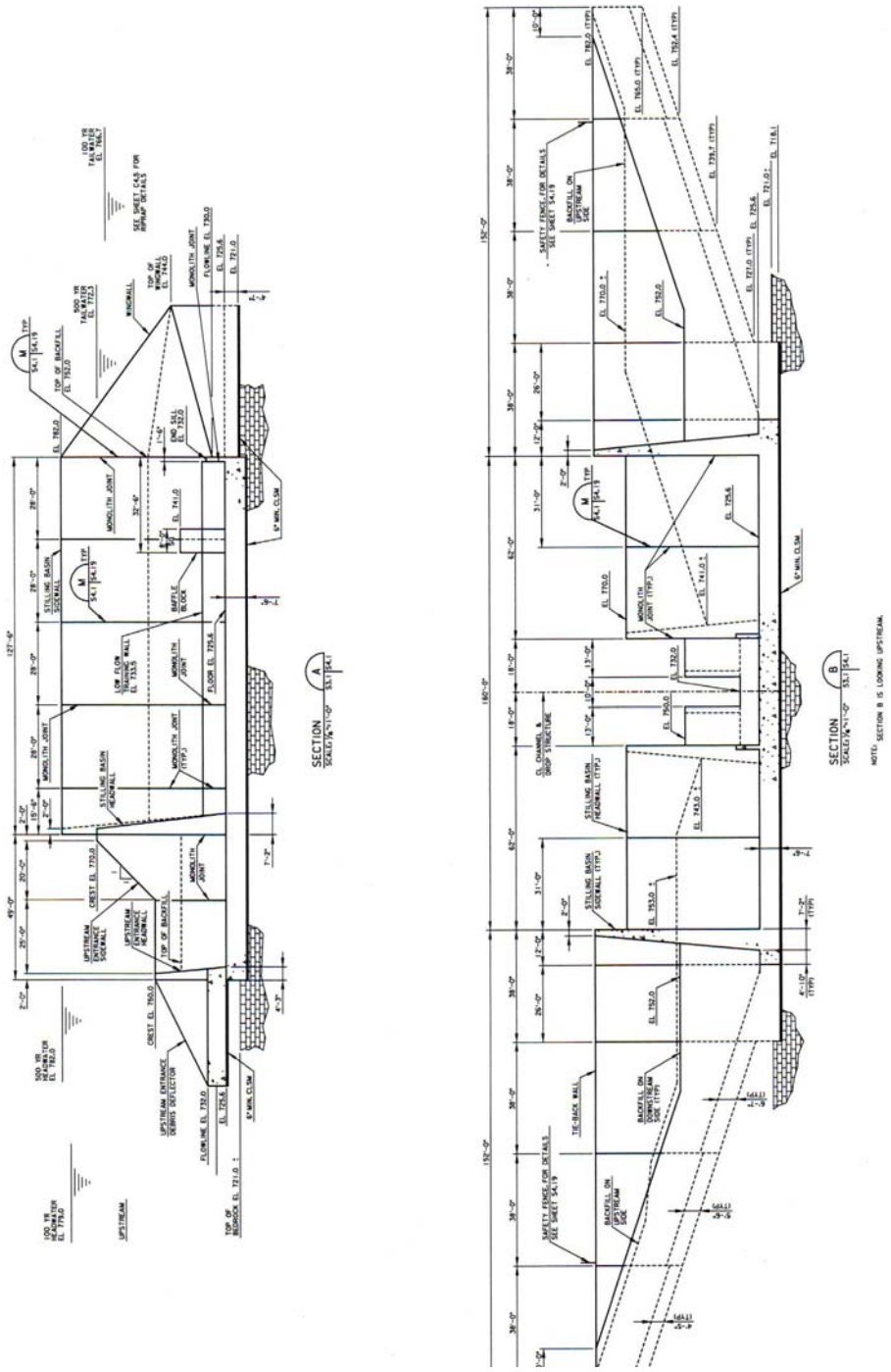
No apparent adverse constructability, scheduling, or operational issues exist with this alternative.

The loading conditions on the sidewall take into account a unit width of wall. The loading conditions, and the wall design itself, should not be affected by this alternative.

Sketch

Alternative No.: S-03

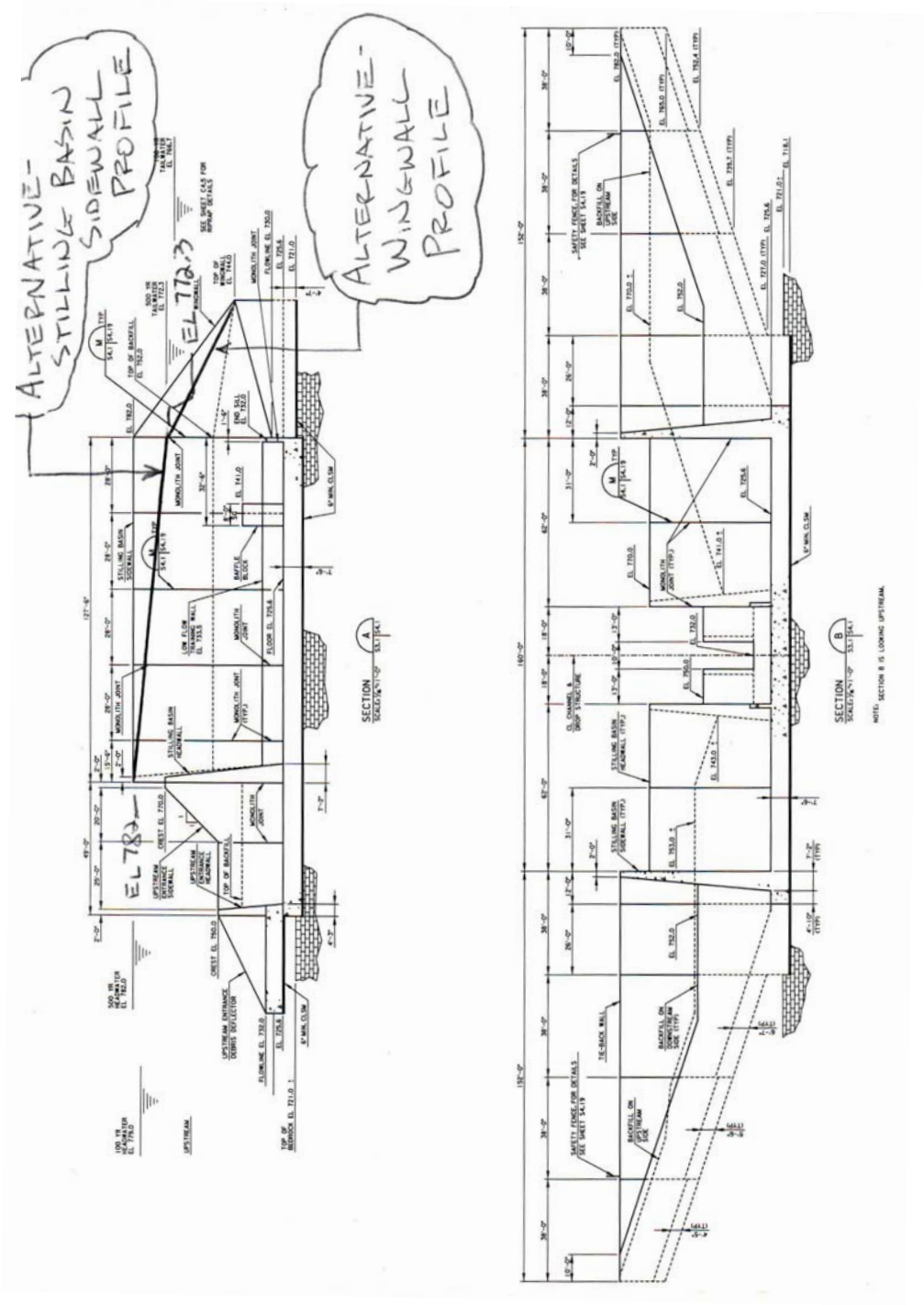
☒ Original ☐ Alternative



Sketch

Alternative No.: S-03

☐ Original ☒ Alternative



Calculations

Alternative No.: S-03

☒ Original ☐ Alternative

Wall Structural Concrete	Cu. Ft.	Cu. Yd.
Stilling Basin Sidewalls		
2x ½(2'+7.167')x56.4' x (127.5'-3.5'±) =	64,110.3 =	2375 YDS³
Stilling Basin Headwall		
2x[½(2'+7.167')x56.4'x(12'-3.5'±) +		
½(2'+7.167')x44.4'x(62')] =	29,629.6	
Low Flow Training Wall & End Sill		
2x(7.9167'x1.5'x 119.667') + (6.417'x1.5'x160') =	4,382.3	
Baffle Blocks		
10 x 8'x8'x15.4' =	9,856.0	
Wing Walls		
2x½[½(1.5'+5')x56.4' + ½(38.54'+5')x18.4']x48.5' =	12,840.7 =	476 YDS³
Total Wall Structural Concrete =	175,240.5	6,490.

From HNTB's quantity calculations

Calculations

Alternative No.: S-03

☐ Original ☒ Alternative

Wall Structural Concrete	Cu. Ft.	Cu. Yd.
Stilling Basin Sidewalls		
$2 \times \frac{1}{2}(2' + 7.167') \times 56.4' \times (127.5' - 3.5'\pm)$ =	64,110.3 =	2375 YDS³
$2\left[\frac{1}{2}(9.7)(2)(127.5) + \frac{1}{2}\left(\frac{1}{3}\right)\left(\frac{10.44}{12}\right)(9.7)(127.5)\right]$ =	112 YDS	
Stilling Basin Headwall		
$2 \times \left[\frac{1}{2}(2' + 7.167') \times 56.4' \times (12' - 3.5'\pm) + \frac{1}{2}(2' + 7.167') \times 44.4' \times (62')\right]$ =	29,629.6	2375 − 112 = 2263 YDS³ VOLUME (SIDEWALLS) ALTERNATIVE S-3
Low Flow Training Wall & End Sill		
$2 \times (7.9167' \times 1.5' \times 119.667') + (6.417' \times 1.5' \times 160')$ =	4,382.3	
Baffle Blocks		
$10 \times 8' \times 8' \times 15.4'$ =	9,856.0	
Wing Walls		
$2 \times \frac{1}{2}\left[\frac{1}{2}(1.5' + 5') \times 56.4' + \frac{1}{2}(3.854' + 5') \times 18.4'\right] \times 48.5'$ =	12,840.7 =	476 YDS³
$2 \times \frac{1}{2}\left[\frac{1}{2}(2.1 + 5) \times 46.7' + \frac{1}{2}(3.854' + 5') \times 18.4'\right] \times 48.5$		
Total Wall Structural Concrete =	175,240.5	6,490
= 445 YDS³ VOLUME (WING WALL) ALTERNATIVE S-3		

Construction Cost Estimate

Alternative No.: S-03

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas.**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Stilling Basin Sidewalls - Mass Concrete	cu yd	$992	2,375	$2,356,000	2,263	$2,244,896
Wingwall	cu yd	$992	476	$472,192	445	$441,440
Project Marked Up Cost				$2,828,192		$2,686,336
Contingency	5.0%			$141,410		$134,317
SIOH	5.7%			$169,267		$160,777
TOTALS				$3,138,869		$2,981,430
NET SAVINGS						$157,439

Value Alternative

Project: Grade Control Structure, Blue River Channel
Location: Kansas City, MO

Alternative No:
S-04

Title:
Eliminate downstream wingwalls

Description of Original Concept:

At the end of the stilling basin, on each side are wingwalls (with footings). These wingwalls are retaining fill on the backside of the stilling basin in addition to providing protection from eddy effects as the water exits the stilling basin. Eddy effects are deflected downstream by the wingwalls.

Description of Alternative Concept:

The alternative concept suggests deleting the wingwalls and replacing with riprap. The fill on the backside of the wingwalls will slope back up the stilling basin sidewalls to design/original EL 752. Riprap, that replaces the wingwall will extend up the back of the sidewalls at approximately a 2.75:1 slope. This matches the original riprap slope in this area. Both sides of the structure will be similar.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☐ Increased
☒ Maintained	☐ Maintained
☐ Decreased	☒ Decreased

Cost Savings Summary

First Cost Savings: $1,113,000

Advantages/Disadvantages

Advantages of Alternative Concept

- Concrete volume is reduced
- Excavation is reduced (no excavation of footings is required)
- Riprap, in-lieu of wingwalls, will still provide adequate erosion and scour protection

Disadvantages of Alternative Concept

- Some debris collection will likely occur
- Eddy effects will likely occur as water exits the stilling basin

Discussion

Alternative No.: S-04

At the end of the stilling basin, on each side, are wingwalls (with footings). These wingwalls are retaining fill on the backside of the stilling basin walls in addition to providing protection from eddy effects as the water exits the stilling basin. See attached existing/original sketch for this configuration. The alternative concept suggests deleting the wingwalls and replacing with riprap. The fill on the backside of the wingwalls will slope back up the stilling basin sidewalls to design/original EL 752. Riprap, that replaces the wingwall will extend up the back of the sidewalls at approximately a 2.75:1 slope. This matches the original riprap slope in this area. Both sides of the structure will be similar. See the attached alternative sketch for this configuration.

The main feature that this alternative addresses is reduction in concrete volume. The riprap extension still provides sufficient scour and erosion protection. Also, due to the concrete deletion, excavation volumes will be reduced. See the attached sketches and calculations for the materials. There will be an overall net reduction in concrete and earth fill. Riprap volume, providing protection, in-lieu of the wingwalls, will increase slightly. Earth fill is reduced by approximately 5,020 cubic yards, while concrete is reduced by approximately 1,102 cubic yards. To provide adequate protection, approximately 3,050 cubic yards of riprap will be added. Significant cost savings outweigh the riprap addition. See the attatched cost estimate for relative cost data.

Eddy effects, with this alternative, will occur as the water exits the stilling basin. With the original design, the effects are deflected to some point downstream. With the wingwalls, the effects will still exist - they will just occur at some point downstream. Some debris collection will occur as it exits the stilling basin, wrapping around the corner. With routine maintenance, this should be minimized.

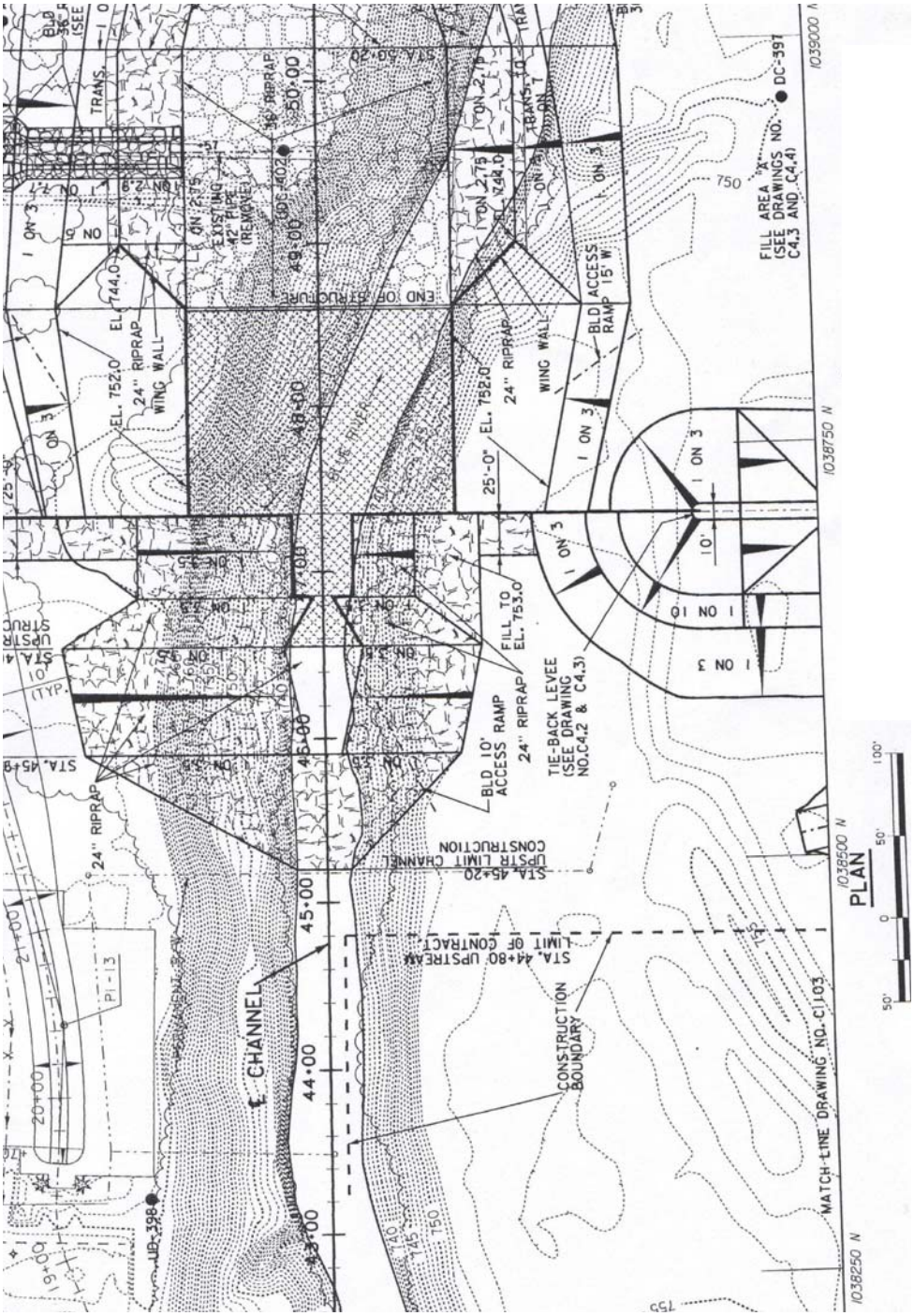
While fill on the backside of the sidewalls will be reduced, the design loads will still be valid. The sidewalls are designed for one-way action on a per unit width basis and the upstream portion of the sidewall design will still control.

Although there will be some debris collection, the savings from reducing concrete and fill volumes will outweigh any existing disadvantages. Routine maintenance will adequately address any debris concerns, and the addition of riprap will provide adequate protection at a minimal cost. There are no apparent constructibility or scheduling issues that will be affected by this alternative.

Sketch

Alternative No.: S-04

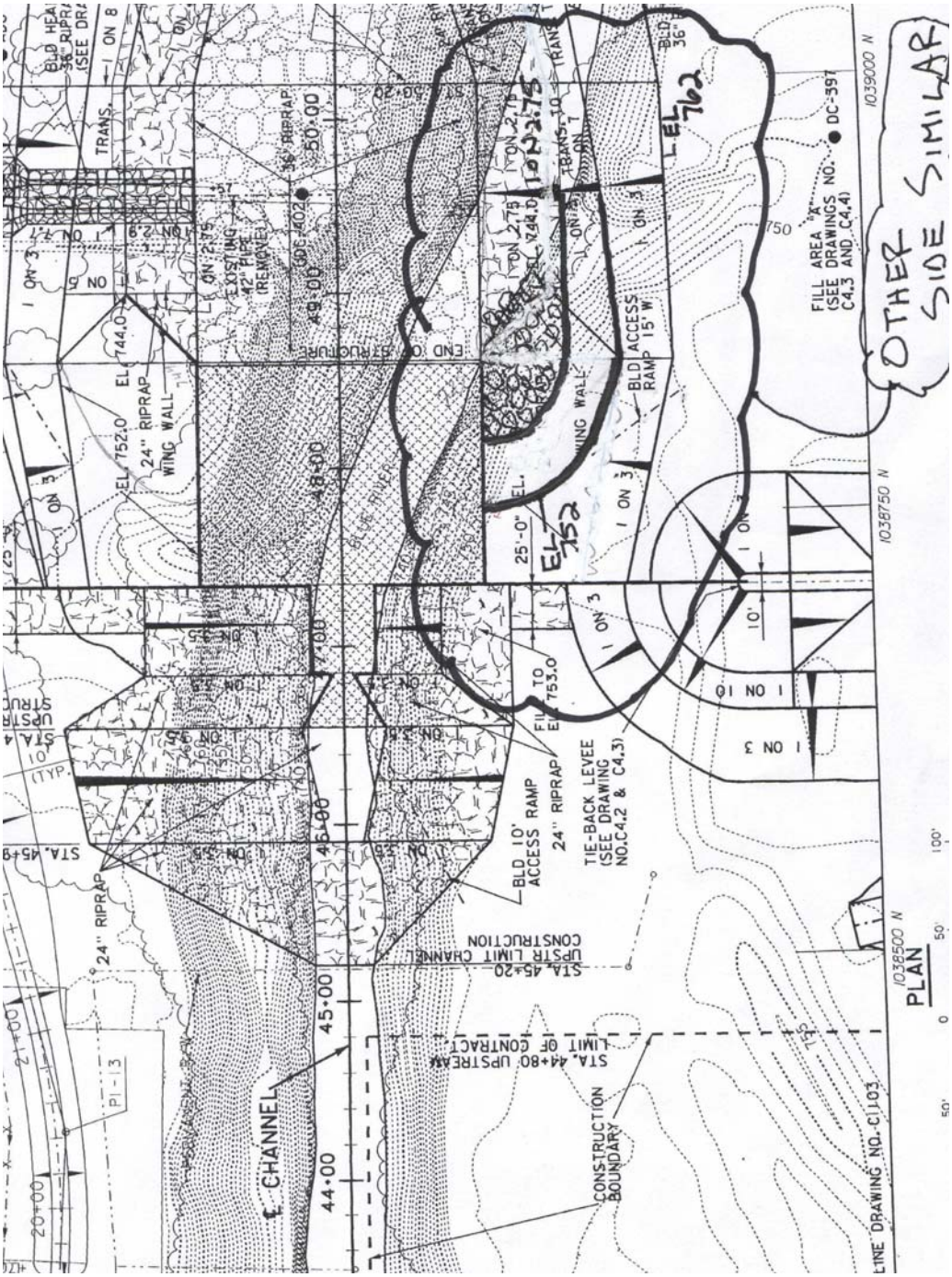
☒ Original ☐ Alternative



Sketch

Alternative No.: S-04

☐ Original ☒ Alternative



Construction Cost Estimate

Alternative No.: S-04

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas.**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
D/S Wingw alls East & West Mass Concrete						
(Footings & Walls)	cu yd	$992	1,100	$1,091,200		
Fill & Compaction Behind Wall	cu yd	$20	5,020	$100,400		
Rip Rap	cu yd	$62			3,050	$189,100
Project Marked Up Cost				$1,191,600		$189,100
Contingency	5.0%			$59,580		$9,455
SIOH	5.7%			$71,317		$11,318
TOTALS				$1,322,497		$209,873
NET SAVINGS						$1,112,625

Value Alternative

Project: Grade Control Structure, Blue River Channel
Location: Kansas City, MO

Alternative No:
S-10

Title:
Lower the entire structure with the ability to expand up to 500-year

Description of Original Concept:

The original concept is to construct a concrete grade control structure for a 30-year, 100-year & 500-year flood.

Description of Alternative Concept:

The alternative concept is to build a concrete grade control structure for a 30-year flood with the ability to expand the structure to control a 100-year and 500-year flood at some future date.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☐ Increased
☒ Maintained	☐ Maintained
☐ Decreased	☒ Decreased

Cost Savings Summary

First Cost Savings: $16,115,000

Advantages/Disadvantages

Alternative No.: S-10

Advantages of Alternative Concept

- Meets the 30-year flood control plan
- Reduces the massive concrete structure required for the 100-year & 500-year flood
- Reduces schedule requirements

Disadvantages of Alternative Concept

- Does not specifically provide for 100-year and 500-year protection

Discussion

Alternative No.: S-10

The basic requirement is for 30-year flood control on the Blue River. A grade control structure to meet the 30-year flood will meet that requirement.

The hydraulic conditions during the 100-year and 500-year flood are not detrimental to the flood plain in the area of the battlefield. The area is so dense with vegetation and tree growth that the over bank condition will not erode the battlefield at Byram's Ford.

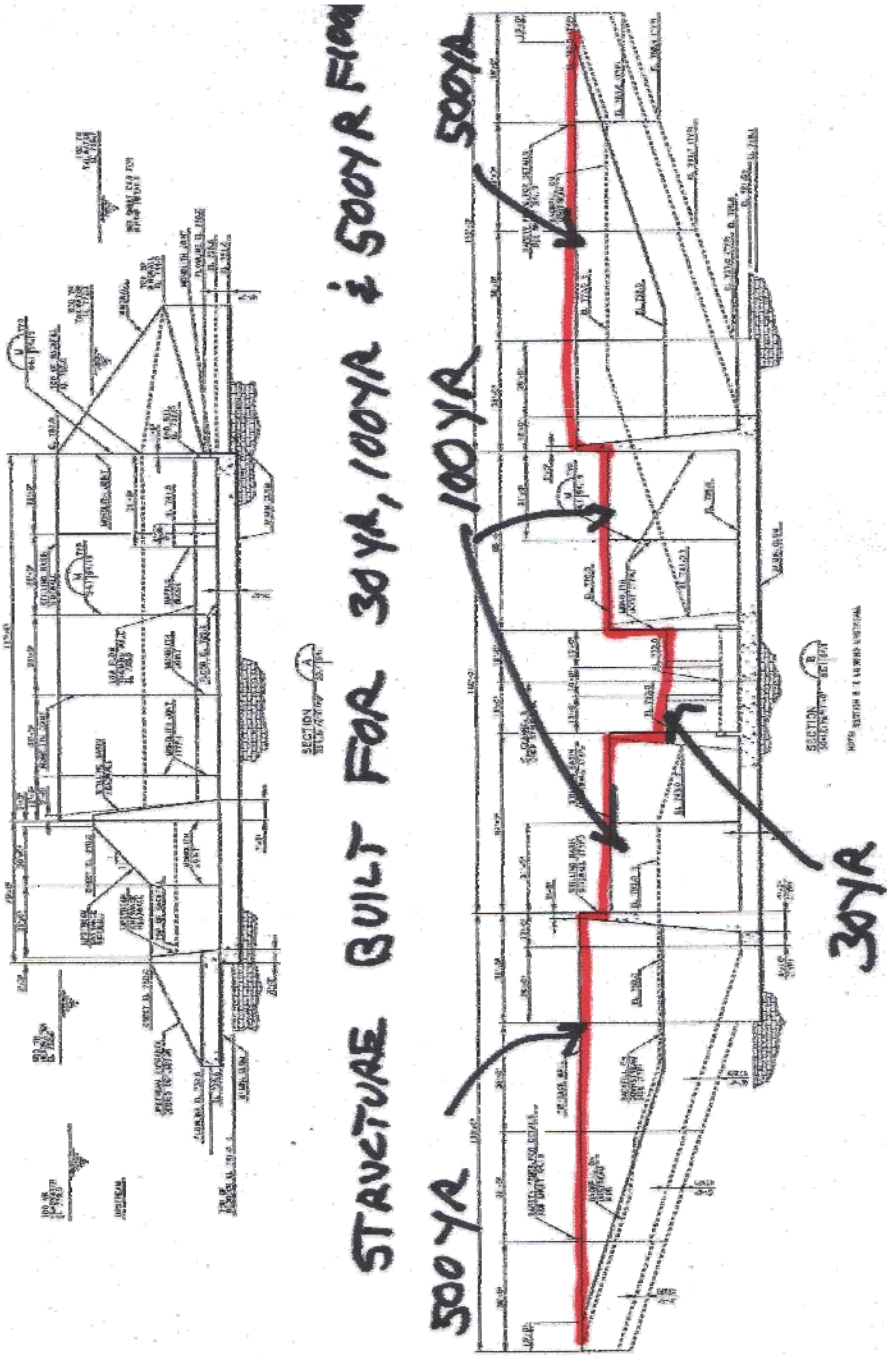
By reducing the size of the structure, a savings will be realized in both concrete and schedule.

No additional embankment will be necessary since the original embankment is established at El. 750.

Sketch

Alternative No.: S-10

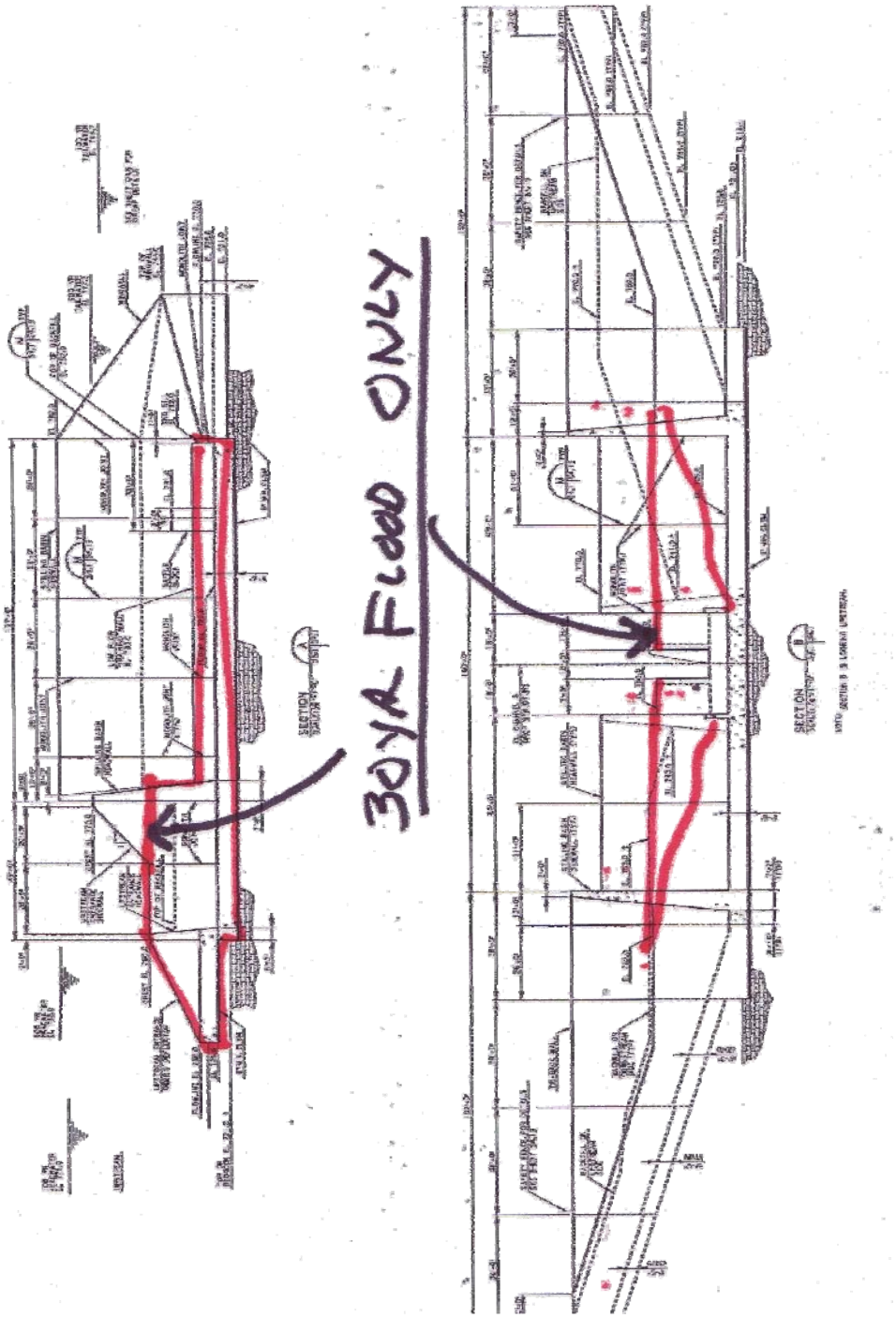
☒ Original ☐ Alternative



Sketch

Alternative No.: S-10

☐ Original ☒ Alternative



Calculations

Alternative No.: S-10

☒ Original ☐ Alternative

Footing Concrete	11,926 cy
Wall Concrete	6,490 cy
Total	18,416 cy

Lean Concrete	851 cy

Rock Excavation	3,686 cy

Calculations

Alternative No.: S-10

☐ Original ☒ Alternative

All of these Quantities are deductions for structure that is eliminated

Cast-in-Place Tie Walls

Total 141,975 cf / 27 = 5,258 cy Mass Concrete

286 cy Lean Concrete

361 cy Rock Excavation

14,735 cy Common Excavation

Cast-in-Place Stilling Basin

Side Walls 64,110/27 = 2,374 cy

Slab (127.5 x 148 x 7.5)/27 = 5,241 cy

Headwall (29630/2)/27 = 548 cy

Baffle Blocks (9856/10 x 8)/27 = 292 cy

Wing Walls 12841/27 = 476 cy

Total 8931 cy Mass Concrete

349 cy Lean Concrete

2205 cy Rock Excavation

Construction Cost Estimate

Alternative No.: S-10

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas.**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Mass Concrete	cu yd	$992	18,416	$18,268,672	4,227	$4,193,184
Lean Concrete	cu yd	$245	851	$208,495	216	$52,920
Rock Excavation	cu yd	$55	3,686	$202,730	1,120	$61,600
Common Excavation	cu yd	$10	14,735	$147,350		
Project Marked Up Cost				$18,827,247		$4,307,704
Contingency	5.0%			$941,362		$215,385
SIOH	5.7%			$1,126,811		$257,816
TOTALS				$20,895,420		$4,780,905
NET SAVINGS						$16,114,515

Value Alternative

Project: Grade Control Structure, Blue River Channel
Location: Kansas City, MO

Alternative No:
S-24

Title:
Stair step the foundations for the tie back walls

Description of Original Concept:

The original concept has sloping foundations for the walls. This results in a sloping footing.

Description of Alternative Concept:

The alternative concept is to stair step the foundations for segments 2, 3, and 4 on both sides with horizontal footings.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☐ Increased
☒ Maintained	☐ Maintained
☐ Decreased	☒ Decreased

Cost Savings Summary

First Cost Savings: $580,000

Advantages/Disadvantages

Alternative No.: S-24

Advantages of Alternative Concept

- Less excavation
- Easier foundation preparation
- Easier concrete placement
- Enhances schedule

Disadvantages of Alternative Concept

- Potential for higher differential settlement
- May require braced excavation

Discussion

Alternative No.: S-24

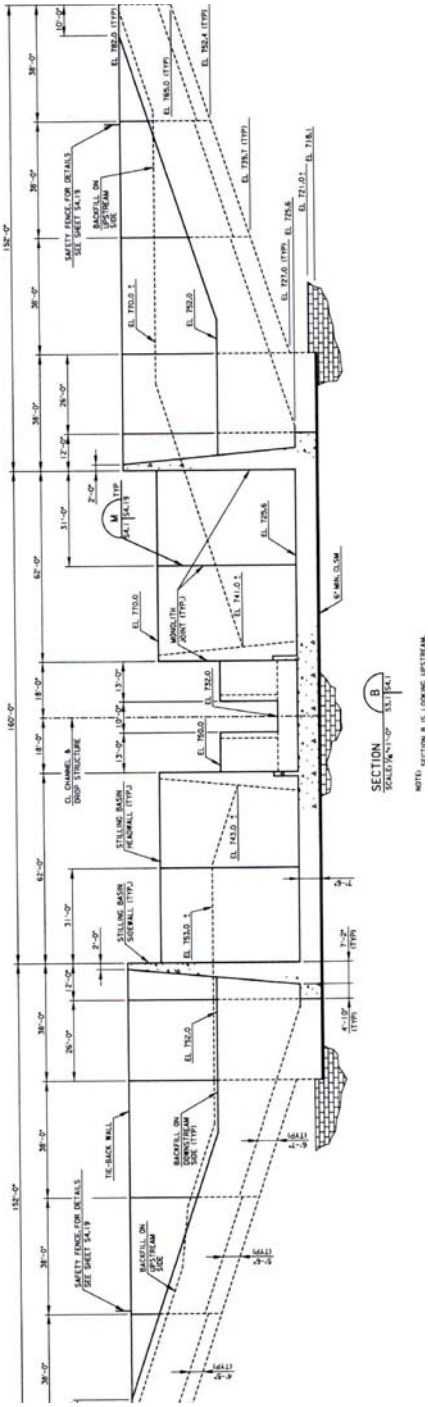
The original concept will have sloping foundations for the tie walls. The alternative concept is to stair step the foundation as a series of horizontal platforms for segments 2, 3 and 4 for both sides. In the proposed concept the valley-side base elevation of each wall was chosen as the bearing elevation. The stair step foundation decreases the amount of excavation and allows for horizontal pours for the footings and simplifies the forming especially for the wall segments. This should improve the schedule.

Stair stepping the foundations increases the potential for differential settlement of the foundation. Most of the settlement would probably occur during the construction.

Sketch

Alternative No.: S-24

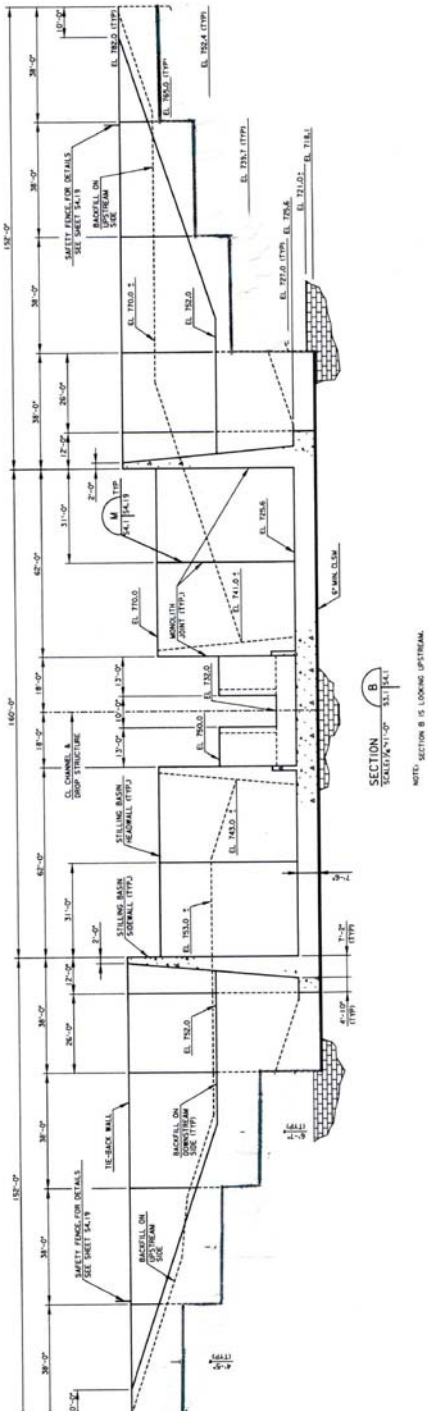
☒ Original ☐ Alternative



Sketch

Alternative No.: S-24

☐ Original ☒ Alternative



Calculations

Alternative No.: S-24

☒ Original ☐ Alternative

wall	12,657.9 cf	7,987 cf	4,267.7 cf	24,912.6 cf	From HNTB estimate
footing	41,536.6 cf	22,084.2 cf	9,315.5 cf	72,936.3 cf	From HNTB estimate
vol cu ft				97,848.9 cf	
vol cu yd				3,624.033 cy	

excavation	14,735 c	From HNTB estimate

Calculations

Alternative No.: S-24

☐ Original ☒ Alternative

Tie-wall

Segment	2	3	4		
Footing					
length of fdn (ft)	88.41667	71.33333	34.33333		from plan
thickness of fdn (ft)	6.6	5.5	4.4		from plan
area of fdn (ft2)	583.55	392.3333	151.0667		
shorten length between sloping and horizontal	3	3	3		Scaled from plan
vol ft3	1,750.65	1177	453.2	3,380.85	
Wall					
width of wall	6	5	4		from plan
height	12.7	12.7	12.7		from plan
length of wall	38	38	38		from plan
vol ft3	1,447.8	1,206.5	965.2	3,619.5	
Vol of fdn and wall (cf)				7,000.35	
vol (cy)				259.2722	both sides
vol of both sides (cy)				518.5444	
Proposed concept					
excavation	13,957.18 cy				Assume excavation 1.5 volume of concrete

Construction Cost Estimate

Alternative No.: S-24

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas.**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Volume Concrete Segments 2, 3 & 4						
both sides Tie-Wall	cu yd	$992	3,624	$3,595,008	3,105	$3,080,160
Excavation of Tie Wall	cu yd	$10	14,735	$147,350	13,957	$139,570
Project Marked Up Cost				$3,742,358		$3,219,730
Contingency	5.0%			$187,118		$160,987
SIOH	5.7%			$223,980		$192,701
TOTALS				$4,153,456		$3,573,417
NET SAVINGS						$580,039

Geometry

Value Alternative

Project: Grade Control Structure, Blue River Channel
Location: Kansas City, MO

Alternative No:
G-12

Title:
Move the structure downstream to Sta 53+00; Build in the dry

Description of Original Concept:

The original concept is to build the grade control structure at Sta 47+00 by diverting the river to the west side of the channel and building the east half of the structure, diverting the river back through the previously constructed entrance of the structure and building the west half.

Description of Alternative Concept:

The alternative concept is to build the structure in the meander at Sta 53+00 in the dry with no channel diversion. Once the structure is completed the river can be diverted through the structure.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☒ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☒ Decreased

Cost Savings Summary

First Cost Savings: $584,000

Advantages/Disadvantages

Alternative No.: G-12

Advantages of Alternative Concept

- No temporary channel diversion required
- Able to construct the structure in one stage

Disadvantages of Alternative Concept

- Structure must be relocated six hundred feet downstream
- Possible temporary berm required between structure and the river

Discussion

Alternative No.: G-12

The original concept is to build a temporary river diversion to the west in order to build the grade control structure in the present river alignment. The construction of the grade control structure is performed in halves which requires a second diversion of the river back through the first constructed half.

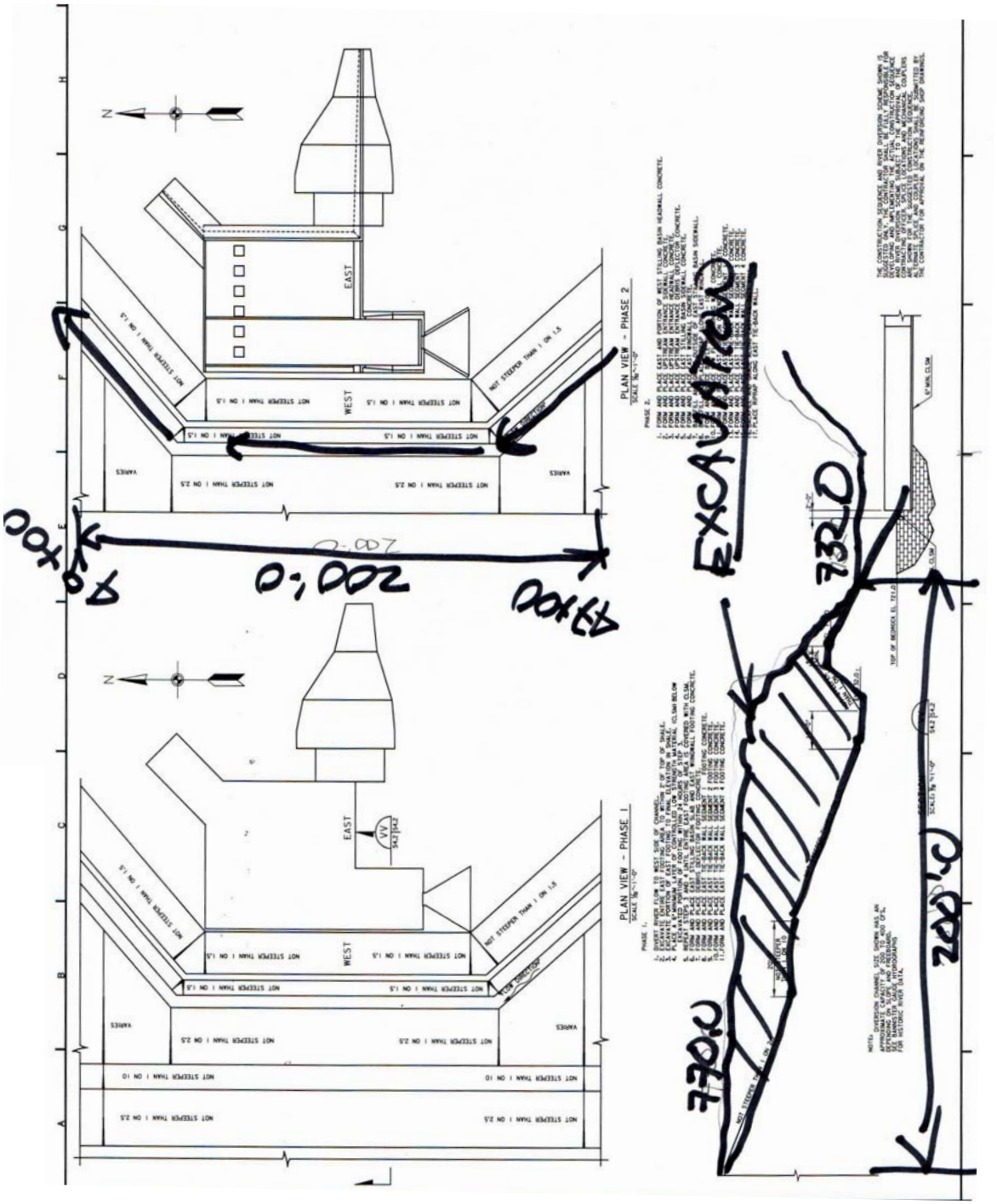
By moving the structure six hundred feet downstream and locating it in the meander of the river, it is possible to build the structure in a dry location without a river diversion.

This will not only save the cost of the temporary river diversion but will also expedite the construction schedule.

Sketch

Alternative No.: G-12

☒ Original ☐ Alternative



Sketch

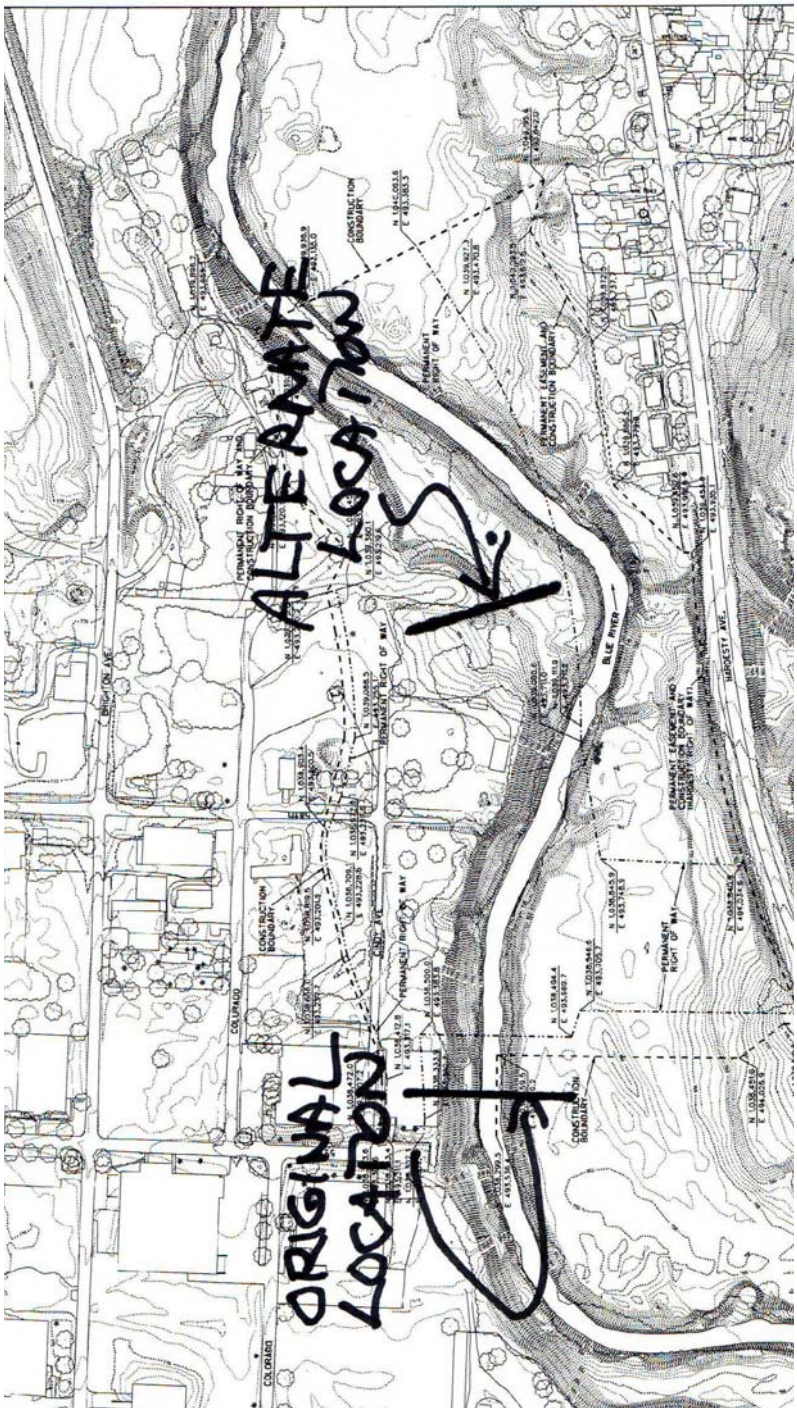
Alternative No.: G-12

☐ Original ☒ Alternative

Sketch

Alternative No.: G-12

☐ Original ☒ Alternative



Calculations

Alternative No.: G-12

☒ Original ☐ Alternative

Diversion Channel Excavation/Construction

Elev. (770 – 732)/2 = 19 ft

Left of center line 200 ft

Direction of Station 46+00 to 48+00 = 200 ft

(19 x 200 x 200)/ 27 = 28,148 cy

Construction Schedule

1 month to build diversion channel

1 month to switch the river

1 month to gear concrete operation up a second time

3 months savings

Construction Cost Estimate

Alternative No.: G-12

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas.**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Diversion Channel	cu yd	$12	28,148	$337,776		
Schedule						
Supervision	month	$42,500	24	$1,020,000	21	$892,500
Temporary facilities	month	$10,200	24	$244,800	21	$214,200
Temporary utilities	month	$6,800	24	$163,200	21	$142,800
Equipment rental & misc.	month	$3,400	24	$81,600	21	$71,400
Project Marked Up Cost				$1,847,376		$1,320,900
Contingency	5.0%			$92,369		$66,045
SIOH	5.7%			$110,565		$79,056
TOTALS				$2,050,310		$1,466,001
NET SAVINGS						$584,309

Value Alternative

Project: Grade Control Structure, Blue River Channel
Location: Kansas City, MO

Alternative No:
G-18

Title:
Minimize fill and use existing channel for habitat

Description of Original Concept:

The original concept is to relocate the Blue River channel that is immediately downstream of the grade control structure to the East and fill the existing Blue River channel with excavated material to reestablish the right (downstream) bank.

Description of Alternative Concept:

The alternative concept is to minimize the fill of existing channel which is immediately downstream of the grade control structure and use the existing channel as a habitat for wildlife.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☒ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☒ Decreased

Cost Savings Summary

First Cost Savings: $328,000

Advantages/Disadvantages

Alternative No.: G-18

Advantages of Alternative Concept

- Reduces the amount of embankment needed for the construction of the right side downstream bank
- Provides additional habitat for creatures that are natural to the area
- Additional 30-year flood control downstream of the new grade control structure (wider flood plain)
- Connects the original flood plain to the new river channel

Disadvantages of Alternative Concept

- Could require more off site disposal of embankment material

Discussion

Alternative No.: G-18

The original concept is to build the embankment downstream of the grade control structure to realign the Blue River channel between the grade control structure and the existing downstream channel. This will require a large cut and fill operation to shape the existing right bank and slopes into the shape and slopes for the new downstream alignment in addition to a large quantity of riprap.

By using the existing downstream channel for a habitat and overflow area very little fill is required to realign the Blue River channel below the new grade control structure. Also the existing downstream channel alignment will require less riprap for bank stabilization.

It is possible to use the embankment material in other areas of the project such as trail levees, overflow embankment on both the right and left side of the grade control structure and behind the high stilling basin walls.

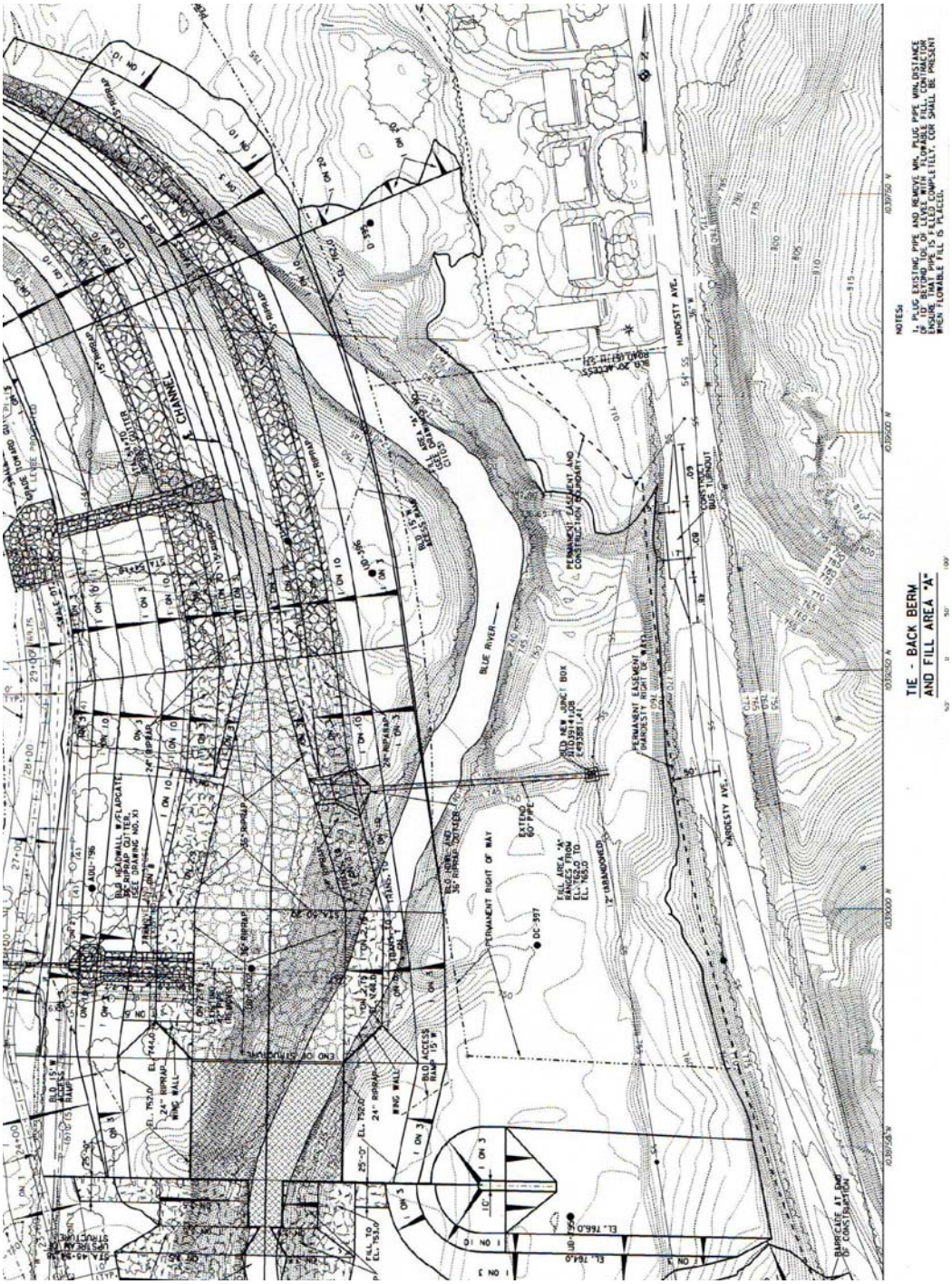
The 60" RCP pipe planned for the right embankment can be eliminated as well.

In addition, of course the old channel alignment will provide a large habitat area for plants and animals to live and flourish.

Sketch

Alternative No.: G-18

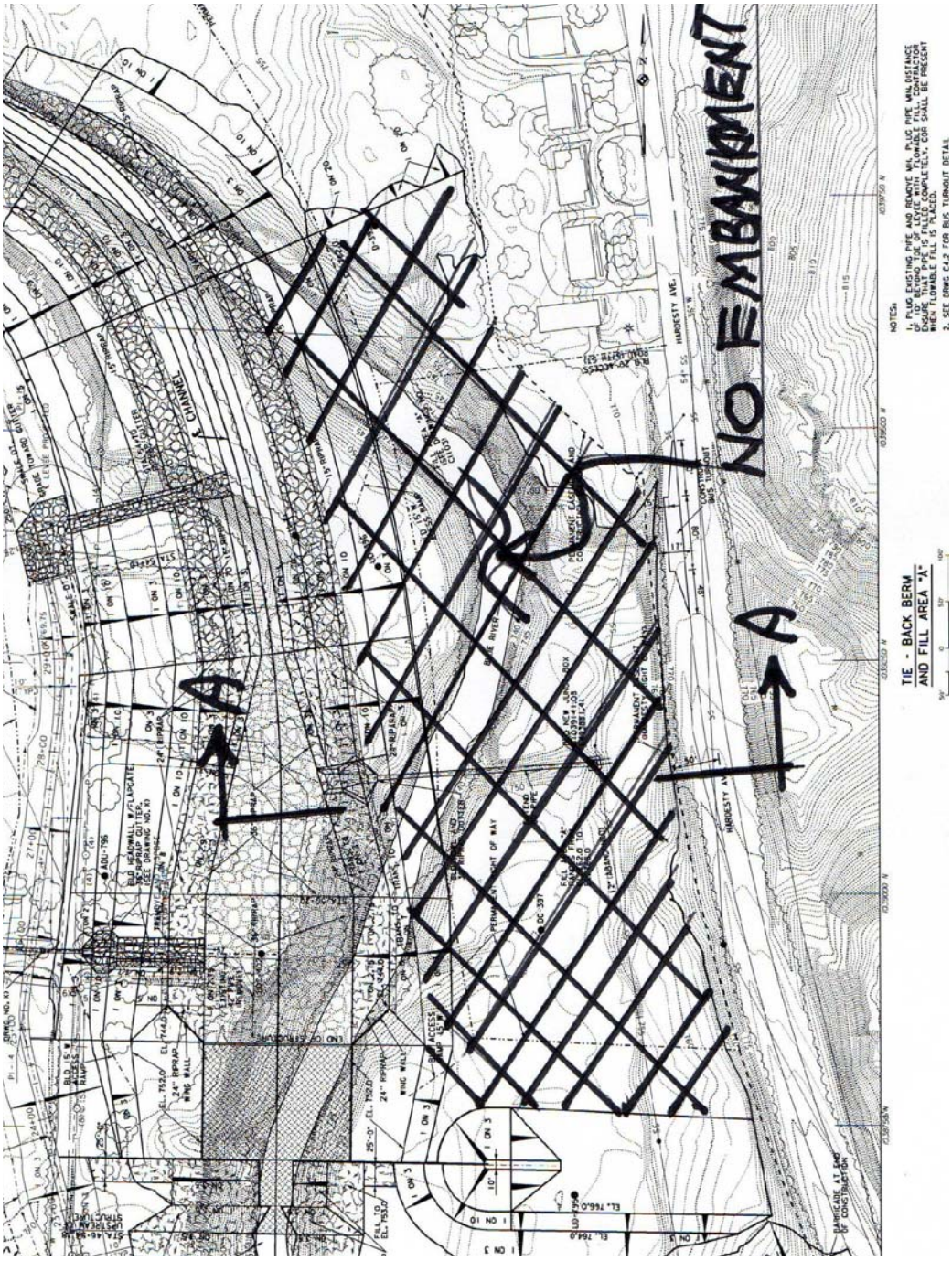
☒ Original ☐ Alternative



Sketch

Alternative No.: G-18

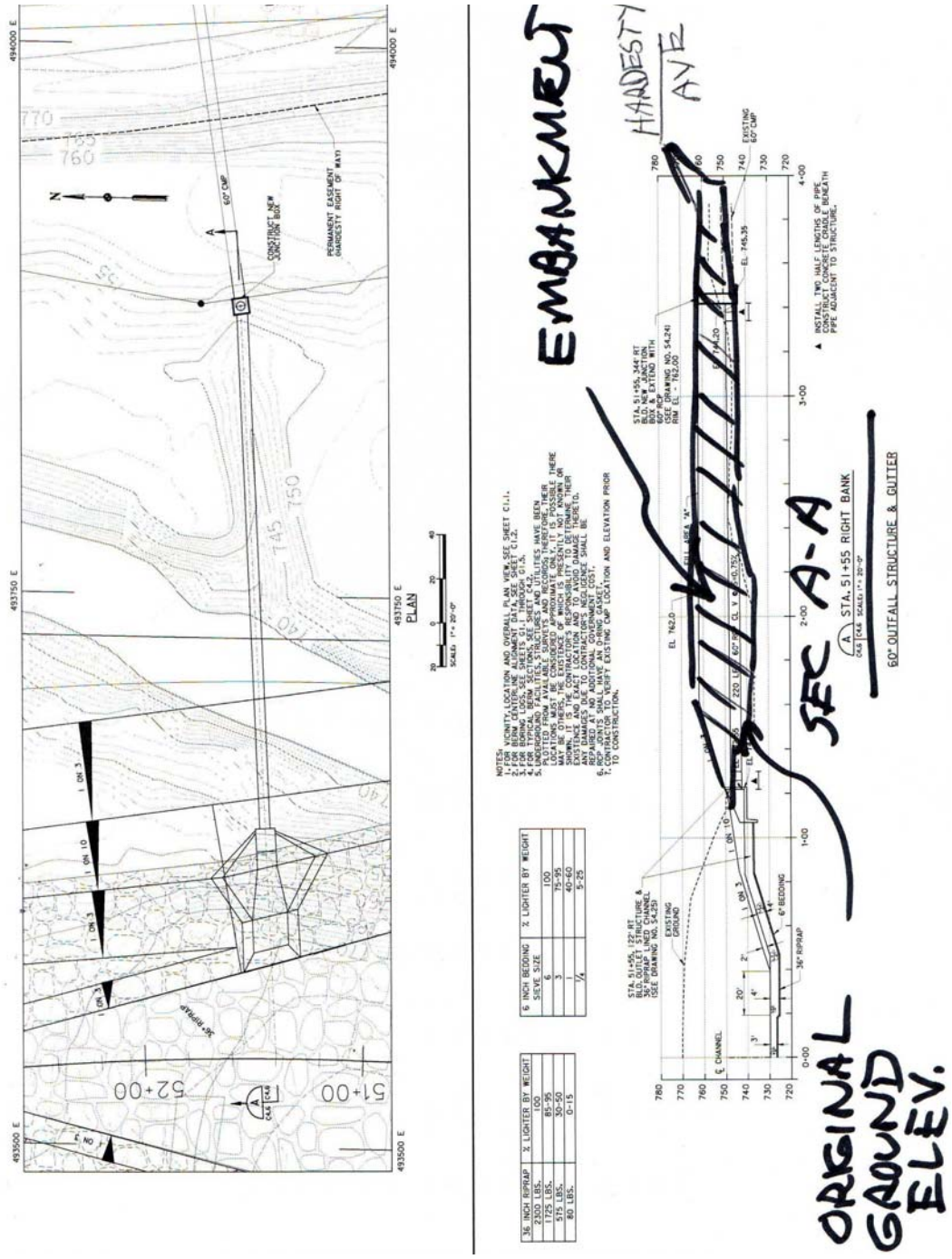
☐ Original ☒ Alternative



Sketch

Alternative No.: G-18

☐ Original ☒ Alternative



Calculations

Alternative No.: G-18

☒ Original ☐ Alternative

<u>Embankment over original ground</u>

762.00-742.00 = 20’

Right Bank 1+25 to 3+50 = 225’

Station 49+00 to 57+00 = 800’

(20 x 225 x 800)/27 = 133,333 cy

<u>60” Outfall Pipe and Structure</u>

Right Bank 1+25 to 3+45 = 220’

Right Bank 3+44 = Junction Box

Construction Cost Estimate

Alternative No.: G-18

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas.**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Embankment	cu yd	$10	13,333	$133,330		
60" RCP Pipe	lin ft	$744	220	$163,680		
60" RCP Junction Box	each	$56,203	1	$56,203		
Waste off site	cu yd	$4.35			13,333	$57,999
Project Marked Up Cost				$353,213		$57,999
Contingency	5.0%			$17,661		$2,900
SIOH	5.7%			$21,140		$3,471
TOTALS				$392,013		$64,370
NET SAVINGS						$327,644

Construct

Value Alternative

Project: Grade Control Structure, Blue River Channel
Location: Kansas City, MO

Alternative No:
C-18

Title:
Use a series of flat pipe runs and vertical drops instead of gutters

Description of Original Concept:

The original concept calls for riprap gutters to convey flow from the 48" & 60" outfalls to the Blue River. The gutters were to be constructed using 36" riprap 3 feet and 4 feet deep for the 48" and 60" outfalls respectively. The slope of the gutters ranged from 10:1 to 3:1 (h:v).

Description of Alternative Concept:

The alternative concept involves replacing the riprap gutters with pipes and junction boxes. The 48" and 60" outfalls are extended to the proposed channel location. For the third riprap gutter, a 48" pipe outfall is assumed. These pipe systems will follow the same alignment as the riprap gutters.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☒ Increased
☒ Maintained	☐ Maintained
☐ Decreased	☐ Decreased

Cost Savings Summary

First Cost Savings: ($116,000)

Advantages/Disadvantages

Alternative No.: C-18

Advantages of Alternative Concept

- Removes the maintenance required for riprap gutters to remain stable
- Reduces chances of channel bank failure
- City crews can perform maintenance on pipe system

Disadvantages of Alternative Concept

- While capital cost increases, life cycle costs will be reduced
- Maintenance activities will require confined-space entry
- Sedimentation of pipe may occur if not properly designed

Discussion

Alternative No.: C-18

Riprap gutters like those proposed have traditionally required significant maintenance to maintain their integrity. The forces acting on these structures includes gravity, flowing water from the stormwater pipe system, and flowing water from the river. This combination of forces often displaces the riprap resulting in bank scour and in some cases, bank failure.

By replacing these gutters with pipes and vertical drops (junction boxes), the flowing water forces are eliminated. The storm water is also conveyed in the pipe which reduces chances of bank scour and failure.

While capital cost may be greater for the pipe system, the life cycle cost should be reduced because of reduced maintenance costs and reduced replacement costs.

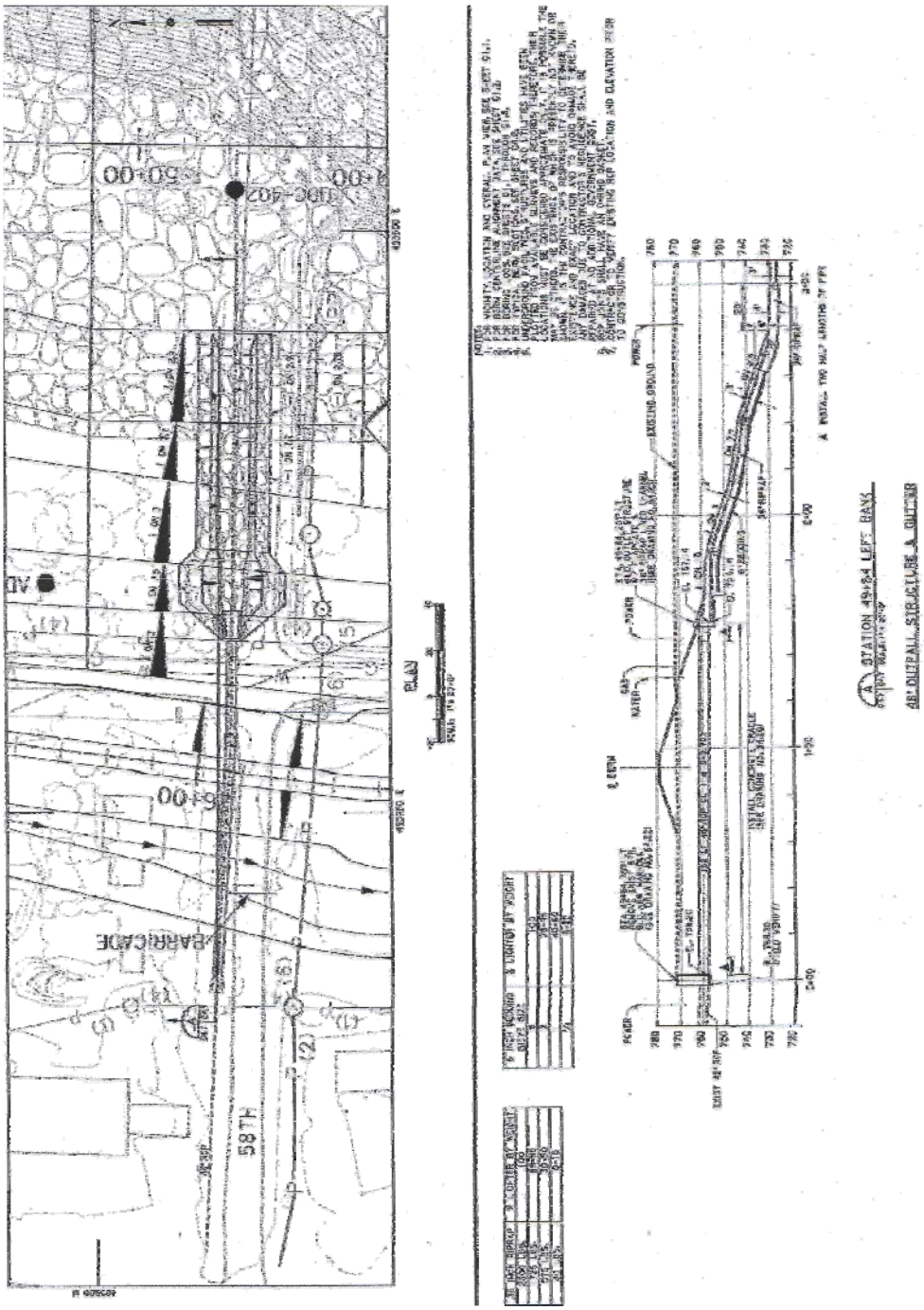
The construction of the pipe systems will require more excavation and will require trench support for safety.

The cost of the pipe systems could be reduced if something other than RCP was used. The feasibility of using different pipe materials should be investigated since the only loading on the pipe is earth loading.

Sketch

Alternative No.: C-18

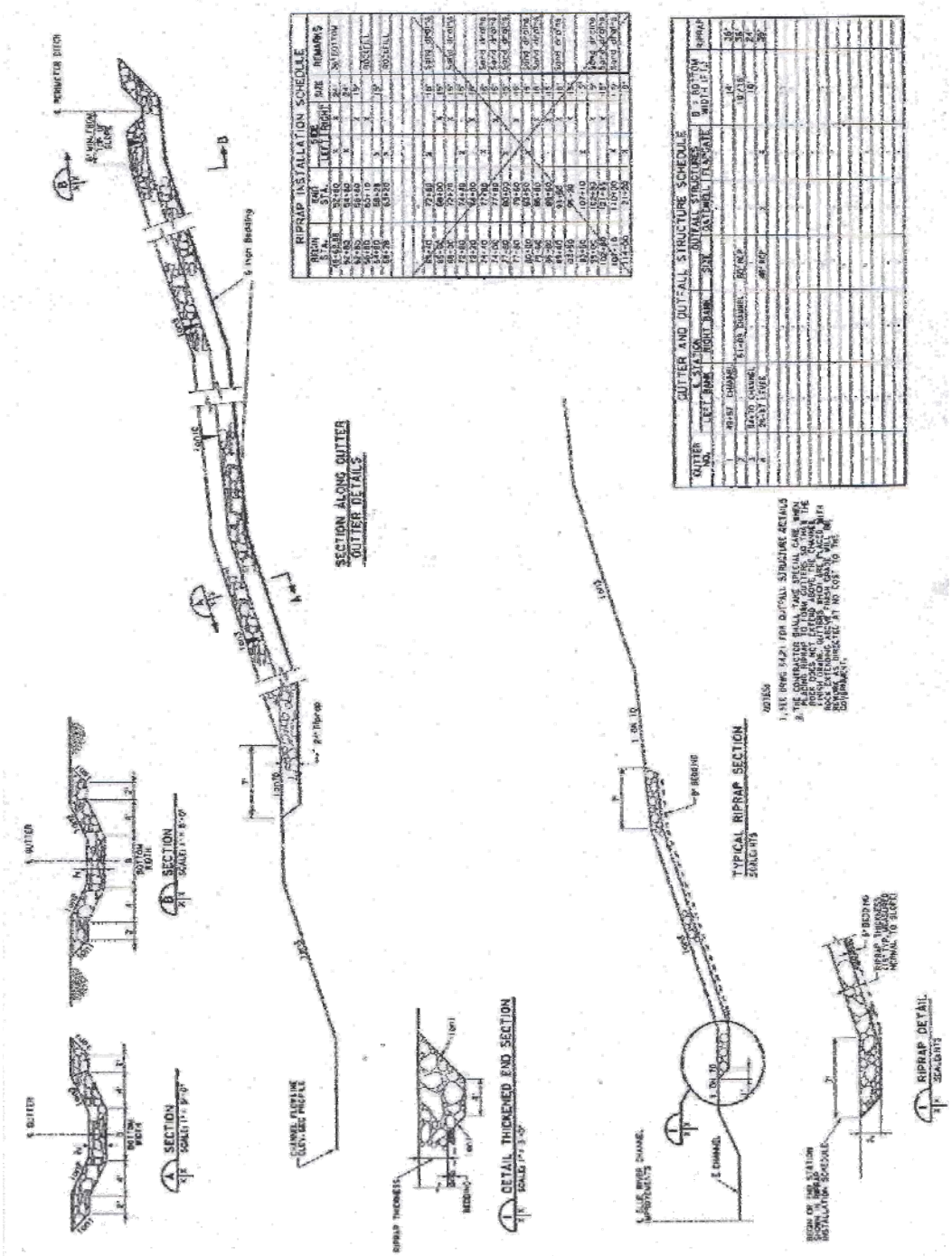
☒ Original ☐ Alternative



Sketch

Alternative No.: C-18

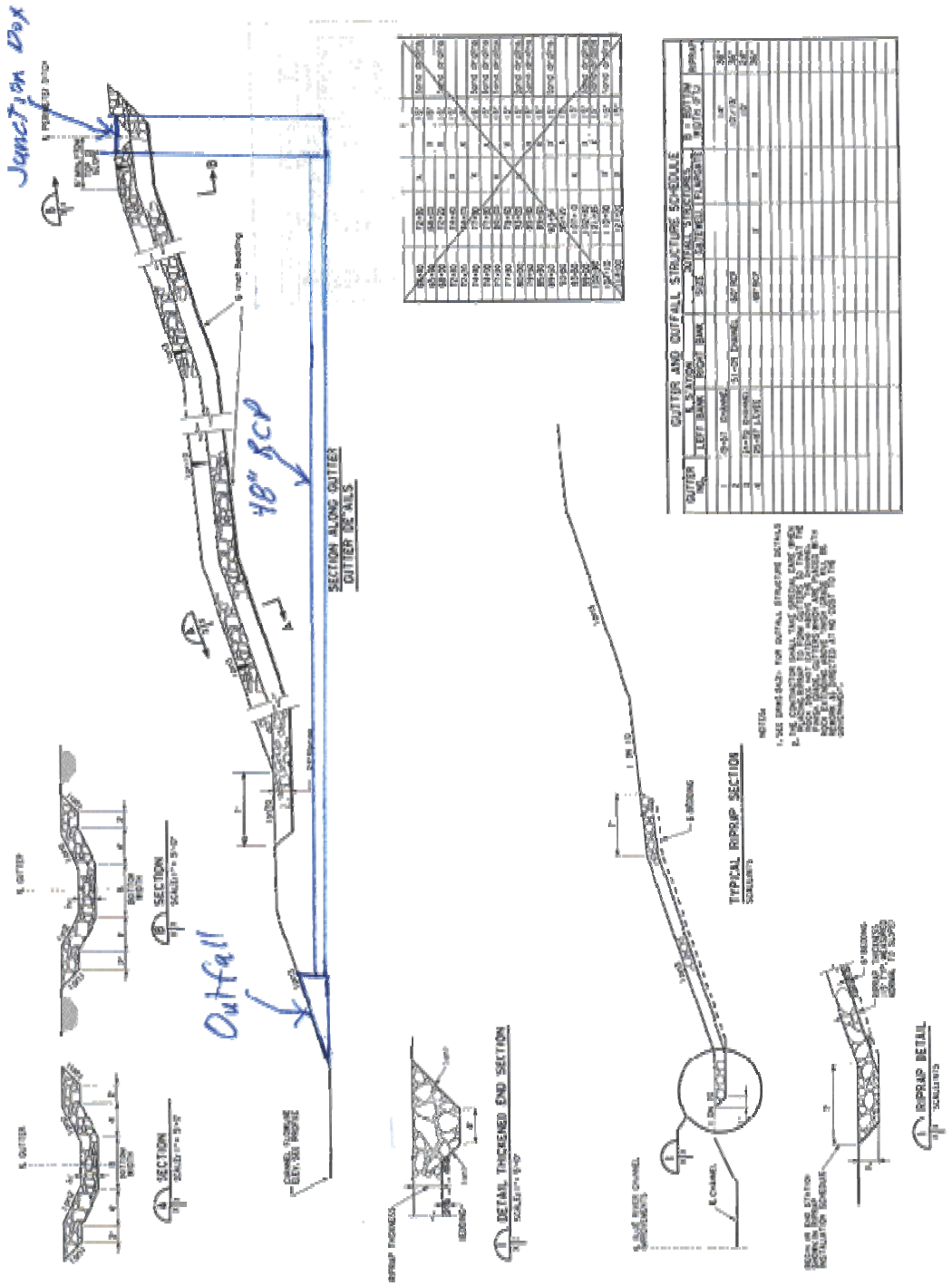
☒ Original ☐ Alternative



Sketch

Alternative No.: C-18

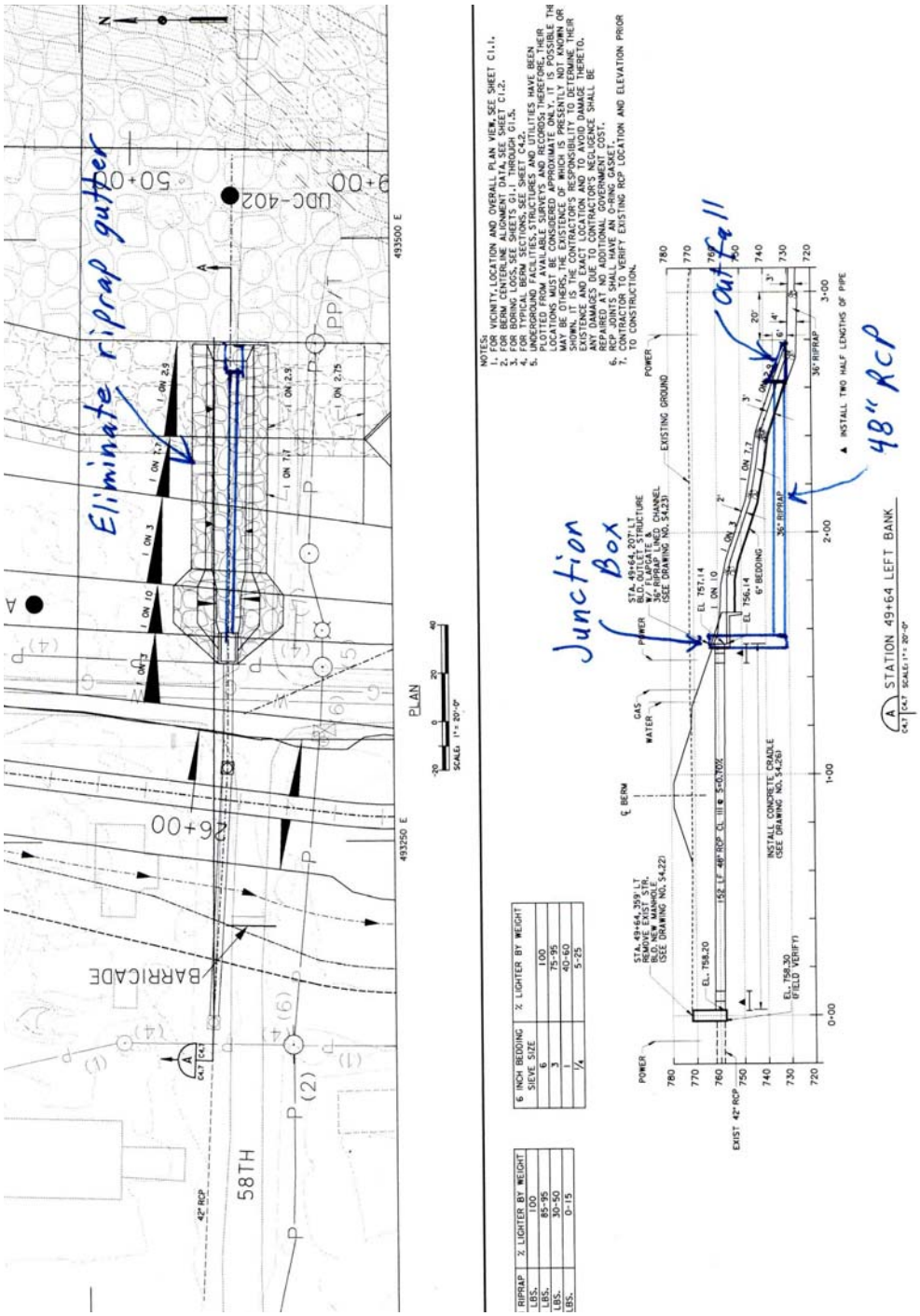
☐ Original ☒ Alternative



Sketch

Alternative No.: C-18

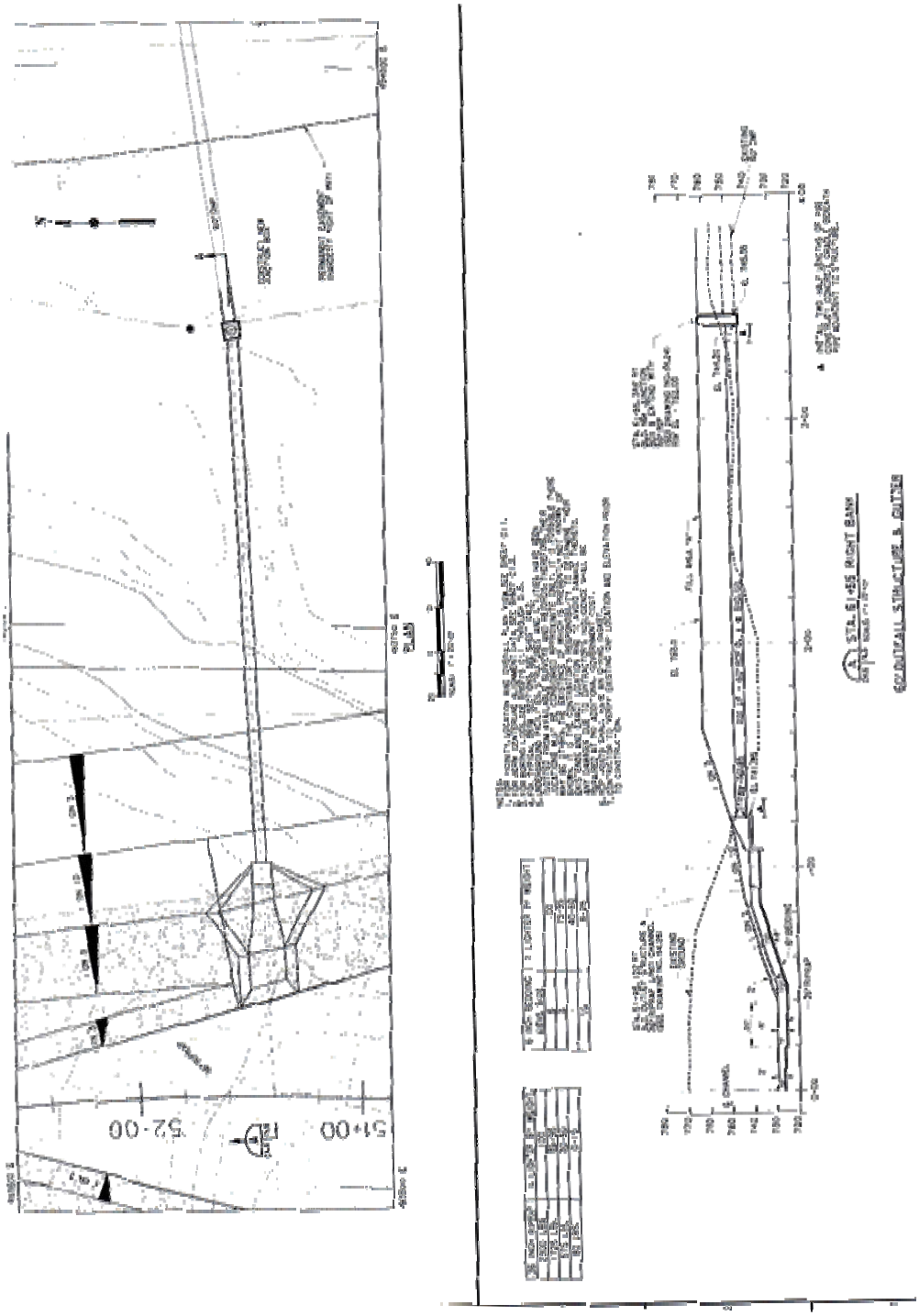
☐ Original ☒ Alternative



Sketch

Alternative No.: C-18

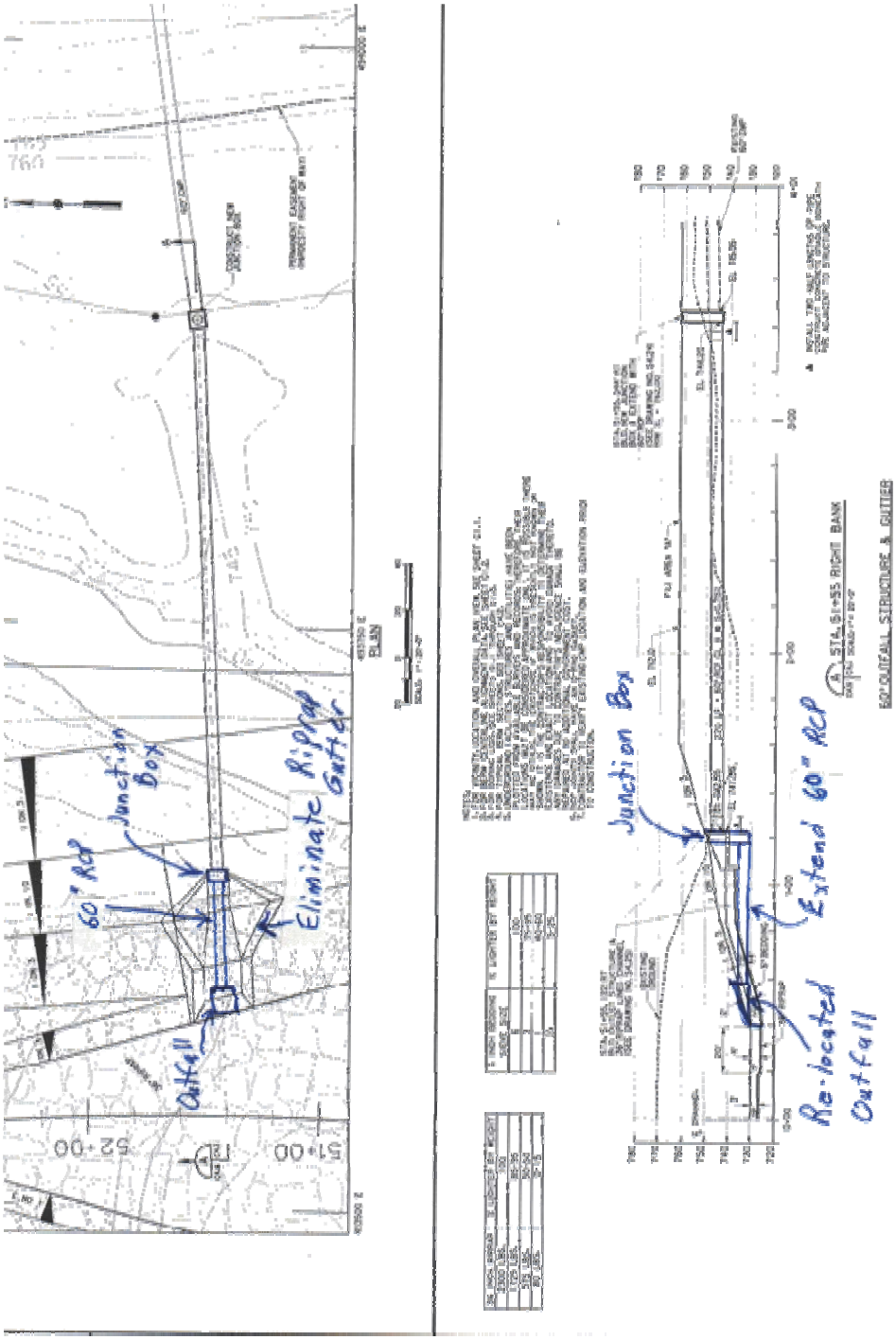
☒ Original ☐ Alternative



Sketch

Alternative No.: C-18

☐ Original ☒ Alternative



Construction Cost Estimate

Alternative No.: C-18

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas.**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
60" RCP	lin ft	$744			60	$44,640
60" Junction Box	each	$28,000			1	$28,000
48" RCP	lin ft	$595			110	$65,450
48" Junction Box	each	$16,000			1	$16,000
Riprap Gutters (54+70, 51+55, 49+64)	LS	$377,022	1	$377,022		
48" Junction Box	each	$80,600			1	$80,600
48" Outfall	each	$80,600			1	$80,600
48" RCP	lin ft	$595			280	$166,600
Project Marked Up Cost				$377,022		$481,890
Contingency	5.0%			$18,851		$24,095
SIOH	5.7%			$22,565		$28,841
TOTALS				$418,438		$534,826
NET SAVINGS						($116,388)

SECTION 5

DESIGN SUGGESTIONS

SECTION 5
DESIGN SUGGESTIONS

In addition to the Value Alternatives in the previous section, the team generated several other ideas that we have termed design suggestions. These are presented to bring attention to areas of the design which, in the opinion of the team, should be changed. In general, these ideas were designated as design suggestions rather than Value Alternatives for one of two reasons:

1. the value improvement opportunity is relatively small
2. the concept could not be adequately evaluated or developed within the constraints of the workshop resources

Design suggestions typically are associated with issues such as:

- improved operation
- ease of maintenance
- easier construction
- reduced risk of construction claims
- clarification of construction documents
- or safer working conditions

C-13

Provide early notice of material quantities to community

Being able to provide the required quantities of concrete, steel, rock, etc will be critical to completion of the work, particularly the mass concrete. Discussions with local suppliers will assist the Corps and the successful contractor in obtaining the required quantities at the least cost. Perhaps holding an industry forum, that may or may not include a site visit, would be an easy way to provide information from material vendors, as well as answering questions regarding contract requirements. It's also an opportunity for contractors to determine who might be an interested vendor and begin those discussions. This type of forum should be held prior to the actual CBD announcement to allow changes to be made to the contract requirements should new information become known.

C-17

Use corrugated HDPE pipe instead of RCP

The current design requires all drainage pipe to be reinforced concrete pipe (RCP). The project use 60", 48", and 36" RCP for outfall structures. Consider opening up the specification to allow high-density polyethylene (HDPE) pipe as an option. These materials have a long history and proved to be very reliable in drainage applications. Even if the contractor chooses not to use HDPE, it will result in better prices for RCP due to the increased competition.

C-20

Use a separate contract to establish plantings

Large civil construction projects often usually require the re-establishment of vegetation disturbed by the project. Current environmental laws and requirements often require that native vegetation be used to replace disturbed vegetation.

The establishment of native vegetation is not completed in the same manner as cool season grass, such as fescue, establishment. This combined with the current inexperience in planting native vegetation often results in failures for this part of the project.

General contractors usually have limited experience with this type of planting and usually do not give it much consideration in there construction schedules or their budgets. As a result, the planting does not have sufficient budget to be done properly and the planting is usually completed in seasons that are no conducive to successful vegetation establishment.

Local project owners have had successful project plantings by contracting separately with the native plant contractor. The general contractor is still required to establish temporary vegetation on finished grade for erosion & sediment control purposes.

By contracting separately with the native plant contractor, the influence of the general contractor is eliminated. By bidding the planting separately, the native planting contractors are competing only against their peers rather than meeting a budget dictated by the general contractor. With the native plant contractor in control of the planting, the project is able to be run in a manner that will make it successful. On addition, if the low-bid requirement is waived, the owner can choose the most qualified contractor which increases the chance of successful plant establishment.

Another issue associated with the native planting involves temporary irrigation. Project owners and contractors are hesitant to use temporary irrigation to help with the native plant establishment. This hesitancy is usually associated with cost. Project owners should insist that temporary irrigation be part of the project and be prepared for the cost associated with it. This could be the difference between success and failure of the planting.

SECTION 6

IMPLEMENTATION DECISIONS

SECTION 6
IMPLEMENTATION DECISIONS

VALUE ALTERNATIVES

The last stage of the Value Study addressed implementation actions by USACE and HNTB. On November 7, 2007, an implementation meeting was held at USACE's office in Kansas City.

The purpose of this meeting was to discuss each Value Alternative and design suggestion, answer questions, and determine implementation actions. Some ideas were accepted, others partially accepted or modified, and some were rejected. Others were left open or undecided because additional information was needed before making a commitment for action.

The following paragraphs show the decisions reached.

Accepted Value Alternatives

These Value Alternatives were accepted for implementation generally as presented in the Value Alternative write-up included in Section 4 of this report.

Alt. No.	Description	Comments
S-04	Eliminate downstream wingwalls	This concept will require some additional riprap that was not included in the cost estimate for the Value Alternative.
G-12	Move the structure downstream to approximately Sta. 53+00; build in the dry	The Value Alternative to not include any additional berm length to protect the commercial properties.
G-18	Minimize fill and use existing channel for habitat	

Partially Accepted or Modified Value Alternatives

Some Value Alternatives were accepted in part or with certain modifications. These Value Alternatives and subsequent changes to these Value Alternatives are discussed below.

Alt. No.	Description	Comments
S-24	Stair step the foundations for the tie back walls	The concept was accepted however, the actual design will probably require more concrete than estimated in the Value Alternative based on constructability considerations. There are also some details that need to be further developed on how to make the footings continuous from a structural perspective.

Rejected Value Alternatives

Some Value Alternatives were rejected at the implementation meeting. A brief discussion is provided below to help explain and to document the rationale behind the rejection of these Value Alternatives.

Alt. No.	Description	Comments
S-01	Replace tie back walls with earth embankment	Using earth embankment increases the loading factor on the walls by a factor of 7, thereby making the alternative infeasible. The Value Team did not take in to consideration the earth load that would be placed on these 60-foot high walls.
S-03	Match stilling basin sidewall geometry/profile to hydraulic profile	This alternative was rejected based on constructability concerns with constructing a battered back wall with a sloping top. This would require a difficult forming operation. The District felt a contractor would prefer to simplify the forming and pour extra concrete. Also after additional consideration of the hydraulic conditions, the District believes the water level will be higher than anticipated in the Value Alternative resulting in only a 6” to 24” savings in wall height.
S-10	Lower the entire structure with the ability to expand up to 500-year	The Value Team misunderstood which portion of the structure was in use for the 30-year flood event. The actual water surface elevation is greater than elevation 770. There is only twelve feet of additional structure height required to convey the 100-year flood and to survive the 500-year flood. Further, the District was concerned that any flood event greater than the 30-year event would cause severe channel and bank erosion.

Open or Undecided Value Alternatives

A decision could not be made at the implementation meeting on some Value Alternatives. The following explains why a decision was not made at this meeting.

Idea No.	Description	Comments
MS-02	Replace GCS with series of grade control structures and bank protection to Brush Creek	This option requires a more rigorous hydraulic study to assess shear. The estimated velocities from the hydraulic model are very close to the expected shear strength of the channel. This could potentially induce erosion and headcutting. Before accepting this proposal, the District wanted to conduct a more detailed hydraulic analysis to confirm that the anticipated velocities are acceptable. If the velocities are too high, it may be necessary to reinforce the banks in select locations.
S-02	Replace large concrete walls with MSE walls	The District was not comfortable with the concept of using MSE walls in this application. It was suggested that they talk further with Don Baker at Black & Veatch about the design at Lake Lenexa. Don Baker offered to take any interested parties on a site visit. It was also identified that the cost estimate may not have included the necessary excavation cost for installing the tieback straps. Further, the foundation must be placed on rock and it is uncertain how this will affect excavation and placement of the straps.
C-18	Use a series of flat pipe runs and vertical drops instead of gutters	The District preferred the riprap gutters as proposed in the original design concept. The City stated that these gutters are a significant maintenance problem and would prefer the pipe concept proposed in the Value Alternative if the District's design concerns can be resolved. The District is concerned that the pipes will fill with silt from low flow situations which will affect their performance when the capacity is needed for higher flow situations. This may result in localized flooding. The District will do further analysis of this concept to determine if a 2%-3% grade on the pipes will be sufficient to avoid silt settling out in pipes.

DESIGN SUGGESTIONS

In addition to the Value Alternatives, the team also identified three design suggestions. These are suggestions for changes or clarifications to the project documents that did not have an

identifiable or quantifiable cost impact that could be determined within the scope of the workshop.

Accepted Design Suggestions

These Design Suggestions were accepted for implementation generally as presented in the Design Suggestion paragraph included in Section 5 of this report.

Alt. No.	Description	Comments
C-13	Provide early notice of material quantities to community	
C-20	Use a separate contract to establish plantings	

Rejected Design Suggestions

The following Design Suggestion was rejected at the implementation meeting. The comment is provided below to help explain and to document the rationale behind the rejection of this Design Suggestion.

Alt. No.	Description	Comments
C-17	Use corrugated HDPE instead of RCP	The District does not have any experience with using HDPE pipes in similar applications with pipe diameters greater than or equal to 48". The District rejected the use of 60" HDPE and will have to develop a complete specification for the acceptable use of HDPE in this application. The District will not support using HDPE in plastic soils due to concerns with differential settlement.

COST SAVINGS

Savings from the ideas selected by USACE for implementation, including cost revisions based on modifications, are:

Accepted and Modified Value Alternatives

Alt. No.	Description	Capital Cost Savings
S-04	Eliminate downstream wingwalls	$1,113,000
S-24	Stair step the foundations for the tie back walls	$580,000
G-12	Move the structure downstream to approximately Sta. 53+00; build in the dry	$584,000
G-18	Minimize fill and use existing channel for habitat	$328,000

Alt. No.	Description	Capital Cost Savings
	Total	**$2,605,000**

Note: The savings on these Value Alternatives have been adjusted based on the results of the implementation decisions.

Some Value Alternatives are still undecided for various reasons, and there are some Value Alternatives that decisions are waiting on the results of additional analysis. Implementing these items remaining open for decision could result in additional savings as shown below:

Value Alternatives that are Open, Undecided, or require Further Study

Alt. No.	Description	Capital Cost Savings
MS-02	Replace GCS with series of grade control structures and bank protection to Brush Creek	$32,882,000
S-02	Replace large concrete walls with MSE walls	$9,584,000
C-18	Use a series of flat pipe runs and vertical drops instead of gutters	($116,000)
	Total	**$42,350,000**

Note: The savings on these Value Alternatives have been adjusted based on the results of the implementation decisions.

APPENDICES

APPENDIX
A - PARTICIPANTS

APPENDIX A – PARTICIPANTS

Day 1 (Mon) – Workshop Introduction & Design Presentations
Day 4 (Th) – Presentation of Alternatives

Name	Organization	Phone	Email	Day	
				M	T
John L. Robinson	Strategic Value Solutions	816-228-6160	John@StrategicValueSolutions.com	X	X
Don Baker	Black & Veatch	913-458-3093	bakerdw@bv.com	X	X
Scott Fehnel	HNTB	816-527-2431	sfehnel@hntb.com	X	X
Lynda L. Hoffman	KCMO, Water Services Division - Waterways	816-513-0489	lynda_hoffman@kcmo.org	X	X
John Holm	Corps of Engineers	816-389-3111	john.d.holm@usace.army.mil	X	X
Pete Jarchow	HNTB	816-527-2248	pjarchow@hntb.com	X	X
Robert Prager	Intuition & Logic	904-261-5555	robert@ilincworld.com	X	X
Korene Robinson	Strategic Value Solutions	816-228-6160	Korene@StrategicValueSolutions.com	X	X
Carl Schipfman	HNTB	816-527-2183	cschipfmann@hntb.com	X	X
Bob Schoen	Corps of Engineers	816-389-3291	robert.m.schoen@usace.army.mil	X	
Cecil Stegman	Black & Veatch	913-458-3700	stegmancr@bv.com	X	X
Mike Vanek	Black & Veatch	913-458-9309	vanekm@bv.com	X	X
Terry L. Winbush	KCMO, Water Services Division – Waterways	816-513-0495	terry_winbush@kcmo.org	X	X
Bill Womack	National Constructors Group	508-295-1718	bwocons@aol.com	X	X
Tom Wright	Corps of Engineers	816-389-3245	thomas.d.wright@usace.army.mil	X	X

IMPLEMENTATION MEETING PARTICIPANTS

Name	Organization	Phone
John Robinson	Strategic Value Solutions	816-228-6160
Chance Bitner	Corps of Engineers	816-389-3482
Rob Rastorfer	HNTB	816-472-1201
Carl Schipfman	HNTB	816-527-2183
John Blancett	HNTB Water Resources	816-527-2539
Tom Wright	Corps of Engineers	816-389-3245
Helena Moser	Corps of Engineers	816-389-3131
Pat Micamontez	Corps of Engineers	816-389-3322
Scott Gard	Corps of Engineers	816-389-3100
Randy Kuznalowski	Corps of Engineers	816-389-3685
John Holm	Corps of Engineers	816-389-3111
Terry L. Winbush	KCMO, Water Services Division – Waterways	816-513-0495
Lynda L. Hoffman	KCMO, Water Services Division - Waterways	816-513-0489

APPENDIX
B - COST INFORMATION

APPENDIX B – COST INFORMATION

Basis for Pricing

The Value Team used the following information for pricing the work:

- a 2-year construction duration
- escalation of 7.5% per year
- notice to proceed being issued in November 2007
- the midpoint of construction being November 2008
- construction completion in November, 2009

The estimator used quantities from the project drawings, HNTB takeoff document, and COE cost document labeled “Assembly Detail Report.”

The following adjustments have been made based on the:

- information provided in the project documents
- the Value Team’s review and opinion of the required construction phasing and staging necessary to construct this project

Mark-Ups

The table below shows the mark-ups used in the current construction cost estimate and the recommended mark-ups used by the Value Team. Where the percentages differ, an explanation is provided.

Mark-Up	Original	Recommended	Comment
Home & Office Overhead		10%	Used in VE Estimator Cost Opin.
Profit		10%	Used in VE Estimator Cost Opin
Bond		2%	Used in VE Estimator Cost Opin
Design Contingency			
Construction Contingency	5%	5%	
Owner’s Supervision & Admin	5.7%	5.7%	

Review of Unit Costs

After review of the unit costs in the project cost estimate, the Value Team recommends the following adjustments:

- Mass concrete = $992 cu yd
- Cast-in-place concrete = $744 cu yd
- Rock excavation = $55 lin ft
- Lean Concrete = $245 cu yd
- Common excavation = $8.50 cu yd
- See attached cost opinion for additional cost items

Significant Cost Issues

The following items represent some of the more significant cost variations identified during the review.

- Mass Concrete

  Items to consider when placing mass concrete that add cost and time to the contract. These are needed to control temperature and temperature differences in mass placements.

  - Optimal Concrete Mix Design
  - Form Insulation
  - Concrete Material Cooling before Placement
  - Concrete Cooling after Placement
  - Use of Smaller Placement

  In addition, there is a Monitoring Program necessary to ensure that the thermal control measures are keeping the temperature and temperature differences within the specified limits.

  The burden of implementing the mass concrete program is normally the responsibility of the contractor. The cost for taking that responsibility is carried in the proper bid item for mass concrete. If there is no specific bid item it is carried in the cost per cubic yard for the appropriate concrete bid item.

Conclusions

After making the adjustments discussed above, the Value Team has revised the estimated project cost from $25,680,000 to $40,027,000.

A revised project cost estimate is attached.

Assembly Detail Report is attached.

BLACK & VEATCH
Corporation

8400 Ward Parkway, P.O. Box 8405, Kansas City, Missouri 64114, (913) 458-2000

B&V Project 00000.0000

VE STUDY SUBMITTAL

US ARMY CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

BLUE RIVER BASIN
GRADE CONTROL STRUCTURE

OPINION OF
PROBABLE CONSTRUCTION COST
April 25, 2007

SUMMARY

Sta. 51+55 Right Bank (60" Outfall Structure & Gutter)		347,851
Sta. 49+65 Right Bank (48" Outfall Structure & Gutter)		251,670
Grade Control Structure		18,268,672
Outfall Structure		709,520
General		13,971,291
Mid-Point of Construction		2,516,175
Rate = % 7.5%		
Time = Years 1		
Contingency	5%	1,803,300
SIOH	5.7%	2,158,500
TOTAL PROBABLE CONSTRUCTION COST		**$40,026,979**

BLACK & VEATCH

US Army Corps of Engineers
Kansas City, Missouri
Grade Control Structure - Blue River Basin
Probable Construction Cost
April 25, 2007

Item Description	Quantity	Unit	Unit Cost $	Total Cost $
STA. 51+55 RIGHT BANK (60" OUTFALL STRUCTURE & GUTTER)				
Modification to connect to exist pipe and demo		Lump Sum		43,400
60" RCP	224	lin ft	744.00	166,656
Flap gate, 60"	1	each	19,220.00	19,220
Junction box				
Excavation	135	cu yd	37.20	5,022
Sheeting	515	sq ft	31.00	15,965
Cast in place concrete	24	cu yd	744.00	17,856
CMP connection to structure		Lump Sum		17,360
Outlet structure				
Excavation	140	cu yd	31.00	4,340
Cast in place concrete	28	cu yd	744.00	20,832
Channel protection		Lump Sum		37,200
Total - Sta. 51+55 Right Bank (60" Outfall Structure & Gutter)				**$347,851**
			COE	*$197,081*
STA. 49+64 LEFT BANK (48" OUTFALL STRUCTURE & GUTTER)				
Modification to connect to exist pipe and demo		Lump Sum		43,400
48" RCP	152	lin ft	595.20	90,470
Flap gate, 48"	1	each	12,400.00	12,400
Junction box		Lump Sum		37,200
Outlet structure		Lump Sum		31,000
Channel protection		Lump Sum		37,200
Total - Sta. 49+65 Right Bank (48" Outfall Structure & Gutter)				$251,670
			COE	*$82,570*
GRADE CONTROL STRUCTURE				
Cast in place concrete	18,416	cu yd	992.00	18,268,672
Total - Grade Control Structure				**$18,268,672**
			COE	*$13,939,180*
OUTFALL STRUCTURE				
36" RCP	152	lin ft	535.68	81,423
Boundary fence	5,786	lin ft	31.00	179,366
Excavation	2,376	cu yd	6.20	14,731
Sheeting	8,000	sq ft	31.00	248,000
Cast in place concrete	250	cu yd	744.00	186,000

BLACK & VEATCH

US Army Corps of Engineers
Kansas City, Missouri
Grade Control Structure - Blue River Basin
Probable Construction Cost
April 25, 2007

Item Description	Quantity	Unit	Unit Cost $	Total Cost $
Total - Outfall Structure				**$709,520**
			COE	*$394,428*
GENERAL				
Stripping areas L & R banks				
Clearing	15	acre	3,720.00	55,800
Tree removal	1,870	each	62.00	115,940
Grubbing	12,273	cu yd	18.60	228,278
Debris disposal	8,231	cu yd	24.80	204,129
Clear heavily tree area	1,530	each	186.00	284,580
Erosion and sediment control	4,620	lin ft	12.40	57,288
Temporary vehicular stream crossing		Lump Sum		136,400
Access ramp entrance off of Hardesty Ave		Lump Sum		638,600
Access ramp to GCS		Lump Sum		807,240
Pad for pumper truck		Lump Sum		520,800
Trail levee 19+70 to 30+25		Lump Sum		803,520
Seeding project		Lump Sum		74,400
Armor rip rap & bedding				
Excavation		Lump Sum		43,400
Compact sand subgrade	11,247	sq yd	31.00	348,657
Riprap	24,609	cu yd	62.00	1,525,758
Gravel	11,247	cu yd	49.60	557,851
Lean concrete riprap/headwall/splash	23,000	sq ft	18.60	427,800
Cut Channel	490,000	cu yd	12.40	6,076,000
Fill-Off-Site (Dodson)		Lump Sum		322,400
Bus turnout		Lump Sum		38,440
Permanent traffic barriers		Lump Sum		4,588
Fill-Off-Site (Vance)		Lump Sum		322,400
Riprap gutter 54+70				
Excavation		Lump Sum		12,400
Compact sand subgrade	1,400	cu yd	31.00	43,400
Riprap	1,500	cu yd	74.40	111,600
Gravel	233	cu yd	62.00	14,446
Riprap gutter 51+55				
Excavation		Lump Sum		12,400
Compact sand subgrade	700	cu yd	31.00	21,700
Riprap	750	cu yd	74.40	55,800
Gravel	115	cu yd	62.00	7,130
Riprap gutter 49+64				
Excavation		Lump Sum		12,400
Compact sand subgrade	700	cu yd	31.00	21,700
Riprap	750	cu yd	74.40	55,800
Gravel	133	cu yd	62.00	8,246

BLACK & VEATCH

US Army Corps of Engineers
Kansas City, Missouri
Grade Control Structure - Blue River Basin
Probable Construction Cost
April 25, 2007

Item Description	Quantity	Unit	Unit Cost $	Total Cost $
Total - General				**$13,971,291**
			COE	
Allowance adder (GR 9%, Estimator Contingency 15%)		1.24		

BLACK & VEATCH

NOTE: All cost in YELLOW need to be adjusted by getting quotes from vendors that would supply material to the job site being priced.
NOTE: All cost in GREEN need to be adjusted by getting hourly labor rates for the job site being priced.
NOTE: All quantity units in RED need to be adjusted to match the project drawings.
NOTE: All units in BLUE need to be adjusted to match the project scope.

Cost for 1 cuyd of concrete for SIMPLE SLAB-ON-GRADE CONSTRUCTION

	Quantity	Unit	MH/cuyd	Manhours	$/Hour w/markup Base	Total Labor	Material/Unit	Total Material	Sales Tax on Material	Contractor Profit	Mid-Point of Construction	Total w/out General Requirements
B&V					$43.63				4.00%	10%	3%	
Forms, 1' ft thick slab	24.00	sq ft	0.075	1.800	67.63	121.73	0.78	18.72	0.75	14.12	4.66	159.98
Rebar (SOG) #5@12" EWEF	150.00	pound	0.006	0.900	67.63	60.86	0.55	82.50	3.30	14.67	4.84	166.17
Concrete (4000 psi), pumped	1.00	cu yd	0.340	0.340	67.63	22.99	161.00	161.00	6.44	19.04	6.28	215.76
Finish & Cure (slab)	24.00	sq ft	0.025	0.600	67.63	40.58	0.25	6.00	0.24	4.68	1.54	53.04
TOTAL - COST FOR ONE CUBIC YARD OF CAST-IN-PLACE CONCRETE						$246.16		$268.22	$10.73	$52.51	$17.33	$594.95

Cost for 1 cuyd of concrete for SIMPLE WALL CONSTRUCTION

	Quantity	Unit	MH/cuyd	Manhours	$/Hour w/markup Base	Total Labor	Material/Unit	Total Material	Sales Tax on Material	Contractor Profit	Mid-Point of Construction	Total w/out General Requirements
B&V					$43.63				4.00%	10%	3%	
Forms (2 sides), 1' ft wall	54.00	sq ft	0.082	4.428	67.63	299.45	0.78	42.12	1.68	34.33	11.33	388.91
Rebar (Wall) #5@12" EWEF	150.00	pound	0.008	1.200	67.63	81.15	0.55	82.50	3.30	16.70	5.51	189.16
Concrete (4000 psi), pumped	1.00	cu yd	0.582	0.582	67.63	39.36	161.00	161.00	6.44	20.68	6.82	234.30
Finish & Cure (2 sides)	54.00	sq ft	0.025	1.350	67.63	91.30	0.25	13.50	0.54	10.53	3.48	119.35
TOTAL - COST FOR ONE CUBIC YARD OF CAST-IN-PLACE CONCRETE						$511.26		$299.12	$11.96	$82.23	$27.14	$931.71

Cost for 1 cuyd of concrete for SIMPLE SUSPENDED SLAB CONSTRUCTION

	Quantity	Unit	MH/cuyd	Manhours	$/Hour w/markup Base	Total Labor	Material/Unit	Total Material	Sales Tax on Material	Contractor Profit	Mid-Point of Construction	Total w/out General Requirements
B&V					$43.63				4.00%	10%	3%	
Forms (1 side), 1' ft thick slab	27.00	sq ft	0.250	6.743	67.63	456.02	0.78	21.06	0.84	47.79	15.77	541.49
Rebar (Wall) #5@12" EWEF	150.00	pound	0.011	1.650	67.63	111.58	0.55	82.50	3.30	19.74	6.51	223.64
Concrete (4000 psi), pumped	1.00	cu yd	0.711	0.711	67.63	48.08	161.00	161.00	6.44	21.55	7.11	244.19
Finish & Cure (slab)	27.00	sq ft	0.025	0.675	67.63	45.65	0.25	6.75	0.27	5.27	1.74	59.67
TOTAL - COST FOR ONE CUBIC YARD OF CAST-IN-PLACE CONCRETE						$661.34		$271.31	$10.85	$94.35	$31.14	$1,068.98

Construction Cost Summary Report

Facility: Grade Control Structure
Model Type: Site Work

Facility Direct Cost	$10,727,537
Total Direct Cost	$10,727,537

Facility: Outfall Structure
Model Type: Site Work

Facility Direct Cost	$303,146
Total Direct Cost	$303,146

Facility: Pavement/surfaces/foundations Demo
Model Type: Site Work

Facility Direct Cost	$303,550
Total Direct Cost	$303,550

Facility: Removing Pipe Outside Outfall 49+57
Model Type: Site Work

Facility Direct Cost	$63,546
Total Direct Cost	$63,546

Facility: Constructing new Outfall 51+55 R
Model Type: Site Work

Facility Direct Cost	$151,673
Total Direct Cost	$151,673

Facility: Stripping Areas L & R banks
Model Type: Site Work

Facility Direct Cost	$218,398
Total Direct Cost	$218,398

Facility: Clearing Heavily Treed Areas
Model Type: Site Work

Facility Direct Cost	$48,344
Total Direct Cost	$48,344

Construction Cost Summary Report

Facility: Erosion and Sediment Control
Model Type: Site Work

Facility Direct Cost	$31,537
Total Direct Cost	$31,537

Facility: Temporary Vehicular Stream Crossing
Model Type: Site Work

Facility Direct Cost	$85,066
Total Direct Cost	$85,066

Facility: Access Ramp Entrance off of Hardesty Ave
Model Type: Site Work

Facility Direct Cost	$396,072
Total Direct Cost	$396,072

Facility: Access Ramp to GCS
Model Type: Site Work

Facility Direct Cost	$501,331
Total Direct Cost	$501,331

Facility: Pad for Pumper Truck
Model Type: Site Work

Facility Direct Cost	$323,334
Total Direct Cost	$323,334

Facility: Trail levee 19+70 to 30+25
Model Type: Site Work

Facility Direct Cost	$498,112
Total Direct Cost	$498,112

Facility: Seeding project
Model Type: Site Work

Facility Direct Cost	$45,990
Total Direct Cost	$45,990

Construction Cost Summary Report

Facility: Armor rip rap & Bedding
Model Type: Site Work

Facility Direct Cost	$1,352,637
Total Direct Cost	$1,352,637

Facility: Cut Channel
Model Type: Site Work

Facility Direct Cost	$2,114,077
Total Direct Cost	$2,114,077

Facility: Fill - Off-Site (Dodson)
Model Type: Site Work

Facility Direct Cost	$199,239
Total Direct Cost	$199,239

Facility: Bus Turnout
Model Type: Site Work

Facility Direct Cost	$24,237
Total Direct Cost	$24,237

Facility: Permanent Traffic Barricades
Model Type: Site Work

Facility Direct Cost	$2,784
Total Direct Cost	$2,784

Facility: Fill - Off-Site (Vance)
Model Type: Site Work

Facility Direct Cost	$199,239
Total Direct Cost	$199,239

Facility: riprap gutter 54+70
Model Type: Site Work

Facility Direct Cost	$107,089
Total Direct Cost	$107,089

Construction Cost Summary Report

Facility: riprap gutter 51+55 RBank
Model Type: Site Work

Facility Direct Cost	$56,037
Total Direct Cost	$56,037

Facility: riprap gutter 49+64 LBank
Model Type: Site Work

Facility Direct Cost	$54,279
Total Direct Cost	$54,279
Total Facilities Direct Cost:	**$17,807,254**

Project Direct Cost:			**$17,807,254**
Markups	29.9	%	$5,331,197
Project Marked Up Cost:			**$23,138,451**
Contingency	5.0	%	$1,156,923
SIOH	5.7	%	$1,384,836
Project Cost:			**$25,680,210**
Design/Indirect Cost:	0.0	%	$0
Total Project Cost:			**$25,680,210**

Construction Start 04/01/2009
Construction Midpoint: 04/01/2010
Construction End Date: 04/01/2011

Escalation Rate: 8.93% Based on Construction Midpoint

Database Version: Jan 2006 Cost Book
PACES Version: 7.0.11

APPENDIX
C - CREATIVE IDEA LISTING

APPENDIX C – CREATIVE IDEA LISTING

IDEA NO.	IDEA DESCRIPTION	RATING
Manage Shear		
MS-01	Replace GCS with series of grade controls structures and bank protection through battlefield area	1
MS-02	Replace GCS with series of grade control structures and bank protection to Brush Creek	6
MS-03	Provide overflow channels	3
MS-04	Replace downstream channel with a widened bench west of existing channel	0
MS-05	Do MS-04 to Brush Creek	1
MS-06	Lower priority of project on head cutting	0
MS-07	Replace original ford with an engineered riffle	3
MS-08	Eliminate GCS and continue channel improvements; rock grade control at the ford	1
MS-09	Reduce size of GCS and install sluice gates to control flow	2
MS-10	Eliminate GCS and replace with reservoir	0
MS-11	Allow higher velocities and protect banks with vegetation	0
MS-12	Allow higher velocities with sheet pile	1
MS-13	Allow higher velocities and protect banks with gabions	0
MS-14	Build split weir with siphon for overflow	0
MS-15	put channel in culvert to reduce bank erosion	1
MS-16	Raise bed of channel to reconnect to natural flood plain and lower bed slope	1
MS-17	Combine MS-15 & MS-16	0
MS-18	Plant vegetation to reduce over-bank scour	3
MS-19	Build a grade control upstream of ford	0
MS-20	Build detention in Swope Park	1
MS-21	Build a pump storage reservoir in Swope Park	0
MS-22	Build downstream structures in the improved channel sections to control critical flows	0
MS-23	Dig up battlefield artifacts and don't manage scour	0
MS-24	Build levee around battlefield area to prevent scour	0
MS-25	Build bypass channel from 63rd St to oxbow	2
MS-26	Build tunnel to connect 63rd St to oxbow	0
MS-27	Use precast structures to protect banks	0
MS-28	Tunnel through oxbow around ford	0
MS-29	Revise channel plan form for predicted flows	1
MS-30	Use tunnel for low flow; build weir for 100/500-year flows	
O cpcig"U gcf"E wv		
MH-01	simplify GCS	1
MH-02	Place GCS at Brush Creek	3
MH-03	Put a cutoff wall at existing rock ford	0
MH-04	Put a cutoff wall just downstream of the historic ford and restore the ford for park purposes	0
MH-05	Line stream invert with concrete	0
MH-06	Line stream invert with riprap	0
MH-07	Grout inject soil mixing of the channel invert	0
MH-08	Excavate channel invert to shale	0

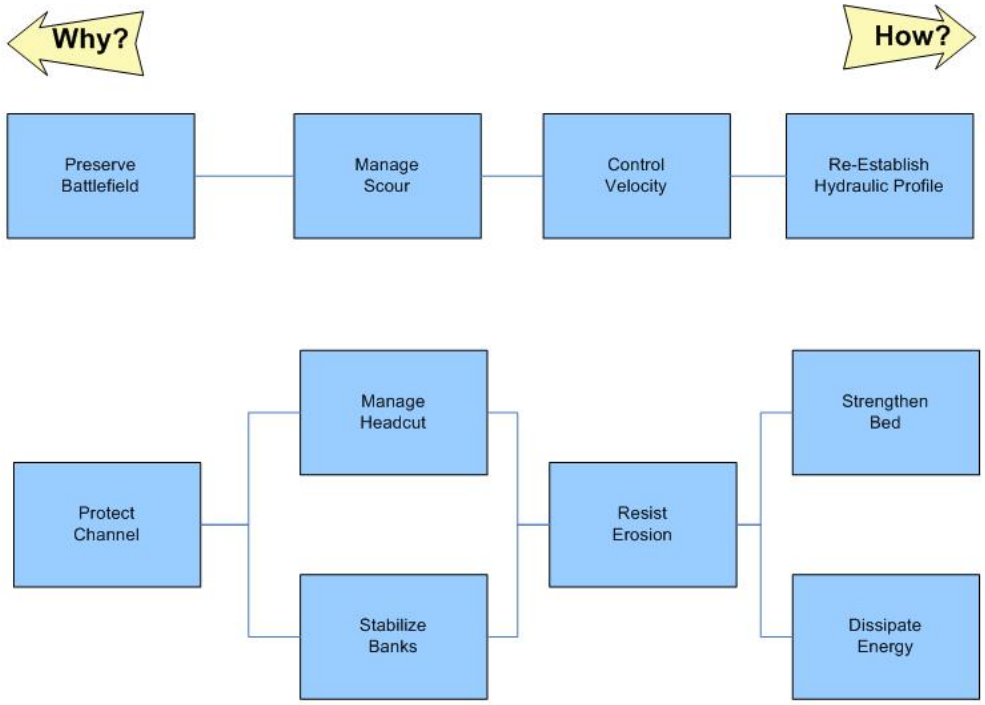
IDEA NO.	IDEA DESCRIPTION	RATING
MH-09	Drive piles/stone columns to densify the soil	0
MH-10	choke the channel	0
Uvtwewtg		
S-01	Replace tie back walls with earth embankment	0
S-02	Replace large concrete walls with MSE walls	6
S-03	Match stilling basin sidewall geometry/profile to hydraulic profile	5
S-04	Eliminate downstream wingwalls	4
S-05	Use shear key to thin up stilling basin slab	4
S-06	Use tie downs to reduce slab thickness	2
S-07	Use anchored side walls	3
S-08	Use a "v" type slotted structure	0
S-09	Lower the entire structure for top of wall at 500-year	0
S-10	Lower the entire structure with the ability to expand up to 500-year	1
S-11	Precast walls and post-tension to slab	5
S-12	Reduce structure with a rock fill or roller compacted concrete	1
S-13	Build Plunge pool instead of a baffled stilling basin	1
S-14	Build a GCS for 30-year event with diversion channel for higher flows	0
S-15	Build a box with different height weirs	0
S-16	Rotate the baffle blocks 45 degrees	1
S-17	Slope the upstream face of the baffle blocks to reduce debris collection	1
S-18	Create openings in the back wall to allow flushing	3
S-19	Use a sloping end sill	DS
S-20	Put sluice gates on the end sill to allow flushing	0
S-21	Use secant pile wall for tie back walls starting at top	0
S-22	Build a narrower low flow channel through stilling basin	2
S-23	Raise stilling basin training walls up to El 750	0
S-24	Stair step the foundations for the tie back walls	2
S-25	Raise the foundation elevation of the tie back walls	5
S-26	Replace debris deflector with riprapped embankment	0
S-27	Use stair step spillway on back side of weir	0
S-28	Replace baffle blocks with boulders	1
S-29	Replace baffle blocks with ogee weir	0
S-30	Use a labyrinth weir	0
S-31	Use tainter gates to control flow	0
S-32	Use self-regulating gates to control flow	1
S-33	Build weir with low flow slot, 30-year slot and 100-year slot (3 rectangles)	0
S-34	Build inverted siphon under the QCS with a an ogee weir for higher flows	0
S-35	Use trash racks instead of debris deflectors	1
S-36	Leave a gap in the stilling basin for flushing	1
S-37	Use post tension slab with pilings	0
S-38	Build a 30-year flow weir and use earth embankment	2
S-39	Build a 30-year flow weir and channel with a stair stepped weir for higher flows	1
S-40	Build three structures for required flows at three different locations (30, 100, 500)	0
S-41	Eliminate Sumps	3

IDEA NO.	IDEA DESCRIPTION	RATING
I gqo gvt{		
G-01	Eliminate embankment and stop at grade in northeast corner of new channel alignment	1
G-02	Shorten transition from station 50+00 to 53+00	1
G-03	Use natural channel design to set internal benches	1
G-04	Put rock grade control at station 59+76 at end of new channel	1
G-05	Extend project on left descending bank downstream to stabilize the bank and meander	0
G-06	Realign the channel to eliminate the compound curve	0
G-07	Move GCS to Sta. 56+00	0
G-08	Do not build fill on east side	1
G-09	Don't riprap above 30-year flood elevation	1
G-10	Move structure upstream to approximately Sta. 35+00 to reduce channel excavation and pass channel east of existing channel	1
G-11	Build structure in the dry and excavate an entrance channel and exit channel	2
G-12	Move the structure downstream to approximately Sta. 53+00; Build in the dry	6
G-13	Use existing channel for low flow and divert high flows to structure as located in G-11	0
G-14	Shorten the tie-back wall on the east side and tie earth back to high ground	1
G-15	Build a berm to protect Hardesty	2
G-16	Raise Hardesty Road	1
G-17	Build a levee/Berm on the east side to confine only the 30-year flood elevations	0
G-18	Minimize fill and use existing channel for habitat	6
G-19	Use jute matting and myrtle to reduce erosion	0
G-20	Reduce size of riprap to match model study	0
G-21	Reduce size of riprap using channel retards	0
G-22	Provide bedding and filter material between rock and soil	2
G-23	Replace riprap gutters with pipe	3
G-24	Angle gutters upstream to deflect flows to the center of the channel to reduce erosion	2
G-25	Make outfall structures the same size	1
G-26	End the Trail Berm at the west tie back wall	0
G-27	Reduce amount of riprap from end of basin to downstream transition	0
E qpuvtwev		
C-01	Use existing channel for diversion channel	1
C-02	Provide construction staging and access in the industrial park rather than off Hardesty	0
C-03	Dispose of all materials on-site	0
C-04	Allow stockpiling in the industrial park	2
C-05	Adjust specification for cleaning shale to account for the fact that the shale will slake	0
C-06	Change battered wall to stair stepped	3
C-07	Form baffle blocks with interior training wall to eliminate 6" gap	2
C-08	Eliminate water stops in concrete joints	2
C-09	Add weep holes and eliminate water stop	3
C-10	Have more specific specifications on mass concrete mix design and temperature control to allow contractor better information for bidding (partnering spec)	0
C-11	Notify quantities of planned quantities and spec	0
C-12	Have Corps tie up the riprap for the contractors	3
C-13	Provide early notice of material quantities to community	DS
C-14	Allow/permit for an on-site batch plant	0

IDEA NO.	IDEA DESCRIPTION	RATING
C-15	Clarify transitions of riprap	0
C-16	Use slopes and benches to avoid slope to slope interfaces (1 on 10 to 1 on 3)	3
C-17	Use corrugated HDPE instead of RCP	0
C-18	Use a series of flat pipe runs and vertical drops instead of gutters	6
C-19	Revise grass mixture to improve success	2
C-20	Use a separate contract to establish plantings	DS
C-21	Use temporary irrigation to improve plant establishment	0
C-22	Use hydrophilic soil mixes	0
C-23	Use stream water for concrete curing and temperature control	0
C-24	Allow bypass pumping of stream during construction	1
C-25	Don't have vertical faces in shale	0
I gpgtcn		
Gn-01	Develop a reforestation plan for the East side	DS
Gn-02	Develop an erosion and sediment control plan with the contract	3
Gn-03	Have unit costs for erosion control items	0
Gn-04	Allow groups to remove trees for a cost	0
Gn-05	Require selective clearing	1
Gn-06	Have public arts competition to reduce graffiti potential	1
Gn-07	Put graffiti resistant sealer on concrete	0
Gn-08	Use the correct symbol for shale rather than limestone to indicate bedrock	0
Gn-09	Put man ladders on inside of all structures	1
Gn-10	Put broken glass in tops of walls	0
Gn-11	Point tops of walls	1
Gn-12	Add a maintenance bridge on top of 30 yr box weir	3
Gn-13	Put a notch in the upstream sill to allow fish passage	2
Gn-14	Partner with Civil War Roundtable to develop a park plan (multi-use)	0
Gn-15	Build a kayak rodeo hole	1

APPENDIX
D - FAST DIAGRAM

APPENDIX D – FAST DIAGRAM



Functions Resources

Strategic Value Solutions, Inc.

US Army Corps of Engineers, Kansas City
Grade Control Structure
Blue River Channel Modifications
FAST Diagram

	FUNCTION	
COMPONENT	**VERB**	**NOUN**
3-Level Weirs	Re-establish	Profiles
Debris Deflectors	Direct (nuisance)	Debris flow
Debris Deflectors	Resist	Earth load
Tie-back walls	Prevent	Flanking
Side walls	Confine	Flow
Side walls	Contain	Jump
Box Weir Walls	Resist	Earth load
Low flow training walls	Confine	Low flow
Low flow training walls	Reduce	Sedimentation
Baffle blocks	Dissipate	Energy
Slab	Prevent	Sliding
Slab	Support	Sidewalls
Slab	Prevent	Scour
Slab	Strengthen	Bed
Down Stream Wing Walls	Move	Eddying
Down Stream Wing Walls	Retains	Earth
Toe Wall	Create	Pool
Upstream Rip Rap	Maintain	Geometry (of Structure)
Upstream Rip Rap	Stability	Slope
Downstream Rip Rap	Maintain	Geometry
Channel Alignment	Match	Downstream
Channel Alignment	Match	upstream
Channel Alignment	Align	Flow
Channel Alignment	Avoid	Hardesty/ structures
Fill	Waste	Excavation
Fill	Construct	Channel
Gutter	Prevent	Erosion

APPENDIX
E - LIST OF MATERIALS PROVIDED

APPENDIX E – MATERIALS PROVIDED

Ref#	Document	Prepared by	April 2007
1	Grade Control Structure, Blue River Channel Modifications, 90% Plans & Specifications	HNTB	April 2007
2	Grade Control Structure, Blue River Channel Modifications, Draft Design Documentation Report, Site Features Alternatives Analysis	HNTB	March 2007
3	Grade Control Structure, Blue River Channel Modifications, Draft Design Documentation Report	HNTB	March 2007
4	Prelude to Westport: Phase 1 Archaeological Survey of a portion of the Big Blue Battlefield in Kansas City, Jackson County, Missouri	TRC Mariah Associates Inc.	June 1997
5	Color Aerial Map of Blue River, Blue Parkway to 63rd St	COE	unknown
6	USGS Provisional		
7	Site Plan of Grade Control Structure	KCMO	Unknown
8	Memorandum for Record, ADR Agreement		
9	WES Modeling Report	WES	

APPENDIX
F – TECHNICAL REVIEW COMMENTS

VE Recommendation Meeting
19 Nov 07, 9:00, Room 835
Statement of Work
6 Nov 07

1. Introduction. A value engineering (VE) study was conducted the week of 23 Apr 07 for the Grade Control Structure (GCS) in accordance with Corps policy and guidance (ER 11-1-321). A Draft-Final VE study report, dated 23 May 07, was submitted for review and made available to the following individuals (VE review team) for review on 29 May 07.

Reviewer	**Labor Code**	**Status - Comments Received**
Holm	0A2AE8	No comments provided
Kuzniakowski	0830B3	30 Jul 07
Wright	08FEF2	6 Jul 07
Miramontez	0830AB	3 Jul 07
Mosser	0830B0	11 Jul 07
HNTB	W912DQ-07-C-0005	5 Oct 07
Hoffman	NA	No comments provided
Winbush	NA	No comments provided
Other KCMO Reviewers?	NA	No comments provided

2. Scope. The VE study proposed a number of alterations to the GCS as well as one alternative to the structure. Corps guidance requires that the alternatives developed by the VE study be reviewed and formal recommendations developed with regard to acceptance or rejection of the alternatives.

3. The following process will be utilized to conclude this VE Study.
   a. All available comments will be distributed for review by the members of the VE review team on 6 Nov 07. Any additional comments received after that date will be distributed immediately.
   b. The VE review team should re-review the Draft-Final VE study report prior to 19 Nov 07.
   c. The VE review team will meet on 19 Nov 07 to discuss the review comments and the alternatives.
   d. The VE review team will develop a consensus position for each alternative, in accordance with the guidance. This will be documented in writing. Dissenting opinions will be allowed.
   e. The VE consultant will prepare the final VE Study Report.

4. Please direct any questions regarding this matter to John Holm.

CENWK-EC-DS 6 July 2007

MEMORANDUM FOR RECORD

SUBJECT: VE Study, Grade Control Structure, Blue River Channel.

Background. The draft final report on a VE study on the Blue River Channel Grade Control Structure conducted in May 2007 is dated May 23, 2007. The comments below are based on that draft final report.

1. Executive Summary. Page 1-3. The third bullet under "Analyzing the functions of this project gave the team the following key insights" should be more specific. The statement that a "high safety factor was used" should be quantified. "High" is ambiguous. This statement also is somewhat contradictory with a later statement that says "It is appropriate to have a high factor of safety on the structure slab due to the uncertainty of the shale interface." High is a relative term and the apparent conclusion is that it is not too "high".

2. Table 1-2. In the Idea Description column, for S-02 the replacement walls are "MSE walls" not "mass walls". Idea No. C-08 was in the process of being implemented at the time of the VE study. Waterstops were to be eliminated from the walls founded on rock but would remain for the walls founded on soil.

3. Page 4-6. The 4th paragraph says that scour can be seen inside of the meander in the adjacent photo on page 4-7. The scour appears to be on the outside of the meander.

4. The following are comments expressing my opinion on the viability of the propose alternatives:

a. MS-02. Replace GCS with series of grade control structures and bank protection to Brush Creek. This alternative provides the largest savings of all those considered. The savings may be overstated slightly as costs for the alternative appear to be understated such as the outlet structure for $25,000 and the bridge protection for $75,000. Even if these items are understated by 100%, the savings are very significant and the conclusion would not be invalid. The biggest unknown with this alternative is that the design at this point is based on the judgment of the VE team and has on be verified by analysis or model study. The time required to verify the design may have a big impact on the use of available funds and completion of the project. That having been said, this should probably be further investigated to realize cost savings and potentially an improve project for ascetics and operation and maintenance.

b. S-01. Replace tie back walls with earth embankment. This is a good alternative. I am not sure the cost saving shown reflects that a short section of concrete tie back wall will be needed as a cut-off and tie-in to the embankment.

c. S-02. Replace large concrete walls with MSE walls. This concept is good if there are no adverse hydraulic effects and the MSE backfill is properly engineered to prevent piping and erosion of material. Erosion of backfill will obviously make the MSE wall unstable.

d. S-03. Match stilling basin sidewall geometry to the hydraulic profile. I am not convinced that the walls are not already matched to the hydraulic profile. The stated savings may not reflect the additional aggravation of constructing a battered back wall with a sloping top. The savings from this alternative are pretty small ($157k) compared to the cost of repairs if damage occurs as a result of lowering the downstream end of the walls. I would not recommend this alternative.

e. S-04. Eliminate the downstream wing walls. This is a good idea and should be implemented.

f. S-10. Lower the entire structure with the ability to expand to 500 year. Benefits of the larger structure for reducing velocities and erosion to protect the 30 year project are being recognized with this alternative. While the channel is designed for a 30 year flood, it appears that the GCS may provide erosion protecting for higher flows. If the channel design level is every increased to 100 yr of 500 yr levels, the additional cost of modifying the structure later will likely out-weigh the savings. If however, there is no erosion protection for provided for flows above the 30 yr channel design level then this change should probably be implemented.

g. S-24. Stair step the foundations for the tie back walls. I have long questioned the constructability of the sloping foundations. I recommend implementation of this recommendation.

h. G-12. Move the structure downstream to Sta 53+00; Build in the dry. Assuming the foundation conditions at the proposed alternative location are acceptable, I see no reason not to implement this alternative.

i. G-18. Minimize filling and use existing channel for habitat. This may be less desirable for recreation.

j. C-18. Use a series of flat pipe runs and vertical drops instead of gutter. The pipes should not be completely flat. A minimum of 2% to 3% grade should be maintain to assure the silt moves through the pipe and does not settle out in the pipes and drop structures. The narrative says to consider alternatives to concrete pipe. I do not think that is a good idea. The durability of concrete pipe with water tight joints to prevent piping of material is essential and the most cost effective in the long run.

5. Design Suggestions. Comments of Design Suggestions:

a. C-13. Provide early notice of material quantities to the community. Good idea and it does not cost anything.

b. C-17. Use HDPE pipe. Instead of RCP. I do not agree that HDPE "has a long history and proved to be very reliable in drainage applications." This is especially not true for large diameter pipe (≥48"). Consideration must be given to the application of the pipe. If pipe less than 48" can be installed in granular bedding with appropriate filters, then it may be successful. Flexible pipe like HDPE installed in plastic soils or large diameters are not recommended will not provide adequate service.

c. C-20. Use separate contract to establish plantings. No comment.

Thomas D. Wright, P.E.
Structural Engineer
EC-DS

Memorandum for Record 28 November 2005

Subject: Technical Evaluation of Value Engineering Study performed on Grade Control Structure, Blue River, Kansas City, Missouri Submitted by Black & Veatch dated 23 May 2007

1. Reference email dated 23 June 2007 from John Holm requesting the subject submittal be reviewed for reasonableness. The following comments are made on the initial cost estimate supplied by the Corps of Engineers, and the following estimate based on the original estimate supplied by Black & Veatch. Questions or comments concerning these comments should be directed to Patrick Miramontez, 816-389-3322.

2. Tech Code Report – Page 4 of 37 – Grade Control Structure– Site Development – The amount of concrete placed, and the associated items with this concrete are questionable. The quantities for concrete placement appear questionable.

3. Tech Code Report – Page 5 of 37 – Outfall Structure (Sta 51+ 55)– Site Demolition & Relocations – Dump Charge – This cost is questionable. Why are dump charges applicable? Can the demolished rubble material be used onsite?

3. Tech Code Report – Page 6 of 37 – Outfall Structure (Sta 51+55) – Parking Lots - a) The need for a deep precast area drain w/ grate is questionable. This item should be deleted. B) The item "Storm Sewer" is questionable. This appears to be a duplicate item with the "storm sewer" item on page 7.

4. Tech Code Report – Page 7 of 37 – Outfall Structure (Sta 51+55) – Site Earthwork - a) The need for Steel Sheet piling is questionable. This excavation can be made by laying the slopes back.

5. Tech Code Report – Page 8 of 37 – Outfall Structure (Sta 51+55) – Other Site Construction – The need for Bituminous Fiber Expansion Joint, and footing rebar is questionable. What do these items represent?

6. Tech Code Report – Page 8 of 37 – Pavement/Surfaces/Foundations Demo – Site Demolition & Relocations – The quantity of 673.7cy of concrete demolition is questionable. Where did this quantity come from? The dump charges are questionable. These costs should be deleted.

7. Tech Code Report – Page 9 of 37 – Pavement/Surfaces/Foundations Demo – Site Development – The need for galvanized chain link fencing is questionable. This cost item should be replaced with a safety fence type cost.

8. Tech Code Report – Page 11 of 37 – Removing Pipe Outside Outfall 49+57 – Site Earthwork – The earthwork for this item appears to be duplication with the overall excavation that will occur onsite.

9. Tech Code Report – Page 11/12 of 37 – Removing Pipe Outside Outfall 49+57 – Storm Sewer – The earthwork and demolition line items appear to be a duplicate of the overall excavation and demolition items already priced for the outfall structure at Sta 49+65.

10. Tech Code Report – Page 12 of 37 – Constructing new Outfall 51+55 R – Site Demolitions & Relocations – Where is a building shown for demolition?

11. Tech Code Report – Page 13 of 37 – Constructing new Outfall 51+55 R – Fencing – The need for galvanized chain link fencing is questionable. This cost item should be replaced with a safety fence type cost.

12. Tech Code Report – Page 14 of 37 – Constructing new Outfall 51+55 R – Site Demolition & Relocations - The dump charges are questionable. These costs should be deleted.

13. Tech Code Report – Page 17 of 37 – Temporary Vehicular Stream Crossing – Site Earthwork – The need for fill to be delivered from offsite is questionable. Also, the spreading and compacting quantity does not match the fill quantity.

14. Tech Code Report – Page 18 of 37 – Temporary Vehicular Stream Crossing – Entire Page appears to be duplicative with page 17 efforts. It should be noted that 2 streams crossings will be required.

15. Tech Code Report – Page 19 of 37 – Access Ramp Entrance off of Hardesty Ave- The need for clearing, 24" CMP, and concrete structures for this item is questionable.

16. Tech Code Report – Page 20 of 37 – Access Ramp Entrance off of Hardesty Ave- The quantity for the access ramp entrance is questionable. These quantities do not match the backup support. Why is sand and topsoil needed to be brought to the site for this item?

17. Tech Code Report – Page 20/21 of 37 – Access Ramp Entrance to GCS- The need for clearing, 24" CMP, and concrete structures for this item is questionable.

18. Tech Code Report – Page 22/23 of 37 – Access Ramp Entrance to GCS- The quantity for the access ramp entrance is questionable. These quantities do not match the backup support. Why is sand and topsoil needed to be brought to the site for this item? Why is fine hand grading required for this item?

19. Tech Code Report – Page 23 of 37 – Pad for Pumper Truck - The need for clearing, 24" CMP, and concrete structures for this item is questionable.

20. Tech Code Report – Page 24/25 of 37 – Pad for Pumper Truck - The quantity for the access ramp entrance is questionable. These quantities do not match the backup support. Why is sand and topsoil needed to be brought to the site for this item? Why is fine hand grading required for this item?

21. Tech Code Report – Page 25/26 of 37 – Trail Levee 19+70 to 30+25 - The need for concrete structures and general area cleanup for this item is questionable.

22. Tech Code Report – Page 27 of 37 – Pad for Pumper Truck - The quantity for the access ramp entrance is questionable. These quantities do not match the backup support. Why is sand and topsoil needed to be brought to the site for this item? Why is fine hand grading required for this item?

23. Tech Code Report – Page 29 of 37 – Armor Rip Rap & Bedding - The need for site earthwork under this item is questionable. What does this item represent?

24. Tech Code Report – Page 33 thru 36 of 37 – Riprap Gutters - The additional quantity for riprap gutter is questionable. Was this quantity accounted for in the Armor Riprap and Bedding Item? Please clarify.

Patrick J. Miramontez
Cost Engineer

29 July 2007

Blue River Grade Control Structure – 90% Design

Review of Value Engineering Study Results
Review by Randy Kuzniakowski, EC-GD

1. A review of the Value Engineering Study Final Report, Grade Control Structure Blue River Channel, dated 23 May 2007 was performed. The review consisted of evaluating the developed alternatives for technical feasibility and completeness. The review focused mainly on the geotechnical aspects of the project. The following discussion documents my review comments.

a. Page 2-1, 4th paragraph, 4th sentence. The word "back" should be "bank".

b. Alternative S-01, Earth Embankments in Lieu of Concrete Tie-Back Walls. I generally like the approach, however I have a few comments on the evaluation.

1. There are no costs included for erosion protection. These embankments will potentially be overtopped at some point, so some type of erosion protection needs to be included. Additional cost would probably double or triple the current estimate for the alternative.

2. This alternative would require some type of stub-out wall from the structure that ties into the embankment section to prevent seepage along the outside edge of the structure.

3. This approach will probably require reconfiguration and redesign of the structure to accommodate the revised grading upstream of the structure that would be required to construct the earth embankments. This would add significant additional design, excavation, and structure costs that are currently not reflected in the alternative estimate.

c. Alternative S-02, Use MSE Walls in Lieu of Large Cast-in-Place Walls.

1. I would not propose MSE walls within the stilling basin itself, due to high turbulence and high velocities.

2. If an MSE wall was used for the stilling basin side walls, the excavation for a 50' tall MSE wall would be significant. In fact, there may be real estate issues due to the additional excavation. The additional costs for excavation and backfill are not currently reflected in the estimate for this alternative.

3. A 50-foot tall MSE wall is pushing the envelope for this technology. Not many of these walls have been constructed to this height or higher.

4. MSE walls are typically designed for active earth pressures because movement is generally not a concern and these walls can take significant deformation. For this application, however, I would recommend designing for at-rest pressures. This increase in loading would increase the size of the wall section, thus the excavation and increase costs.

5. The tie back walls could probably safely be constructed using MSE technology, but the wall backfill would have to be protected against overtopping with hard armor to prevent unraveling of the MSE wall backfill and failure of the wall.

d. Alternative S-03, Sloping Basin Sidewall. I would recommend studying the hydraulics in the stilling basin in more detail prior to making this decision. Turbulence and waves could be excessive, and you would want to contain as much of this energy as possible.

e. Page B-2, Review of Unit Costs. Why is rock excavation in linear feet?

f. Alternative G-18. I think the waste off site cost is too low. The alternative is probably a wash with respect to cost of the original plan, plus the stability of the river bank would have to be investigated further.

2. If there are any questions, please contact Randy Kuzniakowski at x3685.

VE Recommendation Meeting
19 Nov 07, 9:00, Room 835
Statement of Work
6 Nov 07

1. Introduction. A value engineering (VE) study was conducted the week of 23 Apr 07 for the Grade Control Structure (GCS) in accordance with Corps policy and guidance (ER 11-1-321). A Draft-Final VE study report, dated 23 May 07, was submitted for review and made available to the following individuals (VE review team) for review on 29 May 07.

Reviewer	**Labor Code**	**Status - Comments Received**
Holm	0A2AE8	No comments provided
Kuzniakowski	0830B3	30 Jul 07
Wright	08FEF2	6 Jul 07
Miramontez	0830AB	3 Jul 07
Mosser	0830B0	11 Jul 07
HNTB	W912DQ-07-C-0005	5 Oct 07
Hoffman	NA	No comments provided
Winbush	NA	No comments provided
Other KCMO Reviewers?	NA	No comments provided

2. Scope. The VE study proposed a number of alterations to the GCS as well as one alternative to the structure. Corps guidance requires that the alternatives developed by the VE study be reviewed and formal recommendations developed with regard to acceptance or rejection of the alternatives.

3. The following process will be utilized to conclude this VE Study.
   a. All available comments will be distributed for review by the members of the VE review team on 6 Nov 07. Any additional comments received after that date will be distributed immediately.
   b. The VE review team should re-review the Draft-Final VE study report prior to 19 Nov 07.
   c. The VE review team will meet on 19 Nov 07 to discuss the review comments and the alternatives.
   d. The VE review team will develop a consensus position for each alternative, in accordance with the guidance. This will be documented in writing. Dissenting opinions will be allowed.
   e. The VE consultant will prepare the final VE Study Report.

4. Please direct any questions regarding this matter to John Holm.

Blue River VE Study
Technical Review Comments
July 2007

Reviewer: Helena Mosser, P.E.
Hydraulic Engineer

Summary of Alternatives:

Alt No.	Comments Regarding Hydraulic Feasibility
MS-02	Major hydraulic concerns have not been adequately addressed.
S-01	No Comment
S-02	No Comment
S-03	Appears feasible from a hydraulic standpoint.
S-04	Appears feasible from a hydraulic standpoint.
S-10	Does not actually accomplish a 30-yr level of protection
S-24	No Comment
G-12	Appears feasible from a hydraulic standpoint.
G-18	Partially feasible. See comments.
C-18	No Comment

Hydraulic Comments on Alternative MS-02:

1. The VE report claims that the proposed improvements in alternative MS-02 will decrease the channel shear from the existing range of 0.5 to 1.5 psf to a range of 0.25 to 1.0 psf and thus prevent erosion. However, when comparing calculated values of channel shear in the HEC-RAS model, there is little to no difference between existing and proposed conditions in the area of Byram's Ford. Channel shear values still range between 0.5 to 1.5 psf through the Ford. Figures 1 through 3 compare the calculated channel shear for Alternative MS-2 with existing conditions and completed conditions for the authorized channel project (Scenario 1). Channel shear for the 2, 20, and 100-yr profiles are shown in Figures 1, 2, and 3 respectively.

2. The extremely high shear values at the transition between natural and modified channel (Cross section 10.646) have not been addressed (See high point on Figures 1 through 3). The channel shear that that location ranges from 3.8 to 5.0 psf, many times higher than the maximum acceptable value for soil of 0.8 psf as stated in the VE report. Without a much more substantial stabilization structure at this location, the banks will continue to erode upstream towards the Blue Parkway bridge.

3. The proposed rock structures for this alternative only address stabilization for the bottom of the channel. It does not prevent bank erosion, especially around the transition area where the channel width is reduced from 300-ft to120-ft in the upstream direction. The high

velocities and shear stresses modeled through this area would tend to erode the banks of the natural channel to approach the 300-ft width seen downstream.

4. The proposed rock grade control structures were modeled incorrectly in HEC-RAS. They were modeled with blocked obstructions in the bottom of the channel, sometimes on several cross sections in a row. When these obstructions are placed on consecutive cross sections, the model sees it as one continuous obstruction, effectively raising the invert of the channel for long reaches of the river. See Figure 4 for an illustration of the raised invert locations. In one location, the obstruction stretches for a reach almost half a mile long. This technique is not representative of the actual rock grade control structures that are being proposed.

5. When discussing the cost savings of Alternative MS-02 over the original authorized Grade Control Structure (GCS), one should keep in mind that this alternative does not accomplish the same things as would the GCS. Alternative MS-02 attempts to locally stabilize the banks through a series of rock structures, but it does not increase water surface elevations or mitigate for increased velocities upstream of the project reach. Figure 5 compares the 20-yr water surface profiles for Alternative MS-02 with the original GCS profile upstream of the project area. One can see from this figure that there is virtually no difference in upstream water surface elevations between existing conditions and the proposed alternative. The drawdown in water surface profiles caused by the channel project would continue to cause increased velocities and erosion to areas upstream of 63rd Street, including Swope Park. The original GCS, on the other hand, would reestablish the pre-project rating curve by increasing upstream water surface elevations by several feet and thus protect all areas upstream of the GCS from the effects of the channel project. Since Alternative MS-02 does not mitigate for changes in the profiles upstream of 63rd Street, the long-term costs of this alternative would most likely include bank stabilization measures continuing all the way through Swope Park for several miles upstream.

6. Excavation of the three internal floodplains recommended in Alternative MS-02 may have some benefit if the remainder of the authorized channel is not built. Excavating the floodplain reduces local velocities by increasing the available flow area at that location. This option may be helpful to reduce velocities in short reaches where the channel is narrowly constricted. If this option is pursued, other locations besides the three proposed in MS-02 should also be investigated to find the most effective combination.

<u>Hydraulic Comment on Alternative S-03:</u>

1. Alternative S-03 recommends lowering the elevation of the stilling basin sidewalls to more closely match the hydraulic profile. This option appears to be feasible from a hydraulic standpoint, but some freeboard above the tailwater elevation will be desirable to allow for water surface variations due to turbulence. See EM 1110-2-1601 and -1602 for recommendations on stilling basin sidewall heights.

Hydraulic Comment on Alternative S-04:

1. Alternative S-04 recommends eliminating the downstream wingwalls from the GCS and using riprap on the side slopes instead to control scour from eddy effects at the downstream end of the sidewalls. This design is similar to what has been used at many of the Corps' lake projects whose stilling basins do not have downstream wingwalls. This alternative should be feasible from a hydraulic standpoint. If this alternative is used, maintenance issues should be minimized by incorporating lessons learned from the lake projects.

Hydraulic Comments on Alternative S-10:

1. Alternative S-10 recommends building the GCS only to a 30-yr level (meaning the channel's design discharge of 35,000 cfs), with the option of expanding to the 100 & 500-yr levels at a later date. To do this, the VE report suggests building the GCS weir only up to elevation 750-ft. It should be noted that the term "30-yr level" may not be an accurate description of this alternative. The WES physical model study showed that the GCS headwaters exceed elevation 750-ft for any discharge above 5,000 cfs. At the channel design discharge of 35,000 cfs (termed the 30-yr flood), headwaters are already overtopping the 770-ft wall on the GCS by more than 4 feet. Suggest removing the term "30-yr level" and replacing with "750-ft level."

2. If the structure is built to elevation 750-ft, which is overtopped at only 5,000 cfs, water surface elevations upstream of the structure would be substantially lower than was originally designed for any flows greater than 5,000 cfs. This means that Byram's Ford would still commonly experience increased velocities during peak flows. More extensive hydraulic modeling would be required to correctly estimate the effects of this lower structure on upstream channel velocities.

3. In order to actually replicate the function of the GCS up to a 30-yr level (35,000 cfs), the structure would need to be built up to at least elevation 770-ft. This would require a much larger structure, including baffle blocks and side walls, than is described in Alternative S-10. Therefore, the cost savings for this alternative would be much less than are claimed in the report.

Hydraulic Comment on Alternative G-12:

1. Alternative G-12 proposed moving the entire GCS structure downstream to Sta 53+00 in order to save on construction costs by building it in the dry with no channel diversion needed. Moving the structure will require some redesign of the upstream and downstream transitions, but it should operate effectively in the new location. However, the flood control benefits to Byram's Ford Industrial Park would be reduced in the 600-ft reach between the old and new locations, and the 30-yr berm planned to border the park would also need to be

extended. The costs and benefits of this alternative need to be further evaluated, but it appears to be hydraulically feasible at this time.

Hydraulic Comment on Alternative G-18:

1. Alternative G-18 involves eliminating the fill area on the right bank immediately downstream of the Grade Control Structure and allowing natural vegetation and wildlife to use the low areas and existing channel. I agree that it is not necessary to fill the entire area as proposed in the design drawings. However, the existing channel itself should still be filled at least to elevation 746-ft and sloped to drain into the constructed channel in order to prevent erosion and flanking around the right side of the GCS. In addition, the 60" RCP which provides drainage to approximately 150 acres on the east side of Manchester Rd would still be needed. Aside from these two areas, the remainder of the right bank fill area could be left at its existing elevation and its natural habitat left undisturbed. This modified alternative would also provide additional floodplain area during high flow events.

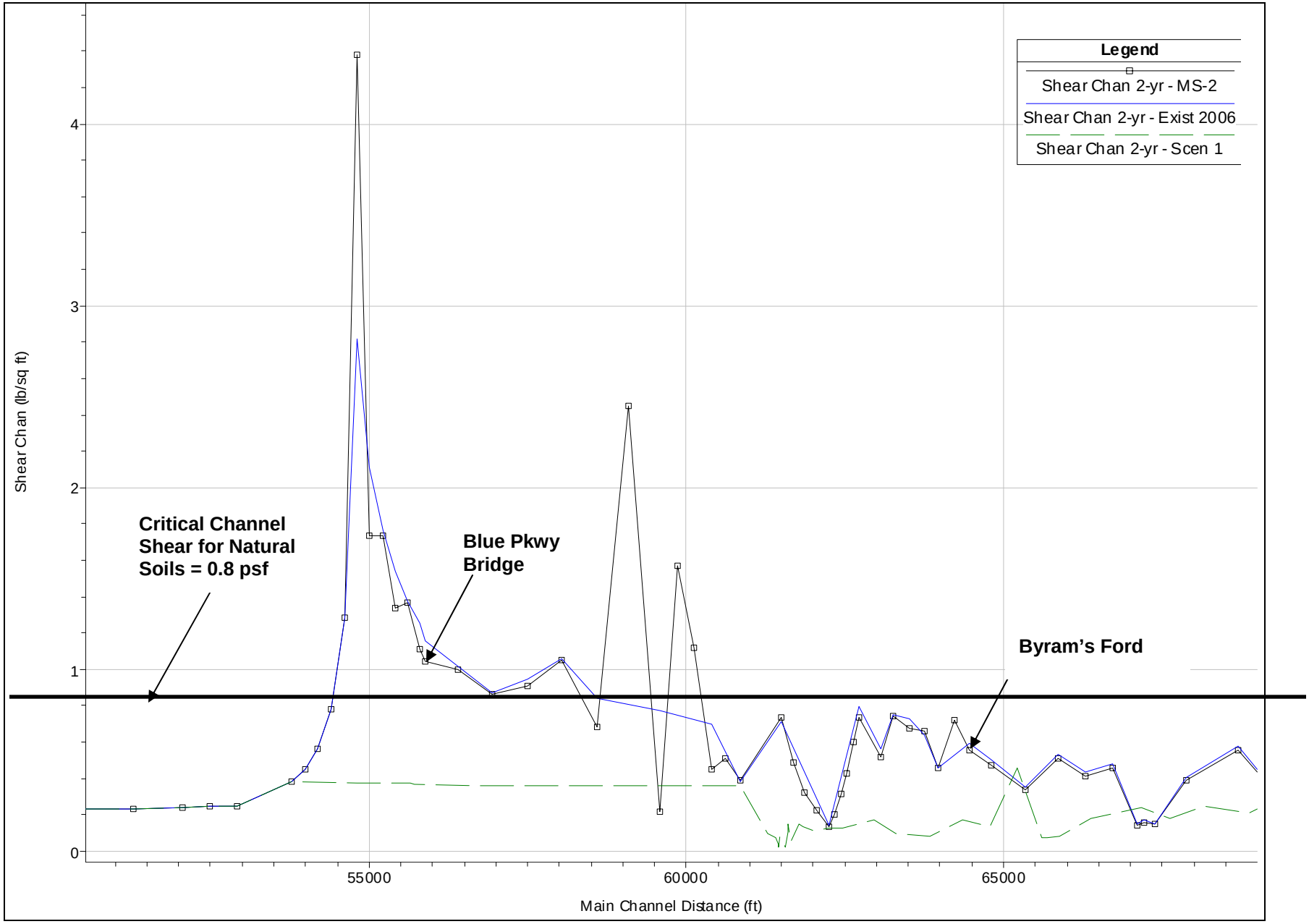

Legend
Shear Chan 2-yr - MS-2
Shear Chan 2-yr - Exist 2006
Shear Chan 2-yr - Scen 1
Shear Chan (lb/sq ft)
0
1
2
3
4
55000
60000
65000
Main Channel Distance (ft)
Critical Channel Shear for Natural Soils = 0.8 psf
Blue Pkwy Bridge
Byram's Ford

Figure 1

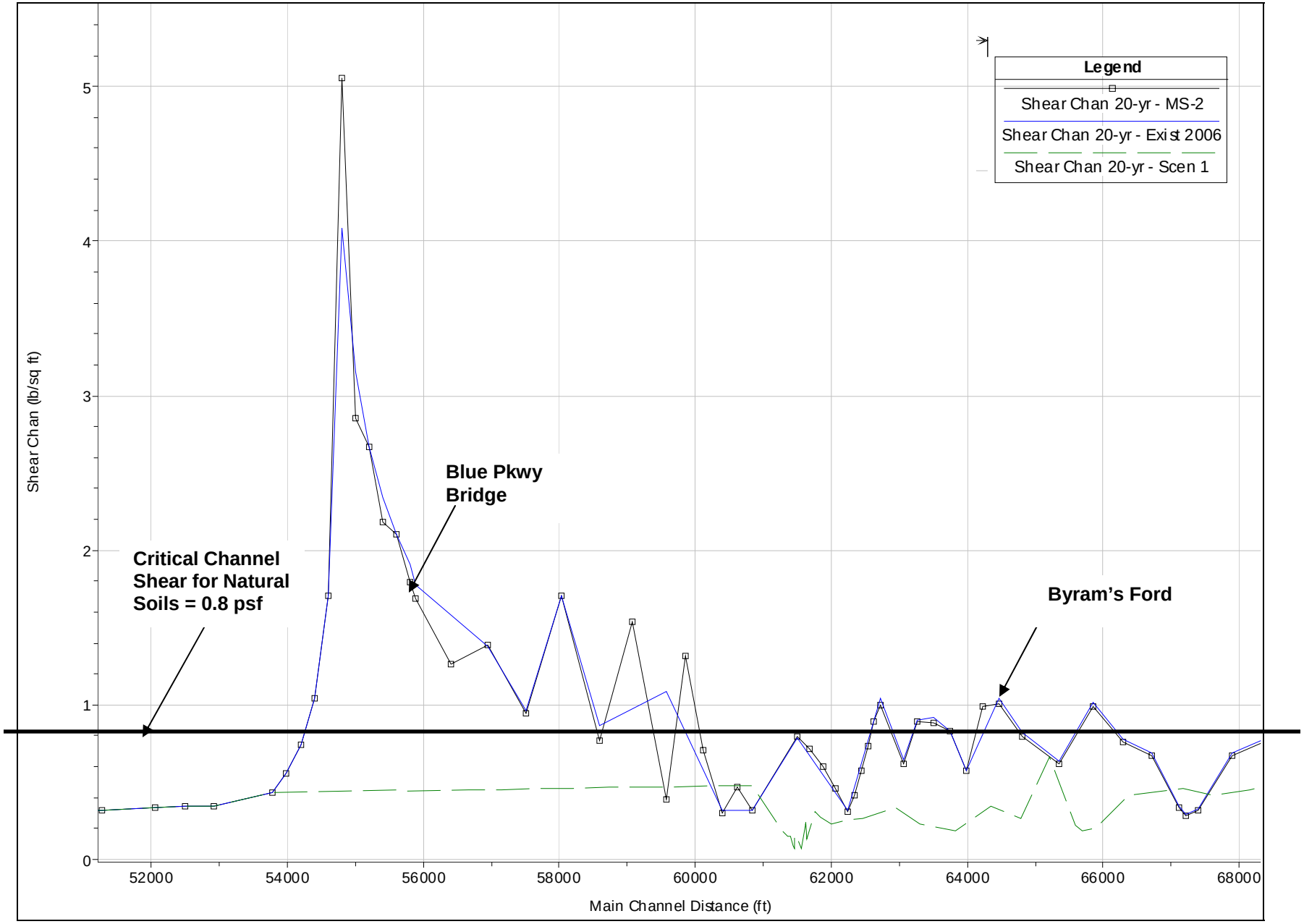

Legend
Shear Chan 20-yr - MS-2
Shear Chan 20-yr - Exist 2006
Shear Chan 20-yr - Scen 1
Shear Chan (lb/sq ft)
Main Channel Distance (ft)
0
1
2
3
4
5
52000
54000
56000
58000
60000
62000
64000
66000
68000
Blue Pkwy Bridge
Critical Channel Shear for Natural Soils = 0.8 psf
Byram's Ford

Figure 2

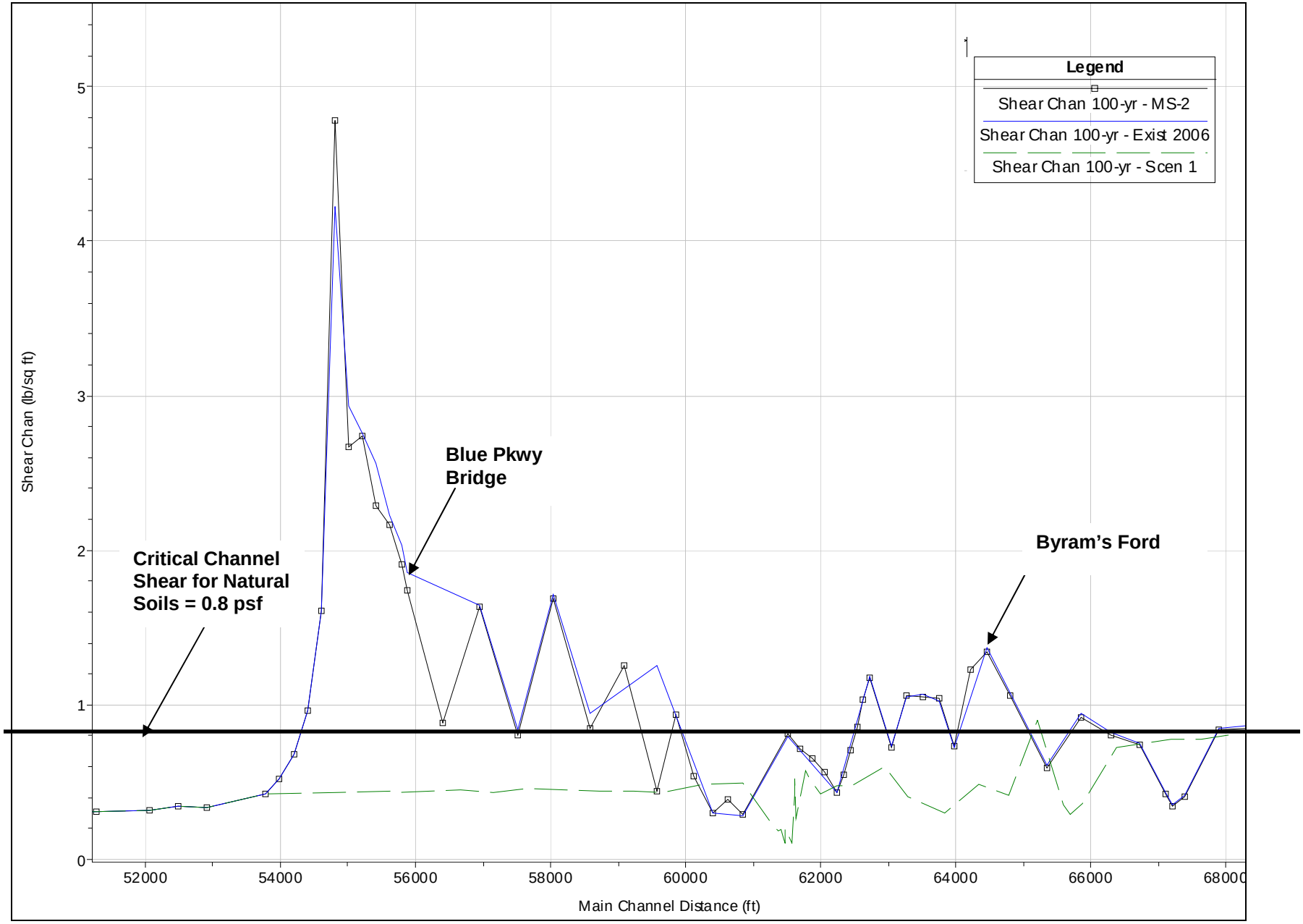
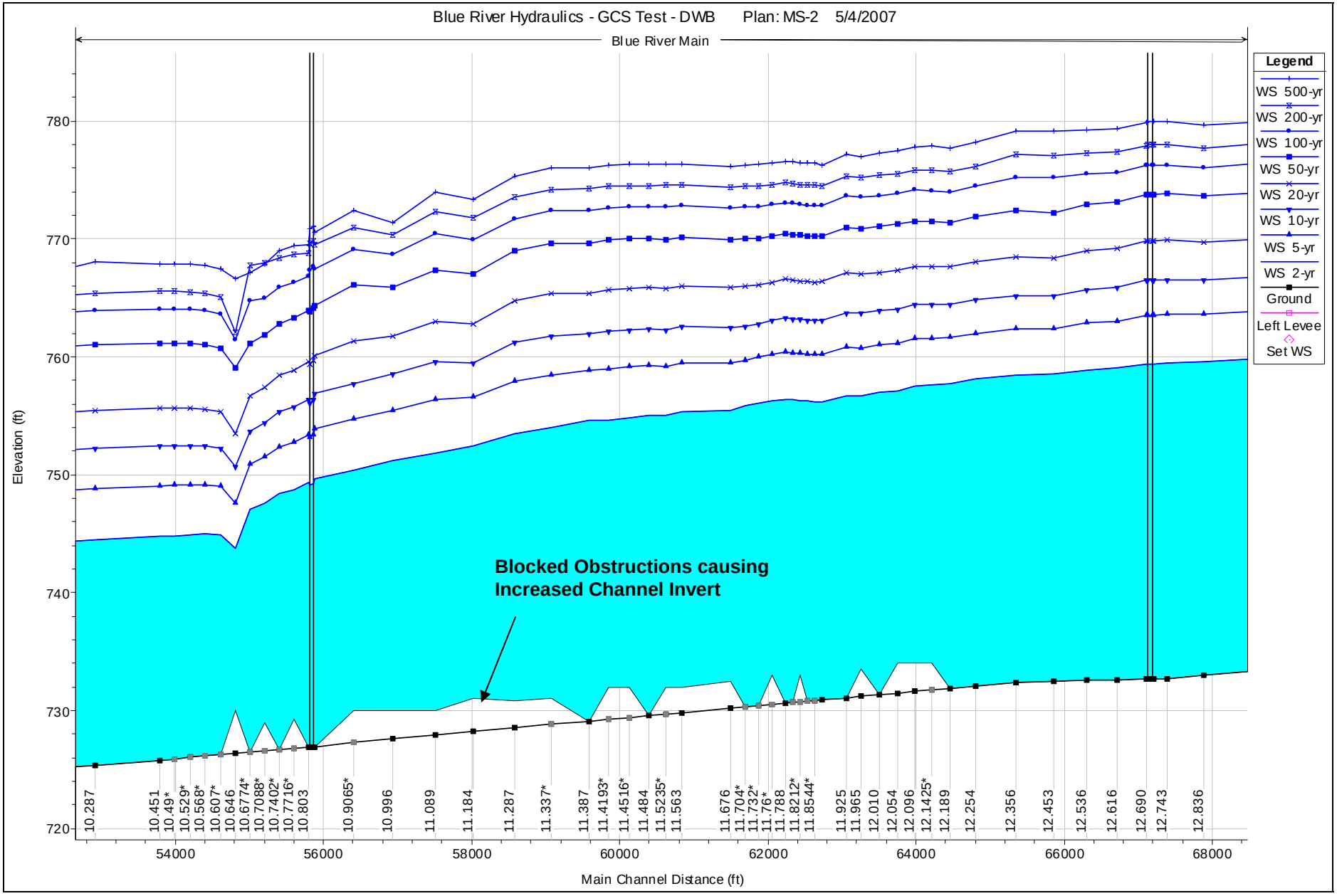

Legend
Shear Chan 100-yr - MS-2
Shear Chan 100-yr - Exist 2006
Shear Chan 100-yr - Scen 1
Shear Chan (lb/sq ft)
Main Channel Distance (ft)
0
1
2
3
4
5
52000
54000
56000
58000
60000
62000
64000
66000
68000
Blue Pkwy Bridge
Byram's Ford
Critical Channel Shear for Natural Soils = 0.8 psf

Figure 3


Blue River Hydraulics - GCS Test - DWB Plan: MS-2 5/4/2007
Blue River Main
Legend
WS 500-yr
WS 200-yr
WS 100-yr
WS 50-yr
WS 20-yr
WS 10-yr
WS 5-yr
WS 2-yr
Ground
Left Levee
Set WS
Blocked Obstructions causing
Increased Channel Invert
Elevation (ft)
Main Channel Distance (ft)
720
730
740
750
760
770
780
54000
56000
58000
60000
62000
64000
66000
68000
10.287
10.451
10.49*
10.529*
10.568*
10.607*
10.646
10.6774*
10.7088*
10.7402*
10.7716*
10.803
10.9065*
10.996
11.089
11.184
11.287
11.337*
11.387
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11.4516*
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11.732*
11.76*
11.788
11.8212*
11.8544*
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12.536
12.616
12.690
12.743
12.836

Figure 4

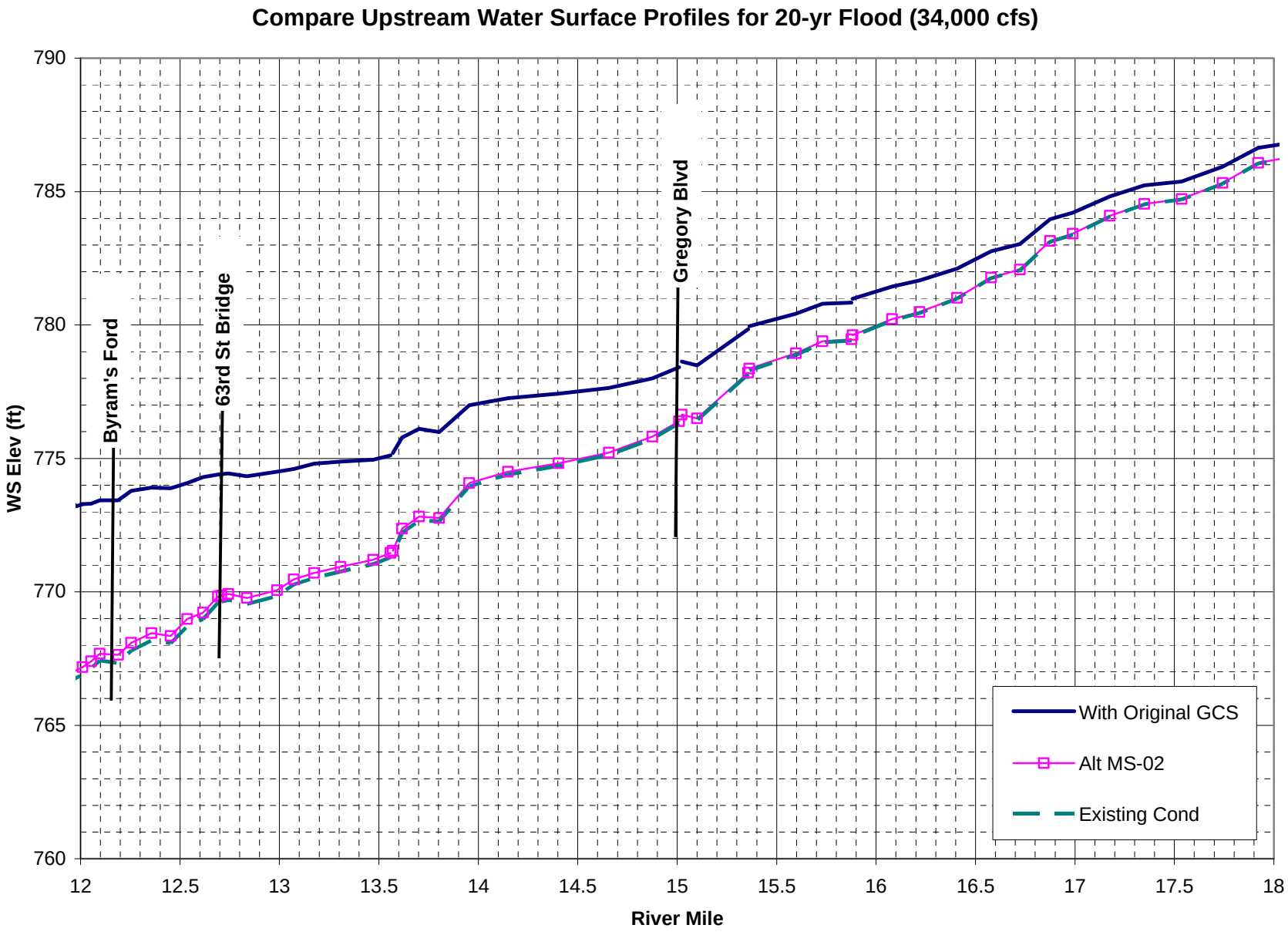
Compare Upstream Water Surface Profiles for 20-yr Flood (34,000 cfs)
WS Elev (ft)
River Mile
790
785
780
775
770
765
760
12
12.5
13
13.5
14
14.5
15
15.5
16
16.5
17
17.5
18
Byram's Ford
63rd St Bridge
Gregory Blvd
With Original GCS
Alt MS-02
Existing Cond

Figure 5