US Army Corps of Engineers ®
Chicago District

BUBBLY CREEK, SOUTH BRANCH OF THE CHICAGO RIVER, ILLINOIS FEASIBILITY STUDY

APPENDIX I
VALUE ENGINEERING STUDY

DRAFT - NOT FOR DISTRIBUTION

APRIL 2015

BUBBLY CREEK, SOUTH BRANCH OF THE CHICAGO RIVER, ILLINOIS ECOSYSTEM RESTORATION FEASIBILITY STUDY

APPENDIX I – Value Engineering Study

April 2015

List of Attachments

Attachment 1: Evaluation of Value Engineering Proposals Memorandum for Record

Attachment 2: Bubbly Creek South Branch of the Chicago River Ecosystem Restoration Value Engineering Study Final Report

Attachment 1:

Evaluation of Value Engineering Proposals Memorandum for Record

DEPARTMENT OF THE ARMY
CHICAGO DISTRICT, U.S. ARMY CORPS OF ENGINEERS
231 SOUTH LA SALLE STREET, SUITE 1500
CHICAGO IL 60604

REPLY TO
ATTENTION OF

0 8 MAY 2014

CELRC-PM-PL

MEMORANDUM FOR RECORD

SUBJECT: Evaluation of Value Engineering Proposals – Bubbly Creek, South Branch of the Chicago River, Illinois, Ecosystem Restoration Feasibility Study

1. References

a. Final Value Engineering Study Report for the Bubbly Creek, South Branch of the Chicago River, Ecosystem Restoration, Chicago, IL, March 2014, prepared by Strategic Value Solutions, Inc.

b. South Fork of the South Branch of the Chicago River, Illinois (Bubbly Creek) Ecosystem Restoration Feasibility Study, Alternative Formulation Briefing, November 2013.

2. The Project Delivery Team (PDT) evaluated the proposals developed during the Value Engineering (VE) Study for the Bubbly Creek Ecosystem Restoration Feasibility Study (see reference 1a). The VE alternatives were grouped in the following categories: constructability, diversify plants, increase benthic dissolved oxygen, limit disturbance and remove invasives. Many of the VE alternatives will be incorporated for specific reaches of the channel or will be considered during the design phase. Adopted alternatives resulted in a total estimated cost savings of approximately $5,400,000. Certain alternatives were not adopted based on the PDT experiences with implementing similar ecosystem restoration projects in the region. A summary of the alternatives and the PDT's evaluation is found in Table 1. The PDT's evaluation of each alternative is presented in the paragraphs that follow.

Table 1: Summary of Evaluation of VE Alternatives

VE Alternative	VE Estimated Cost Savings[1]	PDT Evaluation
CO-1	DS	Adopt
CO-6	$773,000	Adopt
CO-7	DS	Consider in design phase
CO-8	DS	Consider in design phase
CO-9	$1,239,000	Adopt
DP-2	DS	Consider in design phase
DP-3	DS	Reject
DP-8	DS	Reject
DP-11	$698,000	Reject
IB-2	$2,842,000	Adopt in section of channel
IB-3	$928,000	Adopt in section of channel
IB-5	$579,000	Adopt, version of IB-2
IB-7	$2,173,000	Adopt
IB-10	$2,100,000	Reject
IB-25	$903,000	Reject
LD-7	$348,000	Consider in design phase
LD-9	$179,000	Consider in design phase
RI-2	DS	Reject
RI-3	DS	Reject

DS – design suggestion
[1] VE team's estimated cost savings

3. *Constructability (CO)*

a. *CO-1, Use performance specification and avoid specifying methods of work.* The VE Team acknowledged they did not know what specification approach the PDT was planning but proposed performance based specifications in lieu of specifying methods of work. PDT adopts this alternative.
Action: Adopt

b. *CO-6, Conduct as much riparian restoration from the landside as is feasible.* Access to channel banks from the landside will depend on the local sponsor's ability to negotiate access agreements. At this point in the study, the PDT does not know which parcel owners will be willing to enter into these agreements. The PDT adopts this recommendation which is dependent on executed access agreements.
Action: Adopt

c. *CO-7, Plant riparian areas first to protect aquatic substrate.* The channel depth is shallow in certain areas which limits vessel access. The project's construction methods

assume addition of soil to the banks and all bank plantings would occur from the water. If new substrate is placed prior to plantings, then sections of the channel may be too shallow for boat access. The VE team recommended that the riparian (bank) plantings be completed prior substrate placement. The PDT adopts this recommendation.
Action: Adopt

d. *CO-8, Complete marine work in the off-season.* Incorporation of this alternative will depend on timing of the contract and the availability of equipment.
Action: Consider during design phase

e. *CO-9, Shorten duration for placing growth media, stone, and sand substrate and complete riparian work concurrent with substrate placement.* The PDT adopts this alternative; however, the PDT cautions that duration of the substrate restoration installation is heavily dependent on the contract award occurring prior to the beginning of the construction season.
Action: Adopt

4. Diversify Plants (DP).

a. *DP-2, For woody plants, use smallest plant available.* This alternative will be considered during design. Size of plant is dictated by species requirements for successful establishment.
Action: Consider during design phase *Est. Cost Savings:* Unknown

b. *DP-3, Use lowest cost native.* The PDT rejected this alternative because with-project conditions were taken into consideration during the selection of restoration plant species and only those that would thrive under these conditions were chosen.
Action: Reject *Est. Cost Savings:* N/A

c. *DP-8, Acquire plants from Natural Resource Conservation Service (NRCS) sources.* The PDT rejected this alternative. The PDT contacted the NRCS and learned that NRCS only provides free plants for small-scale plantings and testing purposes. This program does not meet the project's needs.
Action: Reject *Est. Cost Savings:* N/A

d. *DP-11, Seed and plant on native soil where possible.* The PDT rejected this alternative. Based on field inspection of the bank areas recommended for plantings, the PDT believes additional soil would be needed to ensure sustainability of riparian plantings.
Action: Reject *Est. Cost Savings:* N/A

5. Increase Benthic Dissolved Oxygen (IB). The original substrate restoration design included 12 inches of sand with 8 inches of rounded river rock over the entire channel bottom (see enclosed Figure 1). This section includes alternatives to reduce the cost of

the substrate restoration measure. These alternatives cannot be implemented together throughout the channel because certain ones will preclude or limit the use of the remaining alternatives. The PDT adopted various recommendations that not only achieved restoration objectives, but met engineering requirements. A revised substrate restoration design was developed based upon the recommendations (see enclosed Figures 2 and 3).

a. *IB-2, Use angular stone in place of rounded river stone.* The PDT reviewed this alternative and determined angular stone could be used between Stations 40+00 and 71+50. In this area, the water's depth is greater than 10 feet and prohibits most rooted vascular plant growth; therefore, angular stone can be used without compromising the achievement of ecosystem restoration objectives.
Action: Adopted between Stations 40+00 and 71+50.

b. *IB-3, Use a smaller stone size in the substrate armor layer to protect against 95% of expected shear stresses, instead of 100%.* This alternative pertains to the armor layer of rounded river stone. As explained above, angular stone will be utilized over a portion of the channel, therefore changes in design includes smaller rounded river stone between Stations 00+00 and 40+00, between Station 71+50 and the Bubbly Creek Turning Basin, and throughout the turning basin.
Action: Adopt between Stations 00+00 and 40+00, between Station 71+50 and the Bubbly Creek Turning Basin, and throughout the turning basin

c. *IB-5, Eliminate growth media and replace stone with angular stone where plants are not expected to grow.* This alternative recommended, in the deep section of the channel (between Stations 40+00 and 71+50), that growth media not be mixed into the substrate and angular stone replace the rounded river rock. This alternative incorrectly assumed growth media was added to the substrate throughout the entire channel bottom. In the deep areas of the channel, plants are not expected to grow and therefore no growth media was included in the plan. The PDT is adopting the portion of the alternative that proposes use of angular stone in the deep areas of the channel as noted above.
Action: Adopt angular stone portion of alternative

d. *IB-7, Decrease sand thickness.* The sand acts as habitat but also serves the following functions: bedding for armor layer, isolation from current sediment and filtration of suspended sediment from released gas. In the original design, it was assumed that each function was served by a separate layer of sand. In reality, these functions overlap. By accounting for the overlap, the sand layer can be reduced from 10 inches to 6 inches without compromising the achievement of ecosystem restoration objectives. The PDT adopted this alternative.
Action: Adopt

e. *IB-10, Use a synthetic geoweb product to stabilize the sand substrate layer instead of the stone armor layer.* The PDT adopted other VE alternatives pertaining to the substrate as outlined above; therefore, this alternative cannot be adopted. Additionally, as noted in the VE report, the VE team did not have experience placing geoweb products in submerged environments. The geoweb would have to be placed on the current channel bottom which has a depth of up to 16 feet. Additionally, this alternative reduces the thickness of the restored substrate to 10 inches and compartmentalizes this substrate into a plastic web, which is not compatible with the restoration objectives of the project to create a substrate layer that promotes plant growth, microinvertabrate colonization and habitat for other aquatic life. The proposed synthetic geoweb is not expected to provide adequate habitat structure for a sustainable aquatic community.

Action: Reject. Accepted other VE alternatives.

f. *IB-25, Replace eight inches of rounded river stone with five inches of pea gravel and three inches of rounded river stone.* The PDT adopted other substrate recommendations as outlined above; therefore, this alternative cannot be adopted.

Action: Reject. Accepted other VE alternatives.

6. *Limit Disturbance (LD).*

a. *LD-7, Reduce riparian planting area.* The PDT will consider this alternative during the design phase after more detailed site investigations and real estate negotiations are initiated.

Action: Consider during design phase

b. *LD-9, Use biosolids from Metropolitan Water Reclamation District in place of topsoil in riparian planting areas.* The PDT will consider the use of biosolids during the design phase that meet the requirements for aquatic plant establishment and growth. The PDT has concerns with higher than normal levels of salt, which many plant species will not tolerate, and higher than normal levels of available nutrients (e.g., nitrogen and phosphorous).

Action: Consider during design phase

7. *Remove Invasives (RI).*

a. *RI-2, Remove riparian invasive species progressively.* The PDT rejected this alternative. As noted by the VE team, this alternative does not result in a cost savings. The PDT has used the project's proposed removal method at similar sites with success.

Action: Reject

b. *RI-3, Remove riparian invasive species selectively.* The PDT rejected this alternative. The PDT has used the project's proposed removal method at similar sites with success.

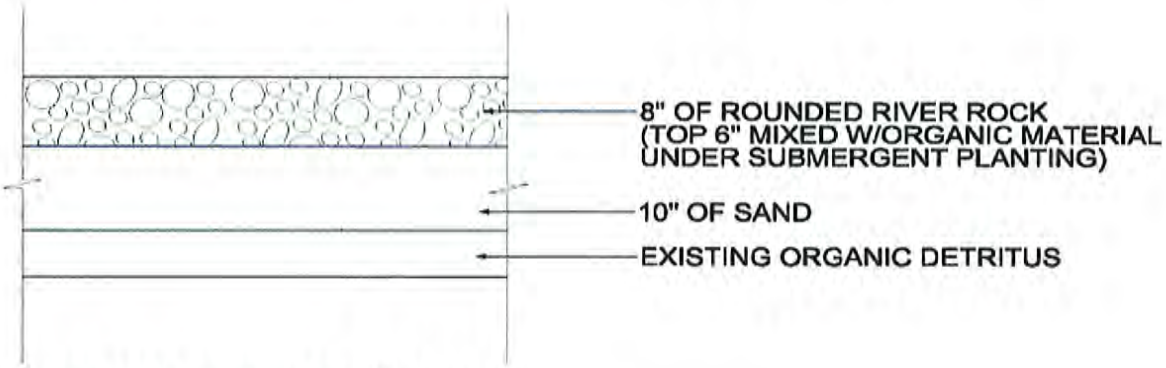
Action: Reject

8. The alternatives prepared by the VE Team provided several alternatives that can both result in cost savings and add value to the project. The PDT appreciates the alternatives and value-added to the feasibility study by this process. The actions discussed in the paragraphs above will be incorporated in the feasibility report or during the design phase, as appropriate. The point of contact for this memorandum is Ms. Johnna J. Potthoff, Lead Planner, the undersigned who can be reached at 312-846-5446 or johnna.j.potthoff@usace.army.mil.

SUSANNE J. DAVIS, P.E.
Chief, Planning Branch
Chicago District

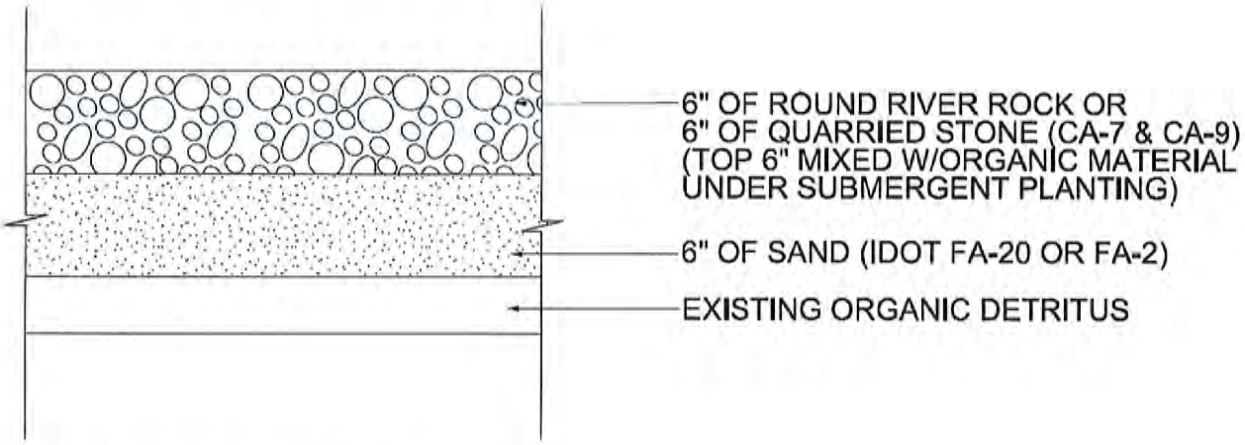
encl

Figure 1. Pre Value Engineering Substrate Restoration Design



SUBSTRATE RESTORATION SECTION

Figure 2. Substrate Restoration Design After VE



SUBSTRATE RESTORATION SECTION

Figure 3. Substrate Restoration Design After VE – Location of Design Types

Attachment 2:

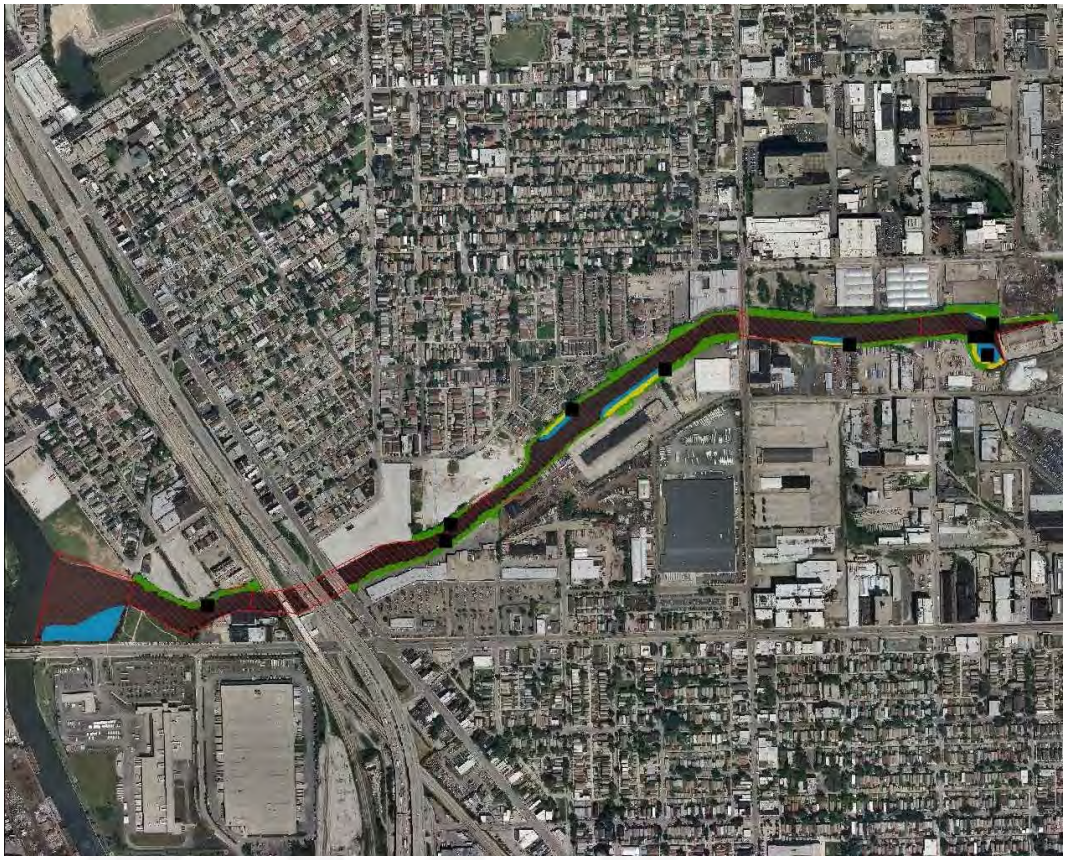
Bubbly Creek South Branch of the Chicago River Ecosystem Restoration Value Engineering Study Final Report

Value Engineering Study

Final Report

US Army Corps of Engineers®

Chicago District



Bubbly Creek
South Branch of the Chicago River
Ecosystem Restoration

Chicago, IL

March 2014

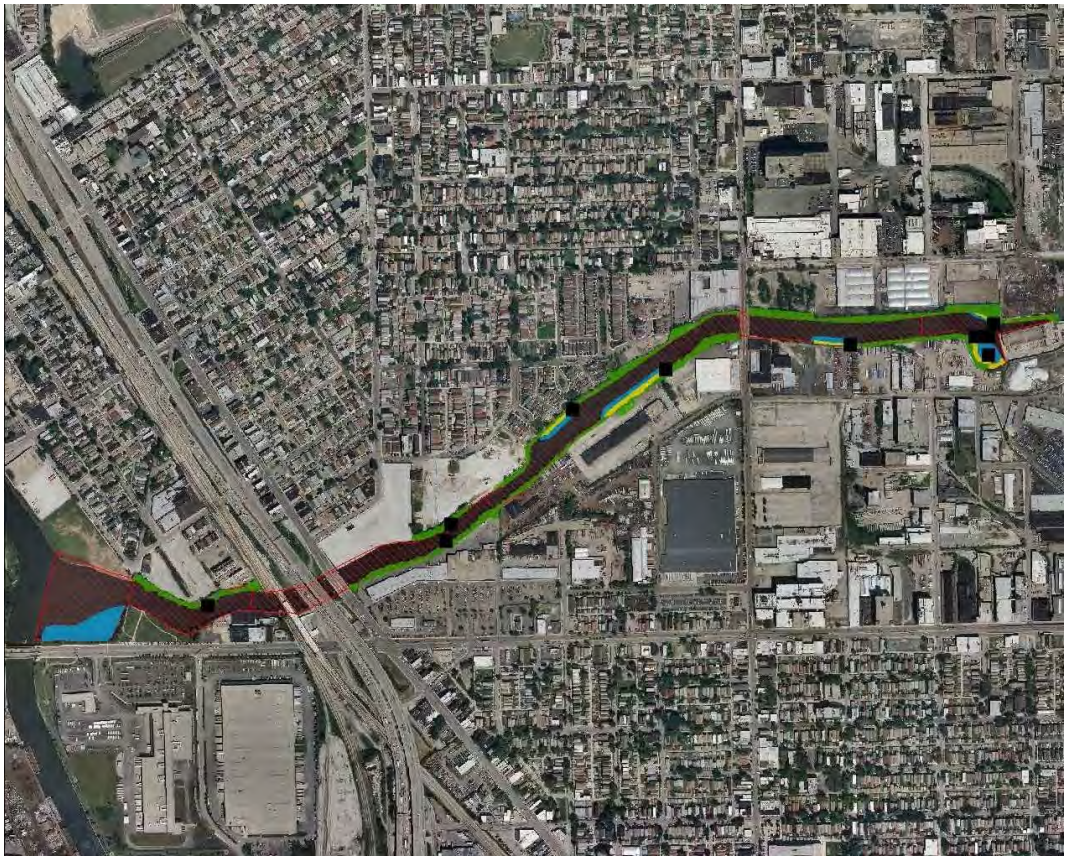
Strategic Value Solutions, Inc.
Value Improvement Specialists

LimnoTech
Water Environment | Scientists Engineers

Value Engineering Study

US Army Corps of Engineers®

Chicago District



Bubbly Creek South Branch of the Chicago River Ecosystem Restoration

Chicago, IL

March 2014

Strategic Value Solutions, Inc.
Value Improvement Specialists

LimnoTech
Water Environment | Scientists Engineers

Final

Value Engineering Study Report

for

Bubbly Creek, South Branch of the Chicago River, Ecosystem Restoration

Chicago, IL

March 2014

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Value Team Members

Name	Organization	Role
Scott Bell, PE, BCEE	LimnoTech	Biologist/Ecorestoration
Scott Cieniawski	EPA	Sediment
Erin Maloney, PE, LEED AP	USACE Chicago District	Hydraulics
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Preface

What is Value Engineering?

Value Engineering is the application of a systematic process called the Value Methodology (VM) Job Plan that integrates analytical, creative, and evaluation techniques within a multidisciplinary team setting. According to SAVE International®, the professional society for value engineering, the focus of VM is on Improving Value by identifying the most resource efficient way to reliably accomplish the required functions of the program, project, or process that meets the performance expectations of the customer.

It is proven to be a highly effective process for identifying solutions to achieve the required functions at a minimum expenditure of resources without sacrificing the required performance. We must remember that the optimum use of our resources is as important as the technical reliability of the project.

Why does USACE require Value Engineering?

In 1964, USACE was one of the first federal agencies to implement a formal value engineering program. After several decades, the Federal Government recognized that in today's environment of escalating costs and shrinking budgets value engineering (VE) continues to deliver essential cost control and performance improvement opportunities throughout the design and construction process. For this reason, every U.S. President and Congress since 1993 have issued Executive Orders, Directives and promulgated laws to ensure that every federal agency is effectively employing value engineering.

Today, the use of value engineering is codified in USACE through the following laws, directives, and regulations:

Office of Federal Procurement Act 41 USC 432, Public Law 104-106, Section 4306

Water Resources Development Act (WRDA), Public Law 99-662, Title IX, Section 911

Office of Management and Budget (OMB) Circular A-131

Department of Defense Directive 4245.8-H, Value Engineering

USACE Engineering Regulation (ER) 11-1-321 Army Programs, Value Engineering

Compliance with Standards & Regulations

This Value Study was performed in a manner to comply with the laws, directives and regulations listed above. More specifically, this Value Study was conducted in accordance with the international standard Value Methodology established by SAVE International®. This standard requires the execution of a specific six-phase process using a workshop format and a multidisciplinary team.

Using this Report

The purpose of this Value Study was to identify alternatives to the current design. This is in no way intended to be a critique of the project design but rather, it is intended to be a supplement or progression of the Project Development Team's (PDT) efforts. The Value Team's role is an extension of the PDT. The Value Team has the benefit of having a fresh perspective while at the same time having a starting point that builds on the work of the PDT. The Value Team also benefits from a unique approach to problem solving that is founded in the Value Methodology which specifically focuses on understanding the project needs from a functional perspective before conceptualizing solutions.

By design, these value studies are intense but short duration efforts. The Value Alternatives and Design Suggestions provided in this report are conceptual and advisory in nature. It is important to note that the Value Team makes no project decisions and has performed no detailed engineering analysis beyond that shown within this report. Detailed feasibility assessment and final design development of any of the alternatives or suggestions, should they be accepted, remain the responsibility of the District and the designer of record.

When reviewing the results of this Value Study, each part of a Value Alternative or Design Suggestion should be evaluated on its own merit. Concern over a particular aspect of the proposed change should not be grounds for dismissal of the entire concept. Some of these ideas may challenge established standards or other project specific constraints. It is an intended purpose of the USACE Value Engineering Program to question or challenge perceived constraints that may create a less than optimal solution to the required function. Over the many decades, the USACE Value Engineering Program has been the catalyst for many changes to standard designs, policies, and procedures and has introduced many concepts that have become the new standard. The District is encouraged to use the results of this study to make changes that result in the maximum benefit for the end users, as well as for the American taxpayers.

To that end, all of the ideas shown in the creative idea listing in the Appendix should be reviewed for additional value improvement opportunities. Since the Value Team was constrained by a finite duration for the workshop and the production capacity of the team, not all ideas were developed. Therefore there may be other ideas in that list that would provide additional value improvement opportunities for the project.

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

This report presents the results of a Value Study conducted by LimnoTech in association with Strategic Value Solutions, Inc. (SVS) on the Bubbly Creek, South Branch of the Chicago River, Ecosystem Restoration project for the USACE Chicago District.

Design/Construction Strategy:	Design-Bid-Build
Level of Project Development:	Feasibility
Designer:	USACE Chicago District

The Value Study included a 3-day (24-hour) value methodology workshop that was conducted with a multidisciplinary team in Chicago, IL, February 4-6, 2014.

Project Summary[1]

The project is to restore diverse habitat structure to the 1.25 mile long channel of the South Fork of the South Branch of the Chicago River, commonly referred to as Bubbly Creek, located entirely within the City of Chicago, Cook County, Illinois. Before the 1830's, the Bubbly Creek was a prairie slough that drained five square miles of pristine aquatic and terrestrial habitat mosaic. Over the last 175 years, this ecosystem was severely altered by human activities. Currently, Bubbly Creek no longer provides a diversity of habitats, nor is the existing habitat quality sufficient to maintain structure and support healthy plant and animal communities. Only species tolerant to habitat loss, anthropogenic disturbance and poor water quality are present. Slight improvements in water quality that have occurred are not enough for native plant and animal communities to reestablish. Critical structural habitat components are currently missing from the Bubbly Creek ecosystem. The alteration of the landscape has resulted in the historic loss of significant migratory bird, fish and wildlife aquatic habitat.

Alternative 3 from the Alternative Formulation Briefing Document was selected as the National Ecosystem Restoration (NER) Plan (preferred plan). This alternative consists of seven restoration measures as summarized below:

- Substrate restoration consisting of a sand and rounded gravel layer over 34.83 acres within the channel and turning basin.
- Riparian plant restoration consisting of invasive species removal, soil amendments and native riparian plantings over 9.53 acres within the channel corridor.
- Emergent plant restoration consisting of substrate amendments and native emergent plantings over 1.03 acres within the channel.

[1] Adapted from Bubbly Creek, South Branch of the Chicago River, Illinois, Integrated Feasibility Report and Environmental Assessment

- Submergent plant restoration consisting of substrate amendments and native submergent plantings over 7.58 acres within the channel and turning basin.
- Woody debris restoration consisting of anchoring trees, rootwads, trunks and large branches in areas that experience high velocities in approximately 10 locations within the channel.
- Pebble and cobble restoration consisting of filling existing wood cribs with pebble and cobble substrates over 0.25 acres within the channel.
- The estimated cost of the project is $23,234,000. It is anticipated that the project will begin in Fiscal Year 2017 and be completed in FY 2021.

Action Items

The following issues were identified by the District project development team (PDT) as action items for the Value Team. These are aspects of the project or specific issues that the PDT or other stakeholders have asked the Value Team to review for validation of the current concept or to offer alternative solutions.

- Reduce project cost while maintaining value.
- Assess substrate design

Project Constraints

There are typically agreements, formal and informal, assumptions, and other factors which become constraints affecting the decision-making throughout the planning and design process. The following were identified as key constraints that have influenced the current design.

- Maintain conveyance for the Racine Avenue Pumping Station (RAPS).
- RAPS operations may not be modified.
- Avoid impact to historic property and the Illinois and Michigan Canal Heritage Corridor including the Turning Basin.
- Avoid areas of potential contamination.
- Rounded stone is necessary to achieve preferred macroinvertebrate community.

Study Constraints

Constraints or limits on the Value Study are used 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. Excessive constraints tend to inhibit the team's ability to identify creative opportunities for value improvement. Inadequately defined constraints can result in the team's effort being wasted in areas where there is no possibility of change.

Constraints identified for this study were:

- Maintain the footprint of the project.

Study Results

The purpose of the workshop is to identify and develop alternative concepts that will improve the overall value of the project. With an understanding of the functional requirements of the project, the Value Team brainstormed on all of the possible ways to accomplish each of those functions. The team generated 82 ideas for potential changes to the current design. Based on the team members' professional judgment, eleven of these ideas were selected for developing into Value Alternatives.

In addition to the Value Alternatives, the team also identified eight 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.

Risks

From the Value Team's understanding of the project plan, the following risks and opportunities were identified.

- The substrate is designed at 100% reliability at the maximum pumping capacity discharge of 6,000 cubic feet per second (cfs) for RAPS plus 1,000 cfs from other combined sewer overflows (CSOs). The substrate design assumes that discharge from other CSOs will occur in an unsubmerged condition. This is unlikely. Also, in seventy-four years RAPS has never discharged at greater than 5,200 cfs. The opportunity is to review the assumptions and design of the substrate.
- Frequent or prolonged discharges from RAPS may degrade ecosystem.
- The submergent grasses may not spread or may not spread quickly.
- Currently a single substrate restoration design is used for the entire footprint. It may be possible to vary the design based on local conditions.

Recommendations

Table 1, at the end of this section, includes a complete list of all the Value Alternatives and Design Suggestions developed. In the opinion of the Value Team, based on our understanding of the project requirements, all of these are viable alternatives to the current design and should be given full consideration for incorporation into the project.

Some of the more significant Value Alternatives include:

IB-3 Use a smaller stone size in the substrate armor layer to protect against 95% of expected shear stresses, instead of 100%

The armor layer in the current design is based on hydrodynamic modeling and substrate stability analysis performed by the USACE ERDC. The stone specification is a d_{50} of 50 mm and a maximum stone size, d_{100}, of 75 mm to provide a stable, unmoving substrate over 100 percent of the Bubbly Creek project area under the design conditions. The ERDC modeling also showed that a stable, unmoving substrate over 95 percent of the Bubbly Creek project area under the same conditions can be achieved with a smaller stone size, d_{5o} of 20 mm and d_{100} of 40 mm. This finding was verified during the Value Study by Dr. Paul Schroeder, primary author of the ERDC study report.

The slight reduction in armor layer function from 100 percent protection to 95 percent protection would be compensated for by the planned adaptive management for the project. In addition, the Value Team feels the original stone size design was based on the most conservative peak flow rate. The ERDC report states that the assumptions were conservatively assumed. The modeled discharges for RAPS and the combined discharge sewer overflow (CSO) outfall locations are considered to be very conservative and the Value Team feels that since the original sizing of stone size was based on very conservative assumptions, the suggestion of reduction of stone size is likely to function at a higher percent protection than predicted, greater than 95 percent.

IB-5 Eliminate growth media where plants are not expected to grow

The current plan calls for construction of a uniform benthic layer throughout the project area, including approximately 10 inches of sand, eight inches of rounded river stone, and one inch of growth media. During the PDT presentation, the project team indicated that the submergent plants would not be planted in deeper areas, nor would the submergent plants be expected to expand into these deeper areas. Between Station 40+00 and Station 71+50 represents a contiguous stretch of creek with limited to no shallow areas that would likely support submergent plants. Significant cost savings could be realized by eliminating growth media placement within this stretch and replacing the expensive, rounded river stone with similarly sized angular stone.

IB-7 Decrease thickness of sand

The sand substrate provides habitat and also provides bedding for larger stone, isolates water column from sediment and serves as a filter for gas, and is independent from the armor layer. The assumption in the original design is that each function occurs as a separate layer of sand. In reality, these functions overlap. The 10 inches of sand in the original design satisfies the two inches of mixing, six inches of isolation that includes the four inches of filter and provides two inches for construction tolerance.

As an alternative, the armor substrate above the sand substrate provides the six inches of isolation in addition to the sand substrate. The alternative allows the conservative two inch mixing requirement to be satisfied jointly with the four inch

filter requirement. This still provides a two inch construction tolerance with only six inches of sand substrate.

DP-11 Seed and plant on native soil where possible

Most of the riparian areas selected for planting are already vegetated. This suggests that much of the area has soil suitable for plant medium. Less or no topsoil may be needed to plant a sizeable fraction of these riparian areas and ensure survivability. The Value Team estimates that 50% of the riparian areas may be able to be planted on native soil based on aerial photography review of the project area.

CO-9 Shorten duration for placing growth media, stone, and sand substrate and complete riparian work concurrent with substrate placement

The current construction schedule calls for 390 days to place sand and armor stone in the river and 55 days to complete submergent plantings. This in-water work is then followed by 120 days of riparian soil preparation and planting. The end result is a construction schedule of approximately 21 months. Significant daily/monthly costs (approximately $82,600 per month) are associated with this extended project schedule, including equipment/trailer rental, construction management and oversight, etc. Additionally, the 390 day schedule for the aquatic work appears to be significantly longer than necessary for the work to be completed based on experience at other, similar sites. Based on experience on similar projects, the recommendation is to assume a 6 month construction schedule.

Maximum Potential Savings

After completing the development of the Value Alternatives, the team reviewed the list of alternatives to identify the maximum potential cost savings that could be realized from the implementation of the alternatives presented in this report. This review concluded that the maximum project benefits would be realized by combining the alternatives indicated in Table 2, Optimum Combination of Alternatives 1. Table 3, Optimum Combination of Alternatives 2 is a variation with reduced savings.

This combination results in the following potential cost savings:

Capital Cost Savings	$7,815,000

The savings from some of the individual Value Alternatives have been adjusted to account for overlapping savings when combined with other Value Alternatives.

Implementation

To finalize the Value Study it is essential that decisions are made in a timely manner on the resolution of each of the Value Alternatives and Design Suggestions presented in

this report. This needs to be a collaborative effort of management and the PDT. The focus of the decision-making process should be on maximizing the value improvement potential for the project and end users. The ultimate disposition of the Value Alternatives will be documented separately from this report.

Table 1
Summary of Alternatives

Alt. No.	Description	First Cost Savings
Constructability		
CO-1	Use performance specification and avoid specifying methods of work	DS
CO-6	Conduct as much riparian restoration from the landside as is feasible	$773,000
CO-7	Plant riparian areas first to protect aquatic substrate	DS
CO-8	Complete marine work in the off-season	DS
CO-9	Shorten duration for placing growth media, stone, and sand substrate and complete riparian work concurrent with substrate placement	$1,239,000
Diversify Plants		
DP-2	For woody plants, use smallest plant available	DS
DP-3	Use lowest cost native plants	DS
DP-8	Acquire plants from Natural Resource Conservation Service sources	DS
DP-11	Seed and plant on native soil where possible	$698,000
Increase Benthic Dissolved Oxygen		
IB-2	Use angular stone in place of rounded river stone	$2,842,000
IB-3	Use a smaller stone size in the substrate armor layer to protect against 95% of expected shear stresses, instead of 100%	$928,000
IB-5	Eliminate growth media and replace stone with angular stone where plants are not expected to grow	$579,000
IB-7	Decrease thickness of sand	$2,173,000
IB-10	Use a synthetic geoweb product to stabilize the sand substrate layer instead of the stone armor layer	$2,100,000
IB-25	Replace eight inches of rounded river stone with five inches of pea gravel and three inches of rounded river stone	$903,000
Limit Disturbance		
LD-7	Reduce riparian planting area	$348,000
LD-9	Use biosolids from Metropolitan Water Reclamation District in place of topsoil in riparian planting areas	$179,000
Remove Invasive		
RI-2	Remove riparian invasive species progressively	DS
RI-3	Remove riparian invasive species selectively	DS

DS – Indicates the Idea was selected to be written as a Design Suggestion and is included in the Study Results Section of this report

1. *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.*
2. *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.*

Table 2
Optimum Combination of Alternatives #1

Alt. No.	Description	First Cost Savings
Constructability		
CO-6	Conduct as much riparian restoration from the landside as is feasible	$773,000
CO-9	Shorten duration for placing growth media, stone, and sand substrate and complete riparian work concurrent with substrate placement	$1,239,000
Diversify Plants		
DP-11	Seed and plant on native soil where possible	$698,000
Increase Benthic Dissolved Oxygen		
IB-2	Use angular stone in place of rounded river stone	$2,842,000
IB-7	Decrease thickness of sand	$2,173,000
Limit Disturbance		
LD-7	Reduce riparian planting area	$0
LD-9	Use biosolids from Metropolitan Water Reclamation District in place of topsoil in riparian planting areas	$90,000
Total		**$7,815,000**

1. *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.*
2. *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.*

Table 3
Optimum Combination of Alternatives #2

Alt. No.	Description	First Cost Savings
Constructability		
CO-6	Conduct as much riparian restoration from the landside as is feasible	$773,000
CO-9	Shorten duration for placing growth media, stone, and sand substrate and complete riparian work concurrent with substrate placement	$1,239,000
Diversify Plants		
DP-11	Seed and plant on native soil where possible	$698,000
Increase Benthic Dissolved Oxygen		
IB-3	Use a smaller stone size in the substrate armor layer to protect against 95% of expected shear stresses, instead of 100%	$928,000
IB-5	Eliminate growth media and replace rounded stone with angular stone where plants are not expected to grow	$579,000
IB-7	Decrease thickness of sand	$2,173,000
Limit Disturbance		
LD-7	Reduce riparian planting area	$347,000
LD-9	Use biosolids from Metropolitan Water Reclamation District in place of topsoil in riparian planting areas	$179,000
Total		**$6,916,000**

1. *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.*
2. *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.*

STUDY RESULTS

STUDY RESULTS

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

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.

In addition to the Value Alternatives, 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 considered.

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

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:

Constructability (CO)

Diversify Plants (DP)

Increase Benthic Dissolved Oxygen (IB)

Limit Disturbance (LD)

Remove Invasive (RI)

Design Suggestion

	Alternative No:
Title:	CO-1
Use performance specifications and avoid specifying methods of work	
Discussion	
The Value Team does not currently know what specification approach the project design team (PDT) is planning, but because some assumptions have been made about construction methods in preparing the cost estimate, it's possible that those assumptions could carry over into the specifications. We recommend that project specifications avoid specifying methods of work where feasible alternatives may exist and potentially be less expensive. One example, is for the placement of riparian topsoil, which has been estimated based on placement from barges, but could potentially be accomplished from the landside. Additionally, specifying the performance outcome requirements may increase the successful plant establishment by holding the contractor accountable for the results. Finally, allowing contractors flexibility may increase innovation, reduce cost, and result in a more successfully vegetated final project.	

Project: Bubbly Creek, South Branch of the Chicago River, Ecosystem Restoration
Location: Chicago, IL

	Alternative No:
Title:	CO-6
Conduct as much riparian restoration from the landside as is feasible	
Description of Original Concept:	
The original concept is based on the assumption that all of the riparian construction work must be done from barges in Bubbly Creek.	
Description of Alternative Concept:	
The alternative concept is to maximize the amount of riparian restoration work that is conducted from the landside.	

Value Improvement

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

Function	Resources
☐ Increased	☐ Increased
☑ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$773,000
O&M Savings:	$0
Life Cycle Cost Savings:	$773,000

Advantages/Disadvantages

Alternative No.: CO-6

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Does not alter the design form or function • Allows riparian work to be performed concurrent with placement of the substrate, thus reducing schedule • Better accommodates breaking the riparian work out as a separate contract which could further reduce costs	• Will likely require some cost for access through private properties

Discussion

Alternative No.: CO-6

It's the understanding of the Value Team that the current plan for the project involves conducting riparian restoration activities from the water side. Cost estimates were based on all access and material transfer conducted from barges in the waterway, which is a significantly more expensive approach than if these activities are conducted from the landside. Both staging and placement costs would be reduced as hourly crew rates for landside placement are significantly lower than a marine placement crew. For example, the unit cost for placing topsoil on the banks is $123.31/cubic yard for a total placement estimate of about $1.1 million.

Although there are access challenges, it is likely feasible to conduct a portion of the riparian restoration from the landside. Some riparian properties may be currently unused or they may be used for activities with which riparian construction is compatible. Inspection of aerial photographs of the project area show many areas that would support construction activities. The Value Team recommends that the design team look more closely at the possibility of conducting as much riparian restoration work from the landside as possible. If even half of the riparian construction is conducted from the landside, significant cost savings can be achieved.

Examples of areas that could potentially be accessed from the landside are shown in the following two aerial photographs.

Sketch

Alternative No.: CO-6

☐ Original ☑ Alternative

Sketch

Alternative No.: CO-6

☐ Original ☑ Alternative

Construction Cost Estimate

Alternative No.: CO-6

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Topsoil placement from water	CY	123.31	8,950	$1,103,625		
Topsoil placement from landside	CY	37.00			8,950	$331,150
TOTALS				$1,104,000		$331,000
NET SAVINGS						$773,000

Design Suggestion

	Alternative No:
Title:	CO-7
Plant riparian areas first to protect aquatic substrate	
Discussion	
The project schedule currently calls for placement of the sand and armor stone substrate and the aquatic planting before the riparian soil preparation and plantings. The result of this schedule would be that the bathymetry in the creek would be shallowed and then planted with aquatic plant plugs followed by bringing marine vessels back through the project area to complete the riparian work. The end result would be reduced maneuverability of the vessels during riparian work due to the reduced water depths and the potential for the vessels to disturb the newly planted aquatic plugs. The schedule should be revised to specifically avoid this possibility. Since the riparian work is not dependent on the aquatic work, the project team should consider modifying the schedule to complete the riparian work ahead of the aquatic work; both the sand and armor stone substrate placement and the aquatic plantings. This schedule can easily be accommodated by having the riparian construction crews begin work at the head of the channel, followed closely, whether weeks, days, or hours, behind by the aquatic construction crew and the aquatic planting crew. Incorporation of this suggestion would increase the project value by improving the likelihood of establishment of vegetation while having no or minimal impacts to project cost or schedule.	

Design Suggestion

	Alternative No:
Title:	CO-8
Complete marine work in the off-season	
Discussion	
As is generally the case in construction projects, allowing flexibility in the construction schedule for this project will promote competition and should reduce bid pricing. This is especially true in the Great Lakes region where environmental windows typically limit the yearly dredging and marine construction window to the months from June through December for direct tributaries to the Great Lakes. This can potentially result in the wide availability of equipment and more favorable pricing during January through May. Given the currently low habitat value of the Bubbly Creek site, this project may not be impacted by the schedule restrictions imposed by these environmental windows. If allowable by regulatory agencies, the project schedule should allow maximum flexibility in this schedule with the goal of allowing year round construction of the aquatic portion of the project. If environmental windows are currently applicable to this site, the project team should consider discussions with the applicable permitting agency, e.g., the Illinois Environmental Protection Agency (EPA) to allow for a longer construction window. Permitting agencies have been receptive to relaxing environmental window restrictions for other similar projects.	

Project: Bubbly Creek, South Branch of the Chicago River, Ecosystem Restoration
Location: Chicago, IL

	Alternative No:
Title:	CO-9
Shorten duration for placing growth media, stone, and sand substrate and complete riparian work concurrent with substrate placement	
Description of Original Concept:	
Original plan calls for 21 months of construction activities based on extended substrate placement schedule and completion of riparian work after aquatic work is complete.	
Description of Alternative Concept:	
Alternative concept calls for completion of riparian work concurrently with placement of aquatic substrate and aquatic plantings. Additionally, a four month construction schedule for placement of the sand and stone substrate is a more reasonable assumption for duration of this activity based on production rates at similar projects. Total construction schedule would be reduced to six months.	

Value Improvement

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

Function	Resources
☐ Increased	☐ Increased
☑ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 1,239,000
O&M Savings:	$0
Life Cycle Cost Savings:	$1,239,000

Advantages/Disadvantages

Alternative No.: CO-9

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Reduced local noise and traffic impacts • Reduced project risks, i.e., storms and accidents • Reduces risk of cost growth which tends to occur as contract durations lengthen	• None identified

Discussion

Alternative No.: CO-9

The current construction schedule calls for 390 days to place sand and armor stone in the river and 55 days to complete submergent plantings. This in-water work is then followed by 120 days of riparian soil preparation and planting. The end result is a construction schedule of approximately 21 months. Significant daily and monthly costs, approximately $82,600 per month, are associated with this extended project schedule; including equipment/trailer rental, construction management and oversight, etc. Additionally, the 390 day schedule for the aquatic work appears to be significantly longer than necessary for the work to be completed based on experience at similar sites.

These daily and monthly costs can be significantly reduced by:

1. Completing aquatic and riparian work concurrently, and
2. Reducing the estimated aquatic construction schedule from 21 months to a more reasonable six months.

Little or no impact is anticipated from the contractor completing the riparian and water work concurrently as the main impact would be additional equipment on the waterway. Given the limited use of this creek by other vessels, the additional equipment is not anticipated to have impact on other users.

Calculations

Alternative No.: CO-9

☑ Original ☑ Alternative

Monthly unit rate

Duration change = 21 months - 6 months

= 15 months

Cost change = $14,323,000 - $13,084,000

= $1,239,000

Monthly unit rate = $1,239,000/15 months

= $82,600

Construction Cost Estimate

Alternative No.: CO-9

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
All monthly rate items	Month	82,600.00	21	$1,734,600	6	$495,600
TOTALS				$1,735,000		$496,000
NET SAVINGS						$1,239,000

Design Suggestion

	Alternative No:
Title:	DP-2
For woody plants, use smallest plants available	
Discussion	
Table 13 in the feasibility report lists several native trees and shrubs that should be considered for planting in the riparian areas. The assumption is that all trees and shrubs used will be three or five gallon pots. The Value Team suggests reducing tree and shrub planting size to plugs or seedlings with a maximum size of three gallon pots. If provided with appropriate protection, seedlings may have a better survivability rate due to a lower transplant shock impact. The team suggests reviewing this option and considering its impacts to the success of establishment of revegetation. Reducing plant costs by reducing the size of trees and shrubs will result in a lower project cost and may not significantly impact the successful establishment of revegetation. Note: The Value Team suggests that this design suggestion be considered as part of a comprehensive revegetation plan in conjunction with design suggestions DP-3, DP-8, RI-2, and RI-3. This comprehensive plan should consider physical features that may limit the maximum habitat quality that is achievable on the banks.	

Design Suggestion

	Alternative No:
Title:	DP-3
Use lowest cost native plants	
Discussion	
Table 13 in the feasibility report lists several native plants within specified zones, submergent, emergent, and riparian. However, specific plant selection has not been specified. The Value Team assumed that the PDT intends to use a variety of native plants including, potentially, rarer higher cost natives. The Value Team suggests limiting planting diversity to include more commonly available, lower cost native plant species to reduce cost. The developed habitat area is not contiguous or extensive and includes steep slopes not conducive to allowing this project area to develop into a high quality native habitat. Reducing plant costs by reducing diversity and quality, with submergent, emergent, and/or riparian, will result in a lower project cost and should not significantly impact the successful attraction of desired aquatic and terrestrial species to the project area. Note: The Value Team suggests that this design suggestion be considered as part of a comprehensive revegetation plan in conjunction with design suggestions DP-2, DP-8, RI-2, and RI-3. This comprehensive plan should consider physical features that may limit the maximum habitat quality that is achievable on the banks.	

Design Suggestion

	Alternative No:
Title:	DP-8
Acquire plants from Natural Resources Conservation Service sources	
Discussion	

The Value Team recommends acquiring available plants through the Natural Resources Conservation Service (NRCS). The NRCS Plant Materials Centers provide no cost to low cost native seeds, plugs, and seedlings for vegetation restoration purposes. More information can be found at the NRCS Plant Materials website, link provided below, and plant materials specialists can be contacted for support, contact information provided at link.

The feasibility report does not specifically state an anticipated source for purchase of riparian plugs and seedlings, but the cost estimate assumed commercial nursery vendors.

Obtaining some of the plant material for this project at a low or no cost from the NRCS will result in a reduction of overall project cost. Additionally, the Value Team feels that working jointly with the NRCS will result in a mutual benefit to both agencies.

Link to the NRCS website:

http://www.nrcs.usda.gov/wps/portal/nrcs/main/plantmaterials/pmc/central/

Note: The Value Team suggests that this design suggestion be considered as part of a comprehensive revegetation plan in conjunction with design suggestions DP-2, DP-3, RI-2, and RI-3. This comprehensive plan should consider physical features that may limit the maximum habitat quality that is achievable on the banks.

Project: Bubbly Creek, South Branch of the Chicago River, Ecosystem Restoration
Location: Chicago, IL

	Alternative No:
Title:	DP-11
Seed and plant on native soil where possible	
Description of Original Concept:	
The original concept is to cover all riparian areas being vegetated with 12 inches of topsoil.	
Description of Alternative Concept:	
The alternative concept is to seed and plant the native soil when possible; place topsoil only where needed to create planting medium.	

Value Improvement

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

Function	Resources
☐ Increased	☐ Increased
☑ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$698,000
O&M Savings:	$0
Life Cycle Cost Savings:	$698,000

Advantages/Disadvantages

Alternative No.: DP-11

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Lower mass of topsoil required • Decreases access requirements • Potentially reduces construction duration for this component • Simplifies riparian constructive component of the project	• Potential lower plant survivability • Limits isolation of potential existing contaminants • Less improvement of aesthetics and surface conditions, i.e., uniformity, contouring, etc.

Discussion

Alternative No.: DP-11

Most of the riparian areas selected for planting are already vegetated. This suggests that much of the area has soil suitable for plant medium. Less or no topsoil may be needed to plant a sizeable portion of these riparian areas and ensure survivability. The Value Team has assumed that 50 percent of the riparian areas may be able to be planted on native soil based on aerial photography review of the project area.

Calculation:

0.5 x 8,950 = 4,475 cubic yards

Construction Cost Estimate

Alternative No.: DP-11

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Topsoil	CY	156.00	8,950	$1,396,200	4,475	$698,100
TOTALS				$1,396,000		$698,000
NET SAVINGS						$698,000

Project: Bubbly Creek, South Branch of the Chicago River, Ecosystem Restoration
Location: Chicago, IL

	Alternative No:
Title:	IB-2
Use angular stone in place of rounded river stone	
Description of Original Concept:	
The original concept is to use rounded river stone to armor the sand substrate in the waterway.	
Description of Alternative Concept:	
The alternative concept is to use uniform washed angular stone to armor in the waterway.	

Value Improvement

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

Function	Resources
☐ Increased	☐ Increased
☑ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$2,842,000
O&M Savings:	$0
Life Cycle Cost Savings:	$2,842,000

Advantages/Disadvantages

Alternative No.: IB-2

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Greater resistance to erosion, lower coefficient of drag • Smaller d_{50} and d_{100} allowing for a thinner layer	• Potentially denser packing limiting interstitial space for root development • Potential for less attraction of the targeted macroinvertebrate population

Discussion

Alternative No.: IB-2

There are numerous projects where angular stone has been used for armoring in conjunction with vegetation or to create substrate and bed heterogeneity. The key to its success is to design an angular stone to meet project requirements by specifying or selecting the grain size distribution for porosity and interstitial dimension. The required stone may be readily available. Many quarries now produce open-graded angular rock for use in porous pavement. This is normally achieved by screening and washing the stone, restrict the grain size distribution, place limits on fines, and ensure uniformity. In addition, the selection of the angularly stone should insure that the stone is not reactive, i.e. alter the pH, etc. Xuehua Duan, Zhaoyin Wang and Shimin Tian report in "Effect of streambed substrate on macroinvertebrate biodiversity." Frontiers of Environmental Science & Engineering in China Vol 2, Issue 1, pp.122-128, "The sampling results indicated that the macroinvertebrate assemblage is significantly affected by the grain size, porosity and interstitial dimension of the substrate, while it is rarely affected by the shape and the surface roughness of the experimental substrata."

The d_{50} required for angular stone would be about 20 percent smaller than required for rounded river stone. Since the thickness of armor required is a function of particle size, the armor layer minimum requirements would be about 20 percent thinner. Therefore, the eight inch rounded river rock layer would be replaced with an approximately six inch angular stone layer.

Calculations

Alternative No.: IB-2

☑ Original ☐ Alternative

Armor: 49,170 tons

Organics: 7,634 cubic yards

Calculations

Alternative No.: IB-2

☐ Original ☑ Alternative

Assume 20% reduction

0.8 x 49,170 = 39,336 tons

0.8 x 7,634 = 6,107 cubic yards

Construction Cost Estimate

Alternative No.: IB-2

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Rounded river armor stone	TON	66.68	49,170	$3,278,656		
Rounded river armor stone placement	TON	28.56	49,170	$1,404,295		
Organics	CY	38.64	7,634	$294,978	6,107	$235,982
Organics placement	CY	39.98	7,634	$305,238	6,107	$244,158
Angular stone	TON	21.30			39,336	$837,857
Angular stone placement	TON	28.56			39,336	$1,123,436
TOTALS				$5,283,000		$2,441,000
NET SAVINGS						$2,842,000

Project: Bubbly Creek, South Branch of the Chicago River, Ecosystem Restoration
Location: Chicago, IL

	Alternative No:
Title:	IB-3
Use a smaller stone size in the substrate armor layer to protect against 95 percent of expected shear stresses, instead of 100 percent	
Description of Original Concept:	
The concept is to use a stone size specification, d_{50} = 50 millimeters (mm), based on the most protective standard of 100 percent immobility. The design calls for a total stone thickness of eight inches. An alternate stone size, d_{50} = 20 mm, was determined by the USACE Environmental Research and Development Center (ERDC) to achieve 95 percent immobility.	
Description of Alternative Concept:	
The alternative concept is to use the alternate stone size specification, d_{50} = 20 mm, which will prevent 95 percent armor movement and rely on adaptive management after construction to compensate for the possible movement of five percent of the armor during extreme high flows. Based on the reduction of the stone size, total thickness of the armor layer is reduced to six inches, from the original eight inch design, resulting in an approximately 25 percent reduction, 12,300 tons, of stone required.	

Value Improvement

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

Function	Resources
☐ Increased	☐ Increased
☑ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 928,000
O&M Savings:	$0
Life Cycle Cost Savings:	$928,000

Advantages/Disadvantages

Alternative No.: IB-3

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Reduces costs of armor layer, with only a slight reduction in function • Maintains a minimum of 95 percent level of protection for the armor layer • Reduces the required quantity of stone in the armor layer, since a smaller stone is used, which reduces the thickness of the armor layer • Takes advantage of the adaptive management that is already part of the project plan	• Not the most conservative design • May require additional adaptive management effort or cost

Discussion

Alternative No.: IB-3

The planned stone size for the armor layer in the current design is based on hydrodynamic modeling and substrate stability analysis performed by the USACE ERDC, as documented in attachment six of appendix A of the Bubbly Creek Feasibility Study (FS) Report. That stone specification is for a d_{50} = 50 mm and a maximum stone size, d_{100}, of 75 mm. This stone size was found to provide a stable, unmoving substrate over 100 percent of the Bubbly Creek project area under the following conditions:

- 22-inch total substrate thickness in place over existing substrate and
- Peak flows of 6,000 cubic feet per second (cfs) from the Racine Avenue Pumping Station (RAPS), which represents the current maximum permitted pumping rate from RAPS.

The ERDC modeling also showed that a stable, unmoving substrate over 95 percent of the Bubbly Creek project area under the same conditions can be achieved with a smaller stone size, d_{50} = 20 mm and d_{100} = 40 mm. This finding was verified during the VE study by Dr. Paul Schroeder, primary author of the ERDC study report. This alternative involves use of this smaller stone size which would provide nearly the same function and would significantly reduce material costs for the armor layer in two ways:

- The smaller stone would have a lower unit cost.
- The smaller stone would require a thinner armor layer, since the thickness of the layer is estimated as two times the maximum stone size, d_{100}, in inches plus two inches. Using this estimator, the armor layer thickness would be reduced from eight inches to six inches, a 25 percent reduction in overall stone quantity.

The slight reduction in armor layer function from 100 percent protection to 95 percent protection would be compensated for by the planned adaptive management for the project which is described in Section 6.5.2 of the FS Report.

In addition, the Value Team feels the original stone size design was based on the most conservative peak flow rate. As stated in attachment 2, Hydrologic Engineering Center River Analysis System (HEC-RAS) Modeling of Bubbly Creek, of Appendix A of the Bubbly Creek Feasibility Study (FS) Report, a 6,000 cfs discharge at RAPS and a combined total of 1,083 cfs at the nine combined sewer overflow (CSO) outfall locations were the assumed design flow rates. The report states that both of these assumptions were conservatively assumed to be the 100-year event, a one percent annual chance. It is noted that the historic maximum discharge at RAPS in an approximately 74 year period of record, since 1939, is 5,200 cfs while the assumed design flow is 6,000 cfs. In addition, the assumed discharge rates at the CSO outfalls do not account for submergence which would occur during a peak flow event, therefore reducing the outflow rate.

Therefore, both modeled discharges are considered to be very conservative and the Value Team feels that since the original sizing of stone was based on very conservative assumptions, the suggestion of reducing the stone size is likely to function at a higher percent protection than predicted; greater than 95 percent.

Construction Cost Estimate

Alternative No.: IB-3

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Rounded river stone (d_{50} = 50 mm)	TON	66.68	49,170	$3,278,656		
Rounded river stone (d_{50} = 20 mm)	TON	63.76			36,878	$2,351,341
TOTALS				$3,279,000		$2,351,000
NET SAVINGS						$928,000

Project: Bubbly Creek, South Branch of the Chicago River, Ecosystem Restoration
Location: Chicago, IL

	Alternative No:
Title:	IB-5
Eliminate growth media and replace rounded stone with angular stone where plants are not expected to grow	
Description of Original Concept:	
Sand, rounded river stone, and growth media are placed uniformly throughout the project area.	
Description of Alternative Concept:	
The alternative concept would eliminate the growth media from Stations 40+00 through 71+50. In this reach, the rounded river stone would be replaced with a less expensive local dolomitic or limestone angular stone of appropriate size.	

Value Improvement

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

Function	Resources
☐ Increased	☐ Increased
☑ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$579,000
O&M Savings:	$0
Life Cycle Cost Savings:	$579,000

Advantages/Disadvantages

Alternative No.: IB-5

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Easier placement • Faster placement since growth media is not needed • Eliminates mixing of the mixed media	• Potential loss of benthic organism benefits in deeper areas due to lower function of the angular stone without organic matter compared to rounded river stone with organic matter

Discussion

Alternative No.: IB-5

The current plan calls for construction of a uniform benthic layer throughout the project area, including approximately 10 inches of sand, eight inches of rounded river stone, and one inch of growth media. However, during the PDT presentation, the project team indicated that the submergent plants would not be planted in the deeper areas, nor would the submergent plants be expected to expand into these deeper areas. The area between Station 40+00 and Station 71+50 represent a contiguous stretch of creek with limited to no shallow areas, that would be expected to support the growth of submergent plants. Given the limited expected functionality in this area, significant cost savings could be realized by eliminating growth media placement within this stretch and replacing the more expensive, rounded river stone with similarly sized angular stone.

The d50 required for angular stone would be about 20 percent smaller than required for rounded river stone. Since the thickness of armor required is a function of particle size, the armor layer minimum requirements would be about 20 percent thinner. Therefore, the eight inch rounded river rock layer would be replaced with an approximately six inch angular stone layer.

No significant impacts to labor or construction process would be anticipated, since the same construction equipment would be utilized and the media switch would take place over a long, contiguous reach.

Although this recommendation specifically identifies the reach from Station 40+00 to Station 71+50, the design team should consider physical attributes of the system and requirements for plant growth, including depth of light penetration and water clarity in determining locations where this replacement can be made without significant negative impacts to project function.

Sketch

Alternative No.: IB-5

☐ Original ☑ Alternative

Approximate area between Station 40+00 and Station 71+50

Calculations

Alternative No.: IB-5

☑ Original ☑ Alternative

Original

Estimated area between Station 40+00 and Station 71+50

Area = reach length x average reach width

= 3,150 feet x 100 feet

= 315,000 square feet

Quantity of rounded stone = Depth of stone x area

= 8 inches x 315,000 square feet

= 7,778 cubic yards x 1.4 tons/CY

= 10,889 tons

Change in volume of growth media = Depth of growth media x area

= 1 inch x 315,000 square feet

= 972 cubic yards

Alternative

Quantity of angular stone

Armor layer with angular stone decreases by 20%. Use 80% of original volume.

= 10,890 tons x 0.80

= 8,700 tons

Construction Cost Estimate

Alternative No.: IB-5

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Angular stone	TON	21.30			8,700	$185,310
Rounded stone	TON	66.68	10,890	$726,145		
Growth media	CY	38.64	972	$37,558		
TOTALS				$764,000		$185,000
NET SAVINGS						$579,000

Project: Bubbly Creek, South Branch of the Chicago River, Ecosystem Restoration
Location: Chicago, IL

	Alternative No:
Title:	IB-7
Decrease thickness of sand	
Description of Original Concept:	
The original concept is to use ten inches of sand for the lower layer of substrate.	
Description of Alternative Concept:	
The alternative concept is to use six inches of sand for the lower layer of substrate by relying on the armor substrate to fulfill isolation requirements not satisfied by the sand substrate, as well as allowing the mixing allowance or bedding layer to also satisfy filter requirements.	

Value Improvement

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

Function	Resources
☐ Increased	☐ Increased
☑ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$2,173,000
O&M Savings:	$0
Life Cycle Cost Savings:	$2,173,000

Advantages/Disadvantages

Alternative No.: IB-7

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Decreased construction schedule since less material is placed • Less loss of creek cross-section for conveyance, resulting in lower peak stage and lower bottom shear stress	• Requires greater construction constraints, limiting construction tolerance to two inches, one inch per placement pass • Less isolation

Discussion

Alternative No.: IB-7

The sand substrate provides habitat and also provides bedding for larger stone, isolates water column from sediment and serves as a filter for gas, and is independent from the armor layer. In the original design, it was assumed that each function was served by a separate layer of sand. In reality, these functions overlap. The 10 inches of sand in the original design satisfies the two inches of mixing, the minimum of four inches of filter, and six inches of isolation and provides two inches for construction tolerance, where the four inch requirement for a filter is satisfied by the six inches desired for isolation.

As an alternative, the armor substrate above the sand substrate could be relied upon to provide the six inches of isolation in addition to the sand substrate; however, the armor substrate will not provide isolation as effectively as sand. In addition, this alternative requires the conservative two inch mixing requirement(which is generally less than a half inch when the sand is rained through several feet of water) to be satisfied jointly by the four inch filter requirement. It still provides a two inch construction tolerance. Therefore, the six inch isolation requirement could potentially be satisfied entirely in the sand if little mixing occurs and the construction meets or exceeds the average design target thickness for the sand substrate. Under the worst case, four inches of the six inch isolation requirement would need to be satisfied by the armor substrate, but typically less than two inches of the isolation requirement would need to be satisfied in the armor substrate.

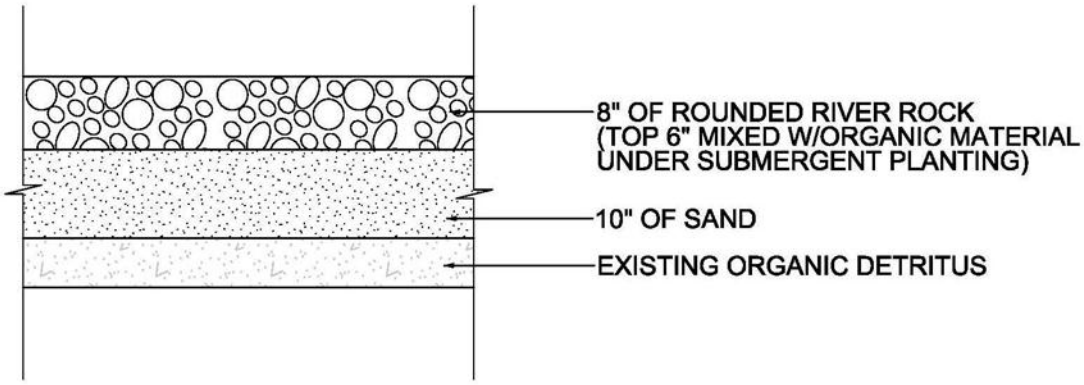
Calculation:

0.6 x 86,000 = 51,600 tons

Sketch

Alternative No.: IB-7

☑ Original ☐ Alternative

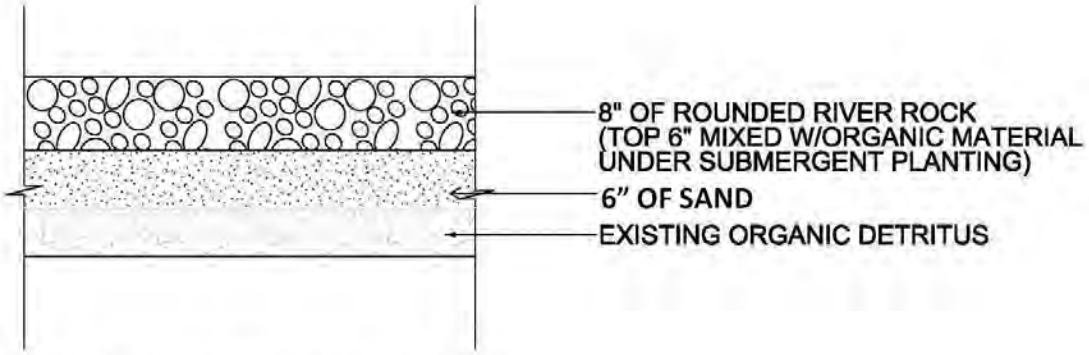


SUBSTRATE RESTORATION SECTION

Sketch

Alternative No.: IB-7

☐ Original ☑ Alternative



SUBSTRATE RESTORATION SECTION

Construction Cost Estimate

Alternative No.: IB-7

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Sand	TON	31.55	86,000	$2,713,300	51,600	$1,627,980
Sand placement	TON	31.62	86,000	$2,719,320	51,600	$1,631,592
TOTALS				$5,433,000		$3,260,000
NET SAVINGS						$2,173,000

Project: Bubbly Creek, South Branch of the Chicago River, Ecosystem Restoration
Location: Chicago, IL

	Alternative No:
Title:	IB-10
Use a synthetic geoweb product to stabilize the sand substrate layer instead of the stone armor layer	
Description of Original Concept:	
The original concept is to use an eight inch thick stone armor layer to stabilize the sand substrate layer.	
Description of Alternative Concept:	
The alternative concept is to use a synthetic geoweb product embedded in the sand layer which would replace the stone armor layer.	

Value Improvement

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

Function	Resources
☐ Increased	☐ Increased
☑ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$1,396,000
O&M Savings:	$0
Life Cycle Cost Savings:	$1,396,000

Advantages/Disadvantages

Alternative No.: IB-10

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Provides an alternate way to stabilize the sand layer • Reduces the overall thickness of the substrate restoration layer, which will reduce shear stress and increase conveyance	• May be difficult to install in submerged conditions • May increase complexity of design and construction • Uncertainty of success without additional research

Discussion

Alternative No.: IB-10

The current design calls for an eight inch thick stone layer to be placed on top of the sand substrate layer to prevent erosion of the sand layer. This alternative would use a synthetic geoweb product in place of the stone layer, with the geoweb embedded in the upper portion of the sand layer. Some vendors, e.g., Strata, also refer to this type of product as geocell. The figures below depict the geoweb product from Presto Geosystems:

Under this alternative, submerged aquatic plants would be planted in the sand. It is assumed that the upper sand layer would still need to be augmented with organic material, just as the stone layer would be under the original concept.

It should be noted that the Value Team does not have personal experience with using the geoweb product in this type of application. Furthermore, there may be limitations on installing the geoweb product in a submerged environment. The PDT can investigate this further if they wish to do so.

An added benefit of this alternative is that it reduces the overall thickness of the restored substrate thickness, which will reduce bed shear stress.

Calculations

Alternative No.: IB-10

☐ Original ☑ Alternative

Based on laying 4,000 square yards (S.Y.) per day

Rental for barge with small shore boat and small tug = $4,000 rental rate per day

Crew for on and off water = $10,000 per day

General conditions = $1,500 per day

Total per day =$15,500

Total construction time = 168,600 S.Y. / 4000 S.Y. per day = 42 days

Total probable construction cost 42 day x $15,000 per day = $630,000

Cost per square yard = $630,000/168,600 S.Y. = $3.75 S.Y.

Add a 20% contingency = $3.75 x 1.2 = $4.50/S.Y.

Construction Cost Estimate

Alternative No.: IB-10

			Original Concept		Alternative Concept	
			(Deletions)		(Additions)	
Item	**Unit of Meas**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Armor stone layer (material)	TON	66.68	49,170	$3,278,656		
Armor stone layer (placement)	TON	28.56	49,170	$1,404,295		
Sand layer (10 IN, material & placement)	TON	63.17	86,000	$5,432,620		
Geoweb (material)	SY	15.00			168,577.00	$2,528,655
Geoweb (placement)	SY	4.50			168,577.00	$758,597
Sand layer (4 IN, material & placement)	TON	63.17			34,400	$2,173,048
Pea gravel (6 IN, material & placement)	TON	49.37			51,600	$2,547,492
TOTALS				$10,116,000		$8,008,000
NET SAVINGS						$2,108,000

Project: Bubbly Creek, South Branch of the Chicago River, Ecosystem Restoration
Location: Chicago, IL

	Alternative No:
Title:	IB-25
Replace eight inches of rounded river stone with five inches of angular stone and three inches of rounded river stone	
Description of Original Concept:	
The substrate armor layer consists of an eight inch layer of rounded river stone and growth media.	
Description of Alternative Concept:	
The alternative concept would replace the lower five inches of rounded river stone with a less expensive, angular stone layer, followed by a three inch layer of the higher quality, rounded river stone for the exposed surficial layer.	

Value Improvement

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

Function	Resources
☐ Increased	☐ Increased
☑ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 903,000
O&M Savings:	$0
Life Cycle Cost Savings:	$903,000

Advantages/Disadvantages

Alternative No.: IB-25

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Angular stone is more readily available than rounded river stone • Maintains desired surface layer of rounded river rock	• May increase thickness due to added construction allowance

Discussion

Alternative No.: IB-25

The current plan calls for the armor layer to consist of eight inches of rounded river stone. In addition to providing armoring against erosion, the PDT believes that the rounded river stone, in conjunction with the growth media, will provide a high quality substrate habitat for benthic organisms and submergent and emergent plants. The PDT prefers the rounded river stone over a less expensive angular stone based on habitat function.

The alternative proposal is a compromise to capture both the function of the rounded river stone and the cost effectiveness of the angular stone. Under the alternative approach, the bottom five inches of armor stone will be the less expensive angular stone for cost savings, while the top three inches of armor stone will be the rounded river stone for maximum habitat function. This multiple layer design will be used uniformly across the entire project area.

Cost savings are due to the reduced material costs. Since the current design calls for the armor stone to be placed in lifts, no additional construction costs are anticipated.

Calculations

Alternative No.: IB-25

☐ Original ☑ Alternative

Original rounded stone volume	= 49,170 tons
Alternate rounded stone volume	= 49,170 tons x (5/8)
	= 30,731 tons
Alternate angular stone volume	= 49,170 tons x (3/8)
	= 18,439 tons

Construction Cost Estimate

Alternative No.: IB-25

			Original Concept		Alternative Concept	
			(Deletions)		(Additions)	
Item	**Unit of Meas**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
(Costs are for material delivered to site)						
Angular stone	TON	17.75			18,439	$327,292
Rounded stone	TON	66.70	49,170	$3,279,639	30,731	$2,049,758
TOTALS				$3,280,000		$2,377,000
NET SAVINGS						$903,000

Project: Bubbly Creek, South Branch of the Chicago River, Ecosystem Restoration
Location: Chicago, IL

	Alternative No:
Title:	LD-7
Reduce riparian planting area	
Description of Original Concept:	
The current design calls for a riparian planting area of 8.79 acres accounting for approximately 100 percent of the riparian area along the length of the project that are not behind vertical walls.	
Description of Alternative Concept:	
The alternative concept is to selectively reduce the planting area based on professional judgment of areas which are unlikely to sustain the targeted diverse native habitat. A suggested targeted reduction of riparian planting area is 15 percent resulting in a total planting area of approximately 7.47 acres.	

Value Improvement

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

Function	Resources
☐ Increased	☐ Increased
☑ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$348,000
O&M Savings:	$0
Life Cycle Cost Savings:	$348,000

Advantages/Disadvantages

Alternative No.: LD-7

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Significant cost savings can be achieved by reducing resource use in areas where successful native vegetation is unlikely • Focusing effort in areas most likely to be successful will contribute to overall project success	• Reduction of native riparian habitat • Potential threat of invasive vegetation spreading to replanted areas

Discussion

Alternative No.: LD-7

The Value Team suggests a reduction of 15 percent of total riparian planting area based professional judgment of the PDT.

Potential targeted reduction in planting areas may include:

- Bridge abutments
- Areas of significant riprap/ rubble which cannot be removed
- Areas of significant slope where removal or eradication of existing vegetation will pose a threat to the bank stability or increase likelihood of significant erosion
- Areas where vegetation has not currently been successful

Should 15 percent reduction be inappropriate or unattainable, the Value Team suggests considering any level of reduction in planting where appropriate.

There are no assumed operation and maintenance cost savings with this alternative due to the potential increase of removal of spreading non-native vegetation to adjacent areas.

Calculations

Alternative No.: LD-7

☑ Original ☐ Alternative

Assumptions: Current cost estimate for riparian planting and invasive species removal are based on 8.79 acres of riparian planting and invasive species removal.

Invasive species removal	$307,600 / 8.79 acres = $34,994 per acre
Soil preparation and planting	$2,009,000 / 8.79 acres = $228,555 per acre

Construction Cost Estimate

Alternative No.: LD-7

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Invasive species removal	AC	34,994.00	8.79	$307,597	7.47	$261,458
Soil preparation and planting	AC	228,555.00	8.79	$2,008,998	7.47	$1,707,649
TOTALS				$2,317,000		$1,969,000
NET SAVINGS						$348,000

Project: Bubbly Creek, South Branch of the Chicago River, Ecosystem Restoration
Location: Chicago, IL

	Alternative No:
Title:	LD-9
Use biosolids from Metropolitan Water Reclamation District in place of topsoil in riparian planting areas	
Description of Original Concept:	
The original concept is to use topsoil from off-site to cover areas where soil quality is insufficient to support new planting or where disturbance of existing soil is undesirable.	
Description of Alternative Concept:	
The alternative concept is to use biosolids from the Metropolitan Water Reclamation (MWRD) instead of topsoil.	

Value Improvement

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

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$179,000
O&M Savings:	$0
Life Cycle Cost Savings:	$179,000

Advantages/Disadvantages

Alternative No.: LD-9

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Likely to be free from seeds, inert materials and other foreign matter than topsoil • Likely to be more uniform in quality than commercial topsoil • Commonly used to support plant growth	• May be unacceptable to local residents due to perception • Additional permitting may be necessary

Discussion

Alternative No.: LD-9

This alternative would use biosolids from MWRD instead of topsoil to support native planting in riparian areas. According to the MWRD web site, biosolids from MWRD have been used to provide organic matter and nutrients to sod farms and nurseries, top dressing on golf course fairways, soil conditioner for construction of golf courses, parks, and athletic fields, and soil substitute in final landfill cover. They have also been used for landscaping at the Chicago Riverwalk, so there is a precedent for using them in riparian areas used for human recreation.

It is assumed that delivery, storage, handling and placement requirements for biosolids would be identical to the requirements for topsoil. It is further assumed that the quantity requirements would be identical. As of February 5, 2014, MWRD does not charge for their biosolids, based on e-mail communication with Lakhwinder Hundal, who is currently the head of MWRD's Biosolids Section. MWRD will charge for delivery from their site or the material can be picked up. Their current delivery charge is $25 per cubic yard within a 30 mile radius from the Stickney Plant, should MWRD deliver. If the contractor uses their own equipment it can be delivered for $13 per cubic yard.

Construction Cost Estimate

Alternative No.: LD-9

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Topsoil (material delivered to site)	CY	32.97	8,950	$295,082		
MWRD biosolids (delivery only)	CY	13.00			8,950	$116,350
TOTALS				$295,000		$116,000
NET SAVINGS						$179,000

Design Suggestion

	Alternative No:
Title:	RI-2
Remove riparian invasive species progressively	
Discussion	

The FS report states that "all invasive plant species would be physically and if necessary chemically eradicated from the planting zones to minimize disturbance to existing bank areas." It is an assumption that this is planned to occur all at one time.

As part of a comprehensive revegetation plan, the Value Team recommends considering that the option of temporarily retaining selected invasives for the purposes of providing shade, maintaining bank stability, and providing temporary habitat for birds. Specifically, the team recommends considering temporarily retaining selected existing trees. Following successful revegetation of the placed seeds and plugs, retained invasives should be removed.

Temporarily retaining some trees and shrubs while the native revegetation is underway may improve bank stability and reduce erosion, which would lead to greater overall success of the project. Additionally, the Value Team sees a potential increased success of revegetation of the banks if shade is provided to maturing seedlings and plugs.

Temporarily retaining invasives and subsequently removing them will increase overall removal cost, currently estimated at $307,600. However, the Value Team feels that if this progressive removal will lead to an increased overall likely success of the project, this strategy should be considered.

Note: The Value Team suggests that this design suggestion be considered as part of a comprehensive revegetation plan in conjunction with design suggestions DP-2, DP-3, DP-8, and RI-3. This comprehensive plan should consider physical features that may limit the maximum habitat quality that is achievable on the banks.

Design Suggestion

	Alternative No:
Title:	RI-3
Remove riparian invasive species selectively	
Discussion	

The feasibility report states that "all invasive plant species would be physically and if necessary chemically eradicated from the planting zones to minimize disturbance to existing bank areas." As part of a comprehensive revegetation plan, the Value Team recommends considering the option of allowing selected riparian invasives to permanently remain in place if they do not pose a significant threat to the success of a native revegetation plan.

Retaining some trees and shrubs on steep slopes may improve bank stability and reduce erosion, which would lead to greater overall success of the project. Additionally, the Value Team sees a potential for increased success of revegetation of the banks if shade is provided to maturing seedlings and plugs.

Selectively retaining invasives, particularly selected tree and shrubs, may slightly reduce overall removal cost, currently estimated at $307,600.

Note: The Value Team suggests that this design suggestion be considered as part of a comprehensive revegetation plan in conjunction with design suggestions DP-2, DP-3, DP-8, and RI-2. This comprehensive plan should consider physical features that may limit the maximum habitat quality that is achievable on the banks.

APPENDICES

A – AGENDA

VALUE ENGINEERING WORKSHOP AGENDA

BUBBLY CREEK SOUTH BRANCH OF THE CHICAGO RIVER ECOSYSTEM RESTORATION

Chicago, IL

February 4-6, 2014

Tuesday		Who Should Attend
8:30 – 8:45	VE Study Introduction	Stakeholders & PDT
8:45 – 9:15	Project Manager/Owner Presentation	Stakeholders & PDT
9:15 – 10:30	Project Development Team (PDT) Presentation	Stakeholders & PDT
10:30 – 12:00	Value Team Review	VE Team Members
12:00 – 1:00	Lunch Break	
1:00 – 3:30	Project/Function Analysis	VE Team Members
3:30 – 5:30	Creative Idea Generation	VE Team Members
Wednesday		
8:00 – 10:15	Creative Idea Generation (Cont.)	VE Team Members
10:15 – 11:30	Evaluation of Ideas	VE Team Members
11:30 – 12:00	Value Alternative Development	VE Team Members
12:00 – 1:00	Lunch Break	
1:00 – 6:00	Value Alternative Development (Cont.)	VE Team Members
Thursday		
8:00 – 12:00	Value Alternative Development (Cont.)	VE Team Members
12:00 – 1:00	Lunch Break	
1:00 – 2:00	Prepare for Value Team Presentation	VE Team Members
2:00 – 4:00	Value Team Presentation of Value Alternatives	Stakeholders & PDT

B – PARTICIPANTS

Bubbly Creek South Branch of the Chicago River Ecosystem Restoration
Chicago, IL
February 4-6, 2014

Name:	Company:	Phone:	Email:	Introduction	VE Presentation
Robert Prager	SVS	816-795-0700	Robert@svs-inc.com	X	
Anne Ruzicka	SVS	816-795-0700	Anne@svs-inc.com	X	X
John Groboshi	USACE	312-046-5917	john.a.groboshi@usace.army.mil	X	X
Scott Cieniawski	EPA	312-353-9184	cieniawski.scott@epa.gov	X	X
Erin Maloney	USACE	312-846-5525	erin.c.maloney@usace.army.mil	X	X
Scott Bell	LimnoTech	734-332-1200	sbell@limno.com	X	X
Paul Schroeder	USACE	601-634-3709	paul.r.schroeder@usace.army.mil	X	X
David Kiel	USACE	312-846-5515	david.l.kiel@usace.amry.mil	X	
Mike Padilla	USACE	312-846-5427	michael.c.padilla@usace.army.mil	X	
Shawna King	USACE	312-846-5407	shawna.s.herleth-king@usace.army.mil	X	X
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Nick Barkowski	USACE	312-846-5578	nicholas.a.barkowski@usace.army.mil	X	X
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Johnna Potthoff	USACE	312-846-5446	johnna.j.potthoff@usace.army.mil	X	X
David Bucaro	USACE	312-846-5583	david.f.bucaro@usace.army.mil	X	X
John Robinson	SVS	816-795-0700	john@svs-inc.com	X	X
Joe Schulenberg	USACE	312-846-5454	joseph.w.schulenberg@usace.army.mil	X	X
Rana Mishra	USACE	312-846-5428	rana.s.mishra@usace.army.mil	X	X
Roy Deda	USACE	312-846-5302	roy.j.deda@usace.army.mil		X
Susanne Davis	USACE	312-846-5580	susanne.j.davis@usace.army.mil		X

Bubbly Creek South Branch of the Chicago River Ecosystem Restoration
Chicago, IL
February 4-6, 2014

Name:	Company:	Phone:	Email:	Introduction	VE Presentation
Joe Schmidt	USACE				X
Linda Sorn	USACE				X
Dave Drvzbiki	USACE				X
Brook Herman	USACE				X

C – VALUE STUDY PROCESS

Value Study Process

This Value Study used the international Value Methodology (VM) Standard established by SAVE International®. The VM Standard establishes the specific six-phase sequential job plan and outlines the objectives of each of those phases, but does not standardize the specific activities in each phase.

Value Methodology 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. Workshop
3. Post-Workshop documentation and implementation

Figure C-1 at the end of this section shows a diagram of the VM Job Plan used for this Value Study.

Defining Value

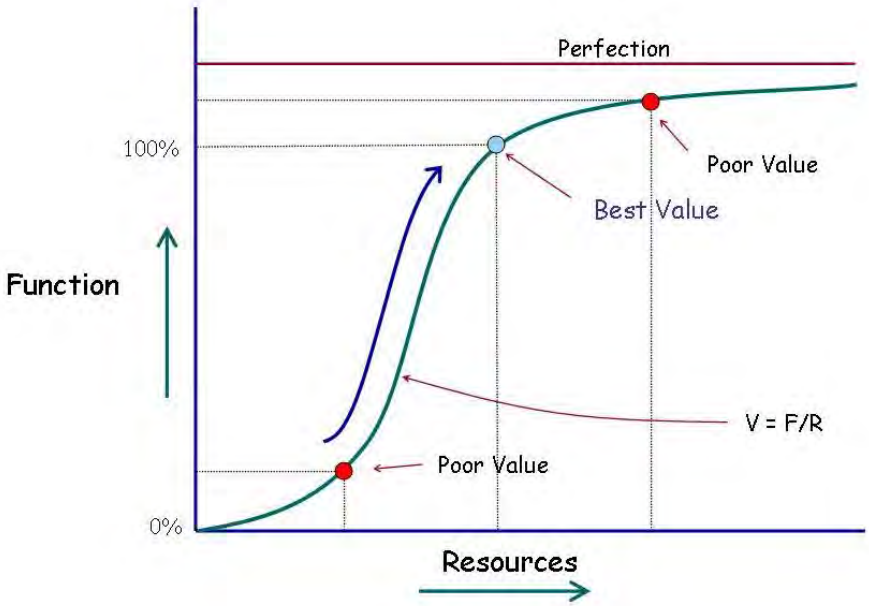
Within the context of VM, Value is commonly represented by the following relationship:

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

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

Understanding how Value is affected by changes in function and resources provides the foundation for all Strategic Value Solutions, Inc. (SVS) Value Studies. The following paragraphs describe the general process we used. This is followed by the specific workshop agenda used for this Value Study.

Figure 3-1
The Value Curve™



Pre-Workshop

Before the start of the workshop, the Value Team is tasked with reviewing the most current documentation on the project development. The team does this to become familiar with the project design and to identify questions for the project team to address during the project presentations at the beginning of the workshop. Much of the background information for this study was generated by the project design team.

VM Workshop

The VM workshop is an intensive session during which the project design is 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 six phases during the workshop:

Information Phase

From the beginning of the workshop, it is important to understand the background of the project and the rationale underlying the design decisions. An overview of the project history, objectives, issues, as well as an overview of the project design to date, is critical to the success of the Value Study. The workshop agenda will indicate whether this project overview was provided at the beginning of the workshop.

When the project development team does not provide an overview, the Value Team allocates a greater portion of the workshop time for Team Review.

When appropriate, the workshop includes a team visit to the project site. The workshop agenda will indicate whether a site visit was performed during this workshop.

Function Analysis Phase

During the Function Analysis Phase, the team identifies functions that describe the expected outcomes of the project under study. These functions are described using a two-word, active verb and measurable noun pairing. Function Analysis also defines the intended methods for accomplishing the desired outcomes.

Some of the specific function tools the Value Team uses in studies include Tabular Function, FAST Diagraming, and the Function Wheel. The Function Analysis appendix of this report includes documentation of the Function Analysis phase and the tools used.

Creative Phase

This step in the VM process involves generating ideas using creativity techniques. The team records all ideas regardless of their feasibility. In order to maximize the Value Team's creativity, evaluation of the ideas is not allowed during the Creative Phase. The Value Team's efforts are directed toward generating a large quantity of ideas. These ideas are later screened in the Evaluation Phase of the workshop.

The creative ideas generated by the team are included in the Creative Idea Listing appendix of this report. The list also includes ratings for each idea based on the Evaluation Phase of the workshop.

Evaluation Phase

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

The evaluation process is designed to identify those ideas with the greatest potential for value improvement that can be developed into Value Alternatives. The evaluation process is also influenced by the duration of the workshop and the production capacity of the team. As a result, the remaining ideas that are not selected for development are not given any further consideration by the team during the workshop. It is recommended that the other ideas also be reviewed by the project team, as there may be circumstances which may make these ideas viable. These ideas may be further evaluated or modified to gain the maximum benefit for the project.

Development Phase

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

Each alternative is developed with a brief narrative to compare the original concept and the alternative concept. Sketches and brief calculations are also developed, if needed, to clarify and support the alternative. The value alternatives developed during this Value Study are presented in the Study Results section of this report.

Presentation Phase

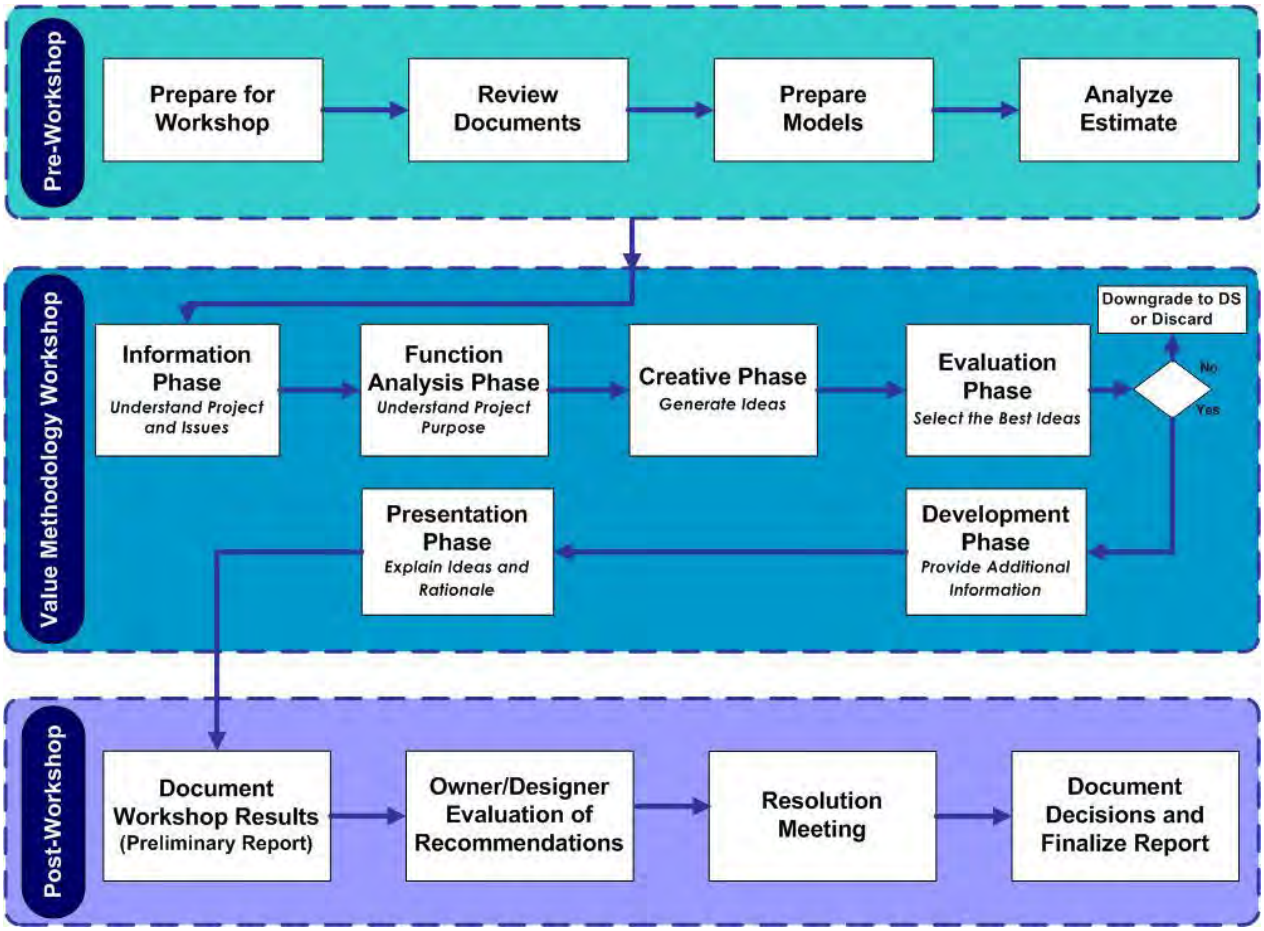
In this final phase of the workshop the Value Team presents the work that was produced during the workshop. The Value Team presents alternatives and fields any final questions from the project stakeholders who were present. This presentation phase also closes out the responsibilities of the Value Team's subject matter experts.

The workshop agenda will indicate whether a presentation was performed by the Value Team during this workshop.

Post-Workshop

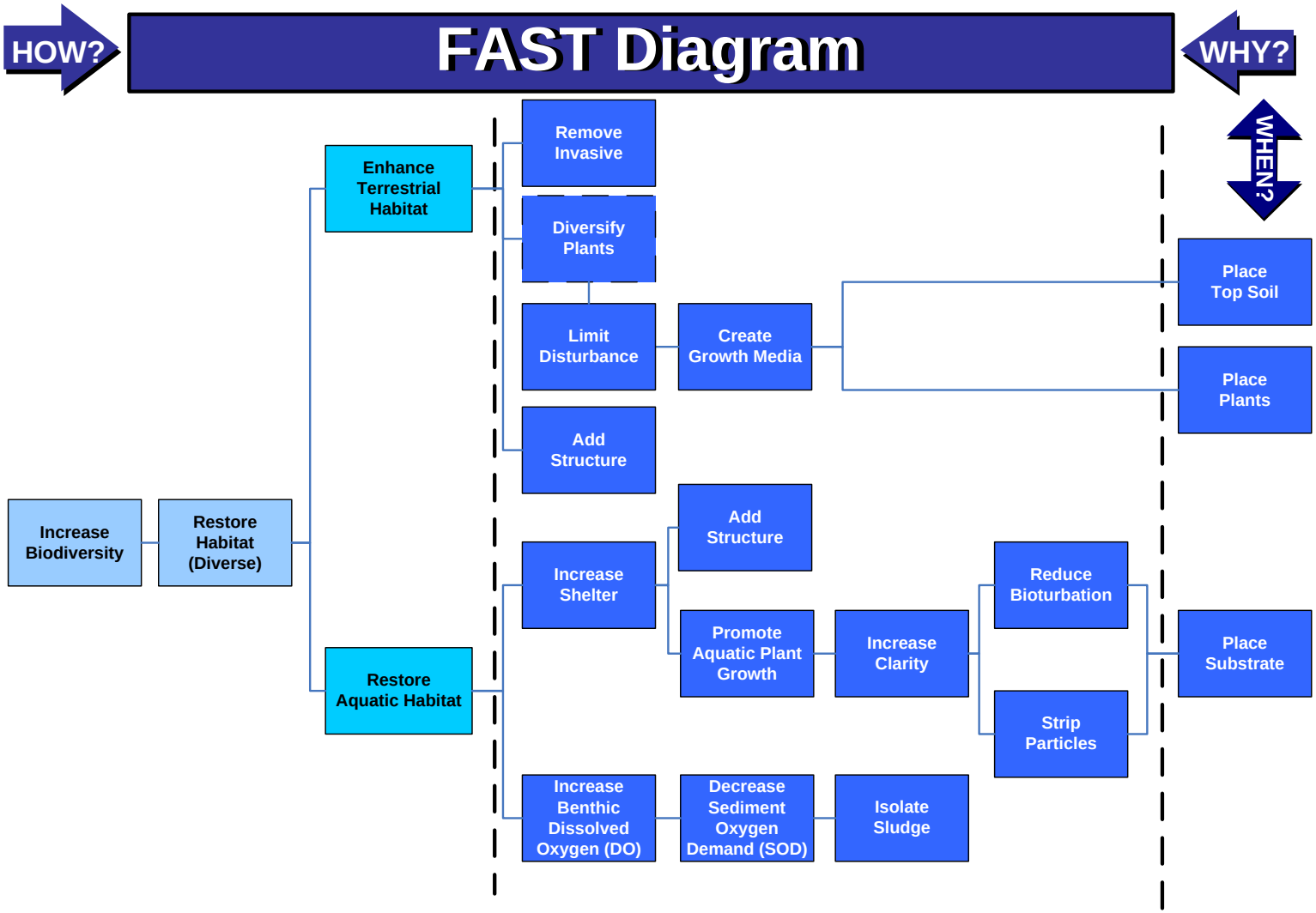
The Post-Workshop activities of a Value Study consist of preparing the value study report. This Final Value Study Report includes the Value Alternatives developed during the workshop, as well as documentation of the Value Process.

Figure C-1
Value Engineering Process Diagram



D – FUNCTION ANALYSIS

FAST Diagram



Scope Lines
Higher Order Function (Mission)
Secondary Function
Basic Function
Required Secondary Function

Bubbly Creek South Branch of the Chicago River
Ecosystem Restoration
Chicago, IL

E – CREATIVE IDEA LISTING

Creative Idea Listing

Idea No.	Description	Votes
Constructability		
CO-1	Use performance specification and avoid specifying methods of work	DS
CO-2	Prequalify contractors	1
CO-3	Use separate contract for aquatic and terrestrial restoration	1
CO-4	Sample layer thicknesses to control placement	0
CO-5	Use single stockpile and hydraulic slurry to placement barge	1
CO-6	Conduct as much riparian restoration from the landside as is feasible	2
CO-7	Plant riparian areas first to protect aquatic substrate	DS
CO-8	Complete marine work in the off-season	DS
CO-9	Shorten duration for placing growth media, stone, and sand substrate and complete riparian work concurrent with substrate placement	2
Diversify Plants		
DP-1	Seed only with topsoil	0
DP-2	For woody plants, use smallest plant available	DS
DP-3	Use lowest cost native plants	DS
DP-4	Plant plugs, whips, containers at lower density	0
DP-5	Use volunteers for planting	1
DP-6	Use National Guard as labor force for planting	0
DP-7	Harvest plants from within area of other areas as source	0
DP-8	Acquire plants from Natural Resource Conservation Service sources	DS
DP-9	Allow contractor to use Bubbly Creek water for establishment	0
DP-10	Only remove invasives and rely on volunteers	0
DP-11	Seed and plant on native soil where possible	3
Increase Aquatic Shelter		
IA-1	Use human made objects	0
IA-2	Use quarry rock piles	1
IA-3	Add overhangs on vertical walls	0
IA-4	Build docks	0
IA-5	Create off-channel coves/bays	1

Idea No.	Description	Votes
IA-6	Create groins, weirs, etc.	0
IA-7	Place walkway with piers	0
IA-8	Replace sheet pile with wood or rock structures	0
IA-9	Acquire riparian property to enhance environment	0
IA-10	Create micro typography	0
IA-11	Create more structure around bridge pier	0
IA-12	Add floating island	0
IA-13	Build island in channel	0
IA-14	Build "fish hotels"	0
IA-15	Build lunker structure	0
IA-16	Use preplanted bog mat and gravel and replace mat	0
Increase Benthic Dissolved Oxygen		
IB-1	Aerate the benthic zone	1
IB-2	Use angular stone in place of rounded river stone	3
IB-3	Use a smaller stone size in the substrate armor layer to protect against 95% of expected shear stresses, instead of 100%	3
IB-4	Remove sludge	0
IB-5	Eliminate growth media and replace rounded stone with angular stone where plants are not expected to grow	3
IB-6	Size stone on expected discharge (Combined with IB-3)	3
IB-7	Decrease thickness of sand	2
IB-8	Dissipate energy at Racine Avenue Pumping Station to eliminate stone	0
IB-9	Place habitat structures to eliminate stone downstream	0
IB-10	Use a synthetic geoweb product to stabilize the sand substrate layer instead of the stone armor layer	2
IB-11	Modify substrate to create solums	0
IB-12	Create a mixture of sand and clay to replace armor	0
IB-13	Replace substrate layers with well graded mixture	0
IB-14	Eliminate stone and allow scour	0
IB-15	Use thicker sand layer and allow scour	0
IB-16	Use dredged material as growth media in lieu of gravel	0
IB-17	Use clinkler ash in lieu of gravel	0
IB-18	Use slag in lieu of gravel	1
IB-19	Use crushed stone from McCook in lieu of round gravel	0

Idea No.	Description	Votes
IB-20	Inject chemical oxidants into stadge to decrease SOD	0
IB-21	Let nature run its course	1
IB-22	Use tumbled concrete or angular stone for rounded gravel	1
IB-23	Use dolomitic rock to create angular stone	0
IB-24	Use angular stone to reduce thickness	0
IB-25	Replace eight inches of rounded river stone with five inches of pea gravel and three inches of rounded river stone	2
IB-26	Use bog mat and eight inches round stone and replace sand	0
Increase Terrestrial Shelter		
IT-1	Add birdhouses	0
IT-2	Create brush piles instead of mulching	1
IT-3	Add bat houses	0
IT-4	Create off-channel wetlands	0
IT-5	Put a green roof on pumping station	0
Limit Disturbance		
LD-1	Use preseed erosion control blankets only	0
LD-2	Hydroseed slopes	1
LD-3	Build facines from invasives to terrace	0
LD-4	Use prairie logs to terrace	0
LD-5	Use planted riprap	0
LD-6	Use biopolymers for erosion control and establish plants	0
LD-7	Reduce riparian planting area	2
LD-8	Plant within invasives to out compete	0
LD-9	Use biosolids from Metropolitan Water Reclamation District in place of topsoil in riparian planting areas	4
Remove Invasives		
RI-1	Leave invasives	0
RI-2	Remove riparian invasive species progressively	DS
RI-3	Remove riparian invasive species selectively	DS
RI-4	Burn invasives with controlled burn	0
RI-5	Compost chipped mulch before use	0
RI-6	Only remove invasives from select areas	1

DS – Indicates the Idea was selected to be written as a Design Suggestion and is included in the Study Results Section of this report