

Pontoon Construction Project



Value Engineering Study Report

June 8 - 9, 2009

Prepared By:



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Disclaimer

The information contained in this report is the professional opinions of the team members during the VE study. These opinions were based on the information provided to the team at the time of the study. As the project continues to develop, new information will become available and this information will need to be evaluated on how it may effect the recommendations and findings in this report. All costs displayed in the report are based on best available information at the time of the study and unless otherwise noted are in current year dollars.

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- [REDACTED]

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Executive Summary

Introduction

The mission of the Value Engineering (VE) team was to verify or improve upon various concepts for the SR 520 Pontoon Construction project. This project is currently in the early design phase. The VE team applied the principles and practices of the VE job plan.

The primary objective for this study was to recommend cost-effective solutions for providing a pontoon construction facility that meets WSDOT's catastrophic failure preparation and ultimate bridge replacement needs.

Eleven subject-matter experts and a team leader made up the study team.

Project Purpose

The purpose of this facility is to construct and store pontoons to be better prepared for a catastrophic failure of the SR 520 floating bridge.

Recommendations

The VE team generated 45 ideas for the project. These concepts were compared against the baseline that was developed by the project team. The concepts that performed the best and reduced cost were further developed by the VE team.

From the various concepts, the VE team developed 5 recommendations. Four of the recommendations were improvements to the proposed design and recommendation number 5 is an alternative basin design that incorporates all four of the recommendations as well as a modification to the basin floor that allows for a much higher floor elevation for the majority of the basin. Implementation of these recommendations can net a cost savings of approximately [REDACTED].

#	Description	Cost Savings
1	Gate	[REDACTED]
2	Basin Floor	[REDACTED]
3	Wall – Center	[REDACTED]
4	Walls – Outside	[REDACTED]
	Sub total	[REDACTED]
5	At Grade Casting Yard	[REDACTED]

Recommendations 1-4 can be used together for the baseline project. Recommendation 5 is a stand alone and includes most of the efficiencies of Recommendations 1-4.

Implementation of Recommendations

WSDOT is required to report VE results annually to FHWA. To facilitate this reporting requirement, a Value Engineering Recommendation Approval Form is included at the end of this report. If the region elects to reject or modify a recommendation, please include a brief explanation of why. Please complete the form and return it to WSDOT HQ Design, Attn: State Value Engineering Coordinator, MS 47330

The VE team wishes to express its appreciation to the project design managers for the excellent support they provided during the study. Hopefully, the recommendations and other ideas provided will assist in the management decisions necessary to move the project forward through the project delivery process.

Ken L. Smith, PE, CVS

VE Team Leader

Introduction

This Value Engineering (VE) Report summarizes the events of the VE study conducted by Urban Corridors and facilitated by HDR. The subject of the study was the SR 520 Pontoon Construction project.

The VE study was conducted June 8-9, 2009.

Purpose of the Workshop

The purpose of the workshop is to verify (or recommend improvement for) the proposed casting basin.

- Design criteria
- Design approach for the pontoon dry dock/casting basin to be built in Grays Harbor. Specifically consider the information listed below, which is provided in the enclosed materials:
 - Geotechnical information for site(s)
 - Proposed seismic criteria and approach
 - Proposed performance criteria for construction of pontoons
 - Proposed foundation structural designs and approach
 - Proposed wall structural designs and approach.

Reason for the Workshop

The reason for the workshop is that estimated construction costs are significant and have caught the eye of executive management. This workshop will either 1) confirm whether the proposed design criteria and approach are appropriate, or 2) recommend changes to be less – or more – conservative.

Background Information Summary

Geotechnical Information

For the Aberdeen Log Yard (ALY) site, four borings have been drilled on the site, and the information from these along with conceptual-level geotechnical analysis form the basis of the geotechnical recommendations contained in the draft technical memorandum by Landau Associates dated May 5, 2009. A more comprehensive field investigation is currently underway, with laboratory testing to follow.

Advanced geotechnical analysis and modeling has only been performed for the IDD#1 site.

Seismic Criteria and Approach

The basic criteria and approach is consistent with the AASHTO Guide Specification for LRFD Seismic Bridge Design. Essentially, this is a design for a “life safety performance objective considering a seismic hazard corresponding to a 7% probability of exceedance in 75 years” (also known as the 1,000-year seismic event). Currently the facility is being viewed as a permanent, not temporary, facility because its anticipated lifespan exceeds the lifespan for temporary facilities as defined by AASHTO as well as the International Building Code (IBC).

At the IDD#1 site, lateral spreading was identified as a major hazard under the design seismic event, and advanced numerical modeling was done by the geotechnical engineer to assess its extent and implications for structural design. At the ALY site, it is not yet known whether lateral spreading is a concern. Designing for a life safety performance objective remains the seismic design criterion even under a lateral spreading scenario.

Performance Criteria for Construction of pontoons

For the casting basin foundation and floor, differential settlement during pontoon construction is a key criterion. Control of differential settlement of the basin floor is important because the pontoons are essentially cast directly on the basin floor. Excessive differential settlement of the floor could lead to excessive cracking of the base slab, as well as dimensional/geometric problems with the pontoons that cause pontoon-to-pontoon fit-up issues.

Foundation Structural Design and Approach

Conceptual foundation and basin floor design to date has been driven by the pontoons themselves. The settlement criteria described above for pontoon construction led the team to select a deep pile option for the conceptual design on the ALY site. This is because the draft technical memorandum by Landau Associates dated January 5, 2009 indicated that shallow foundation options on the ALY may lead to unacceptable differential settlement or be impractical to construct. Once that selection was made, the design was then governed by pile load capacity and concrete strength design considerations. Controlling loads for the design of the piles and floor slab are either the weight of the pontoons or the weight of water when the basin is flooded.

At this stage, sufficient geotechnical criteria are not available for the ALY site for an analysis of a floor slab without piles or with shallow timber piles to determine if these systems would meet the performance criteria for pontoon construction. Also, to date, no structural analysis or design for seismic loads has been performed on the current deep pile basin foundation/floor system. However, the deep pile system is currently seen as the best option for mitigating the effects of lateral spreading. Structural analysis for seismic loads is currently underway for the gate sill as a standalone structure.

Wall Structural Design and Approach

The current conceptual design of the walls is based on earth pressure recommendations contained in the May 5, 2009 geotechnical memorandum. Design thickness is controlled by the seismic active earth pressure and the walls are designed elastically for this loading as is common practice for retaining walls. The design of the piles directly under the walls is controlled by the downdrag forces induced on the piles by wall backfilling.

The need for walls (as opposed to permanent laid-back slopes) is largely driven by the need to maintain a certain amount of usable area around the basin to support pontoon construction. Secondary concerns include environmental permitting issues and hydraulics issues.

Constraints and Controlling Decisions

- Utilize conventional pontoon construction and launch methodology, i.e., casting (largely) in place concrete pontoons within a casting basin
- Sizing of the casting basin is outside the scope of this VE workshop
- Accommodate all known and dedicated environmental commitments
- Primary emphasis is on life-safety, not structural durability, during the design seismic event
- Meet the contract schedule with design build project beginning late summer, 2010
- Pontoon shape and size are fixed.

VE Team Members

Bob Bittner	Marine Construction Engineer
Ray Castelli	Senior Engineering Manager
Blane Long	Design/Value Engineering
Richard Mogel	Senior Engineer
Bob Murray	Structural Engineer
Endi Zhai	Geotechnical Engineer
Ken Smith	Team Leader
Lynda Jensen	Technical Editor

VE Team Members – Part Time

Christine Lavra	Manager
John Villager	Project Engineer
Brian Harris	Casting Basin Structures Lead
Alan Chan	Design PEO
Bill Hegge	Geotechnical Engineer
Patrick Clarke	Structural Engineer
Reda Mikhail	Geotechnical Engineer



VE team discussing ideas.

Project Analysis

Summary of Analysis

The following analysis tools were used to study the project:

- Cost model
- FAST diagram
- Base line cost estimate.

Cost Model

The VE team leader prepared a cost model from the cost estimate provided by the project team. The model is organized to identify major construction elements or trade categories, the designer's estimated costs, and the percent of total project cost for the significant cost items.

The cost models clearly showed the cost drivers for the project and were used to guide the VE team during the VE study.

The following conclusions were noted by the VE team regarding the project costs:

- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]

Functional Analysis

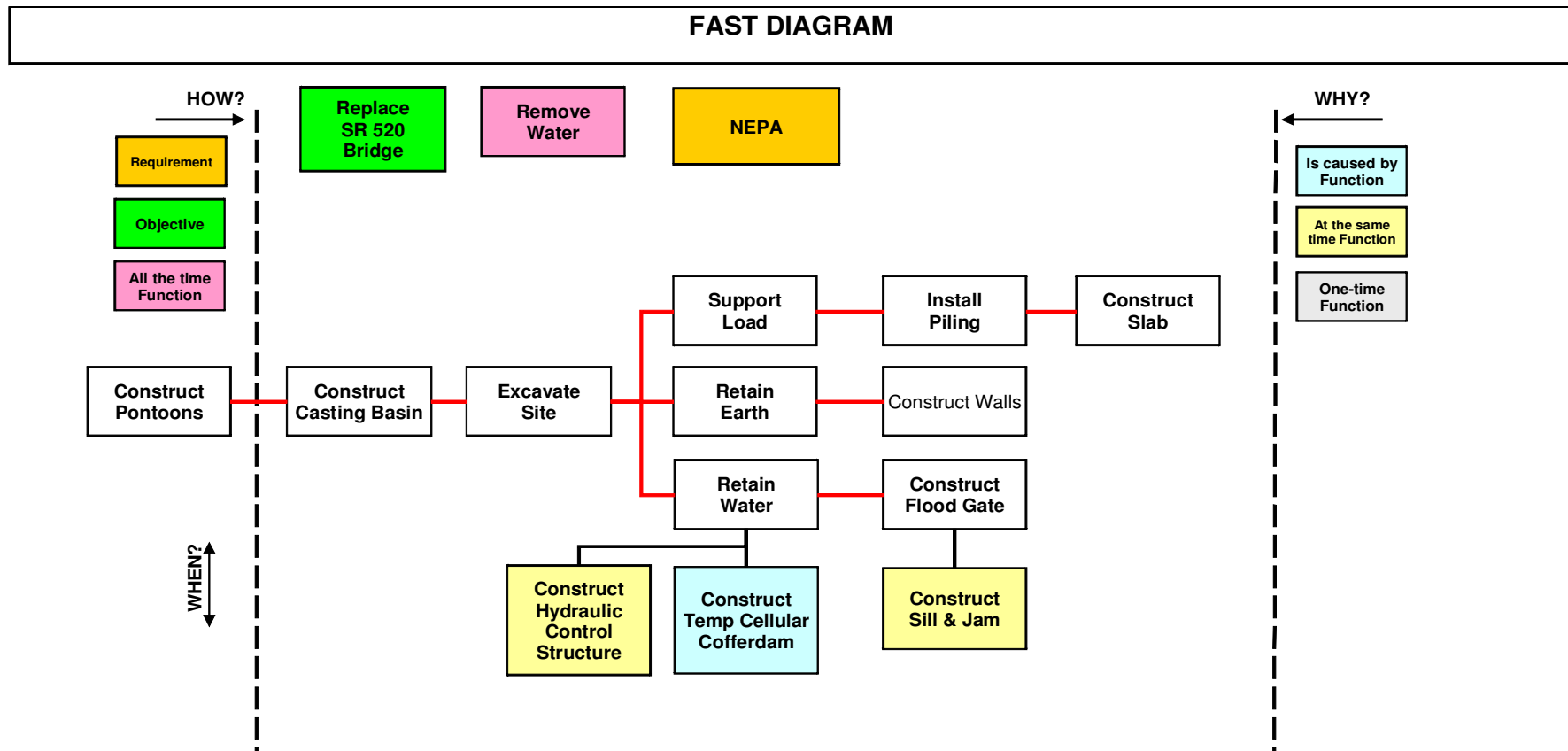
Function analysis results in a unique view of the study project. It transforms project elements into functions, which moves the VE team mentally away from the original design and takes it toward a functional concept of the project. Functions are defined in verb-noun statements to reduce the needs of the project to their most elemental level. Identifying the functions of the major design elements of the project allows a broader consideration of alternative ways to accomplish the functions.

Items	Verb	Noun	Cost
Excavation	Excavate	Site	[REDACTED]
Walls	Retain	Earth	[REDACTED]
Piling, caps, and slab	Support	Load	[REDACTED]

FAST Diagram

The FAST diagram arranges the functions in logical order so that when read from left to right; the functions answer the question “How?” If the diagram is read from right to left, the functions answer the question “Why?”

This provided the VE team with an understanding of the project design rationale and which functions offer the best opportunity for cost or performance improvement. The shaded functions are functions the VE team brainstormed improvement opportunities for.



Base Line Cost Estimate

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Idea Evaluation

Introduction

The ideas generated by the VE team are carefully evaluated, and project-specific attributes are applied to each idea to assure an objective evaluation.

Idea Evaluation Forms

All of the ideas that were generated during the creative phase using brainstorming techniques were recorded on the following Idea Evaluation forms. These ideas were discussed, and the advantages and disadvantages of each were listed. The VE team, as a group, generated and evaluated ideas on how to perform the various functions. The idea list was grouped by function or major project element.

Evaluation Process

The team compared each of the ideas with the baseline concept to determine whether it was better than, equal to, or worse than the original concept (1-5). The team reached a consensus on the ranking of the idea. High-ranked ideas would be developed further; low-ranked ones with a score of less than 3 were dropped from further consideration.

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IDEA EVALUATION
SR 520 Pontoon Construction Project

Ideas		Advantages	Disadvantages	Rank
#	Function			
1	Support Load			
1-1	Ground improvement (Deep soil mixing, stone columns)	<ul style="list-style-type: none"> ◆ Reduce the number of piles required ◆ Reduce settlement ◆ Provide lateral support for the walls 	<ul style="list-style-type: none"> ◆ Cost 	1
1-2	Surcharging	<ul style="list-style-type: none"> ◆ Economical ◆ Reduces settlement ◆ Accelerate consolidation ◆ Eliminate the need for piles 	<ul style="list-style-type: none"> ◆ May require wick drains outside walls ◆ Where is the surcharge source? 	3
1-3	Rolling surcharge	<ul style="list-style-type: none"> ◆ Economical ◆ Reduces settlement ◆ Accelerate consolidation ◆ Eliminate the need for piles 	<ul style="list-style-type: none"> ◆ May require wick drains outside walls 	3
1-4	Frame wall (deeper walls)	<ul style="list-style-type: none"> ◆ Eliminates piles under crane rails ◆ Reduces the seismic load on the center wall ◆ Could support crane loads 	<ul style="list-style-type: none"> ◆ Requires a lot of sheet piles ◆ Could cost more 	4

IDEA EVALUATION
SR 520 Pontoon Construction Project

Ideas		Advantages	Disadvantages	Rank
#	Function			
1-5	Timber piles	<ul style="list-style-type: none"> ◆ Could cost less ◆ Smaller equipment requirements ◆ Eliminates the need for grade beams (allows for thinner slab) ◆ Higher production 	<ul style="list-style-type: none"> ◆ Shorter lifespan ◆ More piles 	4
1-6	Thicker slab without grade beams	<ul style="list-style-type: none"> ◆ Reduce construction labor and equipment cost 	<ul style="list-style-type: none"> ◆ Increase concrete 	4
1-7	Check subgrade modulus, if appropriate, reduce the thickness of the slab	<ul style="list-style-type: none"> ◆ Reduce cost ◆ May reduce number of piles 	<ul style="list-style-type: none"> ◆ May require testing 	4
1-9	Dewater to less than a full head to reduce the load (semi-buoyant slab)	<ul style="list-style-type: none"> ◆ Reduce cost ◆ May reduce number of piles 	<ul style="list-style-type: none"> ◆ Requires an active monitoring system 	4
1-10	Combined foundation of piles and mat	<ul style="list-style-type: none"> ◆ Reduce cost ◆ Shorten piles ◆ Reduces settlement in comparison to mat-only 	<ul style="list-style-type: none"> ◆ May require more piles ◆ Takes more analysis 	3
1-11	Have grade beams at 30 feet to match pontoon walls	<ul style="list-style-type: none"> ◆ Decreases the number of piles ◆ Could decrease or eliminate the transverse grade beams 	<ul style="list-style-type: none"> ◆ Constrains the contractor's ability to use the site ◆ Limits the size of the pontoons for future use 	2

IDEA EVALUATION
SR 520 Pontoon Construction Project

Ideas		Advantages	Disadvantages	Rank
#	Function			
1-12	Battered piles for crane rails	<ul style="list-style-type: none"> ◆ May help stabilize the wall 	<ul style="list-style-type: none"> ◆ May not work 	1
1-13	Freeze the ground	<ul style="list-style-type: none"> ◆ Proven practice for shallow and short term 	<ul style="list-style-type: none"> ◆ Cost 	1
1-14	Static and drivability pile load test pre-bid	<ul style="list-style-type: none"> ◆ Could shorten the piles ◆ Increases the soil resistance factor ◆ Could decrease the number and size of piles 	<ul style="list-style-type: none"> ◆ No time for load testing before RFP ◆ Possible schedule impact 	5
1-15	No piles and a thicker slab	<ul style="list-style-type: none"> ◆ Cost savings ◆ Would reduce time ◆ Eliminates piles 	<ul style="list-style-type: none"> ◆ Increased concrete 	4

IDEA EVALUATION
SR 520 Pontoon Construction Project

Ideas		Advantages	Disadvantages	Rank
#	Function			
2	Retain Earth (walls)			
2-1	Interlocking concrete sheet piles for walls	<ul style="list-style-type: none"> ◆ Wall installation could be performed from existing ground level ◆ Reduces seismic load from center wall ◆ Eliminates piles for crane rails ◆ Can be done prior to excavation and be used as the support point for excavation ◆ Frame action is very efficient for resisting seismic loads ◆ Less time required ◆ Less excavation 	<ul style="list-style-type: none"> ◆ High expense for large quantity of interlocking concrete sheet pile ◆ Existing debris such as logs or existing piles would create additional work 	4

IDEA EVALUATION
SR 520 Pontoon Construction Project

Ideas		Advantages	Disadvantages	Rank
#	Function			
2-2	Concrete reinforced slopes	<ul style="list-style-type: none"> ◆ Eliminates the walls ◆ Lower cost than walls 	<ul style="list-style-type: none"> ◆ Effects the distance of cranes from casting basin ◆ Additional excavation ◆ Would have to include drainage system behind concrete slope ◆ Slope stability during seismic event ◆ Need larger right of way or additional structure for cranes 	3
2-3	Double run of sheet pile	<ul style="list-style-type: none"> ◆ Less excavation ◆ Can be constructed from the ground surface ◆ Better seal than concrete piles 	<ul style="list-style-type: none"> ◆ Length could be a factor for vertical loads ◆ Could require tie backs with dead men ◆ Requires additional support for cranes ◆ External water has no way of draining 	3

IDEA EVALUATION
SR 520 Pontoon Construction Project

Ideas		Advantages	Disadvantages	Rank
#	Function			
2-4	MSE walls	<ul style="list-style-type: none"> ◆ No concrete wall (lower cost) ◆ Inside wall to access roads could be MSE 	<ul style="list-style-type: none"> ◆ Crane rails ◆ Sealing issues ◆ Additional excavation ◆ Must be built from bottom up ◆ Complicates pile installation 	4
2-5	Open cell cofferdam	<ul style="list-style-type: none"> ◆ Top down construction ◆ Self anchoring ◆ Possible costs savings 	<ul style="list-style-type: none"> ◆ Proprietary system ◆ External water has no way of draining 	3
2-6	Secant piles	<ul style="list-style-type: none"> ◆ Top down construction ◆ Variable stiffness – reduces deflection ◆ Could be used as a foundation element to support crane foundations 	<ul style="list-style-type: none"> ◆ May require grouting for leaks ◆ May require supplemental drainage system 	2
2-7	Circular cell cofferdam	<ul style="list-style-type: none"> ◆ Acts as gravity structure (eliminates the need for an anchor system) 	<ul style="list-style-type: none"> ◆ External water has no way of draining ◆ Select fill ◆ Expensive system due to large amount of steel required 	2

IDEA EVALUATION
SR 520 Pontoon Construction Project

Ideas		Advantages	Disadvantages	Rank
#	Function			
2-8	Interlocking pipe piles	<ul style="list-style-type: none"> ◆ Could be used with sheets in between ◆ Could help support the crane rail ◆ Provides high bending resistance 	<ul style="list-style-type: none"> ◆ High steel requirements (possible high costs) ◆ External water has nowhere to go ◆ Corrosion protection required 	3
2-9	Master pile with sheeting	<ul style="list-style-type: none"> ◆ Could help support the crane rail ◆ Provides high bending resistance 	<ul style="list-style-type: none"> ◆ High steel requirements (possible high costs) ◆ External water has nowhere to go ◆ Corrosion protection required 	3
2-10	Inclined ground anchors	<ul style="list-style-type: none"> ◆ Allows lower bending capacity vertical wall 	<ul style="list-style-type: none"> ◆ Requires higher vertical support capacity for the vertical wall ◆ Anchors would have to be long (140 feet) ◆ Down drag would be an issue 	2
2-11	Lightweight fill behind the wall	<ul style="list-style-type: none"> ◆ Reduces static and seismic pressure ◆ Less settlement ◆ Possibly eliminate down drag on piles in some places 	<ul style="list-style-type: none"> ◆ Cost ◆ Less passive resistance 	4

IDEA EVALUATION
SR 520 Pontoon Construction Project

Ideas		Advantages	Disadvantages	Rank
#	Function			
2-12	Do not backfill the top 5 feet of back side of wall	<ul style="list-style-type: none"> ◆ Reduce static and seismic pressures ◆ Reduce settlement ◆ Possibly eliminate down drag on piles in some places ◆ Less material for backfill 	<ul style="list-style-type: none"> ◆ Less passive resistance ◆ Possible flooding in staging area 	5
2-13	Shorten the walls to +15	<ul style="list-style-type: none"> ◆ Reduce static and seismic pressures ◆ Reduce settlement ◆ Possibly eliminate down drag on piles in some places ◆ Less material for backfill ◆ Shortens the wall (less material required) 	<ul style="list-style-type: none"> ◆ Possible flooding 	4
2-14	Reevaluate seismic criteria due to shorter lifespan	<ul style="list-style-type: none"> ◆ Could reduce the wall thickness 	<ul style="list-style-type: none"> ◆ Reduced seismic criteria (increased risk) 	4

IDEA EVALUATION
SR 520 Pontoon Construction Project

Ideas		Advantages	Disadvantages	Rank
#	Function			
2-15	Place berm around the site away from the walls and use 8-foot shorter walls	<ul style="list-style-type: none"> ◆ Reduce static and seismic pressures ◆ Reduce settlement ◆ Possibly eliminate down drag on piles in some places ◆ Less material for backfill ◆ Shortens the wall (less material required) ◆ Similar flood protection as existing scheme ◆ Reduce amount of fill needed for the site 	<ul style="list-style-type: none"> ◆ Additional right-of-way consumed by berm ◆ Risk of breach of berm could cause flooding ◆ Would not work on the river side 	2
3	De-Water			
3-1	Utilize the temporary dewatering for permanent dewatering	<ul style="list-style-type: none"> ◆ Cost ◆ Some of the temporary overlaps with the permanent 	<ul style="list-style-type: none"> ◆ Different functions and different soil units are involved 	2
3-2	Do not dewater for permanent condition	<ul style="list-style-type: none"> ◆ May reduce operational cost 	<ul style="list-style-type: none"> ◆ Doesn't remove hydrostatic pressure behind walls, slab and walls require additional design ◆ May increase capital cost 	2

IDEA EVALUATION
SR 520 Pontoon Construction Project

Ideas		Advantages	Disadvantages	Rank
#	Function			
3-3	Allow permanent dewatering to seep into the basin	<ul style="list-style-type: none"> ◆ Less load on the retaining walls and no uplift on invert slab ◆ No dewatering system required 	<ul style="list-style-type: none"> ◆ If there are contaminants in the groundwater, it would have to be kept separate from process and stormwater 	2
4	Excavate			
4-1	Barge out the spoils	<ul style="list-style-type: none"> ◆ Reduces trucking 	<ul style="list-style-type: none"> ◆ Still needs to go to an upland site 	3
4-2	Truck out the spoils		<ul style="list-style-type: none"> ◆ Increased traffic on local streets 	3
4-3	Train out the spoils	<ul style="list-style-type: none"> ◆ Reduces trucking 	<ul style="list-style-type: none"> ◆ May require secondary handling 	3
4-4	Build the walls first and use cranes, drag line, or back hoe for excavation	<ul style="list-style-type: none"> ◆ No disturbance to the subgrade 	<ul style="list-style-type: none"> ◆ Requires a system that builds the walls first 	5
4-5	Flood the hole and drive piles from segmental barge	<ul style="list-style-type: none"> ◆ Delays the need for temporary dewatering ◆ No disturbance to the subgrade 	<ul style="list-style-type: none"> ◆ Would have to treat flood water 	4

IDEA EVALUATION
SR 520 Pontoon Construction Project

Ideas		Advantages	Disadvantages	Rank
#	Function			
4-6	Drive piles before excavation with follower	<ul style="list-style-type: none"> ◆ Easier access ◆ Can work simultaneously 	<ul style="list-style-type: none"> ◆ Have to excavate around piles 	4
4-7	Construct deeper pontoons at CTC	<ul style="list-style-type: none"> ◆ May not be possible 	<ul style="list-style-type: none"> ◆ Not enough draft at CTC 	1
4-8	Shallower excavation with supplemental floatation for deeper pontoons		<ul style="list-style-type: none"> ◆ Cost ◆ Requires a lot of construction area ◆ Requires additional time 	1
5	Overall			
5-1	Remove batch plant from estimate	<ul style="list-style-type: none"> ◆ Similar to the cranes and will remove cost from estimate 		5

IDEA EVALUATION
SR 520 Pontoon Construction Project

Ideas		Advantages	Disadvantages	Rank
#	Function			
5-2	Floating dry dock launch	<ul style="list-style-type: none"> ◆ More flexibility ◆ Floor at grade (reduces excavation) ◆ Reduces site disposal (excavation can be disposed of in-water) ◆ Becomes a useful site once pontoon construction is complete 	<ul style="list-style-type: none"> ◆ Temporary bulkheads required between each pontoon row ◆ Additional in-water work ◆ Additional pile support required for floating dry dock (unless ballast is used) ◆ Increased cost for waterfront bulkhead ◆ Cost of floating dry dock ◆ Multiple moorings required ◆ Requires surcharge 	4
5-3	Super flood slot	<ul style="list-style-type: none"> ◆ Floor of pontoon site is much higher ◆ Outside perimeter could be sheet pile walls ◆ Could use excavation as backfill 	<ul style="list-style-type: none"> ◆ Would have to widen the site ◆ Would take longer to super flood ◆ Would require twice as many gate openings ◆ Requires surcharge 	5
5-4	Removable lift gate	<ul style="list-style-type: none"> ◆ Reduce costs 		

Recommendations

Introduction

The results of this study are presented as individual recommendations to the original concept. The VE recommendation documents in this section are presented as written by the team during the VE study. While they have been edited to correct errors or better clarify the recommendation, they represent the VE team's findings during the VE study.

VE Recommendation

The recommendation consists of a summary of the original concept, a description of the suggested change, a listing of its advantages and disadvantages, a rough cost comparison, and a brief narrative comparing the original design with the recommendation. Sketches, calculations, and performance measure ratings are also presented. The rough cost comparisons reflect a comparable level of detail as in the original estimate.

Mark ups

Mark ups were applied to the potential savings to account for the items in the estimate that are a percentage of the unit items. The following was used in the mark up calculations:

██████████	████
██████████	████
██████████	████
██████████	████
██████████	████
██████████	████
██████████	████
██████████	████
██████████	████

Summary of Recommendation

#	Description	Cost Savings
1	Gate	██████████
2	Basin Floor	██████████
3	Wall – Center	██████████
4	Walls – Outside	██████████
	Sub total	██████████
5	At Grade Casting Yard	██████████

Recommendations 1-4 can be used together for the baseline project. Recommendation 5 is a stand alone and includes most of the efficiencies of Recommendations 1-4.

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Recommendation 1: Gate

Original Concept:

Use a floating concrete gate positioned and removed with tug boats. The gate would likely be constructed on the gate sill to endure proper fit of the gate seals. The Original gates have a 105' opening. (pontoon width 75')

Recommendation Concept:

Use a trussed-steel lift gate that spans from one side of opening to the other. The gate would be raised and lowered with a multi-part load block and hydraulic winch. The gate would travel in slots on each gate abutment. The revised gate is designed for an 82' opening. (could be larger if needed.)

Advantages:

- Faster operating gate system.
- Ballasting system not required.
- Smaller sill.

Disadvantages:

- Corrosion protection system required.
- As designed may not be wide enough to accommodate barges.

Cost Summary

Cost

Original Concept

██████████

Recommendation Concept

██████████

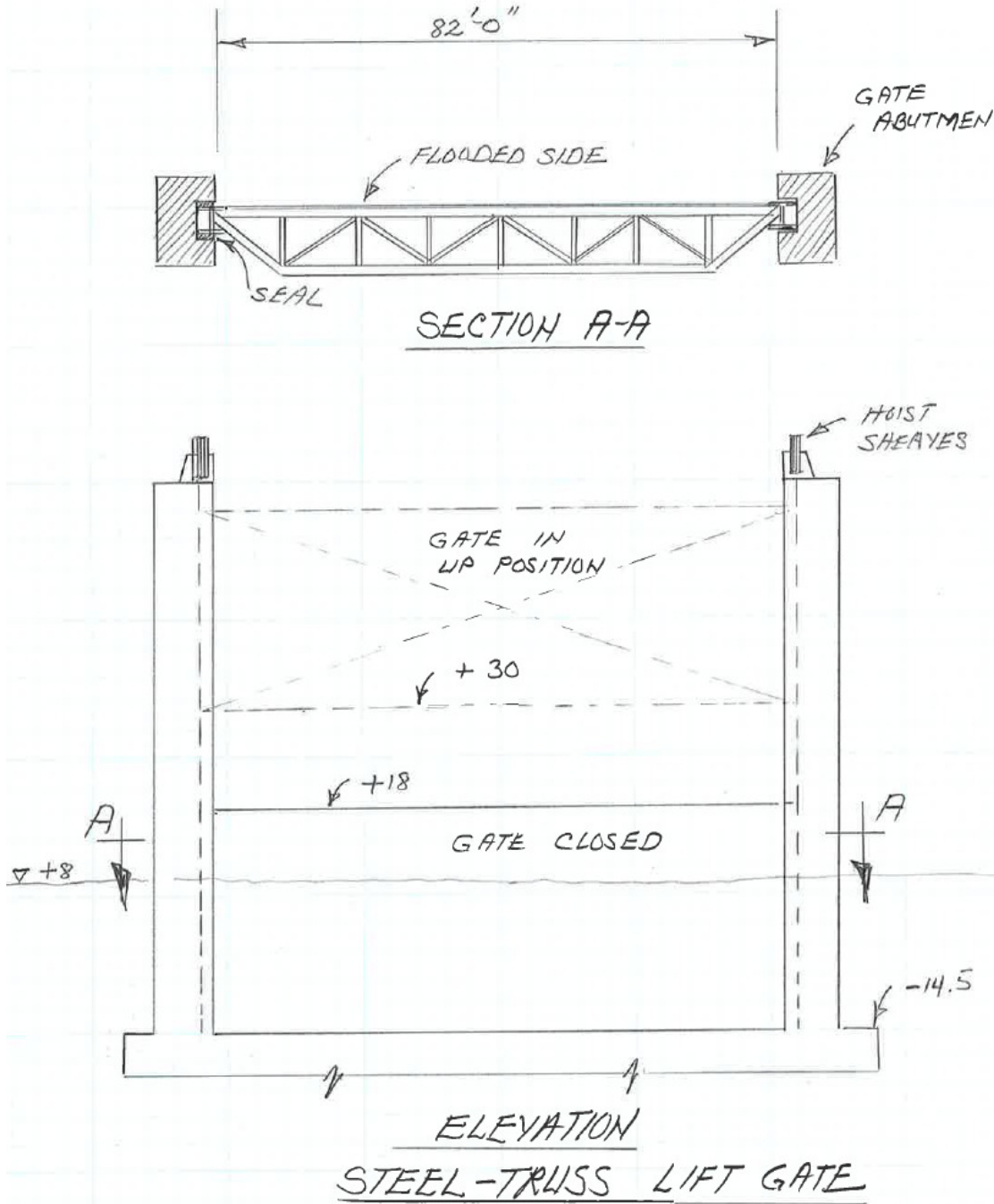
Savings

██

Discussion/Justification:

- Based on all other costs for electrical/mechanical, and gate sill remains unchanged.
- Can be modified to accommodate wider opening for 100' wide barge.

Sketches:



Assumptions and Calculations:

Gate cost calculation:



Assume electrical and mechanical are a push for both concrete gate and lift gate.

Assume cost of gate side abutments and sill foundation are the same for both options.

Recommendation 2: Basin Floor - Slab only

Original Concept:

Slab, grade beam, and piling

Recommendation Concept:

Slab only

Advantages:

- Potential cost savings.
- Reduced construction time.
- Eliminates piles.

Disadvantages:

- Increased concrete.

Cost Summary

Cost

Original Concept

[REDACTED]

Recommendation Concept

[REDACTED]

Savings

[REDACTED]

Discussion/Justification:

- [REDACTED]
- [REDACTED]
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Assumptions and Calculations:

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Recommendation 4: Wall – Outside

Original Concept:

31' tall cantilever concrete retaining walls on concrete piling is used for the exterior walls.

Recommendation Concept:

Use 20' tall (exposed face) coated sheet piles to construct the exterior walls.

Advantages:

- Reduces static & seismic pressures.
- Reduces settlement.
- Eliminates the piling.
- Less backfill material.
- Top down construction.
- Reduces excavation costs.
- Reduce height of gates needed.

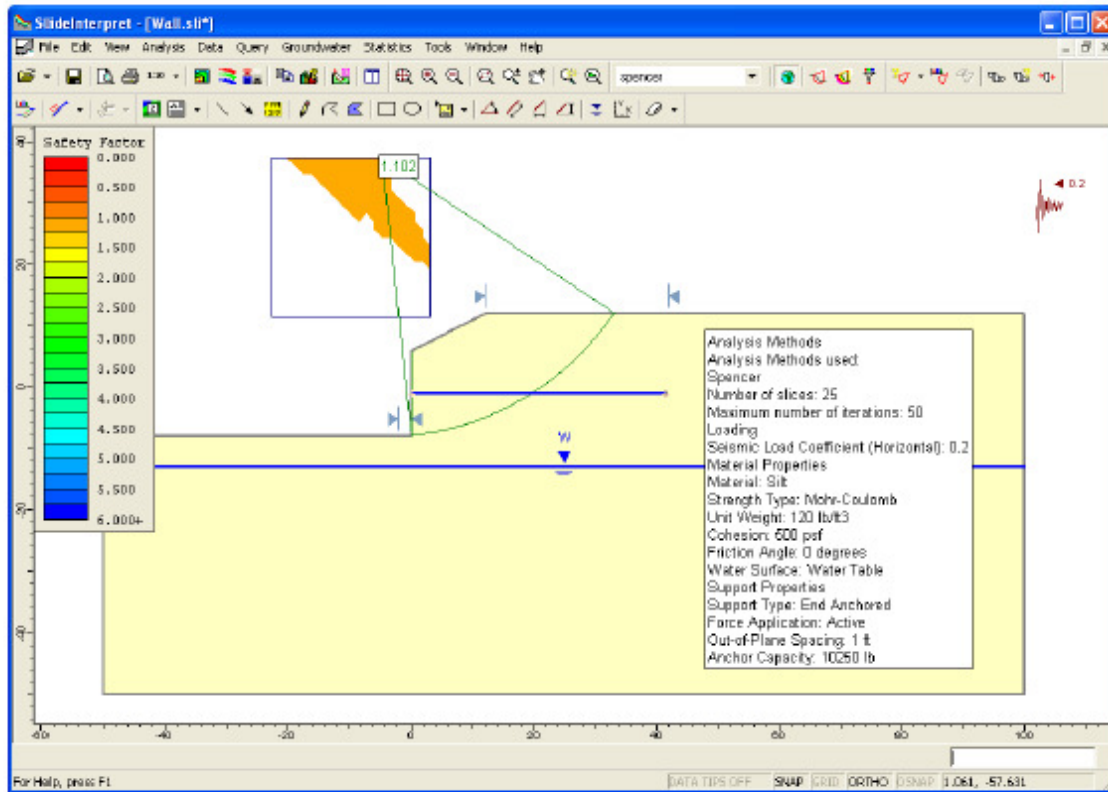
Disadvantages:

- Cross pontoons will need to be staged.
- More restrictive on allowable tides.
- Possible flooding in staging area.
- Some effect on the distance of the crane reach to casting basin.
- May need additional excavation on outside to maintain wall stability prior to placing beam invert slab
- Need to collect and treat surface water
- Risk of flooding casting yard is water level raises above +12

Cost Summary	Cost
Original Concept	██████████
Recommendation Concept	██████████
Savings	████████████████████

Discussion/Justification:

- This concept proposes setting the staging area at +12. This may have some flooding implications if the site was to see the highest observed tide (HOT) of +13.86. However, during the last 100 year event no flooding was noted at the site. This would suggest that the HOT may not be realistic.
- The top of the sheet pile wall will also be set at elevation 12.0 with the ground line behind the wall set at elevation 6.0 then sloping back at a 2H:1V to elevation 12.0. Top of slab elevation would be at elevation -8. This results in 17' of water (enough to float the CIP floats) at a 9.0' tide.
- The effective height of the cantilevered sheet pile wall would be 14' (elevation 6.0 to -8.0).
- Assume the 14' the design of the cantilevered sheet pile wall is still controlled by seismic.
- Assumes basin invert slab provides lateral support to sheet pile.

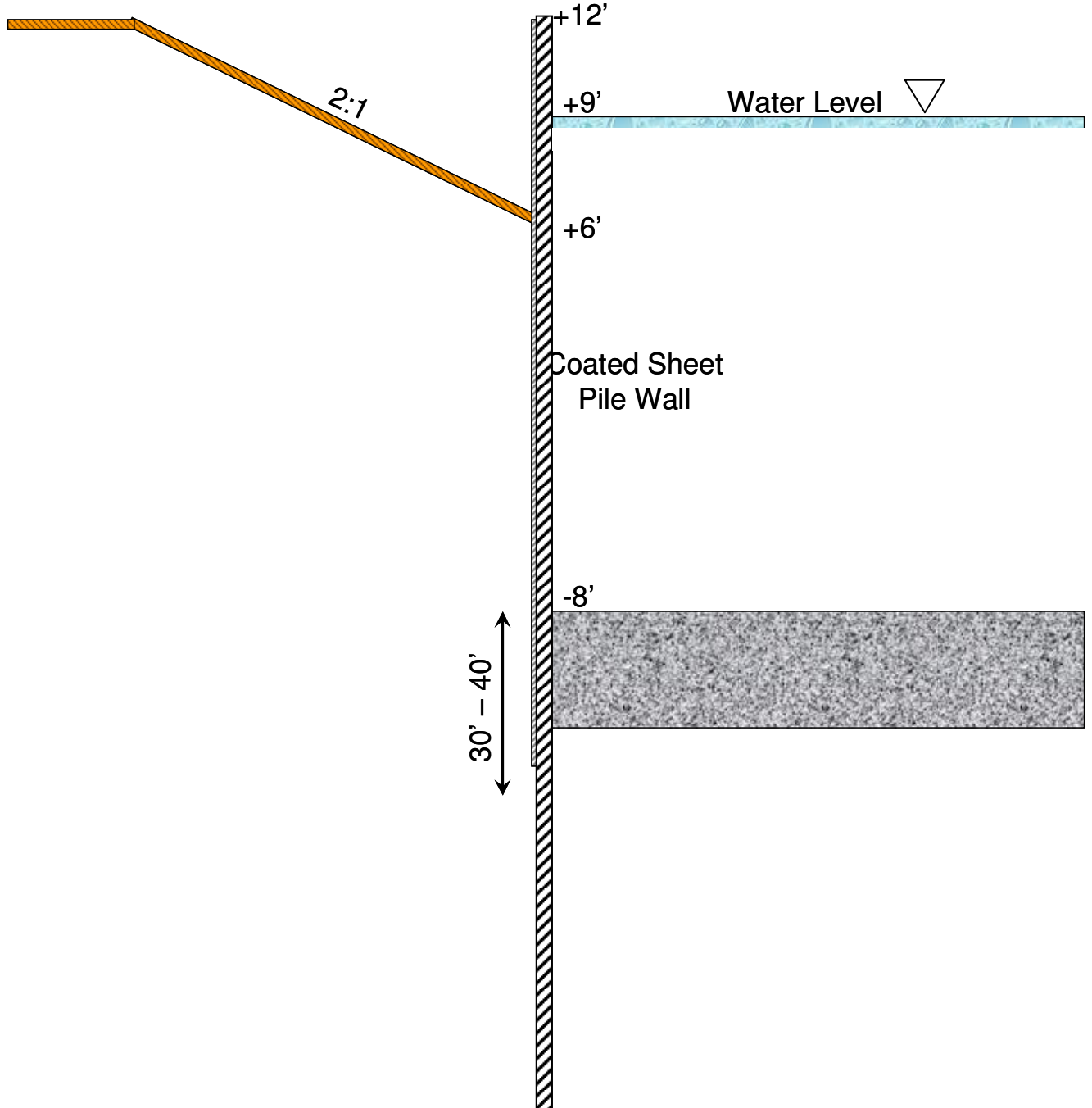


Notes:

Validation of recommended seismic earth pressure coefficient (K_{ae}) by a pseudo-static slope stability analysis:

- 1) Use a horizontal seismic coefficient of $\frac{1}{2}$ of $PGA = 0.4g/2 = 0.2g$
- 2) Soil parameters: $\gamma = 120$ pcf, $c = 500$ psf, $\phi = 0$
- 3) To vary a wall loading P (acting at the middle of the wall) in order to result in a FOS of 1.1.
- 4) When $FOS = 1.1$, the calculated $P = 10$ kips per foot of wall.
- 5) $P = 10$ kips is approx. equivalent to have a $K_{ae} = 0.8$ for a rectangular pressure distribution ($P = 0.5 * K_{ae} * 120 * 14^2$)
- 6) This approach tends to be conservative than soil-structure-interaction (SSI) dynamic analysis

Sketches:



Assumptions and Calculations:

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Seismic Earth Pressure:

$$\frac{1}{2} K_{ae} \times \gamma \times H$$

$K_{ae} = .8$ (which is conservative, considering a 2:1 backslope)

$$\gamma_t = 120 \text{ psf}$$

$$\frac{1}{2} (.8)(120)(14) \approx 700 \text{ psf}$$

$$(700)(14) \approx 10 \text{ k}$$

$$M = (10)(7) = 70 \text{ ft k/ft}$$

Assume 1" thick sheet pile (AZ 50 $S \approx 100 \text{ in}^3/\text{ft}$)

$$f = \frac{M}{S} = \frac{(70)(12)}{100} = 8.4 \text{ ksi (un-factored)}$$

Note: Pile section could be reduced.

This proposed concept eliminates all of the wall piling, allows for easier construction methods, less construction time and a substantial savings in the overall cost.

Recommendation 5: At Grade Casting Yard

Original Concept:

Casting basin base at elevation -9 and -13
Deep foundation concrete piles (20' on center)
Pile Caps and grade beams
13" reinforced concrete slab
Pile supported concrete cantilever walls for center and exterior walls

Recommendation Concept:

Landlevel Pontoon Casting Yard
Casting yard constructed as 4-ft thick slab-on-grade (no piles)
Central launching trench
Single, centered launch gate
Maintain existing ground surface outside the casting yard

Construction and Operation Sequencing:

1. Install perimeter walls (sheet piling).
2. Excavate and dispose of existing fill material.
3. Flood site to preload foundation soils (with bottom membrane and vertical drains, if necessary).
4. Excavate casting yard to elevation $+6 \pm$.
5. Construct bulkhead and gate structure.
6. Excavate center trench and construct U-wall structure.
7. Construct concrete slabs within casting yard (4-feet thick?).
8. Construct pontoons at land level (elevation $+10 \pm$).
9. Install temporary longitudinal flood wall on one side of the center trench.
10. Flood half of casting yard to elevation $+24 \pm$ on one side of trench.
11. Float two pontoons to trench.
12. Lower water level in yard and trench to sea level.
13. Launch two pontoons.
14. Flood same half of casting yard.
15. Repeat above steps to launch remaining two pontoons.
16. Switch temporary flood wall to opposite side of trench.
17. Repeat above steps to launch other four pontoons.

Advantages:

- Splits casting yard into 4 separate areas that can launch independently.
- All work is above sea level.
- No piles under casting yard.
- Single gate (rather than two in original concept).
- Sheet pile wall for perimeter (rather than more costly CIP cantilever wall).
- Movable soldier pile center wall (rather than more costly CIP cantilever wall)
- Less costly waterfront bulkhead.
- Less excavation and disposal.
- Reduces dewatering requirements (temporary and permanent).
- Reduces impact of seismic criteria.
- Eliminates need for access ramps on sides of basin.
- Fits within current site footprint.
- Shorter schedule for construction of casting yard; earlier start to pontoon construction.
- Lower total cost.
- Facilitates construction of pontoons (easier access for materials and personnel)
- Allows for more continuous flow of work by allowing launch of whichever pontoon pair are completed first. Flooding only disrupts one quadrant at a time
- May eliminate need for USH&L coverage since all work is performed above sealevel.

Disadvantages:

- Requires cast-in-place U-wall trench structure.
- Requires twice as many flooding cycles as base option.
- More settlement than pile-supported casting yard (but remains within tolerance).
- Requires time for surcharging the site.

Cost Summary

Cost

Original Concept	██████████
Recommendation Concept	██████████
Savings	██████████

Discussion/Justification:

- Essentially all work is at land level, above sea level. This eliminates the risk associated with possible breach of bulkhead or gate structure during a seismic event. This may have a secondary benefit of lowering the insurance cost.
- Greatly reduces the cost and construction time for the perimeter retaining walls. The sheetpiling used for the exterior walls is much less costly, and can be installed much faster than the Cast-in-Place concrete cantilever walls shown for the Original Concept. Sheetpile walls become a viable option for the Landlevel Casting Yard option due to the shorter exposed height of the wall.
- Greatly reduces the cost and construction time for the center wall. (See Recommendation 3)
- Reduces the impact of designing for a seismic event. (Seismic loading need not be considered for the very brief period of time the yard is flooded for pontoon launching.)
- Eliminates the need for foundation piles, except for support of the crane rails. However, the use of a pile supported slab remains a viable option for the casting yard, and can be used, if desired, to reduce potential foundation settlement, and/or shorten the construction schedule. (If piles are used, the total cost increase is estimated to be about █ in comparison to a 4-ft thick slab on grade at █; added excavation; vertical drains; and water containment membrane.) If piles are used, they would likely be precast, prestressed concrete piles since the greater pile length needed for a landlevel slab would preclude the use of timber piles. If piles are used, they would need to be driven before excavation and construction of the center U-wall structure to avoid potential damage to the structure from pile driving operations.
- Allows for efficient preloading of the site using water to preload. Preloading may require the use of an impermeable membrane to contain the water, as well as vertical drains through the silt layer to accelerate consolidation.
- Yard layout and operation would be similar to the base scheme except that the number of gate openings would double.
- The center trench can be used for floating cranes to assist in pontoon construction and for tugs to assist in pontoon launching. The width of the center trench can be increased to accommodate 100-ft wide barges, if desired.
- One option would be to use the center trench as the casting basin for the two cross pontoons that require greater draft for launching. With this option, there would be no need to lower a portion of the landlevel casting yard to cast these two deeper pontoons. However, this option would require the center trench width to be increased from 80 to at least 100 ft, and would require that it be designed to be dewatered (either with increased weight to resist buoyancy, or a pressure relief system beneath the U-wall structure to eliminate or reduce the hydrostatic uplift pressure.)
- Temporary bridges can be placed across the center trench to facilitate transfer of equipment, material and personnel.
- Little fill would be placed outside the casting yard, except for grading. Maintaining the final grade close to the existing eliminates a considerable quantity of imported fill. This approach also avoids or minimizes ground settlement and the resulting downdrag loads on the piles for the crane foundations.
- Considering the difference in ground level inside and outside the casting yard will be only 2 to 8 ft, access to the casting yard can be provided by multiple openings through the exterior walls at convenient locations. These openings could then be closed with stop logs when the casting yard

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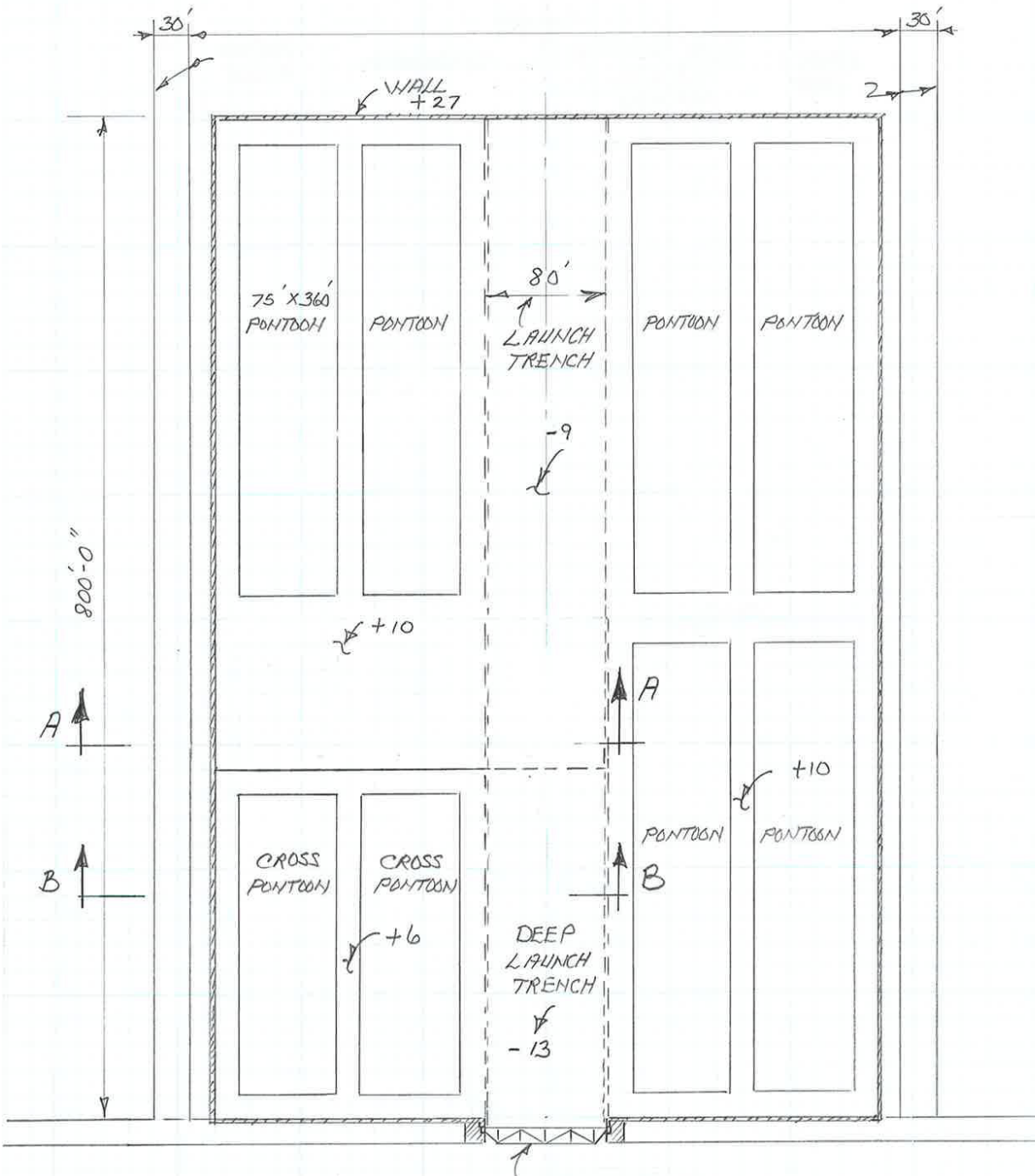
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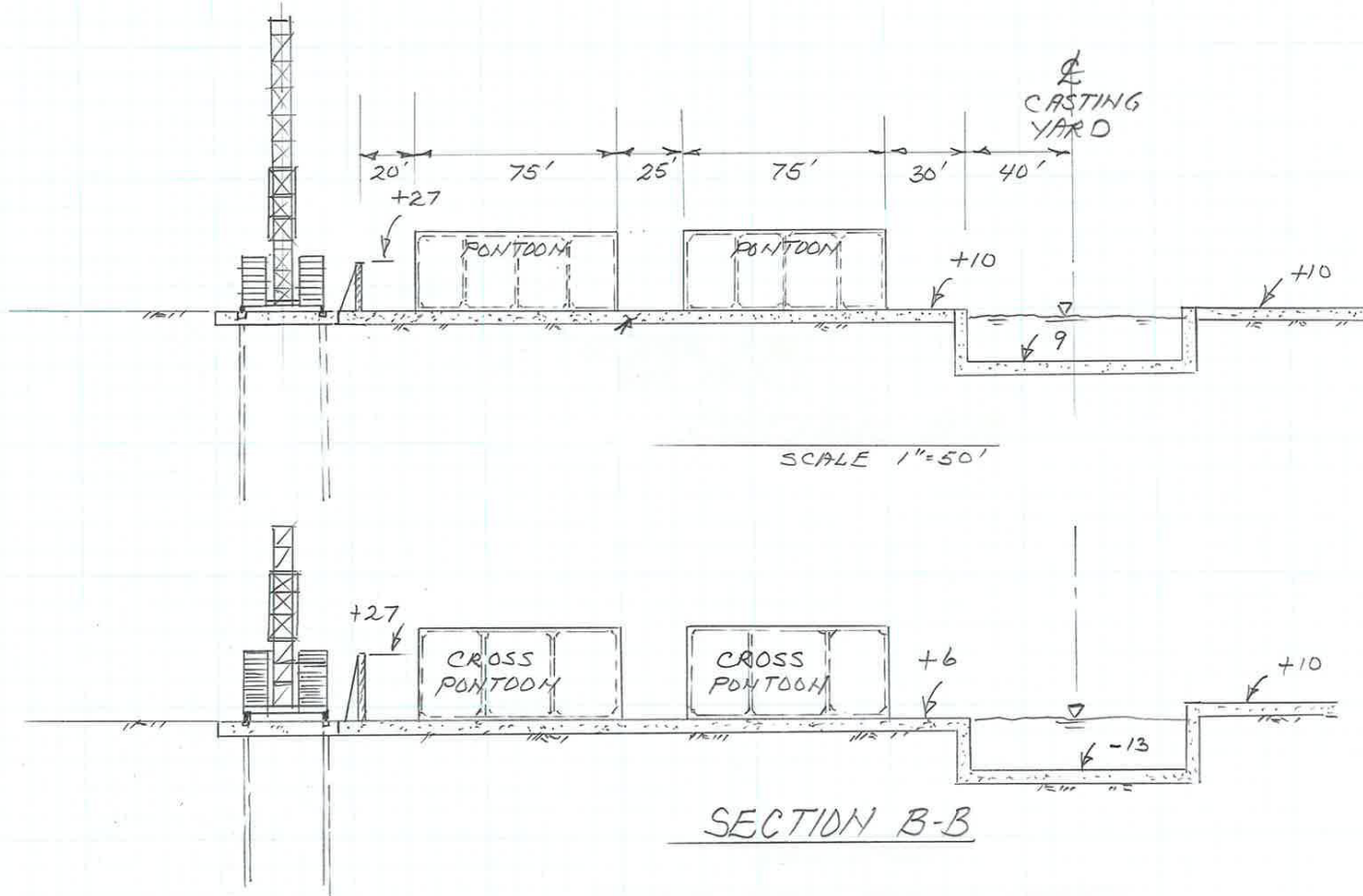
Sketches:



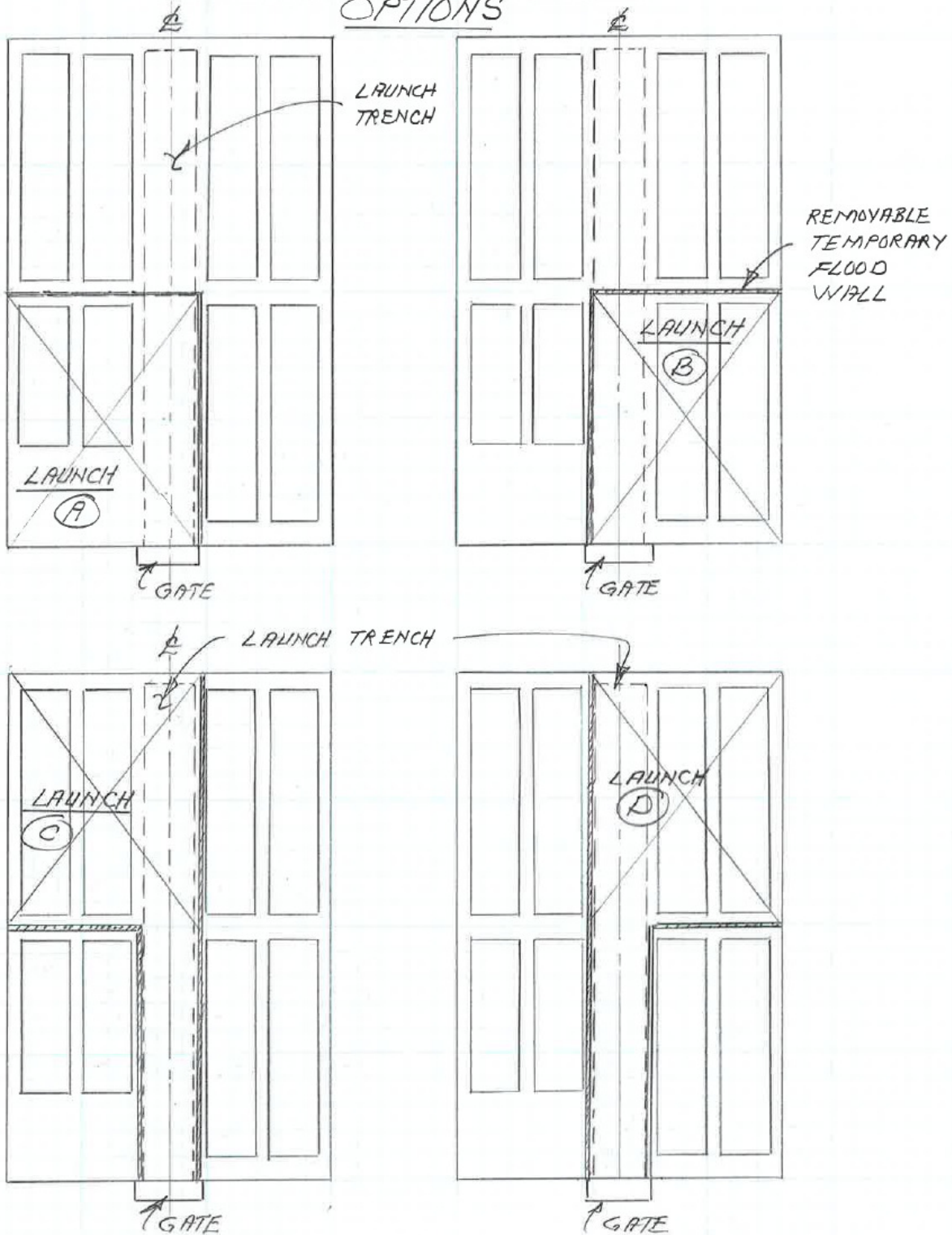
PLAN
1" = 100'-0"

SHEET 1

6-09-09



CENTER TRENCH LAUNCH OPTIONS



Value Engineering Process

Introduction

Value Engineering (VE) is a systematic process using a multidisciplinary team to improve the value of a project through the analysis of its functions. The VE process incorporates, to the extent possible, the values of design; construction; maintenance; contractor; state, local and federal approval agencies; other stakeholders; and the public.

The primary objective of a VE study is value improvement. The value improvements might relate to scope definition, functional design, constructability, coordination (both internal and external), or the schedule for project development. Other possible value improvements are reduced environmental impacts, reduced public (traffic) inconvenience, or reduced project cost.

Pre-VE Study

Prior to the start of a VE study, the project manager and the VE team leader carry out the following activities:

- Initiate study – identify study project and define study goals
- Organize study – conduct pre-VE study meeting and select team members
- Prepare data – collect and distribute data and prepare cost models.

All of the information gathered prior to the VE study is given to the team members for their use.

Value Engineering Job Plan

The VE team employed the six-phase VE job plan in analyzing the project. This process is recommended by SAVE International and is composed of the following phases:

Investigation/Information - The objective of this phase was to obtain a thorough understanding of the project's design criteria and objectives by reviewing the project's documents and drawings, cost estimates, and schedules.

Function - The purpose of this phase was to identify and define the primary and secondary functions of the project. A Functional Analysis System Technique (FAST) was used to quickly define the functions of the project.

Speculation/Creative - During this phase, the team employed creative techniques such as team brainstorming to develop a number of alternative concepts that satisfy the project's primary functions.

Evaluation - The purpose of this phase was to evaluate the alternative concepts developed by the VE team during the brainstorming sessions. The team used a number of tools to determine the qualitative and quantitative merits of each concept.

Development - Those concepts that ranked highest in the evaluation were further developed into VE recommendations. Narratives, drawings, calculations, and cost estimates were prepared for each recommendation.

Presentation - The VE team presented their finding in the form of a written report. In addition, an oral presentation was made to the owner and the design team to discuss the VE recommendations.

Report

Following the VE study, the team leader assembles all study documentation into the final report:

- Publish results – Prepare a draft and a final VE study report; distribute printed and electronic copies.

The VE study is complete when the report is issued as a record of the VE team's analysis and development work, as well as the project development team's implementation dispositions for the recommendations.

VE Recommendation Approval

The project manager will review and evaluate the VE team's recommendation(s) that are included in the final report. The project engineer/manager shall complete the VE Recommendation Approval form that is included at the end of this report.

For each recommendation that is not approved or is modified by the project engineer/manager, justification needs to be provided in the form of a VE Decision Document. The VE Decision Document includes a specific response for each of the disapproved or modified recommendations. Responses include a summary statement containing the project manager's decision not to use the recommendation in the project.

The completed VE Recommendation Approval form and, if necessary, the VE Decision Document shall be sent to the Statewide VE Manager by September 1 of each year so the results can be included in the annual WSDOT VE Report to FHWA. If a VE Decision Document was submitted, it shall be forwarded to the State Design Engineer for review. The VE Recommendation Approval form and VE Decision Document are to be included in the Design Documentation Package.

VE Study Agenda SR 520 Pontoon Construction Project

Monday, June 8th

- 8:00 am Team Meet and Greet
- 8:15 am Project Team presentation of the project
 - Goal and objectives
 - Constraints and controlling decisions
 - Potential risks
- 10:15 am Investigation phase - Team review project data, cost estimate and issues
- 12:00 pm Lunch
- 1:00 pm Begin Speculation (Brainstorming)
- 4:00 pm Adjourn for the day

Tuesday, June 9th

- 8:00 am Evaluation phase
- 10:00 am Continue Evaluation phase and move into Development phase
- 12:00 pm Lunch
- 1:00 pm Complete recommendations and
- 3:00 pm Present findings
- 4:30 pm Adjourn

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VE Study Attendees SR 520 Pontoon Construction Project							
2009		NAME	ORGANIZATION	POSITION/DISCIPLINE	TELEPHONE		CELL
June					E-MAIL		
8	9						
✓	✓	Robert Bittner	Bittner-Shen Consulting Engineers	Marine Construction	503	766-3562	
						rbb@bittner-shen.com	
✓	✓	Ray Castelli	Parsons Brinckerhoff	Senior Engineering Manager	212	465-5212	
						castelli@pbworld.com	
✓	✓	Blane Long	WSDOT	Design/VE	360	705-7397	
						longb@wsdot.wa.gov	
✓	✓	Richard Mogel	Ben C. Gerwick, Inc.	Senior Engineer	415	288-2754	
						richardmogel@yahoo.com	
✓	✓	Bob Murray	Parametrix	Structural Engineer	253	863-5128	
						bmurray@parametrix.com	
✓	✓	Ken Smith	HDR	Senior Transportation Manager	360	570-4415	
						ken.l.smith@hdrinc.com	
✓	✓	Endi Zhai	HDR	Geotechnical Engineer	714-	730-2320	
						endi.zhai@hdrinc.com	
✓	✓	Lynda Jensen	HDR	Technical Editor	360	224-3990	
						lynda.jensen@hdrinc.com	
✓		Brian Harris	HDR/Project Team	Casting Basin Structures Lead	206	826-4681	
						harrisb@consultant.wsdot.wa.gov	
✓		John Villager	HDR/WSDOT	Project Engineer	206	826-4747	
						villagj@consultant.wsdot.wa.gov	
✓		Alan Chan	WSDOT	Design PEO	206	770-3514	
						chana@wsdot.wa.gov	
✓		Christine Lavra	WSDOT	Civil/Manager	206		
						lavrac@wsdot.wa.gov	
✓		Bill Hegge	WSDOT	HQ Geotechnical	360	826-4710	
						heggewi@wsdot.wa.gov	
✓		Patrick Clarke	WSDOT – Bridge	Structural	360	705-7220	485-2076
						clarkep@wsdot.wa.gov	
✓		Reda Mikhail	Landau Associates	Geotechnical Consultant	425	778-0907	
						rmikhail@landauinc.com	

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Value Engineering Recommendation Approval Form

Project: SR 520 Pontoon Construction Project

VE Study Date: June 8 – June 9, 2009

Recommendation	Approved Y/N	Performance Measures							VE Team Estimated Cost Avoidance or Cost Added	Actual Estimated Cost Avoidance or Cost Added
		Improve Mainline Operations	Improve Local Operations	Improve Maintainability	Reduce Construction Impacts	Reduce Environmental Impacts	Shorten Project Schedule	Reduce Risk		
1- Gate				✓	✓	✓	✓		■	\$
2. Basin Floor					✓		✓		■	
3. Wall – Center					✓	✓	✓		■	
4. Walls – Outside					✓		✓		■	
5. Basin Concept (includes implementing 1-4)				✓	✓	✓	✓		■	

Please provide justification if the value engineering study recommendations are not approved or are implemented in a modified form.

Please return this form to: Blane Long, WSDOT HQ Design

Signature Project manager

Date

Name (please print)