

RED RIVER DIVERSION

FARGO – MOORHEAD METRO FLOOD RISK MANAGEMENT PROJECT, FEASIBILITY STUDY, PHASE 4

**Report for the US Army Corps of Engineers
and the cities of Fargo, ND & Moorhead, MN**

**Moore Engineering, Inc.; Houston Engineering, Inc.;
Barr Engineering Company; HDR Engineering, Inc.**

VOLUME 5

APPENDIX G

FINAL – Version April 19, 2011*

***Contents of this report are the same as the February 28, 2011 submittal unless otherwise specified.**

G0.0 UPDATES AFTER USACE-ATR

The methodology and summary tables of the cost estimates for the FCP and LPP that are presented in Table G1 and Table G2, respectively, correspond to the February 28, 2011 submittal of the Consultant's Report. Revisions to the cost estimates following U.S. Army Corps of Engineers (USACE) Agency Technical Review (ATR) dated April 15, 2011 have been fully addressed in Appendix L of the Feasibility Report by the USACE Project Delivery Team (PDT). For completeness, the revised summary cost estimates for the FCP and LPP are presented in Table G3 and Table G4, respectively of this April 19, 2011 submittal of the Consultant's Report. It is important to note that a contingency has been intentionally omitted from the cost estimates in Table G3 and Table G4, as the contingency will be determined by the PDT after the Cost Schedule Risk Analysis (CSRA) currently underway is completed.

RED RIVER DIVERSION

FARGO – MOORHEAD METRO FLOOD RISK MANAGEMENT PROJECT, FEASIBILITY STUDY, PHASE 4

APPENDIX G – COST ESTIMATES

Report for the US Army Corps of Engineers, and the cities of Fargo, ND &
Moorhead, MN

By: Barr Engineering Co.

FINAL – February 28, 2011

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Table G2 – LPP North Dakota Diversion – MII Cost Estimate Summary
Table G3 – FCP Minnesota Diversion – MII Cost Estimate Summary (<i>Revised 4-18-2011 following USACE Agency Technical Review (ATR)</i>)
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EXHIBITS

Exhibit A	FCP Minnesota Diversion - MII Cost Estimate (<i>Exhibit Submitted in Digital Format Only</i>)
Exhibit B	LPP North Dakota Diversion - MII Cost Estimate (<i>Exhibit Submitted in Digital Format Only</i>)
Exhibit C	Quantity Summary for Cost Estimates – FCP Minnesota Diversion
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Exhibit K	Contractor Assumptions Summary
Exhibit L	Estimate Detail Framework

APPENDIX G COST ESTIMATES

G1.0 INTRODUCTION

G1.1 Estimate Project Information and Scope

Project Title: Fargo-Moorhead Metro Flood Risk Management Project, Feasibility Study, Phase 4, Report for the U.S. Army Corps of Engineers (USACE) and the Cities of Fargo, ND & Moorhead, MN; LPP and FCP

Project Location: Cass County, ND and Clay County, MN

Software: MCACES cost estimating software MII, version 3.01 (MII)

Work Breakdown: Civil Works Breakdown Structure (as coordinated with USACE)

Costbook: 2008 Cost Book for MII (English units)

Measurements: English

Currency: August 2010 US Dollars (\$); temporal escalation to be performed by USACE

Quantities: Quantity calculations are performed by Moore Engineering, Inc., Barr Engineering Co. (Barr) and Houston Engineering, Inc. (Consulting Team)

Schedule: The schedule assumed in these estimates is the \$200 million per year funding scenario breakdown, as developed by HDR Engineering, Inc. in the report titled DRAFT – Project Phasing and Project Scheduling, dated June 11, 2010

Estimator: This feasibility construction cost estimate was compiled by Barr Engineering Co.

Inclusions (Estimates by Barr):

- 02 Relocations (Roadway Bridges & Roadway Raises only)
- 08 Roads, Railroads and Bridges
- 09 Channels & Canals
- 11 Levees & Floodwalls

Exclusions (Estimates by USACE):

- 01 Lands and Damages
- 02 Relocations (except for Roadway Bridges & Roadway Raises)

06 Fish and Wildlife Facilities (except for fishways on Red River of the North, Wild Rice River, Lower Rush River and Rush River, which are included in 09 Channels & Canals)
14 Recreation Facilities
30 Planning Engineering & Design (PED)
31 Construction Management (CM)
Other additions as determined by USACE (HTRW, contingency, environmental mitigation, habitat restorations, cultural resources etc.)

G1.2 Estimator's Qualification of Construction Cost

The feasibility level construction cost estimate provided in this report is made on the basis of Barr's experience and qualifications and represents our best judgment as experienced and qualified professionals familiar with the project. This opinion is based on project-related information available to Barr at this time, current information about probable future costs and a feasibility level design of the project.

G1.3 Estimate Type

This Consultant Appendix G of the February 28th, 2011 (Phase 4) submittal represents an updated and revised version of the Appendix G included in the January 6th, 2010 (Phase 2) submittal, the July 30th, 2010 (Phase 3) submittal, and the September 17th, 2010 submittal (Phase 3 FCP revisions). The updates and revisions have been driven by:

- Design modifications (mostly associated with changes on hydrology, unsteady flow modeling, upstream staging and storage in addition to the diversion, new geotechnical information and analysis, and different structural design criteria);
- Cost estimate changes to reflect changes to project features and new features.
- Additional design and development of the Phase 2 cost estimates was required to bring certain cost items that were at Class 4 in detail up to a Class 3 cost estimate level for Phase 3 and Phase 4.

The updates and revisions incorporate input from a number of entities, including:

- The USACE Project Delivery Team (PDT), including input received during a July 1st, 2010 workshop meeting, a February 1st, 2011 meeting and ongoing coordination through emails and conference calls;
- Comments from USACE Agency Technical Review (ATR);
- Comments from USACE Independent External Peer Review (IEPR);
- The Fargo-Moorhead Metro Technical Committee (FMMTC), with representatives from the City of Fargo, North Dakota; the City of Moorhead, Minnesota; Cass County, North Dakota; Clay County, Minnesota; and the City of Oxbow, North Dakota;
- Input from State and Federal Agencies, with representatives from the Minnesota Department of Natural Resources (MnDNR); the North Dakota Fish and Game Department (NDFGD); the North Dakota Department of Health – Division of Water Quality (NDDH-DWQ); the U.S. Fish and Wildlife Service (USFWS); the

U.S. Federal Emergency Management Agency (FEMA); and the U.S. Environmental Protection Agency (EPA).

These cost estimates, documentation and discussion are intended to provide background information for feasibility cost risk assessment and analysis purposes by the USACE and to be finalized by the USACE and used for congressional budgetary appropriation per ER 1110-2-1302. These construction cost estimates, upon their completion by USACE (to account for the exclusions listed in Section G1.1), correspond to a Class 3 (ASTM E 2516-06 Standard Classification for Cost Estimate Classification System) as outlined in Engineer Regulation ER 1110-2-1302, Table 1 and Table 2 for congressional approval of the alternative selected by USACE.

Cost estimate calculations for selected construction costs of the Current Working Estimate (CWE) have been prepared for two alternatives of the Red River Diversion, Fargo-Moorhead Metro Flood Risk Management Project (henceforth referred to as the Project), Feasibility Study, Phase 4. The two alternatives analyzed for Phase 4 include the following:

- North Dakota Alignment Alternative, Locally Preferred Plan (LPP)
- Minnesota Alignment 35,000 cfs Alternative (MN Short 35K), Federally Comparable Plan (FCP)

For this report the LPP diversion alternative is designated as the plan comparable to the North Dakota East alignment with a discharge of 35,000 cfs and no upstream staging. For Phase 4, the LPP includes upstream staging and storage immediately upstream of the diversion works in addition to the diversion. Upstream staging is incorporated for elimination of impacts on flood levels downstream of the diversion outlet.

All cost estimates are completed using the MII cost estimating program. Estimates have been completed by Barr for selected portions of the construction costs of the CWE (08 Roads, Railroads and Bridges, 09 Channels & Canals, 11 Levees & Floodwalls), with the other portions to be completed by USACE, as coordinated with USACE. The schedule assumed in these estimates is the \$200 million per year funding and construction scenario breakdown, as developed by HDR Engineering, Inc. in the report titled DRAFT – Project Phasing and Project Scheduling, dated June 11, 2010.

Summary tables of the cost estimates for the two alternatives (FCP and LPP) are included at the end of this report (see Table G1 and Table G2). Full estimates of construction costs (including breakdown of labor, equipment and materials) for both alternatives are submitted to the USACE in the form of two (2) digital MII files, which are provided as Consultant **Exhibit A** and **Exhibit B**.

G2.0 OVERALL COST ESTIMATE METHODOLOGY

G2.1 Methodology Introduction

This section summarizes the general methodology used to calculate quantity tabulations and to prepare cost estimates for the feasibility level design of the different components of the Project. The methodology used follows the requirements of the USACE. The general format of the cost estimates and key assumptions are formulated through cooperation and discussion with the USACE to reflect the Civil Work Breakdown Structure (CWBS). Project cost estimates are prepared in line with ETL 1110-2-573, Item 1.8, as estimated by a “prudent and well-equipped contractor estimating the project.”

The cost estimates provided here allow estimation of construction costs of diversion channel facilities, tie-back levees, storage area embankments, roadway bridges, railroad bridges and hydraulic structures for inclusion in the overall cost estimates of the two alternatives (i.e., the FCP and LPP). Quantities and cost estimates are calculated for constructing the following project features (numbering shown refers to categories presented in the USACE Total Project Cost Summary):

02 Relocations

- LPP & FCP Roadway bridges and road raises in the vicinity of the project

09 Channels & Canals

- LPP & FCP Diversion Channel Facilities
- LPP Hydraulic structure at Wolverton Creek
- LPP & FCP Hydraulic structure at Red River of the North
- LPP Weir between Wild Rice River and Red River of the North
- LPP Hydraulic structure at Wild Rice River
- LPP & FCP Diversion Inlet Weir
- LPP Hydraulic structure at Sheyenne River
- LPP Hydraulic structure at Maple River
- LPP Hydraulic structure at Lower Rush River
- LPP Hydraulic structure at Rush River
- LPP & FCP Diversion Outlet to the Red River of the North

Other hydraulic structures at various locations, such as where the proposed diversion channel alignments intersect existing drainage ditches or waterways

08 Roads, Railroads and Bridges

- LPP & FCP Railway facilities, railway bridges and track raises in the vicinity of the project

11 Levees & Floodwalls

- LPP & FCP Tie-back levees and floodwalls
- LPP Floodwater Storage Area 1 (embankment, inlet and outlet structures)

The designs have been carried out to a feasibility level using general hydrologic, hydraulic, environmental, geotechnical, structural and general civil design considerations. It is acknowledged that additional investigations of the alternative selected for detailed design may result in changes to the proposed configuration, estimated cost and functioning of some of the project features. This may include further investigation into:

- aquatic ecosystems
- fish passage
- ice engineering
- sediment transport and geomorphology (some of these investigations are underway)
- future revisions and updates of the HEC-RAS unsteady flow models
- future updates to the hydrology
- physical modeling, and potentially 2D numerical modeling of the more critical hydraulic structures
- detailed structural design and additional site specific information (e.g., topography, soil borings, soil mechanics laboratory tests, field-scale pile-driving tests)
- detailed bridge abutment design

USACE cost estimates for planning purposes are prepared in accordance with the following guidance:

- ER 1100-2-1150 Engineering and Design for Civil Works Projects
- ER 1105-2-100 Planning Guidance Notebook
- ER 1110-1-1300 Cost Engineering Policy and General Requirements
- ER 1110-2-1302 Civil Works Cost Engineering
- ETL 1110-2-573 Construction Cost Estimating Guide for Civil Works
- EM 1110-2-1304 Civil Works Construction Cost Index System (CWCCIS)
- Direct communications with USACE

The cost estimates presented herein do not include costs for the following categories, which are also required for a complete estimate (they will be provided by USACE or others to complete the Total Project Cost Summary):

- 01 Lands and Damages (e.g. easements, right-of-way acquisition)
- 02 Utility Relocations (e.g. electric power, natural gas pipelines, petroleum pipelines, fiber optic lines, water mains, sewer lines, local stormwater pipes, subsurface drain pipes, etc.)
- 06 Fish and Wildlife Facilities (e.g. ecological mitigation, both on-site and off-site, as coordinated with USACE on July 1st, 2010)
- 14 Recreation Facilities (e.g. multi-purpose trails, soft trails, trail river crossing(s), trailhead facilities, parking lots, interpretive signage, landscaping other than site restoration)

- 30 PED by owner
- 31 CM by owner
- Temporal escalation factors
- Contingency generated by USACE cost risk analysis
- Other items included under Exclusions as listed in Section G1.1
- Other items by USACE

G2.2 Direct Costs

G2.2.1 Quantity Calculations

Cost estimates for the project features are based on quantities calculated using:

- Digital 3-dimensional civil grading models
- The diversion channel Drawings (see Appendix D)
- The roadway bridges Drawings (see Appendix E)
- The hydraulic structure Drawings (see Appendix F)
- Engineering quantity calculations and feasibility analysis

Dimensions, areas and volumes for channel construction are determined using 3-D civil model CAD software (Bentley Microstation InRoads & Geopak, Autodesk Civil3D), existing topographic elevation information, digital drawings and comparison to similar installations. The stratigraphic soil profile was developed in coordination with USACE based on soil boring data collected, upon which Houston Engineering, Inc.'s earthwork quantity calculations for each soil type are based.

Dimensions, areas and volumes for hydraulic structure construction are determined using 3-D civil model CAD software (Bentley Microstation InRoads & Geopak, Autodesk Civil3D), 3-D structural modeling software (Revit), existing topographic elevation information, structural micro-siting, digital drawings, feasibility analysis, hand computations and comparison to similar installations. These measurements are used to generate quantity tabulations in spreadsheet and hand computation formats. Major dimensions are the result of preliminary feasibility engineering analysis. Approximations are necessary to account for less costly items (generally considered those individually representing not more than 5% of the estimated cost of a given facility/component of the project), utilizing cost engineering judgment, and are expected to be refined during detailed design. Methodology for individual cost items are included in Sections G4.0 and G5.0 of this appendix. Summaries of quantities estimated for the diversion channel, hydraulic structures and levees for each alternative are in **Exhibit C** and **Exhibit D**.

G2.2.2 Unit Prices and Work Analysis

Unit prices are based on work analysis, crew productivity estimates, contractor conversations, estimates based on typical observed costs, similar diversion works projects, material quotes from suppliers, recent bid prices, published construction cost index resources and the 2008 English Cost Book for MII cost estimating software (MII

version 3.01). Unit prices developed are compared with historical project costs, including:

- Winnipeg Red River Floodway and Expansion Projects
- Grand Forks Red River Floodway Feasibility Study
- Grand Forks Phase 1 and 2 Levee Projects
- Breckenridge Flood Reduction Project
- Sheyenne River Diversion
- Rose Coulee Pump Station Feasibility Study
- Roseau Flood Damage Reduction Project
- East Grand Forks Heartsville Coulee Diversion
- Grand Forks English Coulee Diversion
- North Dakota Department of Transportation (ND DOT) Price Sheet Lists (2009 and 2010)
- Other local and regional projects
- Bid results for USACE projects in the New Orleans region and other regions.
- Barr staff experience while working for heavy contractor as field engineer and estimator/project manager

A listing of projects referenced is in **Exhibit G**.

The work analysis approach was coordinated with USACE and guided the development of the Phase 3 and Phase 4 cost estimates. Work analysis was performed for key cost items by developing assumptions for material costs, crews and productivities in the MII software. Guidance Document ETL 1110-2-573, Section 3.2.5.2 recommends focusing work analysis on the 20% of the project elements that generate 80% of the estimated costs. Phase 2 estimated costs were analyzed to determine which items generated 80% of the estimated costs, and to identify work items on which to perform work analysis (assigning crews, productivities, etc.) for Phase 3 and Phase 4 estimates. **Exhibit L** shows a summary of this analysis for construction items (08 Roads Railroads & Bridges, 09 Channels and Canals, 11 Levees & Floodwalls) from the Phase 2 Total Project Cost Summary. **Exhibit L** also shows a summary of the analysis for selected items from Phase 2, omitting items for which detailed work analysis is not provided, pending additional detailed design refinement. These summaries identify the Phase 2 items that together exceed 80% of the estimated construction costs for categories 09 (Channels & Canals), 08 (Roads, Railroads and Bridges) and 11 (Levees & Floodwalls). These items are the focus of work analysis efforts. Certain grouped construction items exceeding 5% of the total estimated construction cost are grouped together as single systems for the purposes of calculating estimated costs, as coordinated with the USACE. Selected lesser cost items (lump sum user costs) are allocated an assumed percentage of labor, materials and equipment based on past projects, experience and engineering judgement.

Feasibility work analysis for large cost items such as earthwork, piles, concrete, steel reinforcement, hydraulic gates, sheet piles, riprap, site restoration, etc. was performed and is included in the MII files. Labor and Equipment MII reports which illustrate crew laborers and individual pieces of equipment are included in **Exhibit A** and **Exhibit B** for

reference. **Exhibit E** contains calculations and information used to help formulate earthwork crews and productivities for the Project.

Feasibility work analysis for roadway bridges was performed outside of the MII program to determine the percentage of labor, materials and equipment and is included in **Exhibit G** for reference. These percentages are also used for railroad bridges in the MII program. A breakdown of quantities and costs for roadway bridges and road raises is included in **Exhibit I**. A breakdown of quantities and costs for railroad bridges is included in **Exhibit J**.

G2.2.3 Wage Rate Assumptions

Wage rate assumptions were coordinated with the USACE. Conversations with contractors were also used to develop wage rate assumptions. Due to a competitive labor market and the likelihood of large contracts attracting a regional and/or national workforce, rates higher than the local Davis-Bacon minimum rates are assumed. Guidance Document ETL 1110-2-573, Section 4.3.1.2 indicates that higher rates may be used if warranted by market conditions.

Wage rate assumptions were developed in coordination with USACE in response to Agency Technical Review (ATR) Comment 3079992 from Phase 2, citing the need to address possible wage rate variations between states (ND and MN). A review was performed to analyze potential variations in wage rates for North Dakota Davis-Bacon rates, Minnesota Davis-Bacon rates as well as regional rates and Twin Cities union rates. Rates have been formulated to include an overtime rate and an allowance for subsistence (\$7.50/hour, non-taxed). **Exhibit K** attached shows a summary of these wage rate comparisons. Labor rates include an overtime rate for time over 8 hours per shift per worker. For skilled workers, the estimates apply Twin Cities Davis-Bacon wage rates for both work in ND and MN. For basic laborers, the estimates apply Cass County, ND Davis-Bacon wage rates for work in ND and Clay County, MN Davis-Bacon wage rates for work in MN. Varying workers' compensation rates are applied according to the state and work task of the laborer for each type of contractor in the estimate. For example, a structural steel worker commands a higher workers' compensation rate than a common laborer. This rate also varies by the state.

The assumed work schedule is 10 hour shifts, 1 or 2 shifts per day, 6 to 7 days per week depending on the season, 10 to 12 months per year. Because the project is being constructed in predominantly rural areas, it is assumed that work can be conducted in a manner not restricted by a municipal working day or work hour restrictions.

Equipment rates for work analysis are the Equipment Region 4 rates available in the MII software program.

G2.2.4 Tax Assumptions

Tax assumptions are coordinated with USACE. Differing sales tax rates and wage rate taxes are assumed for work in MN (6.875%) and ND (5%). A summary of tax assumptions is included in **Exhibit K**.

G2.3 Indirect Costs

Contractor assumptions for the MII estimates were coordinated with the USACE. Contractor assumptions are developed in the estimate to reflect one possible scenario by which the work could be constructed. Other scenarios are certainly possible, and it is anticipated that the next stage of design will look into some other contractor scenarios. These contractor assumptions apply to items in estimate groups 09 Channels & Canals and 11 Levees & Floodwalls. These assumptions do not apply to cost estimate group 08 Roads, Railroads and Bridges, as discussed in Section G3.1 and Section G3.2 below.

The cost estimate assumes the work is performed by a prime general contractor performing management duties, and one layer of discipline-specific subcontractors performing work tasks, which often occurs on large, complex projects. However, this arrangement and the estimated costs are assumed to be applicable to each 1-year to 2-year phase of the \$200M/year funding scenario utilized, as discussed during the July 1st, 2010 meeting with USACE. A summary of contractor assumptions is included in **Exhibit K**. Brief summaries of available indirect costs from referenced historical projects and USACE cost estimates are included in **Exhibit G**.

G2.3.1 Prime Contractor Assumptions

G2.3.1.1 Job Office Overhead

Job Office Overhead (JOOH) costs are those that occur specifically as a result of a particular project (not general operations and maintenance activities) and include contractor supervision, field engineering, surveying, quality control, testing, shop drawings, safety and security, temporary offices, permits and fees, travel, vehicles, supplies and other miscellaneous items to run a field office. JOOH rates are individualized by contractor. A JOOH of 5% is assumed for the prime contractor. This is assumed to cover all estimated costs associated with mobilization/demobilization for the prime contractor. This percentage assumes the prime contractor functions as a management company in this estimate and does not incur significant costs to manage the fleet of equipment (rather, this cost is incurred by the subcontractors). The prime contractor is assumed to not be performing the role of a subcontractor for facilities/components of the Project. A summary of contractor assumptions is included in **Exhibit K**.

G2.3.1.2 Home Office Overhead

Home Office Overhead (HOOH) is commonly referred to as general and administrative (G & A) cost. Typical estimated costs associated with HOOH are the contractor's main

office, furniture and equipment, equipment yard, management and staff, office utilities, corporate vehicles, business insurance and taxes. A HOOH of 5% was used for the prime contractor. A summary of contractor assumptions is included in **Exhibit K**.

G2.3.1.3 Mobilization/Demobilization

Mobilization/demobilization includes all costs required to furnish construction equipment and supplies at the beginning, during and at the end of the Project. The prime contractor is assumed to have no mobilization/demobilization (0%), as the prime contractor is assumed to be performing a managerial role only. The prime contractor is assumed to not be performing the role of a subcontractor for facilities/components of the Project, and it does not have significant field equipment mobilization needs beyond that covered under JOOH. A summary of contractor assumptions is included in **Exhibit K**.

G2.3.1.4 Profit

Contractor profit is determined using USACE weighted guidelines method (ETL 1110-2-573, Section 5.3.3) to calculate the percentage for prime contractor profit at 9%. **Exhibit K** attached shows weighted guidelines profit calculations performed to help develop the assumed rate.

G2.3.1.5 Bonding

All government construction contracts require the contractor to provide a Performance and Payment Bond. The assumed percentage rate for Performance and Payment Bond Premium is 1% (running percent) for the prime contractor. **Exhibit K** attached shows a calculation to help develop the assumed percentage rate for Performance and Payment Bond Premium.

G2.3.2 Subcontractor Assumptions

G2.3.2.1 Job Office Overhead

JOOH rates are individualized by subcontractor. This is assumed to include a small tools allowance. ATR Comment 3080002 from Phase 2 recommended using a percentage for Job Office Overhead (JOOH) between 10% and 15% for structural work. A JOOH of 10% is assumed for steel, concrete and pile subcontractors. A JOOH of 7% is assumed for the earthwork subcontractor. In both cases, the JOOH for the subcontractors is in addition to that considered for the prime contractor, see Section G2.3.1.1 for additional information. A lower JOOH on earthwork is assumed based on less overhead compared to that associated with structural work, and was developed in coordination with USACE following ATR. A summary of contractor assumptions is included in **Exhibit K**.

G2.3.2.2 Home Office Overhead

HOOH rate of 5% is used for all subcontractors. The HOOH for the subcontractors is in addition to that considered for the prime contractor. A summary of contractor assumptions is included in **Exhibit K**.

G2.3.2.3 Mobilization/Demobilization

Mobilization/demobilization is included in the estimates as a markup of 5% for subcontractors. This markup for the subcontractors is in addition to that considered for the prime contractor. A summary of contractor assumptions is included in **Exhibit K**.

G2.3.2.4 Profit

Subcontractor profit is determined using USACE weighted guidelines method (ETL 1110-2-573, Section 5.3.3) to calculate a subcontractor profit at 5%. Estimated subcontractor costs (including all indirect costs) are considered direct costs to the prime in accordance with Guidance Document ETL 1110-2-573, Section 4.7.2.2. **Exhibit K** attached shows weighted guidelines profit calculations performed to help develop the assumed rate.

G2.3.2.5 Bonding

No subcontractor bonding is assumed (0%). Liability is allocated to the prime contractor in this estimate. A summary of contractor assumptions is included in **Exhibit K**.

G3.0 RELOCATIONS

This section summarizes cost estimate information related to relocating transportation bridges and facilities as a result of the Project.

G3.1 Road Bridges & Road Raises

Road bridge and road raise costs are estimated for each alternative and included under estimate section 02 Relocations. Costs are used in the range of \$105/SF to \$125/SF. Conversations with contractors indicate that an estimated cost (before contingency) of \$120/SF is in the upper range of typical bridge costs. A review of historical bridge costs (see **Exhibit G**) indicated that construction costs are typically below \$120/SF. Given this fact, a 10% contingency was used for these estimated costs. Preliminary work analysis was performed (outside of MII) on a typical roadway bridge for this estimate, and the split was 48% material, 25% labor plus burden, 6% equipment and 21% other costs (6% construction expenses, 10% subcontracting expenses and 5% other). A summary of this preliminary work analysis is in **Exhibit G**. Estimated roadway bridge and road raise quantities and costs are in **Exhibit I**. Although hydraulic modeling performed for Phase 4 assumed 7H:1V (LPP) or a combination of 7H:1V and 10H:1V (FCP) channel slopes at bridge crossings, cost estimates assume bridge crossings for the full width of the benched channel cross section (i.e. non 5H:1V slopes) for both ND and MN alternatives. This assumption is conservative cost-wise, and any surplus cost is intended to cover costs of potential slope stabilizations at these locations, if side slopes steeper than the benched diversion cross section are desired in subsequent stages of design. Road raise quantities and costs for the LPP include those required at Cass County 17, I-29 and Highway 75 at the upstream staging area. Both the FCP and LPP require road raises due to tieback levees. Estimated costs developed include all costs for contractor direct costs, indirect costs and markups and are therefore included in the estimate under a no-markup contractor in the MII estimate.

Roadway reconstruction costs and road raises due to levee construction are estimated. A summary of quantities is presented in **Exhibit I**.

G3.2 Railroad Bridges

Railroad bridge costs are estimated for each alternative and included under estimate section 08 Roads, Railroads & Bridges. A similar procedure (work analysis outside of MII) was used to develop contingency, labor and material costs as shown in the Road Bridges section above. Cost information for railroad bridges (both LPP and FCP) and relocating the rail yard in Dilworth, MN (FCP) was provided by TKDA and Moore Engineering, Inc. The estimate includes a 35% contingency for railroad bridges (structure only), 30% contingency for track raises at railroad bridges (included as part of the bridge cost in the MII cost estimate) and a 31% contingency for relocation of the railroad yard in MN. Estimated railroad bridge quantities and costs are included in **Exhibit J**. Estimated railroad raise costs for one raise in the LPP are included in

Exhibit I. Costs developed for railroad bridges included all costs for contractor direct costs, indirect costs and markups and are therefore included in the estimate under a no-markup contractor in the MII estimate.

G4.0 DIVERSION CHANNEL COST CONSIDERATIONS

This section summarizes cost estimate information related to constructing the diversion channel. Major cost items are discussed. Lesser cost items are included in the estimate but are not discussed here. For additional information about the diversion alternative corridors see Appendix D Civil Design. Diversion channel quantities and costs are organized according to the \$200 million per year funding scenario breakdown, as developed by HDR Engineering, Inc. in the report titled DRAFT – Project Phasing and Project Scheduling, dated June 11, 2010. A summary of construction reaches, quantity tabulations and assumptions developed by Houston Engineering, Inc. is presented in **Exhibit H**. Detailed assumptions, unit costs and project costs are included in output from the MII software in **Exhibit A** and **Exhibit B**.

G4.1 Topsoil Stripping and Stockpiling

It is assumed that the contractor will strip and salvage 12 inches of topsoil from work areas. This assumption could change with additional soil boring information along the diversion corridor and at the hydraulic structure locations. Two moves of topsoil are assumed, as it is stripped and stockpiled, and the second when it is taken from the stockpile and placed in the channel and on spoil berms during site restoration work. In most cases, the easement acquisitions are agricultural crop land and will not require clearing and grubbing. Nominal quantities of clearing and grubbing are included. Additional soil boring and soil analysis data will reduce uncertainty with earthwork assumptions. Topsoil quantities for suitable topsoil stripping are based on channel and spoil pile plan areas multiplied by the depth of 12 inches. Topsoil stripping volumes are not subtracted from channel excavation volumes. This assumption is conservative. Dimensions shown on Drawings and quantities in the Appendix G Exhibits are preliminary, pending detailed design. Preliminary work analysis was used to estimate a unit cost for topsoil stripping and stockpiling that is found comparable to similar historical projects. The estimate assumes scraper crews stripping material over the channel excavation areas and stockpiling at the edges. Spoil berm topsoil is assumed to be stripped and stockpiled with dozer crews. A summary of this work analysis is presented in **Exhibit E**. A summary of quantities by construction reach, quantity tabulations and assumptions developed by Houston Engineering, Inc. is presented in **Exhibit H**.

G4.2 Excavation and Embankment

Preliminary work analysis was used to estimate a unit cost for excavation-related earthwork. Unit costs are estimated using productivity rates calculated from equipment information, historical project references (such as productivity rates in the MII program and in RS Means cost references) and conversations with contractors. Dimensions shown on Drawings and quantities are preliminary, pending more detailed design efforts.

Preliminary work analysis is used to estimate unit costs for excavation and embankment for four different assumed material types based on available soil boring data, material characterization and stratigraphic profiles developed in coordination with USACE. Crews and productivities are developed for each material (predominantly clay material; see Exhibit L of Appendix F for geotechnical information). Factoring for material shrink and swell are incorporated into productivity calculations. Swell was assumed to be 15% from bank excavation to haul, as coordinated with USACE. Unit prices developed are found to be comparable to similar historical projects in the region, such as the Manitoba Floodway Expansion (see **Exhibit G**).

In addition to the number of borings obtained by USACE and the associated corridor soil profile, soil boring data was obtained from the following projects:

- 1) Red River Bridge Corridor Study, 76th Avenue South
- 2) Proposed Bridge Replacement CB2001 County Highway 81 over Wild Rice River
- 3) Geotechnical Design Report Rose Coulee Pump Station
- 4) Stability Evaluation of Conceptual Diversion Channel and Levee Construction Wild Rice River, South Side Flood Control
- 5) South Side Flood Control – South University and 52nd Avenue South Segments
- 6) South Side Flood Control – River Keepers Pinch Point and Existing University Drive Levee 52nd to 64th Avenues South

The volume of each type of excavation is calculated by Houston Engineering, Inc. based on the stratigraphic profiles developed in coordination with USACE, based on a number of soil borings performed by the Corps of Engineers. Digital 3-D grading models (Bentley Microstation InRoads and Geopak) are developed to calculate volumes of excavations in bank cubic yards. Earthwork quantities are calculated using the average end area method using cross sections at 100 foot intervals as well as at specific stations. Channel cross sections vary along the diversion alignment to accommodate changing soil conditions and excavation depths. Cut and fill are balanced within each reach to the extent possible by varying spoil pile dimensions. No-spoil areas are defined as within 200 feet upstream and downstream of bridges, within 100 feet upstream and downstream of local drainage structures. Abrupt changes in cross section are assumed at no-spoil transitions. Shrinkage and swell are assumed 1:1 for spoil pile placement assuming minor amounts of compaction, as coordinated with USACE. Different equipment crews and productivity rates are assumed for each material type as discussed below (for more detailed calculations and information see **Exhibit E**).

Type 1 and Type 2 excavation crews are assumed to be push-pull scraper crews with dozer crews performing spoil spreading. Tractor dozers are assumed for the purposes of maintaining haul road areas. Type 2 crew productivity is assumed to be lower than Type 1 productivity due to increased moisture content in the material and potentially decreased workability.

Type 3 and Type 4 excavation crews are assumed to use hydraulic excavators and off-road articulated haul trucks carrying material to the spoil berms. Type 4 crew productivity is assumed to be lower than Type 3 due to the softer type 4 material's

potentially reduced workability and longer haul distances as work proceeds towards the diversion channel centerline and deeper below existing grade. Tractor dozers are assumed in the Type 3 and 4 crews for the purposes of maintaining haul road and loading areas. It is assumed that Type 4 material can be excavated with the excavator sitting on more supportive Type 3 material and reaching down to excavate the Type 4 material, with a tractor dozer beneath performing shaping on the Type 4 material. Both Type 3 and Type 4 crews assumed a loader/backhoe in the haul crew for the purposes of scraping material stuck to the truck beds, if necessary. Alternatively, this additional loader/backhoe cost could represent truck-bed units equipped with ejector blade systems.

Images from similar earthwork techniques applied in Manitoba floodway construction/expansion, images of City of Fargo borrow pits, summary of crews and equipment work analysis is presented in **Exhibit E**. A summary of construction reaches, quantity tabulations and assumptions developed by Houston Engineering, Inc. is presented in **Exhibit H**.

Barr incorporated information obtained from the following contractors in developing pricing for earthwork:

- 1) Wanzek Construction - Fargo, ND
- 2) Veit Construction – Rogers, MN
- 3) Hugh Munro Construction – Canada

In addition, average excavation and disposal costs on fourteen contracts for the recent Winnipeg floodway expansion project of the Manitoba Floodway Authority was obtained from Rick Hay, Manager – Floodway Channel for comparison.

Copies of the telephone memos and meeting minutes recording contractor information are in **Exhibit F**. The contractors suggest possible equipment to use for various conditions in clay. Blow counts and moisture content of the clay are used to determine when self loading scrapers are no longer used and a track mounted hydraulic excavator is required. It is assumed that hauling distances are no longer than the adjacent embankment and that only minor compaction work will be performed by disk-drying material and applying nominal sheepfoot rollers as needed.

Hugh Munro Construction has worked on the channel expansion in Winnipeg and worked on the original Winnipeg diversion project. They indicated that it was not possible to work on soils in the rain and that a construction ditch to capture surface water was essential to maintaining drainage during construction. A strategy that proved successful in that project, but is not included in these cost estimates, was excavation of softer material in the winter when it is firmed due to freezing. In this method, areas of softer soil are left exposed to freezing temperatures and then removed with self-propelled scrapers or tractors with pan scrapers. Future estimating efforts should investigate the applicability of this technique and its potential benefits in terms of schedule and cost.

Significantly additional site-specific soil boring and soil analysis information is required to provide greater certainty on the designs and cost estimates. Fluctuations in water table,

permeability, soil gradations, shrink/swell factors, settlement behavior, optimum moisture and compaction requirements could affect design and cost assumptions.

Fluctuation of fuel costs could also have a major impact on the unit price of earthwork items because of the requirement to use heavy equipment performing at high rates of productivity. Nothing has been included in this feasibility cost estimate to account for future changes in fuel costs because we assume that the USACE-PDT will weigh these fluctuations in the escalation factors and project cost risk assessment considerations. Therefore, the assumed fuel costs (on-road diesel, off-road diesel and gasoline) assumed in the MII estimates presented here are from the 2008 equipment library only. Revisions of the fuel costs are recommended in detailed design to use more current data such as from the US Energy Information Administration at: <http://tonto.eia.doe.gov/oog/info/gdu/gasdiesel.asp>. However, it is worthwhile highlighting that construction of the proposed project will take several years.

G4.3 Riprap and Aggregates

Preliminary work analysis was used to estimate a unit cost for installing riprap. The estimated material cost for riprap was based on similar type projects as well as a material price quote from Aggregate Industries in Fargo-Moorhead ranging from \$38.50/ton (Class III riprap) to \$42.50/ton (Class V riprap), delivered. Riprap shown on Drawings is an allowance pending further design efforts to better determine necessity, protection extents and sizing. Uncertainty exists in the unit price for very large sizes of stone, should they be required by additional phases of design. Conversations with suppliers indicated riprap would likely be imported by train on a regional basis. Uncertainty exists in the quantity of riprap, due to the fact that riprap has not been sized using a detailed engineering analysis. More in-depth analysis of flow velocities at the hydraulic structures will reduce uncertainty, and add or subtract to assumed layer thicknesses shown on Drawings of both riprap and underlying filter aggregate. 2-Dimensional velocity modeling was used to develop preliminary riprap protection extents. Where soft underlying soils exist (such as on Brenna clays), riprap may be installed in the winter, as was performed for portions of the Winnipeg, Manitoba Floodway. A similar strategy could be used to install the low-flow channel in these weaker soils. Nominal amounts of snow removal are included in the estimates at hydraulic structures and in each diversion channel reach to facilitate riprap installation. Additional design refinement and velocity modeling may identify locations of high localized velocities that could require more robust protection, such as concrete sills or baffling, neither of which is included in this estimate. Dimensions shown on Appendix F Drawings and quantities included in Appendix G Exhibits are preliminary, pending more detailed design efforts. Copies of the telephone memos and meeting minutes recording contractor information are in **Exhibit F**. A summary of construction reaches, quantity tabulations and assumptions developed by Houston Engineering, Inc. is presented in **Exhibit H**.

G4.4 Topsoil Placement

Topsoil is assumed to be placed from stockpiles of topsoil removed from the site. It is assumed the contractor will sequence work to eliminate excessive hauling or the need to import topsoil. Channel excavation quantities include a 4 inch over-excavation for topsoil placement in the channel. Topsoil placement in the channel excavation was an assumed 4 inch depth to the limits of the cross sectional cut areas. The remainder of suitable topsoil was placed on top of spoil piles and is 1.25 to 1.5 feet in depth. Topsoil stripping/stockpiling/placement volumes are assumed to balance. Preliminary work analysis is used to estimate a unit cost for topsoil placement that was comparable to similar historical projects. The estimate assumes scraper crews placing topsoil from stockpiles near the edges over the channel excavation areas. Berm topsoil is assumed to be placed from stockpiles by dozer crews. A summary of this work analysis is in **Exhibit E**. Dimensions shown on Drawings and quantities included in Appendix G Exhibits are feasibility level, pending detailed design efforts. Additional soil boring and soil analysis data will reduce uncertainty with earthwork assumptions. Future efforts during detailed design should investigate other topsoil handling patterns to eliminate double-handling of the material and to potentially reduce costs. A summary of construction reaches, quantity tabulations and assumptions developed by Houston Engineering, Inc. is presented in **Exhibit H**.

G4.5 Site Restoration

Native prairie seeding (including cover crop) and disk-anchored straw mulching of disturbed areas are assumed. Estimated costs for two years of vegetation establishment and maintenance are included, to encourage establishment of vegetation. The estimated costs assumed are to achieve vegetative stabilization with deep-rooted native prairie and meadow and do not include costs for more complex native plant community ecological restorations or other plantings. Costs for other additional landscaping, trees and plantings are provided by USACE. Dimensions shown on the Drawings and quantities included in the Appendix G Exhibits are preliminary, pending detailed design efforts.

The cost estimates incorporate installation cost information and material pricing information obtained from the following contractor and seed suppliers:

- 1) Prairie Restorations, Inc.
- 2) Shooting Star Native Seed

A summary of construction reaches, quantity tabulations and assumptions developed by Houston Engineering, Inc. is presented in **Exhibit H**.

G4.6 Tie-Back Levees and Storage Area 1 Embankment

The LPP includes both Tie-Back Levee 2B into Minnesota, the Storage Area 1 Embankment, and the Cass County 17 Tie-Back Levee. Tie-back levees are also presented with the FCP. Cost estimates for Tie-Back Levees and Storage Area 1 Embankment assume a 15% shrinkage factor based on direction from the USACE.

Additional soil boring and soil analysis data will reduce uncertainties with earthwork assumptions. Dimensions shown on the Drawings and quantities are preliminary, pending additional design efforts. The same crews that are developed for the diversion channel earthwork are used for tie-back levees. However, additional crews are included to compact levee material.

Preliminary work analysis was used to estimate a unit cost for levee embankment earthwork. Unit costs are estimated using productivity rates from equipment information, historical project references and conversations with contractors. Field Manual No. 5-434 (U.S. Army, 2000) is used to estimate levee compaction effort and productivity. Additionally, the cost of similar levees constructed recently in Roseau, Breckenridge and Grand Forks was referenced to develop levee unit costs in the MII files.

Estimated costs are included for road raises and railroad track raises associated with tie-back levee construction, and are discussed in Sections G3.1 and G3.2 above.

Dimensions shown on Drawings and quantities are preliminary, pending more detailed design efforts. A summary of levee quantity tabulations and assumptions developed by Houston Engineering, Inc. is presented in **Exhibit H**.

G4.7 Miscellaneous

Some earthwork could be conducted during late fall, early spring and some winter periods. Work related to the low flow channel and riprap installation could be performed when the ground is frozen to take advantage of enhanced traffic on softer soils (for example, on areas of Brenna clay).

For information regarding other lesser cost items that are included in the estimate, see Section G5.1.10 below.

G5.0 HYDRAULIC STRUCTURE COST CONSIDERATIONS

This section summarizes feasibility cost estimate information related to constructing the hydraulic structures. Detailed assumptions, unit costs and project costs are included in output from the MII software in **Exhibit A** and **Exhibit B**. The structural design of the hydraulic structures, including loads, load combinations, reinforced concrete design, pile design, sheet piles, and assumptions are described in Appendix F, Section 4.0. The structural design performed for Phase 4 is at the feasibility level only and is intended only to support the feasibility cost estimate.

G5.1 Considerations for All Hydraulic Structures

The following discussion identifies important cost estimate considerations common to all proposed hydraulic structures for the alternatives. The final structure types and construction costs of these structures will depend on analysis performed and decisions made during feasibility, permitting, detailed design and during construction.

G5.1.1 Overall Global Factors

A global factor that could affect the estimated cost of all structures is the hydrology used to compute flows and structure hydraulics. Each phase of the feasibility study has been accompanied by a new round of hydrology. In some cases the new hydrology has changed substantially with a corresponding significant impact up the size and cost of the hydraulic structures. Most of the hydrology in early phases focused on the main stem of the Red River of the North. During final design the hydrology for the Red River of the North might still need to be revised. During this phase significant revisions were provided for the hydrology on the tributaries. During final design, tributary hydrology will likely be further refined as a result of the current modeling efforts going on associated with those watersheds. Each of those structures has been sized to account for flows in the diversion, coincidental flows in the tributary and local floods on the tributary. Refining the coincidental analysis of the diversion flows as they are associated with given flood events on the tributaries will be valuable information for the final design that may result in significant cost changes to the structures in this project.

An additional global factor that could significantly impact costs for all structures is how upstream and downstream impacts are dealt with. Designs developed in previous phases were focused on maintaining upstream water levels south of the metropolitan area to pre-project levels. This resulted in downstream impacts that extended for a significant distance. During this Phase 4 another flood management strategy was chosen that mitigates downstream impacts by staging and storing flood waters upstream of the metropolitan area. This has had a significant effect on project design and on some individual structure costs though the total project cost was not substantially impacted.

The previous phases have bracketed the estimated impacts by analyzing a condition during Phase 3 where all the impacts were pushed downstream and a condition during this Phase 4 where all impacts were stored upstream of the project. Lower water levels south of the project will result in shorter structures, shorter tie back levees and shorter fish passages among other things. A reduced drop across the project could result in lower velocities at many points as well, and that in turn may result in a reduction in energy dissipation and erosion control related costs. However, it will also likely result in an increased channel cross section, and potentially larger structures in some cases. A balanced impacts option could also result in the complete elimination of the need for Storage Area 1 with its associated land costs.

Other global factors could include material shortages; specifically riprap. Construction of flood control features at Devils Lake and other areas has resulted in the potential for the cost of rip rap to rise should local sources be exhausted. Finally, items such as the price of fuel, steel, concrete and the general economy will also affect costs globally.

G5.1.2 Concrete and Reinforcement

Preliminary work analysis was used to estimate a unit cost for concrete-related work, including forming, reinforcing, pouring and stripping and is included within the MII cost estimate files. Dimensions shown on Appendix F Drawings and quantities included in Appendix G Exhibits are preliminary, pending additional design efforts.

The cost estimates incorporate pricing information obtained from the following contractors and concrete suppliers

Contractors:

1. Barr staff experience while working for heavy contractor as field engineer and estimator/project manager
2. Lunda Construction - Rosemount, MN
3. Midwest Concrete Pumping – Fargo, ND
4. Obayashi/PSM JV

Suppliers:

1. Cemstone – Mendota Heights, MN
2. Strata Ready-Mix – West Fargo, ND
3. Aggregate Industries – Moorhead, MN
4. Cretex Concrete Products (Precast Beams)

The cost estimate is based on material prices for concrete supplied by Aggregate Industries. The estimate assumes a footing concrete material cost of \$106.40/CY plus tax, and a concrete material cost of \$109.90/CY plus tax for piers, walls and all other concrete. A material-only cost equating to a 5% waste volume was included for concrete. All concrete pours are assumed to be placed with a pump truck. The average cost of the pump truck adds \$10/CY to each concrete pour. Miscellaneous concrete accessories including curing compounds are added by an “other cost” of \$7/CY.

Forming, Pouring, and Stripping (FPS) cost are broken into a square foot cost of the forming area. Crew size and production varied for footing, walls, piers, decks, and mass concrete as a function of the degree of difficulty of the form work required. Typical crews used for heavy construction work are assumed.

Quantities of concrete are based on assumed sizes and simplified structural calculations. It is assumed that all construction will occur in non-freezing conditions. Costs for winter construction have not been included (daily temperatures below 40 deg F), when material costs would be higher during winter construction to heat the aggregate and water at the batch plants. In addition, the contractor would need to heat and provide additional freeze protection of concrete during curing. Costs for cold weather concrete work are not included in the cost estimate.

In developing pricing for steel reinforcing Barr incorporated information obtained from the following contractor and rebar supplier:

- 1) J & L Steel Erectors – Hudson, WI
- 2) Sioux City Foundry – Sioux City, IA

Estimated cost of furnishing and installing rebar was based on the material quotes \$0.41 / LB and installation cost of \$0.40 / LB. An additional cost of hoisting the rebar was also included in the installation cost.

Steel reinforcement for reinforced concrete for the structures was not designed. Rebar quantities for reinforced concrete are based on Lb /CY ratios obtained from similar type concrete structures.

Uncertainty is associated with reinforcement and concrete quantities include that associated with the volume of concrete required for each structure, design changes resulting from additional site and geotechnical information, reinforcing requirements based on future structural design and future fluctuations in global commodity prices.

G5.1.3 Piles and Foundations

Preliminary work analysis was used to estimate a unit cost for piles and foundations. Dimensions shown on Appendix F Drawings and quantities included in Appendix G Exhibits are preliminary, pending detailed design efforts.

In developing pricing for piling, the estimates incorporate information obtained from the following contractor and piling suppliers:

- 1) Lunda Construction – Rosemount, MN
- 2) Skyline Steel – Chicago, IL
- 3) LB Foster Company – Oak Brook, IL

For the concrete structures on the Project, it was determined that a pile foundation was necessary to provide a suitable foundation whereby the piles go through the clay layer into the competent till. Both drained and undrained properties of the soils are used to

assess the ultimate pile capacities. Factors of safety based on load classification (usual, unusual, extreme) are applied to the ultimate capacities to calculate pile capacities. This estimate assumes HP 14X73 piles at the foundations.

Boring data was reviewed near each structure to determine the competent till elevation. Based on the available geotechnical data it was assumed that a 5 foot penetration into the till would be required. The final pile tip elevation varies at each structure. Piles are assumed to be embedded 1 foot into the pile cap/footings.

Estimated cost of furnishing steel piles was based on the material quotes and installation cost was based on a crew driving 65 LF/HR. Nominal costs for unloading piles and splicing are also included in the cost estimates for piles.

A significant uncertainty in piling costs is the actual final pile quantity. The drained (long-term) capacity of the soils controls the capacity of the piles. For the usual load case, the pile capacities are as low as 31 tons. The review of existing bridge plans in the area indicate pile capacities of 60 tons and 100 tons. Testing of the till is necessary to give more certain properties at the structures and to justify higher pile capacities. Additional soil boring and soil analysis data can reduce uncertainty with pile and foundation assumptions.

G5.1.4 Sheet Piles

Preliminary work analysis was used to estimate a unit cost for steel sheet piling work. Dimensions shown on Appendix F Drawings and quantities included in Appendix G Exhibits are preliminary, pending more detailed design efforts.

In developing pricing for steel sheet piling Barr incorporated information obtained from the following contractor and steel sheet pile suppliers:

- 1) Lunda Construction - Rosemount, MN
- 2) Skyline Steel – Chicago, IL
- 3) LB Foster Company – Oak Brook, IL

Estimated cost of furnishing piles was based on the material quotes. Installation cost was based on a crew driving 5 pairs/hr. Nominal costs for unloading piles and cut-offs are also included.

Quantities for sheet pile cut-off walls are assumed based on the Drawings. Sheet piles used to construct the weirs are based on preliminary wall designs using the USACE program CWALSHT. For final design, borings at the site will be necessary and both drained and undrained conditions of the soil should be checked. Additional soil boring and soil analysis data will help reduce uncertainty with sheet piling assumptions.

G5.1.5 Hydraulic Gates

Preliminary work analysis was used to derive a cost for the hydraulic gates. Costs are developed for the Red River Control Structure gates and applied on a unit-basis to gates for the other structures. Dimensions shown on the Appendix F Drawings and quantities in the Appendix G Exhibits are preliminary, pending detailed design efforts.

In developing pricing for tainter gates Barr obtained information on costs from Rodney Hunt based on an assumed gate size of 30' x 20' (\$240,000 or \$400/SF). It should be noted that without drawings they are reluctant to give any type of costs. Actual gate costs will be very dependent upon additional detailed design detail.

Gate sizes and gate weights from the USACE projects around the country are referenced. Based on the existing gate sizes and weights Barr assumes that gates on this Project will weigh about 100 LB/SF. PDM Steel and Lunda Construction indicated that plate girders on bridges are currently costing \$1.50 / LB and the current raw price of steel is \$0.55 / LB. Tainter gates feature bending material and more members than a simple plate girder. Assuming fabrication cost 2.5 times more than a simple plate girder, the gates would cost \$325 /SF without tax or freight. This cost information confirms that \$400/SF is a reasonably conservative estimate for feasibility.

It is assumed that the gates would need to be assembled in the field. Barr assumed that a crew could assemble each gate in 9 working days based on a 10 hour shift. Hoisting devices will add additional cost to each gate.

Uncertainty with gate costs will be reduced with future detailed design and better understood operational and structural requirements.

G5.1.6 Hydraulic Structure Earthwork

Preliminary work analysis was used to estimate unit costs for earthwork by material types. The same crews, productivity and costs are used as are used for the diversion channel earthwork items. Earthwork was calculated with a digital 3-D grading model using existing and proposed grading for the structure sitework, including approach and exit channels, spoils and levees. In general, quantities for earthwork at structures include diversion channel excavations upstream and downstream of the centerline of each structure. The distances varies by structure, and in most cases are greater than the distances used in Phase 3 to ensure spillway and fish passage grading is within the structure grading extent. This increased site work costs from Phase 3 at hydraulic structures, but it should be noted that this occurs with a corresponding shortening (and quantity reduction) for the adjacent reaches of the Diversion Channel. Earthwork for the Diversion Channel and at hydraulic structures was not double counted.

Hydraulic modeling was performed for the Sheyenne and Maple River approaches and exit channels assuming 5H:1V side slopes. Quantity calculations for these areas also assume 5H:1V side slopes. Haul quantities are included to account for material movement out of no-spoil areas. Earthwork volume allowances are included at each

hydraulic structure location for temporary earthwork and excavations in the immediate vicinity of walls, etc. Uncertainty exists in the quantity of this earthwork pending additional site geotechnical and topographic information.

In general, the sites of individual hydraulic structures on tributaries are assumed to be alongside the existing tributaries. Construction outside of the existing tributary channel is assumed (i.e. in dry areas). This requires excavating a new channel to the structure location from the waterway. Exceptions to this in-the-dry construction configuration are three closure/drainage structures (which are assumed to be constructed in existing lower-flow drainageways):

- LPP Storage Area 1 Structure (N) in the north embankment of SA1
- LPP Storage Area 1 Structure (E) in the east embankment of SA1
- LPP Drain 14

Regarding flooding risk during construction, the estimate assumes a temporary earthen levee set back around the immediate work area of each hydraulic structure, constructed to the 10-year frequency flood event (Phase 3) water surface elevation. This assumption was coordinated with USACE and should be refined with design. Risk of events above this minimum protection level is assumed to be outside the scope of the CWE.

Dimensions shown on Appendix F Drawings and quantities included in Appendix G Exhibits are preliminary, pending additional design.

G5.1.7 Low-Flow Channel and Erosion Control of Main Channel Lower Banks

A low flow channel is provided at the bottom of the diversion channel for conveying overland drainage to the rivers. An armored toe (embedded riprap) is provided at the base of the diversion channel excavated slope. The low flow channel is designed to meander about the bottom of the diversion channel. The toe armoring prevents it from undermining the excavated channel slopes. Periodic rock grade control will set the invert elevation of the low flow channel throughout the diversion channel. The cost of ecological mitigation features at the low flow channel are provided by USACE. See also the discussion in Section G4.3 Riprap and Aggregates above.

G5.1.8 Ice/Debris Handling Measures

An item for floating ice booms is included at each hydraulic structure, but not at road or rail bridges. Feasibility level design alternatives are discussed with Andy Tuthill of the USACE Engineering and Research Development Center: Cold Regions Research and Engineering Laboratory. No ice-deflection piers are included in the cost estimate. Significant uncertainty exists in both the unit price and quantity of the ice booms. Other methods for ice control, such as concrete piers are not included in the cost estimate but could be considered in future detailed design. The design and estimated cost of an ice-handling system is customized to local site conditions and is difficult to estimate at this stage of design. Cost estimates for floating ice/debris boom included herein are based upon conversations with BMC Fleet Technology and referencing historical costs from ten projects, as shown in **Exhibit G**. Dimensions shown on Appendix F Drawings and

quantities included in Appendix G Exhibits are preliminary, pending additional detailed design efforts.

No costs are included to retrofit structures upstream of the new structures due to modified ice flow conditions resulting from construction of the hydraulic structures. A high degree of uncertainty related to unit cost and quantity exist for ice handling measures at hydraulic structures.

G5.1.9 Fish Passage Systems

The cost estimates include fish passages at key locations. Cost estimates are included for fish passage systems at selected hydraulic structures:

- FCP Red River Control Structure
- LPP Red River Control Structure
- LPP Wild Rice River Control Structure
- LPP Lower Rush River Drop Structure
- LPP Rush River Drop Structure
- LPP Outlet to the Red River

Dimensions shown on Drawings and quantities included in Appendix G Exhibits are preliminary, pending more detailed design efforts.

Pricing was based on costs observed in similar scale projects (similar head drops, but generally shorter lengths and/or smaller widths) including:

1. Milestone River (BC, Canada) – 2,800 ft length, 6 ft width, 90 ft drop; \$450,000 Canadian, or about \$18.30 per square foot US including gates.
2. Belvidere Dam (Belvidere, IL) – approx. 10 ft drop; \$800,000 for fish bypass.
3. Batavia Dam (Kane Co., IL) – approx. \$1,000,000 associated with fish and canoe passage via a whitewater cut –through (i.e. bypass channel), excluding overbank armoring.
4. Elmendorf Dam (Anchorage, AK) – 300 ft long, 12 ft drop; \$550,000.

The unit costs (per square foot of footprint extent) used for this cost estimate appear to be at the upper end of the referenced projects.

The fish passage feasibility level designs in general utilize wall openings or multiple gates leading to downstream series of pools and riffles to provide fish access at rising flood levels. This design iteration incorporates specific site conditions and topography at the site of the passages. Additional phases of design should optimize the design of pools and riffles for desired velocity regime, minimum depth criteria, gate functionality, and conditions necessary for specific species of aquatic life. Options should be considered that reduce the footprint of the system if possible to help reduce cost. Options should be considered that reduce the number and size of gates.

The estimated cost of fish passage systems could be reduced if fish passage is sacrificed at higher flood flows at selected hydraulic structure locations. A moderate degree of

uncertainty related to unit cost and high degree of uncertainty related to quantity exist for fish passage measures at the hydraulic structures.

G5.1.10 Ecological Mitigation and Enhancement

Cost estimates for ecological enhancements are estimated by USACE and not discussed here in the Consultant Appendix G, as coordinated with USACE on July 1st, 2010.

G5.1.11 Miscellaneous

In general, for lesser cost items for which work analysis are not performed, allowances are estimated using cost engineering judgment or by scaling costs and sizes from similar projects. These designs and costs are to be further refined with additional design. Cost estimates for less costly project features are developed to include:

1. The sites of individual hydraulic structures, including the Red River Control Structure are assumed to be within 1 mile of existing 3-phase electrical utilities and roadways. Where possible, distances to existing electrical utilities are determined and used in the estimate. Operable gate systems at hydraulic structures are assumed to require 480V, 3-phase electrical utilities to operate internal hydraulic pumps.
2. Erosion and sedimentation control, dewatering and control of water allowances are included for the diversion corridor and at each hydraulic structure location, as well as for the diversion channel as a whole. Total costs for these items are developed to be at levels comparable to historical project references.
3. Allowances for site preparation and some traffic control are included at each hydraulic structure and diversion channel reach. Major detour construction costs are not included. Total costs for these items are developed to be at levels comparable to historical project references.
4. Allowances for clearing and grubbing areas with tree and brush are included at each hydraulic structure location and diversion channel reach.
5. Permanent aggregate-surfaced access roads are included at each hydraulic structure. These costs assume purchased aggregate material. Salvaging of aggregate from roadways removed for construction of the diversion channel is assumed to supplement the quantities and costs provided for the purposes of haul road and possible traffic augmentation in the lower portions of the diversion cross section. Costs for salvaging and placing this material are currently not included in the estimate.
6. Costs for Supervisory Control and Data Acquisition (SCADA) are included at each hydraulic structure. An allowance is included at each control structure, intended to cover costs for central data gathering at a location to be determined in future design refinement.
7. Costs associated with restoring local roadways damaged during construction are included for each hydraulic structure and each reach of the diversion channel. Allowances are determined in an approximate fashion, and should be further refined in additional stages of design.

8. Costs are included to connect some local roadways interrupted by the channel corridor.
9. Costs are included for lower-flow debris handling measures at hydraulic structures.
10. Costs are included for lesser-cost small drains and ditching on the unprotected side of the diversion channel.
11. Costs are included for deck heating of winter low flow channels at the Maple and Sheyenne River aqueduct structures.
12. Costs are included for a maintenance facility/storage building at each of the large hydraulic structures. No water or sewer service lines are included.
13. For a full listing of other lesser cost items included, please see the quantity summary in **Exhibit C** and **Exhibit D**.

Cost estimates for less costly project features are developed to not include:

1. Paved roads, paved parking facilities and permanent storm sewerage crossings under haul roads.
2. Sanitary sewerage and communications utilities to/from each hydraulic structure are not proposed in this phase of design and are not included.

G5.2 Considerations Specific to Individual Hydraulic Structures

The following discussion identifies important design considerations unique to each proposed hydraulic structure for the current design scheme proposed. Each structure has been conceptually sited within the existing terrain at each site. There are estimated costs to account for the following considerations at each hydraulic structure:

- Site layout and grading, which ties into surrounding topography and surface features
- Hydraulic capacity for the design event based on Phase 4 Hydrology and HEC-RAS unsteady flow modeling for the LPP and on Phase 3.1 Hydrology and HEC-RAS steady flow modeling for the FCP.
- Structural dimensions based upon resulting design flood (500 year) water levels at each structure. This includes 500 year flows in the diversion and the associated coincidental flows in the tributaries and 500 year flows in the tributaries and the associated coincidental flows in the diversion.
- Pile capacities based on geotechnical analysis of data gathered from the field (though not always data gathered at each exact structure location)
- Slopes and retaining walls accounting for geotechnical stability calculated from field data (though not always data gathered at each exact structure location)
- Site access to all key parts of each structure during a design flood event
- Costs to prevent construction on FEMA deed restricted properties
- Structural dimensions based on load conditions approved by the Corps including ice loads and hydraulic uplift. The structural design of the hydraulic structures, including loads, load combinations, reinforced concrete design, pile design, sheet piles, and assumptions are described in Appendix F, Section 4.0. The structural

design performed for Phase 4 is at the feasibility level only and is intended only to support the feasibility cost estimate.

- Fish passage as agreed to with the regulator agencies
- Operation and maintenance facilities at each structure
- Electrical power and SCADA at each structure
- Erosion control
- Debris and ice handling features
- Other items not listed here

The following structures were assumed to be built in the dry at locations that are reasonably accessible:

- The LPP & FCP control structures on the Red River of the North and the LPP Wild Rice River
- The LPP Sheyenne and LPP Maple River Aqueducts
- The LPP Lower Rush and LPP Rush Drop Structures
- The LPP main diversion inlet and outlet ogee spillways
- The FCP main diversion inlet and outlet
- The LPP Wolverton Creek Closure/Drainage structure

Four additional major structures were considered and are assumed to be built in the main drainage channel with which they are associated. These structures are located on intermittent drainageways. They include:

- LPP Storage Area 1 North Closure structure
- LPP Storage Area 1 East Closure structure
- LPP Drain 14 Drop structure

This discussion will focus on factors that could cause the quantities to vary significantly and to a lesser extent, on factors that could cause the unit prices to vary significantly. Land area will be discussed where appropriate but not the specific value of the land, which is assumed to be a USACE consideration. Each structure will be reviewed from the standpoint of function, site, and in some cases other considerations.

Following is a structure specific discussion of the potential for cost variation.

G5.2.1 Red River Control Structure

Function. The main gated structure will change based on desired function, i.e. range of operation for the given total gated width. This is not expected to change significantly from what has been presented in Appendix F Hydraulic Structures, unless hydrology changes or significant modifications of the design to handle ice are considered necessary in the detailed design. The structure is already wide enough to pass expected ice slabs but further design is needed in this area. Due to the staging and storage concept being used in this phase costs are NOT included for ice and debris handling facilities upstream of this structure. The reason for this is that no concentrated flood flows are generated as a

result of staging. Instead large inundated areas will allow ice to dissipate rather than plug a channel. Gate widths should allow normal ice flows to pass during non flood events.

Alternatively, a wide central bay with narrower side bays could be found a preferred arrangement. Another potential functional change could be the inclusion of recreational features such as boat ramp access or trails that would affect the main structure. These facilities are being handled by the Corps and no specific costs are included in the estimates. Additionally, if the closure structure is given a dual purpose of also being a bridge for vehicle traffic across the Red River of the North the design would change. At this time the structure has been designed to allow for low speed vehicle traffic on the operators deck for maintenance purposes only. The structure already includes fish passage. However if the conditions of the fish passage designs become more stringent or restrictive some additional costs would be incurred. Design has assumed a variable submerged orifice coefficient for all gates (see Appendix F for details). Boat traffic could also result in some changes. Currently if boats pass through the structure they will pass under an open tainter gate. During final design it is possible that the type of gate or bulkhead selected for the central bay, or other changes to the structure layout could be modified to better accommodate boat traffic.

Site. Now that a specific site has been selected less variability is expected due to this consideration. An important point to note is that while this feasibility level of design includes geotechnical considerations in the vicinity of the site, they generally are not based on data gathered right at the proposed structure location. Geotechnical assumptions have been conservative for this design. Specifically as they relate to pile capacity. Site specific geotechnical investigations and soil property characterization as they relate to slope stability, soil strength parameters, permeability and other soil parameters could impact the cost of this structure. Issues that could impact cost include soil properties different than those currently assumed, unanticipated communication of work areas with groundwater, etc. Current pile capacities are based on the drained case which has resulted in very weak piles. Those used at this location are among the weakest on the project. There is a strong likelihood that during final design higher-capacity piles will be used resulting in some decrease in costs. Physical modeling will be performed for the structure built on the Red River of the North. It is possible that the way this structure fits into the existing specific channel configuration will result in structural modification based on the physical modeling that could affect estimated cost.

Other considerations. It is currently assumed that placing the control structure in Minnesota (for both the LPP and FCP), thereby moving the centerline of the Red River of the North eastward from its existing position will not change the state line between North Dakota and Minnesota, and therefore no costs are required to accommodate it. Regulatory costs and timeline associated with a structure on the Red River of the North will also be a variable as such a structure affects two states and multiple cities and counties. Regulatory coordination costs are not included in the construction cost estimates. If upstream impacts are mitigated by moving some impacts downstream then this structure would likely get shorter and less expensive as a result. Fish passage costs would likely fall. Another potential impact is Wolverton Creek. Hydrology and

hydraulics associated with Wolverton Creek are still at a feasibility level. At this time it appears that this will most likely only affect gate operation on this structure and not its size or cost.

G5.2.2 Diversion Inlet Ramp

Function. The function of the inlet structure is relatively straight forward and will not likely change. Fish passage from the diversion into the staging area upstream of the diversion inlet of from there to the Wild Rice River or the Red River of the North is not currently part of the feasibility structure, nor part of the cost estimate. If this function is added a significant cost increase would occur. The structure drops water into the diversion from the staging area with a significant head across it during design events analyzed during this Phase 4 analysis. The current design includes a very robust structure that utilizes mass concrete in the form of an ogee spillway. If a balanced approach to upstream and downstream impacts results in a significant reduction in head across the inlet then a less massive concrete structure or a multiple sheet pile weir concept may be warranted.

Site. The site is immediately adjacent to Cass CR 17. A bridge for this road is planned to cross the diversion. For this project it is assumed that the two structures are independent of each other. It is possible that a future design could include a concept to integrate the two structures into one to save costs. An important point to note is that while this feasibility level of design includes geotechnical considerations in the vicinity of the site, they generally are not based on data gathered right at the proposed structure location. Geotechnical assumptions have been conservative for this design. The basic structure consists of sheet pile cells to control erosion. If site specific geotechnical information results in more or deeper piles required then the estimated cost could go up.

The current concept includes ice and debris control measures. This is one of the more critical places where ice and debris control are needed. It is possible that the width of the ramp as currently designed, 90 feet, and the nature of the storage area will result in the determination that no ice or debris control is needed but until that determination is made control measures are assumed.

Other considerations. This phase of work did not include a full analysis of hydraulic conditions during low flow events for the feasibility design. During final design a full assessment of head and tail water conditions should be undertaken and may result in a changed design.

If upstream impacts are mitigated by moving some downstream it is possible that less head will be available across the entire project. This could result in a larger weir with lower velocities. The larger weir would push estimated costs up while the lower velocities could result in a reduction in erosion control required.

G5.2.3 Red River Outlet Structure

Function. The function of the outlet structure has changed from Phase 3. This is a result of a significant increase in the elevation of the invert of the diversion channel. As a result there is a significant drop from the diversion into the Red River of the North where the channels meet. This structure is now proposed to be a mass concrete ogee ramp. Since the drop is significant the scour energy potential is high. Rip Rap is still included for additional scour and erosion protection along the banks of the Red River at the intersection with the diversion. In previous phases the design was focused on bank stabilization and protection from diversion channel flow. While this consideration remains the main portion of the structure is now focused on dissipating the energy associated with the drop. Potential functional changes that could affect estimated cost include a more detailed analysis of tail water associated with various design events.. Preliminary analysis of Red River flood events indicates that high flows in the diversion are always accompanied by high tail water conditions in the Red River. This could lead to the idea that a much less costly outlet structure such as a sheet pile weir concept, narrower ogee or hybrid two-stage outlet could be acceptable.

However, before such a decision is made a more thorough analysis of low flow events in the Diversion Channel and tributary flood events are needed since they could result in substantial flows over the outlet structure when tail water in the Red River is low. In such a case, a massive ogee ramp could still be needed but it may be possible to reduce the total width of the concrete section and transition the structure to other more cost effective materials. This could reduce costs for the sections associated with events which include high tail water on the Red River of the North.

Furthermore if future efforts result in balancing impacts between upstream and downstream, greater flows in the diversion are likely along with a lower invert in the diversion itself. Depending on the specific changes this could result in significant changes to the outlet structure.

Recreational features such as boat navigation considerations and trails could also affect quantities and costs. Fish passage into the diversion channel is planned for in this phase. If significant habitat mitigation is needed in this area it would also affect the design of the channel armoring and may impact costs. Finally if the function of the outlet must incorporate additional ice control features then costs could also rise. Additional investigation related to the interaction of the outlet structure with ice during both normal river flows and flood events is warranted. Finally, sedimentation in the section downstream of the structure and before the point where the diversion meets the Red River of the North is also a concern that should be addressed in final design.

Site. Now that a specific site has been selected these considerations are less likely to affect estimated cost. An important point to note is that while this feasibility level of design includes geotechnical considerations in the vicinity of the site, they generally are not based on data gathered right at the proposed structure location. Geotechnical considerations are a significant issue. Poor soils may require some design modifications but slopes are already very conservative and should not change significantly.

Other considerations. Regulatory costs associated with a structure at the Red River of the North could also be a variable as such a structure affects two states and multiple cities and counties. Regulatory costs are not included in the construction cost estimates. If upstream impacts are mitigated by moving some impacts downstream then the extent of erosion protection required at the outlet could be affected.

G5.2.4 Hydraulic Structure on the Wild Rice River (ND)

Function. The main gated structure on the Wild Rice will change based on desired function which, like the structure on the Red River of the North, is not expected to change significantly. Possible functional changes would include modifications of the design to handle ice. The structure is already wide enough to pass expected ice slabs but further design is needed in this area. The current design and cost estimate includes ice and debris handling measures upstream of the structure. Another potential functional change could be the inclusion of recreational features such as boat ramp access or trails that would affect the main structure. It is assumed that the Corps will identify and address such features and include them in their portion of the cost estimate for this project. Additionally, if the closure structure is given a dual purpose of also being a bridge for vehicle traffic across the Wild Rice the design would change. At this time the structure has been designed to allow for low speed vehicle traffic on the operators deck for maintenance purposes only. The structure already includes fish passage. However, if the conditions of the fish passage designs become more stringent or restrictive some additional costs would be incurred. The complexity of this structure is very similar to the Red River of the North structure but the complexity of the flow in front of the structure is greater during flood events. It is possible that further analysis of the flow conditions created by the diversion crossing the Wild Rice River near this structure will create the need for additional features not considered to this point. Ice handling is less complicated under this phase since the staging concept results in less concentrated flows during flood events. However, the potential for sedimentation associated with the staging of flood waters is greater now than in previous phases and warrants additional investigation. Design has assumed a variable submerged orifice coefficient for all gates (See Appendix F for additional discussion). If refinements to the Wild Rice River hydrology results in increases to peak flow rate or depth during local flood events, then the function of this structure could be changed to provide additional protection not considered in the current design.

The Wild Rice structure is located adjacent to the inlet for Storage Area 1. Should future project planning and design result in the elimination of Storage Area 1 then it is possible the exact site or orientation of this structure would change. A detailed analysis of how Storage Area 1 will operate is needed to determine if it would affect the operation of the Wild Rice structure after the peak of a flood when the storage area is emptying back toward the front of the Wild Rice structure. Timing of gate operation may need to be significantly lagged to allow the area to drain to the diversion rather than allowing it to drain via the Wild Rice in order to control potential erosion.

Site. Now that a specific site has been selected less variability is expected due to this consideration. An important point to note is that while this feasibility level of design includes geotechnical considerations in the vicinity of the site, they generally are not based on data gathered right at the proposed structure location. Geotechnical assumptions have been conservative for this design. Specifically as they relate to pile capacity. Current pile capacities are based on the drained case which has resulted in very weak piles. There is a strong likelihood that during final design higher-capacity piles will be used resulting in some decrease in costs. Site specific geotechnical investigations and soil property characterization as they relate to slope stability, soil strength parameters, permeability and other soil parameters could impact the estimated cost of this structure. Physical modeling may be performed for the structure and features in its vicinity. It is possible that the way this structure fits into the existing specific channel configuration will result in structural modification based on the physical modeling that could affect cost. Given the complex interaction between the staging area, Storage Area 1, the Diversion Channel and the Wild Rice River geomorphologic considerations could also require changes to prevent sedimentation or scour. There is also a significant amount of overland flooding in the area between the Wild Rice River and the Red River of the North. Estimated costs could rise or fall depending on how the overland flooding issues are controlled and how staging occurs.

Other Considerations: If upstream impacts are mitigated by moving some impacts downstream then water levels at this structure and at the storage and staging areas would change. This could result in lower water levels and a shorter structure on the Wild Rice.

G5.2.5 Hydraulic Structure on the Sheyenne River (ND)

Function. The function of the structure for tributary crossing of the diversion is relatively clear; an open channel over a culvert. Flow mixing during major floods does NOT occur. The main functional considerations now include fish passage into the protected area 100% of the time and no gate operation (see Exhibit D of Appendix F for additional discussion). One functional change could be the desire to add gates on the protected side of the aqueduct to provide additional control of flow conveyed into the protected area, and that would add costs. Additionally, if lower head loss is needed on the diversion then a wider and more costly crossing would be needed, conversely if more head loss is allowed a narrower less costly crossing would be acceptable. In previous phases the design was based on HEC-RAS steady flow modeling. During this phase HEC-RAS unsteady flow modeling was used to size the hydraulic structure at the Sheyenne River. If recreational features are added that must cross the diversion channel at this crossing then costs would increase. While some heating is assumed in the deck to maintain winter operation it is possible that during final design additional heating may be desired which would result in an increase in costs. It is also possible that no heating will be needed resulting in lower costs. At this time the spillway connecting the tributary flood flows to the diversion channel consists of a series of four wide sheet pile weirs and a corresponding series of plunge pools. This was selected to limit the use of concrete and steel but is a land intensive solution requiring additional area to construct. A cost comparison was done to see if an ogee ramp would be more cost effective. Preliminary

analysis indicated that an ogee ramp would be significantly more costly but the analysis did not include land costs or consider an ogee ramp tied directly into the aqueduct itself. It is possible that such a structure could significantly reduce land costs and result in less total cost. Ice considerations may result in design modifications though this is not expected. The current feasibility level design includes ice and debris handling measures. Finally, the sediment load in the Sheyenne is relatively high and it is possible the final design will require modifications to pass the bed load in a more efficient manner to either the protected side or to the diversion channel. At this time fish passage from the diversion up into the Sheyenne is not included in the design. If this changes, estimated costs would rise.

Site. The invert and cross sections of the tributary channels was taken from the HEC-RAS unsteady flow model developed for this Phase 4 analysis (see Appendix B for additional discussion regarding the source data for cross sections and tributary channels used in developing the HEC-RAS unsteady flow model. It is possible that detailed surveys could show the invert of the tributary at a different elevation, leading to changes in the design. This could raise or lower estimated costs, but it is not estimated to be a significant change. Geotechnical concerns will affect costs. An important point to note is that while this feasibility level of design includes geotechnical considerations in the vicinity of the site, they generally are not based on data gathered right at the proposed structure location. The aqueduct structures produce significant loads and poor soils have been assumed during this design. As with the other structures weak piles have been assumed. During final design it is likely that higher capacity piles will be used resulting in lower costs. Site specific geotechnical investigations and soil property characterization as they relate to slope stability, soil strength parameters, permeability and other soil parameters could impact the estimated cost of this structure.

G5.2.6 Hydraulic Structure on the Maple River (ND)

Function. The function of the structure for tributary crossing of the diversion channel is relatively clear; an open channel over a culvert. The main functional considerations now include fish passage 100% of the time into the protected area (see Appendix F for additional discussion), and gate operation is no longer needed as was the case during Phase 3 (see Appendix F for additional discussion). This structure has benefitted from moving downstream impacts upstream. If upstream impacts are balanced by moving some downstream a significant consideration should be to prevent a condition where tail water rises to the point that the structure is again overtopped during design events as it was in earlier phase concepts. Lower tailwater allows more flow to pass under the structure and lowers the access bridge that is currently set on top of the aqueduct.

Currently the design has been based on HEC-RAS unsteady flow modeling. Phase 4 analysis indicates that there are currently small impacts to the existing floodplain south of the Maple River near Drain 14. During final design, it may be desired to route some flows from Drain 14 to the Maple to minimize impacts on the existing floodplain. It is possible that if future designs alter the allocation of flows between the Maple River and Drain 14 could result in modifications to the costs associated with this structure. If

recreational features are added that must cross the diversion channel at this crossing then costs would increase. While some heating is assumed in the deck to maintain winter operation it is possible that during final design additional heating may be desired which would result in an increase in costs. It is also possible that no heating will be needed resulting in lower costs. At this time the spillway connecting the tributary flood flows to the diversion channel consists of a series of four wide sheet pile weirs and a corresponding series of plunge pools. This was selected to limit the use of concrete and steel but is a land intensive solution requiring additional area to construct. A cost comparison was done to see if an ogee ramp would be more cost effective. Preliminary analysis indicated that an ogee ramp would be significantly more costly but the analysis did not include land costs or consider an ogee ramp tied directly into the aqueduct itself. It is possible that such a structure could significantly reduce land costs and result in less total cost. Final ice considerations may result in design modifications though this is not expected. Ice and debris handling measure are including in this feasibility level design and costs. Access to the unprotected side during the design flood has been included in the current feasibility level design and cost estimate. Flooding conditions on the unprotected side need to be carefully evaluated at this location.

Site. The invert and cross sections of the tributary channels was taken from the HEC-RAS unsteady flow model developed for this Phase 4 analysis (see Appendix B for additional discussion regarding the source data for cross sections and tributary channels used in developing the HEC-RAS unsteady flow model). It is possible that detailed surveys could show the invert of the tributary at a different elevation, leading to changes in the design. This could raise or lower estimated costs, but it is not estimated to be a significant change. Geotechnical concerns will affect costs. An important point to note is that while this feasibility level of design includes geotechnical considerations in the vicinity of the site, they generally are not based on data gathered right at the proposed structure location. The aqueduct structures produce significant loads and poor soils have been assumed during this design. As with the other structures weak piles have been assumed. During final design it is likely that higher-capacity piles will be used resulting in lower costs. Site specific geotechnical investigations and soil property characterization as they relate to slope stability, soil strength parameters, permeability and other soil parameters could impact the estimated cost of this structure.

G5.2.7 Hydraulic Structure on the Lower Rush River, Rush River and Drain 14(ND)

Function. The structures at the Lower Rush and Rush Rivers and Drain 14 are relatively simple in functionality. The main functional considerations for the rivers include fish passage up from the diversion channel with no gate operation. The main functional consideration for Drain 14 is to provide a drainage connection to the Diversion Channel. Currently the design has been based on HEC-RAS unsteady flow modeling. If recreational features are added at this location then estimated costs would increase. A possible functional change would be to reorient the drop structures to aim downstream at the diversion channel. This would increase costs. Final design needs to further address tail water effects to the existing floodplain at these locations. Current hydrology results in flood levels outside the diversion being higher than in the diversion during extreme

events. If this changes tie back levees and back flow prevention may be needed. Under some alternative concepts interior drainage pump station(s) may also be needed but this is not considered likely at this juncture. Flooding conditions on the unprotected side need to be carefully evaluated at these locations utilizing detailed topographic information.

During final design a more detailed review of structure hydraulics is needed; specifically to address the total capacity needed during a design flood event. For the Rush and Lower Rush it is possible that the fish passage as currently designed can also pass enough water so that the drop feature and associated connected concrete wall section of each of these structures are not needed. This could easily cut the cost of the structure by 1/3 to 1/2.

Site. Now that a specific site has been selected less variability is expected due to this consideration. An important point to note is that while this feasibility level of design includes geotechnical considerations in the vicinity of the site, they generally are not based on data gathered right at the proposed structure location. Site specific geotechnical investigations and soil property characterization as they relate to slope stability, soil strength parameters, permeability and other soil parameters could impact the cost of this structure. Geotechnical assumptions have been conservative for this design. Specifically as they relate to pile capacity. Current pile capacities are based on the drained case which has resulted in very weak piles. There is a strong likelihood that during final design higher-capacity piles will be used resulting in some decrease in costs.

A substantial additional cost savings could be realized if during future stages planners and designers consider completely eliminating the Lower Rush Structure. Flows from this river could be routed at grade along the west side of the diversion all the way north to the Rush River where a single combined drop structure and fish passage could be constructed. A similar option should be considered to possibly eliminate the Drain 14 structure by routing that flow north at existing grade to the Maple River and constructing a single combined structure at that location.

G5.2.8 Other Hydraulic Structures (ND LPP and MN FCP)

Function. Small drainage structures are included in the cost estimates to provide a drainage connection into the Diversion Channel. These small drainage structures are relatively simple drop structures and do not make up a substantial portion of the cost estimate. Changes if they did occur would not result in significant estimated costs. During the higher flood events water is above ground surface at some of these locations on the ND alignment. Back flow prevention is currently included in the feasibility level design. Under some alternative concepts interior drainage pump station(s) may also be needed but this is not considered likely at this juncture. Flooding conditions on the unprotected side need to be evaluated at these locations.

Site. Site considerations will not have significant impacts on most of these structures since they are not nearly as large as the others considered.

G6.0 CONTINGENCY

G6.1 Estimate Contingency

This section summarizes important cost estimate considerations related to contingency levels referenced in the previous sections and used to obtain project costs. The contingency recommendations here will be taken into consideration during the Cost and Schedule Risk Assessment, after which the final contingency will be presented in the Total Project Cost Summary.

Contingencies used in this estimate are intended to help identify an estimated construction cost amount for the items included in the current Project scope. The contingency includes the estimated cost of ancillary items not currently shown in the quantity summaries but commonly identified in more detailed design and required for completeness of the work. Contingency as used herein.

The contingency provided with the estimate does not:

- account for uncertainties in quantities;
- account for uncertainties in unit pricing;
- include changes in scope during detailed design or construction;
- include changes or revisions to hydrologic, hydraulic, environmental, geotechnical, structural or civil design criteria;
- include costs that may result from differing site conditions determined during design or construction;
- include costs that may result from construction change orders;
- include costs that may result from sequencing or expediting work to avoid critical path slippage;
- include costs that may result from possible project schedule slippage;
- include costs that may result from differing economic conditions or future cost growth;
- cover items that change from the current Project scope (e.g., does not cover changes on the diversion flows, flood water storage areas, the alignment of the diversion channel, or the location of the hydraulic structures).

Contingencies are assigned to the cost estimate of each project feature on the basis of engineering judgment and on the completeness of project definition. Contingency, as used in this cost estimate, will decrease with future design efforts. Assigned contingencies are as follows:

- 10% for Road Bridges. Historical bridge costs are well-documented and are used to develop the cost estimates for the bridges. Bridge costs are developed using a cost per square foot, which was based on comparative actual costs of bridges of similar size and type. The selected contingency is intended to include the cost of ancillary items that will be identified during final design.
- 35% for Railroad Bridges (structure only) (per USACE direction).

- 30% for Railroad track raises (track raises are included under Railroad Bridge costs in the MII cost estimate, resulting in a net contingency between 30% and 35% for both a bridge and track raise).
- 31% for relocation of the Railroad yard in Minnesota (per USACE direction)
- 50% for small flow control structures. The smaller hydraulic structures on the drainage features (small drains, large drains, side inlet control structures and side channel control structures) along the diversion alignment are allocated a contingency of 50%. This contingency was based on engineering judgment and in consideration of the typical designs presented herein. In later, more detailed phases of project definition, the potential for individual hydraulic structures at these locations vary from the typical dimensions shown is high. The quantities and unit prices presented reflect the higher cost items at each structure. The contingency is assigned to address limited project definition.
- 50% for floodwalls – very minor component of the FCP with limited project definition.
- 25% for the Storage Area 1 embankment. Feasibility design of the embankments began in the current Phase 4 of this study. Pending additional site specific geotechnical information to confirm the geotechnical slope stability analysis as well as the availability of sufficient Type 1 and Type 2 materials for construction of the embankment in the immediate vicinity, we consider that a somewhat higher contingency (in comparison to the other earthworks items associated with the Diversion Channel) is warranted for this facility.
- 20% for all other items, including diversion channel, tie-back levees and hydraulic structures, and other items. This contingency is within the -15% to +30% recommended per ER 1110-2-1302, Table 1 for a Class 3 Estimate (without changed conditions), and it is justifiably smaller than the 25% contingency used in the Phase 2 cost estimates because of the additional characterization of hydrologic and geotechnical conditions as well as better definition of slope stability and structural design considerations (per USACE direction).

G6.2 Uncertainty and Risk Discussion

The contingencies, cost estimates, documentation and discussion provided are intended to provide background information for feasibility cost risk assessment and analysis purposes by the USACE for contingency-appropriation purposes, and to identify areas where additional design effort in future stages of refinement could significantly reduce uncertainty of the project cost.

Unknowns have been identified that could affect project designs and costs, and are not included in the project costs or contingencies provided with the cost estimate. These unknowns could affect design assumptions, pending more detailed design and information, including the following:

- additional requirements resulting from further hydrologic and hydraulic numerical and physical modeling, and additional design requirements resulting from this;
- additional development of final structure site selection and topography;

- unanticipated construction phasing requirements;
- uncertain seasonal flood prevention requirements associated with operating construction sites near the Red River of the North and its tributaries;
- feasibility level information of soil properties, soil geotechnical characterizations and soil strength parameters due to soil boring spacing and pending future development of shrink/swell data;
- development of operational and maintenance procedures;
- uncertainty regarding dewatering and control of water pending final construction critical path for the main components of the project and overall;
- uncertainty regarding dewatering and control of water pending additional site-specific geotechnical data (for example, if sand seams exist in areas currently assumed to have impermeable clay soils);
- seasonal working condition uncertainties and extended schedule, including possible reduced efficiencies of second-shift workers working in non-daylight hours, the cold of winter, etc;
- changes to laborer work shift assumptions;
- unanticipated utilities at hydraulic structure locations, including communications utilities or unmarked or abandoned utilities;
- unanticipated fluctuations in fuel costs and material costs;
- unanticipated fluctuations in interest rates and the time value of money;
- additional development of the construction contracting and acquisition strategy;
- unexpected or site-specific geotechnical or groundwater issues;
- unexpected hazardous waste or soil/groundwater contamination;
- lawsuits;
- unexpected design requirements resulting from permitting;
- encountering unexpected historic sites, archaeological sites, endangered species or wetlands;
- delays in property, utility and easement acquisition;
- unanticipated requirements from drought planning activities;
- unanticipated requirements from drinking water supply protection measures;
- unexpected seismic considerations;
- unanticipated subsurface agricultural drain tile flows and abandonment/rerouting measures;
- additional investigation into geomorphology and sediment transport;
- additional requirements resulting from future unsteady flow modeling;
- additional requirements resulting from further investigation of ice behavior;
- additional investigations into ice and debris handling at hydraulic structures;
- unanticipated funding stream delays;
- unanticipated local, regional, national or global economic conditions;
- unanticipated project requirements resulting from investigations of upstream and downstream impacts due to the Project;
- additional requirements resulting from investigations of allowable pile capacity design criteria, such as pile driving tests;
- changes to contractor assumptions;

- additional requirements resulting from further investigation of ecological impacts and required mitigation;
- additional requirements resulting from refinements in slope stability analysis;

G7.0 RECOMMENDED FUTURE REFINEMENT

To reduce cost uncertainties, future phases of cost estimating work should, at a minimum address the following:

- Finalize the hydrology;
- Finalize the unsteady state modeling;
- Detailed design must include a critical path analysis for the primary project features and the project overall to match construction costs and funding allocation with possible construction sequencing and schedule;
- Perform site specific pile load tests to determine pile capacities for use in final design;
- Gather more site specific geotechnical information to more completely determine soil properties;
- Future design efforts to determine if any paved or more robust roadways are required at any of the hydraulic structure locations;
- Some future local mapping (county, township, property meets and bounds surveys, floodplain Letter of Map Revision (LOMR), etc.) should be anticipated as design and budgeting proceeds. These are not construction costs, but should be anticipated;
- Design and cost assumptions related to fish passage, ice handling and debris handling;
- The applicability and impact of excavating softer material during winter;
- Temporary facilities, temporary retaining structures, control of water or traffic management (detours) as additional site-specific data is obtained and in consideration of critical path construction work;
- Contracting, acquisition and bid letting strategies as they are further refined;
- Costs associated with overhead items by itemizing these costs, as opposed to contractor markups (JOOH, HOOH and Mobilization/Demobilization);
- Costs for items discussed in the Uncertainty and Risk Discussion above as investigations are performed and additional design criteria are developed;
- Project refinements as a result of detailed design.

G8.0 MII COST ESTIMATE INTRODUCTION

Feasibility construction cost estimates have been prepared for two flow scenarios and diversion alignments for the Red River Diversion, Fargo-Moorhead Metro Flood Risk Management Project, Feasibility Study, Phase 4. All cost estimates are completed using the MCACES MII cost estimating program, version 3.01. Assumptions and documentation are provided in **Exhibit A** and **Exhibit B** in the form of MII cost estimates. The following are descriptions of column data displayed in the cost estimates.

1. BARE COST = bare labor cost (no overtime) + bare equipment cost + bare material cost (no tax) + bare user cost
2. DIRECT COST = BARE COST + payroll tax + workers' compensation cost + overtime + taxes
3. COST TO PRIME CONTRACTOR = DIRECT COST + subcontractor indirect costs (Home Office Overhead (HOOH) + Job Office Overhead (JOOH) + Profit + Bond + Mobilization/Demobilization)
4. CONTRACT COST = COST TO PRIME CONTRACTOR + Contractor indirect costs (Home Office Overhead (HOOH) + Job Office Overhead (JOOH) + Profit + Bond)
5. PROJECT COST = CONTRACT COST + Contingency + Escalation
Note (for costs above small tools allowance is part of JOOH).

In summary, for this deliverable, Contract Cost corresponds to the cost associated with comparable unit bid prices, without contingency. Project cost is this Contract Cost plus contingency as defined herein. It is anticipated that contingency and an allowance for the risk of changed conditions will be evaluated by the USACE as determined during Cost Risk Analysis and finalized by USACE.

Fargo-Moorhead Metro Flood Risk Management Project

Table G1				
FCP Minnesota Diversion - MII Cost Estimate Summary				
Phase 4 - MII Estimate Revised 2-28-2011				
Minnesota Diversion				
Description	Contract Cost	(1) Contingency	Project Cost	Percent of total
RELOCATIONS				
Roadway bridges	79,730,554	9,309,137	89,039,691	11.3%
Railroad bridges	132,712,322	39,662,974	172,375,295	21.8%
CHANNELS AND CANALS				
Diversion channel	353,339,582	70,667,916	424,007,499	53.6%
Control structure on Red River	59,545,729	11,909,146	71,454,875	9.0%
Small drain structure (3)	752,396	376,198	1,128,593	0.1%
Side channel inlet 1x72" (7)	3,128,818	1,564,409	4,693,227	0.6%
Side channel inlet 2x72" (11)	8,986,446	4,493,223	13,479,669	1.7%
Channel Drop Structure	2,123,007	424,601	2,547,609	0.3%
Outlet to Red River	1,595,053	319,011	1,914,064	0.2%
LEVEES AND FLOODWALLS				
Levees and floodwalls	8,246,709	1,954,203	10,200,912	1.3%
Subtotal	\$650,160,615	\$140,680,818	\$790,841,433	100.0%

(1) Allowance for costs that will be in the Project Cost and are not included in Contract Cost. Does not account for changed conditions either in final design or during construction.

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Table G2				
LPP North Dakota Diversion - MII Cost Estimate Summary				
Phase 4 - MII Estimate 2-28-2011				
North Dakota Diversion				
Description	Contract Cost	(1) Contingency	Project Cost	Percent of Total
RELOCATIONS				
Roadway Bridges, Road Raises & Local Road Construction	103,611,762	14,740,166	118,351,928	11.74%
Railroad Bridges	46,497,415	13,614,538	60,111,954	5.96%
CHANNELS AND CANALS				
Diversion Channel	318,633,134	63,726,627	382,359,760	37.91%
Control Structure on Red River	47,355,147	9,471,029	56,826,177	5.63%
Hydraulic Structure at Wolverton Creek	4,290,478	858,096	5,148,573	0.51%
Hydraulic Structure at Wild Rice River	29,348,084	5,869,617	35,217,701	3.49%
Hydraulic Structure - East Weir (at Connecting Channel)	219,666	43,933	263,599	0.03%
Hydraulic Structure - Inlet Weir to Diversion	9,786,068	1,957,214	11,743,281	1.16%
Hydraulic Structures at Sheyenne River	49,677,739	9,935,548	59,613,286	5.91%
Hydraulic Structure - Drain 14 - Large Drain Structure	8,236,281	1,647,256	9,883,537	0.98%
Hydraulic Structures at Maple River	45,108,856	9,021,771	54,130,627	5.37%
Hydraulic Structures at Lower Rush River	17,256,300	3,451,260	20,707,560	2.05%
Hydraulic Structures at Rush River	17,215,143	3,443,029	20,658,171	2.05%
Small Drain Structures (2)	252,369	126,185	378,554	0.04%
Large Drain Structure (1)	448,922	224,461	673,383	0.07%
Side Channel Inlets 1x72" (19)	8,343,417	4,171,708	12,515,125	1.24%
Side Channel Inlets 2x72" (7)	5,616,955	2,808,477	8,425,432	0.84%
Outlet to Red River	22,007,824	4,401,565	26,409,389	2.62%
LEVEES AND FLOODWALLS				
Tie-Back Levee - TBL East 2B (Constructed in MN)	18,573,020	3,714,604	22,287,624	2.21%
Tie-Back Levee - TBL Cass 17 (Constructed in ND)	6,320,611	1,264,122	7,584,733	0.75%
Levee - Connecting Channel - Reach 2018 (ND-23, 26)	1,683,581	336,716	2,020,297	0.20%
Levee - Connecting Channel - Reach 2019 (ND-25)	6,971,436	1,394,287	8,365,723	0.83%
Storage Area 1 Embankment and Inlet	57,965,277	14,481,249	72,446,526	7.18%
Storage Area 1 Closure/Drainage Structure (North)	5,169,828	1,033,966	6,203,794	0.62%
Storage Area 1 Closure/Drainage Structure (East)	5,169,828	1,033,966	6,203,794	0.62%
Subtotal	\$835,759,138	\$172,771,389	\$1,008,530,528	100.0%

(1) Allowance for costs that will be in the Project Cost and are not included in Contract Cost. Does not account for changed conditions either in final design or during construction.

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Table G3				
FCP Minnesota Diversion - MII Cost Estimate Summary				
Phase 4 - MII Estimate Revised 4-18-2011 following USACE Agency Technical Review (ATR)				
Minnesota Diversion				
Description	Contract Cost	(1) Contingency	Project Cost	Percent of total
RELOCATIONS				
Roadway bridges	79,730,554	0	79,730,554	11.6%
RAILROAD BRIDGES				
Railroad bridges	127,294,440	0	127,294,440	18.4%
CHANNELS AND CANALS				
Diversion channel	385,841,384	0	385,841,384	55.9%
Control structure on Red River	64,323,225	0	64,323,225	9.3%
Small drain structure (3)	785,494	0	785,494	0.1%
Side channel inlet 1x72" (7)	3,180,752	0	3,180,752	0.5%
Side channel inlet 2x72" (11)	9,076,396	0	9,076,396	1.3%
Channel Drop Structure	4,312,324	0	4,312,324	0.6%
Outlet to Red River	1,617,839	0	1,617,839	0.2%
LEVEES AND FLOODWALLS				
Levees and floodwalls	14,144,391	0	14,144,391	2.0%
Subtotal	\$690,306,798	\$0	\$690,306,798	100.0%

(1) Contingency must be added to complete this estimate. Contingency to be determined by USACE with Cost Schedule Risk Analysis (CSRA). Allowance for costs that will be in the Project Cost and are not included in Contract Cost. Does not account for changed conditions either in final design or during construction. A/E recommended contingencies were presented in the 2-28-2011 deliverable to USACE (See Table G1).

Fargo-Moorhead Metro Flood Risk Management Project

Table G4				
LPP North Dakota Diversion - MII Cost Estimate Summary				
Phase 4 - MII Estimate Revised 4-18-2011 following USACE Agency Technical Review (ATR)				
North Dakota Diversion				
Description	Contract Cost	(1) Contingency	Project Cost	Percent of Total
RELOCATIONS				
Roadway Bridges, Road Raises & Local Road Construction	103,611,762	0	103,611,762	11.91%
RAILROAD BRIDGES				
Railroad Bridges	46,497,415	0	46,497,415	5.35%
CHANNELS AND CANALS				
Diversion Channel	338,217,173	0	338,217,173	38.88%
Control Structure on Red River	48,276,228	0	48,276,228	5.55%
Hydraulic Structure at Wolverton Creek	4,366,235	0	4,366,235	0.50%
Hydraulic Structure at Wild Rice River	29,630,288	0	29,630,288	3.41%
Hydraulic Structure - East Weir (at Connecting Channel)	215,712	0	215,712	0.02%
Hydraulic Structure - Inlet Weir to Diversion	9,942,054	0	9,942,054	1.14%
Hydraulic Structures at Sheyenne River	50,805,769	0	50,805,769	5.84%
Hydraulic Structure - Drain 14 - Large Drain Structure	8,378,185	0	8,378,185	0.96%
Hydraulic Structures at Maple River	45,799,454	0	45,799,454	5.26%
Hydraulic Structures at Lower Rush River	17,743,527	0	17,743,527	2.04%
Hydraulic Structures at Rush River	17,709,812	0	17,709,812	2.04%
Small Drain Structures (2)	254,374	0	254,374	0.03%
Large Drain Structure (1)	447,425	0	447,425	0.05%
Side Channel Inlets 1x72" (19)	8,454,002	0	8,454,002	0.97%
Side Channel Inlets 2x72" (7)	5,662,176	0	5,662,176	0.65%
Outlet to Red River	22,704,305	0	22,704,305	2.61%
LEVEES AND FLOODWALLS				
Tie-Back Levee - TBL East 2B (Constructed in MN)	19,829,863	0	19,829,863	2.28%
Tie-Back Levee - TBL Cass 17 (Constructed in ND)	6,801,067	0	6,801,067	0.78%
Levee - Connecting Channel - Reach 2018 (ND-23, 26)	1,830,998	0	1,830,998	0.21%
Levee - Connecting Channel - Reach 2019 (ND-25)	7,570,035	0	7,570,035	0.87%
Storage Area 1 Embankment and Inlet	62,505,446	0	62,505,446	7.19%
Storage Area 1 Closure/Drainage Structure (North)	5,332,286	0	5,332,286	0.61%
Storage Area 1 Closure/Drainage Structure (East)	5,332,286	0	5,332,286	0.61%
Road Raise for LPP SA1 Levees ND	1,987,535	0	1,987,535	0.23%
Subtotal	\$869,905,414	\$0	\$869,905,414	100.0%

(1) Contingency must be added to complete this estimate. Contingency to be determined by USACE with Cost Schedule Risk Analysis (CSRA).

Allowance for costs that will be in the Project Cost and are not included in Contract Cost. Does not account for changed conditions either in final design or during construction. A/E recommended contingencies were presented in the 2-28-2011 deliverable to USACE (See Table G2).