AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
J	1 of 5

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO.(If applicable)
0004	16-Oct-2003	W68MD9-2183-1410	

6. ISSUED BY CODE W912DW

USA ENGINEER DISTRICT, SEATTLE
ATTN: CENWS-CT
4735 EAST MARGINAL WAY SOUTH
SEATTLE WA 98134-2329

7. ADMINISTERED BY (If other than item 6) CODE

See Item 6

8. NAME AND ADDRESS OF CONTRACTOR (No., Street, County, State and Zip Code)

CODE FACILITY CODE

X	9A. AMENDMENT OF SOLICITATION NO. DACW67-03-R-0001
X	9B. DATED (SEE ITEM 11) 19-Sep-2003
	10A. MOD. OF CONTRACT/ORDER NO.
	10B. DATED (SEE ITEM 13)

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

[X] The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offer [X] is extended, [ ] is not extended.

Offer must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended by one of the following methods: (a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

[ ] A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.

[ ] B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(B).

[ ] C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:

[ ] D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor [ ] is not, [ ] is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

FISH PASSAGE FACILITY COFFERDAM AND EXCAVATION, HOWARD HANSON DAM, KING COUNTY, WASHINGTON

The purpose of this amendment (R0004) is to incorporate the following:

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print) TEL: EMAIL:	
15B. CONTRACTOR/OFFEROR _____ (Signature of person authorized to sign)	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA BY _____ (Signature of Contracting Officer)	16C. DATE SIGNED 24-Oct-2003

SECTION SF 30 BLOCK 14 CONTINUATION PAGE

SUMMARY OF CHANGES
AMENDMENT 0004

A. This amendment provides for the following changes:

(1) Revisions to Drawing Sheets G-1.2, G-1.3, G-1.4, GT-2.10, GT-2.11, GT-2.12, GT-2.13, GT-2.14, GT-3.2, GT-3.3, GT-3.4, GT-4.2, EP-1.1, EP-1.2, EP-1.3, EP-1.4, EP-2.4, C1.4, C1.5, C1.6, C2.1, C2.2, S1.1, S1.2, S2.1, S2.2, S2.3, S2.4, S2.5, S2.6, S2.7, S2.8, S2.11, S2.18, S2.20, S3.1, S3.2, S3.4, S3.6, S3.8, S3.9, S3.11, S4.2, S4.3, S5.2, S5.4, S5.5, S5.6, S5.7, S6.1, S6.2, S6.3, S6.4, S7.2, S8.3 and S8.6;

(2) Addition of new Drawing Sheet C1.7;

(3) Reissue of the Bid Schedule in its entirety;

(4) Addition of Geotechnical Baseline Report addendum as an attachment to the Special Clauses, 00800.

(5) Reissue of Section 01025 in its entirety;

(6) Revisions to Section 02300; Earthwork

(7) Revisions to Section 02490; Soil and Rock Anchors

(8) Revisions to Section 02845; Soldier Pile with Tiebacks Retaining Wall

(9) Revisions to Section 03100; Structural Concrete Formwork

(10) Revisions to Section 03301; Cast-In Place Structural Concrete for Civil Works

(11) Revisions to Section 03400; Tremie Concrete

(12) Revisions to Section 05055; Metal Fabrication, Machine Work, Miscellaneous

(13) Revisions to Section 05616. Stoplogs and Lifting Beam

B. **Proposal Due Date is extended to: November 18, 2003, 2:00 p.m. local time.**

C. SECOND SITE VISIT. A Second site visit is scheduled for November 4th, 2003, 10:00 a.m. local time. Offerors wishing to visit the site should show up at the Tacoma Watershed Security gate before 10:00 a.m. local time where they will be directed to park their vehicles. Transportation by bus will be provided by the government to the dam site. Offerors must provide photo identification to be allowed onto the bus and into the dam site and will be ask to sign an attendance sheet. Offerors are not required to sign up prior to site visit. Questions will not be answered by Government at site visit. Offerors are required to direct all question to Dr. checks at www.projnet.org. See attached site visit directions.

D. Addition of October 08, 2003 Site Visit sign in sheet.

E. Addition of minuets of Pre Proposal Conference dated October 08, 2003. Note: These minuets are information only and will not be part of the contract.

F. Addition of Bidder Inquiries Information. For information only.

G. Incorporated herein is FAR clause 52.236-2 Differing Site Conditions.

H. Incorporated herein is clause 52.236-4902 Magnitude of Construction.

I. The attached revised pages supersede and replace the corresponding pages. The attached revised specification sections supersede and replace the corresponding specification sections. Specification changes are generally identified, for convenience, by strikeout for deletions, and underlining of text for additions. All portions of the revised or new pages shall apply whether or not changes have been indicated.

Encl:

Revisions to Drawing Sheets
Addition of new Drawing Sheet C1.7;
Bid Schedule
Special Clauses, 00800.
Section 01025
Section 02300
Section 02490
Section 02845
Section 03100
Section 03301
Section 03400
Section 05055
Section 05616.
Bidder Inquiries Information
FAR Clause 52.236-2 Differing site conditions
FAR Clause 52.236-4902
Site Visit Sign in Sheet
Pre Proposal conference Minuets
Second Site Visit Map

BIDDER INQUIRIES INFORMATION

Process for Bidder Inquiries----

Bidder Inquires are technical or administrative questions from Qualified Contractors on solicitations that are advertised on the Seattle District Contracting Public Home Page.

The CORPS has developed the DrChecks Bidder Inquiries Module to simplify this process.

Since all of Seattle District Army CORPS solicitations are available to qualified Contractors on the Internet, it follows that all Contractor's technical questions concerning items within those solicitations would be submitted and answered over the Internet.

Instructions and web links are provided to Contractors on the Public Home Page and in the Solicitation. Required password are provided upon registration.

The Contractor goes to the projnet website, enters his password and submits his question.
He receives an e-mail notification when his question is entered into the DrCheck data base (which is instantaneous).

Designated designers and managers also receive notification of pending questions. They enter the DrCheck data base and evaluate the pending question. One question may have a number of evaluations. These evaluations are for internal use only and are not automatically forwarded to the bidder.

A chosen arbitrator reads all evaluations, does additional research and coordination, and formulates the official response. The arbitrator closes the item and the system e-mails the official response to the Contractor.

The Contractor sees only his original question, and the official response. He does not see any other evaluations or correspondence with competing contractors.

Site: www.projnet.org

52.236-2 DIFFERING SITE CONDITIONS (APR 1984)

As prescribed in 36.502, insert the following clause in solicitations and contracts when a fixed-price construction contract or a fixed-price dismantling, demolition, or removal of improvements contract is contemplated and the contract amount is expected to exceed the small purchase limitation. The Contracting Officer may insert the clause in solicitations and contracts when a fixed-price construction or a fixed-price contract for dismantling, demolition, or removal of improvements is contemplated and the contract amount is expected to be within the small purchase limitation.

(a) The Contractor shall promptly, and before the conditions are disturbed, give a written notice to the Contracting Officer of

(1) subsurface or latent physical conditions at the site which differ materially from those indicated in this contract, or

(2) unknown physical conditions at the site, of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inhering in work of the character provided for in the contract.

(b) The Contracting Officer shall investigate the site conditions promptly after receiving the notice. If the conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performing any part of the work under this contract, whether or not changed as a result of the conditions, an equitable adjustment shall be made under this clause and the contract modified in writing accordingly.

(c) No request by the Contractor for an equitable adjustment to the contract under this clause shall be allowed, unless the Contractor has given the written notice required; provided, that the time prescribed in (a) above for giving written notice may be extended by the Contracting Officer.

(d) No request by the Contractor for an equitable adjustment to the contract for differing site conditions shall be allowed if made after final payment under this contract.

(End of clause)

FAR 52.236-4902 MAGNITUDE OF CONSTRUCTION (FAR 36.204) (52. 236-4902) DEC 1999

(a) Amount of Construction for this solicitation is in the range of $10,000,000.00 to $25,000,000.00.

(End of Summary of Changes)

This page was intentionally left blank for duplex printing.

NOTE: THE SCHEDULE IS REISSUED IN ITS ENTIRETY BY AMENDMENT 0004

SCHEDULE

Item No.	Description of Item	Quantity	Unit	Unit Price	Amount
0001	All Work for Fish Passage Facility Cofferdam and Excavation, Except for Items 0002 Through 0039	1	JOB	L.S.	$_____
0002	Mobilization And Demobilization	1	JOB	L.S.	$_____
0003	All Work for Reservoir Excavation & Debris Removal From Trash Racks				
0003AA	First 600 Cubic Yards	600	CY	$_____	$_____
0003AB	All Over 600 Cubic Yards	400	CY	$_____	$_____
0004	All Work for Multi-Point Borehole Extensometers	1	JOB	L.S.	$_____
0005	All Work for Piezometers	1	JOB	L.S.	$_____
0006	All Work for Inclinometers	1	JOB	L.S.	$_____
0007	All Work for Load Cells	1	JOB	L.S.	$_____
0008	All Work for Passive Relief Wells	2,260	LF	$_____	$_____
0009	All Work for Dewatering Wells	3,000	LF	$_____	$_____
0010	All Overburden Drilling for Grout Curtain Holes, (1, 2 & 4 Stage Holes)				
0010AA	First 10 Linear Feet	10	LF	$_____	$_____
0010AB	Over 10 Linear Feet	400	LF	$_____	$_____
0011	All Rock Drilling for Grout Holes (1,2 & 4 Stage Holes)				
0011AA	First 5,000 Linear Feet	5,000	LF	$_____	$_____
0011AB	All Over 5,000 Linear Feet	5,600	LF	$_____	$_____

This page intentionally blank

Item No.	Description of Item	Quantity	Unit	Unit Price	Amount
0012	All Work for Redrilling Grout Curtain Holes (2 Stage Grout Curtains only)				
0012AA	First 600 Linear Foot	600	LF	$_____	$_____
0012AB	All Over 600 Linear Foot	1,000	LF	$_____	$_____
0013	All Hookups To Grout Holes used in Placement of Cement Grout Curtains				
0013AA	First 150 Each	150	EACH	$_____	$_____
0013AB	All Over 150 Each	160	EACH	$_____	$_____
0014	All Portland Cement used in Grout Curtains				
0014AA	First 1,450 94-lb Bags	1,450	BAGS	$_____	$_____
0014AB	All Over 1,450 94-lb Bags	500	BAGS	$_____	$_____
0015	All Bentonite used in Grout Curtains				
0015AA	First 10 94-lb Bags	10	BAGS	$_____	$_____
0015AB	All Over 75 94-lb Bags	75	BAGS	$_____	$_____
0016	All HRWR Water Reducing Admixture (Anti-Washout Admixture) used in Grout Curtains				
0016AA	First 50 Gallons	50	GAL	$_____	$_____
0016AB	Over 50 Gallons	100	GAL	$_____	$_____
0017	All New Intake Tower Addition Tremie Concrete Below Elevation 1085				
0017AA	First 200 Cubic Yards	200	CY	$_____	$_____
0017AB	All Over 200 Cubic Yards	100	CY	$_____	$_____
0018	All 37 Each Vertical 1-3/4” Diameter Bars for New Intake Tower Addition (Plate S8.3)				
0018AA	First 740 Linear Foot	740	LF	$_____	$_____
0018AB	All Over 740 Linear Foot	2,200	LF	$_____	$_____

This page intentionally blank

Item No.	Description of Item	Quantity	Unit	Unit Price	Amount
0019	All Shoulder H-Piles Tie Back for Permanent Retaining Wall				
0019AA	First 1,800 Linear Foot of H piles	1,800	LF	$_____	$_____
0019AB	All Over 1,800 Linear Foot of H piles	1,000	LF	$_____	$_____
0020	All Tie Back Anchors for Permanent Retaining Wall				
0020AA	First 3,600 Linear Foot	3,600	LF	$_____	$_____
0020AB	All Over 3,600 Linear Foot	1,000	LF	$_____	$_____
0021	All Common Excavation Above Elevation 1074				
0021AA	First 10,000 Cubic Yard	10,000	CY	$_____	$_____
0021AB	Over 10,000 Cubic Yard	5,500	CY	$_____	$_____
0022	All Rock and Concrete Excavation Above Elevation 1074				
0022AA	First 23,000 Cubic Yard	23,000	CY	$_____	$_____
0022AB	Over 23,000 Cubic Yard	12,100	CY	$_____	$_____
0023	All 30’ Long Rock Bolts #11, Threaded Bar Grade 150 Above Elevation 1074				
0023AA	First 90 Each	90	EACH	$_____	$_____
0023AB	All Over 90 Each	85	EACH	$_____	$_____
0024	All 30’ Long Rock Bolts, #8 Threaded Bar Grade 75 Above Elevation 1074				
0024AA	First 100 Each	100	EACH	$_____	$_____
0024AB	All Over 100 Each	185	EACH	$_____	$_____
0025	All 20’ Long Rock Bolts, #8 Threaded Bar Grade 75 Above Elevation 1074				
0025AA	First 600 Each	600	EACH	$_____	$_____

This page intentionally blank

Item No.	Description of Item	Quantity	Unit	Unit Price	Amount
0025AB	All Over 600 Each	215	EACH	$_____	$_____
0026	All 30' Long Weep Holes Above Elevation 1074				
0026AA	First 200 Each	200	EACH	$_____	$_____
0026AB	All Over 200 Each	70	EACH	$_____	$_____
0027	All 6" Thick Shotcrete				
0027AA	First 25,000 Square Foot	25,000	SF	$_____	$_____
0027AB	All Over 25,000 Square Foot	14,000	SF	$_____	$_____
0028	All Welded Wire Fabric Above Elevation 1074				
0028AA	First 1,000 Square Foot	1,000	SF	$_____	$_____
0028AB	All Over 1,000 Square Foot	3,600	SF	$_____	
0029	All Rock and Concrete Excavation Below Elevation 1074				$_____
0029AA	First 1,500 Cubic Yard	1,500	CY	$_____	$_____
0029AB	All Over 1,500 Cubic Yard	800	CY	$_____	$_____
0030	All 30' Long Rock Bolts #11, Threaded Bar Grade 150 Below Elevation 1074				
0030AA	First 5 Each	5	EACH	$_____	$_____
0030AB	All Over 5 Each	5	EACH	$_____	$_____
0031	All 30' Long Rock Bolts, #8 Threaded Bar Grade 75 Below Elevation 1074				
0031AA	First 12 Each	12	EACH	$_____	$_____
0031AB	All Over 12 Each	12	EACH	$_____	$_____

This page intentionally blank

Item No.	Description of Item	Quantity	Unit	Unit Price	Amount
0032	All 20' Long Rock Bolts, #8 Threaded Bar Grade 75 Below Elevation 1074				
0032AA	First 16 Each	16	LF	$_____	$_____
0032AB	All Over 16 Each	16	LF	$_____	$_____
0033	All 30' Long Weep Holes Below Elevation 1074				
0033AA	First 4 Each	4	EACH	$_____	$_____
0033AB	AllOver 4 Each	5	EACH	$_____	$_____
0034	All Welded Wire Fabric Below Elevation 1074				
0034AA	First 700 Square Foot	700	SF	$_____	$_____
0034AB	All Over 700 Square Foot	300	SF	$_____	$_____
0035	All Work for Cut-Off-Wall (South Shore) 5' into Rock to Elevation 1170'	1	JOB	LS	$_____
0036	Emergency Mobilization & Demobilization For When Water Elevation Is Above Elevation 1150	2	EACH	$_____	$_____
0037	Emergency Mobilization & Demobilization For When Water Elevation Is Above Elevation 1165	2	EACH	$_____	$_____
0038	Emergency Mobilization & Demobilization For When Water Elevation Is Above Cofferdam Elevation 1169	2	EACH	$_____	$_____
0039	All Work for As-Built Drawings as specified in Section 01702 from preparation to final approval	1	JOB	LS	$25,000.00
	TOTAL ALL ITEMS				$_____

NOTES:

This page intentionally blank

1. The dollar amount established in Item No. 0039 shall not be revised by bidder.

2. Contract Clause “Variation in Estimated Quantity” in Section 00700 does not apply to Bid Items 0036, 0037, and 0038. If Emergency Demobilization and Remobilization and Standby of Equipment and Crew is used, the Contractor will be paid the unit price for the actual number of moves out of the work demobilization and remobilization and for number of standby days of equipment and crew as described in Section 01025 of the specifications. If Emergency Demobilization, Remobilization, Standby of Equipment, and Crew do not occur, the Bid Items will not be used and the government will issue a credit modification for each unused bid item in its entirety.

This page intentionally blank

TABLE OF CONTENTS

SPECIAL CLAUSES

This page is intentionally left blank.

SPECIAL CLAUSES

SC-1. COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK (APR 1984) (FAR 52.211-10).

The Contractor shall be required to (a) commence work under this Contract within 10 calendar days after the date the Contractor receives the notice to proceed, (b) prosecute the work diligently, and (c) complete the entire work ready for use not later than 685 calendar days after date of receipt by Contractor of notice to proceed. The time stated for completion shall include final cleanup of the premises.

~~SC-1.1 OPTION FOR INCREASED QUANTITY~~

~~a. The Government may increase the quantity of work awarded by exercising one or more of the Optional Bid Items 0019 and 0020 at any time, or not at all, but no later than 500 calendar days after receipt by Contractor of notice to proceed. Notice to proceed on work Item(s) added by exercise of the option(s) will be given upon execution of consent of surety.~~

~~b. The parties hereto further agree that any option herein shall be considered to have been exercised at the time the Government deposits written notification to the Contractor in the mails.~~

~~c. The time allowed for completion of any optional items awarded under this contract will be the same as that for the base item(s), and will be measured from the date of receipt of the notice to proceed for the base item(s).~~

SC-2. LIQUIDATED DAMAGES - CONSTRUCTION (SEP 2000) (FAR 52.211-12)

(a) If the Contractor fails to complete the work within the time specified in the Contract, or any extension, the Contractor shall pay to the Government as liquidated damages, the sum of $2,415.00 for each day of delay.

(b) If the Government terminates the Contractor's right to proceed, the resulting damage will consist of liquidated damages until such reasonable time as may be required for final completion of the work together with any increased costs occasioned the Government in completing the work.

(c) If the Government does not terminate the Contractor's right to proceed, the resulting damage will consist of liquidated damages until the work is completed or accepted.

SC-3 DELETED.

SC-4. VARIATIONS IN ESTIMATED QUANTITIES - SUBDIVIDED ITEMS (MAR 1995) (EFARS 52.212-5001): This variation in estimated quantities clause is applicable only to Item Nos. 0003, 0010, 0011, 0012, 0013, ~~and~~ 0014, 0015, 0016, 0017, 0018, 0019, 0020, 0021, 0022, 0023, 0024, 0025, 0026, 0027, 0028, 0029, 0030, 0031, 0032, 0033 and 0034.

(a) Variation from the estimated quantity in the actual work performed under any second or subsequent sub-item or elimination of all work under such a second or subsequent sub-item will not be the basis for an adjustment in contract unit price.

(b) Where the actual quantity of work performed for Items Nos. 0003, 0010, 0011, 0012, 0013 and 0014 is less than 85 % of the quantity of the first sub-item listed under such item, the Contractor will be paid at the contract unit price for that sub-item for the actual quantity of work performed and, in addition, an equitable adjustment shall be made in accordance with the clause FAR 52.211-18, Variation in Estimated Quantities.

(c) If the actual quantity of work performed under Items Nos. 0003, 0010, 0011, 0012, 0013 and 0014 exceeds 115 percent or is less than 85 percent of the total estimated quantity of the sub-item under that item and/or if the quantity of the work performed under the second sub-item or any subsequent sub-item under Items Nos. 0003, 0010, 0011, 0012, 0013 and 0014 exceeds 115 % or is less than 85 % of the estimated quantity of any such sub-item, and if such variation causes an increase or a decrease in the time required for performance of this contract the contract completion time will be adjusted in accordance with the clause FAR 52.211-18, Variation in Estimated Quantities.

SC-5. INSURANCE - WORK ON A GOVERNMENT INSTALLATION (JAN 1997) (FAR 52.228-5)

(a) The Contractor shall, at its own expense, provide and maintain during the entire performance period of this Contract at least the kinds and minimum amounts of insurance required in the Insurance Liability Schedule or elsewhere in the Contract.

(b) Before commencing work under this Contract, the Contractor shall certify to the Contracting Officer in writing that the required insurance has been obtained. The policies evidencing required insurance shall contain an endorsement to the effect that any cancellation or any material change adversely affecting the Government's interest shall not be effective:

(1) for such period as the laws of the State in which this Contract is to be performed prescribe; or

(2) until 30 days after the insurer or the Contractor gives written notice to the Contracting Officer, whichever period is longer.

(c) The Contractor shall insert the substance of this clause, including this paragraph (c), in subcontracts under this Contract that require work on a Government installation and shall require subcontractors to provide and maintain the insurance required in the Schedule or elsewhere in the Contract. The Contractor shall maintain a copy of all subcontractors' proofs of required insurance, and shall make copies available to the Contracting Officer upon request.

(d) Insurance Liability Schedule (FAR 28.307-2)

(1) Workers' compensation and employer's liability. Contractors are required to comply with applicable Federal and State workers' compensation and occupational disease statutes. If occupational diseases are not compensable under those statutes, they shall be covered under the employer's liability section of the insurance policy, except when Contract operations are so commingled with a Contractor's commercial operation that it would not be practical to require this coverage. Employer's liability coverage of at least $100,000 shall be required, except in states with exclusive or monopolistic funds that do not permit workers' compensation to be written by private carriers.

(2) General Liability.

(a) The Contracting Officer shall require bodily injury liability insurance coverage written on the comprehensive form of policy of at least $500,000 per occurrence.

(b) Property damage liability insurance shall be required only in special circumstances as determined by the agency.

(3) Automobile liability. The Contracting Officer shall require automobile liability insurance written on the comprehensive form of policy. The policy shall provide for bodily injury and property damage liability covering the operation of all automobiles used in connection with performing the Contract. Policies covering automobiles operated in the United States shall provide coverage of at least $200,000 per person and $500,000 per occurrence for bodily injury and $20,000 per occurrence for property damage. The amount of liability coverage on other policies shall be commensurate with any legal requirements of the locality and sufficient to meet normal and customary claims.

(4) Aircraft public and passenger liability. When aircraft are used in connection with performing the Contract, the Contracting Officer shall require aircraft public and passenger liability insurance. Coverage shall be at least $200,000 per person and $500,000 per occurrence for bodily injury, other than passenger liability, and $200,000 per occurrence for property damage. Coverage for passenger liability bodily injury shall be at least $200,000 multiplied by the number of seats or passengers, whichever is greater.

(5) Environmental Liability If this contract includes the transport, treatment, storage, or disposal of hazardous material waste the following coverage is required.

The Contractor shall ensure the transporter and disposal facility have liability insurance if effect for claims arising out of the death or bodily injury and property damage from hazardous material/waste transport, treatment, storage and disposal, including vehicle liability and legal defense costs in the amount of $1,000,000.00 as evidenced by a certificate of insurance for General, Automobile, and Environmental Liability Coverage. Proof of this insurance shall be provided to the Contracting Officer.

SC-6. CONTINUING CONTRACTS (EFARS 52.232-5001) (MAR 1995):

(a) This is a continuing contract, as authorized by Section 10 of the River and Harbor Act of September 22, 1922 (33 U.S. Code 621). The payment of some portion of the contract price is dependent upon reservations of funds from future appropriations, and from future contribution to the project having one or more non-federal project sponsors. The responsibilities of the Government are limited by this clause notwithstanding any contrary provision of the "Payments to Contractor" clause or any other clause of this contract.

(b) The sum of $7,000,000.00 has been reserved for this contract and is available for payments to the Contractor during the current fiscal year. It is expected that Congress will make appropriations for future fiscal years from which additional funds together with funds provided by one or more non-federal project sponsors will be reserved for this contract.

(c) Failure to make payments in excess of the amount currently reserved, or that may be reserved from time to time, shall not entitle the Contractor to a price adjustment under the terms of this contract, except as specifically provided in paragraphs (f) and (i) below. No such failure shall constitute a breach of this contract, except that this provision shall not bar a breach-of-contract action if an amount finally

determined to be due as a termination allowance remains unpaid for one year due solely to a failure to reserve sufficient additional funds therefore.

(d) The Government may at any time reserve additional funds for payments under the contract if there are funds available for such purpose. The Contracting Officer will promptly notify the Contractor of any additional funds reserved for the contract by issuing an administrative modification to the contract.

(e) If earnings will be such that funds reserved for the contract will be exhausted before the end of any fiscal year, the contractor shall give written notice to the Contracting Officer of the estimated date of exhaustion and the amount of additional funds which will be needed to meet payments due, or to become due, under the contract during that fiscal year. This notice shall be given not less than 45 nor more than 60 days prior to the estimated date of exhaustion.

(f) No payments will be made after exhaustion of funds except to the extent that additional funds are reserved for the contract. The Contractor shall be entitled to simple interest on any payment that the contracting officer determines was actually earned under the terms of the contract and would have been made except for exhaustion of funds. Interest shall be computed from the time such payment would otherwise have been made until actually or constructively made, and shall be at the rate established by the Secretary of the Treasury pursuant to Public Law 92-41, 85 STAT 97, as in effect on the first day of the delay in such payment.

(g) Any suspension, delay, or interruption of work arising from exhaustion or anticipated exhaustion of funds shall not constitute a breach of this contract and shall not entitle the contractor to any price adjustment under the "Suspension of Work" clause or in any other manner under this contract.

(h) An equitable adjustment in performance time shall be made for any increase in the time required for performance of any part of the work arising from exhaustion of funds or the reasonable anticipation of exhaustion of funds.

(i) If, upon the expiration of sixty (60) days after the beginning of the fiscal year following an exhaustion of funds, the Government has failed to reserve sufficient additional funds to cover payments otherwise due, the contractor, by written notice delivered to the Contracting Officer at any time before such additional funds are reserved, may elect to treat his right to proceed with the work as having been terminated. Such a termination shall be considered a termination for the convenience of the Government.

(j) If at any time it becomes apparent that the funds reserved for any fiscal year are in excess of the funds required to meet all payments due or to become due the contractor because of work performed and to be performed under the contract during the fiscal year, the Government reserves the right, after notice to the contractor, to reduce said reservation by the amount of such excess.

SC-7. PERFORMANCE OF WORK BY THE CONTRACTOR (APR 1984) (FAR 52.236-1): The Contractor shall perform on the site, and with its own organization, work equivalent to at least fifteen percent (15%) of the total amount of work to be performed under the Contract. The percentage may be reduced by a supplemental agreement to this Contract if, during performing the work, the Contractor requests a reduction and the Contracting Officer determines that the reduction would be to the advantage of the Government.

SC-8. PHYSICAL DATA (APR 1984) (FAR 52.236-4): Data and information furnished or referred to below is for the Contractor's information. The Government will not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.

(a) Physical Conditions: The indications of physical conditions on the drawings and in the specifications are the result of site investigations by test holes shown on the drawings.

(b) Weather Conditions: Each bidder shall be satisfied before submitting his bid as to the hazards likely to arise from weather conditions. Complete weather records and reports may be obtained from any National Weather Service Office.

(c) Transportation Facilities: Each bidder, before submitting his bid, shall make an investigation of the conditions of existing public and private roads and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress at the jobsite. The unavailability of transportation facilities or limitations thereon shall not become a basis for claims for damages or extension of time for completion of the work.

(d) Right-of-Way: The right-of-way for the work covered by these specifications will be furnished by the Government, except that the Contractor shall provide right-of-way for ingress and egress across private property where necessary to gain access to the jobsite. The Contractor may use such portions of the land within the right-of-way not otherwise occupied as may be designated by the Contracting Officer. The Contractor shall, without expense to the Government, and at any time during the progress of the work when space is needed within the right-of-way for any other purposes, promptly vacate and clean up any part of the grounds that have been allotted to, or have been in use by, him when directed to do so by the Contracting Officer. The Contractor shall keep the buildings and grounds in use by him at the site of the work in an orderly and sanitary condition. Should the Contractor require additional working space or lands for material yards, job offices, or other purposes, he shall obtain such additional lands or easements at his expense.

(e) Condition of Area: The condition of the area when last surveyed is shown on the drawings. Topography is in feet and represents elevation with reference to National Geodetic Vertical Datum (N.G.V.D.).

(f) Datum and Bench Marks: The plane of reference of N.G.V.D. as used in these specifications is that determined by the bench marks, as shown on the drawings.

(g) Howard Hanson Dam and Reservoir Hydraulics and Hydrology: More information on conditions at the reservoir that will directly effect construction and the scheduling of construction is available attached to the end of Section 01005.

(h) Geotechnical Baseline Report. This report is attached to the end of this section. It provides available information on the Geotechnical properties of the site.

SC-9. DELETED.

SC-10. LAYOUT OF WORK (APR 1984) (FAR 52.236-17): The Contractor shall lay out its work from Government-established base lines and bench marks indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at its own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the Contracting Officer. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the Contracting Officer until authorized to remove them. If such marks are destroyed by the Contractor or through its negligence

before their removal is authorized, the Contracting Officer may replace them and deduct the expense of the replacement from any amounts due, or to become due, to the Contractor.

SC-11. PAYMENT FOR MOBILIZATION AND DEMOBILIZATION. Payment No. 0002 (DEC 1991) (FAR 52.236-7004):

(a) The Government will pay all costs for the mobilization and demobilization of all of the Contractor's plant and equipment at the contract lump sum price for this item.

(1) Fifty percent (50%) of the lump sum price upon completion of the Contractor's mobilization at the work site.

(2) The remaining fifty percent (50%) upon completion of the demobilization.

(b) The Contracting Officer may require the Contractor to furnish cost data to justify this portion of the bid if the Contracting Officer believes that the percentages in paragraphs (a)(1) and (2) of this clause do not bear a reasonable relation to the cost of the work in this contract.

(1) Failure to justify such price to the satisfaction of the Contracting Officer will result in payment, as determined by the Contracting Officer, of --

(i) Actual mobilization costs at completion of mobilization;

(ii) Actual demobilization costs at completion of demobilization; and

(iii) The remainder of this item in the final payment under this contract.

(2) The Contracting Officer's determination of the actual costs in paragraph (b)(1) of this clause is not subject to appeal.

(c) This item is not to be confused with Emergency De-mobilization and Re-mobilization due to floods. See Specifications Section 01050 for more information.

SC-12 AND SC-13 DELETED.

SC-14. EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE (MAY 1999)-(EFARS 52.231-5000)

(a) This clause does not apply to terminations. See 52.249-5000, Basis for Settlement of Proposals and FAR Part 49.

(b) Allowable cost for construction and marine plant and equipment in sound workable condition owned or controlled and furnished by a contractor or subcontractor at any tier shall be based on actual cost data for each piece of equipment or groups of similar serial and series for which the Government can determine both ownership and operating costs from the contractor's accounting records. When both ownership and operating costs cannot be determined for any piece of equipment or groups of similar serial or series equipment from the contractor's accounting records, costs for that equipment shall be based upon the applicable provisions of EP 1110-1-8, Construction Equipment Ownership and Operating Expense Schedule, Region VIII. Working conditions shall be considered to be average for determining equipment rates using the schedule unless specified otherwise by the contracting officer. For equipment

not included in the schedule, rates for comparable pieces of equipment may be used or a rate may be developed using the formula provided in the schedule. For forward pricing, the schedule in effect at the time of negotiations shall apply. For retroactive pricing, the schedule in effect at the time the work was performed shall apply.

(c) Equipment rental costs are allowable, subject to the provisions of FAR 31.105(d)(ii) and FAR 31.205-36. Rates for equipment rented from an organization under common control, lease-purchase arrangements, and sale-leaseback arrangements, will be determined using the schedule, except that actual rates will be used for equipment leased from an organization under common control that has an established practice of leasing the same or similar equipment to unaffiliated lessees.

(d) When actual equipment costs are proposed and the total amount of the pricing action exceeds the small purchase threshold, the contracting officer shall request the contractor to submit either certified cost or pricing data, or partial/limited data, as appropriate. The data shall be submitted on Standard Form 1411, Contract Pricing Proposal Cover Sheet.

(e) Copies of EP1110-1-8 “Construction Equipment Ownership and Operating Expense Schedule” Volumes 1 through 12 are available in Portable Document Format (PDF) and can be viewed or downloaded at http://www.usace.army.mil/inet/usace-docs/eng-pamplets/cecw.htm. A CD-ROM containing (Volumes 1-12) is available through either the Superintendent of Documents or Government bookstores. For additional information telephone 202-512-2250, or access on the Internet at http://www.access.gpo.gov/su_docs.

SC-15. PAYMENT FOR MATERIALS DELIVERED OFF-SITE (MAY 1999)-(EFARS 52.232-5000)

(a) Pursuant to FAR clause 52.232-5, Payments Under Fixed Priced Construction Contracts, materials delivered to the contractor at locations other than the site of the work may be taken into consideration in making payments if included in payment estimates and if all the conditions of the General Provisions are fulfilled. Payment for items delivered to locations other than the work site will be limited to: (1) materials required by the technical provisions; or (2) materials that have been fabricated to the point where they are identifiable to an item of work required under this contract.

(b) Such payment will be made only after receipt of paid or receipted invoices or invoices with canceled check showing title to the items in the prime contractor and including the value of material and labor incorporated into the item.

SC-16 AND SC-17 DELETED.

SC-18. CONTRACT DRAWINGS, MAPS, AND SPECIFICATIONS (OCT 1996) (52.0236-4001 EBS)

(a) The Government--

(1) Will provide the Contractor, without charge, one set of contract drawings and one set of specifications in electronic format on a compact disk. The Government will not give the Contractor any hard copy paper drawings or specifications for any contract resulting from this solicitation.

(b) The Contractor shall--

(1) check all drawings furnished immediately upon receipt;

(2) Compare all drawings and verify the figures before laying out the work;

(3) Promptly notify the Contracting Officer of any discrepancies; and

(4) Be responsible for any errors which might have been avoided by complying with this paragraph (b).

(c) Large scale drawings shall, in general, govern small scale drawings. Figures marked on drawings shall, in general, be followed in preference to scale measurements.

(d) Omissions from the drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the work, but shall be performed as if fully and correctly set forth and described in the drawings and specifications.

(e) The work shall conform to the specifications and the contract drawings identified in the index of drawings attached at the end of the Special Clauses.

SC-19 THROUGH SC-21 DELETED.

SC-22. EPA ENERGY STAR: The Government requires that certain equipment be Energy Star compliant. Initially, the sole Energy Star requirement shall be the self certification by the bidder that the specified equipment is Energy Star compliant. Within 3 months of the availability of an EPA sanctioned test for Energy Star compliance, the Contractor shall submit all equipment upgrades and additions for testing and provide proof of compliance to the Government upon completion of testing. Testing shall be at the Contractor's expense.

SC-23. RECOVERED MATERIALS: The Corps of Engineers encourages all bidders to utilize recovered materials to the maximum extent practicable. The attached APPENDIX R contains procurement guidelines for products containing recovered materials.

APPENDIX R

PART 247 - COMPREHENSIVE PROCUREMENT GUIDELINE FOR PRODUCTS CONTAINING RECOVERED MATERIALS

40 CFR Ch. 1 (9-1-99 Edition)

Subpart B-Item Designations

§ 247.10 Paper and paper products.

Paper and paper products, excluding building and construction paper grades.

§ 247.11 Vehicular products.

(a) Lubricating oils containing re-refined oil, including engine lubricating oils, hydraulic fluids, and gear oils, excluding marine and aviation oils.
(b) Tires, excluding airplane tire
(e) Reclaimed engine coolants, excluding coolants used in non-vehicular applications.

247.12 Construction products.

(a) Building insulation product including the following items:
(1) Loose-fill insulation, including but not limited to cellulose fiber, mineral fibers (fiberglass and rock vermiculite, and perlite;
(2) Blanket and batt insulation, including but not limited to mineral fibers (fiberglass and rock wool).
(3) Board (sheathing, roof decking wall panel) insulation, including but not limited to structural fiberboard and laminated paperboard products perlite composite board, polyurethane, polyisocyanurate, polystyrene, phenolics, and composites; and
(4) Spray-in-place insulation, including but not limited to foam-in-place polyurethane and polyisocyanurate and spray-on cellulose.
(b) Structural fiberboard and laminated paperboard products for applications other than building insulation, including building board, sheathing shingle backer, sound deadening board, roof insulating board, insulating wallboard, acoustical and non-acoustical ceiling tile, acoustical and non-acoustical lay-in panels, floor underlayments, and roof overlay (cover board).
(c) Cement and concrete, including concrete products such as pipe and block, containing coal fly as ground granulated blast furnace (GGBF) slag.
(d) Carpet made of polyester fiber use in low- and medium-wear applications.
(e) Floor tiles and patio block containing recovered rubber or plastic.
(f) Shower and restroom dividers/partitions containing recovered plastic or steel.
(g) (1) Consolidated latex paint used for covering graffiti; and
(2) Reprocessed latex paint used for interior and exterior architectural applications such as wallboard, ceilings, and trim; gutter boards; and concrete, stucco, masonry, wood and metal surfaces.

§247.13 Transportation products.

(a) Traffic barricades and traffic cones used in controlling or restricting vehicular traffic.
(b) Parking stops made from concrete or containing recovered plastic or rubber.
(c) Channelizers containing recovered plastic or rubber.
(d) Delineators containing recovered plastic, rubber, or steel.

(e) Flexible delineators containing recovered plastic.

§ 247.14 Park and recreation products

(a) Playground surfaces and running tracks containing recovered rubber or plastic.
(b) Plastic fencing containing recovered plastic for use in controlling snow or sand drifting and as a warning/safety barrier in construction or other applications.

247.15 Landscaping products.

(a) Hydraulic mulch products containing recovered paper or recovered wood used for hydroseeding and as an over-spray for straw mulch in landscaping, erosion control, and soil reclamation.
(b) Compost made from yard trimmings, leaves, and/or grass clippings for use in landscaping, seeding of grass or other plants on roadsides and embankments, as a nutritious mulch under trees and shrubs, and in erosion control and soil reclamation.
(c) Garden and soaker hoses containing recovered plastic or rubber.
(d) Lawn and garden edging containing recovered plastic or rubber.

§ 247.16 Non-paper office product.

(a) Office recycling containers and office waste receptacles.
(b) Plastic desktop accessories.
(c) Toner cartridges.
(d) Binders.
(e) Plastic trash bags.
(f) Printer ribbons.
(g) Plastic envelopes.

§ 247.17 Miscellaneous products.

Pallets containing recovered wood, plastic, or paperboard.

INDEX OF DRAWINGS
FILE NUMBER E-56-14-17
COFFERDAM AND EXCAVATION
HOWARD HANSON DAM, GREEN RIVER, WASHINGTON

SHEET NUMBER	PLATE NUMBER	TITLE	REVISION NUMBER	DATE
1	G-1.1	Cover Sheet With Vicinity Map		27 JUN 03
2	G-1.2	Drawing Index, Abbreviations, & Legends	A	13 OCT 03
3	G-1.3	General Notes	A	13 OCT 03
4	G-1.4	Proposed Cofferdam Construction Sequence Sheet 1	A	13 OCT 03
5	G-1.5	Proposed Cofferdam Construction Sequence Sheet 2		27 JUN 03
6	GT-1.1	Boring Log 94-DD-80		27 JUN 03
7	GT-1.2	Boring Log 94-DD-81		27 JUN 03
8	GT-1.3	Boring Log 94-DD-85		27 JUN 03
9	GT-1.4	Boring Log 94-DD-86		27 JUN 03
10	GT-1.5	Boring Log 94-DD-87		27 JUN 03
11	GT-1.6	Boring Log 99-DD-200		27 JUN 03
12	GT-1.7	Boring Log 99-DD-201		27 JUN 03
13	GT-1.8	Boring Log 99-DD-202		27 JUN 03
14	GT-1.9	Boring Log 99-DD-203		27 JUN 03
15	GT-1.10	Boring Log 99-DD-204		27 JUN 03
16	GT-1.11	Boring Log 99-DD-205		27 JUN 03
17	GT-1.12	Boring Log 99-DD-206		27 JUN 03
18	GT-1.13	Boring Log 00-DD-207		27 JUN 03
19	GT-1.14	Boring Log 00-DD-208		27 JUN 03
20	GT-1.15	Boring Log 00-DD-209		27 JUN 03
21	GT-1.16	Boring Log 00-DD-210		27 JUN 03
22	GT-1.17	Boring Log 00-DD-211		27 JUN 03
23	GT-1.18	Boring Log 00-DD-212		27 JUN 03
24	GT-1.19	Boring Log 00-DD-213		27 JUN 03
25	GT-1.20	Boring Log 00-DD-214		27 JUN 03
26	GT-1.21	Boring Log 00-DD-215		27 JUN 03
27	GT-1.22	Boring Log 00-DD-216		27 JUN 03

SHEET NUMBER	PLATE NUMBER	TITLE	REVISION NUMBER	DATE
28	GT-1.23	Boring Log 00-DD-217		27 JUN 03
29	GT-1.24	Boring Log 00-DD-218		27 JUN 03
30	GT-1.25	Boring Log 01-DD-222		27 JUN 03
31	GT-1.26	Boring Log 01-DD-223		27 JUN 03
32	GT-1.27	Boring Log 01-DD-224		27 JUN 03
33	GT-1.28	Boring Log 01-DD-225		27 JUN 03
34	GT-1.29	Boring Log 01-DD-226		27 JUN 03
35	GT-1.30	Boring Log 01-DD-227		27 JUN 03
36	GT-1.31	Boring Log 01-DD-228		27 JUN 03
37	GT-1.32	Boring Log 01-DD-229		27 JUN 03
38	GT-1.33	Boring Log 01-DD-230		27 JUN 03
39	GT-1.34	Boring Log 03-DD-231, Sheet 1		27 JUN 03
40	GT-1.35	Boring Log 03-DD-231, Sheet 2		27 JUN 03
41	GT-1.36	Boring Log 03-DD-232, Sheet 1		27 JUN 03
42	GT-1.37	Boring Log 03-DD-232, Sheet 2		27 JUN 03
43	GT-1.38	Boring Log 03-DD-233, Sheet 1		27 JUN 03
44	GT-1.39	Boring Log 03-DD-233, Sheet 2		27 JUN 03
45	GT-1.40	Boring Log 03-DD-233, Sheet 3		27 JUN 03
46	GT-1.41	Boring Log 03-DD-234, Sheet 1		27 JUN 03
47	GT-1.42	Boring Log 03-DD-234, Sheet 2		27 JUN 03
48	GT-1.43	Boring Log 03-DD-235, Sheet 1		27 JUN 03
49	GT-1.44	Boring Log 03-DD-235, Sheet 2		27 JUN 03
50	GT-1.45	Boring Log 03-DD-236, Sheet 1		27 JUN 03
51	GT-1.46	Boring Log 03-DD-236, Sheet 2		27 JUN 03
52	GT-1.47	Boring Log 03-DD-237, Sheet 1		27 JUN 03
53	GT-1.48	Boring Log 03-DD-237, Sheet 2		27 JUN 03
54	GT-1.49	Boring Log 03-DD-238, Sheet 1		27 JUN 03
55	GT-1.50	Boring Log 03-DD-238, Sheet 2		27 JUN 03
56	GT-2.2	Project Bedrock Geology Map		27 JUN 03
57	GT-2.3	Geologic Section A-A'		27 JUN 03
58	GT-2.4	Geologic Section B-B'		27 JUN 03
59	GT-2.5	Geologic Section C-C'		27 JUN 03
60	GT-2.6	Geologic Section D-D'		27 JUN 03

SHEET NUMBER	PLATE NUMBER	TITLE	REVISION NUMBER	DATE
61	GT-2.7	Geologic Section E-E'-E"		27 JUN 03
62	GT-2.8	Geologic Section F-F'-F"		27 JUN 03
63	GT-2.10	Excavation Plan Showing Rock Bolt Configuration	A	13 OCT 03
64	GT-2.11	Excavation Rock Bolt Elevations, Sheet 1	A	13 OCT 03
65	GT-2.12	Excavation Rock Bolt Elevations, Sheet 2	A	13 OCT 03
66	GT-2.13	Excavation Rock Bolt Elevations, Sheet 3	A	13 OCT 03
67	GT-2.14	Excavation Rock Bolt Elevations, Sheet 4	A	13 OCT 03
68	GT-3.1	Instrumentation Plan		27 JUN 03
69	GT-3.2	Instrumentation Schedule	A	13 OCT 03
70	GT-3.3	Instrumentation Section, Sheet 1	A	13 OCT 03
71	GT-3.4	Instrumentation Section, Sheet 2	A	13 OCT 03
72	GT-3.5	Instrumentation Section, Sheet 3		27 JUN 03
73	GT-3.6	Instrumentation Section, Sheet 4		27 JUN 03
74	GT-3.7	Instrumentation Details, Sheet 1		27 JUN 03
75	GT- 4.1	Cofferdam Grouting Plan		27 JUN 03
76	GT-4.2	Cofferdam Grouting Sections	A	13 OCT 03
77	GT-4.3	Cofferdam Grouting Schedules, Sheet 1		27 JUN 03
78	GT-4.4	Cofferdam Grouting Schedules, Sheet 2		27 JUN 03
79	GT-4.5	Dewatering Plan		27 JUN 03
80	GT-4.6	Seismic Retrofit Grout Curtain Plan And Profiles		27 JUN 03
81	EP-1.1	Environmental Site Control General Site Layout And Keyplan Features	A	13 OCT 03
82	EP-1.2	Environmental Site Control Collection Basin Layout And Notes	A	13 OCT 03
83	EP-1.3	Environmental Site Controls Layout And Features-1	A	13 OCT 03
84	EP-1.4	Environmental Site Controls Layout And Features-2	A	13 OCT 03
85	EP-1.5	Environmental Site Controls Sedimentation Pond Layout		27 JUN 03
86	EP-2.1	Environmental Site Control Details		27 JUN 03
87	EP-2.3	Environmental Site Controls Details-1		27 JUN 03
88	EP-2.4	Environmental Site Controls Details-2	A	13 OCT 03

SHEET NUMBER	PLATE NUMBER	TITLE	REVISION NUMBER	DATE
89	S2.17	Environmental Site Control Sedimentation Pond Details		27 JUN 03
90	C1.1	General Site Plan		27 JUN 03
91	C1.2	Disposal Sites		27 JUN 03
92	C1.3	Demolition Plan		27 JUN 03
93	C1.4	Excavation Plan - Phase Ia & Ib	A	13 OCT 03
94	C1.5	Excavation Plan - Phase Ic	A	13 OCT 03
95	C1.6	Excavation Sections & Details I	A	13 OCT 03
95A	C1.7	Excavation Cross Sections	A	13 OCT 03
96	C2.1	Temporary Access Road Plan And Profile I	A	13 OCT 03
97	C2.2	Temporary Access Road Plan And Profile Ii	A	13 OCT 03
98	C2.3	Temporary Access Road - Cross Sections I		27 JUN 03
99	C2.4	Temporary Access Road - Cross Sections Ii		27 JUN 03
100	C2.5	Tremie Concrete Infill And Miscellaneous Details		27 JUN 03
101	S1.1	Plans	A	13 OCT 03
102	S1.2	Elevation And Sections	A	13 OCT 03
103	S2.1	Precast Concrete Structure Layout, Sheet 1	A	13 OCT 03
104	S2.2	Precast Concrete Structure Layout, Sheet 2	A	13 OCT 03
105	S2.3	Precast Concrete Structure Segment A, Detail Sheet 1	A	13 OCT 03
106	S2.4	Precast Concrete Structure Segment A, Detail Sheet 2	A	13 OCT 03
107	S2.5	Precast Concrete Structure Segment B, Detail Sheet 1	A	13 OCT 03
108	S2.6	Precast Concrete Structure Segment B, Detail Sheet 2	A	13 OCT 03
109	S2.7	Precast Concrete Structure Segment C, Detail Sheet 1	A	13 OCT 03
110	S2.8	Precast Concrete Structure Segment C, Detail Sheet 2	A	13 OCT 03
111	S2.9	Precast Concrete Structure Segments D & E, Sheet 1		27 JUN 03
112	S2.10	Precast Concrete Structure Segments D & E, Sheet 2		27 JUN 03
113	S2.11	Precast Concrete Structure Segments F & G	A	13 OCT 03

SHEET NUMBER	PLATE NUMBER	TITLE	REVISION NUMBER	DATE
114	S2.12	Precast Concrete Structure Segment H		27 JUN 03
115	S2.13	Precast Concrete Structure Segment J & K		27 JUN 03
116	S2.14	Precast Concr. Structure Segments L, M, N, & P, Sheet 1		27 JUN 03
117	S2.15	Precast Concr. Structure Segments L, M, N, & P, Sheet 2		27 JUN 03
118	S2.16	Precast Concrete Structure Backflood Pipe		27 JUN 03
119	S2.17	Precast Concrete Structure Segment Anchor Details		27 JUN 03
120	S2.18	Typical Stoplog Bearing & Seal Surface And Segment Joint Details	A	13 OCT 03
121	S2.19	Precast Concrete Segment Support Frame Sheet 1		27 JUN 03
122	S2.20	Precast Concrete Segment Support Frame Sheet 2	A	13 OCT 03
123	S3.1	Cast-In-Place Concrete South Wall Detail Sheet 1	A	13 OCT 03
124	S3.2	Cast-In-Place Concrete South Wall Detail Sheet 2	A	13 OCT 03
125	S3.3	Cast-In-Place Concrete North Wall Detail Sheet 1		27 JUN 03
126	S3.4	Cast-In-Place Concrete North Wall Detail Sheet 2	A	13 OCT 03
127	S3.5	Cast-In-Place Concrete North Wall Detail Sheet 3		27 JUN 03
128	S3.6	Cast-In-Place Concrete Crane Rail Support Beams Sht. 1	A	13 OCT 03
129	S3.7	Cast-In-Place Concrete Crane Rail Support Beams Sht. 2		27 JUN 03
130	S3.8	South Wall Rock Anchors	A	13 OCT 03
131	S3.9	South Wall Rock Anchor Details	A	13 OCT 03
132	S3.10	South Counterfort Walls Elevations And Sections		27 JUN 03
133	S3.11	Waterproof Wall Joint Between Phase 1 And Phase 2	A	13 OCT 03
134	S4.1	Trash Rack Detail Sheet 1		27 JUN 03
135	S4.2	Trash Rack Detail Sheet 2	A	13 OCT 03
136	S4.3	Trash Rack Detail Sheet 3	A	13 OCT 03

SHEET NUMBER	PLATE NUMBER	TITLE	REVISION NUMBER	DATE
137	S5.1	Stoplog Details Sheet 1		27 JUN 03
138	S5.2	Stoplog Details Sheet 2	A	13 OCT 03
139	S5.3	Stoplog Details Sheet 3		27 JUN 03
140	S5.4	Stoplog Details Sheet 4	A	13 OCT 03
141	S5.5	Lifting Beam Plan & Elevation	A	13 OCT 03
142	S5.6	Lifting Beam Detail Sheet 1	A	13 OCT 03
143	S5.7	Lifting Beam Detail Sheet 2	A	13 OCT 03
144	S6.1	Flood / Retaining Walls, Sheet 1	A	13 OCT 03
145	S6.2	Flood / Retaining Walls, Sheet 2	A	13 OCT 03
146	S6.3	Personnel Stair Plan And Sections	A	13 OCT 03
147	S6.4	Personnel Stair Details	A	13 OCT 03
148	S7.1	Access Road Permanent Retaining Wall, Plan And Elevation		27 JUN 03
149	S7.2	Access Road Permanent Retaining Wall, Details	A	13 OCT 03
150	S8.1	Existing Intake Tower Seismic Retrofit Trashrack Beams		27 JUN 03
151	S8.2	Existing Intake Tower Seismic Retrofit Wingwalls		27 JUN 03
152	S8.3	Existing Intake Tower Seismic Retrofit Plan & Elevation	A	13 OCT 03
153	S8.4	Existing Intake Tower Seismic Retrofit Section And Detail 1		27 JUN 03
154	S8.5	Existing Intake Tower Seismic Retrofit Section And Detail 2		27 JUN 03
155	S8.6	Existing Intake Tower Seismic Retrofit Tremie Concrete	A	13 OCT 03

REFERENCE DRAWINGS

Reference drawings provided show conditions at time of construction. These drawings are furnished for information only and the Government does not warrant that conditions will be exactly as shown. Minor deviations can be anticipated and shall not be the basis for a claim for extra compensation.

DRAWING NUMBER	SHEET NUMBER	PLATE NUMBER	TITLE	REVISION NUMBER	DATE
	156	25	Spillway General Layout		23 AUG 59
	157	27	Spillway Intermediate Pier Plan, Elevations & Sections		12 SEP 58
	158	28	Spillway Intermediate Pier Reinforcement		12 SEP 58
	159	29	Spillway Left Abutment Pier Plan, Elevations & Sections		12 SEP 58
	160	33	Spillway Right Abutment		10 OCT 60
	161	42	Spillway Crest Gate Elevations & Sections		12 SEP 58
	162	43	Spillway Crest Gate Details		12 SEP 58
	163	44	Spillway Crest Gate Details		12 SEP 58
	164	48	General Layout		12 SEP 58
	165	49	Substructure Sectional Plans I		12 SEP 58
	166	50	Substructure Sectional Plans II	B	21 APR 65
	167	51	Substructure Sectional Elevations I	B	22 SEP 59
	168	52	Substructure Sectional Elevations II	B	22 SEP 59
	169	53	Substructure Elevations	C	22 SEP 59
	170	54	Substructure Plans & Sections	B	28 AUG 59
	171	55	Reinforcement I	B	27 OCT 58
	172	56A	Reinforcement IIA		28 AUG 58
	173	56B	Reinforcement IIB	A	21 APR 65

DRAWING NUMBER	SHEET NUMBER	PLATE NUMBER	TITLE	REVISION NUMBER	DATE
	174	57	Reinforcement III	B	21 APR 65
	175	58	Reinforcement IV	A	3 OCT 58
	176	59	Trash Rack Bars		12 SEP 58
	177	65	Equipment General Arrangement I		12 SEP 58
	178	66	Equipment General Arrangement II	A	21 APR 65
	179	67	Regulating Gate Plans & Sections	A	21 APR 65
	180	68	Regulating Gate Elevations & Sections	A	21 APR 65
	181	69	Regulating Gate Details		12 SEP 58
	182	70	Regulating Gate Details	A	21 APR 65
	183	71	Regulating Gate Seals	A	21 APR 65
	184	72	Regulating Gate Hoist Assembly	A	21 APR 65
	185	87	Tunnel Upstream Transition		12 SEP 58
	186	88A	Tunnel Sections & Details	A	27 OCT 58
	187	88B	Tunnel Downstream Transition	A	27 OCT 58
	188	89	Stilling Basin Plan & Section I	B	10 APR 61
	189	90	Stilling Basin Plan & Section II	C	21 APR 65
	190	91	Stilling Basin Sections	C	10 APR 61
	191	92	Stilling Basin Details	B	2 FEB 60
	192	93	Stilling Basin Bypass Outlet Gate	A	10 APR 61
	193	94	Bridge Plan, Elevation & Sections	D	10 APR 61
	194	95	Bridge Detail Plan, Elevation & Sections	B	10 OCT 60
	195	96	Bridge Details	A	3 OCT 58
	196	97	Bridge Piers	A	3 OCT 58

DRAWING NUMBER	SHEET NUMBER	PLATE NUMBER	TITLE	REVISION NUMBER	DATE
	197	G-1	Seismic Upgrade – Cover Sheet		1 NOV 96
	198	G-2	Seismic Upgrade – Index		1 NOV 96
	199	G-3	Seismic Upgrade – Site Map		1 NOV 96
	200	G-4	Existing Surface Topography		1 NOV 96
	201	S-1	Structural Notes And Rock Anchor Detail		1 NOV 96
	202	S-2	Modifications To The Existing Bridge And Tower		20 NOV 95
	203	S-3	Foundation		1 NOV 96
	204	S-4	Elevation & Section		1 NOV 96
	205	S-5	Details I		1 NOV 96
	206	S-6	Details II		1 NOV 96
	207	S-7	Footing Caps		1 NOV 96
	208	S-8	Shear Panels for Pier I		1 NOV 96
	209	S-9	Shear Panels For Piers 2 And 3		1 NOV 96
	210	S-10	Shear Panel Sections		1 NOV 96
	211	S-11	Deck Restraint Cable Details		1 NOV 96
	212	S-12	Deck Lateral Restraint		1 NOV 96
	213	M-1	Hoist Carriage Restraint		1 NOV 96
	214	GT-1A	Instrumentation On Existing Structures, Site Plan	`	3 JUL 03
	215	GT-1B	Instrumentation On Existing Structures, Outlet Tunnel Plan		3 JUL 03
	216	GT-2	Instrumentation On Existing Structures, Instrumentation Schedule		3 JUL 03
	217	GT-3	Instrumentation On Existing		3 JUL 03

DRAWING NUMBER	SHEET NUMBER	PLATE NUMBER	TITLE	REVISION NUMBER	DATE
			Structures, Structure Elevation		
	218	Gt-4	Instrumentation On Existing Structures, Liquid Level Gages		3 JUL 03
	219	GT-5	Instrumentation On Existing Structures, Intake Tower Instruments, Seismic Retrofit		3 JUL 03
	220	GT-6	Instrumentation On Existing Structures, North Wall Cofferdam Instruments		3 JUL 03
	221	P-1	Existing Intake Tower Photograph		26 JUN 03

STANDARD DETAILS BOUND IN THE SPECIFICATIONS

DRAWING NUMBER	SHEET NUMBER	TITLE	DATE
SECTION 01501 - CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS			
	1, 2	Civil Works Project Identification Sign	REV 07APR88
	1	Hard Hat Sign	10SEP90

END OF SECTION

HOWARD HANSON DAM
COFFERDAM FOUNDATION AND EXCAVATION CONTRACT – FISH PASSAGE FACILITY, ADDITIONAL WATER STORAGE PROJECT

GEOTECHNICAL BASELINE REPORT

HOWARD HANSON DAM
COFFERDAM FOUNDATION AND EXCAVATION CONTRACT
- FISH PASSAGE FACILITY, ADDITIONAL WATER STORAGE PROJECT

GEOTECHNICAL BASELINE REPORT

TABLE OF CONTENTS

List of Figures

HOWARD HANSON DAM
COFFERDAM FOUNDATION AND EXCAVATION CONTRACT
- FISH PASSAGE FACILITY, ADDITIONAL WATER STORAGE PROJECT

GEOTECHNICAL BASELINE REPORT

PART 1 – GENERAL

1.1 General Information

This report is part of the contract documents for the Howard Hanson Dam Cofferdam Foundation and Excavation Contract – Fish Passage Facility, Additional Water Storage Project.

This Geotechnical Baseline Report (GBR) presents the Government's interpretation of the anticipated subsurface conditions to be encountered during the execution of this contract and to record the basis of the design developed in the Drawings and Specifications. This report, and documents and drawings incorporated by reference, shall be considered to be the sole source of the Government's interpretation of the geotechnical conditions for this contract. This report also establishes the geotechnical baseline that serves as a basis for the identification of differing site conditions. The sources of the geotechnical data on which this report is based are referenced in Paragraph 1.6.

In developing the geotechnical criteria used in the design and preparation of the Contract Documents, certain assumptions have been made concerning the contractor's construction methods and performance capabilities. The actual procedures, techniques and craftsmanship employed by the Contractor may result in ground behavior different from that postulated herein.

This report is prepared in three parts: Part 1 provides background information regarding this document, Part 2 gives general background information regarding the project site conditions, and Part 3 establishes the geotechnical baseline and some construction considerations.

1.2 Description of Work

Geotechnical work to be performed under this contract is outlined in the contract Drawings and Specifications. Some, but not all, of the work to be performed includes rock excavation, overburden excavation, foundation preparation, foundation grouting, installation and operation of a dewatering system, installation of geotechnical instruments, design and construction of retaining walls/berms, and rock mass stabilization.

1.3 Intended Methods

Activities conducted under this contract shall be carried out in accordance with the procedures and practices outlined in the contract. Required specifications for materials and equipment are also included in the contract Drawings and Specifications.

1.4 References

The following references were used in the preparation of this document or in the evaluation of the data presented in this document (to include Appendix A):

- American Society for Testing and Materials, 1995, Standard Test Method for Unconfined Compressive Strength of Intact Rock Core Specimens (D2938-95)
- American Society for Testing and Materials, 1998, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass (D2216-98)
- Barton, N.R., Lien, R., and Lunde, Jr., 1974, Engineering classification of rock masses for the design of tunnel support. *Rock Mechanics* **6**(4), 189-239.
- Bates, R.L. and J.A. Jackson, 1984, Dictionary of Geological Terms, Third Edition, Doubleday
- Bieniawski, Z.T., 1974, Geomechanics classification of rock masses and its application to Tunneling: Transactions South African Institute Civil Engineering, v. 15, no. 12, p. 335-343.
- Call, R.D., Savely, J.P., and Pakalnis, R., 1982, A simple core orientation technique, Proceedings, Third International Conference on Stability in Surface Mining, Society of Mining Engineers, AIME, Vancouver, Canada, p. 465-481.
- Cooper, H.H., Jr., and C.E. Jacob, 1946, A Generalized Graphical method for Evaluating Formation Constants and Summarizing Well-Field History: Transactions, American Geophysical Union, v. 27, p. 526-534.
- Frizzell, V.A., 1984, Preliminary Geologic Map of the Snoqualmie Pass 1:100,000 Quadrangle, Washington U.S.Geological Survey (USGS) Open File Map 84-693.
- Hammond, P.E., 1963, Structure and stratigraphy of the Keechelus volcanic group and associated Tertiary rocks in the West-Central Cascade Range, Washington, Ph.D. dissertation, University of Washington, 264 p.
- Hoek, E. and Bray, J., 1981, Rock Slope Engineering, Third Edition, Chapman & Hall, Inc.
- International Society of Rock Mechanics, 1981, Suggested Method for Laboratory Determination of direct Shear Strength
- Neuman, S.P., 1975, Analysis of pumping test data from anisotropic unconfined aquifers concerning delayed gravity response: Water Resources research, v. 11, No. 2, p. 329-342.
- U. S. Army Corps of Engineers, 1983, Earthquake Analysis of Howard Hanson Dam, Design Memorandum No. 26: Seattle District, Seattle, Washington.
- U.S. Army Corps of Engineers, 1994, Rock Foundations (EM 1110-1-2908)
- U. S. Army Corps of Engineers, 1998, Additional Water Supply Project, Final Feasibility Study Report and Final Environmental Impact Statement (EIS), Howard Hanson Dam, Green River, Washington: Seattle District, Seattle, Washington.
- U.S. Department of the Interior, Bureau of Reclamation, 1985, Ground Water Manual, Third Edition, A Water Resources Technical Publication

1.5 Definitions

Definitions are primarily taken from the Dictionary of Geological Terms, edited by Bates and Jackson.

Aphanitic	Textural term applied to any fine-grained igneous rock whose constituents are too small to be distinguished by the unaided eye.
Ash	Pyroclastic material under 2 mm in diameter.
Autobreccia	Syn-depositional texture developed through the non-uniform cooling of a volcanic flow. The outer margins of the flow cool more rapidly and are subsequently incorporated into the remainder of the flow as solid fragments from 2 mm to greater than 64 mm.
Blocks/Bombs	Pyroclastic material greater than 64 mm in diameter.
Glaciolacustrine	General classification of sediments derived from or deposited in glacial lakes.
Hypabyssal	General adjective applied to minor intrusions such as sills and dikes which have crystallized under conditions intermediate between plutonic and extrusive.
Lapilli	Pyroclastic material between 2 mm and 64 mm.
Lapilli Tuff	Pyroclastic rock composed of roughly equal parts of lapilli and ash.
Moraine	Unstratified sediments deposited directly by the actions of glacial ice. Sediments typically include a mixture of clay, silt, sand, gravel, and boulders.
Porphyritic	Textural term applied to an igneous rock which contains some constituents which are visible to the naked eye. The remainder of the constituents are aphanitic.
Pyroclastic Rock	Any primary rock composed of solid materially explosively or aerially ejected from a volcanic vent.
Tuff	Pyroclastic rock predominately composed of volcanic ash.
Tuff Breccia	Pyroclastic rock composed of roughly equal parts blocks/bombs and lapilli or ash.

1.6 Sources of Information

Geotechnical data used in the preparation of this report is presented in Appendix A and in the following documents:

- NORCAL Geophysical Consultants, 2001, Borehole Geophysical Logging Survey, Cofferdam and Fish Collection Facility, Howard Hanson Dam, King county, Green River, Washington. Contract No. DACW67-99-M-0436.
- NORCAL Geophysical Consultants, 2000, Borehole Geophysical Logging Survey, Cofferdam and Fish Collection Facility, Howard Hanson Dam, King county, Green River, Washington. Contract No. DACW67-99-M-0436.
- Shannon & Wilson, Inc., 2002, 95% Draft Geotechnical Report, Howard Hanson Dam Fish Bypass Facility, Excavation and Tunnel Rock Support Analyses and Recommendations, Eagle Gorge, Washington. Contract No. DACW67-00-D-2002, Task Order Nos. 8, 9, and 11.
- Shannon & Wilson, Inc., 2000, Geotechnical Report: Cofferdam Rock Mass Study, Howard Hanson Dam, Eagle Gorge, Washington, Contract No. DACW67-00-D-2002, Task Order No. 2.

- U. S. Army Corps of Engineers, 1963, Howard A. Hanson Dam Foundation Report, Rock Fill Dam, Spillway and Outlet Works, Green River, Washington: Seattle District, Seattle, Washington

1.7 Design Team

The Seattle District Corps of Engineers, in conjunction with Shannon & Wilson, Inc. and Inca Engineers Inc., performed the design work for this contract. The project manager for this project is Mike Padilla, Seattle District Corps of Engineers, phone number 206-764-6734. The senior geologist for this contract is Richard Smith, Seattle District Corps of Engineers, phone number 206-764-3309.

1.8 Geotechnical Explorations

Between 1994 and 2003, United States Army Corps of Engineers personnel conducted a series of exploration programs in support of the Howard Hanson Dam – Fish Passage Facility project. These programs included field and laboratory based investigations. Field investigations included geologic mapping of surface outcrops, drilling and logging of 41 core borings, borehole packer and groundwater pumping tests, topographic and sediment bathymetry of the left abutment, excavation of four shallow test pits, and borehole geophysics. Acoustic televiewer, optical televiewer, caliper, temperature-fluid conductivity, heat-pulse flow meter, and sonic profile surveys were the geophysical methods employed.

Laboratory investigations included petrographic analyses of thin sections and laboratory tests on select rock core samples. Laboratory tests included unconfined compressive strength, splitting tensile strength, and direct shear tests.

Borehole locations and logs are presented in the Drawings (plate GT2.2 and GT1.1 thru GT1.50, respectively).

PART 2 – GENERAL SITE CONDITIONS

2.1 Location and Access

The Howard Hanson Dam (HHD) is located on the Green River, within the Green River Watershed, approximately 35 miles southeast of Seattle, Washington. Access to the Green River Watershed, and therefore the project site, is restricted. Information on arranging access to the project site can be found in the contract Specifications, section 01005. A discussion of general access requirements and availability of access roads is also included in section 01005 of the contract Specifications. Information on widths and locations of access roads is included in the contract Drawings. Directions to the site are included on the cover of the contract Drawings.

2.2 Geologic Background

The dam spans a narrow rock canyon located 5 miles inside the western Cascade margin. To the east, the Cascade Range rises sharply to elevations over 7,000 feet. The Cascades in this part of Washington are largely composed of a complex assemblage of lava flows, pyroclastic deposits, and fluvial sedimentary deposits. Intrusive igneous rocks are present, but to a lesser extent than

those mentioned above. Most of these rocks were deposited during the upper Eocene to Miocene (10 to 40 million years ago) and were later uplifted during the Pliocene (5 million years ago) to form the Cascade Range. This uplift was accompanied by Pliocene and Pleistocene (1 million years ago) volcanism that formed the major Cascade volcanoes such as Mt. Rainier.

The ancestral Green River was tributary to the Cedar River drainage prior to the glaciation of the Puget Sound Lowland. Before the last glacial event the river flowed out of the North Fork Valley to the Cedar. During the Pleistocene, glacial ice extended eastward up into the alpine valley headwaters. The ice and associated glacial deposits (moraine and glaciolacustrine) diverted the proto-Green River from its North Fork Valley. The diverted river flowed on a bedrock floor at elevation 1,000 feet in the river gorge. This gorge is presently buried north of the dam site. The nearest (southwest) rim of the ancestral valley is located several hundred feet northeast of the right abutment of HHD.

During subsequent interglacial periods, the Green River cut its channel approximately 150 feet deeper resulting in over steepened side slopes and collapse of the eastern valley side. Several episodes of deposition, erosion, and landsliding may have followed. The present gorge beneath the dam was cut as a result of river blockage by the last massive slide off the northeast valley wall. Today this landslide is a major landform forming part of the right abutment of HHD.

The present North Cascade Range was uplifted during the Pliocene by a series of complex folds and faults. One such fault is the west-northwest trending Green River fault (also mapped as the Lemolo fault) located approximately 1,500 feet north of the dam (Figure 1). Active during the Miocene and/or Pliocene, the fault shows about 4,000 feet of right-lateral, oblique slip displacement. The width of the fault zone is unknown, although between the area of the dam site and the mountain front, the Green River preferentially follows the weak/fractured zone of this fault trace. Several structural folds are present along the south side of the Green River fault. A landslide at the right (north) abutment obscures the fault trace at the dam. The fault zone probably contributed to the landslide based on the proximity of hydrothermally altered, weaker rock comprising the fault zone. In this area of the Washington Cascades, most major faults strike northwest and dip southwest. Although the strike of the Green River fault west of the dam site reflects this trend, east of the dam site the Green River fault exhibits an east-west trend.

The project site is underlain by bedrock composed of a series of Tertiary age volcanic rocks. Locally, these rocks are known as the Eagle Gorge Andesite, and regionally they correlate with the Fifes Peak formation of early Miocene age. Geologic maps of the area suggest the dam site lies within the western extent of a structural nose of an east-west trending, eastward plunging syncline. The axis of the syncline generally trends parallel to the Green River fault. Regional dip of the bedrock is roughly 45 to 50 degrees to the east.

2.3 Surface and Subsurface Materials

Both bedrock and unconsolidated materials are located on-site. Results from the geotechnical explorations identified in Section 1.8 were used to characterize the properties of these materials. The characteristics of these materials are outlined in the following section.

2.3.1 Bedrock Materials

Bedrock within the project area is entirely igneous in origin and includes volcanic flows, shallow intrusions, and pyroclastic deposits. A top-of-rock contour map is included as Figure 2 for excavation estimation purposes. For the purposes of this project, three informal units have been differentiated: andesite, pyroclastite, and basaltic andesite. A description of each unit and the adopted rock properties are discussed below. Rock mass characterization is discussed in section 2.3.2.

1) Andesite. The Andesite unit accounts for approximately 70 percent of the bedrock volume and is comprised of aphanitic and porphyritic flows and hypabyssal intrusions of intermediate composition. The unit is largely unweathered, of moderate strength, moderately hard to hard, dense, and light to dark grey to dark green. Autobreccia textures are commonly (greater than 50% by volume) displayed within the unit. Discontinuities within the unit include both primary and secondary features. Primary discontinuities are limited to occasional flow banding which does not affect unit stability. Secondary discontinuities are limited to the moderately abundant to abundant fractures. Fracture characteristics are discussed in the closing paragraph of this section.

Adopted Rock Properties (Andesite)

Property	Range	Average (One Std Deviation)
Specific Gravity (Bulk Dry)	2.50 to 2.60	
Moist Unit Weight (pcf)	136.1 to 205.1	
Unconfined Compressive Strength (psi)	2,230 to 27,130	7,363 (4,260)
Shear Strength at 50 psi Normal (psi/phi)	27/29 to 95/62	52(19)/45(10)
Tensile Strength (psi)	413 to 2,540	1,360 (807)
Poisson's Ratio	0.0019 to 0.4325	0.2661 (0.0873)

pcf – pounds per cubic foot
phi – internal angle of friction
psi – pounds per square inch

2) Pyroclastite. The bedrock component attributable to the Pyroclastite unit is roughly 19 percent of the volume. The unit is comprised of basaltic andesite to andesite pyroclastic deposits (tuffs, lapilli tuffs, and tuff breccias). Deposits are light gray to dark gray to buff, soft to moderately hard, and of low to moderate strength. Weathering has strongly impacted surface outcrops but has had little impact on subsurface rocks. The pervasive alteration present within the unit can be inferred as the reason for the unit's rapid deterioration upon exposure to the atmosphere. Discontinuities within the unit include primary depositional features and secondary structures. Primary features do not affect the unit's stability. Secondary fractures within the Pyroclastite unit share the same characteristics as the other units but are more difficult to discern due to the nature of the unit. Fracture characteristics are discussed in the closing paragraph of this section.

Adopted Rock Properties (Pyroclastite)

Property	Range	Average (One Std Deviation)
Specific Gravity (Bulk Dry)	2.25 to 2.35	
Moist Unit Weight (pcf)		not available

Unconfined Compressive Strength (psi)		not available
Shear Strength at 50 psi Normal (psi/phi)		not available
Tensile Strength (psi)		not available

pcf – pounds per cubic foot
phi – internal angle of friction
psi – pounds per square inch

3) Basaltic Andesite. The Basaltic Andesite unit, the youngest bedrock unit in the project area, makes up approximately 11 percent of the bedrock volume. Occurrences of the unit are in the form of dikes, sills, and thin flows. Rocks within the unit are dark gray to black, of moderate to high strength, moderately hard to hard, dense, and blocky. Weathering is minimal and alteration is minimal to moderate. Discontinuities are limited to the abundant secondary fractures. Fracture characteristics are discussed in the closing paragraph of this section.

Adopted Rock Properties (Basaltic Andesite)

Property	**Range**	**Average (One Std Deviation)**
Specific Gravity (Bulk Dry)	2.60 to 2.65	
Moist Unit Weight (pcf)	159.2 to 170.4	
Unconfined Compressive Strength (psi)	4,730 to 10,390	8,140 (3,003)
Shear Strength at 50 psi Normal (psi/phi)	31/31	31/31
Tensile Strength (psi)		not available

pcf – pounds per cubic foot
phi – internal angle of friction
psi – pounds per square inch

Secondary structures within all three bedrock units share common characteristics. Fracture spacing ranges from tenths of inches to several feet. Fracture aperture ranges from less than 0.1 mm to greater than 5.0 mm with some fractures healed or partially healed with calcite. Chlorite, calcite, and pyrite are the three most common fracture coatings. Slickenside fractures have been identified in all three units but are most common within the Basaltic Andesite unit.

2.3.2 Rock Mass Classification and Slope Stability

The following section addresses the anticipated excavation rock slope stability and the parameters used in anticipating slope stability.

2.3.2.1 Discontinuities – Orientation and Condition

Throughout the course of the exploration programs identified in section 1.8, data has been collected regarding the frequency, orientation, and condition of discontinuities in the rock mass.

Orientations of discontinuities were measured in core borings using geophysical logging techniques (optical and acoustic borehole televiewers) and along surface outcrops and drill core using conventional mapping and logging techniques. To assess the uniformity of joint orientations, approximately 1,200 discontinuities were analyzed using stereonets following the recommendations by Call, et al. Although a broad spectrum of discontinuity orientations were observed, only statistically significant clusterings of data points were selected as preferred joint

orientations. The selected preferred joint orientations are listed here and the mean pole orientations are shown in Figure 3.

Approximate Preferred Orientations of Discontinuities

Joint Set Designation	Dip Direction (degrees)	Dip (degrees)
J1	215	90
J2	135	45
J3	75	50
J4	10	25
J5	240	53
J6	295	55
J7	155	20

2.3.2.2 Rock Mass Ratings

Three rock mass classification methods were used to determine the overall quality of the rock mass for engineering purposes. The methods used were the Rock Quality Designation (RQD), Rock Mass Rating (RMR), and Tunnel Quality Index (Q-system) methods. Each of these methods is discussed in the following sections.

1) RQD. The RQD method is expressed as a ratio of the sum of intact core pieces greater than four inches in length to the total length of the core run. This is a quick and easy way to quantify the frequency and intensity of discontinuities within a rock mass and is used as a parameter in the other classification methods discussed here. Bedrock within the project area has an average RQD of 74.08%. Average RQD by unit is as follows: Andesite – 86.17%, Pyroclastite – 83.63%, Basaltic Andesite – 55.08%.

RQD Values

RQD (%)	≤ 25	25 ≤ 50	50 ≤ 75	75 ≤ 90	90 ≤ 100
Rock Quality	Very Poor	Poor	Fair	Good	Excellent

2) RMR. The RMR system was proposed by Bieniawski (1973) and initially used for tunneling conditions. The RMR system considers six parameters:

- Uniaxial compressive strength of the intact rock
- RQD
- Spacing of discontinuities
- Condition of discontinuities
- Ground water conditions
- Orientation of discontinuities

The above parameters are dependent on the rock mass condition and quality. The last two parameters, however, are also dependent on the location and orientation of the proposed structure with respect to depth of the groundwater table and the orientation of the discontinuities. For this

report, 'completely dry' groundwater conditions and 'very favorable' joint orientations have been assumed. There are five rock mass classes, ranging from class I for 'very good rock' (RMR of 81 to 100) to class V for 'very poor rock' (RMR less than 20). The average RMR for bedrock at the project site is 65.92. By unit, the average RMR are 68.99 for the Andesite, 67.42 for the Pyroclastite, and 60.36 for the Basaltic Andesite. For all units, the minimum RMR is 39.69 and the maximum RMR is 83.84.

Rock Mass Rating Values

Rating	100 - 81	80 - 61	60 - 41	40 - 21	< 20
Class No.	I	II	III	IV	V
Description	Very good rock	Good rock	Fair rock	Poor rock	Very poor rock

3) Q-System. The Q-system was proposed by Barton, Lien, and Lunde (1974) and was developed specifically for tunnel support systems, but has been expanded for other rock excavation applications. The Q-system uses the following equation:

$$\mathbf{Q = (RQD/J_n) * (J_r/J_a) * (J_w/SRF)}$$

where RQD - Rock Quality Designation
J_n - Joint set number dependent on the number of discontinuity sets
J_r - Joint roughness number dependent on roughness of the most unfavorable discontinuity
J_a - Joint alteration number dependent on the degree of alteration or filling along the weakest discontinuity
J_w - Joint water reduction number dependent on water flow
SRF - Stress reduction factor.

Within the Q-system, rock mass quality is divided into nine classes ranging from "exceptionally poor" to "exceptionally good". Modified Q* system was used for this project. Modified Q* does not consider J_w or SRF, as these two factors can vary significantly depending on the type, size and location of the structure. Q values for bedrock within the project area averaged 84.12 with a data range between 0.22 and 533.33. The Andesite unit averaged the highest Q value with an average of 84.87. The Pyroclastite and Basaltic Andesite units averaged Q values of 76.84 and 11.67, respectively.

Q-System Values

Rating	**Description**
0.001-0.01	Exceptionally Poor
0.01-0.1	Extremely Poor
0.1-1	Very Poor
1-6	Poor
6-10	Fair
10-60	Good
60-100	Very Good
100-600	Extremely Good

600-1000	Exceptionally Good

The three rock mass classifications were conducted for each exploratory borings core run. Rock mass ratings were developed from boring log, core photograph, and geophysical data. These ratings, and associated rock classes and descriptions, are presented in Appendix A.

2.3.2.3 Excavation Slope Stability (Rock Block Stability)

During construction of the excavation, discrete rock blocks with dimensions that are much less than the height of the slope will daylight in the slope. The stability of these blocks and the necessity for the installation of rock reinforcement were evaluated by performing both kinematic and limiting equilibrium analyses. Kinematic analyses were performed to evaluate whether the potential rock blocks will fall out of the slope due only to geometry and the limiting equilibrium analyses were conducted to evaluate the stability of the rock blocks and estimate rock reinforcement requirements. Modes of potential rock slope instability, results of the kinematic analyses, and results of the limiting equilibrium analyses are discussed here.

1) Modes of Rock Slope Instability. The typical modes of rock slope instability are described below.

a) *Circular Failures*. Circular failures occur in highly weathered, altered, or fractured rock masses. In this failure mode, the rock mass behaves as a soil and shear planes do not follow a single discrete structure or combination of discrete structures.
b) *Plane Shear Failures*. Plane shear failures consist of a block of rock sliding on a single discontinuity, such as a joint, bedding plane, geologic contact, or fault dipping into the excavation. The stability of the slope is dependent upon the following: (i) the orientation of the discontinuity with respect to that of the excavation, (ii) the shear strength of the discontinuity, (iii) the weight of the block, and (iv) the pressure due to water on the base of the block or in joints that could form tension cracks behind the rock face.
c) *Simple Wedge Failures*. A simple wedge failure consists of a block of rock sliding on two discontinuities that intersect such that the intersection of the discontinuities plunges into the excavation. The stability of the slope is dependent upon the same factors that determine stability for the plane shear type failure.
d) *Toppling Failures*. Blocks of rocks that are formed by vertical or high angle discontinuities, such as joints that dip into the slope form toppling failures. Toppling can also occur where overhangs are created by poor blasting practice or the disintegration of weak, non-durable rock at the toe of the slope.

Possible modes of failure at the project site are plane shear, simple wedge and toppling. Circular failure within the rock excavation is unlikely.

2) Kinematic Analyses. The results of the kinematic analyses are listed in the table below and indicate the following:

a) For the north slope, the principal failure modes would likely consist of toppling and wedge failure.

b) For the west and south slopes, all modes of failure are possible.
c) For the intake channel slopes, the most likely failures would be plane shear and wedge failures.

Potential Slope Stability Failures Based on Kinematic Analyses

Slope Face	Slope Orientation		Permissible Failure Mechanisms	Joint Sets	Factor of Safety (dry conditions)
	Dip Direction (degrees)	Slope Angle (degrees)			
North	203	85	Toppling	J1	--
			Wedge	J2 & J5	1.51
			Wedge	J7 & J5	2.41
West	135	85	Toppling	J6	--
			Plane Shear	J2	0.84
			Wedge	J2 & J3	0.96
			Wedge	J7 & J3	2.37
South	23	85	Toppling	J1	--
			Plane Shear	J4	1.80
			Wedge	J6 & J3	2.83
Intake Channel	0	85	Plane Shear	J4	1.80
			Wedge	J6 & J3	2.83

These potential modes of failure are based on the preferred joint orientations discussed in section 2.3.2.1 of this document.

3) Limiting Equilibrium Analysis. Based on the predominant joint orientations, a limiting equilibrium analysis was conducted for each of the potential failure mechanisms identified in item number 2 of this section. In general, when the expected water condition in the slope is not known, rock wedges and plane shear failure surfaces with a dry factor of safety equal to approximately 2.0 will remain stable even under the most severe groundwater pressure conditions (Hoek and Bray, 1980). Wedges and plane shear failure surfaces with factors of safety of less than 2.0 are potentially unstable, and rock wedges with factors of safety less than 1.0 for assumed dry conditions would be unstable under even the most favorable groundwater conditions.

Rock blocks in either the wedge or plane shear failure modes with computed factors of safety less than 2.0 are likely to occur in all excavation slopes. In addition, the west slope may contain rock blocks in orientations that have computed factors of safety equal to or less than 1.0. This indicates that for the west slope, rock blocks could be expected to be unstable, even if there were no water pressure in joints that bound the rock blocks.

2.3.3 Unconsolidated Materials

Unconsolidated materials within the project area are limited to the slope above the existing access road and in the area of the contract wastewater recycling setup and include both fill and native materials. The fill consists of randomly placed silty, sandy, gravels (GP-GM). Native materials are moderately dense silty, sandy gravels (GP-GM) and soft to medium stiff clayey silts (ML). Figure 4 shows the location of excavated test pits and figure 5 shows the test pit logs.

Standard penetration test (SPT) blow counts for all unconsolidated materials averaged 7.8 blows per foot. The minimum and maximum SPT blow counts per foot are 6.5 and 10.5, respectively.

Adopted Unconsolidated Materials Properties

Type	Classification	Unit Weight (dry)	Shear Strength (ϕ, c)[1]
Fill Materials	GP-GM	125 lb/ft3	35°, 0
Native Materials	GP-GM	133 lb/ft3	37°, 0
Native Materials	ML	100 lb/ft3	27°, 100

[1] estimated values based on material classification

ϕ – internal angle of friction (phi)

c – cohesion (in pounds per square foot)

2.4 Hydrogeologic Conditions

Groundwater within the project area primarily originates from the south slope and flows towards the north. The dam reservoir makes little impact on the area groundwater volume or flow direction. Groundwater is located within the relatively impervious bedrock and flow is therefore largely controlled by discontinuities. Permeability within the rock depends on the spacing, orientation, width, filling, and interconnectivity of these discontinuities. Packer tests were conducted to measure the hydraulic conductivity of discrete zones within boreholes. Long-term pumping tests were conducted to measure bulk hydraulic conductivity of the rock mass.

1) Packer Testing. Upon completion of exploration boreholes, each borehole was hydraulically pressure tested. Each pressure test consisted of two phases. The first phase consisted of a flow test that was immediately followed by a duration test – the second phase. Results of the pressure tests were used in estimating the bedrock hydraulic conductivity. Testing was performed using a double packer assembly separated by 20 feet, a water pressure gauge and a flow meter. The lower-most zone for each boring was tested with a single packer assembly. Calculated values of hydraulic conductivity varied considerably and included a number of horizons with artesian conditions. Hydraulic conductivity calculations followed the procedures outlined on page 259 of the Bureau of Reclamation's Ground Water Manual. The hydraulic conductivity for zones without artesian conditions ranged from 0.001 ft/day to 9.80 ft/day with an average hydraulic conductivity of 0.74 ft/day.

2) Pumping Tests. Two pumping tests, on separate wells, were conducted to determine bulk bedrock hydraulic conductivity. One pumping test was conducted over a 48-hour period and the other over a 72-hour period. Prior to each pumping test, a step test was conducted to determine the optimum pumping rate. Test wells were then pumped for 48/72 hours with a 48/72 hours recovery test. The pumping well and selected available open boreholes were monitored for every segment of the tests. Test results were analyzed using the Neuman (1975) unconfined method and the Cooper-Jacob (1946) method to determine the hydraulic conductivity (ft/day) for the rock mass between the pumped well and observation wells. Based on the methods of Neuman, the average rock mass hydraulic conductivity is 1.87 ft/day. Based on the Cooper-Jacob methods, the average rock mass hydraulic conductivity is 1.80 ft/day.

Average hydraulic conductivity values for both the packer testing and the pumping tests are on the same order of magnitude indicating that at the scale of the distance between boreholes, the fracture connectivity may approximate a porous medium.

Artesian conditions have been encountered within the project area during geotechnical explorations. Artesian conditions are encountered over discrete intervals and are typically relieved by further drilling. The majority of the artesian conditions encountered have been between the 1,070 ft. and 1,130 ft. elevations. Discrete zones of moderately pressurized groundwater can be expected during the excavation process.

PART 3 – GEOTECHNICAL BASELINE AND CONSTRUCTION CONSIDERATIONS

3.1 Geotechnical Baseline

The following section summarizes the geotechnical baseline properties identified in Part 2 of this document.

Summary – Geotechnical Baseline Properties

Property	Andesite	Pyro-clastite	Basaltic Andesite	GP-GM - Fill	GP-GM - Native	ML - Native
Specific Gravity (bulk dry)	2.55[1]	2.30[1]	2.63[1]	--	--	--
Weight (dry, pcf)	--	--	--	125.0	133.0	100.0
Weight (moist, pcf)	170.6[1]	--	164.8[1]	--	--	--
Unconfined Compressive Strength (psi)	7,363[1]	--	8,140[1]	--	--	--
Shear Strength at 50 psi (psi/phi)	52/45[1]	--	31/31[1]	--	--	--
Shear Strength (phi/c)	--	--	--	35°/0[2]	37°/0[2]	27°/100[2]
Tensile Strength (psi)	1,360[1]	--	--	--	--	--
Poisson's Ratio	0.266[1]	--	--	--	--	--
RQD (%)	86.17[1]	83.63[1]	55.08[1]	n/a	n/a	n/a
RMR	68.99[1]	67.42[1]	60.36[1]	n/a	n/a	n/a
Q	84.87[1]	76.84[1]	11.67[1]	n/a	n/a	n/a
Hydraulic Conductivity (ft/day)	<2	<2	<2	--	--	--

[1] Average values – actual values my vary as much as 20 percent
[2] Estimated values based on material classification
pcf – pounds per cubic foot
phi – internal angle of friction
psi – pounds per square inch

c – cohesion (in pounds per square foot)

3.2 Construction Considerations

This section addresses some of the construction considerations affected by the geotechnical properties identified in Part 2 and Section 3.1 of this document. This includes only a very limited number of considerations and should not be viewed as the extent of potential considerations.

3.2.1 Rock Mass Reinforcement

Based on the nature of the bedrock in the area of excavation and the presence of existing critical structures, a number of soil and rock mass reinforcement measures are required. These are briefly discussed here and in detail in the contract Drawings and Specifications.

1) *Scaling*. Rock scaling will be conducted immediately following excavation of a given area. Scaling will remove any loose, hanging, or potentially dangerous rock that may create a dangerous environment. Due to the nearly random orientation of fractures within the rock mass, scaling is a particularly important, and perhaps difficult, step in the rock mass reinforcement. Where encountered, rocks of the Pyroclastite unit degrade very rapidly upon exposure and increase the difficulty in preparing a suitable rock surface, both for engineered slopes and foundation preparation.

2) *Rock Anchors*. Tensioned and grouted rock anchors will be used during construction to anchor the permanent soldier pile, tie down the cofferdam structure, and support the left abutment cofferdam slope. Information regarding anchor materials, location, installation methods and tolerances, and stressing is included in the contract Drawings and section 02490 of the Specifications.

3) *Rock Bolts*. Untensioned rock bolts will be used in the excavation rock slope support. Based on the results of the Watertightness Test, rock bolts may or may not be required to be grouted. The government estimates that 40% of the rock bolt borings will require grouting and redrilling prior to the installation of the rock bolts. Requirements regarding the specifications for the materials, locations, and installation methods and tolerances are included in the contract Drawings and section 02491 of the Specifications.

4) *Shotcrete*. Shotcrete will be used as a slope stability measure on soil and rock slopes. The required materials, preparation and placement methods, and curing and testing requirements are outlined in section 03371 of the contract Specifications.

5) *Welded Wire Fabric*. Welded wire fabric will be used as a slope stability measure on those slopes that will be removed during a later contract.

6) *Weep Holes*. Weep holes will be used to mitigate pore water pressures in the excavation slopes. Section 02491 of the contract Specifications provides details on the location, orientation and tolerances required.

3.2.2 Existing Rock Mass Reinforcement

Rock mass reinforcement measures, primarily rock bolts, are present in areas to be excavated. The vast majority of the rock bolts encountered will be between the 1,070 and 1,140 foot elevations, as represented in figures 6 and 7.

3.2.3 Dewatering

The dewatering system outlined in the contract Drawings and Specifications was designed to serve a threefold purpose: 1) keep the excavation dry for excavation and construction, 2) reduce the hydrostatic pressure on rock discontinuities intersecting excavation slopes, and 3) reduce uplift pressures under the cofferdam.

Estimated flows into the excavation have been calculated from the hydraulic conductivity values calculated from the packer and pumping tests. These flows may be anywhere from 80-2,800 gallons per minute (gpm). An analysis of data collected from the pumping tests indicates that water is moving from the south towards the dam. Contributions of water from the reservoir itself were relatively insignificant during pumping tests.

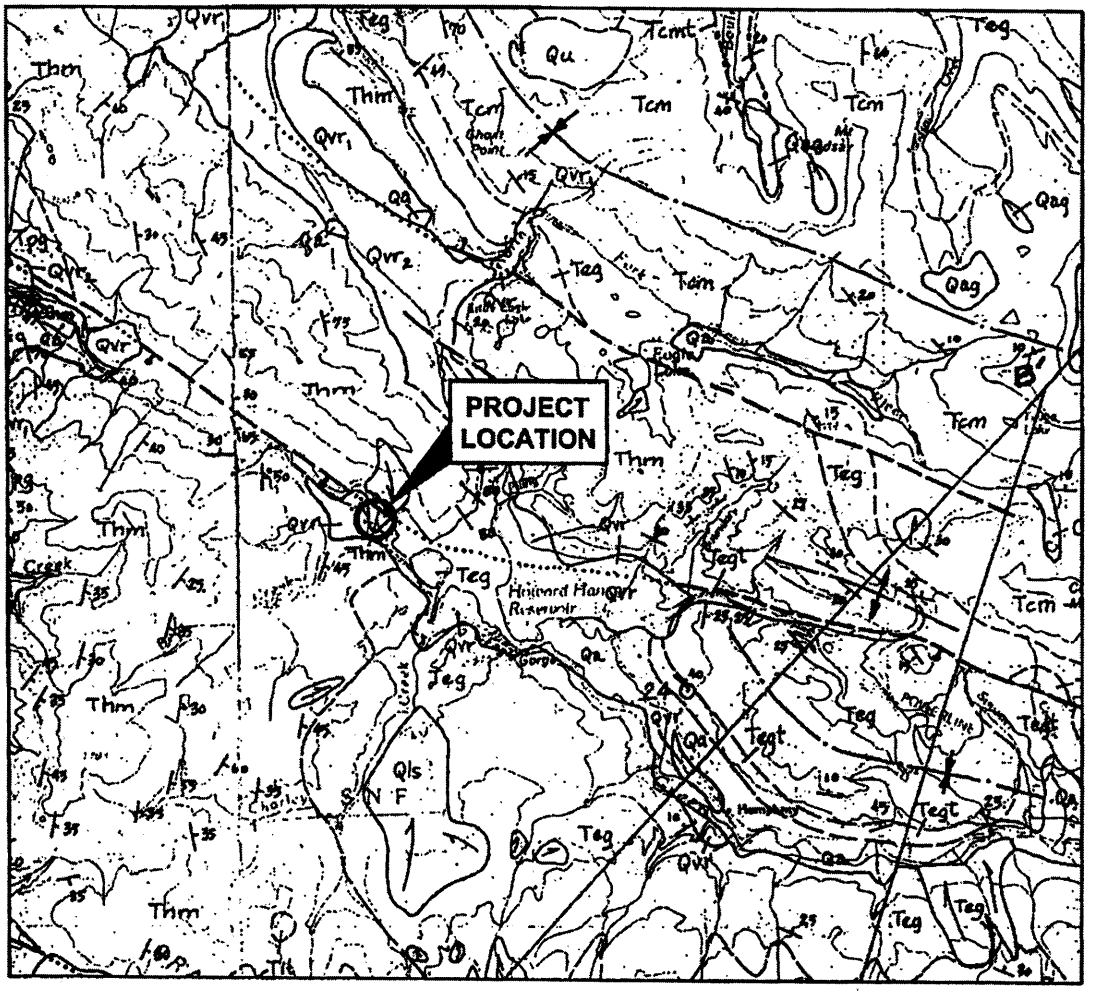
The dewatering system is conservatively designed in that it is designed to stop flows into the excavation assuming a flow rate of 2,800 gpm. Eight deep dewatering wells can each accommodate up to 300 gpm (for a total of 2,400 gpm), and the 10 relief wells can accommodate an additional 400 gpm. The proposed grouting program adjacent to the cofferdam and existing intake tower will further reduce seepage flow into the excavation from the reservoir.

Specifications regarding the construction of water wells and relief wells are presented in the contract Drawings and Specifications, sections 02521a and 02525a, respectively.

3.2.4 Grouting

Grouting is an integral part of the contract. Grouting will reduce seepage into the excavation and will enhance the stability of the left abutment, intake structure foundation, and cofferdam foundation. Details regarding the grouting materials and methods can be found in the contract Drawings and Specifications, section 02251a.

Based on original dam construction grouting activities, average rock grout takes for the construction foundation and left abutment were 0.1 and 0.2 sacks of Portland cement (94 lbs.) per linear foot, respectively. Grout takes are based on an assumed borehole outside diameter of four inches. Cement to water content within the original grout varied from 4:1 to 1:1 depending on the results of borehole water pressure tests. Rock grout takes encountered during the execution of this contract are expected to be consistent with the above grout takes.



LEGEND

Qa	Alluvium
Qvr	Vashon Recessional Outwash
Qag	Alpine Glacial Deposits
Qls	Landslide Deposit
Tcm	Volcanic Rocks of Cougar Mountain
Teg	Volcanic Rocks of Eagle Gorge
Thm	Volcanic Rocks of Huckleberry Mountain
Tit	Tonalite Intrusive

0 2 4

Scale in Miles

NOTE

Map adapted from "Preliminary Geologic Map of Snoqualmie Pass 1:100,000 Quadrangle, WA", Frizzell, Jr. et. Al., USGS OF Map OF-84-693, 1984.

High-angle fault, dashed where inferred, dotted. where concealed. Ball and bar on down thrown side.

Anticline Axis

Syncline Axis

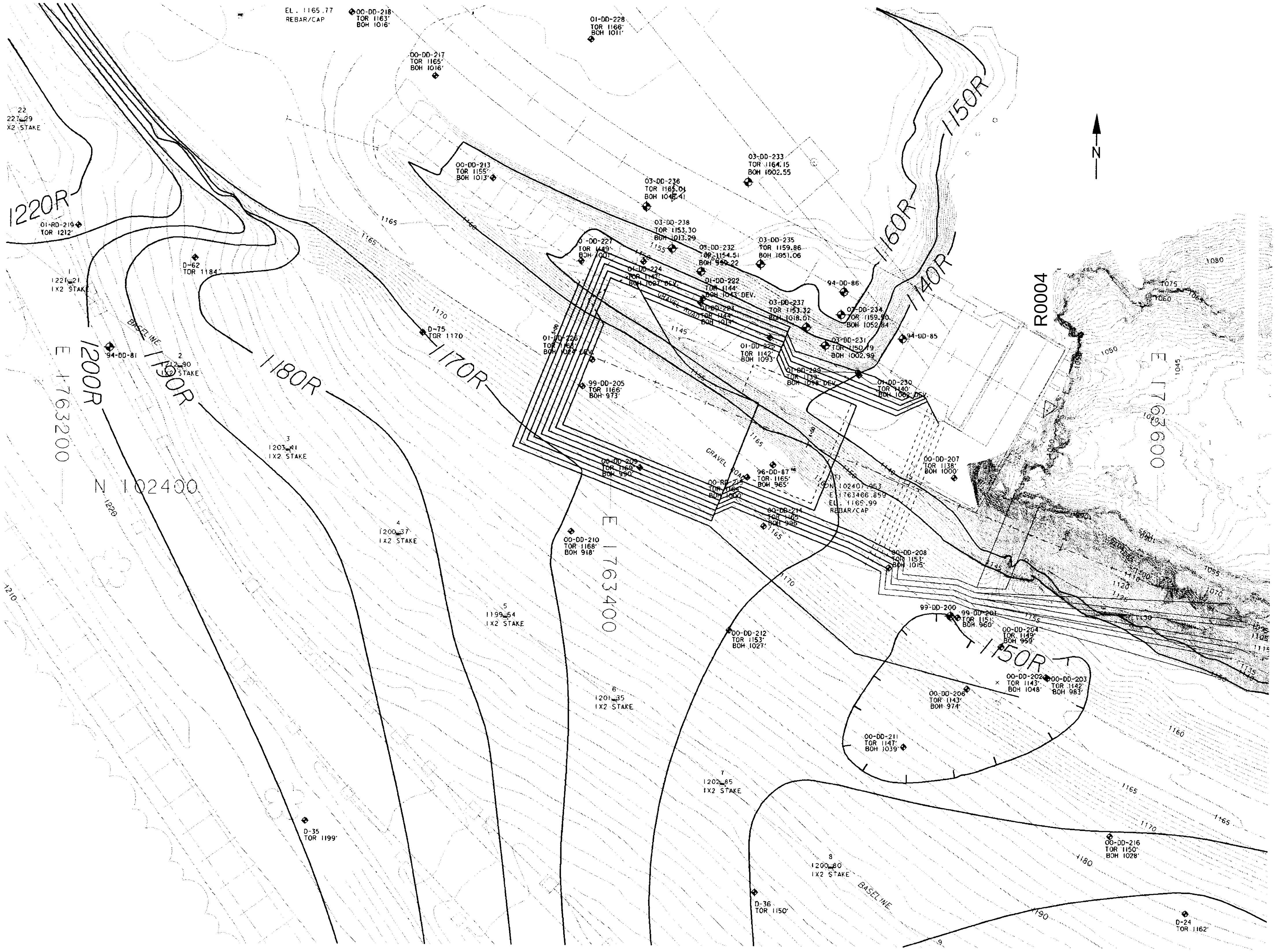
60 Strike and dip of bedding

U.S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

FIGURE 1.
REGIONAL GEOLOGIC MAP
IN THE AREA OF HHD

HOWARD HANSON DAM
EAGLE GORGE WASHINGTON

DATE 31 JULY 2002 | CHECKED BY HESS



LEGEND

- 1150R - APPROXIMATE BEDROCK CONTOURS (CONTOURS EVERY 10.0')
- 10 1203.81 1X2 STAKE - EXPLORATION BASELINE FROM INITIAL PROJECT LAYOUT
- Sta 15+00 - EXISTING OUTLET TUNNEL CENTERLINE W/STATIONING EVERY 100.0' [STATIONS 15+00 - 19+00]
- 01-DD-224 TOR 1147' BOH 1027' DEV. - EXPLORATION HOLE YEAR, TYPE AND NUMBER
- (RB) - REBAR/CAP

BOH - BOTTOM OF HOLE (FEET)
DEV. - DEVIATED FROM VERTICAL
TOR - TOP OF ROCK (FEET)

NOTES:

CONTOURS ARE PROVIDED FOR VISUALIZATION PURPOSES, ONLY. EVALUATIONS OF TOP OF ROCK ELEVATIONS SHALL BE BASED UPON ACTUAL VALUES MEASURED AT EACH DATA POINT.

SCALE IN FEET
20' 10' 0 20' 40'

This project was designed by the Seattle District U.S. Army Corps of Engineers. The initials or signatures and registration designations of individuals appear within the specifications or on these project documents within the scope of their employment as required by ER 1110-1-8152, Professional Registration.

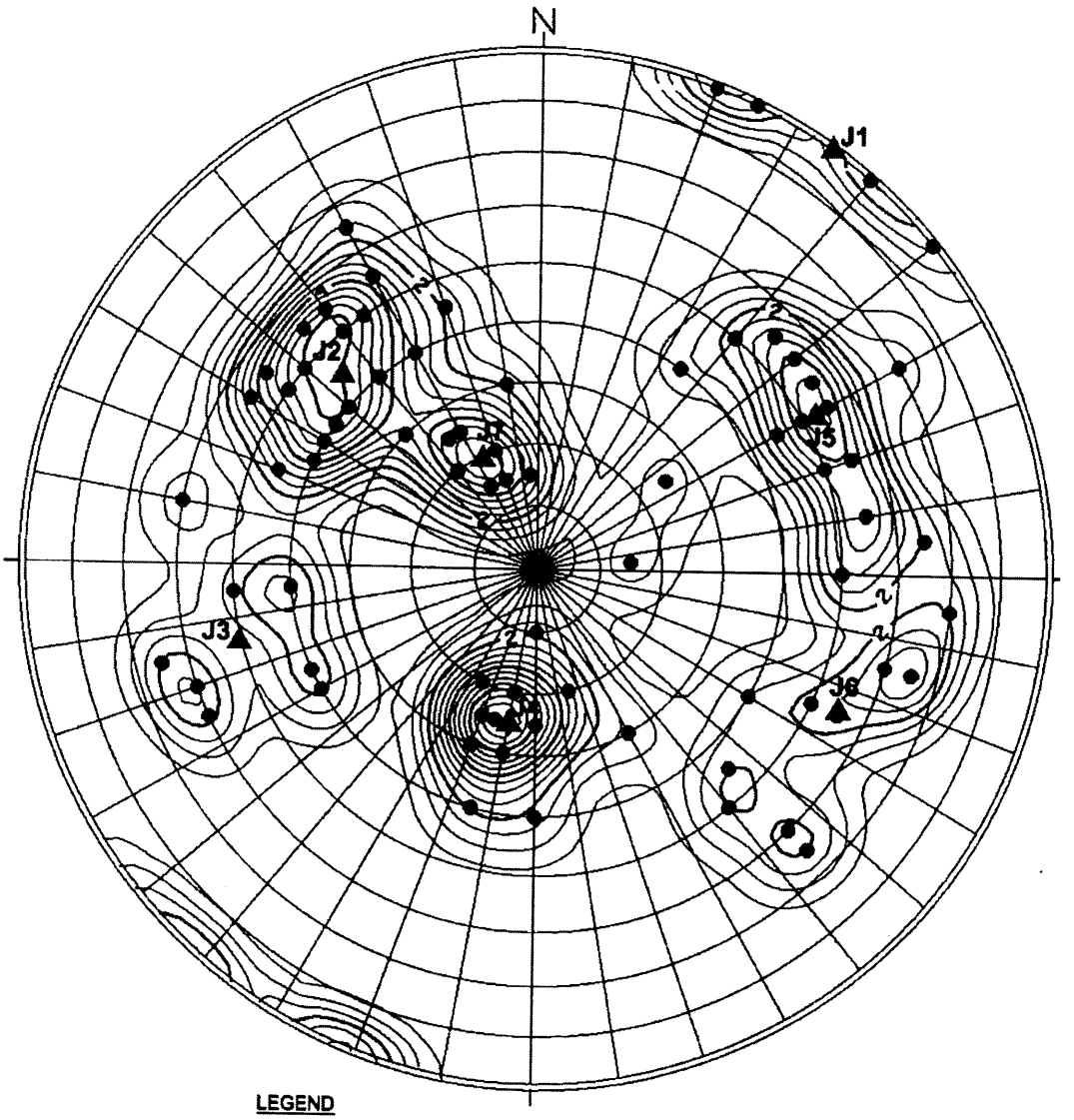
DATE AND TIME PLOTTED: 10-SEP-2003 07:41
DESIGN FILE: I:\DESIGNS\HHAW\GEOTEC-I\DBR\HHAWFS04_3.DGN

U.S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

HOWARD HANSON DAM - AWS

CONTOURS ON BEDROCK SURFACE AND EXPLORATION MAP (LOCATIONS OF EXPLORATIONS)

HOWARD HANSON DAM			WASHINGTON	
SIZE D	INVITATION NO.	FILE NO.	DATE:	PLATE
DSGN. DANIELSON/HESS	CHK. SMITH		SHEET FIGURE 2	



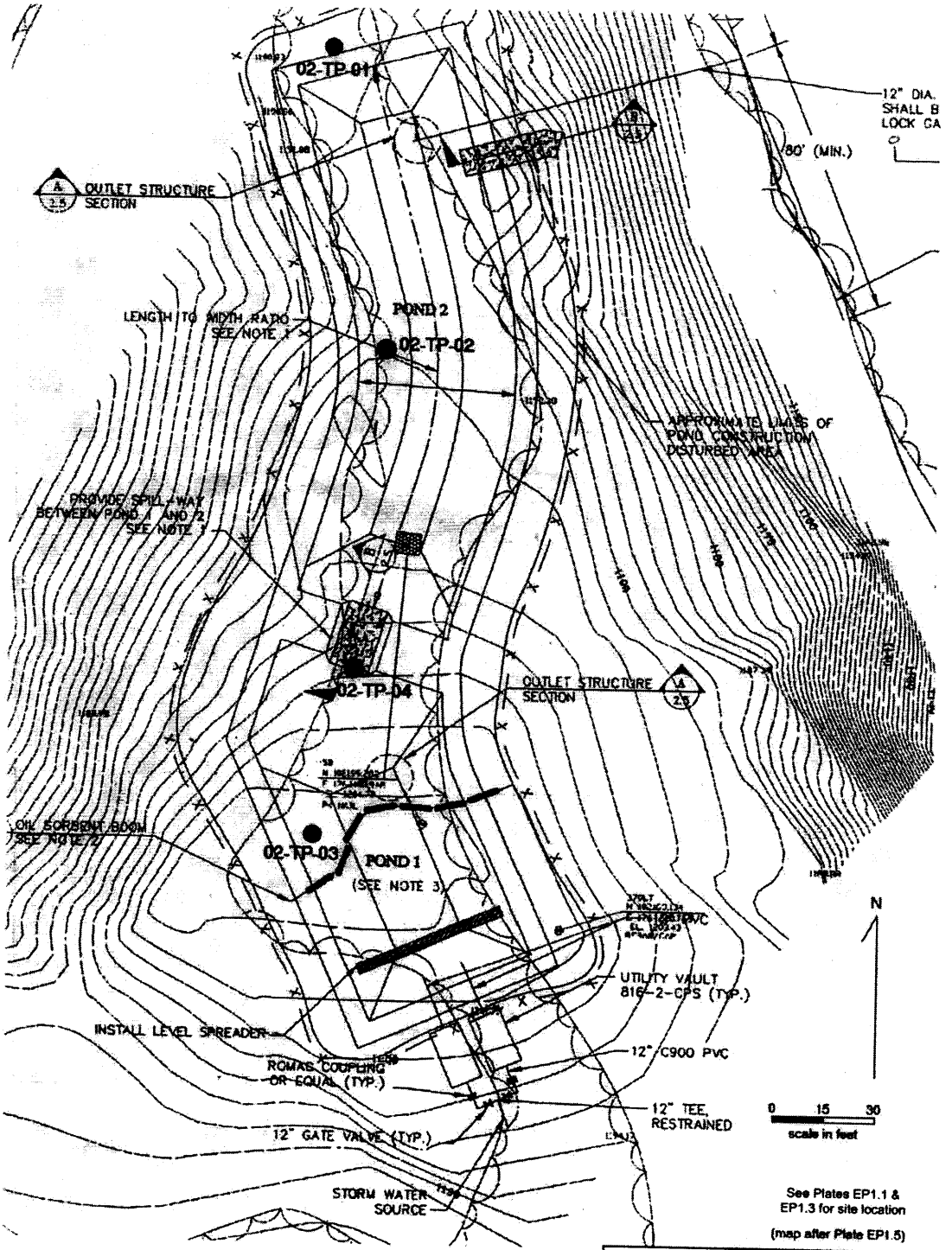
LEGEND

- ● Average of Orientation Measurement from BHTV data
- ▲ Approximate Mean Orientation from BHTV data

NOTES

1. Contour interval is 0.5 percent.
2. Data is based on average joint clusters selected from BHTV and surface data.
3. Symbols represent poles to planes.
4. Stereonet is equal area projection of lower hemisphere of reference sphere.

U.S. ARMY ENGINEER DISTRICT, SEATTLE CORPS OF ENGINEERS SEATTLE, WASHINGTON	
FIGURE 3. AVERAGE ORIENTATIONS OF DISCONTINUITY CLUSTERS MEASURED IN BHTV SURVEYS	
HOWARD HANSON DAM EAGLE GORGE WASHINGTON	
DATE 31 JULY 2002	CHECKED BY HESS



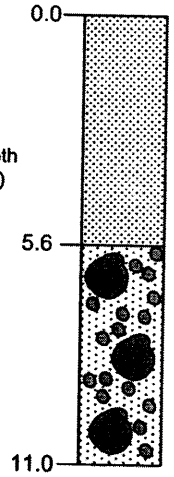
U.S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

FIGURE 4.
Test Pit Location Map

HOWARD HANSON DAM
EAGLE GORGE WASHINGTON

DATE 3 Nov 2002 | CHECKED BY HESS

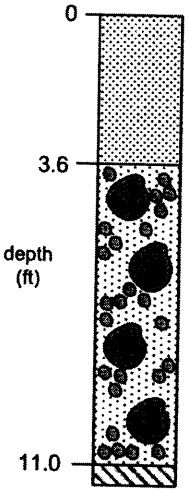
02-TP-01



SM-ML, silty SAND-sandy SILT, lt brown, dry, medium dense/ stiff, organics. Sand is very fine grained.
[Fill]

GP, sandy Gravel w/silt, brown, dry-damp, medium dense. Gravels and cobbles 1"+/- up to 4"+/-, sub-rounded to rounded. Sand is fine to medium grained. Becomes darker brown with depth.
[Glacial Outwash Deposit]

02-TP-02

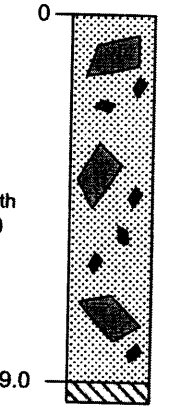


SP, Sand w/silt, light brown, dry, medium dense, organics. Sooty woody material in upper foot of test pit.
[Fill]

GP, sandy Gravel w/silt, brown, dry, medium dense. Gravels and cobbles 1"+/- up to 4"+/-, sub-rounded to rounded. Sand is fine to medium grained. Becomes darker brown with depth.
[Glacial Outwash Deposit]

Bedrock @ 11.0 feet depth.

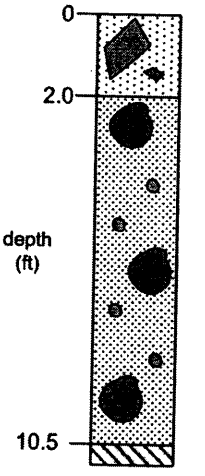
02-TP-03



SP-GP, gravelly Sand-sandy Gravel w/silt and clay, gray-green, damp, medium dense, organics near surface. Gravels 1"=/-, angular. Grades laterally into SP, Sand w/gravel and silt, brown, medium dense.
[Fill]

Bedrock

02-TP-04



GP, sandy Gravel w/silt, gray-brown, dry-damp, medium dense, organics near surface.
[Fill]

SP, silty Sand w/ gravel, brown, dry-damp, medium dense. Gravel 1" +/- sub-rounded to rounded. Sand is fine to medium grained.
[Glacial Outwash Deposits]

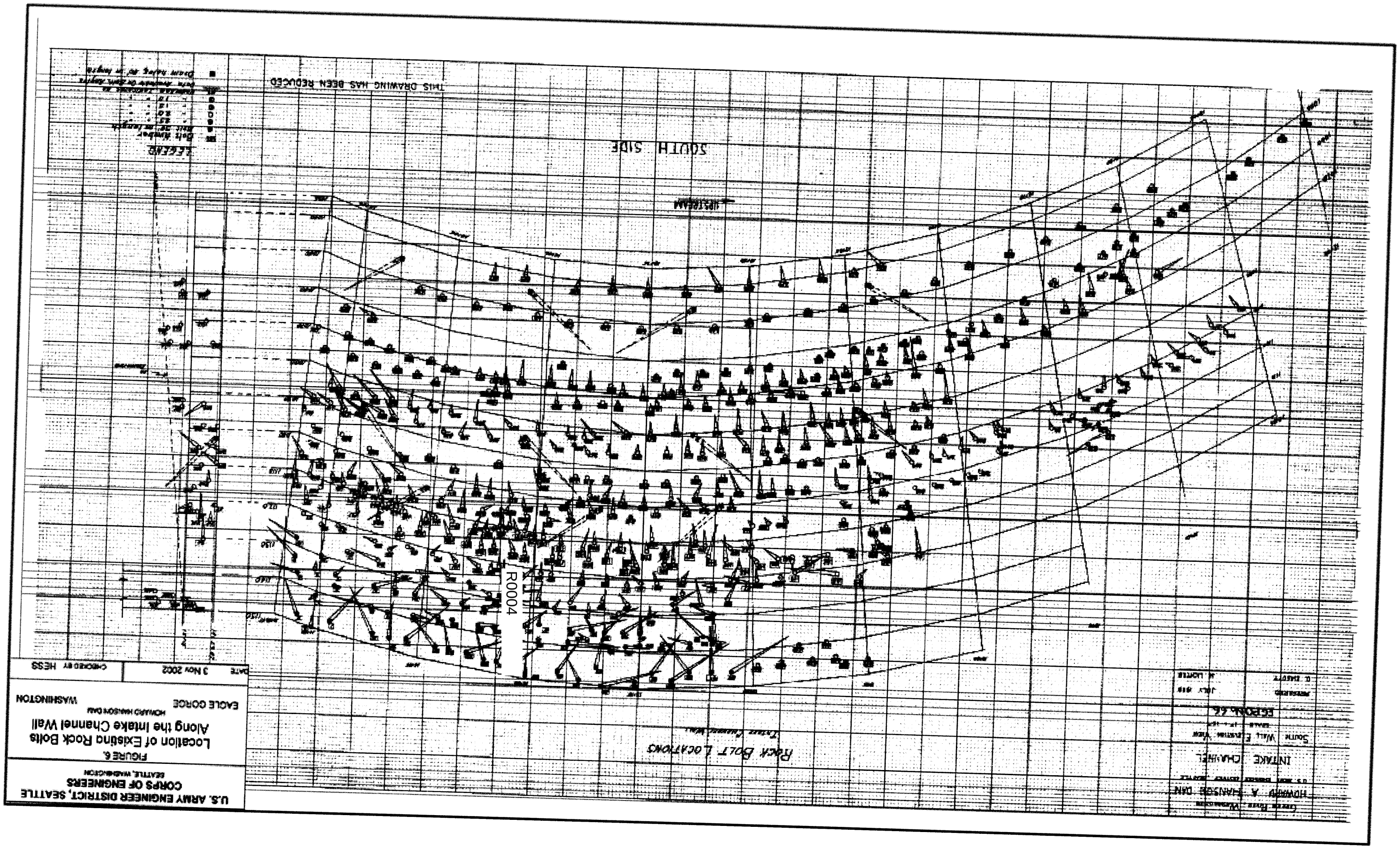
Bedrock

U.S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

FIGURE 5.
Test Pit Logs

EAGLE GORGE HOWARD HANSON DAM WASHINGTON

DATE 3 Nov 2002 R0004



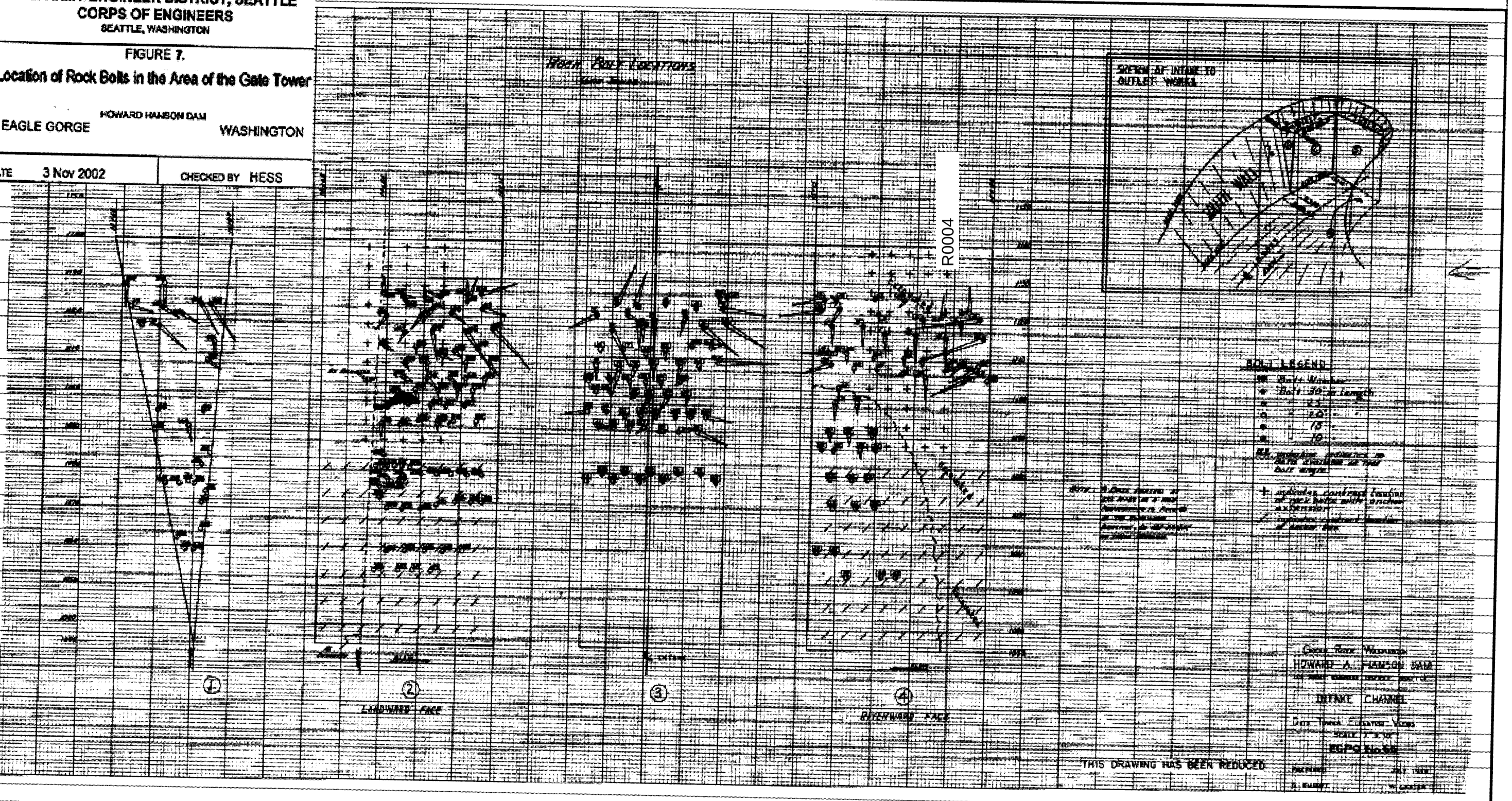
U.S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

FIGURE 7.

Location of Rock Bolts in the Area of the Gate Tower

HOWARD HANSON DAM
EAGLE GORGE WASHINGTON

DATE 3 Nov 2002 CHECKED BY HESS



R0004

DACW67-03-R-0001

HOWARD HANSON DAM
COFFERDAM FOUNDATION AND EXCAVATION CONTRACT
- FISH PASSAGE FACILITY, ADDITIONAL WATER STORAGE PROJECT

GEOTECHNICAL BASELINE REPORT – APPENDIX A

This appendix contains much of the geotechnical data collected during the explorations mentioned in section 1.8 of the Geotechnical Baseline Report. Some of the geotechnical data associated with the 2003 exploration program has not yet been incorporated into this appendix. The data is presented in the following tables:

Table A1	Unconfined Compressive Strength Test Results
Table A2	Direct Shear Test Results
Table A3	Splitting Tensile Strength Results
Table A4	Compression (P) and Shear (S) Wave Velocities and Poisson's Ratio
Table A5	Joint Condition Data
Table A6	Rock Mass Ratings
Table A7	Packer Test Hydraulic Conductivity Calculations
Table A8	Pumping Test Hydraulic Conductivity Averages

Tables A1 through A3 provide data obtained through laboratory testing of selected rock core samples. Consult the references in section 1.4 of the Geotechnical Baseline Report for information on the laboratory procedures involved.

Table A4 displays full waveform sonic geophysical data collected during borehole geophysical surveys. Measured compressional (P) and shear (S) wave velocities were selected at four foot intervals within each borehole and were used in the calculation of Poisson's Ratio (ν) as follows.

$$\nu = (V_p^2 - 2V_s^2) / 2(V_p^2 - V_s^2)$$

Where V_p and V_s equal the compressional and shear wave velocities, respectively, in feet per second.

Tables A5 through A8 provide field based observations regarding rock mass competency and project area hydrogeology. This data is discussed in parts 2 and 3 of the Geotechnical Baseline Report.

TABLE A1 - Unconfined Compressive Strength Test Results

Boring ID	Depth (ft bgs)		Rock Type	Moist Unit Weight (pcf)	Unconfined Compressive Strength (psi)	Young's Modulus (ksi)
	from	to				
94-DD-80	139.3	-	Andesite	150.8	5410	-
94-DD-81	175.2	-	Andesite	162.6	8790	-
94-DD-81	187.5	-	Andesite	165.1	9170	-
94-DD-85	6.5	6.8	Andesite	-	3670*	670
94-DD-85	13.6	13.9	Andesite	-	4630*	2110
94-DD-85	15	15.4	Andesite	-	8740	-
94-DD-85	19	19.4	Andesite	-	27130	-
94-DD-85	24.7	25	Andesite	-	12440	3260
94-DD-85	25	25.3	Andesite	-	12060	3420
94-DD-86	24	24.7	Andesite	-	6830	-
94-DD-86	39.3	40	Andesite	-	7870	-
99-DD-201	49.6	52	Andesite	-	6391	214
99-DD-201	83.5	85.8	Andesite	-	4743	132
99-DD-201	114.2	115.5	Andesite	-	3542	167
99-DD-201	164.3	165.7	Andesite	-	11721	563
99-DD-203	142.2	144	Andesite	-	3021	127
99-DD-203	155.6	157.3	Andesite	-	5829	261
99-DD-203	173.3	174.9	Andesite	-	8838	357
99-DD-204	141.7	143.6	Andesite	-	4369	245
99-DD-204	147.6	148.6	Andesite	-	6104	300
99-DD-204	152	152.9	Andesite	-	8326	435
99-DD-204	158	159.5	Andesite	-	10560	406
99-DD-204	169.9	171.6	Andesite	-	3995	233
99-DD-204	178.3	179.9	Andesite	-	8576	327
99-DD-204	181.7	183.2	Andesite	-	12170	561
99-DD-204	185.5	186.9	Andesite	-	13107	625
99-DD-205	162.95	163.44	Andesite	-	7910	-
99-DD-205	163.45	163.9	Andesite	-	7426	-
99-DD-205	163.9	164.35	Andesite	-	5452	-
99-DD-205	166	166.45	Andesite	-	9415	-
99-DD-205	171.95	172.45	Andesite	-	6893	-
99-DD-205	172.45	172.9	Andesite	-	5670	-
00-DD-207	29.8	29.1	Andesite	146.5	3070	-
00-DD-207	40.6	41.2	Andesite	145.9	6810	-
00-DD-207	75.7	76.5	Andesite	154	11170	-
00-DD-207	91.75	92.7	Andesite	166.9	5390	-
00-DD-209	7.8	8.6	Andesite	155.4	7310	-
99-DD-209	30.8	31.4	Andesite	136.1	4830	-
99-DD-209	59	59.8	Andesite	173.3	9730	-
99-DD-209	85.75	86.4	Andesite	148.3	2230	-
99-DD-209	100	100.5	Andesite	147.6	4280	-
01-DD-222	61.33	62.01	Andesite	155.9	20360	-
01-DD-223	15.6	16.7	Andesite	154	5710	-
01-DD-223	48.7	49.5	Andesite	160.3	6130	-
01-DD-223	70.5	71	Andesite	148.8	4580	-
01-DD-223	107.3	108.6	Andesite	138	3170	-
01-DD-224	120.9	121.5	Basaltic Andesite	168.7	9300	-

Boring ID	Depth (ft bgs)		Rock Type	Moist Unit Weight (pcf)	Unconfined Compressive Strength (psi)	Young's Modulus (ksi)
	from	to				
01-DD-224	135.4	136.5	Basaltic Andesite	159.2	4730	-
01-DD-226	39.4	40.1	Andesite	142.7	3750	-
01-DD-226	58.9	59.5	Andesite	147	4720	-
01-DD-226	82.25	83	Andesite	153.2	7630	-
01-DD-227	105	105.5	Andesite	148.5	6120	-
01-DD-227	119.5	120.3	Andesite	150.1	7110	-
01-DD-227	129.3	129.8	Andesite	145.4	3840	-
01-DD-227	142.6	143.3	Andesite	147.4	6370	-
01-DD-228	115.1	116.6	Andesite	205.1	2730	-
01-DD-228	128.8	129.8	Andesite	167.7	5020	-
01-DD-228	142	142.9	Andesite	158.8	7220	-
01-DD-230	41.5	42	Andesite	157.4	3160	-
01-DD-230	100	100.5	Basaltic Andesite	170.4	10390	-

Notes:
*Specimen had hairline crack before test.

bgs - below ground surface

Unconfined Compressive Strength corrected in accordance with ASTM D-2938 for cores with a length to diameter ratio of less than 2.

Boring 94-DD-80 is not located on any of the drawings or figures and is located at WA State coordinates 1763725.70 E and 102238.22 N.

TABLE A2 - Direct Shear Test Results

Borehole	Interval (ft bgs)		Bedrock Material	Normal	Shear	Friction
	from	to		Stress (psi)	Stress (psi)	Angle (phi)
99-DD-205	153.3	154	Andesite	50	66	52.64
99-DD-205	153.3	154	Andesite	100	100	44.89
99-DD-205	153.3	154	Andesite	150	178	49.82
99-DD-205	179.5	180	Andesite	50	46	42.8
99-DD-205	179.5	180	Andesite	100	84	39.86
99-DD-205	179.5	180	Andesite	150	111	36.48
99-DD-205	183.5	184	Andesite	50	44	41.54
99-DD-205	183.5	184	Andesite	100	79	38.17
99-DD-205	183.5	184	Andesite	150	107	35.6
99-DD-205	184.5	185.5	Andesite	50	95	62.14
99-DD-205	184.5	185.5	Andesite	100	146	55.55
99-DD-205	184.5	185.5	Andesite	150	180	50.13
00-DD-209	172.5	173	Andesite	50	50	45.23
00-DD-209	172.5	173	Andesite	100	84	40.16
00-DD-209	172.5	173	Andesite	150	115	37.5
00-DD-209	161.5	-	Andesite	50	53	46.61
00-DD-209	161.5	-	Andesite	100	76	37.27
00-DD-209	161.5	-	Andesite	150	98	33.16
01-DD-223	49.4	50.3	Andesite	15	31	64.18
01-DD-223	49.4	50.3	Andesite	50	73	55.59
01-DD-223	49.4	50.3	Andesite	150	167	48.07
01-DD-222	21.4	22.3	Andesite	15	12	38.66
01-DD-222	21.4	22.3	Andesite	50	27	28.37
01-DD-222	21.4	22.3	Andesite	150	69	24.7
01-DD-222	47	48	Andesite	15	23	56.89
01-DD-222	47	48	Andesite	50	47	43.23
01-DD-222	47	48	Andesite	150	125	39.81
01-DD-226	21.15	21.5	Andesite	15	10	33.69
01-DD-226	21.15	21.5	Andesite	50	40	38.66
01-DD-226	21.15	21.5	Andesite	150	145	44.03
01-DD-228	142	142.9	Andesite	15	9	30.96
01-DD-228	142	142.9	Andesite	50	35	34.99
01-DD-228	142	142.9	Andesite	150	79	27.77
01-DD-224	135.4	136.5	Basaltic Andesite	15	9	30.96
01-DD-224	135.4	136.5	Basaltic Andesite	50	31	31.8
01-DD-224	135.4	136.5	Basaltic Andesite	150	79	27.77

TABLE A3 - Splitting Tensile Strength Test Results

Borehole	Interval (ft bgs)		Bedrock Material	Tensile Strength (psi)
	from	to		
94-DD-85*	10.1	10.5	Andesite	500
94-DD-85	10.5	10.8	Andesite	440
94-DD-85*	11.7	12	Andesite	110
99-DD-201	144	145.8	Andesite	2438
99-DD-201	154	155.6	Andesite	2540
99-DD-201	169.2	171	Andesite	2538
99-DD-201	187.2	188.7	Andesite	933
99-DD-203	137	138	Andesite	413
99-DD-203	142.2	144	Andesite	741
99-DD-203	155.6	157.3	Andesite	755
99-DD-203	173.3	174.9	Andesite	1059
99-DD-204	118.3	179.9	Andesite	993
99-DD-204	141.7	143.6	Andesite	641
99-DD-204	152	152.9	Andesite	2008
99-DD-204	158	159.5	Andesite	1358
99-DD-204	169.9	171.6	Andesite	1056
99-DD-204	185.5	186.9	Andesite	2476

*Specimen had a hyperbolic open seam before test.

TABLE A4 - Compresional (P) and Shear (S) Wave Velocities and Poisson's Ratio

Borehole	Depth (ft bgs)	Bedrock Material	P-wave Vp (ft/s)	S-wave Vs (ft/s)	Poisson's Ratio
99-DD-201	96	Andesite	11400	6500	0.2591
99-DD-201	100	Andesite	11100	6500	0.2391
99-DD-201	104	Andesite	12800	6100	0.3531
99-DD-201	108	Andesite	14200	5900	0.3957
99-DD-201	112	Andesite	13250	6850	0.3176
99-DD-201	124	Andesite	12800	5950	0.3622
99-DD-201	128	Andesite	13500	6050	0.3743
99-DD-201	132	Andesite	12750	7100	0.2753
99-DD-201	136	Andesite	14250	7900	0.2781
99-DD-201	140	Andesite	17250	8500	0.3397
99-DD-201	144	Andesite	16600	7300	0.3801
99-DD-201	148	Andesite	15400	6800	0.3789
99-DD-201	152	Andesite	17600	8550	0.3456
99-DD-201	156	Andesite	16600	9400	0.264
99-DD-201	160	Andesite	16250	8250	0.3264
99-DD-201	164	Andesite	15600	7600	0.3444
99-DD-201	168	Andesite	14600	7500	0.3208
99-DD-201	172	Andesite	11500	7150	0.1849
99-DD-201	176	Andesite	12100	7100	0.2374
99-DD-201	180	Andesite	12850	7900	0.1962
99-DD-201	184	Andesite	12250	7850	0.1516
99-DD-204	68	Andesite	9900	5400	0.2882
99-DD-204	72	Andesite	10400	5750	0.2799
99-DD-204	76	Andesite	10600	5750	0.2915
99-DD-204	80	Andesite	10700	7000	0.1259
99-DD-204	84	Andesite	13250	7900	0.2242
99-DD-204	88	Andesite	17150	9500	0.2787
99-DD-204	92	Andesite	13400	7900	0.2336
99-DD-204	108	Andesite	9800	6700	0.0612
99-DD-204	124	Andesite	14700	7400	0.3303
99-DD-204	128	Andesite	16400	8100	0.3387
99-DD-204	132	Andesite	17200	8750	0.3254
99-DD-204	136	Andesite	15600	5500	0.429
99-DD-204	140	Andesite	9700	6400	0.1145
99-DD-204	148	Andesite	12900	7750	0.2176
99-DD-204	152	Andesite	14500	8350	0.2519
99-DD-204	156	Andesite	14300	7500	0.3103
99-DD-204	160	Andesite	14250	9200	0.1426
99-DD-204	164	Andesite	15100	9750	0.1425
99-DD-204	168	Andesite	13850	7500	0.2925
99-DD-204	172	Andesite	14500	8350	0.2519
99-DD-204	176	Andesite	14900	8300	0.275
99-DD-204	180	Andesite	14950	8900	0.2255
99-DD-204	184	Andesite	14000	8100	0.2484
99-DD-204	188	Andesite	12200	6300	0.3182
99-DD-204	192	Andesite	12100	6450	0.3015
99-DD-204	196	Andesite	13350	7600	0.2603
99-DD-205	16	Andesite	10200	5150	0.3289

Borehole	Depth (ft bgs)	Bedrock Material	P-wave Vp (ft/s)	S-wave Vs (ft/s)	Poisson's Ratio
99-DD-205	20	Andesite	9500	5100	0.2976
99-DD-205	24	Andesite	9950	5050	0.3265
99-DD-205	28	Andesite	11000	7450	0.0763
99-DD-205	36	Andesite	13400	7850	0.2387
99-DD-205	40	Andesite	13300	6050	0.3695
99-DD-205	44	Andesite	13400	7500	0.2719
99-DD-205	52	Andesite	12750	7800	0.201
99-DD-205	60	Andesite	11200	7600	0.0733
99-DD-205	64	Andesite	12200	7350	0.2151
99-DD-205	72	Andesite	11000	7450	0.0763
99-DD-205	76	Andesite	11300	6950	0.1958
99-DD-205	80	Andesite	11050	6850	0.1879
99-DD-205	88	Andesite	12500	6500	0.3147
99-DD-205	92	Andesite	13300	7800	0.2379
99-DD-205	96	Andesite	12250	7200	0.2361
99-DD-205	100	Andesite	11800	7100	0.2163
99-DD-205	104	Andesite	12400	7200	0.2457
99-DD-205	108	Andesite	14200	6500	0.3675
99-DD-205	112	Andesite	12700	6100	0.3501
99-DD-205	116	Andesite	11150	5650	0.3273
99-DD-205	120	Andesite	11300	5800	0.3212
99-DD-205	128	Andesite	10100	6500	0.1465
99-DD-205	132	Andesite	10700	6600	0.1929
99-DD-205	136	Andesite	11100	6900	0.1851
99-DD-205	140	Andesite	11250	6950	0.1914
99-DD-205	144	Andesite	11250	6850	0.2054
99-DD-205	148	Andesite	11100	6750	0.2066
99-DD-205	152	Andesite	10950	6800	0.1861
99-DD-205	156	Andesite	11550	6650	0.2521
99-DD-205	160	Andesite	10900	7700	0.0019
99-DD-205	168	Andesite	11650	7000	0.2175
99-DD-205	172	Andesite	12050	7350	0.2038
99-DD-205	176	Andesite	11700	7800	0.1
99-DD-205	184	Andesite	10750	6500	0.2118
00-DD-209	12	Andesite	10050	5450	0.2917
00-DD-209	16	Andesite	10000	5450	0.2887
00-DD-209	20	Andesite	10200	5500	0.295
00-DD-209	24	Andesite	10150	5500	0.2922
00-DD-209	28	Andesite	10050	5500	0.2862
00-DD-209	32	Andesite	9900	5450	0.2826
00-DD-209	36	Andesite	10000	5750	0.253
00-DD-209	40	Andesite	9650	5650	0.2392
00-DD-209	44	Andesite	10300	6750	0.1236
00-DD-209	56	Andesite	14500	8150	0.2691
00-DD-209	60	Andesite	14250	7700	0.2938
00-DD-209	64	Andesite	14500	5000	0.4325
00-DD-209	68	Andesite	14450	5700	0.4079
00-DD-209	72	Andesite	13600	5800	0.3888
00-DD-209	76	Andesite	12800	6200	0.3467
00-DD-209	80	Andesite	12000	6000	0.3333

Borehole	Depth (ft bgs)	Bedrock Material	P-wave Vp (ft/s)	S-wave Vs (ft/s)	Poisson's Ratio
00-DD-209	84	Andesite	12350	5950	0.3489
00-DD-209	88	Andesite	13150	5550	0.3916
00-DD-209	92	Andesite	10850	5600	0.3184
00-DD-209	96	Andesite	10450	5850	0.2718
00-DD-209	100	Andesite	11950	7050	0.2331
00-DD-209	104	Andesite	10750	6700	0.1824
00-DD-209	108	Andesite	10850	6750	0.1843
00-DD-209	112	Andesite	11100	6900	0.1851
00-DD-209	116	Andesite	11450	7050	0.1947
00-DD-209	120	Andesite	11350	7000	0.1931
00-DD-209	124	Andesite	11650	7150	0.1979
00-DD-209	128	Andesite	11500	7100	0.192
00-DD-209	132	Andesite	12000	7850	0.126
00-DD-209	140	Andesite	10800	6850	0.1635
00-DD-209	144	Andesite	11050	6900	0.1804
00-DD-209	148	Andesite	11100	6850	0.1925
00-DD-209	152	Andesite	12000	7200	0.2188
00-DD-209	156	Andesite	13650	8100	0.2282
00-DD-209	160	Andesite	16700	6900	0.3971
00-DD-209	164	Andesite	16350	6950	0.3897
00-DD-217	40	Andesite	13050	7900	0.2108
00-DD-217	44	Andesite	13500	7850	0.2446
00-DD-217	48	Andesite	14650	8550	0.2417
00-DD-217	52	Andesite	14600	8350	0.257
00-DD-217	56	Andesite	15250	6850	0.3736
00-DD-217	60	Andesite	15950	7150	0.3743
00-DD-217	64	Andesite	15350	6750	0.3801
00-DD-217	68	Andesite	14750	6450	0.3818
00-DD-217	72	Andesite	13900	5800	0.3946
00-DD-217	76	Andesite	15250	5700	0.4188
00-DD-217	80	Andesite	13600	6450	0.3549
00-DD-217	84	Andesite	13350	6500	0.3446
00-DD-217	88	Andesite	13550	6450	0.3535
00-DD-217	92	Andesite	15250	6750	0.3782
00-DD-217	96	Andesite	13100	6450	0.34
00-DD-217	100	Andesite	12050	5900	0.3423
00-DD-217	104	Andesite	12650	5400	0.3886
00-DD-217	108	Andesite	12050	5800	0.3492
00-DD-217	112	Andesite	11150	6700	0.2174
00-DD-217	116	Andesite	11350	6750	0.2264
00-DD-217	132	Andesite	14000	9050	0.1411

TABLE A5 - Joint Condition Data

Boring ID	Depth, ft		Persistance		Separation		Roughness		Infilling		Weathering		Total Rating
	From	To	Length	Rating	Aperture	Rating	Description	Rating	Description	Rating	Class	Rating	
99-DD-205	0	6	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	SW	5	21
99-DD-205	6	11	3 -10 m	2	<0.1 mm	5	Rough	5	Soft, <5mm	2	SW	5	19
99-DD-205	11	13	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	SW	5	21
99-DD-205	13	18	3 -10 m	2	<0.1 mm	5	Sl R/Sm	2	Hard, >5mm	2	SW	5	16
99-DD-205	18	23	3 -10 m	2	<0.1 mm	5	Sl R/Sm	2	Hard, <5mm	4	SW	5	18
99-DD-205	23	25	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	U	6	22
99-DD-205	25	30	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, >5mm	2	U	6	20
99-DD-205	30	32	3 -10 m	2	<0.1 mm	5	Sl. Rough	3	Hard, >5mm	2	U	6	18
99-DD-205	32	37	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	U	6	22
99-DD-205	37	38	3 -10 m	2	<0.1 mm	5	Sl R/Sm	2	Hard, >5mm	2	U	6	17
99-DD-205	38	43	3 -10 m	2	<0.1 mm	5	Sl R/Sm	2	Hard, <5mm	4	U	6	19
99-DD-205	43	48	3 -10 m	2	<0.1 mm	5	Sl R/Sm	2	Hard, >5mm	2	U	6	17
99-DD-205	48	53	3 -10 m	2	<0.1 mm	5	Sl R/Sm	2	Hard, <5mm	4	U	6	19
99-DD-205	53	58	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, >5mm	2	U	6	20
99-DD-205	58	63	3 -10 m	2	<0.1 mm	5	Sl R/Sm	2	Hard, <5mm	4	U	6	19
99-DD-205	63	68	3 -10 m	2	<0.1 mm	5	Sl. Rough	3	Hard, >5mm	2	U	6	18
99-DD-205	68	73	3 -10 m	2	<0.1 mm	5	Sl R/Sm	2	Hard, <5mm	4	U	6	19
99-DD-205	73	78	3 -10 m	2	<0.1 mm	5	V. Rough	6	None	6	U	6	25
99-DD-205	78	83	3 -10 m	2	<0.1 mm	5	V. Rough	6	None	6	U	6	25
99-DD-205	83	88	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, >5mm	2	U	6	20
99-DD-205	88	93	3 -10 m	2	<0.1 mm	5	Sl R/Sm	2	Hard, <5mm	4	U	6	19
99-DD-205	93	98	3 -10 m	2	<0.1 mm	5	Sl R/Sm	2	Hard, <5mm	4	U	6	19
99-DD-205	98	103	3 -10 m	2	<0.1 mm	5	Smooth	1	Hard, <5mm	4	U	6	18
99-DD-205	103	108	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	U	6	22
99-DD-205	108	113	3 -10 m	2	<0.1 mm	5	Sl R/Sm	2	None	6	U	6	21
99-DD-205	113	118	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, >5mm	2	U	6	20
99-DD-205	118	123	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, >5mm	2	U	6	20
99-DD-205	123	128	3 -10 m	2	<0.1 mm	5	Sl R/Sm	2	Hard, >5mm	2	U	6	17
99-DD-205	128	133	3 -10 m	2	<0.1 mm	5	Sl R/Sm	2	Hard, <5mm	4	U	6	19
99-DD-205	133	138	3 -10 m	2	<0.1 mm	5	Sl. Rough	3	Hard, <5mm	4	U	6	20
99-DD-205	138	143	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	U	6	22
99-DD-205	143	148	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
99-DD-205	148	153	3 -10 m	2	<0.1 mm	5	Sl. Rough	3	Hard, >5mm	2	U	6	18

Boring ID	Depth, ft		Persistance		Separation		Roughness		Infilling		Weathering		Total
	From	To	Length	Rating	Aperture	Rating	Description	Rating	Description	Rating	Class	Rating	Rating
99-DD-205	153	158	3 -10 m	2	<0.1 mm	5	Sl R/Sm	2	Hard, <5mm	4	U	6	19
99-DD-205	158	162.9	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, >5mm	2	U	6	20
99-DD-205	162.9	168	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
99-DD-205	168	173	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
99-DD-205	173	178	3 -10 m	2	<0.1 mm	5	Sl R/Sm	2	Hard, <5mm	4	U	6	19
99-DD-205	178	183	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
99-DD-205	183	188	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, >5mm	2	U	6	20
99-DD-205	188	193	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	U	6	22
99-DD-209	0	5	3 -10 m	2	<0.1 mm	5	Smooth	1	None	6	U	6	20
99-DD-209	5	10	3 -10 m	2	<0.1 mm	5	Rough	5	Soft, <5mm	2	SW	5	19
99-DD-209	10	15	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	SW	5	21
99-DD-209	15	20	3 -10 m	2	<0.1 mm	5	Smooth	1	None	6	MW	3	17
99-DD-209	20	25	3 -10 m	2	<0.1 mm	5	Smooth	1	None	6	MW	3	17
99-DD-209	25	30	3 -10 m	2	<0.1 mm	5	Smooth	1	None	6	U	6	20
99-DD-209	30	35	3 -10 m	2	<0.1 mm	5	Sl. Rough	3	None	6	U	6	22
99-DD-209	35	40	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
99-DD-209	40	45	3 -10 m	2	<0.1 mm	5	Sl. Rough	3	None	6	SW	5	21
99-DD-209	45	50	3 -10 m	2	<0.1 mm	5	Sl. Rough	3	Soft, <5mm	2	SW	5	17
99-DD-209	50	55	3 -10 m	2	<0.1 mm	5	Rough	5	Soft, <5mm	2	SW	5	19
99-DD-209	55	60	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	SW	5	23
99-DD-209	60	65	3 -10 m	2	1-5 mm	1	Sl R/Sm	2	None	6	SW	5	16
99-DD-209	65	70	3 -10 m	2	1-5 mm	1	Rough	5	Hard, >5mm	2	U	6	16
99-DD-209	70	75	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	SW	5	21
99-DD-209	75	80	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	SW	5	21
99-DD-209	80	85	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	SW	5	23
99-DD-209	85	90	3 -10 m	2	<0.1 mm	5	Rough	5	Soft, <5mm	2	SW	5	19
99-DD-209	90	95	3 -10 m	2	<0.1 mm	5	Rough	5	Soft, <5mm	2	U	6	20
99-DD-209	95	100	3 -10 m	2	1-5 mm	1	Rough	5	Hard, <5mm	4	U	6	18
99-DD-209	100	105	3 -10 m	2	None	6	Rough	5	None	6	SW	5	24
99-DD-209	105	110	3 -10 m	2	None	6	Rough	5	None	6	SW	5	24
99-DD-209	110	115	3 -10 m	2	None	6	Rough	5	None	6	SW	5	24
99-DD-209	115	120	3 -10 m	2	None	6	Rough	5	None	6	U	6	25
99-DD-209	120	125	3 -10 m	2	None	6	Rough	5	None	6	U	6	25
99-DD-209	125	130	3 -10 m	2	None	6	Rough	5	None	6	U	6	25
99-DD-209	130	135	3 -10 m	2	None	6	Rough	5	Soft, <5mm	2	SW	5	20

Boring ID	Depth, ft		Persistance		Separation		Roughness		Infilling		Weathering		Total Rating
	From	To	Length	Rating	Aperture	Rating	Description	Rating	Description	Rating	Class	Rating	
99-DD-209	135	140	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
99-DD-209	140	145	3 -10 m	2	<0.1 mm	5	Rough	5	Soft, <5mm	2	MW	3	17
99-DD-209	145	150	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	SW	5	21
99-DD-209	150	155	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	SW	5	21
99-DD-209	155	160	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	SW	5	21
99-DD-209	160	164	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	SW	5	21
99-DD-209	164	169	3 -10 m	2	.1 -1 mm	4	Rough	5	Soft, >5mm	0	SW	5	16
99-DD-209	169	174	3 -10 m	2	.1 -1 mm	4	Rough	5	Soft, >5mm	0	SW	5	16
99-DD-209	174	175	3 -10 m	2	.1 -1 mm	4	Rough	5	Soft, >5mm	0	SW	5	16
99-DD-209	174	180	3 -10 m	2	.1 -1 mm	4	Rough	5	Soft, <5mm	2	SW	5	18
00-DD-213	0	2.1	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	MW	3	19
00-DD-213	2.1	5	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	U	6	22
00-DD-213	5	8.9	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	U	6	22
00-DD-213	8.9	13.9	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	U	6	22
00-DD-213	13.9	15	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	U	6	22
00-DD-213	15	20	3 -10 m	2	<0.1 mm	5	Sl. Rough	3	Soft, <5mm	2	U	6	18
00-DD-213	20	20.8	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Soft, <5mm	2	U	6	17
00-DD-213	20.8	25	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Soft, <5mm	2	U	6	17
00-DD-213	25	27.7	3 -10 m	2	1-5 mm	1	Smooth	1	Soft, <5mm	2	U	6	12
00-DD-213	27.7	32.8	3 -10 m	2	.1 -1 mm	4	Rough	5	Soft, <5mm	2	U	6	19
00-DD-213	32.8	35	3 -10 m	2	.1 -1 mm	4	Rough	5	Soft, <5mm	2	U	6	19
00-DD-213	35	39.7	3 -10 m	2	1-5 mm	1	Smooth	1	Soft, <5mm	2	U	6	12
00-DD-213	39.7	43	3 -10 m	2	1-5 mm	1	Smooth	1	Soft, <5mm	2	U	6	12
00-DD-213	43	45	3 -10 m	2	1-5 mm	1	Smooth	1	Soft, <5mm	2	U	6	12
00-DD-213	45	49.3	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Hard, <5mm	4	U	6	19
00-DD-213	49.3	54.4	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, >5mm	2	U	6	20
00-DD-213	54.4	59.4	3 -10 m	2	<0.1 mm	5	Sl. Rough	3	Hard, >5mm	2	U	6	18
00-DD-213	59.4	64.4	3 -10 m	2	<0.1 mm	5	Sl. Rough	3	Hard, <5mm	4	U	6	20
00-DD-213	64.4	69.2	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, >5mm	2	U	6	20
00-DD-213	69.2	74.2	3 -10 m	2	None	6	Rough	5	Hard, <5mm	4	U	6	23
00-DD-213	74.2	75	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
00-DD-213	75	80	3 -10 m	2	None	6	Rough	5	None	6	U	6	25
00-DD-213	80	84.7	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	U	6	22
00-DD-213	84.7	89.8	3 -10 m	2	.1 -1 mm	4	Rough	5	Hard, <5mm	4	U	6	21
00-DD-213	89.8	94.9	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	U	6	22

Boring ID	Depth, ft		Persistance		Separation		Roughness		Infilling		Weathering		Total Rating
	From	To	Length	Rating	Aperture	Rating	Description	Rating	Description	Rating	Class	Rating	
00-DD-213	94.9	100	3 -10 m	2	.1 -1 mm	4	Rough	5	Hard, >5mm	2	U	6	19
00-DD-213	100	105	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	U	6	22
00-DD-213	105	110	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	U	6	22
00-DD-213	110	115	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	U	6	22
00-DD-213	115	120	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	U	6	22
00-DD-213	120	125	3 -10 m	2	1-5 mm	1	Rough	5	Soft, <5mm	2	U	6	16
00-DD-213	125	130	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	U	6	22
00-DD-213	130	135	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	U	6	22
00-DD-213	135	140	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	U	6	22
00-DD-213	140	145	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	U	6	22
00-DD-214	0	5	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	MW	3	21
00-DD-214	5	10	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-214	10	15	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	MW	3	21
00-DD-214	15	20	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	SW	5	23
00-DD-214	20	25	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-214	25	30	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-214	30	35	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-214	35	40	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-214	40	45	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-214	45	50	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-214	50	55	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	SW	5	23
00-DD-214	55	60	3 -10 m	2	.1 -1 mm	4	Rough	5	Hard, <5mm	4	SW	5	20
00-DD-214	60	65	3 -10 m	2	.1 -1 mm	4	Rough	5	Hard, <5mm	4	SW	5	20
00-DD-214	65	70	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	SW	5	23
00-DD-214	70	75	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	SW	5	23
00-DD-214	75	78.9	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	SW	5	23
00-DD-214	78.9	84.1	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	SW	5	23
00-DD-214	84.1	89.3	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	SW	5	23
00-DD-214	89.3	94.4	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	SW	5	21
00-DD-214	94.4	99.4	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	SW	5	21
00-DD-214	99.4	103.2	3 -10 m	2	.1 -1 mm	4	Rough	5	Hard, <5mm	4	SW	5	20
00-DD-214	103.2	105.7	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	SW	5	23
00-DD-214	105.7	110.8	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	SW	5	23
00-DD-214	110.8	115	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	SW	5	23
00-DD-214	115	120	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	SW	5	23

Boring ID	Depth, ft		Persistance		Separation		Roughness		Infilling		Weathering		Total Rating
	From	To	Length	Rating	Aperture	Rating	Description	Rating	Description	Rating	Class	Rating	
00-DD-214	120	125	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	SW	5	23
00-DD-214	125	130	3 -10 m	2	None	6	Rough	5	Soft, <5mm	2	U	6	21
00-DD-214	130	135	3 -10 m	2	.1 -1 mm	4	Rough	5	Soft, <5mm	2	SW	5	18
00-DD-214	135	140	3 -10 m	2	<0.1 mm	5	Rough	5	Hard, <5mm	4	SW	5	21
00-DD-214	140	145	3 -10 m	2	.1 -1 mm	4	Rough	5	Soft, <5mm	2	SW	5	18
00-DD-214	145	150	3 -10 m	2	.1 -1 mm	4	Rough	5	Soft, <5mm	2	SW	5	18
00-DD-214	150	155	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	SW	5	23
00-DD-214	155	160	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	SW	5	23
00-DD-214	160	165	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	SW	5	23
00-DD-214	165	170	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	0	5	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	5	10	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	10	15	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	15	20	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	20	24.5	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	24.5	29.6	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	29.6	34.9	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	34.9	39.9	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	39.9	45	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	45	50	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	50	54.6	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	54.6	55	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	55	60	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	60	65	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	65	70	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	70	75	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	75	80	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	80	85	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	85	90	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	90	95	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	95	100	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	100	105	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	105	110	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	110	115	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	115	120	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24

Boring ID	Depth, ft		Persistance		Separation		Roughness		Infilling		Weathering		Total Rating
	From	To	Length	Rating	Aperture	Rating	Description	Rating	Description	Rating	Class	Rating	
00-DD-217	120	125	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	125	130	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	130	135	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	135	140	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	140	143.5	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	143.5	145	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	145	150	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-217	150	150	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	2.1	5	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	5	10	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	10	15	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	15	20	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	20	25	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	25	30	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	30	35	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	35	40	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	40	45	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	45	50	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	50	55	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	55	60	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	60	65	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	65	70	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	70	75	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	75	80	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	80	85	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	85	90	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	90	95	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	95	100	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	100	103	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	103	105	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	105	110	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	110	115	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	115	120	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	120	125	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	125	130	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24

Boring ID	Depth, ft		Persistance		Separation		Roughness		Infilling		Weathering		Total
	From	To	Length	Rating	Aperture	Rating	Description	Rating	Description	Rating	Class	Rating	Rating
00-DD-218	130	135	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	135	140	3 -10 m	2	<0.1 mm	5	Sl. Rough	3	None	6	U	6	22
00-DD-218	140	144.5	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	144.5	145	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
00-DD-218	145	150	3 -10 m	2	<0.1 mm	5	Rough	5	None	6	U	6	24
01-DD-222	0	1.9											
01-DD-222	1.9	4.6	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Hard, <5mm	4	U	6	19
01-DD-222	4.6	5.7	3 -10 m	2	None	6	Sl R/R	4	None	6	U	6	24
01-DD-222	5.7	7.8	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-222	7.8	12	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-222	12	17	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-222	17	21.1	3 -10 m	2	.1 -1 mm	4	Sl R/R	4	Hard, <5mm	4	U	6	20
01-DD-222	21.1	26.3	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-222	26.3	31.4	3 -10 m	2	None	6	Sl R/R	4	None	6	U	6	24
01-DD-222	31.4	36.5	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-222	36.5	41.6	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-222	41.6	46.7	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-222	46.7	51.8	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-222	51.8	56.9	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-222	56.9	62	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-222	62	67.1	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-222	67.1	72	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-222	72	77.2	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-222	77.2	82	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-222	82	85.8	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Soft, <5mm	2	U	6	17
01-DD-222	85.8	91	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Soft, <5mm	2	U	6	16
01-DD-222	91	95.1	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-222	95.1	100.3	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-222	100.3	105.4	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-222	105.4	106.9	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-222	106.9	109.5	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-222	109.5	110.3	3 -10 m	2	.1 -1 mm	4	Slick.	0	Hard, <5mm	4	U	6	16
01-DD-222	110.3	115.5	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-222	115.5	117.7	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-222	117.7	122	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22

Boring ID	Depth, ft		Persistance		Separation		Roughness		Infilling		Weathering		Total
	From	To	Length	Rating	Aperture	Rating	Description	Rating	Description	Rating	Class	Rating	Rating
01-DD-222	122	125.4	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-223	0	2.1											0
01-DD-223	2.1	6.5	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-223	6.5	10.6	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-223	10.6	13.5	3 -10 m	2	.1 -1 mm	4	Rough	5	Hard, <5mm	4	U	6	21
01-DD-223	13.5	18.6	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-223	18.6	23.5	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-223	23.5	28.5	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Soft, <5mm	2	U	6	17
01-DD-223	28.5	33.5	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-223	33.5	38.7	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-223	38.7	43.5	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-223	43.5	48.7	3 -10 m	2	.1 -1 mm	4	Sl R/R	4	Soft, <5mm	2	U	6	18
01-DD-223	48.7	53.5	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	None	6	U	6	20
01-DD-223	53.5	58.7	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-223	58.7	63.5	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-223	63.5	68.6	3 -10 m	2	>5 mm	0	Sl R/Sm	2	Hard, >5mm	2	U	6	12
01-DD-223	68.6	73.2	3 -10 m	2	None	6	V. Rough	6	None	6	U	6	26
01-DD-223	73.2	78.4	3 -10 m	2	.1 -1 mm	4	Sl R/R	4	Hard, <5mm	4	U	6	20
01-DD-223	78.4	83.5	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-223	83.5	88.6	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Soft, <5mm	2	U	6	16
01-DD-223	88.6	93.5	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-223	93.5	98.6	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Hard, <5mm	4	U	6	19
01-DD-223	98.6	103.5	3 -10 m	2	.1 -1 mm	4	V. Rough	6	None	6	U	6	24
01-DD-223	103.5	108.6	3 -10 m	2	None	6	Sl R/R	4	Hard, <5mm	4	U	6	22
01-DD-223	108.6	113.3	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Soft, <5mm	2	U	6	17
01-DD-223	113.3	118.3	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Hard, <5mm	4	U	6	19
01-DD-223	118.3	123.5	3 -10 m	2	.1 -1 mm	4	Sl R/R	4	Hard, <5mm	4	U	6	20
01-DD-223	123.5	128.7	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-223	128.7	131.4	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-224	1.1	1.5											0
01-DD-224	1.5	4.3	3 -10 m	2	.1 -1 mm	4	Rough	5	None	6	U	6	23
01-DD-224	4.3	9	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-224	9	12.5	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Hard, <5mm	4	U	6	19
01-DD-224	12.5	17.5	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-224	17.5	22.5	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22

Boring ID	Depth, ft		Persistance		Separation		Roughness		Infilling		Weathering		Total Rating
	From	To	Length	Rating	Aperture	Rating	Description	Rating	Description	Rating	Class	Rating	
01-DD-224	22.5	27.5	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-224	27.5	32.5	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-224	32.5	37.5	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	None	6	U	6	20
01-DD-224	37.5	42.5	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-224	42.5	47.5	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-224	47.5	52.7	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	None	6	U	6	20
01-DD-224	52.7	57.7	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-224	57.7	62.5	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-224	62.5	67.4	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-224	67.4	72.5	3 -10 m	2	None	6	Sl R/Sm	2	Hard, <5mm	4	U	6	20
01-DD-224	72.5	77.7	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-224	77.7	82.5	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Hard, <5mm	4	U	6	19
01-DD-224	82.5	87.7	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-224	87.7	92.5	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-224	92.5	97.7	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-224	97.7	102.5	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-224	102.5	107.6	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	None	6	U	6	20
01-DD-224	107.6	112.5	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-224	112.5	115.4	3 -10 m	2	None	6	Sl R/Sm	2	Soft, <5mm	2	U	6	18
01-DD-224	115.4	120.6	3 -10 m	2	None	6	Smooth	1	None	6	U	6	21
01-DD-224	120.6	124.4	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-224	124.4	129.6	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-224	129.6	134.6	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-224	134.6	139.8	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-224	139.8	145	3 -10 m	2	None	6	Smooth	1	None	6	U	6	21
01-DD-224	145	150.2	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-225	0	1.3											0
01-DD-225	1.3	3.3	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-225	3.3	5.4	3 -10 m	2	.1 -1 mm	4	Sl R/R	4	Soft, <5mm	2	SW	5	17
01-DD-225	5.4	8.1	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-225	8.1	10.4	3 -10 m	2	.1 -1 mm	4	Smooth	1	Hard, <5mm	4	U	6	17
01-DD-225	10.4	15	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-225	15	20.2	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	None	6	U	6	20
01-DD-225	20.2	25.3	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-225	25.3	28.5	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18

Boring ID	Depth, ft		Persistance		Separation		Roughness		Infilling		Weathering		Total Rating
	From	To	Length	Rating	Aperture	Rating	Description	Rating	Description	Rating	Class	Rating	
01-DD-225	28.5	33.5	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Soft, <5mm	2	U	6	16
01-DD-225	33.5	38.4	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-225	38.4	41	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-225	41	46.2	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	None	6	U	6	20
01-DD-225	46.2	47.8	3 -10 m	2	None	6	Sl. Rough	3	Hard, <5mm	4	SW	5	20
01-DD-225	47.8	50.5	3 -10 m	2	None	6	Sl R/Sm	2	None	6	HW	1	17
01-DD-225	50.5	55.4	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-225	55.4	60.4	3 -10 m	2	.1 -1 mm	4	Slick.	0	None	6	U	6	18
01-DD-225	60.4	65.5	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Soft, <5mm	2	U	6	17
01-DD-225	65.5	70.5	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-225	70.5	75.7	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-225	75.7	79.6	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-225	79.6	81.9	3 -10 m	2	None	6	Smooth	1	None	6	U	6	21
01-DD-225	81.9	85.6	3 -10 m	2	None	6	Slick.	0	None	6	U	6	20
01-DD-225	85.6	90.8	3 -10 m	2	None	6	Sl R/Sm	2	Soft, >5mm	0	U	6	16
01-DD-225	90.8	92.2	3 -10 m	2	.1 -1 mm	4	Smooth	1	Hard, <5mm	4	U	6	17
01-DD-225	92.2	94.7	3 -10 m	2	None	6	Smooth	1	None	6	U	6	21
01-DD-225	94.7	95.7	3 -10 m	2	None	6	Smooth	1	None	6	U	6	21
01-DD-225	95.7	98.7	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-225	98.7	100.1	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Soft, <5mm	2	U	6	16
01-DD-225	100.1	104.6	3 -10 m	2	None	6	V. Rough	6	Soft, <5mm	2	U	6	22
01-DD-225	104.6	106.1	3 -10 m	2	None	6	V. Rough	6	None	6	U	6	26
01-DD-225	106.1	108	3 -10 m	2	None	6	Smooth	1	None	6	U	6	21
01-DD-225	108	110.6	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-225	110.6	115.7	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-225	115.7	120.7	3 -10 m	2	None	6	Smooth	1	None	6	U	6	21
01-DD-225	120.7	123.4	3 -10 m	2	None	6	Smooth	1	None	6	U	6	21
01-DD-225	123.4	127.3	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-225	127.3	130.4	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-225	130.4	135.1	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-225	135.1	139.7	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-225	139.7	144.6	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-225	144.6	149.6	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-226	0	1											0
01-DD-226	1	1.7	3 -10 m	2	None	6	V. Rough	6	None	6	U	6	26

Boring ID	Depth, ft		Persistance		Separation		Roughness		Infilling		Weathering		Total Rating
	From	To	Length	Rating	Aperture	Rating	Description	Rating	Description	Rating	Class	Rating	
01-DD-226	1.7	4.3	3 -10 m	2	None	6	V. Rough	6	None	6	U	6	26
01-DD-226	4.3	7.7	3 -10 m	2	None	6	V. Rough	6	None	6	U	6	26
01-DD-226	7.7	12.5	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	None	6	U	6	21
01-DD-226	12.5	17.6	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	None	6	U	6	20
01-DD-226	17.6	22.7	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-226	22.7	27.8	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	None	6	U	6	21
01-DD-226	27.8	33	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-226	33	38.1	3 -10 m	2	None	6	V. Rough	6	None	6	U	6	26
01-DD-226	38.1	43	3 -10 m	2	None	6	V. Rough	6	None	6	U	6	26
01-DD-226	43	48.2	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Hard, <5mm	4	U	6	19
01-DD-226	48.2	53	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Hard, <5mm	4	U	6	19
01-DD-226	53	58	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	None	6	U	6	21
01-DD-226	58	63	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-226	63	68.2	3 -10 m	2	None	6	Sl R/R	4	None	6	U	6	24
01-DD-226	68.2	73	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	None	6	U	6	20
01-DD-226	73	78	3 -10 m	2	None	6	Sl R/Sm	2	Hard, <5mm	4	U	6	20
01-DD-226	78	83	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-226	83	88.2	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-226	88.2	93	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Hard, <5mm	4	U	6	19
01-DD-226	93	98	3 -10 m	2	None	6	V. Rough	6	None	6	U	6	26
01-DD-226	98	103	3 -10 m	2	None	6	V. Rough	6	None	6	U	6	26
01-DD-226	103	108.1	3 -10 m	2	None	6	V. Rough	6	None	6	U	6	26
01-DD-226	108.1	113	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Soft, <5mm	2	U	6	16
01-DD-226	113	118.2	3 -10 m	2	.1 -1 mm	4	V. Rough	6	None	6	U	6	24
01-DD-226	118.2	123	3 -10 m	2	.1 -1 mm	4	V. Rough	6	None	6	U	6	24
01-DD-226	123	128	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Soft, <5mm	2	U	6	17
01-DD-226	128	133	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Soft, <5mm	2	U	6	16
01-DD-226	133	138.2	3 -10 m	2	.1 -1 mm	4	Rough	5	Hard, <5mm	4	U	6	21
01-DD-226	138.2	143	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	None	6	U	6	21
01-DD-226	143	148	3 -10 m	2	None	6	V. Rough	6	None	6	U	6	26
01-DD-226	148	153	3 -10 m	2	None	6	V. Rough	6	None	6	U	6	26
01-DD-226	153	158.1	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-226	158.1	163.2	3 -10 m	2	.1 -1 mm	4	Sl R/R	4	Soft, <5mm	2	U	6	18
01-DD-226	163.2	165	3 -10 m	2	None	6	V. Rough	6	None	6	U	6	26
01-DD-227	0	2.3											0

Boring ID	Depth, ft		Persistance		Separation		Roughness		Infilling		Weathering		Total Rating
	From	To	Length	Rating	Aperture	Rating	Description	Rating	Description	Rating	Class	Rating	
01-DD-227	2.3	4.6	3 -10 m	2	None	6	Slick.	0	None	6	U	6	20
01-DD-227	4.6	8.5	3 -10 m	2	.1 -1 mm	4	Smooth	1	Hard, <5mm	4	U	6	17
01-DD-227	8.5	11.1	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	None	6	U	6	20
01-DD-227	11.1	14	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-227	14	19	3 -10 m	2	.1 -1 mm	4	Slick.	0	Hard, <5mm	4	U	6	16
01-DD-227	19	22.9	3 -10 m	2	None	6	Slick.	0	None	6	U	6	20
01-DD-227	22.9	27.9	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-227	27.9	33.1	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Soft, <5mm	2	U	6	16
01-DD-227	33.1	38.3	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-227	38.3	43.3	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-227	43.3	48.5	3 -10 m	2	.1 -1 mm	4	Slick.	0	Soft, <5mm	2	U	6	14
01-DD-227	48.5	53.7	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Soft, <5mm	2	U	6	17
01-DD-227	53.7	58.9	3 -10 m	2	.1 -1 mm	4	Sl R/R	4	Hard, <5mm	4	U	6	20
01-DD-227	58.9	64	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	None	6	U	6	21
01-DD-227	64	69.1	3 -10 m	2	.1 -1 mm	4	Smooth	1	Hard, <5mm	4	U	6	17
01-DD-227	69.1	74.1	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-227	74.1	79.3	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Soft; <5mm	2	U	6	17
01-DD-227	79.3	84.4	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Soft, <5mm	2	U	6	16
01-DD-227	84.4	89.5	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Hard, <5mm	4	U	6	19
01-DD-227	89.5	94.5	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-227	94.5	99.6	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Hard, <5mm	4	U	6	19
01-DD-227	99.6	104.5	3 -10 m	2	.1 -1 mm	4	Smooth	1	Soft, <5mm	2	U	6	15
01-DD-227	104.5	109.6	3 -10 m	2	.1 -1 mm	4	V. Rough	6	None	6	U	6	24
01-DD-227	109.6	114.5	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	None	6	U	6	20
01-DD-227	114.5	119.5	3 -10 m	2	.1 -1 mm	4	Smooth	1	Hard, <5mm	4	U	6	17
01-DD-227	119.5	122.5	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Hard, <5mm	4	U	6	19
01-DD-227	122.5	127.7	3 -10 m	2	None	6	Smooth	1	None	6	U	6	21
01-DD-227	127.7	132.9	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-227	132.9	138.1	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Soft, <5mm	2	U	6	16
01-DD-227	138.1	143.3	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Hard, <5mm	4	U	6	19
01-DD-227	143.3	148.3	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Hard, <5mm	4	U	6	19
01-DD-227	148.3	150	3 -10 m	2	.1 -1 mm	4	Smooth	1	Soft, <5mm	2	U	6	15
01-DD-228	0	2.6	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	None	6	MW	3	17
01-DD-228	2.6	2.8	3 -10 m	2	None	6	V. Rough	6	None	6	MW	3	23
01-DD-228	2.8	3.9	3 -10 m	2	.1 -1 mm	4	Rough	5	None	6	SW	5	22

Boring ID	Depth, ft		Persistance		Separation		Roughness		Infilling		Weathering		Total Rating
	From	To	Length	Rating	Aperture	Rating	Description	Rating	Description	Rating	Class	Rating	
01-DD-228	3.9	9	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	None	6	U	6	20
01-DD-228	9	13.3	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-228	13.3	18.4	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-228	18.4	23.6	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-228	23.6	27.3	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	None	6	U	6	21
01-DD-228	27.3	32.3	3 -10 m	2	None	6	V. Rough	6	None	6	U	6	26
01-DD-228	32.3	37.4	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	None	6	U	6	21
01-DD-228	37.4	42.6	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	None	6	U	6	21
01-DD-228	42.6	47.7	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-228	47.7	52.7	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Soft, <5mm	2	U	6	17
01-DD-228	52.7	57.7	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-228	57.7	62.9	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Soft, <5mm	2	U	6	17
01-DD-228	62.9	68.1	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Soft, <5mm	2	U	6	17
01-DD-228	68.1	73.2	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-228	73.2	78.4	3 -10 m	2	None	6	V. Rough	6	None	6	U	6	26
01-DD-228	78.4	83.6	3 -10 m	2	None	6	Slick.	0	None	6	U	6	20
01-DD-228	83.6	87.3	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-228	87.3	92.5	3 -10 m	2	None	6	Smooth	1	None	6	U	6	21
01-DD-228	92.5	94.9	3 -10 m	2	None	6	Sl R/Sm	2	Soft, <5mm	2	U	6	18
01-DD-228	94.9	98.7	3 -10 m	2	None	6	Smooth	1	None	6	U	6	21
01-DD-228	98.7	99.7	3 -10 m	2	None	6	V. Rough	6	Soft, <5mm	2	U	6	22
01-DD-228	99.7	104	3 -10 m	2	None	6	Rough	5	None	6	U	6	25
01-DD-228	104	106.6	3 -10 m	2	.1 -1 mm	4	Slick.	0	Soft, <5mm	2	U	6	14
01-DD-228	106.6	111.8	3 -10 m	2	None	6	Smooth	1	None	6	U	6	21
01-DD-228	111.8	113.7	3 -10 m	2	.1 -1 mm	4	Slick.	0	None	6	U	6	18
01-DD-228	113.7	118.7	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-228	118.7	121.9	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-228	121.9	127	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-228	127	131.8	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Hard, <5mm	4	U	6	19
01-DD-228	131.8	136.3	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-228	136.3	141.5	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-228	141.5	146.7	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-228	146.7	151.9	3 -10 m	2	.1 -1 mm	4	Sl R/R	4	Soft, <5mm	2	U	6	18
01-DD-228	151.9	157	3 -10 m	2	None	6	Slick.	0	None	6	U	6	20
01-DD-228	157	162	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22

Boring ID	Depth, ft		Persistance		Separation		Roughness		Infilling		Weathering		Total Rating
	From	To	Length	Rating	Aperture	Rating	Description	Rating	Description	Rating	Class	Rating	
01-DD-228	162	164.5	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	None	6	U	6	20
01-DD-229	0	1.5											0
01-DD-229	1.5	2.5	3 -10 m	2	None	6	V. Rough	6	None	6	SW	5	25
01-DD-229	2.5	4.7	3 -10 m	2	None	6	V. Rough	6	None	6	SW	5	25
01-DD-229	4.7	5.3	3 -10 m	2	None	6	V. Rough	6	None	6	SW	5	25
01-DD-229	5.3	8.5	3 -10 m	2	None	6	Sl R/R	4	None	6	U	6	24
01-DD-229	8.5	11	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-229	11	16.1	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-229	16.1	21	3 -10 m	2	None	6	Sl R/R	4	None	6	U	6	24
01-DD-229	21	26	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-229	26	31	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-229	31	35	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-229	35	40	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-229	40	45.1	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Soft, <5mm	2	U	6	16
01-DD-229	45.1	47.7	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-229	47.7	51	3 -10 m	2	None	6	Sl R/R	4	None	6	U	6	24
01-DD-229	51	55.3	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-230	0	4.1	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	Hard, <5mm	4	U	6	19
01-DD-230	4.1	8.3	3 -10 m	2	.1 -1 mm	4	Sl. Rough	3	None	6	U	6	21
01-DD-230	8.3	13.3	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-230	13.3	17.6	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-230	17.6	21	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-230	21	26	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	None	6	U	6	20
01-DD-230	26	27.3	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-230	27.3	31	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-230	31	36.1	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-230	36.1	41	3 -10 m	2	.1 -1 mm	4	Sl R/R	4	Hard, <5mm	4	U	6	20
01-DD-230	41	46.2	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-230	46.2	51	3 -10 m	2	.1 -1 mm	4	Sl R/R	4	Soft, <5mm	2	U	6	18
01-DD-230	51	56.2	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-230	56.2	61	3 -10 m	2	None	6	Sl. Rough	3	None	6	U	6	23
01-DD-230	61	65.9	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-230	65.9	71	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-230	71	76.2	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22
01-DD-230	76.2	81	3 -10 m	2	None	6	Sl R/Sm	2	None	6	U	6	22

Boring ID	Depth, ft		Persistance		Separation		Roughness		Infilling		Weathering		Total
	From	To	Length	Rating	Aperture	Rating	Description	Rating	Description	Rating	Class	Rating	Rating
01-DD-230	81	86	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Soft, <5mm	2	U	6	16
01-DD-230	86	89.9	3 -10 m	2	.1 -1 mm	4	Smooth	1	Soft, <5mm	2	U	6	15
01-DD-230	89.9	95	3 -10 m	2	.1 -1 mm	4	Sl R/Sm	2	Hard, <5mm	4	U	6	18
01-DD-230	95	97.1	3 -10 m	2	None	6	Smooth	1	None	6	U	6	21
01-DD-230	97.1	101	3 -10 m	2	.1 -1 mm	4	Smooth	1	Soft, <5mm	2	U	6	15
01-DD-230	101	104.8	3 -10 m	2	.1 -1 mm	4	Smooth	1	Soft, <5mm	2	U	6	15
01-DD-230	104.8	107	3 -10 m	2	None	6	Sl R/Sm	2	Soft, <5mm	2	U	6	18
01-DD-230	107	109.9	3 -10 m	2	.1 -1 mm	4	Smooth	1	Soft, <5mm	2	U	6	15

Legend

Boring ID: Year - (i.e. 01 for 2001)
Drilling Method - (i.e. DD for diamond drilling)
Borehole Number - (i.e. 230)

Roughness: R - Rough
SM - Smooth
Sl - Slightly
V - Very

Weathering: U - Unweathered
SW - Slightly Weathered
MW - Moderately Weathered

Measures: m - meters
mm - millimeters

TABLE A6 - Rock Mass Ratings

Boring ID	Depth (ft)		RQD (%)	Q* Value	Rock Mass Rating (RMR)		
	From	To			Rating	Class Number	Description
01-DD-222	0.0	1.9					
01-DD-222	1.9	4.6	57	42.8	58.41	III	fair
01-DD-222	4.6	5.7	54	40.5	63.53	II	good
01-DD-222	5.7	7.8	81	81.0	66.77	II	good
01-DD-222	7.8	12.0	93	69.8	71.55	II	good
01-DD-222	12.0	17.0	71	23.7	66.30	II	good
01-DD-222	17.0	21.1	73	9.1	60.92	III	fair
01-DD-222	21.1	26.3	50	4.2	57.16	III	fair
01-DD-222	26.3	31.4	100	50.0	71.08	II	good
01-DD-222	31.4	36.5	86	35.8	62.78	II	good
01-DD-222	36.5	41.6	84	7.0	65.32	II	good
01-DD-222	41.6	46.7	85	17.7	70.14	II	good
01-DD-222	46.7	51.8	85	21.3	67.98	II	good
01-DD-222	51.8	56.9	86	17.9	66.78	II	good
01-DD-222	56.9	62.0	75	9.4	64.77	II	good
01-DD-222	62.0	67.1	94	94.0	70.46	II	good
01-DD-222	67.1	72.0	100	41.7	72.98	II	good
01-DD-222	72.0	77.2	79	39.5	64.27	II	good
01-DD-222	77.2	82.0	100	75.0	75.20	II	good
01-DD-222	82.0	85.8	92	138.0	69.66	II	good
01-DD-222	85.8	91.0	75	12.5	59.65	III	fair
01-DD-222	91.0	95.1	49	16.3	59.90	III	fair
01-DD-222	95.1	100.3	58	3.6	62.00	II	good
01-DD-222	100.3	105.4	33	4.4	58.49	III	fair
01-DD-222	105.4	106.9	0	1.0	54.13	III	fair
01-DD-222	106.9	109.5	35	7.3	58.25	III	fair
01-DD-222	109.5	110.3	0	0.8	46.80	III	fair
01-DD-222	110.3	115.5	62	3.9	63.54	II	good
01-DD-222	115.5	117.7	82	41.0	66.79	II	good
01-DD-222	117.7	122.0	76	31.7	66.62	II	good
01-DD-222	122.0	125.4	94	15.7	69.05	II	good
01-DD-223	0.0	2.1					
01-DD-223	2.1	6.5	95	7.9	69.89	II	good
01-DD-223	6.5	10.6	99	115.5	70.86	II	good
01-DD-223	10.6	13.5	76	76.0	64.42	II	good
01-DD-223	13.5	18.6	81	13.5	65.84	II	good
01-DD-223	18.6	23.5	100	75.0	71.76	II	good
01-DD-223	23.5	28.5	94	31.3	64.58	II	good
01-DD-223	28.5	33.5	96	16.0	70.06	II	good
01-DD-223	33.5	38.7	83	34.6	67.60	II	good
01-DD-223	38.7	43.5	98	98.0	73.39	II	good
01-DD-223	43.5	48.7	96	56.0	68.28	II	good
01-DD-223	48.7	53.5	88	22.0	65.49	II	good
01-DD-223	53.5	58.7	100	75.0	69.25	II	good
01-DD-223	58.7	63.5	100	133.3	79.20	II	good
01-DD-223	63.5	68.6	100	75.0	69.67	II	good
01-DD-223	68.6	73.2	89	178.0	80.26	II	good

Boring ID	Depth (ft)		RQD (%)	Q* Value	Rock Mass Rating (RMR)		
	From	To			Rating	Class Number	Description
01-DD-223	73.2	78.4	96	144.0	76.86	II	good
01-DD-223	78.4	83.5	84	21.0	64.16	II	good
01-DD-223	83.5	88.6	73	4.1	58.39	III	fair
01-DD-223	88.6	93.5	85	28.3	68.43	II	good
01-DD-223	93.5	98.6	96	72.0	75.70	II	good
01-DD-223	98.6	103.5	100	533.3	81.36	I	v. good
01-DD-223	103.5	108.6	96	144.0	78.70	II	good
01-DD-223	108.6	113.3	100	33.3	67.79	II	good
01-DD-223	113.3	118.3	88	44.0	64.18	II	good
01-DD-223	118.3	123.5	100	100.0	77.84	II	good
01-DD-223	123.5	128.7	72	12.0	63.78	II	good
01-DD-223	128.7	131.4	78	26.0	59.51	III	fair
01-DD-224	1.1	1.5					
01-DD-224	1.5	4.3	96	112.0	71.32	II	good
01-DD-224	4.3	9.0	94	94.0	70.15	II	good
01-DD-224	9.0	12.5	57	11.9	56.70	III	fair
01-DD-224	12.5	17.5	56	9.3	55.58	III	fair
01-DD-224	17.5	22.5	70	7.3	63.28	II	good
01-DD-224	22.5	27.5	72	4.5	59.69	III	fair
01-DD-224	27.5	32.5	88	11.0	64.42	II	good
01-DD-224	32.5	37.5	74	12.3	63.09	II	good
01-DD-224	37.5	42.5	98	65.3	72.92	II	good
01-DD-224	42.5	47.5	96	32.0	71.63	II	good
01-DD-224	47.5	52.7	60	6.7	61.43	II	good
01-DD-224	52.7	57.7	85	70.8	64.50	II	good
01-DD-224	57.7	62.5	94	62.7	70.46	II	good
01-DD-224	62.5	67.4	88	36.7	64.70	II	good
01-DD-224	67.4	72.5	98	49.0	69.60	II	good
01-DD-224	72.5	77.7	88	16.5	68.85	II	good
01-DD-224	77.7	82.5	100	66.7	70.26	II	good
01-DD-224	82.5	87.7	94	141.0	71.46	II	good
01-DD-224	87.7	92.5	100	75.0	74.45	II	good
01-DD-224	92.5	97.7	88	29.3	69.85	II	good
01-DD-224	97.7	102.5	100	66.7	72.88	II	good
01-DD-224	102.5	107.6	88	11.0	65.67	II	good
01-DD-224	107.6	112.5	63	10.5	58.82	III	fair
01-DD-224	112.5	115.4	76	7.9	60.96	III	fair
01-DD-224	115.4	120.6	73	9.1	63.74	II	good
01-DD-224	120.6	124.4	63	7.9	63.16	II	good
01-DD-224	124.4	129.6	85	21.3	67.34	II	good
01-DD-224	129.6	134.6	52	10.8	62.08	II	good
01-DD-224	134.6	139.8	98	40.8	72.51	II	good
01-DD-224	139.8	145.0	90	45.0	67.78	II	good
01-DD-224	145.0	150.2	94	58.8	70.72	II	good
01-DD-225	0.0	1.3					
01-DD-225	1.3	3.3	80	33.3	64.58	II	good
01-DD-225	3.3	5.4	0	4.2	48.60	III	fair
01-DD-225	5.4	8.1	41	13.7	53.30	III	fair
01-DD-225	8.1	10.4	83	6.9	59.78	III	fair

Boring ID	Depth (ft)		RQD (%)	Q* Value	Rock Mass Rating (RMR)		
	From	To			Rating	Class Number	Description
01-DD-225	10.4	15.0	78	6.5	64.00	II	good
01-DD-225	15.0	20.2	96	6.0	68.19	II	good
01-DD-225	20.2	25.3	61	15.3	60.95	III	fair
01-DD-225	25.3	28.5	75	31.3	60.63	III	fair
01-DD-225	28.5	33.5	98	163.3	67.63	II	good
01-DD-225	33.5	38.4	100	50.0	67.97	II	good
01-DD-225	38.4	41.0	100	133.3	73.28	II	good
01-DD-225	41.0	46.2	87	21.8	65.08	II	good
01-DD-225	46.2	47.8	31	7.8	56.23	III	fair
01-DD-225	47.8	50.5	41	1.4	55.81	III	fair
01-DD-225	50.5	55.4	69	23.0	64.01	II	good
01-DD-225	55.4	60.4	100	100.0	75.51	II	good
01-DD-225	60.4	65.5	90	22.5	62.69	II	good
01-DD-225	65.5	70.5	82	41.0	61.83	II	good
01-DD-225	70.5	75.7	79	5.5	64.45	II	good
01-DD-225	75.7	79.6	51	12.8	60.99	III	fair
01-DD-225	79.6	81.9	26	3.3	56.42	III	fair
01-DD-225	81.9	85.6	32	0.3	56.20	III	fair
01-DD-225	85.6	90.8	83	5.8	62.02	II	good
01-DD-225	90.8	92.2	64	1.3	59.35	III	fair
01-DD-225	92.2	94.7	44	29.3	58.21	III	fair
01-DD-225	94.7	95.7	0	2.7	51.19	III	fair
01-DD-225	95.7	98.7	13	3.3	58.06	III	fair
01-DD-225	98.7	100.1	36	9.0	50.45	III	fair
01-DD-225	100.1	104.6	36	1.5	67.42	II	good
01-DD-225	104.6	106.1	33	1.4	64.83	II	good
01-DD-225	106.1	108.0	32	5.3	55.83	III	fair
01-DD-225	108.0	110.6	15	1.3	55.51	III	fair
01-DD-225	110.6	115.7	67	16.8	63.30	II	good
01-DD-225	115.7	120.7	32	0.7	55.98	III	fair
01-DD-225	120.7	123.4	52	11.6	59.75	III	fair
01-DD-225	123.4	127.3	62	7.8	62.02	II	good
01-DD-225	127.3	130.4	48	6.0	60.35	III	fair
01-DD-225	130.4	135.1	62	31.0	63.79	II	good
01-DD-225	135.1	139.7	70	70.0	68.51	II	good
01-DD-225	139.7	144.6	100	6.3	72.54	II	good
01-DD-225	144.6	149.6	100	83.3	68.60	II	good
01-DD-226	0.0	1.0					
01-DD-226	1.0	1.7	100	533.3	70.49	II	good
01-DD-226	1.7	4.3	0	53.3	61.74	II	good
01-DD-226	4.3	7.7	100	533.3	80.90	II	good
01-DD-226	7.7	12.5	98	32.7	73.41	II	good
01-DD-226	12.5	17.6	86	19.1	66.61	II	good
01-DD-226	17.6	22.7	63	10.5	61.94	II	good
01-DD-226	22.7	27.8	98	522.7	78.19	II	good
01-DD-226	27.8	33.0	100	150.0	80.84	II	good
01-DD-226	33.0	38.1	100	533.3	83.67	I	v. good
01-DD-226	38.1	43.0	100	533.3	82.35	I	v. good
01-DD-226	43.0	48.2	92	20.4	66.07	II	good

Boring ID	Depth (ft)		RQD (%)	Q* Value	Rock Mass Rating (RMR)		
	From	To			Rating	Class Number	Description
01-DD-226	48.2	53.0	98	49.0	70.41	II	good
01-DD-226	53.0	58.0	100	150.0	77.51	II	good
01-DD-226	58.0	63.0	94	47.0	71.61	II	good
01-DD-226	63.0	68.2	98	147.0	80.34	II	good
01-DD-226	68.2	73.0	100	33.3	72.90	II	good
01-DD-226	73.0	78.0	100	16.7	68.46	II	good
01-DD-226	78.0	83.0	88	0.4	64.99	II	good
01-DD-226	83.0	88.2	83	27.7	62.60	II	good
01-DD-226	88.2	93.0	90	18.0	66.30	II	good
01-DD-226	93.0	98.0	100	533.3	83.51	I	v. good
01-DD-226	98.0	103.0	100	533.3	83.51	I	v. good
01-DD-226	103.0	108.1	100	533.3	83.67	I	v. good
01-DD-226	108.1	113.0	90	10.0	63.37	II	good
01-DD-226	113.0	118.2	100	533.3	81.84	I	v. good
01-DD-226	118.2	123.0	96	512.0	80.22	II	good
01-DD-226	123.0	128.0	100	75.0	74.51	II	good
01-DD-226	128.0	133.0	98	49.0	68.64	II	good
01-DD-226	133.0	138.2	100	150.0	78.84	II	good
01-DD-226	138.2	143.0	100	150.0	78.20	II	good
01-DD-226	143.0	148.0	100	533.3	83.51	I	v. good
01-DD-226	148.0	153.0	98	522.7	83.03	I	v. good
01-DD-226	153.0	158.1	100	25.0	73.16	II	good
01-DD-226	158.1	163.2	100	37.5	75.67	II	good
01-DD-226	163.2	165.0	100	533.3	77.43	II	good
01-DD-227	0.0	2.3					
01-DD-227	2.3	4.6	65	32.5	63.91	II	good
01-DD-227	4.6	8.5	100	75.0	71.75	II	good
01-DD-227	8.5	11.1	27	6.8	52.30	III	fair
01-DD-227	11.1	14.0	97	72.8	71.23	II	good
01-DD-227	14.0	19.0	100	75.0	69.12	II	good
01-DD-227	19.0	22.9	100	150.0	75.76	II	good
01-DD-227	22.9	27.9	96	48.0	72.10	II	good
01-DD-227	27.9	33.1	92	17.3	67.42	II	good
01-DD-227	33.1	38.3	62	4.6	61.80	II	good
01-DD-227	38.3	43.3	98	5.4	71.35	II	good
01-DD-227	43.3	48.5	98	36.8	65.85	II	good
01-DD-227	48.5	53.7	98	147.0	73.34	II	good
01-DD-227	53.7	58.9	87	10.9	64.49	II	good
01-DD-227	58.9	64.0	73	7.3	62.38	II	good
01-DD-227	64.0	69.1	94	15.7	73.22	II	good
01-DD-227	69.1	74.1	100	75.0	71.12	II	good
01-DD-227	74.1	79.3	100	37.5	74.84	II	good
01-DD-227	79.3	84.4	100	25.0	69.23	II	good
01-DD-227	84.4	89.5	100	75.0	68.92	II	good
01-DD-227	89.5	94.5	98	147.0	75.03	II	good
01-DD-227	94.5	99.6	100	150.0	76.67	II	good
01-DD-227	99.6	104.5	92	34.5	70.43	II	good
01-DD-227	104.5	109.6	100	533.3	81.67	I	v. good
01-DD-227	109.6	114.5	84	9.3	66.01	II	good

Boring ID	Depth (ft)		RQD (%)	Q* Value	Rock Mass Rating (RMR)		
	From	To			Rating	Class Number	Description
01-DD-227	114.5	119.5	100	100.0	74.51	II	good
01-DD-227	119.5	122.5	100	75.0	73.16	II	good
01-DD-227	122.5	127.7	100	75.0	72.25	II	good
01-DD-227	127.7	132.9	96	16.0	73.28	II	good
01-DD-227	132.9	138.1	90	11.3	63.61	II	good
01-DD-227	138.1	143.3	100	400.0	72.34	II	good
01-DD-227	143.3	148.3	98	147.0	76.03	II	good
01-DD-227	148.3	150.0	100	25.0	63.52	II	good
01-DD-228	0.0	2.6	0	5.0	47.93	III	fair
01-DD-228	2.6	2.8	0	1.5	52.98	III	fair
01-DD-228	2.8	3.9	36	5.4	60.06	III	fair
01-DD-228	3.9	9.0	96	24.0	67.54	II	good
01-DD-228	9.0	13.3	88	11.0	67.12	II	good
01-DD-228	13.3	18.4	71	35.5	63.20	II	good
01-DD-228	18.4	23.6	94	141.0	76.46	II	good
01-DD-228	23.6	27.3	22	4.4	52.95	III	fair
01-DD-228	27.3	32.3	74	16.4	77.59	II	good
01-DD-228	32.3	37.4	49	16.3	57.54	III	fair
01-DD-228	37.4	42.6	77	25.7	63.01	II	good
01-DD-228	42.6	47.7	61	7.6	63.52	II	good
01-DD-228	47.7	52.7	74	24.7	59.11	III	fair
01-DD-228	52.7	57.7	98	16.3	69.95	II	good
01-DD-228	57.7	62.9	100	33.3	66.17	II	good
01-DD-228	62.9	68.1	83	27.7	60.54	III	fair
01-DD-228	68.1	73.2	94	94.0	69.65	II	good
01-DD-228	73.2	78.4	100	150.0	83.84	I	v. good
01-DD-228	78.4	83.6	100	16.7	73.34	II	good
01-DD-228	83.6	87.3	89	59.3	70.73	II	good
01-DD-228	87.3	92.5	87	9.7	67.01	II	good
01-DD-228	92.5	94.9	42	1.8	54.26	III	fair
01-DD-228	94.9	98.7	63	1.3	59.98	III	fair
01-DD-228	98.7	99.7	0	0.4	55.00	III	fair
01-DD-228	99.7	104.0	88	22.0	72.27	II	good
01-DD-228	104.0	106.6	62	1.3	54.54	III	fair
01-DD-228	106.6	111.8	71	1.2	64.60	II	good
01-DD-228	111.8	113.7	53	3.3	57.29	III	fair
01-DD-228	113.7	118.7	86	7.2	68.54	II	good
01-DD-228	118.7	121.9	88	22.0	68.49	II	good
01-DD-228	121.9	127.0	69	3.5	61.73	II	good
01-DD-228	127.0	131.8	98	13.1	66.85	II	good
01-DD-228	131.8	136.3	82	10.9	68.53	II	good
01-DD-228	136.3	141.5	88	7.3	69.85	II	good
01-DD-228	141.5	146.7	100	33.3	74.25	II	good
01-DD-228	146.7	151.9	98	16.3	70.85	II	good
01-DD-228	151.9	157.0	100	200.0	79.25	II	good
01-DD-228	157.0	162.0	100	100.0	81.09	I	v. good
01-DD-228	162.0	164.5	88	19.6	71.84	II	good
01-DD-229	0.0	1.5					
01-DD-229	1.5	2.5	90	67.5	70.64	II	good

Boring ID	Depth (ft)		RQD (%)	Q* Value	Rock Mass Rating (RMR)		
	From	To			Rating	Class Number	Description
01-DD-229	2.5	4.7	32	24.0	62.94	II	good
01-DD-229	4.7	5.3	0	0.8	51.52	III	fair
01-DD-229	5.3	8.5	53	13.3	61.04	II	good
01-DD-229	8.5	11.0	100	11.1	69.70	II	good
01-DD-229	11.0	16.1	96	21.3	70.13	II	good
01-DD-229	16.1	21.0	35	7.0	57.71	III	fair
01-DD-229	21.0	26.0	66	5.5	61.21	II	good
01-DD-229	26.0	31.0	92	20.4	64.11	II	good
01-DD-229	31.0	35.0	95	23.8	64.29	II	good
01-DD-229	35.0	40.0	72	16.0	62.56	II	good
01-DD-229	40.0	45.1	25	4.2	50.59	III	fair
01-DD-229	45.1	47.7	73	18.3	62.83	II	good
01-DD-229	47.7	51.0	97	97.0	73.28	II	good
01-DD-229	51.0	55.3	65	8.1	61.19	II	good
01-DD-230	0.0	4.1	51	25.5	60.70	III	fair
01-DD-230	4.1	8.3	90	67.5	70.81	II	good
01-DD-230	8.3	13.3	92	69.0	64.54	II	good
01-DD-230	13.3	17.6	63	10.5	62.90	II	good
01-DD-230	17.6	21.0	88	29.3	68.61	II	good
01-DD-230	21.0	26.0	76	8.4	61.55	II	good
01-DD-230	26.0	27.3	77	115.5	66.71	II	good
01-DD-230	27.3	31.0	81	40.5	66.36	II	good
01-DD-230	31.0	36.1	65	10.8	62.00	II	good
01-DD-230	36.1	41.0	69	17.3	61.80	II	good
01-DD-230	41.0	46.2	73	4.9	58.99	III	fair
01-DD-230	46.2	51.0	85	5.7	63.15	II	good
01-DD-230	51.0	56.2	94	20.9	69.72	II	good
01-DD-230	56.2	61.0	42	5.6	58.06	III	fair
01-DD-230	61.0	65.9	82	10.3	66.20	II	good
01-DD-230	65.9	71.0	80	13.3	63.62	II	good
01-DD-230	71.0	76.2	92	15.3	67.65	II	good
01-DD-230	76.2	81.0	69	6.9	62.97	II	good
01-DD-230	81.0	86.0	76	14.3	58.96	III	fair
01-DD-230	86.0	89.9	69	2.9	57.89	III	fair
01-DD-230	89.9	95.0	55	1.7	56.72	III	fair
01-DD-230	95.0	97.1	43	1.8	57.25	III	fair
01-DD-230	97.1	101.0	64	1.6	55.27	III	fair
01-DD-230	101.0	104.8	71	1.5	56.95	III	fair
01-DD-230	104.8	107.0	55	1.4	56.11	III	fair
01-DD-230	107.0	109.9	69	1.4	57.15	III	fair

NOTES
RQD = Rock Quality Designation
Q* = Modified Tunneling Quality Index
RMR = Rock Mass Rating

TABLE A7 - Packer Test Hydraulic Conductivity Calculations

Borehole	Gage Height	Static Water Level	Test ID	Interval		Discharge (Q)		Gage Pressure	Hydraulic Conductivity (K)		
				Top	Bottom	Q (gpm)	Q (ft3/sec)	(psi)	K (ft/sec)	K (ft/min)	K (ft/day)
94-DD-80	0.3	11	1A	156	165	1.6	0.0036	40	2.61E-06	1.57E-04	0.2256
94-DD-80	0.3	11	1B	156	165	5.7	0.0127	80	4.91E-06	2.95E-04	0.4242
94-DD-80	0.3	11	2A	144	158	1.4	0.0031	40	1.51E-06	9.07E-05	0.1305
94-DD-80	0.3	11	2B	144	158	5.3	0.0118	80	3.02E-06	1.81E-04	0.2609
94-DD-80	0.3	11	3A	128	144	0	0.0000	40	0.00E+00	0.00E+00	0.0000
94-DD-80	0.3	11	3B	128	144	0	0.0000	80	0.00E+00	0.00E+00	0.0000
94-DD-80	0.3	11	4A	117	131	0	0.0000	40	0.00E+00	0.00E+00	0.0000
94-DD-80	0.3	11	4B	117	131	0	0.0000	80	0.00E+00	0.00E+00	0.0000
94-DD-80	0.3	11	5A	103	117	0	0.0000	40	0.00E+00	0.00E+00	0.0000
94-DD-80	0.3	11	5B	103	117	0	0.0000	80	0.00E+00	0.00E+00	0.0000
94-DD-80	0.3	11	6A	88	103	0	0.0000	40	0.00E+00	0.00E+00	0.0000
94-DD-80	0.3	11	6B	88	103	0	0.0000	80	0.00E+00	0.00E+00	0.0000
94-DD-80	0.3	11	7A	75	90	0.5	0.0011	40	5.40E-07	3.24E-05	0.0466
94-DD-80	0.3	11	7B	75	90	1.5	0.0033	80	8.54E-07	5.12E-05	0.0738
94-DD-80	0.3	11	8A	64	77	3.2	0.0071	40	3.65E-06	2.19E-04	0.3158
94-DD-80	0.3	11	8B	64	77	9.7	0.0216	80	5.85E-06	3.51E-04	0.5057
94-DD-80	0.3	11	9A	50	64	6.3	0.0140	40	6.81E-06	4.09E-04	0.5886
94-DD-80	0.3	11	9B	50	64	8	0.0178	80	4.56E-06	2.74E-04	0.3940
94-DD-80	0.3	11	10A	37	52	8.1	0.0181	40	8.70E-06	5.22E-04	0.7515
94-DD-80	0.3	11	10B	37	52	4.7	0.0105	80	2.66E-06	1.59E-04	0.2296
94-DD-80	0.3	11	11A	24	38	15.5	0.0346	40	1.68E-05	1.01E-03	1.4531
94-DD-80	0.3	11	11B	24	38	21.9	0.0488	80	1.25E-05	7.52E-04	1.0822
94-DD-80	0.3	11	12A	13	25	6.7	0.0149	40	7.67E-06	4.60E-04	0.6626
94-DD-80	0.3	11	12B	13	25	3	0.0067	20	6.21E-06	3.72E-04	0.5363
94-DD-81	0.3	30.6	1A	178	190	1.3	0.0029	40	1.21E-06	7.24E-05	0.1043
94-DD-81	0.3	30.6	1B	178	190	12.9	0.0288	80	6.88E-06	4.13E-04	0.5941
94-DD-81	0.3	30.6	2A	170	179	18.3	0.0408	40	2.61E-05	1.57E-03	2.2592
94-DD-81	0.3	30.6	2B	170	179	25.7	0.0573	80	2.09E-05	1.25E-03	1.8068
94-DD-81	0.3	30.6	3A	156	170	17.5	0.0390	40	1.61E-05	9.67E-04	1.3928
94-DD-81	0.3	30.6	3B	156	170	30.7	0.0685	80	1.62E-05	9.73E-04	1.4006
94-DD-81	0.3	30.6	4A	143	156	19.7	0.0439	40	1.93E-05	1.16E-03	1.6640
94-DD-81	0.3	30.6	4B	143	156	27.8	0.0620	80	1.55E-05	9.29E-04	1.3375

Borehole	Gage Height	Static Water Level	Test ID	Interval		Discharge (Q)		Gage Pressure	Hydraulic Conductivity (K)		
				Top	Bottom	Q (gpm)	Q (ft3/sec)	(psi)	K (ft/sec)	K (ft/min)	K (ft/day)
94-DD-81	0.3	30.6	5A	130	144	0	0.0000	40	0.00E+00	0.00E+00	0.0000
94-DD-81	0.3	30.6	5B	130	144	0	0.0000	80	0.00E+00	0.00E+00	0.0000
96-DD-87	0.3	11.8	1A	114	130	1.3	0.0029	45	1.19E-06	7.12E-05	0.1026
96-DD-87	0.3	11.8	2A	104	120	1.1	0.0025	45	1.04E-06	6.21E-05	0.0895
96-DD-87	0.3	11.8	3A	94	110	2.6	0.0058	50	2.23E-06	1.34E-04	0.1923
96-DD-87	0.3	11.8	3B	94	110	1.3	0.0029	25	2.04E-06	1.22E-04	0.1763
96-DD-87	0.3	11.8	4A	84	100	3.1	0.0069	64	2.11E-06	1.27E-04	0.1827
96-DD-87	0.3	11.8	4B	84	100	1.4	0.0031	32	1.78E-06	1.07E-04	0.1539
96-DD-87	0.3	11.8	5A	74	90	2.4	0.0054	65	1.61E-06	9.68E-05	0.1394
96-DD-87	0.3	11.8	5B	74	90	0.8	0.0018	30	1.08E-06	6.46E-05	0.0930
96-DD-87	0.3	11.8	6A	64	80	0.65	0.0014	55	5.10E-07	3.06E-05	0.0441
96-DD-87	0.3	11.8	6B	64	80	0.38	0.0008	35	4.47E-07	2.68E-05	0.0386
96-DD-87	0.3	11.8	7A	55	71	0.58	0.0013	52	4.79E-07	2.87E-05	0.0414
96-DD-87	0.3	11.8	7B	55	71	0.18	0.0004	36	2.07E-07	1.24E-05	0.0179
96-DD-87	0.3	11.8	8A	44	60	0.19	0.0004	50	1.63E-07	9.76E-06	0.0141
96-DD-87	0.3	11.8	8B	44	60	0.1	0.0002	25	1.57E-07	9.42E-06	0.0136
96-DD-87	0.3	11.8	9A	33	48	0.23	0.0005	52	1.90E-07	1.14E-05	0.0164
96-DD-87	0.3	11.8	9B	33	48	0.1	0.0002	26	1.52E-07	9.11E-06	0.0131
96-DD-87	0.3	11.8	10A	22	38	26.1	0.0582	20	5.03E-05	3.02E-03	4.3428
96-DD-87	0.3	11.8	11A	11	26	27	0.0602	15	6.55E-05	3.93E-03	5.6628
99-DD-200	0.3	-17.6	1A	190	205	0	0.0000	31	0.00E+00	0.00E+00	0.0000
99-DD-200	0.3	-17.6	1B	190	205	0.1	0.0002	80	6.51E-08	3.91E-06	0.0056
99-DD-200	0.3	-17.6	2A	175	195	0	0.0000	30	0.00E+00	0.00E+00	0.0000
99-DD-200	0.3	-17.6	2B	175	195	0	0.0000	82	0.00E+00	0.00E+00	0.0000
99-DD-200	0.3	-17.6	3A	161	180	1	0.0022	34	1.55E-06	9.33E-05	0.1343
99-DD-200	0.3	-17.6	3B	161	180	1.6	0.0036	80	9.03E-07	5.42E-05	0.0780
99-DD-200	0.3	-17.6	4A	146	165	0	0.0000	24	0.00E+00	0.00E+00	0.0000
99-DD-200	0.3	-17.6	4B	146	165	0.7	0.0016	52	6.45E-07	3.87E-05	0.0558
99-DD-200	0.3	-17.6	5A	131	151	1.6	0.0036	35	2.40E-06	1.44E-04	0.2070
99-DD-200	0.3	-17.6	5B	131	151	3.1	0.0069	80	1.75E-06	1.05E-04	0.1512
99-DD-200	0.3	-17.6	6A	117	136	24.5	0.0546	64	1.76E-05	1.06E-03	1.5246
99-DD-200	0.3	-17.6	6B	117	136	14.8	0.0330	22	4.18E-05	2.51E-03	3.6131
99-DD-200	0.3	-17.6	6C	117	136	19.2	0.0428	52	1.76E-05	1.06E-03	1.5200
99-DD-200	0.3	-17.6	7A	102	122	0.8	0.0018	20	2.67E-06	1.60E-04	0.2303

Borehole	Gage Height	Static Water Level	Test ID	Interval		Discharge (Q)		Gage Pressure (psi)	Hydraulic Conductivity (K)		
				Top	Bottom	Q (gpm)	Q (ft3/sec)		K (ft/sec)	K (ft/min)	K (ft/day)
99-DD-200	0.3	-17.6	7B	102	122	2.6	0.0058	51	2.45E-06	1.47E-04	0.2119
99-DD-200	0.3	-17.6	8A	88	107	0	0.0000	20	0.00E+00	0.00E+00	0.0000
99-DD-200	0.3	-17.6	8B	88	107	0.1	0.0002	52	9.22E-08	5.53E-06	0.0080
99-DD-200	0.3	-17.6	9A	73	93	0	0.0000	25	0.00E+00	0.00E+00	0.0000
99-DD-200	0.3	-17.6	9B	73	93	0	0.0000	55	0.00E+00	0.00E+00	0.0000
99-DD-200	0.3	-17.6	10A	59	78	0	0.0000	24	0.00E+00	0.00E+00	0.0000
99-DD-200	0.3	-17.6	10B	59	78	0	0.0000	50	0.00E+00	0.00E+00	0.0000
99-DD-200	0.3	-17.6	11A	44	64	0	0.0000	25	0.00E+00	0.00E+00	0.0000
99-DD-200	0.3	-17.6	11B	44	64	0	0.0000	53	0.00E+00	0.00E+00	0.0000
99-DD-200	0.3	-17.6	12A	30	49	0.2	0.0004	19	7.26E-07	4.35E-05	0.0627
99-DD-200	0.3	-17.6	12B	30	49	2.4	0.0054	46	2.56E-06	1.54E-04	0.2212
99-DD-201	5.2	22.89	1A	189	203	0	0.0000	30	0.00E+00	0.00E+00	0.0000
99-DD-201	5.2	22.89	1B	189	203	0.2	0.0004	75	1.15E-07	6.88E-06	0.0099
99-DD-201	5.2	22.89	2A	174	194	0	0.0000	27	0.00E+00	0.00E+00	0.0000
99-DD-201	5.2	22.89	2B	174	194	0.4	0.0009	76	1.95E-07	1.17E-05	0.0168
99-DD-201	5.2	22.89	3A	160	179	1.6	0.0036	24	2.06E-06	1.24E-04	0.1780
99-DD-201	5.2	22.89	3B	160	179	2	0.0045	70	1.05E-06	6.30E-05	0.0907
99-DD-201	5.2	22.89	4A	145	165	1.7	0.0038	35	1.62E-06	9.75E-05	0.1404
99-DD-201	5.2	22.89	4B	145	165	2.7	0.0060	60	1.63E-06	9.76E-05	0.1406
99-DD-201	5.2	22.89	5A	131	150	1.2	0.0027	24	1.55E-06	9.27E-05	0.1335
99-DD-201	5.2	22.89	5B	131	150	2.8	0.0062	53	1.88E-06	1.13E-04	0.1626
99-DD-201	5.2	22.89	6A	116	136	1.2	0.0027	26	1.45E-06	8.72E-05	0.1256
99-DD-201	5.2	22.89	6B	116	136	1.8	0.0040	51	1.25E-06	7.51E-05	0.1081
99-DD-201	5.2	22.89	7A	102	121	> 23 gpm - could not pump at high enough rate to achieve pressure					
99-DD-201	5.2	22.89	8A	87	107	> 23 gpm - could not pump at high enough rate to achieve pressure					
99-DD-201	5.2	22.89	9A	73	92	0	0.0000	22	0.00E+00	0.00E+00	0.0000
99-DD-201	5.2	22.89	9B	73	92	0.8	0.0018	52	5.47E-07	3.28E-05	0.0472
99-DD-201	5.2	22.89	10A	58	78	0.2	0.0004	58	1.24E-07	7.45E-06	0.0107
99-DD-201	5.2	22.89	10B	58	78	0	0.0000	24	0.00E+00	0.00E+00	0.0000
99-DD-201	5.2	22.89	11A	44	63	0	0.0000	23	0.00E+00	0.00E+00	0.0000
99-DD-201	5.2	22.89	11B	44	63	1.8	0.0040	48	1.32E-06	7.91E-05	0.1139
99-DD-201	5.2	22.89	12A	29	49	11.2	0.0250	25	1.40E-05	8.43E-04	1.2138
99-DD-201	5.2	22.89	12B	29	49	21.4	0.0477	50	1.52E-05	9.12E-04	1.3129
99-DD-203	2	7.98	1A	163	183	0.4	0.0009	52	2.91E-07	1.75E-05	0.0251

Borehole	Gage Height	Static Water Level	Test ID	Interval		Discharge (Q)		Gage Pressure	Hydraulic Conductivity (K)		
				Top	Bottom	Q (gpm)	Q (ft3/sec)	(psi)	K (ft/sec)	K (ft/min)	K (ft/day)
99-DD-203	2	7.98	1B	163	183	0	0.0000	25	0.00E+00	0.00E+00	0.0000
99-DD-203	2	7.98	2A	149	168	0	0.0000	50	0.00E+00	0.00E+00	0.0000
99-DD-203	2	7.98	2B	149	168	0	0.0000	25	0.00E+00	0.00E+00	0.0000
99-DD-203	2	7.98	3A	134	154	0	0.0000	52	0.00E+00	0.00E+00	0.0000
99-DD-203	2	7.98	3B	134	154	1	0.0022	85	4.63E-07	2.78E-05	0.0400
99-DD-203	2	7.98	3C	134	154	0	0.0000	50	0.00E+00	0.00E+00	0.0000
99-DD-203	2	7.98	4A	119	139	0	0.0000	57	0.00E+00	0.00E+00	0.0000
99-DD-203	2	7.98	4B	119	139	0	0.0000	25	0.00E+00	0.00E+00	0.0000
99-DD-203	2	7.98	5A	104	124	0	0.0000	59	0.00E+00	0.00E+00	0.0000
99-DD-203	2	7.98	5B	104	124	0	0.0000	30	0.00E+00	0.00E+00	0.0000
99-DD-203	2	7.98	6A	90	109	1.8	0.0040	60	1.17E-06	6.99E-05	0.1007
99-DD-203	2	7.98	6B	90	109	0.9	0.0020	28	1.19E-06	7.15E-05	0.1030
99-DD-203	2	7.98	7A	74	94	3	0.0067	59	1.97E-06	1.18E-04	0.1705
99-DD-203	2	7.98	7B	74	94	1.2	0.0027	25	1.76E-06	1.06E-04	0.1522
99-DD-203	2	7.98	8A	60	80	0	0.0000	58	0.00E+00	0.00E+00	0.0000
99-DD-203	2	7.98	9A	45	65	0	0.0000	30	0.00E+00	0.00E+00	0.0000
99-DD-203	2	7.98	9B	45	65	4.6	0.0103	60	2.98E-06	1.79E-04	0.2574
99-DD-203	2	7.98	10A	31	50	0	0.0000	26	0.00E+00	0.00E+00	0.0000
99-DD-203	2	7.98	10B	31	50	0	0.0000	50	0.00E+00	0.00E+00	0.0000
99-DD-204	2.1	23.18	1A	179	198	0	0.0000	64	0.00E+00	0.00E+00	0.0000
99-DD-204	2.1	23.18	2A	164	184	0	0.0000	65	0.00E+00	0.00E+00	0.0000
99-DD-204	2.1	23.18	3A	150	169	0	0.0000	65	0.00E+00	0.00E+00	0.0000
99-DD-204	2.1	23.18	4A	135	155	0	0.0000	65	0.00E+00	0.00E+00	0.0000
99-DD-204	2.1	23.18	5A	121	140	1.2	0.0027	68	6.34E-07	3.81E-05	0.0548
99-DD-204	2.1	23.18	5B	121	140	0.15	0.0003	36	1.36E-07	8.13E-06	0.0117
99-DD-204	2.1	23.18	6A	106	126	0.8	0.0018	69	4.18E-07	2.51E-05	0.0361
99-DD-204	2.1	23.18	6B	106	126	0.15	0.0003	35	1.39E-07	8.32E-06	0.0120
99-DD-204	2.1	23.18	7A	92	111	1.2	0.0027	65	6.60E-07	3.96E-05	0.0570
99-DD-204	2.1	23.18	7B	92	111	0	0.0000	32	0.00E+00	0.00E+00	0.0000
99-DD-204	2.1	23.18	8A	77	97	2.4	0.0054	60	1.42E-06	8.49E-05	0.1223
99-DD-204	2.1	23.18	8B	77	97	1	0.0022	30	1.04E-06	6.25E-05	0.0900
99-DD-204	2.1	23.18	9A	63	82	0	0.0000	60	0.00E+00	0.00E+00	0.0000
99-DD-204	2.1	23.18	10A	48	68	32.8	0.0731	40	2.76E-05	1.66E-03	2.3832
99-DD-204	2.1	23.18	10B	48	68	20.2	0.0450	20	2.86E-05	1.71E-03	2.4685

Borehole	Gage Height	Static Water Level	Test ID	Interval		Discharge (Q)		Gage Pressure (psi)	Hydraulic Conductivity (K)		
				Top	Bottom	Q (gpm)	Q (ft3/sec)		K (ft/sec)	K (ft/min)	K (ft/day)
99-DD-204	2.1	23.18	11A	34	53	10	0.0223	50	6.91E-06	4.15E-04	0.5972
99-DD-204	2.1	23.18	11B	34	53	5.8	0.0129	26	6.75E-06	4.05E-04	0.5832
99-DD-204	2.1	23.18	12A	19	39	40.8	0.0910	22	5.51E-05	3.30E-03	4.7569
99-DD-204	2.1	23.18	12B	19	39	30	0.0669	12	5.95E-05	3.57E-03	5.1389
99-DD-205	6.2	1.8	1A	166	193	3.2	0.0071	36	2.81E-06	1.69E-04	0.2432
99-DD-205	6.2	1.8	1B	166	193	6	0.0134	64	2.90E-06	1.74E-04	0.2503
99-DD-205	6.2	1.8	2A	151	171	9	0.0201	36	1.01E-05	6.05E-04	0.8712
99-DD-205	6.2	1.8	2B	151	171	18.2	0.0406	68	1.05E-05	6.31E-04	0.9088
99-DD-205	6.2	1.8	3A	136	156	17.8	0.0397	31	2.33E-05	1.40E-03	2.0169
99-DD-205	6.2	1.8	3B	136	156	21	0.0468	50	1.67E-05	1.00E-03	1.4403
99-DD-205	6.2	1.8	4A	121	141	14.6	0.0326	52	1.11E-05	6.68E-04	0.9620
99-DD-205	6.2	1.8	4B	121	141	7	0.0156	24	1.21E-05	7.26E-04	1.0456
99-DD-205	6.2	1.8	5A	106	126	1.2	0.0027	25	1.99E-06	1.19E-04	0.1717
99-DD-205	6.2	1.8	5B	106	126	1.4	0.0031	55	1.01E-06	6.05E-05	0.0871
99-DD-205	6.2	1.8	6A	89	109	0.3	0.0007	32	3.81E-07	2.29E-05	0.0329
99-DD-205	6.2	1.8	6B	89	109	0.8	0.0018	60	5.27E-07	3.16E-05	0.0455
99-DD-205	6.2	1.8	7A	76	96	0	0.0000	28	0.00E+00	0.00E+00	0.0000
99-DD-205	6.2	1.8	7B	76	96	0	0.0000	58	0.00E+00	0.00E+00	0.0000
99-DD-205	6.2	1.8	8A	61	81	3.7	0.0083	22	7.04E-06	4.22E-04	0.6084
99-DD-205	6.2	1.8	8B	61	81	6	0.0134	51	4.67E-06	2.80E-04	0.4036
99-DD-205	6.2	1.8	9A	46	66	2	0.0045	22	3.81E-06	2.28E-04	0.3288
99-DD-205	6.2	1.8	9B	46	66	8.4	0.0187	50	6.67E-06	4.00E-04	0.5766
99-DD-205	6.2	1.8	10A	31	51	5	0.0112	22	9.51E-06	5.70E-04	0.8212
99-DD-205	6.2	1.8	10B	31	51	7.2	0.0161	38	7.62E-06	4.57E-04	0.6586
99-DD-205	6.2	1.8	11A	16	36	0	0.0000	20	0.00E+00	0.00E+00	0.0000
99-DD-205	6.2	1.8	11B	16	36	0.5	0.0011	40	5.02E-07	3.01E-05	0.0434
99-DD-206	0.3	23.1	1A	166	190	34.5	0.0769	18	4.16E-05	2.50E-03	3.5952
99-DD-206	0.3	23.1	2A	153	173	30.6	0.0682	20	3.92E-05	2.35E-03	3.3844
99-DD-206	0.3	23.1	3A	138	158	31.6	0.0705	80	1.34E-05	8.07E-04	1.1616
99-DD-206	0.3	23.1	3B	138	158	18.6	0.0415	40	1.43E-05	8.56E-04	1.2322
99-DD-206	0.3	23.1	4A	123	143	39	0.0870	25	4.28E-05	2.57E-03	3.6949
99-DD-206	0.3	23.1	5A	108	128	40.8	0.0910	19	5.40E-05	3.24E-03	4.6688
99-DD-206	0.3	23.1	6A	93	113	40.4	0.0901	19	5.35E-05	3.21E-03	4.6231
99-DD-206	0.3	23.1	7A	78	98	0	0.0000	32	0.00E+00	0.00E+00	0.0000

Borehole	Gage Height	Static Water Level	Test ID	Interval		Discharge (Q)		Gage Pressure (psi)	Hydraulic Conductivity (K)		
				Top	Bottom	Q (gpm)	Q (ft3/sec)		K (ft/sec)	K (ft/min)	K (ft/day)
99-DD-206	0.3	23.1	7B	78	98	0	0.0000	59	0.00E+00	0.00E+00	0.0000
99-DD-206	0.3	23.1	8A	63	83	0	0.0000	27	0.00E+00	0.00E+00	0.0000
99-DD-206	0.3	23.1	8B	63	83	0	0.0000	60	0.00E+00	0.00E+00	0.0000
99-DD-206	0.3	23.1	9A	48	68	39.8	0.0888	20	5.14E-05	3.08E-03	4.4386
99-DD-206	0.3	23.1	10A	33	53	18.6	0.0415	55	1.10E-05	6.61E-04	0.9523
99-DD-206	0.3	23.1	10B	33	53	3.2	0.0071	23	3.72E-06	2.23E-04	0.3216
00-DD-207	3.5	8.6	1A	118	140	11.8	0.0263	50	8.10E-06	4.86E-04	0.6994
00-DD-207	3.5	8.6	1B	118	140	7.8	0.0174	25	1.03E-05	6.16E-04	0.8874
00-DD-207	3.5	8.6	2A	103	123	24	0.0535	18	4.57E-05	2.74E-03	3.9471
00-DD-207	3.5	8.6	2B	103	123	40.2	0.0896	36	4.05E-05	2.43E-03	3.4995
00-DD-207	3.5	8.6	3A	88	108	8.4	0.0187	22	1.33E-05	7.98E-04	1.1487
00-DD-207	3.5	8.6	3B	88	108	14.2	0.0317	40	1.29E-05	7.73E-04	1.1132
00-DD-207	3.5	8.6	4A	73	93	10.6	0.0236	12	2.86E-05	1.72E-03	2.4742
00-DD-207	3.5	8.6	4B	73	93	14.6	0.0326	22	2.31E-05	1.39E-03	1.9980
00-DD-207	3.5	8.6	5A	58	78	3.2	0.0071	22	5.06E-06	3.03E-04	0.4369
00-DD-207	3.5	8.6	5B	58	78	14	0.0312	54	9.53E-06	5.72E-04	0.8238
00-DD-207	3.5	8.6	6A	43	63	23.6	0.0526	12	6.40E-05	3.84E-03	5.5317
00-DD-207	3.5	8.6	6B	43	63	20.2	0.0450	8	7.63E-05	4.58E-03	6.5966
00-DD-207	3.5	8.6	7A	28	48	10.8	0.0241	25	1.52E-05	9.13E-04	1.3141
00-DD-207	3.5	8.6	7B	28	48	24.25	0.0541	50	1.78E-05	1.07E-03	1.5380
00-DD-207	3.5	8.6	8A	13	33	24	0.0535	6	1.13E-04	6.81E-03	9.7994
00-DD-208	3.5	18.5	1A	134	150	12.7	0.0283	36	1.37E-05	8.22E-04	1.1836
00-DD-208	3.5	18.5	1B	134	150	23.4	0.0522	72	1.37E-05	8.20E-04	1.1810
00-DD-208	3.5	18.5	2A	119	139	14.8	0.0330	26	1.75E-05	1.05E-03	1.5129
00-DD-208	3.5	18.5	2B	119	139	22.2	0.0495	48	1.57E-05	9.39E-04	1.3526
00-DD-208	3.5	18.5	3A	104	124	2.4	0.0054	33	2.32E-06	1.39E-04	0.2008
00-DD-208	3.5	18.5	3B	104	124	4.2	0.0094	65	2.25E-06	1.35E-04	0.1943
00-DD-208	3.5	18.5	4A	89	109	2.6	0.0058	80	1.15E-06	6.90E-05	0.0993
00-DD-208	3.5	18.5	5A	74	94	2	0.0045	70	1.00E-06	6.00E-05	0.0864
00-DD-208	3.5	18.5	6A	59	79	1	0.0022	52	6.54E-07	3.92E-05	0.0565
00-DD-208	3.5	18.5	7A	44	64	0.6	0.0013	36	5.40E-07	3.24E-05	0.0467
00-DD-208	3.5	18.5	8A	29	49	2	0.0045	14	3.73E-06	2.24E-04	0.3226
00-DD-208	3.5	18.5	8B	29	49	3	0.0067	30	3.14E-06	1.89E-04	0.2717
00-DD-209	3.6	19.8	1A	164	180	1.7	0.0038	80	8.92E-07	5.35E-05	0.0771

Borehole	Gage Height	Static Water Level	Test ID	Interval		Discharge (Q)		Gage Pressure (psi)	Hydraulic Conductivity (K)		
				Top	Bottom	Q (gpm)	Q (ft3/sec)		K (ft/sec)	K (ft/min)	K (ft/day)
00-DD-209	3.6	19.8	1B	164	180	1	0.0022	40	9.71E-07	5.83E-05	0.0839
00-DD-209	3.6	19.8	2A	149	169	24.8	0.0553	16	4.19E-05	2.51E-03	3.6172
00-DD-209	3.6	19.8	2B	149	169	14.8	0.0330	8	3.82E-05	2.29E-03	3.2980
00-DD-209	3.6	19.8	3A	134	154	24.6	0.0549	42	1.93E-05	1.16E-03	1.6702
00-DD-209	3.6	19.8	3B	134	154	15.8	0.0352	22	2.10E-05	1.26E-03	1.8117
00-DD-209	3.6	19.8	4A	119	139	12.2	0.0272	42	9.55E-06	5.73E-04	0.8254
00-DD-209	3.6	19.8	4B	119	139	6.2	0.0138	20	8.81E-06	5.28E-04	0.7608
00-DD-209	3.6	19.8	5A	104	124	0.4	0.0009	92	1.54E-07	9.27E-06	0.0133
00-DD-209	3.6	19.8	6A	89	109	2.4	0.0054	74	1.13E-06	6.80E-05	0.0979
00-DD-209	3.6	19.8	6B	89	109	1.2	0.0027	36	1.07E-06	6.40E-05	0.0922
00-DD-209	3.6	19.8	7A	74	94	2.2	0.0049	62	1.22E-06	7.31E-05	0.1053
00-DD-209	3.6	19.8	7B	74	94	1.2	0.0027	30	1.24E-06	7.44E-05	0.1071
00-DD-209	3.6	19.8	8A	59	79	1.2	0.0027	50	8.07E-07	4.84E-05	0.0697
00-DD-209	3.6	19.8	8B	59	79	0.8	0.0018	26	9.27E-07	5.56E-05	0.0801
00-DD-209	3.6	19.8	9A	44	64	11.2	0.0250	38	9.54E-06	5.73E-04	0.8245
00-DD-209	3.6	19.8	9B	44	64	6.4	0.0143	20	9.09E-06	5.45E-04	0.7853
00-DD-209	3.6	19.8	10A	29	49	13	0.0290	40	1.06E-05	6.37E-04	0.9169
00-DD-209	3.6	19.8	10B	29	49	5.8	0.0129	20	8.24E-06	4.94E-04	0.7115
00-DD-209	3.6	19.8	11A	14	34	2.6	0.0058	40	2.12E-06	1.27E-04	0.1828
00-DD-209	3.6	19.8	11B	14	34	1.4	0.0031	20	1.98E-06	1.19E-04	0.1713
00-DD-210	3.7	23.5	1A	185	200	25.8	0.0575	28	3.36E-05	2.02E-03	2.9051
00-DD-210	3.7	23.5	1B	185	200	16.2	0.0361	14	3.41E-05	2.05E-03	2.9459
00-DD-210	3.7	23.5	2A	170	190	20.2	0.0450	10	4.23E-05	2.54E-03	3.6536
00-DD-210	3.7	23.5	2B	170	190	27.8	0.0620	20	3.79E-05	2.27E-03	3.2752
00-DD-210	3.7	23.5	3A	155	175	14.2	0.0317	28	1.49E-05	8.96E-04	1.2899
00-DD-210	3.7	23.5	3B	155	175	25	0.0558	56	1.49E-05	8.94E-04	1.2871
00-DD-210	3.7	23.5	4A	140	160	13.8	0.0308	18	2.00E-05	1.20E-03	1.7284
00-DD-210	3.7	23.5	4B	140	160	22.4	0.0500	36	1.94E-05	1.16E-03	1.6728
00-DD-210	3.7	23.5	5A	125	145	8.4	0.0187	30	8.35E-06	5.01E-04	0.7217
00-DD-210	3.7	23.5	5B	125	145	16.8	0.0375	60	9.40E-06	5.64E-04	0.8123
00-DD-210	3.7	23.5	6A	110	130	3.6	0.0080	66	1.85E-06	1.11E-04	0.1595
00-DD-210	3.7	23.5	6B	110	130	12	0.0268	33	1.11E-05	6.65E-04	0.9579
00-DD-210	3.7	23.5	7A	95	115	5.2	0.0116	76	2.35E-06	1.41E-04	0.2033
00-DD-210	3.7	23.5	7B	95	115	2	0.0045	38	1.65E-06	9.92E-05	0.1428

Borehole	Gage Height	Static Water Level	Test ID	Interval		Discharge (Q)		Gage Pressure	Hydraulic Conductivity (K)		
				Top	Bottom	Q (gpm)	Q (ft3/sec)	(psi)	K (ft/sec)	K (ft/min)	K (ft/day)
00-DD-210	3.7	23.5	8A	80	100	10.6	0.0236	60	5.93E-06	3.56E-04	0.5120
00-DD-210	3.7	23.5	8B	80	100	5.6	0.0125	30	5.56E-06	3.34E-04	0.4807
00-DD-210	3.7	23.5	9A	65	85	10.4	0.0232	58	5.99E-06	3.59E-04	0.5175
00-DD-210	3.7	23.5	9B	65	85	6.8	0.0152	29	6.94E-06	4.16E-04	0.5995
00-DD-210	3.7	23.5	10A	50	70	0.6	0.0013	50	3.92E-07	2.35E-05	0.0338
00-DD-210	3.7	23.5	10B	50	70	0.2	0.0004	25	2.28E-07	1.37E-05	0.0197
00-DD-210	3.7	23.5	11A	35	55	10.2	0.0227	30	1.02E-05	6.09E-04	0.8777
00-DD-210	3.7	23.5	11B	35	55	3.2	0.0071	15	5.19E-06	3.11E-04	0.4483
00-DD-210	3.7	23.5	12A	20	40	0.4	0.0009	40	3.15E-07	1.89E-05	0.0272
00-DD-210	3.7	23.5	12B	20	40	0	0.0000	20	0.00E+00	0.00E+00	0.0000
00-DD-211	3.7	11.15	1A	125	140	13.7	0.0306	42	1.43E-05	8.57E-04	1.2338
00-DD-211	3.7	11.15	1B	125	140	9	0.0201	20	1.83E-05	1.10E-03	1.5793
00-DD-211	3.7	11.15	2A	110	130	6.8	0.0152	62	3.99E-06	2.39E-04	0.3446
00-DD-211	3.7	11.15	2B	110	130	4	0.0089	30	4.60E-06	2.76E-04	0.3977
00-DD-211	3.7	11.15	3A	95	115	5.8	0.0129	66	3.21E-06	1.92E-04	0.2769
00-DD-211	3.7	11.15	3B	95	115	3.9	0.0087	33	4.12E-06	2.47E-04	0.3556
00-DD-211	3.7	11.15	4A	80	100	3	0.0067	80	1.38E-06	8.27E-05	0.1191
00-DD-211	3.7	11.15	4B	80	100	1.4	0.0031	40	1.24E-06	7.43E-05	0.1070
00-DD-211	3.7	11.15	5A	65	85	13.2	0.0294	40	1.17E-05	7.02E-04	1.0106
00-DD-211	3.7	11.15	5B	65	85	7.6	0.0169	20	1.25E-05	7.52E-04	1.0827
00-DD-211	3.7	11.15	6A	50	70	15	0.0335	36	1.47E-05	8.79E-04	1.2658
00-DD-211	3.7	11.15	6B	50	70	9.2	0.0205	18	1.66E-05	9.97E-04	1.4354
00-DD-212	3.7	16.5	1A	140	155	6	0.0134	60	4.39E-06	2.63E-04	0.3792
00-DD-212	3.7	16.5	1B	140	155	3.4	0.0076	30	4.50E-06	2.70E-04	0.3889
00-DD-212	3.7	16.5	2A	125	145	9.8	0.0219	62	5.55E-06	3.33E-04	0.4798
00-DD-212	3.7	16.5	2B	125	145	4.8	0.0107	30	5.17E-06	3.10E-04	0.4468
00-DD-212	3.7	16.5	3A	110	130	3.8	0.0085	60	2.22E-06	1.33E-04	0.1915
00-DD-212	3.7	16.5	3B	110	130	2.6	0.0058	30	2.80E-06	1.68E-04	0.2416
00-DD-212	3.7	16.5	4A	95	115	5.6	0.0125	62	3.17E-06	1.90E-04	0.2741
00-DD-212	3.7	16.5	4B	95	115	3	0.0067	31	3.14E-06	1.88E-04	0.2712
00-DD-212	3.7	16.5	5A	80	100	1.6	0.0036	60	9.33E-07	5.60E-05	0.0806
00-DD-212	3.7	16.5	5B	80	100	0.8	0.0018	30	8.61E-07	5.16E-05	0.0743
00-DD-212	3.7	16.5	6A	65	85	4.6	0.0103	56	2.86E-06	1.72E-04	0.2471
00-DD-212	3.7	16.5	6B	65	85	1	0.0022	28	1.14E-06	6.84E-05	0.0985

Borehole	Gage Height	Static Water Level	Test ID	Interval		Discharge (Q)		Gage Pressure (psi)	Hydraulic Conductivity (K)		
				Top	Bottom	Q (gpm)	Q (ft3/sec)		K (ft/sec)	K (ft/min)	K (ft/day)
00-DD-212	3.7	16.5	7A	50	70	5.6	0.0125	34	5.42E-06	3.25E-04	0.4685
00-DD-212	3.7	16.5	7B	50	70	3.2	0.0071	17	5.43E-06	3.26E-04	0.4688
00-DD-212	3.7	16.5	8A	35	55	5.2	0.0116	40	4.37E-06	2.62E-04	0.3777
00-DD-212	3.7	16.5	8B	35	55	3.6	0.0080	20	5.39E-06	3.23E-04	0.4655
00-DD-213	3.7	3.36	1A	130	145	5.8	0.0129	76	3.60E-06	2.16E-04	0.3109
00-DD-213	3.7	3.36	1B	130	145	0.8	0.0018	38	9.95E-07	5.97E-05	0.0859
00-DD-213	3.7	3.36	2A	115	135	2.4	0.0054	72	1.28E-06	7.66E-05	0.1103
00-DD-213	3.7	3.36	2B	115	135	0.8	0.0018	36	8.53E-07	5.12E-05	0.0737
00-DD-213	3.7	3.36	3A	100	120	4.2	0.0094	90	1.79E-06	1.07E-04	0.1544
00-DD-213	3.7	3.36	3B	100	120	2.2	0.0049	45	1.88E-06	1.13E-04	0.1620
00-DD-213	3.7	3.36	4A	85	105	1	0.0022	72	5.32E-07	3.19E-05	0.0460
00-DD-213	3.7	3.36	4B	85	105	0.4	0.0009	36	4.27E-07	2.56E-05	0.0369
00-DD-213	3.7	3.36	5A	70	90	0.6	0.0013	60	3.83E-07	2.30E-05	0.0331
00-DD-213	3.7	3.36	5B	70	90	0.4	0.0009	30	5.12E-07	3.07E-05	0.0443
00-DD-213	3.7	3.36	6A	55	75	1	0.0022	56	6.85E-07	4.11E-05	0.0591
00-DD-213	3.7	3.36	6B	55	75	0.4	0.0009	68	2.25E-07	1.35E-05	0.0195
00-DD-213	3.7	3.36	7A	40	60	5.8	0.0129	34	6.55E-06	3.93E-04	0.5660
00-DD-213	3.7	3.36	7B	40	60	3.2	0.0071	17	7.26E-06	4.36E-04	0.6273
00-DD-213	3.7	3.36	8A	25	45	3.5	0.0078	52	2.58E-06	1.55E-04	0.2230
00-DD-213	3.7	3.36	8B	25	45	2.6	0.0058	26	3.85E-06	2.31E-04	0.3322
00-DD-213	3.7	3.36	9A	10	30	2.6	0.0058	36	2.77E-06	1.66E-04	0.2396
00-DD-213	3.7	3.36	9B	10	30	1.4	0.0031	18	3.00E-06	1.80E-04	0.2591
00-DD-214	3.8	1.2	1A	155	170	21.4	0.0477	16	6.75E-05	4.05E-03	5.8295
00-DD-214	3.8	1.2	1B	155	170	19.3	0.0430	12	8.31E-05	4.99E-03	7.1828
00-DD-214	3.8	1.2	2A	140	160	23.6	0.0526	20	4.77E-05	2.86E-03	4.1175
00-DD-214	3.8	1.2	2B	140	160	12.4	0.0277	10	5.32E-05	3.19E-03	4.5984
00-DD-214	3.8	1.2	3A	125	145	1	0.0022	42	9.35E-07	5.61E-05	0.0808
00-DD-214	3.8	1.2	3B	125	145	0	0.0000	20	0.00E+00	0.00E+00	0.0000
00-DD-214	3.8	1.2	4A	110	130	1.6	0.0036	60	1.04E-06	6.23E-05	0.0898
00-DD-214	3.8	1.2	4B	110	130	0.6	0.0013	30	7.94E-07	4.77E-05	0.0686
00-DD-214	3.8	1.2	5A	95	115	1.6	0.0036	50	1.25E-06	7.51E-05	0.1081
00-DD-214	3.8	1.2	5B	95	115	1	0.0022	25	1.60E-06	9.61E-05	0.1383
00-DD-214	3.8	1.2	6A	80	100	2	0.0045	40	1.97E-06	1.18E-04	0.1699
00-DD-214	3.8	1.2	6B	80	100	1	0.0022	20	2.03E-06	1.22E-04	0.1750

Borehole	Gage Height	Static Water Level	Test ID	Interval		Discharge (Q)		Gage Pressure	Hydraulic Conductivity (K)		
				Top	Bottom	Q (gpm)	Q (ft3/sec)	(psi)	K (ft/sec)	K (ft/min)	K (ft/day)
00-DD-214	3.8	1.2	7A	65	85	2.2	0.0049	62	1.38E-06	8.29E-05	0.1194
00-DD-214	3.8	1.2	7B	65	85	1	0.0022	30	1.32E-06	7.94E-05	0.1143
00-DD-214	3.8	1.2	8A	50	70	25.2	0.0562	16	6.45E-05	3.87E-03	5.5737
00-DD-214	3.8	1.2	8B	50	70	19	0.0424	10	8.15E-05	4.89E-03	7.0416
00-DD-214	3.8	1.2	8C	50	70	11.2	0.0250	47	9.33E-06	5.60E-04	0.8060
00-DD-214	3.8	1.2	8D	50	70	2.6	0.0058	22	4.76E-06	2.86E-04	0.4113
00-DD-214	3.8	1.2	9A	35	55	8	0.0178	32	9.90E-06	5.94E-04	0.8554
00-DD-214	3.8	1.2	9B	35	55	3.4	0.0076	18	7.70E-06	4.62E-04	0.6654
00-DD-214	3.8	1.2	10A	20	40	22.6	0.0504	22	4.13E-05	2.48E-03	3.5664
00-DD-214	3.8	1.2	10B	20	40	10.8	0.0241	8	5.98E-05	3.59E-03	5.1696
00-DD-214	3.8	1.2	11A	10	30	25.3	0.0564	22	4.62E-05	2.77E-03	3.9922
00-DD-214	3.8	1.2	11B	10	30	18.1	0.0404	10	7.76E-05	4.66E-03	6.7089
00-DD-214	3.8	1.2	11C	10	30	18.2	0.0406	10	7.81E-05	4.68E-03	6.7459
00-DD-216	3.7	5.65	1A	130	145	24.4	0.0544	30	3.73E-05	2.24E-03	3.2208
00-DD-216	3.7	5.65	1B	130	145	15	0.0335	15	4.46E-05	2.68E-03	3.8541
00-DD-216	3.7	5.65	2A	115	135	25	0.0558	30	3.10E-05	1.86E-03	2.6813
00-DD-216	3.7	5.65	2B	115	135	24.2	0.0540	30	3.00E-05	1.80E-03	2.5955
00-DD-216	3.7	5.65	2C	115	135	15	0.0335	15			0.0000
00-DD-216	3.7	5.65	3A	100	120	4.8	0.0335	66	8.58E-06	5.15E-04	0.7414
00-DD-216	3.7	5.65	3B	100	120	2	0.0107	33	5.43E-06	3.26E-04	0.4689
00-DD-216	3.7	5.65	4A	85	105	3.6	0.0045	50	1.50E-06	9.02E-05	0.1299
00-DD-216	3.7	5.65	4B	85	105	2	0.0080	25	5.33E-06	3.20E-04	0.4602
00-DD-216	3.7	5.65	5A	70	90	24.2	0.0045	42	1.79E-06	1.07E-04	0.1544
00-DD-216	3.7	5.65	5B	70	90	15.2	0.0540	22	4.05E-05	2.43E-03	3.5027
00-DD-216	3.7	5.65	6A	55	75	0.6	0.0339	50	1.14E-05	6.86E-04	0.9876
00-DD-216	3.7	5.65	6B	55	75	0	0.0013	25	8.88E-07	5.33E-05	0.0767
00-DD-216	3.7	5.65	7A	40	60	2.8	0.0000	32	0.00E+00	0.00E+00	0.0000
00-DD-216	3.7	5.65	7B	40	60	1.6	0.0062	16	6.36E-06	3.81E-04	0.5491
00-DD-217	3.7	38.2	1A	135	150	5	0.0112	60	3.20E-06	1.92E-04	0.2762
00-DD-217	3.7	38.2	1B	135	150	3.2	0.0071	30	3.35E-06	2.01E-04	0.2894
00-DD-217	3.7	38.2	2A	120	140	5	0.0112	58	2.67E-06	1.60E-04	0.2307
00-DD-217	3.7	38.2	2B	120	140	3.2	0.0071	29	2.78E-06	1.67E-04	0.2405
00-DD-217	3.7	38.2	3A	105	125	5.4	0.0120	80	2.21E-06	1.32E-04	0.1907
00-DD-217	3.7	38.2	3B	105	125	0.6	0.0013	40	4.17E-07	2.50E-05	0.0361

Borehole	Gage Height	Static Water Level	Test ID	Interval		Discharge (Q)		Gage Pressure	Hydraulic Conductivity (K)		
				Top	Bottom	Q (gpm)	Q (ft3/sec)	(psi)	K (ft/sec)	K (ft/min)	K (ft/day)
00-DD-217	3.7	38.2	4A	90	110	5.8	0.0129	88	2.16E-06	1.29E-04	0.1864
00-DD-217	3.7	38.2	4B	90	110	1	0.0022	44	6.49E-07	3.89E-05	0.0560
00-DD-217	3.7	38.2	5A	75	95	2.2	0.0049	74	9.46E-07	5.67E-05	0.0817
00-DD-217	3.7	38.2	5B	75	95	0.8	0.0018	37	5.89E-07	3.53E-05	0.0509
00-DD-217	3.7	38.2	6A	60	80	7.8	0.0174	54	4.34E-06	2.60E-04	0.3748
00-DD-217	3.7	38.2	6B	60	80	4.2	0.0094	27	3.94E-06	2.36E-04	0.3404
00-DD-217	3.7	38.2	7A	45	65	7.6	0.0169	44	4.95E-06	2.97E-04	0.4273
00-DD-217	3.7	38.2	7B	45	65	4.8	0.0107	24	4.74E-06	2.84E-04	0.4091
00-DD-217	3.7	38.2	8A	30	50	6.6	0.0147	34	5.17E-06	3.10E-04	0.4469
00-DD-217	3.7	38.2	8B	30	50	5	0.0112	27	4.71E-06	2.82E-04	0.4068
00-DD-217	3.7	38.2	9A	15	35	20	0.0446	34	1.70E-05	1.02E-03	1.4716
00-DD-217	3.7	38.2	9B	15	35	9	0.0201	17	1.22E-05	7.33E-04	1.0556
00-DD-218	3.8	32.7	1A	135	150	7.3	0.0163	80	3.72E-06	2.23E-04	0.3213
00-DD-218	3.8	32.7	1B	135	150	4.2	0.0094	40	3.77E-06	2.26E-04	0.3258
00-DD-218	3.8	32.7	2A	120	140	2.4	0.0054	80	9.93E-07	5.96E-05	0.0858
00-DD-218	3.8	32.7	2B	120	140	5	0.0112	40	3.65E-06	2.19E-04	0.3153
00-DD-218	3.8	32.7	3A	105	125	5	0.0112	70	2.32E-06	1.39E-04	0.2005
00-DD-218	3.8	32.7	3B	105	125	0	0.0000	35	0.00E+00	0.00E+00	0.0000
00-DD-218	3.8	32.7	4A	90	110	4	0.0089	80	1.65E-06	9.92E-05	0.1428
00-DD-218	3.8	32.7	4B	90	110	0.6	0.0013	40	4.37E-07	2.62E-05	0.0377
00-DD-218	3.8	32.7	5A	75	95	1.4	0.0031	72	6.33E-07	3.80E-05	0.0547
00-DD-218	3.8	32.7	5B	75	95	0.6	0.0013	36	4.73E-07	2.84E-05	0.0408
00-DD-218	3.8	32.7	6A	60	80	0.2	0.0004	60	1.05E-07	6.33E-06	0.0091
00-DD-218	3.8	32.7	6B	60	80	0	0.0000	30	0.00E+00	0.00E+00	0.0000
00-DD-218	3.8	32.7	7A	45	65	4.5	0.0100	40	3.28E-06	1.97E-04	0.2836
00-DD-218	3.8	32.7	7B	45	65	2.6	0.0058	20	3.06E-06	1.83E-04	0.2640
00-DD-218	3.8	32.7	8A	30	50	4.8	0.0107	32	4.13E-06	2.48E-04	0.3571
00-DD-218	3.8	32.7	8B	30	50	3	0.0067	16	4.02E-06	2.41E-04	0.3473
00-DD-218	3.8	32.7	9A	15	35	7.2	0.0161	30	6.50E-06	3.90E-04	0.5612
00-DD-218	3.8	32.7	9B	15	35	4.6	0.0103	18	5.79E-06	3.47E-04	0.4999
01-DD-222	0.3	14.74	1A	86	103	2.66	0.0059	70	1.39E-06	8.31E-05	0.1198
01-DD-222	0.3	14.74	1B	86	103	0.34	0.0008	34	3.35E-07	2.01E-05	0.0290
01-DD-222	0.3	14.74	2A	73	90	0.84	0.0019	63	5.30E-07	3.18E-05	0.0458
01-DD-222	0.3	14.74	2B	73	90	0.18	0.0004	30	2.17E-07	1.30E-05	0.0187

Borehole	Gage Height	Static Water Level	Test ID	Interval		Discharge (Q)		Gage Pressure	Hydraulic Conductivity (K)		
				Top	Bottom	Q (gpm)	Q (ft3/sec)	(psi)	K (ft/sec)	K (ft/min)	K (ft/day)
01-DD-222	0.3	14.74	3A	61	77	7.4	0.0165	53	5.47E-06	3.28E-04	0.4727
01-DD-222	0.3	14.74	3B	61	77	3.14	0.0070	30	3.78E-06	2.27E-04	0.3277
01-DD-222	0.3	14.74	4A	49	65	8.34	0.0186	40	7.91E-06	4.75E-04	0.6833
01-DD-222	0.3	14.74	4B	49	65	6.62	0.0148	30	8.01E-06	4.80E-04	0.6918
01-DD-222	0.3	14.74	4C	49	65	6.56	0.0146	30	7.93E-06	4.76E-04	0.6855
01-DD-222	0.3	14.74	5A	36	53	5.74	0.0128	30	6.94E-06	4.16E-04	0.5997
01-DD-222	0.3	14.74	5B	36	53	6.62	0.0148	35	7.03E-06	4.22E-04	0.6077
01-DD-222	0.3	14.74	6A	24	41	1.13	0.0025	30	1.36E-06	8.17E-05	0.1178
01-DD-222	0.3	14.74	6B	24	41	1.056	0.0024	30	1.27E-06	7.64E-05	0.1101
01-DD-222	0.3	14.74	7A	12	28	0	0.0000	30	0.00E+00	0.00E+00	0.0000
01-DD-222	0.3	14.74	7B	12	28	0.02	0.0000	32	2.28E-08	1.37E-06	0.0020
01-DD-222	0.3	14.74	7C	12	28	0.22	0.0005	30	2.65E-07	1.59E-05	0.0229
01-DD-223	0.3	-2	1A	111	131	6.78	0.0151	90	2.75E-06	1.65E-04	0.2375
01-DD-223	0.3	-2	1B	111	131	3.56	0.0079	45	2.91E-06	1.75E-04	0.2515
01-DD-223	0.3	-2	2A	96	116	1.56	0.0035	75	8.03E-07	4.82E-05	0.0694
01-DD-223	0.3	-2	2B	96	116	0.79	0.0018	35	8.82E-07	5.29E-05	0.0762
01-DD-223	0.3	-2	3A	81	101	0.72	0.0016	65	4.28E-07	2.57E-05	0.0370
01-DD-223	0.3	-2	3B	81	101	0.24	0.0005	35	2.68E-07	1.61E-05	0.0231
01-DD-223	0.3	-2	4A	66	86	0.62	0.0014	55	4.37E-07	2.62E-05	0.0377
01-DD-223	0.3	-2	4B	66	86	0.32	0.0007	30	4.18E-07	2.51E-05	0.0361
01-DD-223	0.3	-2	5A	44	64	10.16	0.0227	35	1.13E-05	6.80E-04	0.9789
01-DD-223	0.3	-2	5B	44	64	7.1	0.0158	30	9.27E-06	5.56E-04	0.8011
01-DD-223	0.3	-2	6A	31	51	6.06	0.0135	30	7.91E-06	4.75E-04	0.6838
01-DD-223	0.3	-2	6B	31	51	5.8	0.0129	30	7.57E-06	4.54E-04	0.6545
01-DD-223	0.3	-2	7A	16	36	5.66	0.0126	30	7.39E-06	4.44E-04	0.6387
01-DD-223	0.3	-2	7B	16	36	5.8	0.0129	30	7.57E-06	4.54E-04	0.6545
01-DD-224	0.3	28.32	1A	109	122	1.57	0.0035	90	8.39E-07	5.03E-05	0.0725
01-DD-224	0.3	28.32	1B	109	122	1.1	0.0025	45	1.03E-06	6.17E-05	0.0888
01-DD-224	0.3	28.32	2A	97	113	1.88	0.0042	80	9.31E-07	5.59E-05	0.0804
01-DD-224	0.3	28.32	2B	97	113	1.32	0.0029	40	1.13E-06	6.77E-05	0.0975
01-DD-224	0.3	28.32	3A	85	101	0.76	0.0017	70	4.21E-07	2.52E-05	0.0363
01-DD-224	0.3	28.32	3B	85	101	0.62	0.0014	35	5.83E-07	3.50E-05	0.0504
01-DD-224	0.3	28.32	4A	73	89	2.1	0.0047	60	1.32E-06	7.90E-05	0.1138
01-DD-224	0.3	28.32	4B	73	89	1.16	0.0026	30	1.21E-06	7.27E-05	0.1047

Borehole	Gage Height	Static Water Level	Test ID	Interval		Discharge (Q)		Gage Pressure	Hydraulic Conductivity (K)		
				Top	Bottom	Q (gpm)	Q (ft3/sec)	(psi)	K (ft/sec)	K (ft/min)	K (ft/day)
01-DD-224	0.3	28.32	5A	61	77	1.26	0.0028	50	9.12E-07	5.47E-05	0.0788
01-DD-224	0.3	28.32	5B	61	77	0.72	0.0016	30	7.52E-07	4.51E-05	0.0650
01-DD-224	0.3	28.32	6A	49	65	11.1	0.0248	40	9.58E-06	5.75E-04	0.8281
01-DD-224	0.3	28.32	6B	49	65	8.98	0.0200	30	9.47E-06	5.68E-04	0.8186
01-DD-224	0.3	28.32	7A	36	53	14.54	0.0324	30	1.54E-05	9.27E-04	1.3349
01-DD-224	0.3	28.32	7B	36	53	16.16	0.0360	30	1.72E-05	1.03E-03	1.4866
01-DD-224	0.3	28.32	8A	24	40	19.2	0.0428	30	2.06E-05	1.23E-03	1.7772
01-DD-224	0.3	28.32	8B	24	40	18.84	0.0420	30	2.02E-05	1.21E-03	1.7421
01-DD-224	0.3	28.32	9A	12	28	13.86	0.0309	30	1.60E-05	9.59E-04	1.3811
01-DD-224	0.3	28.32	9B	12	28	12.9	0.0288	30	1.49E-05	8.91E-04	1.2831
01-DD-225	0.3	2.68	1A	102	115	3.78	0.0084	85	2.46E-06	1.47E-04	0.2122
01-DD-225	0.3	2.68	1B	102	115	1.82	0.0041	45	2.20E-06	1.32E-04	0.1903
01-DD-225	0.3	2.68	2A	91	106	6.3	0.0140	75	3.97E-06	2.38E-04	0.3434
01-DD-225	0.3	2.68	2B	91	106	3.02	0.0067	35	4.00E-06	2.40E-04	0.3454
01-DD-225	0.3	2.68	3A	79	95	1.52	0.0034	70	1.03E-06	6.15E-05	0.0886
01-DD-225	0.3	2.68	3B	79	95	0.84	0.0019	35	1.11E-06	6.67E-05	0.0961
01-DD-225	0.3	2.68	4A	68	83	0.44	0.0010	55	3.76E-07	2.26E-05	0.0325
01-DD-225	0.3	2.68	4B	68	83	0.14	0.0003	30	2.15E-07	1.29E-05	0.0186
01-DD-225	0.3	2.68	5A	56	72	0	0.0000	45	0.00E+00	0.00E+00	0.0000
01-DD-225	0.3	2.68	5B	56	72	0	0.0000	30	0.00E+00	0.00E+00	0.0000
01-DD-225	0.3	2.68	6A	45	60	0	0.0000	35	0.00E+00	0.00E+00	0.0000
01-DD-225	0.3	2.68	6B	45	60	-0.1	-0.0002	30	---	---	---
01-DD-225	0.3	2.68	6C	45	60	0	0.0000	35	0.00E+00	0.00E+00	0.0000
01-DD-225	0.3	2.68	6D	45	60	-0.02	0.0000	30	---	---	---
01-DD-225	0.3	2.68	7A	33	49	0.18	0.0004	30	2.76E-07	1.66E-05	0.0239
01-DD-225	0.3	2.68	7B	33	49	0.12	0.0003	30	1.84E-07	1.11E-05	0.0159
01-DD-225	0.3	2.68	8A	22	37	0.02	0.0000	30	3.07E-08	1.84E-06	0.0027
01-DD-225	0.3	2.68	8B	22	37	0	0.0000	30	0.00E+00	0.00E+00	0.0000
01-DD-225	0.3	2.68	9A	10	26	0.28	0.0006	30	4.30E-07	2.58E-05	0.0371
01-DD-225	0.3	2.68	9B	10	26	0.22	0.0005	30	3.38E-07	2.03E-05	0.0292
01-DD-226	0.3	5.11	1A	126	143	21.02	0.0469	60	1.37E-05	8.21E-04	1.1823
01-DD-226	0.3	5.11	1B	126	143	20.8	0.0464	50	1.61E-05	9.68E-04	1.3938
01-DD-226	0.3	5.11	2A	113	130	25	0.0558	60	1.64E-05	9.84E-04	1.4170
01-DD-226	0.3	5.11	2B	113	130	21.86	0.0487	45	1.89E-05	1.13E-03	1.6314

Borehole	Gage Height	Static Water Level	Test ID	Interval		Discharge (Q)		Gage Pressure (psi)	Hydraulic Conductivity (K)		
				Top	Bottom	Q (gpm)	Q (ft3/sec)		K (ft/sec)	K (ft/min)	K (ft/day)
01-DD-226	0.3	5.11	3A	100	117	17.8	0.0397	80	8.82E-06	5.29E-04	0.7624
01-DD-226	0.3	5.11	3B	100	117	8.46	0.0189	40	8.15E-06	4.89E-04	0.7038
01-DD-226	0.3	5.11	4A	87	104	15.3	0.0341	70	8.63E-06	5.18E-04	0.7457
01-DD-226	0.3	5.11	4B	87	104	6.82	0.0152	35	7.44E-06	4.47E-04	0.6430
01-DD-226	0.3	5.11	5A	74	91	1.8	0.0040	60	1.18E-06	7.06E-05	0.1016
01-DD-226	0.3	5.11	5B	74	91	1	0.0022	30	1.26E-06	7.55E-05	0.1087
01-DD-226	0.3	5.11	6A	61	78	5.04	0.0112	50	3.92E-06	2.35E-04	0.3390
01-DD-226	0.3	5.11	6B	61	78	2.66	0.0059	30	3.35E-06	2.01E-04	0.2891
01-DD-226	0.3	5.11	7A	48	65	5.7	0.0127	40	5.49E-06	3.29E-04	0.4739
01-DD-226	0.3	5.11	7B	48	65	4.64	0.0103	30	5.84E-06	3.50E-04	0.5042
01-DD-226	0.3	5.11	8A	35	52	0.86	0.0019	30	1.08E-06	6.49E-05	0.0935
01-DD-226	0.3	5.11	8B	35	52	0.78	0.0017	30	9.81E-07	5.89E-05	0.0848
01-DD-226	0.3	5.11	9A	22	39	1.24	0.0028	30	1.56E-06	9.36E-05	0.1348
01-DD-226	0.3	5.11	9B	22	39	1.08	0.0024	30	1.36E-06	8.15E-05	0.1174
01-DD-228	0.3	112	1A	147	165	22.1	0.0493	120	5.42E-06	3.25E-04	0.4683
01-DD-228	0.3	112	1B	147	165	7.4	0.0165	60	2.78E-06	1.67E-04	0.2398
01-DD-228	0.3	112	2A	132	152	6.08	0.0136	105	1.52E-06	9.15E-05	0.1317
01-DD-228	0.3	112	2B	132	152	1.92	0.0043	55	7.10E-07	4.26E-05	0.0613
01-DD-228	0.3	112	3A	117	137	2.46	0.0055	90	6.80E-07	4.08E-05	0.0587
01-DD-228	0.3	112	3B	117	137	1.06	0.0024	45	4.34E-07	2.60E-05	0.0375
01-DD-228	0.3	112	4A	102	122	0.04	0.0001	80	1.19E-08	7.15E-07	0.0010
01-DD-228	0.3	112	4B	102	122	0	0.0000	40	0.00E+00	0.00E+00	0.0000
01-DD-228	0.3	112	5A	87	107	0.84	0.0019	70	2.79E-07	1.67E-05	0.0241
01-DD-228	0.3	112	5B	87	107	0.46	0.0010	35	2.19E-07	1.31E-05	0.0189
01-DD-228	0.3	112	6A	72	92	0.16	0.0004	60	5.64E-08	3.38E-06	0.0049
01-DD-228	0.3	112	6B	72	92	0.1	0.0002	30	4.87E-08	2.92E-06	0.0042
01-DD-228	0.3	112	7A	57	77	0.12	0.0003	45	4.74E-08	2.84E-06	0.0041
01-DD-228	0.3	112	7B	57	77	0.08	0.0002	30	3.74E-08	2.24E-06	0.0032
01-DD-228	0.3	112	8A	42	62	2.08	0.0046	35	8.83E-07	5.30E-05	0.0763
01-DD-228	0.3	112	8B	42	62	1.96	0.0044	30	8.81E-07	5.29E-05	0.0762
01-DD-228	0.3	112	9A	27	47	17.2	0.0384	30	7.72E-06	4.63E-04	0.6671
01-DD-228	0.3	112	9B	27	47	17.52	0.0391	30	7.86E-06	4.72E-04	0.6795
01-DD-230	0.3	8.13	1A	66	78	5.8	0.0129	55	5.71E-06	3.43E-04	0.4933
01-DD-230	0.3	8.13	1B	66	78	3.88	0.0087	30	6.55E-06	3.93E-04	0.5658

Borehole	Gage Height	Static Water Level	Test ID	Interval		Discharge (Q)		Gage Pressure (psi)	Hydraulic Conductivity (K)		
				Top	Bottom	Q (gpm)	Q (ft3/sec)		K (ft/sec)	K (ft/min)	K (ft/day)
01-DD-230	0.3	8.13	2A	56	70	4.32	0.0096	45	4.25E-06	2.55E-04	0.3670
01-DD-230	0.3	8.13	2B	56	70	3.5	0.0078	30	4.91E-06	2.95E-04	0.4246
01-DD-230	0.3	8.13	3A	45	59	1.14	0.0025	35	1.40E-06	8.41E-05	0.1211
01-DD-230	0.3	8.13	3B	45	59	0.98	0.0022	30	1.38E-06	8.26E-05	0.1190
03-DD-231	11.2	16.3	1A	129	148	17.2	0.0383	38	1.32E-05	7.91E-04	1.1392
03-DD-231	11.2	16.3	3A	99	119	16.4	0.0365	39	1.23E-05	7.38E-04	1.0621
03-DD-231	11.2	16.3	4B	84	104	16	0.0356	35	1.30E-05	7.82E-04	1.1254
03-DD-231	11.2	16.3	5B	69	89	14.4	0.0321	30	1.31E-05	7.87E-04	1.1335
03-DD-231	11.2	16.3	6A	54	74	3.3	0.0074	45	2.18E-06	1.31E-04	0.1884
03-DD-231	11.2	16.3	6B	54	74	1.7	0.0038	25	1.73E-06	1.04E-04	0.1496
03-DD-231	11.2	16.3	7A	39	59	1	0.0022	30	8.97E-07	5.38E-05	0.0775
03-DD-231	11.2	16.3	7B	39	59	-4.6	-0.0102	0	-1.47E-05	-8.82E-04	1.2707
03-DD-231	11.2	16.3	8A	24	44	1.94	0.0043	20	2.29E-06	1.37E-04	0.1975
03-DD-231	11.2	16.3	8B	24	44	0.7	0.0016	10	1.20E-06	7.21E-05	0.1038
03-DD-232	14.6	7.5	1A	135	156	11	0.0245	70	4.88E-06	2.93E-04	0.4214
03-DD-232	14.6	7.5	1B	135	156	9.38	0.0209	55	5.13E-06	3.08E-04	0.4431
03-DD-232	14.6	7.5	2A	120	140	10.22	0.0228	55	5.98E-06	3.59E-04	0.5171
03-DD-232	14.6	7.5	2B	120	140	8.64	0.0192	45	5.98E-06	3.59E-04	0.5167
03-DD-232	14.6	7.5	3A	105	125	10.24	0.0228	40	7.82E-06	4.69E-04	0.6759
03-DD-232	14.6	7.5	3B	105	125	1.38	0.0031	40	1.05E-06	6.28E-05	0.0905
03-DD-232	14.6	7.5	4A	90	110	10.1	0.0225	40	7.72E-06	4.63E-04	0.6667
03-DD-232	14.6	7.5	4B	90	110	8.8	0.0196	35	7.47E-06	4.48E-04	0.6450
03-DD-232	14.6	7.5	5A	75	95	2.3	0.0051	60	1.24E-06	7.46E-05	0.1074
03-DD-232	14.6	7.5	5B	75	95	1.08	0.0024	30	1.03E-06	6.16E-05	0.0887
03-DD-232	14.6	7.5	6A	60	80	1.68	0.0037	45	1.16E-06	6.95E-05	0.1000
03-DD-232	14.6	7.5	6B	60	80	1.36	0.0030	25	1.48E-06	8.88E-05	0.1278
03-DD-232	14.6	7.5	7A	45	65	8.48	0.0189	35	7.19E-06	4.32E-04	0.6214
03-DD-232	14.6	7.5	7B	45	65	6.5	0.0145	20	8.33E-06	5.00E-04	0.7195
03-DD-232	14.6	7.5	8A	30	50	4.04	0.0090	25	4.41E-06	2.65E-04	0.3810
03-DD-232	14.6	7.5	8B	30	50	2.82	0.0063	15	4.32E-06	2.59E-04	0.3729
03-DD-233	2.5	16.5	1A	142	163	0.14	0.0003	110	4.16E-08	2.50E-06	0.0036
03-DD-233	2.5	16.5	1B	142	163	0.06	0.0001	55	3.33E-08	2.00E-06	0.0029
03-DD-233	2.5	16.5	2A	127	147	0.84	0.0019	100	2.92E-07	1.75E-05	0.0252
03-DD-233	2.5	16.5	2B	127	147	0.36	0.0008	50	2.33E-07	1.40E-05	0.0201

Borehole	Gage Height	Static Water Level	Test ID	Interval		Discharge (Q)		Gage Pressure (psi)	Hydraulic Conductivity (K)		
				Top	Bottom	Q (gpm)	Q (ft3/sec)		K (ft/sec)	K (ft/min)	K (ft/day)
03-DD-233	2.5	16.5	3A	112	132	3.5	0.0078	90	1.34E-06	8.04E-05	0.1158
03-DD-233	2.5	16.5	3B	112	132	0.86	0.0019	45	6.08E-07	3.65E-05	0.0525
03-DD-233	2.5	16.5	4A	97	117	5.84	0.0130	80	2.49E-06	1.50E-04	0.2155
03-DD-233	2.5	16.5	4B	97	117	3.8	0.0085	40	2.96E-06	1.78E-04	0.2560
03-DD-233	2.5	16.5	5A	82	102	12.9	0.0287	65	6.66E-06	4.00E-04	0.5757
03-DD-233	2.5	16.5	5B	82	102	8.84	0.0197	35	7.73E-06	4.64E-04	0.6677
03-DD-233	2.5	16.5	6A	67	87	16.92	0.0377	40	1.33E-05	8.00E-04	1.1523
03-DD-233	2.5	16.5	6B	67	87	10.66	0.0238	20	1.44E-05	8.61E-04	1.2400
03-DD-233	2.5	16.5	7A	52	72	5.4	0.0120	40	4.23E-06	2.54E-04	0.3651
03-DD-233	2.5	16.5	7B	52	72	9.64	0.0215	20	1.30E-05	7.79E-04	1.1212
03-DD-233	2.5	16.5	8A	37	57	11.92	0.0266	30	1.18E-05	7.10E-04	1.0228
03-DD-233	2.5	16.5	8B	37	57	-0.34	-0.0008	20	-4.53E-07	-2.72E-05	-0.0391
03-DD-233	2.5	16.5	9A	22	42	9.6	0.0214	20	1.29E-05	7.75E-04	1.1165
03-DD-233	2.5	16.5	9B	22	42	4.64	0.0103	10	9.63E-06	5.78E-04	0.8323
03-DD-234	6.53	9	1A	93	107	0.2	0.0004	75	1.26E-07	7.54E-06	0.0109
03-DD-234	6.53	9	1B	93	107	0.1	0.0002	40	1.10E-07	6.59E-06	0.0095
03-DD-234	6.53	9	2A	78	98	-1.42	-0.0032	60	-8.00E-07	-4.80E-05	-0.0692
03-DD-234	6.53	9	2B	78	98	-3.18	-0.0071	30	-3.26E-06	-1.95E-04	-0.2814
03-DD-234	6.53	9	3A	63	83	0.86	0.0019	50	5.70E-07	3.42E-05	0.0493
03-DD-234	6.53	9	3B	63	83	0.38	0.0008	25	4.50E-07	2.70E-05	0.0389
03-DD-234	6.53	9	4A	48	68	-1.1	-0.0025	40	-8.85E-07	-5.31E-05	-0.0765
03-DD-234	6.53	9	4B	48	68	-5.1	-0.0114	20	-7.18E-06	-4.31E-04	-0.6200
03-DD-234	6.53	9	5A	33	53	0.88	0.0020	25	1.04E-06	6.26E-05	0.0901
03-DD-234	6.53	9	5B	33	53	-3.48	-0.0078	15	-6.02E-06	-3.61E-04	-0.5204
03-DD-235	2.5	5.5	1A	92	110	0.86	0.0019	75	4.75E-07	2.85E-05	0.0410
03-DD-235	2.5	5.5	1B	92	110	0.36	0.0008	35	4.06E-07	2.43E-05	0.0351
03-DD-235	2.5	5.5	2A	77	97	-1.16	-0.0026	60	-6.87E-07	-4.12E-05	-0.0594
03-DD-235	2.5	5.5	2B	77	97	-1.86	-0.0041	30	-2.09E-06	-1.25E-04	-0.1806
03-DD-235	2.5	5.5	3A	62	82	-1.52	-0.0034	50	-1.07E-06	-6.42E-05	-0.0924
03-DD-235	2.5	5.5	3B	62	82	-3.86	-0.0086	25	-5.10E-06	-3.06E-04	-0.4407
03-DD-235	2.5	5.5	4A	47	67	0.44	0.0010	40	3.81E-07	2.28E-05	0.0329
03-DD-235	2.5	5.5	4B	47	67	-1.86	-0.0041	20	-2.98E-06	-1.79E-04	-0.2576
03-DD-235	2.5	5.5	5A	32	52	-2.94	-0.0066	25	-3.88E-06	-2.33E-04	-0.3356
03-DD-235	2.5	5.5	5B	32	52	-1.98	-0.0044	15	-4.03E-06	-2.42E-04	-0.3484

Borehole	Gage Height	Static Water Level	Test ID	Interval		Discharge (Q)		Gage Pressure (psi)	Hydraulic Conductivity (K)		
				Top	Bottom	Q (gpm)	Q (ft3/sec)		K (ft/sec)	K (ft/min)	K (ft/day)
03-DD-236	2.5	9	1A	102	117	8.2	0.0183	75	5.06E-06	3.04E-04	0.4373
03-DD-236	2.5	9	1B	102	117	6.44	0.0143	40	7.07E-06	4.24E-04	0.6112
03-DD-236	2.5	9	2A	87	107	4.98	0.0111	70	2.50E-06	1.50E-04	0.2161
03-DD-236	2.5	9	2B	87	107	2.46	0.0055	35	2.31E-06	1.39E-04	0.1999
03-DD-236	2.5	9	3A	72	92	6.1	0.0136	60	3.54E-06	2.12E-04	0.3056
03-DD-236	2.5	9	3B	72	92	4.02	0.0090	30	4.33E-06	2.60E-04	0.3741
03-DD-236	2.5	9	4A	57	77	9.64	0.0215	45	7.28E-06	4.37E-04	0.6290
03-DD-236	2.5	9	4B	57	77	6.62	0.0147	25	8.34E-06	5.00E-04	0.7203
03-DD-236	2.5	9	5A	42	62	7.04	0.0157	35	6.64E-06	3.99E-04	0.5739
03-DD-236	2.5	9	5B	42	62	4.34	0.0097	20	6.55E-06	3.93E-04	0.5659
03-DD-236	2.5	9	6A	27	47	5	0.0111	20	7.55E-06	4.53E-04	0.6527
03-DD-236	2.5	9	6B	27	47	2.22	0.0049	10	5.57E-06	3.34E-04	0.4815
03-DD-237	14.7	11.6	2A	103	123	0.9	0.0020	80	3.61E-07	2.17E-05	0.0312
03-DD-237	14.7	11.6	2B	103	123	0.66	0.0015	40	4.71E-07	2.83E-05	0.0407
03-DD-237	14.7	11.6	3A	88	108	1.18	0.0026	70	5.45E-07	3.27E-05	0.0471
03-DD-237	14.7	11.6	3B	88	108	0.76	0.0017	35	6.16E-07	3.70E-05	0.0532
03-DD-237	14.7	11.6	4A	73	93	1.04	0.0023	60	5.48E-07	3.29E-05	0.0473
03-DD-237	14.7	11.6	4B	73	93	1.14	0.0025	30	1.04E-06	6.21E-05	0.0895
03-DD-237	14.7	11.6	5A	58	78	0.8	0.0018	45	5.34E-07	3.20E-05	0.0461
03-DD-237	14.7	11.6	5B	58	78	0.36	0.0008	25	3.72E-07	2.23E-05	0.0321
03-DD-237	14.7	11.6	6A	43	63	2.56	0.0057	35	2.08E-06	1.25E-04	0.1793
03-DD-237	14.7	11.6	6B	43	63	1.74	0.0039	20	2.08E-06	1.25E-04	0.1801
03-DD-237	14.7	11.6	7A	28	48	1.44	0.0032	20	1.72E-06	1.03E-04	0.1490
03-DD-237	14.7	11.6	7B	28	48	0.82	0.0018	10	1.44E-06	8.65E-05	0.1245
03-DD-238	15.1	2.9	1A	124	140	1.02	0.0023	95	4.74E-07	2.84E-05	0.0409
03-DD-238	15.1	2.9	1B	124	140	0.5	0.0011	50	4.13E-07	2.48E-05	0.0357
03-DD-238	15.1	2.9	2A	109	129	0.98	0.0022	85	3.97E-07	2.38E-05	0.0343
03-DD-238	15.1	2.9	2B	109	129	0.62	0.0014	45	4.42E-07	2.65E-05	0.0382
03-DD-238	15.1	2.9	3A	94	114	0.7	0.0016	75	3.18E-07	1.91E-05	0.0275
03-DD-238	15.1	2.9	3B	94	114	0.24	0.0005	40	1.89E-07	1.13E-05	0.0163
03-DD-238	15.1	2.9	4A	79	99	1.36	0.0030	60	7.54E-07	4.53E-05	0.0652
03-DD-238	15.1	2.9	4B	79	99	0.68	0.0015	30	6.77E-07	4.06E-05	0.0585
03-DD-238	15.1	2.9	5A	64	84	6.66	0.0148	50	4.35E-06	2.61E-04	0.3756
03-DD-238	15.1	2.9	5B	64	84	3.44	0.0077	25	3.94E-06	2.37E-04	0.3408

Borehole	Gage Height	Static Water Level	Test ID	Interval		Discharge (Q)		Gage Pressure (psi)	Hydraulic Conductivity (K)		
				Top	Bottom	Q (gpm)	Q (ft3/sec)		K (ft/sec)	K (ft/min)	K (ft/day)
03-DD-238	15.1	2.9	6A	49	69	3.74	0.0083	40	2.94E-06	1.77E-04	0.2543
03-DD-238	15.1	2.9	6B	49	69	1.38	0.0031	20	1.87E-06	1.12E-04	0.1613
03-DD-238	15.1	2.9	7A	34	54	0.12	0.0003	25	1.38E-07	8.26E-06	0.0119
03-DD-238	15.1	2.9	7B	34	54	0.08	0.0002	15	1.32E-07	7.92E-06	0.0114

TABLE A8 - Pumping Test Hydraulic Conductivity Averages

Measured Borehole	Surface Elevation (ft)	Bottom of Borehole Elevation (ft)	Calculated Hydraulic Conductivity (ft/day)					
			Test Borehole 00-RD-215			Test Borehole 01-RD-219		
			Neuman Method		Cooper-Jacob Method	Neuman Method		Cooper-Jacob Method
			Horizontal	Vertical		Horizontal	Vertical	
96-DD-87	1165.7	964.9	1.08	12.14	4.51	1.2	1.67	1.46
99-DD-200	1164.5	959.2	0.93	0.45	2.65			
99-DD-205	1168.6	975.6	1.21	0.56	1.38	1.71	0.29	1.65
99-DD-206	1165.8	975.8	1.01	0.59	1.38			
00-DD-208	1165.1	1014.9	1.36	0.23	1.89	1.4	0.64	1.7
00-DD-209	1169.6	989.6	0.81	0.46	1.33	1.79	0.39	1.33
00-DD-210	1182.3	982.3	0.51	0.4	1.35			
00-DD-212	1181.5	1026.5	1	1.71	2.77			
00-DD-213	1158.3	1013.3	No Response to Pumping			No Response to Pumping		
00-DD-214	1165.5	995.5	0.88	6.71	3.22			
00-DD-216	1172.6	1027.6				1.7	0.74	1.49
00-DD-217	1165.6	1015.6	No Response to Pumping			No Response to Pumping		
00-DD-218	1165.8	1015.8	No Response to Pumping			0.12	0.21	0.73
01-DD-223	1145.9	1014.5				0.73	0.1	1.55
01-DD-224	1149	1027.5				0.16	0.14	0.23
01-DD-230	1140.7	1063				1.57	0.18	1.71

This page is intentionally left blank.

HOWARD HANSON DAM
COFFERDAM FOUNDATION AND EXCAVATION CONTRACT
- FISH PASSAGE FACILITY, ADDITIONAL WATER STORAGE PROJECT

GEOTECHNICAL BASELINE REPORT - ADDENDUM

TABLE OF CONTENTS

HOWARD HANSON DAM
COFFERD AND EXCAVATION CONTRACT
- FISH PASSAGE FACILITY, ADDITIONAL WATER STORAGE PROJECT

GEOTECHNICAL BASELINE REPORT – ADDENDUM A1

PART A1.1 – GENERAL

A1.1.1 General Information

This addendum constitutes a part of the Geotechnical Baseline Report (GBR). As part of the GBR this addendum also constitutes a part of the contract documents for the Howard Hanson Dam Cofferdam Foundation and Excavation Contract – Fish Passage Facility, Additional Water Storage Project.

Information that has become available since the preparation of the GBR is discussed in this addendum. The addendum follows the three part format of the GBR: Part 1 provides background information regarding this document, Part 2 gives general background information regarding the project site conditions, and Part 3 establishes the geotechnical baseline and some construction considerations. Sections that remain unchanged from the GBR will direct the reader to the GBR.

A1.1.2 Description of Work

See Geotechnical Baseline Report.

A1.1.3 Intended Methods

See Geotechnical Baseline Report.

A1.1.4 References

See Geotechnical Baseline Report.

A1.1.5 Definitions

See Geotechnical Baseline Report.

A1.1.6 Sources of Information

In addition to the sources of information identified in the GBR, the following documents also contain relevant geotechnical data:

- NORCAL Geophysical Consultants, Inc., 2003, Borehole Geophysical Logging Survey, Cofferdam and Fish Collection Facility, Howard Hanson Dam, King county, Green River, Washington. Contract No. DACW67-03-P-2125.

A1.1.7 Design Team

See Geotechnical Baseline Report.

A1.1.8 Geotechnical Explorations

During the preparation of the GBR, the Government identified potential gaps in the data acquired through the geotechnical explorations identified in the GBR. Specifically, the physical properties of the Pyroclastite unit, and how that unit would respond to normal and shear stresses, had not been defined. To address these data gaps, representative samples of the Pyroclastite unit were submitted for laboratory analyses. The types of analyses and the corresponding results are presented in section 2.3.1.

PART A1.2 – GENERAL SITE CONDITIONS

A1.2.1 Location and Access

See Geotechnical Baseline Report.

A1.2.2 Geologic Background

See Geotechnical Baseline Report.

A1.2.3 Surface and Subsurface Materials

See Geotechnical Baseline Report.

A1.2.3.1 Bedrock Materials

Additional information is only available for the Pyroclastite unit and, as such, the Pyroclastite unit is the only unit that will be addressed in the addendum. See the GBR for information regarding the other bedrock materials.

2) Pyroclastite. The Pyroclastite samples identified in section 1.8 were submitted for laboratory analyses of unconfined compressive strength, direct shear strength, and elastic moduli. Additionally, Atterberg limits were determined for fracture infill material from fractures within the Pyroclastite unit. The results of these analyses are presented in Tables AD-1 through AD-4. A summary of the results is incorporated in the adopted rock properties below. These properties are adopted as the geotechnical baseline for the Pyroclastite unit.

Adopted Rock Properties (Pyroclastite)

Property	**Range**	**Average (One Std Deviation)**
Specific Gravity (Bulk Dry)	2.25 to 2.35	
Moist Unit Weight (pcf)	139.1 to 152.4	
Unconfined Compressive Strength (psi)	1,710 to 4,260	3,190 (1,072)
Shear Strength at 45 psi Normal (psi/phi)	33/23 to 34/16	
Tensile Strength (psi)	not available	
Poisson's Ratio	0.25 to 0.50	0.335 (0.101)
Liquid Limit (fracture infill) (%)	41	
Plastic Limit (fracture infill) (%)	20	

pcf – pounds per cubic foot
phi – internal angle of friction

psi – pounds per square inch

A1.2.3.2 Rock Mass Classification and Slope Stability

See Geotechnical Baseline Report.

A1.2.3.2.1 Discontinuities – Orientation and Condition

See Geotechnical Baseline Report.

A1.2.3.2.2 Rock Mass Ratings

See Geotechnical Baseline Report.

A1.2.3.2.3 Excavation Slope Stability (Rock Block Stability)

Typical modes of rock slope instability and the modes most likely to occur in the project area are discussed in the GBR. The results of kinematic and limiting equilibrium analyses are also discussed in the GBR. The data presented in this addendum do not alter the conclusions established in the GBR.

A1.2.3.3 Unconsolidated Materials

See Geotechnical Baseline Report.

A1.2.4 Hydrogeologic Conditions

See Geotechnical Baseline Report.

PART A1.3 – GEOTECHNICAL BASELINE AND CONSTRUCTION CONSIDERATIONS

A1.3.1 Geotechnical Baseline

The following section incorporates the findings of the GBR and this addendum and summarizes the geotechnical baseline properties of the surface and subsurface materials in the project area.

Summary – Geotechnical Baseline Properties

Property	**Andesite**	**Pyro-clastite**	**Basaltic Andesite**	**GP-GM - Fill**	**GP-GM - Native**	**ML - Native**
Specific Gravity (bulk dry)	2.55[1]	2.30[1]	2.63[1]	--	--	--
Weight (dry, pcf)	--	--	--	125.0	133.0	100.0
Weight (moist, pcf)	170.6[1]	145.8[1]	164.8[1]	--	--	--
Unconfined Compressive Strength (psi)	7,363[1]	3,190[1]	8,140[1]	--	--	--
Shear Strength at 50 psi (psi/phi)	52/45[1]	34/20[1,3]	31/31[1]	--	--	--
Shear Strength	--	--	--	35°/0[2]	37°/0[2]	27°/100[2]

(phi/c)						
Tensile Strength (psi)	1,360[1]	--	--	--	--	--
Poisson's Ratio	0.266[1]	0.335[1]	--	--	--	--
RQD (%)	86.17[1]	83.63[1]	55.08[1]	n/a	n/a	n/a
RMR	68.99[1]	67.42[1]	60.36[1]	n/a	n/a	n/a
Q	84.87[1]	76.84[1]	11.67[1]	n/a	n/a	n/a
Hydraulic Conductivity (ft/day)	<2	<2	<2	--	--	--

[1] Average values – actual values my vary as much as 20 percent
[2] Estimated values based on material classification
[3] Normal pressure at 45 psi
pcf – pounds per cubic foot
phi – internal angle of friction
psi – pounds per square inch
c – cohesion (in pounds per square foot)

A1.3.2 Construction Considerations

See Geotechnical Baseline Report.

A1.3.2.1 Rock Mass Reinforcement

Additional rock mass reinforcement measures are currently being considered. Details of these measures will be provided when available.

A1.3.2.2 Existing Rock Mass Reinforcement

See Geotechnical Baseline Report.

A1.3.2.3 Dewatering

See Geotechnical Baseline Report.

A1.3.2.4 Grouting

See Geotechnical Baseline Report.

This page is intentionally left blank.

SECTION 01025

MEASUREMENT AND PAYMENT

****
NOTE: THIS SECTION IS REISSUED IN ITS ENTIRETY BY AMENDMENT 0004.
****

PART 1 GENERAL

1.1 GENERAL

The contract price for each item shall constitute full compensation for furnishing all plant, labor, materials, appurtenances, and incidentals and performing all operations necessary to construct and complete the items in accordance with these specifications and the applicable drawings, including surveying performed by the Contractor. Payment for each item shall be considered as full compensation, notwithstanding that minor features may not be mentioned herein. Work paid for under one item will not be paid for under any other item. No separate payment will be made for the work, services, or operations required by the Contractor, as specified in DIVISION 1, GENERAL REQUIREMENTS, to complete the project in accordance with these specifications; all costs thereof shall be considered as incidental to the work.

1.2 MEASUREMENT

1.2.1 Measurement of Hookups to Grout Curtain Holes

The quantity of hookups for hydraulic pressure tests and placement of cement grout curtains will be measured for payment as the number of hookups performed as required.

1.2.2 Measurement of Portland Cement and Bentonite by 94-Pound Bag

Portland cement and bentonite used in grout curtains will be measured for payment as the number of bags of portland cement (94 pounds of cement per bag) mixed into grout and satisfactorily pumped into the grout holes.

1.2.3 Measurement of HRWRA Water Reducing Admixture by Gallon

Cement Grout HRWRA (High Range Water Reducing Admixture) water reducing Admixture use in grout curtains will be measured for payment as the number of gallons of admixture used for the cement grouting, unless wasted or used for the convenience of the Contractor.

1.2.4 Cubic Yard Excavation Measurement

1.2.3.1 A survey of the site shall be made by the Contractor just after commencement of the work under this contract and prior to the initiations of any excavation. All measurements for payment for excavation will be based on that survey and additional surveys as specified hereinafter without regard to any changes that may occur during the prosecution of the work. Quantities for payment for excavation will be determined in cubic yards based on cross-section measurements. The Contracting Officer will make all decisions concerning classification of the excavated materials. Payment for excavation will be made only for the volume of materials

actually removed by the Contractor, and only for the materials excavated within the limits shown on the drawings or established in the field by the Contracting Officer. Payment for any given volume of excavation will not be made under more than one classification of excavation. Payment for excavation will constitute full compensation for all cost associated with blasting, ripping, excavating, removal hauling, stockpiling, and disposal of the excavated materials.

1.2.3.2 The total quantity of excavated common material for which payment will be made will be the computed volume between two ground surfaces as determined by surveys performed prior to and immediately after the common excavation is complete. No allowance will be made for overdepth excavation or for the removal of any material outside the required slope lines unless authorized.

1.2.3.3 The total quantity of excavated material from rock and concrete excavation for which payment will be made will be the computed volume between two surfaces as determined by the second survey performed for calculating the common excavation and a subsequent survey performed after completion of rock and concrete excavation.

1.3 PAYMENT

1.3.1 ITEM 0001 (BASE ITEM)

Payment will be made at the contract lump sum price for Item No. 0001, All Work for Fish Passage Facility Cofferdam and Excavation, Except for Items 0002 Through 0039, payment of which shall constitute full compensation for Item No. 0001, complete.

1.3.2 ITEM 0002 (BASE ITEM)

Payment will be made at the contract lump sum price for Item No. 0002, Mobilization and Demobilization, payment of which shall constitute full compensation for Item No. 0002, complete, including costs for assembling all plant and equipment at the site preparatory to initiating the work and for removing it when all work has been completed, in accordance with Special Clause SC-11. This also shall include payment for any interim Demobilization and Remobilization that may be necessary. It is not, however, to be confused with Item No. 0018 below.

1.3.3 ITEM 0003 (BASE ITEM)

Payment will be made at the contract unit price for Item No. 0003, All Work for Reservoir Excavation & Debris Removal From Trash Racks, payment of which shall constitute full compensation for Item No. 0003, complete.

1.3.4 ITEM 0004 (BASE ITEM)

Payment will be made at the contract lump sum price for Item No. 0004, All Work for Multi-Point Borehole Extensometers, payment of which shall constitute full compensation for Item No. 0004, complete, including costs for drilling, groutable anchors, stainless steel rods, pvc tubes, vibrating wire displacement transducers of the appropriate range, the appropriate lengths of transducer cable and conduit, vibrating wire head assembly, grout, surface completion, installation of all components, and for furnishing all labor and supplies incidental to the work.

1.3.5 ITEM 0005 (BASE ITEM)

Payment will be made at the contract lump sum price for Item No. 0005, All Work for Piezometers, payment of which shall constitute full compensation for Item No. 0005, complete, including costs for core drilling, vibrating wire pressure transducers of the appropriate range, the appropriate lengths of transducer cable and conduit, bentonite seals, sand, grout, surface completion, installation of all components, and for furnishing all labor and supplies incidental to the work.

1.3.6 ITEM 0006 (BASE ITEM)

Payment will be made at the contract lump sum price for Item No. 0006, All Work for Inclinometers, payment of which shall constitute full compensation for Item No. 0006, complete, including costs for core drilling, inclinometer casing, grout, the appropriate lengths of inclinometer cable and conduit, surface completion, one portable inclinometer probe and readout box used for reading all inclinometers, installation of all components, and for furnishing all labor and supplies incidental to the work.

1.3.7 ITEM 0007 (BASE ITEM)

Payment will be made at the contract lump sum price for Item No. 0007, All Work for Load Cells, payment of which shall constitute full compensation for Item No. 0007, complete, including costs for vibrating wire load cells, test bolts, grout, the appropriate lengths of cable and conduit, installation of all components, and for furnishing all labor and supplies incidental to the work.

1.3.8 ITEM 0008 (BASE ITEM)

Payment will be made at the contract unit price for Item No. 0008,All Work for Passive Relief Wells, payment of which shall constitute full compensation for Item No. 0008, complete.

1.3.9 ITEM 0009 (BASE ITEM)

Payment will be made at the contract unit price for Item No. 0009, All Work for Dewatering Wells, payment of which shall constitute full compensation for Item No. 0009, complete.

1.3.10 ITEM 0010 (BASE ITEM)

Payment will be made at the contract unit price for Item No. 0010, All Overburden Drilling for Grout Curtain Holes, (1, 2 & 4 Stage Holes), payment of which shall constitute full compensation for Item No. 0010, complete.

1.3.11 ITEM 0011 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0011, All Drilling for Grout Holes (1,2 & 4 Stage Holes) payment of which shall constitute full compensation for Item No. 0011, complete.

1.3.12 ITEM 0012 (BASE ITEM)

Payment will be made at the contract unit price for Item No. 0012, All Work for Redrilling Grout Curtain Holes (2 Stage Grout Curtains only) payment of which shall constitute full compensation for Item No. 0012, complete.

1.3.13 ITEM 0013 (BASE ITEM)

Payment will be made at the contract unit price for Item No. 0013, All Hookups To Grout Holes used in Placement of Cement Grout Curtains, payment of which shall constitute full compensation for Item No. 0013, complete.

1.3.14 ITEM 0014 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0014, All Portland Cement used in Grout Curtains, payment of which shall constitute full compensation for Item No. 0014, complete.

1.3.15 ITEM 0015 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0015, All Bentonite used in Grout Curtains, payment of which shall constitute full compensation for Item No. 0015, complete.

1.3.16 ITEM 0016 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0016, All HRWR Water Reducing Admixture (Anti-Washout Admixture) in Grout Curtains, payment of which shall constitute full compensation for Item No. 0016, complete.

1.3.17 ITEM 0017 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0017, All New Intake Tower Addition Tremie Concrete Below Elevation 1085, payment of which shall constitute full compensation for Item No. 0017, complete.

1.3.18 ITEM 0018 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0018, All 37 Each Vertical 1-3/4" Diameter Bars for New Intake Tower Addition (Plate S8.3), payment of which shall constitute full compensation for Item No. 0018, complete.

1.3.19 ITEM 0019 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0019, All Shoulder H-Piles Tie Back for Permanent Retaining Wall, payment of which shall constitute full compensation for Item No. 0019, complete.

1.3.20 ITEM 0020 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0020, All Tie Back Anchors for Permanent Retaining Wall, payment of which shall constitute full compensation for Item No. 0020, complete, including furnishing, installing, grouting, tensioning, and tie off of all permanent tie back anchors, as specified and as approved.

1.3.21 ITEM 0021 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0021, All Common Excavation, Above Elevation 1074, payment of which shall constitute full compensation for Item No. 0021, complete.

1.3.22 ITEM 0022 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0022, All Rock and Concrete Excavation, Above Elevation 1074, payment of which shall constitute full compensation for Item No. 0022, complete.

1.3.23 ITEM 0023 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0023, All 30' Long Rock Bolts #11, Threaded Bar Grade 150 Above Elevation 1074, payment of which shall constitute full compensation for Item No. 0023, complete.

1.3.24 ITEM 0024 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0024, All 30' Long Rock Bolts, #8 Threaded Bar Grade 75 Above Elevation 1074, payment of which shall constitute full compensation for Item No. 0024, complete.

1.3.25 ITEM 0025 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0025, All 20' Long Rock Bolts, #8 Threaded Bar Grade 75 Above Elevation 1074, payment of which shall constitute full compensation for Item No. 0025, complete.

1.3.26 ITEM 0026 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0026, All 30' Long Weep Holes Above Elevation 1074, payment of which shall constitute full compensation for Item No. 0026, complete.

1.3.27 ITEM 0027 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0027, All 6" Thick Shotcrete, payment of which shall constitute full compensation for Item No. 0027, complete.

1.3.28 ITEM 0028 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0028, All Welded Wire Fabric, Above Elevation 1074, payment of which shall constitute full compensation for Item No. 0028, complete.

1.3.29 ITEM 0029 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0029, All Rock and Concrete Excavation, Below Elevation 1074, payment of which shall constitute full compensation for Item No. 0029, complete.

1.3.30 ITEM 0030 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0030, All 30' Long Rock Bolts #11, Threaded Bar Grade 150 Below Elevation 1074, payment of which shall constitute full compensation for Item No. 0030, complete.

1.3.31 ITEM 0031 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0031, All

30' Long Rock Bolts, #8 Threaded Bar Grade 75 Below Elevation 1074, payment of which shall constitute full compensation for Item No. 0031, complete.

1.3.32 ITEM 0032 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0032, All 20' Long Rock Bolts, #8 Threaded Bar Grade 75 Below Elevation 1074, payment of which shall constitute full compensation for Item No. 0032, complete.

1.3.33 ITEM 0033 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0033, All 30' Long Weep Holes, Below Elevation 1074, payment of which shall constitute full compensation for Item No. 0033, complete.

1.3.34 ITEM 0034 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0034, All Welded Wire Fabric, Below Elevation 1074, payment of which shall constitute full compensation for Item No. 0034, complete.

1.3.35 ITEM 0035 (BASE ITEM)

Payment will be made that the contract lump sum price for Item No. 0035, All Work for Cut-Off-Wall (South Shore) 5' into Rock to Elevation 1170', payment of which shall constitute full compensation for Item No. 0035, complete.

1.3.36 ITEM 0036 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0036, Emergency Mobilization & Demobilization For When Water Elevation Is Above Elevation 1150, payment of which shall constitute full compensation for Item No. 0036, complete.

1.3.37 ITEM 0037 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0037, Emergency Mobilization & Demobilization For When Water Elevation Is Above Cofferdam Elevation 1165, payment of which shall constitute full compensation for Item No. 0037, complete.

1.3.38 ITEM 0038 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0038, Emergency Mobilization & Demobilization For When Water Elevation Is Above Cofferdam Elevation 1169, payment of which shall constitute full compensation for Item No. 0038, complete.

1.3.39 ITEM 0039 (BASE ITEM)

Payment will be made that the contract lump sum price for Item No. 0039, All Work for As-Built Drawings as specified in Section 01702 from preparation to final approval payment of which shall constitute full compensation for Item No. 0039, complete.

1.4 PROGRESS PAYMENT INVOICE

Requests for payment shall be submitted in accordance with Federal Acquisition Regulations (FAR) Subpart 32.9, entitled "PROMPT PAYMENT", and Paragraphs 52.232-5 and 52.232-27, entitled "Payments Under Fixed-Price Construction Contracts", and "Prompt Payment for Construction Contracts", respectively. In addition each request shall be submitted in the number of copies and to the designated billing office as shown in the Contract.

1.3.1 When submitting payment requests, the Contractor shall complete Blocks 1 through 12 of the "PROGRESS PAYMENT INVOICE" Form as directed by the Contracting Officer. (A sample form is attached at the end of this Technical Specification Section.) The completed form shall then become the cover document to which all other support data shall be attached.

1.3.2 One additional copy of the entire request for payment, to include the "PROGRESS PAYMENT INVOICE" cover document, shall be forwarded to a separate address as designated by the Contracting Officer.

1.3.3 The Contractor shall submit with each pay request, a list of subcontractors that have worked during that pay period. The listing shall be broken down into weeks, identifying each subcontractor that has worked during a particular week, and indicate the total number of employees that have worked on site for each subcontractor for each week. The prime Contractor shall also indicate the total number of employees for its on site staff for each week.

PART 2 NOT USED

PART 3 NOT USED

This page is intentionally left blank.

SECTION 02300

EARTHWORK

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 422	(1963; R 1998) Particle-Size Analysis of Soils
ASTM D 1140	(1997) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 2487	(1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 4318	(1998) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP.

1.2.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include rock excavated from the Fish Bypass Facility footprint and new approach channel excavation, man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. The Contracting Officer shall be notified of any contaminated materials.

1.2.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Testing required for classifying materials shall be in accordance with ASTM D 4318, ASTM C 136,

ASTM D 422, and ASTM D 1140.

1.2.4 Rockfall Control Measures

This term applies to the method and materials used to restrain or remove small blocks of rock, generally greater than approximately 6-inches and less that approximately 3 feet in their largest dimension, from falling from excavated rock slopes

1.2.5 Rock Reinforcement

Any combination of ground support systems, including rock bolts, rock anchors, shotcrete, welded wire fabric, and weep holes specified to support the excavation slopes.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Excavation Plan

The Excavation Plan shall contain written descriptions of the following: 1) Methods and equipment used for providing survey control to establish excavation limits, lines, and grades to the tolerances specified, 2) Methods and equipment used for excavation, loading, and transportation of any and all material encountered in the excavations, 3) Methods and equipment used to scale rock slopes, install rock bolts and rock and soil anchors, shotcrete, welded wire fabric, and weep holes, 4) Methods and equipment for draining the excavation of both surface water runoff and groundwater, and 5) The sequence of operations, including stripping of common excavation, drilling and blasting, excavation, loading and hauling excavated material, scaling and installing rock reinforcement on slopes, and measures taken to drain the excavation and project exposed rock surfaces. The descriptions shall be accompanied by schematic and scale drawings showing the order in which each operation shall be accomplished.

SD-03 Product Data

Earthwork; G.

Procedure and location for disposal of unsatisfactory and unused satisfactory material. Proposed source of borrow material.

Rockfall Control Measures; G

The Contractor shall submit for approval proposed Rockfall Control Measures, including descriptions and manufacturer's product literature of all required materials, equipment and methods intended to be used.

SD-06 Test Reports

Testing; G.

Within 24 hours of conclusion of physical tests, 3 copies of test results, including calibration curves and results of calibration tests.

SD-07 Certificates

Testing; G.

Qualifications of the commercial testing laboratory or Contractor's testing facilities.

1.4 SITE CONDITIONS

A foundation investigation has been made at the site by the Government and data is presented on the foundation exploration drawings. Logs of core borings are shown on the drawings. While the foundation information is representative of subsurface conditions at the respective locations of borings, local variations in the characteristics of the subsurface materials may be anticipated. Local variations which may be encountered include, but are not limited to, classification and thickness of rock strata, fractures, and other discontinuities in the rock structure. Such variations will not be considered as differing materially within the purview of the CONTRACT CLAUSES, paragraph DIFFERING SITE CONDITIONS. Core from the borings indicated on the drawings are available for inspection as specified in the SPECIAL CONTRACT REQUIREMENTS, paragraph PHYSICAL DATA. The Contracting Officer is responsible for location of all utilities that may be affected by construction. The Contractor is responsible for verifying the location of all utilities that may be affected by construction or the installation of the rock bolts.

1.5 CLASSIFICATION OF EXCAVATION

Excavation specified shall be done on a classified basis, in accordance with the following designations and classifications.

1.5.1 Rock Excavation

Rock excavation shall include blasting, excavating by mechanical methods, grading, and disposing of material classified as rock and shall include the satisfactory removal and disposal of boulders 1/2 cubic yard or more in volume; solid rock; rock material, which cannot be removed without systematic drilling and blasting, or mechanical excavation using a D-9 Dozer or equivalent with a single point ripper. The removal of any concrete or masonry structures, exceeding 1/2 cubic yard in volume that may be encountered in the work shall be included in demolition. If at any time during excavation, the Contractor encounters material that may be classified as rock excavation, such material shall be uncovered and the Contracting Officer notified by the Contractor. The Contractor shall not proceed with the excavation of this material until the Contracting Officer has classified the materials as common excavation or rock excavation and the Contractor has taken cross sections as required. The frequency of the cross sections will be specified by the Contracting Officer based on the irregularity of the rock surface. Failure on the part of the Contractor to uncover such material, notify the Contracting Officer, and allow ample time for classification and cross sectioning of the undisturbed surface of such material will cause the forfeiture of the Contractor's right of claim to any classification or volume of material to be paid for other than that allowed by the Contracting Officer for the areas of work in which such deposits occur.

1.5.2 Common Excavation

Common excavation shall include the satisfactory removal and disposal of all materials not classified as rock excavation or included under Demolition.

1.6 BLASTING

Blasting shall be performed as specified in Section 02212.

1.7 UTILIZATION OF EXCAVATED MATERIALS

All unsatisfactory and unused satisfactory materials removed from excavations shall be disposed of in designated waste disposal or spoil areas. No excavated material shall be disposed of to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where indicated or directed, topsoil shall be stripped to a depth of 24 inches. Topsoil shall be spread on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Topsoil shall be kept separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations. Any surplus of topsoil from excavations and grading shall be removed from the site.

3.2 GENERAL EXCAVATION

The Contractor shall perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Grading shall be in conformity with the typical sections shown and the tolerances specified in paragraph FINISHING. Such excavated material and the satisfactory material ordered as replacement shall be included in excavation. Surplus satisfactory excavated material not required for fill or embankment shall be disposed of in areas approved for surplus material storage or designated waste areas. Unsatisfactory excavated material shall be disposed of in designated waste or spoil areas. During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times. Material required for fill or embankment in excess of that produced by excavation within the grading limits shall be excavated from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

3.2.1 Rock Excavation

3.2.1.1 General

Systematic drilling and blasting of rock encountered in the 1b and 1c excavations areas shall be accomplished in lifts not exceeding 20 vertical

feet, except as modified herein.

As the excavation progresses, the Contractor shall remove loose and overhanging material and install rock reinforcement on all slopes. Rockfall control measures for all slopes shall be selected by the Contractor and approved by the Contracting Officer prior to installation.

In addition to the requirement set forth in this Section all drilling and blasting and mechanical excavation in the 1b and 1C excavation areas shall be performed as specified in Section 02212, CONTROLLED BLASTING.

The Contractor shall not commence drilling of either test or production blast holes until adequate survey control has been established.

3.2.1.2 Excavation Bench Height Restrictions

The depth of the excavation benches shall not exceed 8 feet or not extend more than 2 feet below the next row of proposed rock bolts, whichever is less, in the vicinity of the existing seismic retrofit slab. This criterion applies to the north excavation slope between Station 3+75 and 4+00 and between El. 1140 and 1094.

The depth of the excavation benches shall not exceed 8 feet or not extend more than 2 feet below the next row of proposed or existing bolts (bolts installed during a previous contract in the sidewall of the existing Outlet Works Tunnel) below the elevation of the crown of the existing Outlet Works Tunnel.

3.2.1.3 Rock Excavation Adjacent to Permanent Retaining Wall

Excavation by drilling and blasting shall not be performed within 3 feet of the permanent soldier pile wall. Excavation within 3 feet of the soldier pile wall shall be accomplished using mechanical methods.

3.2.1.4 Excavation Tolerances in Rock

The excavation tolerance in rock is -0 feet and +0.5 feet for up to 20-foot excavation lifts. No underexcavtion shall be allowed.

3.2.1.5 Excavation Access

After each blast and after the excavated rock has been removed, and prior to placement of shotcrete, the Contractor shall provide the Contracting Officer access to the bench to assess the slope conditions. Access shall be provided in 2 hour and 4 hour continuous blocks of the 1b and 1c excavation areas, respectively.

3.2.2 Rockfall Control Measures and Rock Reinforcement

3.2.2.1 Rock Scaling

Amend R0004

All rock surfaces shall be scaled immediately after excavation to remove all rock that is loose, hanging or which creates a potentially dangerous situation. ~~Payment for scaling shall be incidental to the contract unit price for excavation.~~

****

3.2.2.2 Cement-Grouted Untensioned Rock Bolts and Rock Anchors

Cement-Grouted Untensioned Rock Bolts and Rock Anchors shall be installed as required and indicated in accordance with Sections 02491, CEMENT-GROUTED UNTENSIONED ROCK BOLTS and 02490, SOIL AND ROCK ANCHORS, respectively.

Cement-grouted untensioned rock bolts and rock anchors shall be advanced commensurate with excavation. The unreinforced height of excavated slopes shall not exceed 20 feet or the specified excavation bench height, whichever is less.

3.2.2.3 Shotcrete

Shotcrete applied to final surfaces in the 1b and 1c excavation areas as indicated on the Plans shall be in accordance with Section 03371, SHOTCRETE.

The Contractor shall apply shotcrete to rock surfaces within 24 hours after the rock surface is exposed following excavation.

3.2.2.4 Rockfall Control Measures

Amend R0004

The Contractor shall provide a method to prevent rockfall from all slopes in the 1b or 1c excavation areas. ~~Payment for rockfall control measures shall be incidental to the contract price for excavation.~~

****

3.2.3 Ditches

Excavation of ditches shall be accomplished by cutting accurately to the cross sections, grades, and elevations shown. Ditches shall not be excavated below grades shown. Excessive open ditch or gutter excavation shall be backfilled with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Material excavated shall be disposed of as shown or as directed, except that in no case shall material be deposited less than 4 feet from the edge of a ditch. The Contractor shall maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris through the duration of the contract.

3.3 SELECTION OF BORROW MATERIAL

Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas selected by the Contractor. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

3.4 OPENING AND DRAINAGE OF EXCAVATION

The Contractor shall notify the Contracting Officer sufficiently in advance of the opening of any excavation to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of as directed. The Contractor shall ensure that excavation of any area or dumping of spoil material results in no detrimental effects on natural environmental conditions.

3.5 GRADING AREAS

Where indicated, work will be divided into grading areas within which satisfactory excavated material shall be placed in embankments. The Contractor shall not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing.

3.6 FINISHING

The surface of excavations, other than excavations in rock, shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for graded areas shall be within 0.1 foot of the grades and elevations indicated. Gutters and ditches shall be finished in a manner that will result in effective drainage. If the Contractor over excavates, the area will be backfilled with approved satisfactory material and track-walked using five passes of a dozer having a ground pressure of 5 psi.

3.7 SUBGRADE AND EMBANKMENT PROTECTION

During construction, excavations shall be kept shaped and drained. Ditches and drains shall be maintained to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition.

-- End of Section --

This page is intentionally left blank.

SECTION 02490

SOIL AND ROCK ANCHORS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 301	(1999) Structural Concrete

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO

AASHTO M 252	(1996) Corrugated Polyethylene Drainage Tubing

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53/A 53M	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 500	(1999) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 536	(1984; R 1999e1) Ductile Iron Castings
ASTM A 572/A 572M	(1999) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 722/A 722M	(1998) Uncoated High-Strength Steel Bar for Prestressing Concrete
ASTM C 33	(1999ae1) Concrete Aggregates
ASTM C 109/C 109M	(1999) Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50 mm) Cube Specimens)
ASTM C 144	(1999) Aggregate for Masonry Mortar
ASTM C 150	(1999a) Portland Cement
ASTM C 1107	(1999) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D 1248	(2000) Polyethylene Plastics Molding and Extrusion Materials

ASTM D 1784	(1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 4101	(2000) Propylene Plastic Injection and Extrusion Materials

POST-TENSIONING INSTITUTE (PTI)

PTI Spec	(Dec 2000, Second Edition) Specification for Unbonded Single Strand Tendons
PTI Rec	(June 1996, Third Edition) Recommendations for Prestressed Rock and Soil Anchors
PTI Post Tensioning Manual	(Nov 1990, Fifth Edition) Post Tensioning Manual

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(1996) Safety and Health Requirements Manual

1.2 DEFINITIONS

The following definitions are in addition to those given in PTI Rec, Section 2.0:

Anchored Structure - The wall, foundation or other structure to which the anchor is to transfer force.

Demonstration Test Anchor - An anchor which is performance tested to verify design assumptions and installation practices.

1.3 SYSTEM DESCRIPTION

1.3.1 General

The work includes fabrication, installation, and testing of soil and rock anchors for the permanent soldier pile with tiebacks retaining wall, and the fabrication, installation, and testing of rock anchors to tie down the cofferdam structure and to support the cofferdam slope and wall at the left abutment, and the fabrication, installation, and testing of rock anchors at the north flood/retaining wall.

1.3.1.1 Soil and Rock Anchors for the Permanent Soldier Pile with Tiebacks Retaining Wall

The fabrication, installation, and testing of the soil and rock anchors for the permanent soldier pile with tiebacks retaining wall shall be as shown on the drawings and as specified in these specifications. General criteria for the soil and rock anchors for the permanent retaining wall are shown on the drawings. The materials, stressing, load testing, and acceptance shall be in accordance with PTI Rec and these specifications. Soil and rock

anchors for the permanent retaining wall shall be threaded bar type. The Contractor shall be responsible for determining drilling methods, fabrication and installation. Approval of the drilling methods, fabrication and installation by the Contracting Officer shall not relieve the Contractor of responsibility for performance of the soil and rock anchors. Payment for soil and rock anchors as specified in Section 01270A MEASUREMENT AND PAYMENT, shall include all costs in connection with fabricating, installing, and testing the anchors.

1.3.1.2 Rock Anchors for the Cofferdam and for the North Flood/Retaining Wall

Fabrication, installation, and testing of the rock anchors to tie down the cofferdam and to support the left abutment slope and wall, and for the north flood/retaining wall shall be as shown on the drawings and as specified in these specifications. The materials, stressing, load testing, and acceptance shall be in accordance with PTI Rec and these specifications. Rock anchors shall be threaded bar type. Payment for rock anchors as specified in Section 01270A, MEASUREMENT AND PAYMENT, shall include all costs in connection with fabricating, installing, and testing the anchors.

1.3.2 Permanent Soldier Pile with Tiebacks Retaining Wall Anchor Design Requirements

The individual soil and rock anchors shall meet the following criteria and the criteria shown on the drawings:

The Lock-off Load shall be 30 percent of the ultimate strength of the prestressing steel. The maximum Test Load shall not exceed 40 percent of the ultimate strength of the prestressing steel.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Fabrication and Installation Drawings; G

Shall include: drawings and detailed installation procedures and sequences showing complete details of the installation procedure and equipment; anchor fabrication; grouting methods; grout mix designs; anchor and casing placement and installation; corrosion protection for bond length and for unbonded length, details of corrosion protection, including details of anchorage and installation; stressing length and anchorage; anchorage and trumpet; stressing and testing procedures with lengths, forces, deformations, and elongations for the approval by the Contracting Officer. Shop drawings for anchors shall include locations and details of the spacers, centralizers, and banding. If different types of anchors are to be installed, each anchor type shall be readily identifiable. Once reviewed by the Contracting Officer, no changes or deviation from shop drawings shall be permitted without further review by the Contracting Officer.

Equipment

The Contractor shall submit catalog cuts, brochures, or other descriptive literature describing the equipment to be used for drilling, grouting, handling, and installing the soil and rock anchors. The Contractor shall also submit sketches, drawings or details showing the access and temporary supports where required for the drilling equipment and stressing frames. Descriptions of stressing jacks, gages, dynamometers, load cells, or other devices for measuring stressing load, certified calibration records for each set of jacking equipment, and current testing curves for stress measurement gages which show that gages have been calibrated for the jacks for which they are used shall be submitted for review 30 days prior to the start of the testing operations.

Fabricator Qualifications; G
Installer Qualifications; G
Core Logging and Soil Sampling Qualifications; G

The qualifications and experience records shall be submitted for approval. Experience records shall identify all the individuals responsible for the anchors and shall include a listing of projects of similar scope performed within the specified period along with points of contact. The Contractor shall submit the qualifications prior to the installation of any anchors specified in this section.

Installation Plan; G

The Contractor shall submit to the Contracting Officer for review and comment a plan for installing the soil and rock anchors. The proposal shall describe the sequence for installation and other restrictions as outlined on the drawings or specified. The anchor and casing installation procedures shall be determined by the Contractor as part of the anchor design. The installation plan shall also include descriptions of methods and equipment to be used by the Contractor for alignment checking of anchor holes and casings.

SD-06 Test Reports

Prestressing Steel

Certified test reports for each heat or lot of prestressing steel shall be submitted with materials delivered to the site.

Cement Grout Mixture Proportions

Thirty days prior to installation of anchors, the Contractor shall submit the mixture proportions that will produce grout of the quality required. Applicable test reports shall be submitted to verify that the grout mixture proportions selected will produce grout of the quality specified.

SD-07 Certificates

Prestressing Steel

The Contractor shall furnish five copies of mill reports and five copies of a certificate from the manufacturer stating chemical properties, ultimate strengths, yield strengths, modulus of elasticity, and any other physical properties needed for the required computations, for the type of steel furnished.

SD-11 Closeout Submittals

Anchor Records

Upon completion of installation of each anchor, the Contractor shall furnish top of bond zone elevation, bond length, free stressing length of anchor, grout mix, grouting pressure, bags of cement injected, and a report of performance test or proof test and extended creep test results. The performance test, proof test and extended creep test results shall include measured lengths of drill holes and anchors, the loads and elongations recorded during testing, monitoring and stressing of the anchors, and graphs of test results. In addition as-built drawings showing the completed installation of the anchors shall be furnished upon completion of installation of all anchors.

1.5 QUALIFICATIONS

Anchor fabricator and installer qualifications shall be submitted for approval in accordance with paragraph SUBMITTALS. The submittals shall, where applicable, identify individuals who will be working on this contract and their relevant experience. No changes shall be made in approved personnel without prior approval of the Contracting Officer.

1.5.1 Fabricator Qualifications

The anchors shall be fabricated by a manufacturer that has been in the practice of designing and fabricating soil and rock anchors similar in size and scope to this project for at least ten years.

1.5.2 Installer Qualifications

The anchors shall be installed by a firm which is regularly engaged in the installation of soil and rock anchors and has at least ten years experience in the installation of similar anchors. The superintendent shall have installed anchors on at least five projects of similar scope and size.

1.6 PREPARATORY MEETING

Prior to commencing any work on the anchors, the Contractor, including all field personnel to be involved in drilling and installation of the anchors, shall meet with representatives of the Contracting Officer to review the plans and specifications, work plans, and submittals. Drilling may commence upon approval of the anchor installation plan and procedures described in paragraph SUBMITTALS and after the conduct of the Preparatory Meeting.

1.7 DELIVERY, STORAGE AND HANDLING

Materials shall be suitably wrapped, packaged or covered at the factory or shop to prevent being affected by dirt, water, oil, grease, and rust. Materials shall be protected against abrasion or damage during shipment and

handling. Materials stored at the site shall be placed above ground on a well supported platform and covered with plastic or other approved material. Materials shall be protected from adjacent construction operations. Grounding of welding leads to prestressing steel shall not be permitted. Prestressing steel which is damaged by abrasion, cuts, nicks, heavy corrosions, pitting, welds or weld spatter shall be rejected and removed from the site. Prestressing steel shall be inspected prior to insertion into anchor holes for damage to corrosion protection. Any such damage shall be repaired in a manner recommended by the prestressing steel manufacturer and approved by the Contracting Officer.

1.8 SITE CONDITIONS

Amend R0004

A foundation investigation has been made at the site by the Government and data is presented on the foundation exploration drawings. Logs of core borings and subsurface soil data logs are shown on the drawings. While the foundation information is representative of subsurface conditions at the respective locations, local variations in the characteristics of the subsurface materials may be anticipated. Local variations which may be encountered include, but are not limited to, classification and thickness of rock strata, fractures, and other discontinuities in the rock structure, and variation in the soil classifications. Such variations will not be considered as differing materially within the purview of the CONTRACT CLAUSES, paragraph DIFFERING SITE CONDITIONS. Core from the borings indicated on the drawings are available for inspection as specified in the SPECIAL CONTRACT REQUIREMENTS, paragraph PHYSICAL DATA. The Contracting Officer is responsible for location of all utilities that may be affected by construction. The Contractor is responsible for verifying the location of all utilities that may be affected by construction or the installation of the ~~rock bolts~~soil and rock anchors.

****

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Prestressing Steel

2.1.1.1 High-Strength Steel Bars

ASTM A 722/A 722M, Type II (deformed), (150 ksi ultimate tensile strength) meeting all supplementary requirements.

Mechanical couplings shall support the minimum ultimate tensile strength of the coupled bars.

2.1.2 Structural Steel

ASTM A 572/A 572M, Grade 50 (Fy = 50ksi)

2.1.3 Steel Pipe

ASTM A 53/A 53M,Type E or S, Grade B.

2.1.4 Steel Tube

ASTM A 500; grade B

2.1.5 Ductile Iron Castings

ASTM A 536.

2.1.6 Polyethylene Tubing

2.1.6.1 Smooth Polyethylene Tubing

ASTM D 1248, Type III.

2.1.6.2 Corrugated Polyethylene Tubing

AASHTO M 252, with average minimum wall thickness of 0.06 inch.

2.1.7 Polypropylene Tubing

2.1.7.1 Smooth Polypropylene Tubing

ASTM D 4101, designation PP 210 B5542-11.

2.1.8 Polyvinyl Chloride (PVC) Pipe

ASTM D 1785, Schedule 40.

2.1.9 Polyvinyl Chloride (PVC) Tubing

2.1.9.1 Smooth Polyvinyl Chloride (PVC) Tubing

ASTM D 1784.

2.1.9.2 Corrugated Polyvinyl Chloride (PVC) Tubing

Manufactured from rigid PVC compounds conforming to ASTM D 1784, Class 13464-8 with average minimum wall thickness of 0.04 inch.

2.1.10 Heat Shrinkable Sleeve

Radiation cross linked polyolefin tube internally coated with an adhesive sealant.

2.1.11 Corrosion Inhibiting Compound

The corrosion inhibiting compound shall conform to the requirements of Section 3.2.5 of PTI Spec.

2.2 MANUFACTURED ITEMS

2.2.1 Anchor Head

Anchor head shall consist of steel bearing plate with nut for threaded bar anchors, and corrosion protection. Anchorage devices shall be capable of developing 95 percent of the guaranteed ultimate strength of prestressing steel. The anchorage devices shall conform to the static strength requirements of Section 3.1.6 (1) and (2) of the PTI Post Tensioning Manual.

2.2.2 Prestressing Steel Couplers

Prestressing steel couplers for bars shall be capable of developing 100 percent of the minimum specified ultimate tensile strength of the prestressing steel.

2.2.3 Centralizers and Spacers

Centralizers and spacers shall be fabricated from plastic, steel or other approved material which is nondetrimental to the steel. Wood shall not be used. The centralizer shall be able to support the anchor in the drill hole and position the tendon so a minimum of 0.5 inch of grout cover is provided. Centralizers and spacers shall permit grout to freely flow up the drill hole.

2.2.4 Casing

Casing shall be selected and sized by the Contractor where required. Casing shall be the necessary type and size to permit proper drilling of anchor holes and placing of anchors as specified herein and shown on the drawings. Straightening of casings and machining of joints may be necessary in order to meet specified alignment tolerances.

2.3 GROUT

Amend R0004

All grout used shall be non-shrink type and shall be compatible with the steel anchors.

****

2.3.1 Cement

ASTM C 150, Type I, II, or III.

2.3.2 Water

Water shall be fresh, clean, potable, and free from injurious amounts of sewage, oil, acid, alkali, salts, or organic matter.

2.3.3 Aggregates

Amend R0004

Fine aggregate for sand-cement grout shall conform to ACI 301 and ASTM C 33 for grout for backfilling holes or ASTM C 144 for grout for pregrouting. Aggregates shall not contain substances which may be ~~deleterioulsy~~ deleteriously reactive with alkalies in the cement.

****

2.3.4 Admixtures.

Amend R0004

Non-shrink admixtures shall be used in all grout. Admixtures which control bleed, improve flowability, reduce water content and retard set may be used in the grout subject to the approval of the Contracting Officer. Any admixtures used shall be compatible with the steel and shall be mixed in accordance with the manufacturer's recommendations.

****

2.3.5 Grout for Anchors

2.3.5.1 Cement Grout

Amend R0004

Cement grout mixture proportions shall be the responsibility of the Contractor. Grout for grouting anchors shall consist of a homogenous, pumpable, stable mixture of portland cement and water. The stable mixture is defined as a mixture that does not bleed or segregate. The Contractor shall submit his proposed mix design to the Contracting Officer for approval. The water content shall be the minimum necessary for proper placement but the water-cement ratio shall not exceed 0.45 by weight. Final proportions of materials shall be based on results of tests made on sample mixtures of grout. The minimum compressive strength of two-inch cubes, molded, cured, and tested in accordance with ASTM C 109/C 109M, shall be ~~3,500~~ 4,000 psi at the time of stressing and 6,000 psi at 28 days. The Contractor shall be responsible for taking, curing, and breaking of grout test cubes for determining mix design, and all testing shall be done by an independent laboratory approved by the Contracting Officer. Soil and rock conditions and temperatures shall be replicated in the curing process.

****

2.3.6 Sand-Cement Grout

Amend R0004

Grout for holes which are abandoned shall consist of a mixture of portland cement, masonry sand and water. The grout mix proportions shall be the responsibility of the Contractor. The Contractor shall submit his proposed mix design to the Contracting Officer for approval. The water content shall be the minimum necessary for proper placement. Final proportions of materials shall be based on results of tests made on sample mixtures of grout. The minimum compressive strength of two-inch cubes, molded, cured, and tested in accordance with ASTM C 109/C 109M, shall be 4,000 psi at the time of stressing and 6,000 psi at 28 days. The Contractor shall be responsible for taking, curing, and breaking of grout test cubes for determining mix design, and all testing shall be done by an independent laboratory approved by the Contracting Officer. Soil and rock conditions and temperatures shall be replicated in the curing process.

****

2.3.7 Grout for Anchor Pads

Grout for leveling bearing plates shall be nonshrink grout conforming to ASTM C 1107.

2.4 ANCHOR FABRICATION

2.4.1 General

Fabrication of the anchors shall be as recommended by the suppliers. Anchors shall be completely assembled with all centralizers, spacers, grout

and vent tubes and corrosion protection prior to insertion into the hole. Fabricated anchors shall be protected, transported and stored in a manner to prevent contamination or damage to any components.

2.4.2 Bond Breaker

Bond breaker for free stressing length of unbonded anchors shall consist of smooth polyethylene tubing, minimum wall thickness 0.04 in., or smooth PVC tubing, minimum wall thickness 0.04 in.

2.4.3 Vent Tubes

Vent tubes used during grouting operations, if necessary, shall be any appropriate type for the job, as recommended by the supplier of the anchors.

2.4.4 Grout Tubes

Grout tubes shall be polyethylene tubing or as recommended by the anchor manufacturer and approved by the Contracting Officer. Inside diameter of grout tubes shall be adequate to fully grout the entire hole.

2.4.5 Corrosion Protection

Corrosion protection shall be as indicated. Corrosion protection shall be provided for the entire anchor (free stressing length and bond length).

2.4.5.1 Free Stressing Length Encapsulation

Encapsulation for free stressing length shall consist of a sheath of smooth polyethylene tubing, minimum wall thickness 0.06 inch; smooth polypropylene tubing, minimum wall thickness 0.06 inch; smooth PVC tubing, minimum wall thickness 0.04 inch; steel pipe or tube with minimum wall thickness 0.20 inch or corrugated tubing conforming to paragraph BOND LENGTH ENCAPSULATION. Sheath for bars may be heat shrinkable sleeve with a minimum thickness of 0.024 inch. Free stressing length encapsulation shall extend at least 4 inches into the trumpet, but shall not contact the bearing plate during testing and stressing of the prestressing steel. Where corrugated tubing is used for sheath for unbonded anchors, a separate bond breaker shall be provided.

2.4.5.2 Bond Length Encapsulation

Bond length encapsulation shall consist of corrugated polyethylene tubing, minimum wall thickness 0.060 inch or corrugated PVC tubing, minimum wall thickness 0.040 inch.

2.5 TESTS, INSPECTIONS, AND VERIFICATIONS

Amend R0004

The Contractor shall have required material tests performed on prestressing steel and accessories by an approved laboratory to demonstrate that the materials are in conformance with the specifications. Grout shall be tested in accordance with ASTM C 109/C 109M. These tests shall be at the Contractor's expense. **Grout tests shall be performed on each batch of grout mixed and used for soil and rock anchor installation.** Prestressing steel test results shall be furnished prior to beginning fabrication of any anchors. Grout test results shall be provided to the Contracting Officer within 24 hours of testing.

****

PART 3 EXECUTION

3.1 EQUIPMENT

The Contractor's Quality Control manager shall verify that the equipment used on site is the same as the equipment submitted for approval.

3.1.1 Drilling Equipment

Drilling equipment shall be suitable for advancing the drill tools to the depths and at the alignment specified.

3.1.2 Grouting Equipment

3.1.2.1 Grout Mixer

The grout mixer shall be a high-speed, high-shear, colloidal type grout mixer capable of continuous mechanical mixing that will produce uniform and thoroughly mixed grout which is free of lumps and undispersed cement. The mixer shall be equipped with a suitable water and admixture measuring devices calibrated to read in cubic feet and tenths and so designed that after each delivery the hands can be conveniently set back to zero.

3.1.2.2 Grout Pump

Amend R0004

The grout pump shall be of the positive displacement type, and shall be capable of pumping at all flow rates below 20 gallons per minute, shall be capable of pumping at the pressure of at least 50 psi at zero flow rate. For ~~neat~~ cement grout, the pump shall have a screen with 0.125 inch maximum clearance to sieve the grout before being introduced into the pump. Screens are not required for shear type mixers. A pump shall also be available which is capable of pumping both ~~neat~~ cement grout mixes and ~~sanded~~sand-cement grout mixes. The pumping equipment shall have a pressure gage capable of measuring pressures of at least 150 psi or twice the required grout pressure, whichever is greater.

****

3.1.2.3 Material Safety

Cement, lime, and bentonite clay are respiratory and skin irritants. See Section No. 6 of EM 385-1-1 shall be strictly adhered to and workers shall be equipped with respirators and skin protection during mixing of dry cement and bentonite products. The manufacturer's safety equipment and instructions shall be used.

3.1.3 Stressing Equipment

Stressing equipment shall be hydraulically operated and shall have a capacity sufficient to stress the anchors to the specified Test Loads within the rated capacity in one stroke. Pumps shall be capable of applying each load increment in less than 60 seconds and shall be capable of maintaining the hydraulic pressure within 50 psi. The equipment shall permit stressing of the prestressing steel in increments and raising or

lowering the load in the prestressing steel. The equipment shall be calibrated with an accuracy of ±2% and the calibration certificate and graphs shall be available at the site. The production gage shall have graduations of 100 psi or less. A second certified gage shall be maintained for periodic verification of the production gage. A dial gage or approved device shall be provided to measure total tendon elongation at each load increment to the nearest 0.001 inch. The dial gage shall be capable of measuring the entire anchor movement without being reset. Calibration of gages shall be verified no more than 30 calendar days prior to commencing work under this contract and at six-month intervals throughout the period of use.

3.1.4 Testing Equipment

Testing equipment shall consist of a hydraulic jack with calibrated pressure gage for applying the load and a dial gage or vernier scale to measure anchor movement. The ram travel of the stressing equipment shall be not less than the theoretical elastic elongation of the total anchor length at the maximum Test Load. The pressure gage shall be graduated in 100 psi increments. The stressing equipment and pressure gage must have been calibrated as a unit no more than 30 calendar days prior to commencing work under this contract and at six-month intervals throughout the period of use. The movement measuring device shall have a minimum travel equal to the theoretical elastic elongation of the total anchor length at the maximum Test Load without resetting the device. An approved dial gage or vernier scale and stand shall be provided to measure movement of the wall.

3.2 DRILLING HOLES

3.2.1 General

Amend R0004

The physical conditions indicated on the drawings are the result of soil sampling and core boring. (See also paragraph ~~"PROJECT~~ "SITE CONDITIONS"). Holes shall be drilled at the locations and inclinations shown and to the depths and diameters determined by the Contractor to provide the design bond length and capacity indicated on the drawings. The locations of the holes may be changed only as approved by the Contracting Officer. Any redesign due to relocation of anchor holes will be performed by the Government. Unless otherwise specified, the Contractor shall determine the drilling method to be used. No holes shall be drilled within 20 feet (horizontal and vertical) of a grouted hole until the grout has set at least 24 hours. Pressure grouting and drilling shall not be simultaneously performed within a distance of 20 feet. Care shall be taken while drilling to avoid damage of any kind to the existing structures. Damages of any nature will be evaluated by the Contracting Officer and repairs or replacements shall be made at his discretion. Holes shall be drilled a maximum of 1 foot beyond the required anchor bond length. Waste water from drilling operations shall be collected and recycled or treated; it shall not be discharged directly into the river or lake or on the ground. See also Section 01061 ENVIRONMENTAL PROTECTION.

****

3.2.2 Drilling In Soil

Holes in soil may be drilled by rotary drilling, rotary percussive, vibratory driven casing, or using other methods suitable for the intended

purpose. Holes in soil shall be provided with steel casing where required for support of the surrounding material.

3.2.3 Casing

Casing shall be utilized for drilling through unstable soil formations.

3.2.4 Drilling in Rock

Holes in rock may be drilled by rotary drilling, percussion drilling, down-the-hole hammer, or using other methods suitable for the intended purpose. Precast cofferdam segments shall not be damaged during drilling operations for the rock anchors for the precast cofferdam segments.

3.2.5 Records

The presence of a Government inspector or the keeping of separate drilling records by the Contracting Officer shall not relieve the Contractor of the responsibility for the work specified in this paragraph. Payment will not be made for any work for which the required records have not been furnished by the Contractor.

3.2.6 Alignment

3.2.6.1 Tolerances

The anchor hole shall be located within 12 inches of the plan location, unless noted otherwise. The anchor holes for anchoring the precast cofferdam segments shall be located within 1 inch of the plan location. The entry angle shall be within 3 degrees of the specified inclination, unless noted otherwise. The entry angle shall be within 1 degree of the specified inclination for the cofferdam precast segments. The alignment of the drilled hole shall be within 3 degrees of the theoretical alignment, unless otherwise noted. The alignment of the drilled hole for the cofferdam precast segments shall be within 1 degree of the theoretical alignment. If the hole alignment is not within these tolerances, the hole shall be backfilled with cement or sand-cement grout and a new hole drilled adjacent to the rejected hole.

3.3 INSTALLATION OF ANCHORS

3.3.1 General

The Contractor shall be responsible for each drilled hole until the anchor has been installed, grouted, stressed and accepted. Holes in rock and casings shall be cleaned by pressurized air and/or water to remove drill cuttings and mud. Precast cofferdam segments shall not be damaged during the installation of the rock anchors in the precast cofferdam segments.

3.3.2 Placing

All the equipment used in handling and placing the anchors shall be such that it does not damage or deteriorate the prestressing steel, corrosion protection, or the anchorages. Each anchor shall be inspected prior to insertion into the hole. Any damage to corrosion protection shall be repaired prior to insertion or, if determined by the Contracting Officer to be not repairable, the anchor shall be replaced. Insertion of anchors shall be in accordance with PTI Rec.

3.3.3 Cement Grouted Rock Anchors

Amend R0004

Grouting equipment shall be of type and capacity required for successful installation of the rock anchors. ~~All anchors shall use single stage grouting to encase the anchor.~~ Grouting shall be performed by a method in accordance with PTI Rec, paragraph 7.6. Grouting shall commence at the bottom of the grout zone and proceed to the top of the zone.

****

3.3.4 Grouting of Soil and Rock Anchors

3.3.4.1 General

Amend R0004

Within the bond length, grout placement shall proceed such that the hole is filled in a manner to prevent air voids. The ~~rock~~ anchor hole shall be progressively filled with grout and maintained completely full from bottom to top of the zone until the grout has set. Grouting may be accomplished through the casing pipe, grout tubes, hollow-stem augers or hollow drill rods. The grouting procedure used shall provide rock anchors which meet the specified design capacity.

****

3.3.4.2 Watertightness Test

Amend R0004

For each rock anchor, ~~A~~a watertightness test shall be conducted in drilled holes located above the water surface prior to installing cement-grouted ~~bolts~~anchors. Drilled holes for anchors that terminate in soil do not require the watertightness test. If the leakage rate exceeds 5 inches of water drop (measured along the drilled hole alignment) in 5 minutes then the hole shall be grouted, then redrilled after the grout sets for 18 hours and retested for watertightness. If the test is not satisfactory, the grouting and redrilling shall continue until the hole is watertight at no additional cost to the Government. The Contractor shall assume that 40 percent of the ~~rock bolt~~anchor holes will fail the watertightness test and require grouting and redrilling.

3.3.4.3 Gravity Grouting

~~Gravity grouting shall proceed from the bottom of the hole to the top of the hole.~~ Gravity grouting is not allowed for the soil and rock anchors of ~~the permanent retaining wall~~this specification Section 02490. All soil and rock anchors of Section 02490 shall be pressure grouted.

****

Amend R0004

3.3.4.4 Pressure Grouting ~~(Soil and Rock Anchors for Permanent Retaining~~

~~Wall)~~

****

The method of pressure grouting shall be determined by the Contractor. Grouting pressures and pumping rates shall be controlled to prevent ground surface heave or fracturing. Grouting pressures shall be incrementally increased until a refusal is reached or an acceptable amount of grout is pumped.

Amend R0004

3.3.4.5 Post-Grouting ~~(Soil and Rock Anchors for Permanent Retaining Wall)~~

****

The number of phases of post-grouting shall be determined by the Contractor. Grouting pressures and pumping rates shall be controlled to prevent ground surface heave or fracturing. Grouting pressures shall be incrementally increased until a refusal is reached or an acceptable amount of grout is pumped.

3.3.5 Installation

The bearing plate and nut (threaded bar anchors) and bearing plate, shall be installed perpendicular to the anchor, within 3 degrees, and centered on the anchor without bending of the stressing steel. Nuts, couplers, and threaded bar shall be free of dirt, grout or other contaminants. Corrosion protection shall be maintained intact at the anchorage and any damage shall be repaired prior to stressing.

3.4 STRESSING

After the anchor grout in the bond zone has reached sufficient strength as verified by grout cube break, the anchors shall be stressed. Prior to stressing, surfaces upon which the stressing equipment is resting must be clean and the stressing equipment shall be aligned as nearly with the center of the hole as possible. An Alignment Load of 10 percent of the Design Load shall be applied to the anchor prior to setting dial gauges. The Contractor shall stress the anchor in accordance with the anchor manufacturer's recommendation, subject to the approval of the Contracting Officer. Design and Lock-off loads are given on the drawings. The Contractor shall determine the lock-off procedure so that the lift-off results meet the acceptance criteria specified in paragraph ACCEPTANCE. The maximum stress shall never exceed 80 percent of the guaranteed ultimate strength of anchor steel. The process of stressing the anchors shall be so conducted that accurate elongation of the anchor steel can at all times be recorded and compared with the computations submitted to, and accepted by the Contracting Officer. Safety precautions shall be taken to prevent workers from being behind or in front of the stressing equipment during stressing. Stressing of the anchors shall be performed in a sequence submitted by the Contractor for review by the Contracting Officer. All stressing shall be done in the presence of a representative of the Contracting Officer. At no time during the stressing and testing of an anchor shall the stressing equipment be disconnected from the temporary stressing head or anchor.

3.4.1 Lock-off

After completion of all the required tests, the load shall be returned to the Alignment Load and the Lock-off Load specified on the drawings shall be applied to the anchor. A lift-off test shall be made to verify the load in the anchor before the anchor is locked-off and the stressing equipment is removed. The lift-off reading shall be within 5 percent of the specified lock-off load. If the lift-off reading is not within five percent of the specified lock-off load, the anchorage shall be reset and another lift-off reading shall be made. This procedure shall be repeated until a satisfactory lift-off reading is obtained.

3.5 FIELD QUALITY CONTROL

3.5.1 General

3.5.1.1 Soil and Rock Anchors for Permanent Soldier Pile with Tiebacks Retaining Wall

The first three anchors and a minimum of 5 percent of the remaining anchors shall be performance tested. All other anchors shall be proof tested. During stressing of each anchor, a record shall be kept of gage pressure and of anchor elongation at each stage of stressing to the specified test or Lock-off Load, as applicable. The Test Load shall not be exceeded. The Contractor shall provide a qualified engineer to evaluate the anchor test results and determine the acceptability of the anchors in accordance with the criteria indicated hereunder. Final acceptance of each anchor will be made by the Contracting Officer. All tests shall be run in the presence of the Contracting Officer or his representative.

3.5.1.2 Rock Anchors to Tie-Down the Cofferdam and the North Flood/Retaining Wall

The first three anchors at the cofferdam shall be performance tested. All other anchors shall be proof tested. During stressing of each anchor, a record shall be kept of gage pressure and of anchor elongation at each stage of stressing to the specified test or Lock-off Load, as applicable. The Test Load shall not be exceeded. The Contractor shall provide a qualified engineer to evaluate the anchor test results and determine the acceptability of the anchors in accordance with the criteria indicated hereunder. Final acceptance of each anchor will be made by the Contracting Officer. All tests shall be run in the presence of the Contracting Officer or his representative.

3.5.1.3 Rock Anchors to Support Cofferdam Slope and Wall

Amend R0004

Five percent of the anchors shall be ~~proof~~performance tested. ~~No performance tests will be conducted.~~All other anchors shall be proof tested. During stressing of each anchor, a record shall be kept of gage pressure and of anchor elongation at each stage of stressing to the specified test or Lock-off Load, as applicable. The Test Load shall not be exceeded. The Contractor shall provide a qualified engineer to evaluate the anchor test results and determine the acceptability of the anchors in accordance with the criteria indicated hereunder. Final acceptance of each anchor will be made by the Contracting Officer. All tests shall be run in the presence of the Contracting Officer or his representative.

****

3.5.2 Rock and Soil Anchor Performance Testing

The Contractor shall conduct performance tests on selected rock and soil anchor installations as specified and as directed by the Contracting Officer.

Amend R0004

Cement grouted rock and soil anchors shall be tested following a period of time not less than seven days after the installation has been completed. Minimum compressive strength of the cement grout at time of testing shall be ~~3,500~~4,000 psi.

****

Performance test procedures shall be in accordance with recommendations presented in PTI Post Tensioning Manual for Performance Tests, and shall conform to the following requirements

Amend R0004

1. ~~The maximum test load shall not exceed 80 percent of the guaranteed minimum ultimate tensile strength of the bar.~~ The maximum test load shall not exceed 133 percent of the design lock-off load stated for the bar, and in no case shall the maximum test load exceed 80 percent of the guaranteed minimum ultimate tensile strength of the bar.

2. A dial gage having a minimum range of 2.0 inches capable of measuring 0.001-inch shall be used to measure movement of the pulling head of the ~~rock bolt~~anchor. The gage shall be mounted on a stable reference system approved by the Contracting Officer.

3. A hydraulic center-hole jack and hand pump of the type typically used for testing ~~rock bolts~~anchors shall be used to apply the test load. The jack and pressure gauge shall be calibrated as a unit by an independent firm. The pressure gauge shall be graduated in 100 psi increments or less. The pressure gauge shall be used to measure the applied load. The ram travel of the jack shall not be less than 6 inches. A calibrated master pressure gauge shall be kept at the site. The master gauge shall be used to calibrate the test jack and pressure gauge approximately every five test bars.

****

4. The performance test shall be performed by cyclically and incrementally loading the rock and soil anchors in accordance with the following schedule. The anchor movements shall be measured from the alignment load and recorded to the nearest 0.001 inches with respect to an independent fixed reference point at each increment of load. The alignment load is a nominal load maintained on the anchor to keep the testing equipment in position. The test load shall be monitored with the pressure gauge. At load increments other than the maximum test load, the load shall be held just long enough to obtain the movement reading.

Performance Test Schedule

AL
0.25 DL*

AL
0.25 DL
0.50 DL*

AL
0.25 DL
0.50 DL
0.75 DL*

AL
0.25 DL
0.50 DL
0.75 DL
1.00 DL*

AL
0.25 DL
0.50 DL
0.75 DL
1.00 DL
1.20 DL*

AL
0.25 DL
0.50 DL
0.75 DL
1.00 DL
1.20 DL
1.33 DL* (Max. Test Load)
Reduce to Lock-Off Load

Amend R0004

Where: AL is the alignment load (less than 0.10 DL)
DL is the design load for anchor
(DL = 0.60 *Fpu *Aps for untensioned rock anchors)

****

5. The maximum test load shall be held for 10 minutes. The load-hold period shall start as soon as the maximum test load is applied. The anchor movement, with respect to a fixed reference, shall be measured at 1, 2, 3, 4, 5, 6, and 10 minutes. If the anchor movement between 1minute and 10 minutes exceeds 0.04 inches, the maximum test load shall be held for an additional 50 minutes. If the load hold is extended, the anchor movement shall be recorded at 15, 20, 25, 30 45, and 60 minutes. The Contractor shall plot the rock anchor movement versus test load for each load increment marked with an asterisk(*) in the performance test schedule and plot the residual movement of the anchor at each alignment load versus the highest previously applied load.

6. The Contracting Officer shall determine the acceptability of all performance tests, and may reject those that do not conform to the specifications.

3.5.3 Proof Test

Amend R0004

Proof test shall consist of incrementally loading the rock and soil anchors and shall be conducted in accordance with PTI Rec. During the testing of each rock and soil anchor, a record shall be kept of gage pressure and of ~~rock bolt~~anchor elongation at each stage of stressing to the Test Load required by PTI Rec. Measurements of the elongation of steel bar shall be made in accordance with PTI Rec. If the total movement at the end of 10 minutes at the maximum Test Load exceeds 0.040 inches, the Test Load shall be held an additional 50 minutes and the movement readings shall be taken at the interval specified in PTI Rec, paragraph 4.3.7.2. Test records shall be furnished upon acceptance of each proof tested ~~rock bolt~~anchor in accordance with paragraph: SUBMITTALS, subparagraph: SD-11 Closeout Submittals.

Proof Test Schedule

AL
0.25 DL
0.50 DL
0.75 DL
1.00 DL
1.20 DL
1.33 DL (Max. test Load)
Reduce to Lock-Off Load

Amend R0004

Where: AL is the alignment load (less than 0.10 DL)
DL is the design load for ~~ground~~ anchor
(DL = 0.60 *Fpu *Aps for untensioned rock ~~bolts)~~anchors)

****

3.5.4 Anchor Records

Upon completion of installation of each anchor, the Contractor shall furnish anchor records to the Contracting Officer as specified in paragraph SUBMITTALS.

3.6 ACCEPTANCE

3.6.1 General

Acceptance of anchors shall be determined by the Contracting Officer. The following criteria will be used in determination of the acceptability of each anchor:

a. Creep - Creep movement shall not exceed 0.040 inch at maximum Test Load during the first 10 minutes of the performance or proof test. If the creep movement exceeds this limit, it shall not exceed 0.080 inch at the maximum Test Load at the end of 60 minutes. If the creep movement exceeds 0.080 inch at the maximum Test Load at the end of 60 minutes, the anchor shall be rejected.

b. Movement - Apparent free length shall be calculated from the observed elastic movement in accordance with PTI Rec.

1. Minimum Apparent Free Length - The calculated free length shall be not less than 80% of the designed free tendon length plus the jack length. If the anchor does not meet this criteria, the anchor shall be restressed from the Alignment Load to the Test Load and the apparent free length shall be recalculated. If the anchor does not meet this criteria after 3 attempts (original plus 2 restresses), the anchor shall be rejected.

2. Maximum Apparent Free Length - The calculated free length shall be not more than 100% of the designed free length plus 50% of the bond length plus the jack length. If the anchor does not meet this criteria, and the cause of the behavior is not investigated and explained to the satisfaction of the Contracting Officer, the anchor shall be rejected.

c. Initial Lift-Off Reading - The initial lift-off reading shall be within 5% of the specified Lock-off Load. If the anchor does not meet this criteria, the anchor shall be adjusted as necessary and the lift-off reading shall be repeated.

3.6.2 Replacement of Rejected Anchors

Any anchor that fails the performance or proof test or is rejected by the Contracting Officer shall be replaced. A replacement anchor, including a new anchor hole, shall be provided by the Contractor at no expense to the Government. The location of the replacement anchor shall be as directed by the Contracting Officer. The Contractor shall provide all materials, supplies, equipment, and labor necessary to provide a new anchor assembly to the satisfaction of the Contracting Officer. No drilling shall be performed for a replacement anchor until the grouting of all anchors within 50 feet (horizontal and vertical) of the replacement anchor location has been allowed to set for at least 24 hours. Payment will not be made for rejected or failed anchors. The Contractor shall either remove failed anchors and thoroughly ream and clear the anchor hole or remove the load and cut the anchor and casing flush.

-- End of Section --

SECTION 02845

SOLDIER PILE WITH TIEBACKS RETAINING WALL

PART 1 GENERAL

1.1 DESCRIPTION

This work consists of furnishing and constructing soldier pile with tiebacks retaining walls at locations shown and in close conformity to the lines, grades, and dimensions shown on the plans and shall conform to the requirements herein.

1.2 RELATED WORK

See the following sections for related work:

Section 02490, SOIL AND ROCK ANCHORS
Section 03100a, STRUCTURAL CONCRETE FORMWORK
Section 03201, STEEL BARS AND WELDED WIRE FABRIC FOR CONCRETE REINFORCEMENT FOR CIVIL WORKS
Section 03301a, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS
Section 05055a, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS
Section 05500a, MISCELLANEOUS METAL

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 792	(2000) Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D 1784	(1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 4716	(2000) Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Tieback Wall Work Plan; G

Before the start of wall construction, the Contractor shall submit and have approved a work plan addressing the measures that will be employed to provide for the safety of traffic and the public. The work plan shall be signed by an engineer who is registered as a Civil Engineer in the State of Washington. As a minimum, the work plan shall include:

1. Detailed sequence and procedures for all phases of the wall installation.

2. List of the equipment and standby equipment to be utilized during installation of the tieback wall.

3. Qualifications of the workforce to be utilized in the wall installation.

4. The Contracting Officer shall take 2 weeks to review the tieback wall work plan.

Tieback Installation; G

Procedures and qualifications for altering piles for tieback installation shall be submitted for approval.

Mix Design; G

Mix Design shall be submitted for approval before installation.

SD-02 Shop Drawings

Tieback Drawings; G

Submit Working drawings and calculations for furnishing the specified number of tieback anchors providing the horizontal component and distribution of design force as provided by the tieback anchors shown in the plans.

SD-03 Product Data

Steel Solider Piles; G
Concrete; G
Reinforcing Steel; G
Geocomposite; G

Product data for all materials shall be reviewed and approved by the Contracting Officer.

SD-06 Test Reports

Concrete Mix Design; G

Concrete Mix Design Test Reports shall be submitted for Government approval.

SD-07 Certificates

Piles; G
Tiebacks; G

Certifications for piles and tiebacks shall be submitted to the Contracting Officer for approval.

PART 2 PRODUCTS

2.1 PILES

2.1.1 Soldier Piles

Steel soldier piles shall be of the size and quality as shown on the plans and as specified in Division 5 of the specifications.

Amend R0004

2.1.2 Concrete ~~Piles~~Cylinder Shaft Infill

Concrete filling for cast-in-place concrete ~~piles~~shafts ~~is designated by compressive strength and~~ shall have a minimum 28-day unconfined compressive strength (f'c) of 4,000 psi below elevation 1171, and shall conform to the plans and Division 3 of the specifications. Lean concrete filling for the cast-in-place concrete shafts shall be installed above elevation 1171 and shall conform to the plans and Division 3 of the specifications.

****

2.1.3 Reinforcing Steel

Reinforcing steel shall be Grade 60 and shall conform to Section 03201, STEEL BARS AND WELDED WIRE FABRIC FOR CONCRETE REINFORCEMENT FOR CIVIL WORKS.

2.1.4 Tiebacks

Tiebacks shall be of the size and quality as shown on the plans and as specified in Section 02490, SOIL AND ROCK ANCHORS.

2.2 Geocomposite

Manufactured core not less than 0.25 inch thick or more than 2 inches thick with one side covered with a layer of filter fabric.

Flow rate per ASTM D 4716 of at least 4.0 gallons per minute per foot of width at a hydraulic gradient of 1.0 and a minimum externally applied pressure of 3,800 psf.

PART 3 EXECUTION

3.1 PILE SHAFT EXCAVATION

Holes shall be drilled at the location and depth shown on the plans.

Drilled holes shall be accurately located and shall be drilled straight and true so the steel soldier piles meet the tolerances of being within 1 inch in each horizontal direction of the indicated position at each elevation. Holes which do not conform to the required tolerances shall be corrected at the Contractor's expense. Holes overdrilled by 6 inches or more shall be

backfilled with concrete to required tip elevation as shown on the drawings.

Suitable casings shall be furnished and placed when necessary to control water or to prevent caving of the hole. Casing, if used in drilling operations, shall be removed from the hole as concrete is placed therein. The bottom of the casing shall be maintained not more than 5 feet nor less than one foot below the top of the concrete during withdrawal and placing operations unless otherwise permitted by the Contracting Officer. Separation of the concrete during withdrawal operations shall be avoided by hammering or otherwise vibrating the casing.

All loose materials existing at the bottom of the hole after drilling operations have been completed shall be removed before placing the cast-in drilled-hole (CIDH) pile and backfilling soldier pile with concrete.

Materials resulting from drilling holes shall be disposed of outside the site limits at the designated disposal areas.

Drilling mud or chemical stabilizers shall not be used except when permitted by the Contracting Officer.

Surface water shall not be permitted to enter the hole and all water in the hole shall be removed before placing reinforced concrete therein.

3.2 PILE INSTALLATION

Steel soldier piles shall not be driven.

Piles shall be installed, aligned and held securely for concreting in accordance with the approved procedures. Established tolerances shall be confirmed prior to placing concrete. Steel soldier piles shall be installed to a tolerance of within 1.0 inch in each horizontal direction of the indicated position at each elevation.

3.3 CONCRETE PLACEMENT

Unless otherwise noted, the proportioning, mixing, transporting, placing, curing, and finishing of the concrete shall be as per Section 03301a CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

Uncased excavations shall not be left open overnight; fill uncased excavations before work day is completed.

At the time concrete is placed, the excavation shall be free from accumulated seepage water in excess of 2 inches in depth and any loose material.

Concrete placement shall begin immediately after the pile placement has been approved by the Contracting Officer. Placement shall be continuous throughout the length of the shaft, allowing only the necessary intervals for rodding concrete and pulling casings.

Free fall concrete may be used if there is no water in the shaft excavation and provided it is directed through a hopper equipped with a tube, elephant trunk, or equivalent to prevent segregation of materials, such that fall is vertical down center of shaft without hitting sides. The tube shall be in sections to permit the discharge end to be raised as the shaft is filled.

Concrete shall be of such workability as to require no vibrating and a

minimum amount of rodding in the shaft length below 3 feet from the top.

The top 3 feet of shaft concrete shall be vibrated. Temporary casings shall be withdrawn before vibrating begins.

Once concrete is placed further work shall not proceed until the concrete has attained a compressive strength of not less than 2,600 psi.

3.4 REINFORCED CONCRETE FASCIA WALL

Concrete and reinforcement shall conform to Sections 03201, STEEL BARS AND WELDED WIRE FABRIC FOR CONCRETE REINFORCEMENT FOR CIVIL WORKS and 03301a, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

3.5 BANK EXCAVATION

Excavate to the level of the first lift to install the upper level of tiebacks.

Materials resulting from drilling holes shall be disposed of outside the site limits at the designated disposal areas.

3.6 TIMBER LAGGING INSTALLATION

Install initial level of the timber lagging after sufficient depth along adjacent soldier piles has been exposed by bank excavation. The timber lagging shall be Douglas Fir No. 1 Grade.

Lagging shall be secured in place during tieback installation, testing and lock off and excavation to the next level.

Subsequent levels of lagging shall be placed as installation and excavation moves downward.

3.7 TIEBACK ANCHORS

Amend R0004

The fabrications, installation, grouting, and testing of the tieback anchors shall conform to Section 02490, SOIL AND ROCK ANCHORS, and as specified in this section.

Grouting equipment shall be capable of grouting at a pressure of at least 100 psi. The grout shall consist of Portland cement, water, and a water reducing admixture and shall ~~be mixed in the following proportions:~~meet the requirements of Section 02490, SOIL AND ROCK ANCHORS.

~~Portland Cement Type 1 or II per ASTM C 150, 1 sack;~~
~~Water, 4.5 gallons maximum,;~~
~~Water Reducing Admixture per manufacturer's recommendation.~~
~~Fly Ash, (20 pounds maximum) is optional.~~

~~The water reducing admixture shall be limited to AASHTO M 194 Type A or D and shall not contain ingredients that may corrode steel (that is chlorides, fluorides, sulfates, or nitrates). Fly ash may be used at the option of the Contractor. The grout ejected from the anchor vent shall have a minimum flow of 15 seconds. The grout mix shall be injected within 30 minutes after the water is added to the cement. Test samples of 2-inch cubes shall be made in accordance with WSDOT Test Method 813 and stored in~~

~~accordance with Method 2 of Field Operating Procedure for AASHTO T 23.~~

****

Smooth and corrugated plastic sheathing, including joints, shall be watertight. Polyvinyl chloride (PVC) sheathing shall conform to ASTM D 1784, Class 13464-B. High density polyethylene (HDPE) sheathing shall have a density between 0.940 and 0.960-gram/cm^3 as measured in accordance with ASTM D 792, A-2. Corrugated plastic sheathing shall be PVC or HDPE.

The transition between the corrugated plastic sheathing and the anchorage assembly shall be an approved detail that allows stressing to the design force without evidence of distress in the corrugated plastic sheathing.

Additional requirements for tiebacks with bar type tendons are as follows:

1. Corrugated sheathing for bar tendons shall have a nominal wall thickness of 40 mils.

Tieback anchors shall be installed in accordance with the manufacturer's recommendations. In case of a conflict between the manufacturer's recommendations and these special provisions, these special provisions shall prevail.

Water and grout from tieback anchor construction operations shall not be permitted to fall on public traffic, to flow across shoulders or lanes occupied by public traffic, or to flow into landscaping, gutters or other drainage facilities. Excessive amounts of water shall not be used in any of the drilling and the tieback anchor installation procedures.

The holes drilled in the foundation materials shall be drilled to a depth sufficient to provide the necessary bond length beyond the minimum unbonded length shown on the plans. The diameter of the hole shall be large enough to provide a minimum of one inch grout cover over the corrugated plastic sheathing for the frill-length of the tendon. Centralizers shall be used full-length of the tendon.

Tieback anchor holes in foundation material shall be drilled by either the rotary or percussion drilling method.

Prior to installing each tieback anchor into the anchor hole, the anchor shall be clean and free of oil, grease, din or other extraneous substance.

Tieback anchor steel shall be protected prior to completion of all grouting against rust, corrosion and physical damage. In addition, there shall be no evidence of distress in the plastic sheathing or crushing of the cement grout within the sheathing.

Tieback anchor grout placed in the drilled hole shall be placed using grout tubes.

Grout for all stages shall be injected at the low end of the void being filled and shall be expelled at the high end until there is no evidence of entrapped air, water or diluted grout.

After initial grouting, the tieback anchor shall remain undisturbed until the grout has reached a strength sufficient to provide anchorage during load testing.

Secondary grouting shall be completed after the tieback anchor has been locked off at the required load.

Bars for multiple bar tendons shall be stressed simultaneously.

Additional requirements for tiebacks with bar type tendons are as follows:

1. The bar tendons in the unbonded area shall be sheathed with smooth plastic that extends into the steel tube of the permanent tieback anchorage assembly, as shown on the plans. For this portion of smooth sheathing there is no minimum wall thickness and the sheathing shall be either PVC or HDPE.

2. In addition, bar tendons shall be sheathed full-length with corrugated plastic. The annular space between the bar and the corrugated sheathing shall be pregrouted prior to placing the tendons in the drilled hole.

3. There shall be a seal between the smooth sheathing and the corrugated sheathing at the top and bottom of the length of smooth sheathing.

4. For bar tendons, the initial grout in the drilled hole may be placed before or after insertion of the bar tendons.

5. For drilled holes 6 inches in diameter or less, the initial grouting outside of the corrugated plastic sheathing shall extend to 2 feet below the end of the steel tube of the anchorage assembly. For drilled holes greater than 6 inches in diameter, the initial grouting outside of the corrugated plastic sheathing shall be within the limits of the bonded length.

3.8 TESTING

All tiebacks shall be load tested by either a performance test or a proof test. Testing requirements are given in Section 02490, SOIL AND ROCK ANCHORS.

3.9 LOCK-OFF

After successful testing of the tieback anchors, the tieback anchors shall be locked off. The lock-off requirements are given in Section 02490, SOIL AND ROCK ANCHORS.

After lock-off, the grout shall be extended to the secondary grout level shown on the plans. At least 24 hours after the secondary grout has set, the remaining void in the steel tube and bearing plate shall be filled with grout. Grout shall be injected at the low end and expelled at the high end until there is no evidence of entrapped air or water. A minimum grout head of 2 feet shall be maintained until the grout has set.

The tieback anchor head or anchor nuts shall be enclosed with a grouted anchorage enclosure device. After grouting the steel tube, the bearing plate surface shall be cleaned, silicon sealant placed, and the anchorage enclosure bolted in place. After bolting the anchorage enclosure in place, the void in the anchorage enclosure shall be filled with grout by injecting grout at the low end of the void and venting at the high end. Any holes in the top of the anchorage enclosure used for grout placement shall be cleaned and sealed with silicon sealant.

3.10 WALL DRAINAGE

Geocomposite drainage and weep hole material will be installed as lagging is installed.

Weep hole drains shall be installed in accordance with the plans.

3.11 BACKFILL

Voids between the lagging and excavated bank shall be backfilled in 8-inch layers and compacted. Backfill material shall be pervious pea gravel backfill.

3.12 CLEANUP

Grout, stains and other construction materials shall be cleaned from the lagging and exposed face of the soldier pile flange.

Protective coating on the soldier pile shall be repaired.

-- End of Section --

SECTION 03100

STRUCTURAL CONCRETE FORMWORK

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 117/117R	(1990) Tolerances for Concrete Construction and Materials
ACI 347R	(1994; R1999) Guide to Formwork for Concrete

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995) Basic Hardboard

U.S. DEPARTMENT OF COMMERCE (DOC)

PS-1	(1996) Voluntary Product Standard - Construction and Industrial Plywood

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Formwork

Drawings showing details of formwork, including dimensions of fiber voids, joints, supports, studding and shoring, and sequence of form and shoring removal, shall be provided prior to placing concrete. Permanent formwork for the tremie concrete north of the existing outlet works tower shall include sheet piling as specified in Section 02464a, METAL SHEET PILING

SD-03 Product Data

Design

Amend R0004

Design analysis and calculations for form design and methodology

used in the design of the concrete formwork, including the permanent formwork for the tremie concrete north of the existing outlet works tower, shall be provided prior to placing concrete. The Contractor shall submit a sealed design by a registered engineer for all formwork.

****

Form Materials

Manufacturer's data including literature describing form materials, accessories, and form releasing agents.

Form Releasing Agents

Manufacturer's recommendation on method and rate of application of form releasing agents.

SD-07 Certificates

Fiber Voids

Certificates attesting that fiber voids conform to the specified requirements.

1.3 DESIGN

Amend R0004

Formwork shall be designed in accordance with methodology of ACI 347R for anticipated loads, lateral pressures, and stresses. The Contractor shall submit a sealed design by a registered engineer for all formwork. Forms shall be capable of producing a surface which meets the requirements of the class of finish specified in Section 03301a CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS. Permanent sheet pile forms are not subject to the surface finish requirements. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

****

1.4 STORAGE AND HANDLING

Fiber voids shall be stored above ground level in a dry location. Fiber voids shall be kept dry until installed and overlaid with concrete.

PART 2 PRODUCTS

2.1 FORM MATERIALS

2.1.1 Forms For Class A and Class B Finish

Forms for Class A and Class B finished surfaces shall be plywood panels conforming to PS-1, Grade B-B concrete form panels, Class I or II, or steel forms. Other form materials or liners may be used provided the smoothness and appearance of concrete produced will be equivalent to that produced by the plywood concrete form panels. Forms for round columns shall be the prefabricated seamless type.

2.1.2 Forms For Class C Finish

Forms for Class C finished surfaces shall be plywood conforming to PS-1, Grade B-B concrete form panels, Class I or II; tempered concrete form hardboard conforming to AHA A135.4; other approved concrete form material; or steel, except that steel lining on wood sheathing shall not be used. Forms for round columns may have two vertical seams.

2.1.3 Forms For Class D Finish

This class of finish, unless otherwise noted, shall apply to all surfaces that will be permanently concealed after construction. Forms for Class D finished surfaces, except where concrete is placed against earth, shall be wood or steel or other approved concrete form material.

2.1.4 Form Ties

Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal. Solid backing shall be provided for each tie. Except where removable tie rods are used, ties shall not leave holes in the concrete surface less than 1/4 inch nor more than 1 inch deep and not more than 1 inch in diameter. Removable tie rods shall be not more than 1-1/2 inches in diameter.

2.1.5 Form Releasing Agents

Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

2.1.6 Fiber Voids

Fiber voids shall be the product of a reputable manufacturer regularly engaged in the commercial production of fiber voids. The voids shall be constructed of double faced, corrugated fiberboard. The corrugated fiberboard shall be fabricated of wet strength paper liners, impregnated with paraffin, and laminated with moisture resistant adhesive, and shall have a board strength of 275 psi. Voids which are impregnated with paraffin after construction, in lieu of being constructed with paraffin impregnated fiberboard, are acceptable. Voids shall be designed to support not less than 1000 psf. To prevent separation during concrete placement fiber voids shall be assembled with steel or plastic banding at 4 feet on center maximum, or by adequate stapling or gluing as recommended by the manufacturer.

2.1.7 Sheet Pile Forms

Sheet pile permanent forms shall conform to Section 02464a, METAL SHEET PILING.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Formwork

Amend R0004

Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section 03301a CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS and conforming to construction tolerance given in the contract drawings, ACI 117/117R and in TABLE 1. The more stringent requirements between the contract drawings, ACI 117/117R and Table 1 shall apply. Where concrete surfaces are to have a Class A or Class B finish, joints in form panels shall be arranged as approved. Where forms for continuous surfaces are placed in successive units, the forms shall fit over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and of all other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker. Temporary openings shall be provided as necessary to facilitate cleaning and inspection prior to placement of concrete.

****

3.1.2 Fiber Voids

Voids shall be placed on a smooth firm dry bed of suitable material, to avoid being displaced vertically, and shall be set tight, with no buckled cartons, in order that horizontal displacement cannot take place. Each section of void shall have its ends sealed by dipping in paraffin, with any additional cutting of voids at the jobsite to be field dipped in the same type of sealer, unless liners and flutes are completely impregnated with paraffin. Prior to placing reinforcement, the entire formed area for slabs shall be covered with a 4 x 8 feet minimum flat sheets of fiber void corrugated fiberboard. Joints shall be sealed with a moisture resistant tape having a minimum width of 3 inches. If voids are destroyed or damaged and are not capable of supporting the design load, they shall be replaced prior to placing of concrete.

3.2 CHAMFERING

Except as otherwise shown, external corners that will be exposed shall be chamfered, beveled, or rounded by moldings placed in the forms.

3.3 COATING

Forms for Class A and Class B finished surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions. Forms for Class C and D finished surfaces may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures, coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.4 FINISHING FORMED SURFACES

3.4.1 General

Amend R0004

Finishing of formed surfaces shall be as specified herein. Unless otherwise specified, surfaces shall be left with the texture imparted by the forms except that defective surfaces shall be repaired. Uniform color of the concrete shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure. Surface defects shall be repaired as specified herein within 24 hours after forms are removed. Repairs of the so-called "plaster-type" will not be permitted in any location. Tolerances of formed surfaces shall conform to the requirements of the contract drawings, ACI 117/117R and Table 1 of this section. The more stringent requirements between the contract drawings, ACI 117/117R and Table 1 of this section shall apply. These tolerances apply to the finished concrete surface, not to the forms themselves; forms shall be set true to line and grade. Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter shall be repaired as specified in paragraph 3.5. Repairs shall be demonstrated to be acceptable and free form cracks or loose or drummy areas at the completion of the contract and shall be inconspicuous. Repairs not meeting these requirements will be rejected and shall be replaced.

****

3.4.2 Class A and Class B Finish

Class A finish, unless otherwise noted, is required for all concrete surfaces that will be exposed to flowing water or that will be exposed to view. Fins, ravelings, and loose material shall be removed, all surface defects over 1/2-inch in diameter or more than 1/2-inch deep, shall be repaired and except as otherwise indicated or as specified in paragraph 3.5, holes left by removal of form ties shall be reamed and filled. Defects more than 1/2-inch in diameter shall be cut back to sound concrete to a depth of at least 1 inch and repaired as indicated in paragraph 3.5. The Contractor shall prepare a sample panel for Contracting Officer approval before commencing repair, showing that the surface texture and color match will be attained. Metal tools shall not be used to finish repairs in Class A surfaces.

3.4.3 Class C and Class D Finish

Class C finish, unless otherwise noted, is required on all concrete surfaces not exposed to view. Concrete cast against rock does not have to meet this requirement at the concrete-to-rock interface. Fins, ravelings, and loose material shall be removed, and, except as otherwise indicated,holes left by removal of form ties and areas of honeycomb and other defects more than 2 inches in diameter or more than 1/2-inch deep shall be reamed and filled. Defects greater than 2 inches in diameter shall be cut back to sound concrete, but in all cases at least 1-inch deep and repaired in accordance with provisions of paragraph 3.5.

3.5 REPAIRS

Surface defects shall be repaired within 24 hours after the removal of forms. Honeycombed and other defective areas shall be cut back to solid concrete or to a depth of not less than 1 inch, whichever is greater. Edges shall be cut perpendicular to the surface of the concrete. The prepared areas shall be dampened and bush-coated with neat cement grout. The repair shall be made using mortar consisting of not more than 1 part cement to 2-1/2 parts sand. The mixed mortar shall be allowed to stand to stiffen (approximately 45 minutes), during which time the mortar shall be

intermittently remixed without the addition of water. After the mortar has attained the stiffest consistency that will permit placing, the patching mix shall be thoroughly tamped into place by an approved means and finished slightly higher than the surrounding surface. For Class A and Class B finished surfaces the cement used in the patching mortar shall be a blend of job cement and white cement proportioned to produce a finish repair surface matching, after curing, the color of adjacent surfaces. Holes left after the removal of form ties shall be cleaned and filled with patching mortar. Holes left by the removal of tie rods shall be removed and filled by dry-packed. Repaired surfaces shall be cured as required for adjacent surfaces. The temperature of concrete mortar patching material, and ambient air shall be above 50 degrees Fahrenheit while making repairs and during the curing period. Concrete with defects that affect the strength of the member or with excessive honeycombs will be rejected, or the defects shall be corrected as directed.

3.6 REMOVAL OF FORMS

Forms shall be removed preventing injury to the concrete and ensuring the complete safety of the structure. Formwork for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement. Supporting forms and shores shall not be removed from beams, floors and walls until the structural units are strong enough to carry their own weight and any other construction or natural loads. Supporting forms or shores shall not be removed before the concrete strength has reached 70 percent of design strength, as determined by field cured cylinders or other approved methods. This strength shall be demonstrated by job-cured test specimens, and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured test specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.

TABLE 1

TOLERANCES FOR FORMED SURFACES

1.	Variations from the plumb:	In any 10 feet of length ---------- 1/4 inch
	a. In the lines and surfaces of columns, piers, walls and in arises	Maximum for entire length ---------- 1 inch
	b. For exposed corner columns,control-joint grooves, and other conspicuous lines	In any 20 feet of length ---------- ---- 1/4 inch Maximum for entire length---------- 1/2 inch
2.	Variation from the level or from the grades indicated	In any 10 feet of length ----------1/4 inch In any bay or in any 20

TABLE 1

TOLERANCES FOR FORMED SURFACES

	on the drawings:	feet of length---------- 3/8 inch
	a. In slab soffits, ceilings, beam soffits, and in arises, measured before removal of supporting shores	Maximum for entire length ---------- 3/4 inch
	b. In exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	In any bay or in any 20 feet of length ---------- ----- 1/4 inch Maximum for entire length---------- 1/2 inch
3.	Variation of the linear building lines from established position in plan	In any 20 feet --------- 1/2 inch Maximum ----------1 inch
4.	Variation of distance between walls, columns, partitions	1/4 inch per 10 feet of distance, but not more than 1/2 inch in any one bay,and not more than 1 inch total variation
5.	Variation in the sizes and locations of sleeves, floor openings, and wall opening	Minus ---------- 1/4 inch Plus ---------- 1/2 inch
6.	Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls	Minus ---------- 1/4 inch Plus ---------- 1/2 inch
7.	Footings:	
	a. Variation of dimensions in plan	Minus ---------- 1/2 inch Plus ---------- 2 inches when formed or plus 3 inches when placed against unformed excavation
	b. Misplacement of eccentricity	2 percent of the footing width in the direction of misplacement but not more than 2 inches
	c. Reduction in thickness of specified thickness	Minus ---------- 5 percent
8.	Variation in steps:	Riser ---------- 1/8 inch
	a. In a flight of stairs	Tread ---------- 1/4 inch

TABLE 1

TOLERANCES FOR FORMED SURFACES

b. In consecutive steps	Riser	1/16 inch
	Tread	1/8 inch

-- End of Section --

SECTION 03301

CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 117/117R	(1990) Tolerances for Concrete Construction and Materials
ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 214	(1977; R 1997) Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 305R	(1999) Hot Weather Concreting

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 31/C 31M	(2000) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1999ae1) Concrete Aggregates
ASTM C 39/C 39M	(1999) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	(1999) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 94/C 94M	(2000) Ready-Mixed Concrete
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143/C 143M	(2000) Slump of Hydraulic Cement Concrete
ASTM C 150	(1999a) Portland Cement
ASTM C 172	(1999) Sampling Freshly Mixed Concrete
ASTM C 192/C 192M	(2000) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(1997e1) Air Content of Freshly Mixed Concrete by the Pressure Method

ASTM C 260	(2000) Air-Entraining Admixtures for Concrete
ASTM C 309	(1998a) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494/C 494M	(1999a) Chemical Admixtures for Concrete
ASTM C 566	(1997) Total Evaporable Moisture Content of Aggregate by Drying
ASTM C 597	(1983; R 1997) Pulse Velocity Through Concrete
ASTM C 618	(1999) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 803/C 803M	(1997e1) Penetration Resistance of Hardened Concrete
ASTM C 805	(1997) Rebound Number of Hardened Concrete
ASTM C 881	(1999) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 1017/C 1017M	(1998) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1064/C 1064M	(1999) Temperature of Freshly Mixed Portland Cement Concrete
ASTM C 1077	(1998) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1107	(1999) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D 75	(1987; R 1997) Sampling Aggregates

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 94	(1995) Surface Retarders
COE CRD-C 100	(1975) Method of Sampling Concrete Aggregate and Aggregate Sources, and Selection of Material for Testing
COE CRD-C 104	(1980) Method of Calculation of the Fineness Modulus of Aggregate
COE CRD-C 143	(1962) Specifications for Meters for Automatic Indication of Moisture in Fine Aggregate
COE CRD-C 400	(1963) Requirements for Water for Use in

	Mixing or Curing Concrete
COE CRD-C 521	(1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	(1997) NIST Handbook 44: Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100	(1996) Concrete Plant Standards

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Concrete Placement Plan; G

Details and descriptions of concrete placement in, above and adjacent to water showing conformance to requirements of the Environmental Protection Plan in Section 01061, ENVIRONMENTAL PROTECTION, including preventative measures for spillage, containment and cleanup.

Construction Joint Treatment

The method and equipment proposed for joint cleanup and waste disposal shall be submitted for review and approval.

Curing and Protection

The curing medium and methods to be used shall be submitted for review and approval.

SD-03 Product Data

Concrete Mixture Proportioning, G

Concrete mixture proportions shall be determined by the Contractor and submitted for review. The concrete mixture quantities of all ingredients per cubic yard and nominal maximum coarse aggregate size that will be used in the manufacture of each quality of concrete shall be stated. Proportions shall indicate the mass of cement, pozzolan and ground granulated blast-furnace (GGBF) slag when used, and water; the mass of aggregates in a saturated surface-dry condition; and the quantities of admixtures. The submission shall be accompanied by test reports from a laboratory complying with ASTM C 1077 which show that proportions thus selected will produce concrete of the qualities indicated.

No substitution shall be made in the source or type of materials used in the work without additional tests to show that the quality of the new materials and concrete are satisfactory.

Batch Plant

The Contractor shall submit batch plant data to the Contracting Officer for review for conformance with applicable specifications.

Concrete Mixers
Capacity

The Contractor shall submit concrete mixer data which includes the make, type, and capacity of concrete mixers proposed for mixing concrete.

Conveying Equipment

The conveying equipment and methods for transporting, handling, and depositing the concrete shall be submitted for review by the Contracting Officer for conformance with paragraphs CAPACITY and CONVEYING EQUIPMENT.

Placing Equipment

All placing equipment and methods shall be submitted for review by the Contracting Officer for conformance with paragraph CAPACITY.

Cold-Weather Placing; G

If concrete is to be placed under cold-weather conditions, the proposed materials, methods, and protection shall be submitted for approval.

Hot-Weather Placing; G
Finishing; G

If concrete is to be placed under hot-weather conditions, the proposed materials and methods shall be submitted for review and approval.

SD-04 Samples

Aggregates; G
Cementitious Materials, Admixtures, and Curing Compound; G

Samples of materials for government testing and approval shall be submitted as required in paragraph PRECONSTRUCTION SAMPLING AND TESTING.

SD-06 Test Reports

Quality of Aggregates; G

Aggregate quality tests shall be submitted at least 30 days prior to start of concrete placement.

Mixer Uniformity.

The results of the initial mixer uniformity tests shall be submitted at least 5 days prior to the initiation of placing.

Tests and Inspections

Test results and inspection reports shall be submitted daily and weekly as required in paragraph REPORTS.

SD-07 Certificates

Tests and Inspections
Testing Technicians
Concrete Transportation Construction Inspector (CTCI)

The Contractor shall submit statements that the concrete testing technicians and the concrete inspectors meet the specified requirements.

Cementitious Materials; G

Cementitious Materials, including Cement and Pozzolan, will be accepted on the basis of the manufacturer's certification of compliance, accompanied by mill test reports that materials meet the requirements of the specification under which they are furnished. Certification and mill test reports shall be from samples taken from the particular lot furnished. No cementitious materials shall be used until notice of acceptance has been given by the Contracting Officer. Cementitious materials will be subject to check testing from samples obtained at the source, at transfer points, or at the project site, as scheduled by the Contracting Officer, and such sampling will be by or under the supervision of the Government at its expense. Material not meeting specifications shall be promptly removed from the site of work.

Impervious-Sheet Curing Materials; G

Impervious-Sheet Curing Materials shall be certified for compliance with all specification requirements.

Air-Entraining Admixture; G

Air-Entraining Admixture shall be certified for compliance with all specification requirements.

Other Chemical Admixtures; G

Other Chemical Admixtures shall be certified for compliance with all specification requirements.

Membrane-Forming Curing Compound; G

Membrane-Forming Curing Compound shall be certified for compliance with all specification requirements.

Epoxy Resin; G
Latex Bonding Compound; G

Epoxy Resin and Latex Bonding Compound shall be certified for

compliance with all specification requirements.

Nonshrink Grout; G

Descriptive literature of the Nonshrink Grout proposed for use shall be furnished together with a certificate from the manufacturer stating that it is suitable for the application or exposure for which it is being considered.

1.3 GOVERNMENT TESTING AND SAMPLING

The Government will sample and test aggregates and concrete to determine compliance with the specifications. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Concrete will be sampled in accordance with ASTM C 172.

1.3.1 Preconstruction Sampling and Testing

1.3.1.1 Aggregates

Samples from any source of coarse aggregate and any source of fine aggregate selected by the Contractor, consisting of not less than 150 pounds of each size coarse aggregate and 75 pounds of fine aggregate taken under the supervision of the Contracting Officer in accordance with COE CRD-C 100 shall be delivered to the Contracting Officer within 15 days after notice to proceed. Sampling and shipment of samples shall be at the Contractor's expense. 30 days will be required to complete evaluation of the aggregates. Testing will be performed by and at the expense of the Government in accordance with the applicable COE CRD-C or ASTM test methods. The cost of testing one source for each size of aggregate will be borne by the Government. If the Contractor selects more than one source for each aggregate size or selects a substitute source for any size aggregate after the original source was tested, the cost of that additional testing will be borne by the Contractor. Tests to which aggregate may be subjected are listed in paragraph QUALITY. The material from the proposed source shall meet the quality requirements of this paragraph. Testing of aggregates by the Government does not relieve the Contractor of the requirements outlined in paragraph TESTS AND INSPECTIONS.

1.3.1.2 Cementitious Materials, Admixtures, and Curing Compound

At least 60 days in advance of concrete placement, the Contractor shall notify the Contracting Officer of the sources for cementitious materials, admixtures, and curing compound, along with sampling location, brand name, type, and quantity to be used in the manufacture and/or curing of the concrete.

1.3.2 Construction Testing by the Government

The Government will sample and test chemical admixtures, curing compounds, and cementitious materials.

1.3.2.1 Chemical Admixtures Storage

Chemical admixtures that have been in storage at the project site for longer than 6 months or that have been subjected to freezing shall be retested at the expense of the Contractor when directed by the Contracting

Officer and shall be rejected if test results are not satisfactory. Chemical admixtures will be accepted based on compliance with the requirements of paragraph CHEMICAL ADMIXTURES.

1.3.2.2 Cement and Pozzolan

If cement or pozzolan is to be obtained from more than one source, the initial notification shall state the estimated amount to be obtained from each source and the proposed schedule of shipments.

a. Prequalified Cement Sources - Cement shall be delivered and used directly from a mill of a producer designated as a qualified source. Samples of cement for check testing will be taken at the project site or concrete-producing plant by a representative of the Contracting Officer for testing at the expense of the Government. A list of prequalified cement sources is available from Director, U.S. Army Corps of Engineers, Engineer Research and Development Center - Structures Laboratory, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199, ATTN: CEERD-SC.

b. Prequalified Pozzolan Sources - Pozzolan shall be delivered and used directly from a producer designated as a qualified source. Samples of pozzolan for check testing will be taken at the project site by a representative of the Contracting Officer for testing at the expense of the Government. A list of prequalified pozzolan sources is available from the Director, U.S. Army Corps of Engineers, Engineer Research and Development Center - Structures Laboratory, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199, ATTN: CEERD-SC.

1.3.2.3 Concrete Strength

Compressive strength test specimens will be made by the Government and cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength f'c and no individual test result falls below the specified strength f'c by more than 500 psi. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including nondestructive testing, taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.

a. Investigation of Low-Strength Test Results - When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 500 psi or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. Nondestructive testing in accordance with ASTM C 597, ASTM C 803/C 803M, or ASTM C 805 may be permitted by the Contracting Officer to estimate the relative strengths at various locations in the structure as an aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests shall not be used as a basis for acceptance or rejection.

b. Testing of Cores - When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42/C 42M. At least three representative cores shall be taken from each member or area of concrete in place that is

considered potentially deficient. The location of cores will be determined by the Contracting Officer to least impair the performance of the structure. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement.

1.4 DESIGN REQUIREMENTS

1.4.1 Concrete Strength

Amend R0004

Specified compressive strength f'c shall be as follows:

COMPRESSIVE STRENGTH (PSI)	STRUCTURE OR PORTION OF STRUCTURE
4,000 @ 28 days	Precast Concrete
4,000 @ 28 days	Cast-in-Place Concrete
4,000 @ 28 days	Tremie Placed Concrete
~~5,000~~ 6,000 @ 28 days	Non-Shrink Grout

****

1.4.2 Maximum Water-Cement (W/C) Ratio

Maximum W/C shall be as follows:

Amend R0004

WATER-CEMENT RATIO, BY MASS	STRUCTURE OR PORTION OF STRUCTURE
0.40	Precast Concrete
0.40	Cast-in-Place Concrete
0.40	Tremie Placed Concrete
0.40	Non-Shrink Grout
2.0	Lean Concrete*

* Lean Concrete shall contain between 145 and 200 pounds of cement per cubic yard.

****

These W/C's may cause higher strengths than that required by paragraph CONCRETE STRENGTH.

1.5 CONSTRUCTION TOLERANCES

Except as specified otherwise, a plus tolerance increases and a minus tolerance decreases the dimension to which it applies. A tolerance without sign means plus or minus. Where only one sign is specified, there is no limit in the other direction. Tolerances are not cumulative. The most restrictive tolerance will control. Tolerances shall not extend the structure beyond legal boundaries.

a. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing. When forms or shoring are used, the measurements shall be made prior to removal.

Amend R0004

b. Construction tolerances shall meet the requirements of ACI 117/117R, and the contract drawings, and any of the following requirements that are applicable.

****

1.5.1 Appearance

Permanently exposed surfaces shall be cleaned, if stained or otherwise discolored, by a method that does not harm the concrete and that is approved by the Contracting Officer.

1.6 STORAGE OF MATERIALS

All products shall be stored in such a manner as to avoid contamination and deterioration. Reinforcing steel bats and other products shall be stored above ground on platforms, pallets or other supports. All materials shall be capable of being easily identified on site.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cementitious Materials

Cementitious materials shall be portland cement, or portland-pozzolan cement and shall conform to appropriate specifications listed below. Use of cementitious materials in architectural concrete shall be restricted to one color, one source, and one type.

2.1.1.1 Portland Cement

ASTM C 150, Type I or II, except that the maximum amount of C3A in Type I cement shall be 15 percent including the heat of hydration at 7 days and low alkali when used with aggregates listed at the end of this section which require it.

2.1.1.2 Pozzolan, Other than Silica Fume

Pozzolan shall conform to ASTM C 618, Class F, with the optional requirements for multiple factor, drying shrinkage, and uniformity of Table 2A. Table 1A requirement for maximum alkalies shall apply when used with aggregates listed at the end of this section to require low-alkali cement.

2.1.2 Aggregates

2.1.2.1 General

Concrete aggregates may be furnished from any source capable of meeting the quality requirements as stated in paragraph QUALITY. Fine and coarse aggregates shall conform to the grading requirements of ASTM C 33. The nominal maximum size shall be as listed in paragraph NOMINAL MAXIMUM-SIZE

COARSE AGGREGATE. Where the use of highway department gradations are permitted, proposed gradations shall be submitted for approval.

2.1.2.2 Concrete Aggregate Sources

Selection of Source - After the award of the contract, the Contractor shall designate in writing only one source or combination of sources from which he proposes to furnish aggregates. The Contractor may designate only a single source or single combination of sources for aggregates. Regardless of the source, selected samples for acceptance testing shall be provided as required by paragraph GOVERNMENT TESTING AND SAMPLING. If a source for coarse or fine aggregates so designated by the Contractor does not meet the quality requirements stated in paragraph QUALITY, the Contractor may not submit for approval other non-listed sources but shall furnish the coarse or fine aggregate, as the case may be, from sources listed at the end of this section at no additional cost to the Government.

2.1.2.3 Quality

Concrete aggregates delivered to the mixer may be furnished from any source capable of meeting the quality requirements of ASTM C 33. The test results and conclusions shall be considered valid only for the sample tested and shall not be taken as an indication of the quality of all material from a source nor for the amount of processing required. Fine and coarse aggregates shall conform to the grading requirements of ASTM C 33, Class 5S. The nominal maximum size shall be as listed in paragraph 2.2.2

2.1.3 Chemical Admixtures

Chemical admixtures to be used, when required or permitted, shall conform to the appropriate specification listed.

2.1.3.1 Air-Entraining Admixture

The air-entraining admixture shall conform to ASTM C 260 and shall consistently cause the concrete to have an air content in the specified ranges under field conditions.

2.1.3.2 Water-Reducing or Retarding Admixture

a. Water-Reducing or Retarding Admixtures: ASTM C 494/C 494M, Type A, B, or D, except that the 6-month and 1-year compressive strength tests are waived.

b. High-Range Water Reducing Admixture: ASTM C 494/C 494M, Type F or G except that the 6-month and 1-year strength requirements shall be waived. The admixture may be used only when approved by the Contracting Officer, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan.

2.1.3.3 Other Chemical Admixtures

Other chemical admixtures for use in producing flowing concrete shall comply with ASTM C 1017/C 1017M, Type 1 or 2. These admixture shall be used only for concrete listed in paragraph SLUMP.

Amend R0004

Antiwash admixture agents shall be used in all concrete and grout to be

placed by the tremie method in flowing water. The amount of antiwash admixture used shall be adequate to prevent loss of cement and fines in the water flow velocities expected during construction.

****

2.1.4 Curing Materials

2.1.4.1 Membrane-Forming Curing Compound

The membrane-forming curing compound shall conform to ASTM C 309, Type 1-D or 2. The curing compound selected shall be compatible with any subsequent paint, roofing, coating, or flooring specified. Nonpigmented compound shall contain a fugitive dye and shall have the reflective requirements in ASTM C 309 waived.

2.1.5 Water

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that nonpotable water may be used if it meets the requirements of COE CRD-C 400.

2.1.6 Nonshrink Grout

All grout shall be nonshrink grout. Nonshrink grout shall conform to ASTM C 1107 and shall be a commercial formulation suitable for the application proposed, unless otherwise noted.

2.1.7 Epoxy Resin

Epoxy resin for use in repairs shall conform to ASTM C 881, Type III, Grade I or II. Reference Section 03730, RESIN SYSTEMS FOR CONCRETE REPAIR AND BONDING; GROUTING ANCHOR BARS.

2.2 CONCRETE MIXTURE PROPORTIONING

2.2.1 Quality of Mixture

For each portion of the structure, mixture proportions shall be selected so that the strength and W/C requirements listed in paragraph DESIGN REQUIREMENTS are met.

2.2.2 Nominal Maximum-Size Coarse Aggregate

Nominal maximum-size coarse aggregate shall be 1 inch except 3/4 inch nominal maximum-size coarse aggregate shall be used when any of the following conditions exist: the narrowest dimension between sides of forms is less than 7-1/2 inches, the depth of the slab is less than 4 inches, the minimum clear spacing between reinforcing is less than 2-1/4 inches, or the concrete is placed by the tremie method.

2.2.3 Air Content

Air content as delivered to the forms and as determined by ASTM C 231 shall be between 4 and 7 percent except that when the nominal maximum-size coarse aggregate is 3/4 inch, it shall be between 4-1/2 and 7-1/2 percent.

2.2.4 Slump

The slump shall be determined in accordance with ASTM C 143/C 143M and shall be within the range of 1 to 4 inch. Where placement by pump is approved, the slump shall not exceed 6 inches. Concrete to be placed by the tremie method may contain a chemical admixture for use in producing flowing concrete in accordance with ASTM C 1017/C 1017M, and the slump of the concrete shall range between 8 to 10 inches.

2.2.5 Concrete Proportioning

Trial batches and testing requirements for various qualities of concrete specified shall be the responsibility of the Contractor. Samples of aggregates shall be obtained in accordance with the requirements of ASTM D 75. Samples of materials other than aggregate shall be representative of those proposed for the project and shall be accompanied by the manufacturer's test reports indicating compliance with applicable specified requirements. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios, which will produce a range of strength encompassing those required for the work. The maximum water-cement ratios required in paragraph MAXIMUM WATER-CEMENT RATIO will be converted to a weight ratio of water to cement plus pozzolan by mass, as described in ACI 211.1. If pozzolan is used in the concrete mixture, the minimum pozzolan content shall be 15 percent of the total cementitious material and the maximum shall be 35 percent. Trial mixtures shall be proportioned for maximum permitted slump and air content with due consideration to the approved conveying and placement method. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192/C 192M. They shall be tested at 7 days and at the design age specified in paragraph DESIGN REQUIREMENTS in accordance with ASTM C 39/C 39M. From these test results, a curve will be plotted showing the relationship between water-cement ratio and strength.

2.2.6 Required Average Compressive Strength

In meeting the strength requirements specified in paragraph CONCRETE STRENGTH, the selected mixture proportion shall produce a required average compressive strength f'cr exceeding the specified strength f'c by the amount indicated below.

2.2.6.1 Average Compressive Strength from Test Records

Where a concrete production facility has test records, a standard deviation shall be established in accordance with the applicable provisions of ACI 214. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected, shall represent concrete produced to meet a specified strength or strengths (f'c) within 1,000 psi of that specified for proposed work, and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at another test age designated for determination of f'c.

Required average compressive strength f'cr used as the basis for selection of concrete proportions shall be the larger of the equations that follow using the standard deviation as determined above:

$$f'cr = f'c + 1.34S$$

f'cr = f'c + 2.33S - 500

Where S = standard deviation

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS*	MODIFICATION FACTOR FOR STANDARD DEVIATION Use tabulation in paragraph DETERMINING REQUIRED AVERAGE STRENGTH
less than 15	
15	1.16
20	1.08
25	1.03
30 or more	1.00

*Interpolate for intermediate numbers of tests.

2.2.6.2 Average Compressive Strength without Previous Test Records

When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength fcr shall be determined as follows:

If the specified compressive strength f'c is less than 3,000 psi,

f'cr = f'c + 1,000

If the specified compressive strength f'c is 3,000 to 5,000 psi,

f'cr = f'c + 1,200

If the specified compressive strength f'c is over 5,000 psi,

f'cr = f'c + 1,400

PART 3 EXECUTION

3.1 EQUIPMENT

3.1.1 Capacity

The batching, mixing, conveying, and placing equipment shall have a capacity of at least 50 cubic yards per hour.

3.1.2 Batch Plant

Batch plant shall conform to the requirements of NRMCA CPMB 100and as specified; however, rating plates attached to batch plant equipment are not required.

3.1.2.1 Batching Equipment

The batching controls shall be semiautomatic or automatic. The semiautomatic batching system shall be provided with interlocks such that

the discharge device cannot be actuated until the indicated material is within the applicable tolerance. The batching system shall be equipped with an accurate recorder or recorders that meet the requirements of NRMCA CPMB 100. Separate bins or compartments shall be provided for each size group of aggregate, cement and pozzolan. Aggregates shall be weighed either in separate weigh batchers with individual scales or cumulatively in one weigh batcher on one scale. Aggregate shall not be weighed in the same batcher with cement and pozzolan. If both cement and pozzolan are used, they may be batched cumulatively provided that the portland cement is batched first. If measured by mass, the mass of the water shall not be weighed cumulatively with another ingredient. Water batcher filling and discharging valves shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. An accurate mechanical device for measuring and dispensing each admixture shall be provided. Each dispenser shall be interlocked with the batching and discharging operation of the water so that each admixture is separately batched and discharged automatically in a manner to obtain uniform distribution throughout the batch in the specified mixing period. Admixtures shall not be combined prior to introduction in water. The plant shall be arranged so as to facilitate the inspection of all operations at all times. Suitable facilities shall be provided for obtaining representative samples of aggregates from each bin or compartment. All filling ports for cementitious materials bins or silos shall be clearly marked with a permanent sign stating the contents.

3.1.2.2 Scales

The equipment for batching by mass shall conform to the applicable requirements of NIST HB 44, except that the accuracy shall be plus or minus 0.2 percent of scale capacity. The Contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring devices. Tests shall be made at the frequency required in paragraph TESTS AND INSPECTIONS, and in the presence of a government inspector.

3.1.2.3 Batching Tolerances

a. Weighing Tolerances

MATERIAL	PERCENT OF REQUIRED MASS
Cementitious materials	0 to plus 2
Aggregate	plus or minus 2
Water	plus or minus 1
Chemical admixture	0 to plus 6

b. Volumetric Tolerances - For volumetric batching equipment, the following tolerances shall apply to the required volume of material being batched:

Water: ..... Plus or minus 1 percent.
Chemical admixtures: ..... Zero to plus 6 percent.

3.1.2.4 Moisture Control

The plant shall be capable of ready adjustment to compensate for the varying moisture content of the aggregates and to change the masses of the materials being batched. An electric moisture meter complying with the

provisions of COE CRD-C 143 shall be provided for measuring moisture in the fine aggregate. The sensing element shall be arranged so that the measurement is made near the batcher charging gate of the sand bin or in the sand batcher.

3.1.3 Concrete Mixers

The concrete mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired.

3.1.3.1 Stationary Mixers

Concrete plant mixers shall be tilting, nontilting, horizontal-shaft, vertical-shaft, or pugmill and shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixing time and uniformity shall conform to all the requirements in ASTM C 94/C 94M applicable to central-mixed concrete.

3.1.3.2 Truck Mixers

Truck mixers, the mixing of concrete therein, and concrete uniformity shall conform to the requirements of ASTM C 94/C 94M. A truck mixer may be used either for complete mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Each truck shall be equipped with two counters from which it will be possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed.

3.1.4 Conveying Equipment

The conveying equipment shall conform to the following requirements.

3.1.4.1 Buckets

The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least five times the nominal maximum-size aggregate, and the area of the gate opening shall not be less than 2 square feet. The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically, or hydraulically operated except that buckets larger than 2 cubic yards shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

3.1.4.2 Transfer Hoppers

Concrete may be charged into nonagitating hoppers for transfer to other conveying devices. Transfer hoppers shall be capable of receiving concrete directly from delivery vehicles and have conical-shaped discharge features. The transfer hopper shall be equipped with a hydraulically operated gate and with a means of external vibration to effect complete discharge. Concrete shall not be held in nonagitating transfer hoppers more than 30 minutes.

3.1.4.3 Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C 94/C 94M. Nonagitating equipment may be used for transporting plant-mixed concrete over a smooth road when the hauling time is less than 15 minutes. Bodies of nonagitating equipment shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

3.1.4.4 Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitating equipment, the chutes attached to this equipment by the manufacturer may be used. A discharge deflector shall be used when required by the Contracting Officer. Separate chutes and other similar equipment will not be permitted for conveying concrete.

3.1.4.5 Belt Conveyors

Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means for preventing segregation of the concrete at the transfer points and the point of placing. Belt conveyors shall be constructed such that the idler spacing shall not exceed 36 inches. The belt speed shall be a minimum of 300 feet per minute and a maximum of 750 feet per minute. If concrete is to be placed through installed horizontal or sloping reinforcing bars, the conveyor shall discharge concrete into a pipe or elephant trunk that is long enough to extend through the reinforcing bars.

3.1.4.6 Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least three times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped but not less than 4 inches. Aluminum pipe shall not be used.

3.1.5 Vibrators

Vibrators of the proper size, frequency, and amplitude shall be used for the type of work being performed in conformance with the following requirements:

APPLICATION	HEAD DIAMETER INCHES	FREQUENCY VPM	AMPLITUDE INCHES
Thin walls, beams, etc.	1-1/4 to 2-1/2	9,000 to 13,500	0.02 to 0.04
General construction	2 to 3-1/2	8,000 to 12,000	0.025 to 0.05

The frequency and amplitude shall be determined in accordance with COE CRD-C 521.

3.2 PREPARATION FOR PLACING

3.2.1 Embedded Items

Before placement of concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Embedded items shall be free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids. Welding, including tack welding, will not be permitted on embedded metals within 2 feet of the surface of the concrete.

3.2.2 Concrete on Rock Foundations

Rock surfaces upon which concrete is to be placed shall be clean, free from oil, standing or running water, ice, mud, drummy rock, coating, debris, and loose, semidetached, or unsound fragments. Joints in rock shall be cleaned to a satisfactory depth, as determined by the Contracting Officer, and to firm rock on the sides. Cleanup and foundation preparation, both in-the-dry and underwater as applicable, are described in Section 02217a FOUNDATION PREPARATION and shall be performed prior to concrete placement. All rock surfaces shall be kept continuously wet for at least 24 hours immediately prior to placing concrete thereon.

3.2.3 Construction Joint Treatment

Construction joint treatment shall conform to the following requirements.

3.2.3.1 Joint Preparation

Construction joints shall be roughened to 1/4 inch amplitude minimum roughness per ACI 318/318R, unless noted otherwise. Concrete surfaces to which additional concrete is to be bonded shall be prepared for receiving the next lift or adjacent concrete by cleaning with either air-water cutting, high-pressure water jet, or other approved method. Under **no** conditions shall the cleaning of roughened construction joints reduce the minimum 1/4 inch amplitude roughness. Air-water cutting will not be permitted on formed surfaces or surfaces congested with reinforcing steel. Regardless of the method used, the resulting surfaces shall be free from all laitance and inferior concrete so that clean, well bonded coarse aggregate is exposed uniformly throughout the lift surface. The edges of the coarse aggregate shall not be undercut. The surface shall be washed clean again as the last operation prior to placing the next lift. There shall be no standing water on the surface upon which concrete is placed.

3.2.3.2 Air-Water Cutting

Air-water cutting of a construction joint shall be performed at the proper time and only on horizontal construction joints. The air pressure used in the jet shall be 90 to 110 psi, and the water pressure shall be just sufficient to bring the water into effective influence of the air pressure. When approved by the Contracting Officer, a retarder complying with the requirements of COE CRD-C 94 may be applied to the surface of the lift to prolong the period of time during which air-water cutting is effective. Prior to receiving approval, the Contractor shall furnish samples of the material to be used and shall demonstrate the method to be used in applications. After cutting, the surface shall be washed and rinsed as long as there is any trace of cloudiness of the wash water. Where

necessary to remove accumulated laitance, coatings, stains, debris, and other foreign material, high-pressure water jet or sandblasting will be required as the last operation before placing the next lift.

3.2.3.3 High-Pressure Water Jet

A stream of water under a pressure of not less than 3,000 psi may be used for cleaning. Its use shall be delayed until the concrete is sufficiently hard so that only the surface skin or mortar is removed and there is no undercutting of coarse-aggregate particles. If the water jet is incapable of a satisfactory cleaning, the surface shall be cleaned by sandblasting.

3.2.3.4 Application of Epoxy Adhesive

Epoxy components shall be blended, mixed and applied in accordance with the requirements of Section 03730, RESIN SYSTEMS FOR CONCRETE REPAIR AND BONDING; GROUTING ANCHOR BARS.

3.2.3.5 Waste Disposal

The method used in disposing of waste water employed in cutting, washing, and rinsing of concrete surfaces shall be such that the waste water does not stain, discolor, or affect exposed surfaces of the structures, or damage the environment of the project area. The method of disposal shall be subject to approval.

3.3 PLACING

3.3.1 Placing Procedures

Concrete surfaces shall be prepared as described in paragraph 3.2. Concrete placement will not be permitted when, in the opinion of the Contracting Officer, weather conditions prevent proper placement and consolidation. Concrete shall be deposited as close as possible to its final position in the forms and, in so depositing, there shall be no vertical drop greater than 5 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it may be effectively consolidated in horizontal layers 2.0 feet or less in thickness with a minimum of lateral movement. The amount deposited in each location shall be that which can be readily and thoroughly consolidated. Sufficient placing capacity shall be provided so that concrete placement can be kept plastic and free of cold joints while concrete is being placed. Concrete shall be placed by methods that will prevent segregation or loss of ingredients. Any concrete transferred from one conveying device to another shall be passed through a hopper that is conical in shape. The concrete shall not be dropped vertically more than 5 feet, except where a properly designed and sized elephant truck with rigid drop chute bottom section is provided to prevent segregation and where specifically authorized. In no case will concrete be discharged to free-fall through reinforcing bars.

3.3.2 Placement by Pump

When concrete is to be placed by pump, the nominal maximum-size coarse aggregate shall not be reduced to accommodate the pumps. The distance to be pumped shall not exceed limits recommended by the pump manufacturer. The concrete shall be supplied to the concrete pump continuously. When pumping is completed, concrete remaining in the pipeline shall be ejected without contamination of concrete in place. After each operation,

equipment shall be thoroughly cleaned, and flushing water shall be wasted outside of the forms. Grout used to lubricate the pumping equipment at the beginning of the placement will not be incorporated into the placement.

3.3.3 Time Interval Between Mixing and Placing

Concrete shall be placed within 30 minutes after discharge into nonagitating equipment. When concrete is truck-mixed or when a truck mixer or agitator is used for transporting concrete mixed by a concrete plant mixer, the concrete shall be delivered to the site of the work, and discharge shall be completed within 1-1/2 hours after introduction of the cement to the aggregates. When the length of haul makes it impossible to deliver truck-mixed concrete within these time limits, batching of cement and a portion of the mixing water shall be delayed until the truck mixer is at or near the construction site.

3.3.4 Cold-Weather Placing

When cold-weather placing of concrete is likely to be subjected to freezing temperatures before the expiration of the curing period, it shall be placed in accordance with procedures previously submitted in accordance with paragraph SUBMITTALS. The ambient temperature of the space adjacent to the concrete placement and surfaces to receive concrete shall be above 32 degrees F. The placing temperature of the concrete having a minimum dimension less than 12 inches shall be between 55 and 75 degrees F when measured in accordance with ASTM C 1064/C 1064M. The placing temperature of the concrete having a minimum dimension greater than 12 inches shall be between 50 and 70 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete-placing temperatures. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals, or other materials shall not be mixed with the concrete to prevent freezing.

3.3.5 Hot-Weather Placing

Concrete shall be properly placed and finished with procedures previously submitted in accordance with paragraph SUBMITTALS. The concrete-placing temperature shall not exceed 75 degrees F when measured in accordance with ASTM C 1064/C 1064M. Cooling of the mixing water and aggregates, or both, may be required to obtain an adequate placing temperature. A retarder meeting the requirements of paragraph WATER-REDUCING OR RETARDING ADMIXTURES may be used to facilitate placing and finishing. Steel forms and reinforcement shall be cooled prior to concrete placement when steel temperatures are greater than 100 degrees F. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature.

3.3.6 Consolidation

Immediately after placement, each layer of concrete, including flowing concrete, shall be consolidated by internal vibrating equipment. Vibrators shall not be used to transport concrete within the forms. Hand spading may be required, if necessary, with internal vibrating along formed surfaces permanently exposed to view. Form or surface vibrators shall not be used unless specifically approved. The vibrator shall be inserted vertically at uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding unhardened layer if such exists.

It shall be held stationary until the concrete is consolidated and then withdrawn slowly.

3.3.7 Placing Concrete in Congested Areas

Special care shall be used to ensure complete filling of the forms, elimination of all voids, and complete consolidation of the concrete when placing concrete in areas congested with reinforcing bars, embedded items, waterstops and other tight spacing. An appropriate concrete mixture shall be used, and the nominal maximum size of aggregate (NMSA) shall meet the specified criteria when evaluated for the congested area. Vibrators with heads of a size appropriate for the clearances available shall be used, and the consolidation operation shall be closely supervised to ensure complete and thorough consolidation at all points. Where necessary, splices of reinforcing bars shall be alternated to reduce congestion. Where two mats of closely spaced reinforcing are required, the bars in each mat shall be placed in matching alignment to reduce congestion.

3.3.8 Placing Concrete Underwater

Placing concrete underwater shall be in accordance with Section 03400, TREMIE CONCRETE.

3.4 FINISHING

The ambient temperature of spaces adjacent to surfaces being finished shall be not less than 40 degrees F. In hot weather when the rate of evaporation of surface moisture, as determined by use of Figure 2.1.5 of ACI 305R, may reasonably be expected to exceed 0.2 pounds per square foot per hour. Provisions for windbreaks, shading, fog spraying, or wet covering with a light-colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as finishing operations will allow. All unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish. Additional finishing shall be as specified below and shall be true to the elevation shown in the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown on the drawings and left true and regular. Exterior surfaces shall be sloped for drainage unless otherwise shown in the drawing or as directed. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Grate tampers or jitterbugs shall not be used.

3.4.1 Unformed Surfaces

3.4.1.1 Float Finish

Surfaces shall be screeded and darbied or bullfloated to bring the surface to the required finish level with no coarse aggregate visible. No water, cement, or mortar shall be added to the surface during the finishing operation. The concrete, while still green but sufficiently hardened to bear a man's weight without deep imprint, shall be floated to a true and even plane. Floating may be performed by use of suitable hand floats or power-driven equipment. Hand floats shall be made of magnesium or aluminum.

3.4.1.2 Trowel Finish

A trowel finish shall be applied to the following surfaces: cofferdam slab. Concrete surfaces shall be finished with a float finish, and after surface moisture has disappeared, the surface shall be troweled to a

smooth, even, dense finish free from blemishes including trowel marks.

3.4.1.3 Broom Finish

A broom finish shall be applied to the following surfaces: top of beams and top of walls at elevation 1180 and 1181. The concrete surface shall be finished with a float finish. The floated surface shall be broomed with a fiber-bristle brush in a direction transverse to that of the main traffic.

3.4.2 Formed Surfaces

Unless another finish is specified, surfaces shall be left with the texture imparted by the forms except that defective surfaces shall be repaired as described in paragraph FORMED SURFACE REPAIR.

Unless painting of surfaces is required, uniform color of the concrete shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure that is exposed to view or on which a special finish is required. The form panels used to produce the finish shall be orderly in arrangement, with joints between panels planned in approved relation to openings, building corners, and other architectural features. Forms shall not be reused if there is any evidence of surface wear or defects that would impair the quality of the surface.

3.4.3 Formed Surface Repair

After removal of forms, all ridges, lips, and bulges on surfaces permanently exposed shall be removed. All repairs shall be completed within 48 hours after form removal.

3.4.3.1 Classes A, & B Finishes

Surfaces listed in Section 03100a STRUCTURAL CONCRETE FORMWORK and as shown to have classes A, and B finishes shall have surface defects repaired as follows: defective areas, voids, and honeycombs smaller than 16 square inches in area and less than 1/2 inch deep and bug holes exceeding 1/2 inch in diameter shall be chipped and filled with dry-packed mortar. Holes left by removal of tie rods shall be reamed and filled with dry-packed mortar as specified in paragraph MATERIAL AND PROCEDURE FOR REPAIRS. Defective and unsound concrete areas larger than described shall be defined by 1/2 inch deep dovetailed saw cuts in a rectangular pattern with lines parallel to the formwork, the defective concrete removed by chipping, and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of paragraph EPOXY RESIN, or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with paragraph MATERIAL AND PROCEDURE FOR REPAIRS.

3.4.3.2 Class C Finish

Surfaces listed in Section 03100a STRUCTURAL CONCRETE FORMWORK and as shown shall have defects repaired as follows: defective areas, voids, and honeycombs smaller than 24 square inchesand less than 2 inches deep; bug holes exceeding 1-1/2 inches in diameter shall be chipped and filled with dry-packed mortar; and holes left by removal of the tie rods shall be chipped and filled with dry-packed mortar. Defective and unsound concrete areas larger than 24 square inches and deeper than 1-1/2 inches shall be defined by 1/2 inch deep dovetailed saw cuts in a rectangular pattern, the

defective concrete removed by chipping, and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of paragraph EPOXY RESIN, or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with paragraph MATERIAL AND PROCEDURE FOR REPAIRS.

3.4.3.3 Class D Finish

Surfaces listed in Section 03100a STRUCTURAL CONCRETE FORMWORK and as shown to have class D finish shall have surface defects repaired as follows: defective areas, voids, and honeycombs greater than 48 square inches in area or more than 2 inches deep shall be defined by 1/2 inch deep dovetailed saw cuts in a rectangular pattern, the defective concrete removed by chipping and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of paragraph EPOXY RESIN, or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with paragraph MATERIAL AND PROCEDURE FOR REPAIRS.

3.4.3.4 Material and Procedure for Repairs

The cement used in the dry-packed mortar or replacement concrete shall be a blend of the cement used for production of project concrete and white portland cement properly proportioned so that the final color of the mortar or concrete will match adjacent concrete. Trial batches shall be used to determine the proportions required to match colors. Dry-packed mortar shall consist of one part cement to two and one-half parts fine aggregate. The fine aggregate shall be that used for production of project concrete. The mortar shall be remixed over a period of at least 30 minutes without addition of water until it obtains the stiffest consistency that will permit placing. Mortar shall be thoroughly compacted into the prepared void by tamping, rodding, ramming, etc. and struck off to match adjacent concrete. Replacement concrete shall be produced using project materials and shall be proportioned by the Contracting Officer. It shall be thoroughly compacted into the prepared void by internal vibration, tamping, rodding, ramming, etc. and shall be struck off and finished to match adjacent concrete. Forms shall be used to confine the concrete. If an expanding agent is used in the repair concrete, the repair shall be thoroughly confined on all sides including the top surface. Metal tools shall not be used to finish permanently exposed surfaces. The repaired areas shall be cured for 7 days. The temperature of the in situ concrete, adjacent air, and replacement mortar or concrete shall be above 40 degrees F during placement, finishing, and curing. Other methods and materials for repair may be used only when approved in writing by the Contracting Officer. Repairs of the so called "plaster-type" will not be permitted.

3.5 CURING AND PROTECTION

3.5.1 Duration

Concrete shall be moist cured for a period of not less than 14 days. Concrete shall be cured by an approved method.

Immediately after placement, concrete shall be protected from premature drying, extremes in temperatures, rapid temperature change, and mechanical damage. All materials and equipment needed for adequate curing and protection shall be available and at the placement site prior to the start of concrete placement. Concrete shall be protected from the damaging

effects of rain for 12 hours and from flowing water for 14 days. No fire or excessive heat including welding shall be permitted near or in direct contact with concrete or concrete embedments at any time.

3.5.2 Moist Curing

Moist-cured concrete shall be maintained continuously, not periodically, wet for the entire curing period. Water or curing materials that stain or discolor concrete surfaces shall not be used. Where wooden form sheathing is left in place during curing, the sheathing shall be kept wet at all times. Where steel forms are left in place during curing, the forms shall be carefully broken loose from the hardened concrete and curing water continuously applied into the void so as to continuously saturate the entire concrete surface. Horizontal surfaces may be moist cured by ponding, by covering with a minimum uniform thickness of 2 inches of continuously saturated sand, or by covering with saturated nonstaining burlap or cotton mats.

3.5.3 Membrane-Forming Curing Compound

Concrete may be cured with an approved membrane-forming curing compound in lieu of moist curing except that membrane curing will not be permitted on any surface to which other concrete is to be bonded, on any surface containing protruding steel reinforcement, on an abrasive aggregate finish, or any surface maintained at curing temperature by use of free steam. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing, or flooring specified. Also, the curing compound selected shall not be injurious to fish if used on concrete elements that will be ultimately exposed to flowing water. The curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface. The surfaces shall be thoroughly moistened with water, and the curing compound applied as son as free water disappears. The curing compound shall be applied to unformed surfaces as soon as free water has disappeared and bleeding has topped. The curing compound shall be applied in a two-coat continuous operation by approved motorized power-spraying equipment operating at a minimum pressure of 75 psi, at a uniform coverage of not more than 400 square feet per gallon for each coat, and the second coat shall be applied perpendicular to the first coat. concrete surfaces that have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified. All concrete surfaces on which the curing compound has been applied shall be adequately protected for the duration of the entire curing period from pedestrian and vehicular traffic and from any other cause that will disrupt the continuity of the curing membrane.

3.5.4 Cold-Weather Curing and Protection

When the daily outdoor low temperature is less than 32 degrees F, the temperature of the concrete shall be maintained above 40 degrees F for the first 7 days after placing. In addition, during the period of protection removal, the air temperature adjacent to the concrete surfaces shall be controlled so that concrete near the surface will not be subjected to a temperature differential of more than 25 degrees F as determined by observation of ambient and concrete temperatures indicated by suitable temperatures measuring devices furnished by the Government as required and installed adjacent to the concrete surface and 2 inches inside the surface of the concrete. The installation of the thermometers shall be made by the

Contractor at such locations as may be directed.

3.6 PLACING NONSHRINK GROUT

3.6.1 Nonshrink Grout Application

Nonshrink grout shall conform to the requirements of paragraph NONSHRINK GROUT. Water content shall be the minimum that will provide a flowable mixture and fill the space to be grouted without segregation, bleeding, or reduction of strength.

3.6.1.1 Mixing and Placing of Nonshrink Grout

Mixing and placing shall be in conformance with the material manufacturer's instructions and as specified. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, the batch shall be mixed for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. Forms shall be of wood or other equally suitable material for retaining the grout and shall be removed after the grout has set. If grade "A" grout as specified in ASTM C 1107 is used, all surfaces shall be formed to provide restraint. The placed grout shall be worked to eliminate voids; however, overworking and breakdown of the initial set shall be avoided. Grout shall not be retempered or subjected to vibration from any source. Where clearances are unusually small, placement shall be under pressure with a grout pump. Temperature of the grout, and of surfaces receiving the grout, shall be maintained at 65 to 85 degrees F until after setting.

3.6.1.2 Treatment of Exposed Surfaces

After the grout has set, those types containing metallic aggregate shall have the exposed surfaces cut back 1 inch and immediately covered with a parge coat of mortar proportioned by mass of one part portland cement, two parts sand, and sufficient water to make the mixture placeable. The parge coat shall have a smooth, dense finish. The exposed surface of other types of nonshrink grout shall have a smooth, dense finish.

3.6.1.3 Curing

Grout and parge coats shall be cured in conformance with paragraph CURING AND PROTECTION.

3.7 TESTS AND INSPECTIONS

Tests and inspections shall conform to the following requirements.

3.7.1 General

The Contractor shall perform the inspections and tests described below, and, based upon the results of these inspections and tests, he shall take the action required and submit reports as required. When, in the opinion of the Contracting Officer, the concreting operation is out of control, concrete placement shall cease. The laboratory performing the tests shall be on site and shall conform with ASTM C 1077. The individuals who sample and test concrete or the constituents of concrete as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I. The individuals who perform the inspection of concrete construction shall have

demonstrated a knowledge and ability equivalent to the ACI minimum guidelines for certification of Concrete Transportation Construction Inspector (CTCI). The Government will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and at least once per year thereafter for conformance with ASTM C 1077.

3.7.2 Testing and Inspection Requirements

3.7.2.1 Fine Aggregate

a. Grading - At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 and COE CRD-C 104 for the fine aggregate or for each size range of fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits.

b. Corrective Action for Fine Aggregate Grading - When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall immediately be reported to the Contracting Officer.

c. Moisture Content Testing - When in the opinion of the Contracting Officer the electric moisture meter is not operating satisfactorily, there shall be at least four tests for moisture content in accordance with ASTM C 566 during each 8-hour period of mixing plant operation. The times for the tests shall be selected randomly within the 8-hour period. An additional test shall be made whenever the slump is shown to be out of control or excessive variation in workability is reported by the placing foreman. When the electric moisture meter is operating satisfactorily, at least two direct measurements of moisture content shall be made per week to check the calibration of the meter. The results of tests for moisture content shall be used to adjust the added water in the control of the batch plant.

d. Moisture Content Corrective Action - Whenever the moisture content of the fine aggregate changes by 0.5 percent or more, the scale settings for the fine-aggregate batcher and water batcher shall be adjusted (directly or by means of a moisture compensation device) if necessary to maintain the specified slump.

3.7.2.2 Coarse Aggregate

a. Grading - At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C 136 for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control which are coarser than the specification limits for samples taken at locations other than as delivered to the mixer to allow for degradation during handling.

b. Corrective Action for Grading - When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Contracting Officer. Where two consecutive averages of five tests are outside specification limits, the operation shall be considered out of control and shall be reported to the Contracting Officer. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

c. Coarse Aggregate Moisture Content - A test for moisture content of each size group of coarse aggregate shall be made at least twice per week. When two consecutive readings for smallest size coarse aggregate differ by more than 1.0 percent, frequency of testing shall be increased to that specified above for fine aggregate, until the difference falls below 1.0 percent.

d. Coarse Aggregate Moisture Corrective Action - Whenever the moisture content of any size of coarse aggregate changes by 0.5 percent or more, the scale setting for the coarse aggregate batcher and the water batcher shall be adjusted if necessary to maintain the specified slump.

3.7.2.3 Quality of Aggregates

a. Frequency of Quality Tests - Thirty days prior to the start of concrete placement the Contractor shall perform all tests for aggregate quality as required by ASTM C 33. In addition, after the start of concrete placement, the Contractor shall perform tests for aggregate quality at least every 3 months, and when the source of aggregate or aggregate quality changes. Samples tested after the start of concrete placement shall be taken immediately prior to entering the concrete mixer.

b. Corrective Action for Aggregate Quality - After concrete placement commences, whenever the result of a test for quality fails the requirements, the test shall be rerun immediately. If the second test fails the quality requirement, the fact shall be reported to the Contracting Officer and immediate steps taken to rectify the situation.

3.7.2.4 Scales

a. Weighing Accuracy - The accuracy of the scales shall be checked by test weights prior to start of concrete operations and at least once every 3 months for conformance with the applicable requirements of paragraph BATCHING EQUIPMENT. Such tests shall also be made as directed whenever there are variations in properties of the fresh concrete that could result from batching errors.

b. Batching and Recording Accuracy - Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. The Contractor shall confirm that the calibration devices described in paragraph BATCH PLANT for checking the accuracy of dispensed admixtures are operating properly.

c. Scales Corrective Action - When either the weighing accuracy or batching accuracy does not comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected

immediately.

3.7.2.5 Batch-Plant Control

The measurement of all constituent materials including cementitious materials, each size of aggregate, water, and admixtures shall be continuously controlled. The aggregate weights and amount of added water shall be adjusted as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic yard, amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic yard for each class of concrete batched during plant operation.

3.7.2.6 Concrete Mixture

a. Air Content Testing - Air content tests shall be made when test specimens are fabricated. In addition, at least two tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government quality assurance representative. Tests shall be made in accordance with ASTM C 231. Test results shall be plotted on control charts which shall at all times be readily available to the Government. Copies of the current control charts shall be kept in the field by the Contractor's quality control representatives and results plotted as tests are made. When a single test result reaches either the upper or lower action limit a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the control chart for air content and the control chart for range, and for determining the need for any remedial action. The result of each test, or average as noted in the previous sentence, shall be plotted on a separate chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph AIR CONTENT. An upper warning limit and a lower warning limit line shall be set 1.0 percentage point above and below the average line. An upper action limit and a lower action limit line shall be set 1.5 percentage points above and below the average line, respectively. The range between each two consecutive tests shall be plotted on a control chart for range where an upper warning limit is set at 2.0 percentage points and up upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer and the air content at the mixer controlled as directed.

b. Air Content Corrective Action - Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air-entraining admixture batched. As soon as is practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the control chart range reaches the warning limit, the admixture dispenser

shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted. All this shall be at no extra cost to the Government.

c. Slump Testing - In addition to slump tests which shall be made when test specimens are fabricated, at least four slump tests shall be made on randomly selected batches in accordance with ASTM C 143/C 143M for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government's quality assurance representative. Test results shall be plotted on control charts which shall at all times be readily available to the Government. Copies of the current control charts shall be kept in the field by the Contractor's quality control representatives and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, a second test shall immediately be made on the same batch of concrete. The results of the two tests shall be averaged and this average used as the slump of the batch to plot on both the control chart for percent air and the chart for range, and for determining the need for any remedial action. An upper warning limit shall be set at 1/2 inch below the maximum allowable slump on separate control charts for percent air used for each type of mixture as specified in paragraph SLUMP, and an upper action limit line and lower action limit line shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at 2 inches. Samples for slump shall be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's materials or transportation methods cause slump loss between mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer and the slump at the mixer controlled as directed.

d. Slump Corrective Action - Whenever points on the control chart for slump reach the upper warning limit, an adjustment shall be immediately made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount allowed by the maximum W/C specified, based upon aggregates which are in a saturated surface-dry condition. When a single slump reaches the upper or lower action limit, no further concrete shall be delivered to the placing site until proper adjustments have been made. Immediately after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range at or above the upper action limit, the concreting operation shall immediately be halted and the Contractor shall take appropriate steps to bring the slump under control. Also, additional slump tests shall be made as directed. All this shall be at no additional cost to the Government.

e. Temperature - The temperature of the concrete shall be measured when compressive strength specimens are fabricated. Measurement shall

be in accordance with ASTM C 1064/C 1064M. The temperature shall be reported along with the compressive strength data.

f. Compressive-Strength Specimens - At least one set of test specimens shall be made each day on each different concrete mixture placed during the day. Additional sets of test cylinders shall be made, as directed by the Contracting Officer, when the mixture proportions are changed or when low strengths have been detected. A random sampling plan shall be developed by the Contractor and approved by the Contracting Officer prior to the start of construction. The plan shall assure that sampling is done in a completely random and unbiased manner. A set of test specimens for concrete with a 28-day specified strength per paragraph DESIGN REQUIREMENTS shall consist of four cylinders, two to be tested at 7 days and two at 28 days. Test specimens shall be molded and cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M. All compressive-strength tests shall be reported immediately to the Contracting Officer. Quality control charts shall be kept for individual strength tests, moving average for strength, and moving average for range for each mixture. The charts shall be similar to those found in ACI 214.

3.7.2.7 Inspection Before Placing

Foundation or construction joints, forms, and embedded items shall be inspected for quality by the Contractor in sufficient time prior to each concrete placement to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

3.7.2.8 Placing

a. Placing Inspection - The placing foreman shall supervise all placing operations, shall determine that the correct quality of concrete or grout is placed in each location as directed and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, yardage placed, and method of placement.

b. Placing Corrective Action - The placing foreman shall not permit batching and placing to begin until he has verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

3.7.2.9 Vibrators

a. Vibrator Testing and Use - The frequency and amplitude of each vibrator shall be determined in accordance with COE CRD-C 521prior to initial use and at least once a month when concrete is being placed. Additional tests shall be made as directed when a vibrator does not appear to be adequately consolidating the concrete. The frequency shall be determined at the same time the vibrator is operating in concrete with the tachometer held against the upper end of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be determined with the head vibrating in air. Two measurements shall be taken, one near the tip and another near the upper end of the vibrator head and these results

averaged. The make, model, type, and size of the vibrator and frequency and amplitude results shall be reported in writing.

b. Vibrator Corrective Action - Any vibrator not meeting the requirements of paragraph VIBRATORS shall be immediately removed from service and repaired or replaced.

3.7.2.10 Curing

a. Moist-Curing Inspections - At least once each shift, and once per day on nonwork days an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.

b. Moist-Curing Corrective Action - When a daily inspection report lists an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for such areas shall be extended by one (1) day.

c. Membrane-Curing Inspection - No curing compound shall be applied until the Contractor's authorized representative has verified that the compound is properly mixed and ready for spraying. At the end of each operation, he shall estimate the quantity of compound used by measurement of the container and the area of concrete surface covered and compute the rate of coverage in square feet per gallon. He shall note whether or not coverage is uniform.

d. Membrane-Curing Corrective Action - When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.

3.7.2.11 Cold-Weather Protection and Sealed Insulation Curing

At least once each shift and once per day on nonwork days, an inspection shall be made of all areas subject to cold-weather protection. The protection system shall be inspected for holes, tears, unsealed joints, or other deficiencies that could result in damage to the concrete. Special attention shall be taken at edges, corners, and thin sections. Any deficiencies shall be noted, corrected, and reported.

3.7.2.12 Cold-Weather Protection Corrective Action

When a daily inspection report lists any holes, tears, unsealed joints, or other deficiencies, the deficiency shall be corrected immediately and the period of protection extended 1 day.

3.7.2.13 Mixer Uniformity

a. Stationary Mixers - Prior to the start of concrete placing and once every 6 months when concrete is being placed, or once for every 75,000 cubic yards of concrete placed, whichever results in the longest time interval, uniformity of concrete mixing shall be determined in accordance with ASTM C 94/C 94M.

b. Truck Mixers - Prior to the start of concrete placing and at least once every 6 months when concrete is being placed, uniformity of concrete shall be determined in accordance with ASTM C 94/C 94M. The truck mixers shall be selected randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of

substantially the same design and condition of the blades may be regarded as satisfactory.

3.7.2.14 Mixer Uniformity Corrective Action

When a mixer fails to meet mixer uniformity requirements, either the mixer shall be removed from service on the work, the mixing time shall be increased, batching sequence changed, batch size reduced, or adjustments shall be made to the mixer until compliance is achieved.

3.7.3 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all test and inspection records.

-- End of Section --

This page is intentionally left blank.

SECTION 03400

TREMIE CONCRETE

PART 1 GENERAL

1.1 SCOPE

Amend R0004

The work covered by this specification includes all activities for the preparation, production, and placement of underwater concrete for this project . The work includes diver inspection, cleaning, debris removal, concrete formwork, and tremie concrete placement.

Concrete that shall be deposited under water shall be placed by the tremie method. An antiwash agent shall be used in underwater placed (tremie) concrete and grout around the steel support frame under Precast Segments A, B, and C. All other tremie concrete does not require antiwash agents. The methods and equipment used shall be subject to approval. Concrete buckets will not be permitted for underwater placement of concrete except to deliver concrete to the tremie. ~~the~~The tremie shall be watertight and sufficiently large to permit a free flow of concrete. The discharge end of the pump line or tremie shaft shall be kept continuously submerged in the concrete. The underwater seal shall be effected in a manner that will not produce undue turbulence in the water. The tremie shaft shall be kept full of concrete to a point well above the water surface. ~~Placement shall proceed without interruption until the concrete has been brought to the required height.~~ The tremie shall not be moved horizontally during a placing operation, and a sufficient number of tremies shall be provided so that the maximum horizontal flow will be limited to 15 feet.

****

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 304R	(2000) Guide for Measuring, Mixing, Transporting, and Placing Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 94	(1998c) Ready-Mixed Concrete

1.3 CONSTRUCTION TOLERANCES

Variation in alignment, grade, and dimensions of the tremie concrete structures from the established alignment, grade, and dimensions shown on the drawings shall be within the tolerances specified in Table 1. Variations from the specified dimensions but within the required tolerances

shall not relieve the Contractor from proper field fitting of components.

Amend R0004

TABLE 1
CONSTRUCTION TOLERANCES FOR TREMIE CONCRETE PLACEMENT

(1) Concrete plan view unformed outline variations from the design location	No greater than	+2 feet
	No less than	-2 feet
(2) Concrete plan view formed outline variations from the design locations	No greater than	+3 inches
	No less than	-3 inches
(~~2~~3**)** Concrete top surface variations from design elevation at cofferdam	No greater than	+3 inches
	No less than	-3 inches
(~~3~~4**)** Concrete top surface variations from design elevation at north of existing intake structure	No greater than	+12 inches
	No less than	-12 inches

****

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Concrete Materials; G

All concrete and grout shall meet the materials and mix proportioning requirements of Section 03301a, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

Concrete and Grout Placement; G

This submittal shall consist of drawings, narrative, sketches, schedules and other methods to fully describe the delivery and placement of tremie concrete. The items to address in the submittal include:

a) Concrete batching plant (include type, layout, production rate).

b) Concrete delivery equipment from plant to tremie pipe (include trucks, pumps, drops).

c) Tremie pipe system and supporting equipment (include barges, platforms, layout, diagrams, details).

d) Surface preparation of underwater surfaces (include methods and equipment).

Amend R0004

e) Formwork (include layout, materials, methods, calculations, diver support). The Contractor shall submit a sealed design by a registered engineer for all formwork in conformance to Section 03100a, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

****

f) Concrete placement (sequence, rates, equipment, methods, diving support).

g) Grout placement under Precast Segments A, B, C (include grout tubes and vent tubes locations and details, equipment , and methods).

h) Proposed sonic testing procedures that will be used to verify that there are no void spaces under the Precast Segments A, B, and C.

i) Adverse weather provisions.

j) Stationkeeping for the floating plant.

k) Diver Utilization (equipment, personnel, tasks).

Pre & Post Survey; G

Surveys shall be conducted prior to and after completion of the underwater tremie concrete placement.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

Amend R0004

Concrete placed underwater shall have compressive strength (f'c) of 4,000 psi after 28 days. Grout placed underwater shall have a compressive strength (f'c) of ~~5,000~~6,000 psi after 28 days. All grout placed underwater shall contain an antiwash agent.

****

All concrete and grout shall meet the requirements of Section 03301a, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

PART 3 EXECUTION

3.1 PREPARATIONS

3.1.1 General

The Contractor shall take all necessary precautions to insure against damage to the property of the Government, and any damage shall be repaired or replaced at the expense of the Contractor and as directed by the

Contracting Officer. The rock and concrete surfaces upon which concrete or grout is to be placed shall be shaped and cleaned in accordance with the contract provisions and be approved by the Contracting Officer.

The horizontal construction joint interface surface between the tremie concrete and the grout below Segments A, B, and C shall be cleaned and prepared as specified in Section 03301a, CAST-IN-PLACE CONCRETE FOR CIVIL WORKS, paragraph 3.2.3.1, except that the last sentence of this paragraph shall not apply for underwater joints. The resulting surfaces shall be free from laitance and inferior concrete. The Contractor shall provide an underwater video tape recording of the prepared construction joint surface to the Contracting Officer prior to setting the Precast Concrete Segments A, B and C.

3.1.2 Work Area

The tremie concrete area plans are shown in the contract drawings.

3.1.3 Underwater Surveys

The Contractor shall perform two (2) hydrographic condition surveys of each tremie area. The first survey shall be accomplished prior to the start of underwater tremie concrete placement in order to verify the rock foundation elevation. The second survey shall be performed following completion of the tremie concrete placements. The Contractor shall provide the Contracting Officer with scheduled survey dates 28 calendar days prior to execution.

3.1.4 Diver Inspection

Amend R0004

Prior to tremie concrete placement, the Contractor shall perform a diver inspection of the tremie area. The purpose of the dive is to identify the presence of debris in the tremie areas so that an evaluation can be done and a determination made whether debris removal is necessary. The divers shall inspect the entire area and a video recording shall be made of the base area where the tremie concrete will be placed on the existing rock or on the previous tremie concrete lift.

****

3.1.5 Debris Removal

All material that is not an integral part of the foundation rock shall be removed from the tremie area and disposed in the designated disposal area. The limits of removal areas correspond with the tremie concrete areas shown on the drawings. Excavation of existing intact concrete and foundation rock below the correct elevation is not required.

Amend R0004

3.1.6 Final Cleanup and Lift Cleaning Preparation

Foundation preparation and cleaning shall be performed in conformance to Section 02217a, FOUNDATION PREPARATION. Unless otherwise directed, final cleanup and lift cleaning preparation shall be performed between concrete

lifts. This work shall consist of removing loose and/or damaged objectionable material from the in place concrete surface. Picking, barring, and hand excavation may be necessary to obtain a concrete surface free from loose, drummy, or damaged material. The final concrete surface shall be thoroughly cleaned by use of air lift dredge or any other method approved or directed and shall be maintained in a clean condition until the placement of the concrete/grout thereon. The contractor shall provide divers before, during and after each phase of final cleanup and lift cleaning preparation as directed by the Contracting Officer to inspect the concrete surface conditions. The divers shall videotape the concrete conditions an provide images real time to a monitor located above the water surface. The diver shall also communicate with the Contractor personnel and the contracting Officer during the work so that adjustments to the final cleanup and lift surface preparation work can be completed as the work proceeds. The location of the video monitor shall be as directed by the Contracting Officer.

****

3.2 CONVEYING TO THE TREMIE

3.2.1 General

Concrete shall be conveyed from mixer to the placement area as rapidly as practicable and within the time interval as specified by methods that will prevent segregation or loss of ingredients. Any concrete transferred from one conveying device to another shall be passed through a hopper which is conical in shape and shall not be dropped vertically more than 5 feet, except where suitable equipment is provided to prevent segregation and where specifically authorized by the Contracting Officer.

3.2.2 Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C 94. Trucks shall be used to convey the concrete from the plant to the placement staging area.

3.2.3 Buckets

The interior hopper slope shall be not less than 50 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least five times the nominal maximum size aggregate and the area of the gate opening shall be not less than 2-square feet. The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and shall be hydraulically operated. No manually or pneumatically operated bucket gates are permitted. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

3.2.4 Pump Placement

Concrete shall be conveyed by positive displacement. The pumping equipment shall be piston or squeeze pressure type. The pipeline shall be rigid steel pipe or heavy -duty flexible hose. The inside diameter of the pipe shall be at least three times the nominal maximum size coarse aggregate in

the concrete mixture to be pumped, but not less than 4 inches.

The maximum size coarse aggregate will not be reduced to accommodate the pumps. The distance to be pumped shall not exceed limits recommended by the pump manufacturer. When pumping is completed, concrete remaining in the pipeline shall be ejected without contamination of concrete in place or the reservoir. After each operation, equipment shall be thoroughly cleaned, and flushing water shall be wasted outside of the forms in the designated waste area. Except as modified in this specification, all quality control testing shall be done at the discharge end of the pumpline.

Two independent and equal pump systems shall be provided capable of a combined rated capacity of 120 cubic yards per hour. The minimum pumping rate into the tremie pipes shall be 90 cy/hr. The concrete shall be supplied to the placement area continuously such that no cold joints occur in the placement.

3.2.5 Staging Area Requirements

Concrete shall be pumped or bucketed to the tremie hoppers.

3.3 PLACING TREMIE CONCRETE

3.3.1 General

The delivery and placing of tremie concrete shall be configured to produce a continuous flow of concrete of at least 50 cubic yards per hour. No concrete shall be placed until all the concrete materials, placing plan and inspection plan submittals have been approved by the Contracting Officer. The concrete shall be delivered to the site of the work and discharge shall be completed within 60 minutes after introduction of the cement to the aggregates. The Contractor shall supply a floating plant that provides access for personnel and material to the placement area.

3.3.2 Requirements for Adverse Conditions

Concrete placement will not be permitted when, in the opinion of the Contracting Officer, weather conditions prevent proper placement. This includes hot weather, cold weather, excessive precipitation, excessive wind, and excessive wave action.

3.3.2.1 Cold-Weather Placing

Concrete shall not be placed without a procedure, implementing the recommendations of ACI 304R and approved by the Contracting Officer when the concrete is likely to be subjected to ambient air temperatures below 40 degrees F. Cold weather procedures are to be implemented when ambient air temperatures are 35 degrees F or lower. The placing temperature of the concrete shall be between 40 degrees and 60 degrees F. Heating of the mixing water may be allowed to regulate the concrete placing temperatures if approved by the Contracting Officer to raise and maintain concrete temperatures to the minimum 40 degree limit. Materials entering the mixer shall be free from ice, snow, or frozen lumps.

3.3.2.2 Hot-Weather Placing

Concrete shall not be placed without a procedure approved by the Contracting Officer when the concrete is likely to be subjected to ambient air temperature above 85 degrees F (30C). Hot weather conditions exist

when the ambient air temperatures exceed 85 degrees F (30C). However, when the combination of air temperature, relative humidity, temperature of the concrete, and the wind velocity at the point of placement produces an evaporation rate of 0.20 pounds per square foot of surface per hour or greater, the Contractor shall cease production and placement or construct adequate protection to reduce the evaporation rate below 0.20 pounds per square foot of surface per hour.

3.3.2.3 Wave Action

The reservoir occasionally may have wave conditions that are unacceptable. The Contractor shall coordinate placement activities to prevent damage to the tremie concrete placement due to wave action.

3.3.3 Placing Configuration

A stable platform shall be provided to support the tremie pipes, hoppers, operating personnel, inspectors and other equipment. All tremie pipes required for full coverage of the placement area shall be installed in a manner that prevents vertical or horizontal movement during placement. The sequence of charging tremie pipes shall first fill the basin depressions beginning at the lowest elevations in a manner that prevents flowing concrete from moving in a downward direction. Continued charging of tremie pipes shall raise the concrete surface in a uniform horizontal level.

3.3.4 Alternate Placing Configuration

In lieu of providing tremie pipes for full coverage of the tremie area. A row or rows of tremie pipes shall be provided that cover a portion of the placement area. The placement shall progress to full depth at each location. When one placement area is complete, the placement shall be stopped, the tremie pipes removed as specified, and reinserted into fresh concrete as specified at the next line location. A lateral progression from deepest location in the area to shallowest shall be done. The Contractor shall develop an acceptable mooring layout configuration, and apply adequate pretension to the mooring lines (thru winches) to eliminate or minimize the catenary line profile.

3.3.5 Tremie Platform

The platform on which the tremie pipes and hoppers are supported shall be a stable platform that holds the tremie pipes in a fixed location during the period of placement. The system shall be configured so that horizontal movement of the tremie pipe is limited to 2 inches and vertical movement of the tremie pipe is limited to 3 inches. If barges are used for the work platform shall be moored to prevent this range of movement. Factors effecting water surface variations include weather, crane activity and reservoir operations.

3.3.6 Tremie System

The delivery tube system shall consist of watertight tubes with sufficient rigidity to keep the ends always in the mass of concrete placed. Internal bracing for formwork shall accommodate the delivery tube system. A hopper of at least 2 cubic yard capacity shall be provided on top of each tremie pipe to facilitate transfer of concrete from a bucket or pumpline to the tremie. A crane or other lifting device shall be available to place, remove, and reposition the tremie and hopper.

3.3.7 Delivery Tubes

Delivery tubes (tremie pipes) shall be at least 10 inches in diameter. Joints shall be watertight and the underwater end of the tube capped with a watertight cap. Integral seals shall be provided at underwater joints as well as an external seal. The system shall provide an interior free of accumulated water when installed in to the full depth in the placement position. The cap shall be designed to be released as the tube is charged. Caps lost in the tremie concrete may be left in place. The tremie pipe shall extend to the bottom of the placement before charging the pipe with concrete. For the applicable range of readings, each tremie pipe will be marked to display the length of pipe underwater. Mark intervals shall be at least every 6 inches with the length value for each foot interval.

3.3.8 Initial Charging

The delivery tube shall initially rest on the concrete or rock surface. After charging the delivery tube system with concrete, the flow of concrete through a tube shall be induced by slightly raising the discharge end. During concrete placement, the tip of the delivery tube shall be continuously embedded in fresh concrete to prevent reentry of the water into the tube. Until at least a depth of 3 feet of concrete has been placed, the tip of the delivery tube shall be within 6 inches of the bottom of the placement, and then the embedment of the tip shall be maintained at least three feet below the top surface of the concrete. Rapid raising or lowering of the delivery tube shall not be permitted. Horizontal movement of the tube is not permitted during tremie placement.

3.3.9 Tremie Withdrawal

The following procedure shall be used if it is necessary to remove the tremie pipe from the concrete placement. Placement shall be suspended and the concrete shall be allowed to flow until static condition exists in the pipe. The pipe shall be removed in a manner that does not introduce a flow of water into the placement area. The tremie pipe shall be withdrawn while removing the concrete from the interior of the tremie pipe. This shall be done by bailing methods. An alternate method is to pressurize the tremie in a manner that forces the concrete elevation down the tremie to an elevation equal to the elevation of the new concrete surface.

3.3.10 Lost Seal

If the seal is lost or the delivery tube becomes plugged and must be removed or if the placement of concrete is interrupted more than 30 minutes, the tube shall be withdrawn, the tube cleaned, the tip of the tube capped to prevent entrance of the water, and the operation restarted by pushing the capped tube five feet (or to the bottom of the placement, which ever is less) into the concrete and then re-starting the flow of concrete. Sealed end caps shall be used to seal the tube for the re-start. "Go-devil" plugs shall not be used to restart the concrete placement.

3.3.11 Normal Placement

Concrete shall be delivered to the tremie system in a continuous flow, uniformly flowing down the tremie pipe preventing the entrapment of air in the tremie pipe or in the placement. The concrete deposited under water shall be placed in a compact, monolithic mass in a manner that will prevent washing of the concrete. Except as otherwise specified, placing concrete shall be a continuous operation in near-horizontal layers from start to

finish. This requires that the concrete be discharged through the tubes in such a predetermined order that the differential head of the concrete will not be more than 3 feet at any time during the placement. Tremie pipes shall not be relocated during the placement, unless approved in the placement plan or by the Contracting Officer. The maximum spacing of adjacent tremie tubes shall not exceed 25 feet. The maximum spacing of tremie tubes from the form, existing concrete or rock wall surfaces shall not exceed 15 feet.

3.3.12 Placing Controls

During placement of tremie concrete, the top surface of the tremie concrete shall be continuously monitored. The depth from the water surface to the top of the concrete shall be determined accurately and in a manner that does not disturb or encourage the flow of the tremie concrete. One acceptable device is a neutrally buoyant rod, marked with graduations of 0.1 feet, and equipped with a broad foot. The progress of placement shall be recorded and continuously for each station on at least 15 minute intervals. The data shall be recorded in a manner that the placing and inspection personnel can monitor the progress.

3.3.13 Underwater Inspection

A diving crew shall be available during placement of underwater concrete. Inspection of the tremie placement and related activities shall be done using divers. Unless specifically directed by the Contracting Officer, divers shall not contact the surface of the tremie concrete during placement.

3.4 GROUT PLACEMENT UNDER PRECAST SEGMENTS A, B, AND C

3.4.1 General

Amend R0004

The pressure grouting of the 6-inch ± void space under the Precast Segments A, B, and C must be performed with an adequate series of grout tubes and vent tubes such that the grouting proceeds from one side to the other side of the cofferdam. The grouting procedure shall be designed to eliminate all void spaces under the precast concrete segments without the grout mixing with the water it is displacing. Grout and vent tubes shall be placed in the precast segments or in the web of the steel support frame or in both. Grout tubes in the concrete shall be plastic to prevent corrosion.

****

The grout must be adequately pressurized to displace the water under the precast. Antiwash agents shall be added to the grout to prevent mixing of the grout with the water. Grout and vent tubes in the concrete shall be cut off flush with the concrete surface so the surface of the precast segment meets its specified finish requirements.

The Contractor's Concrete and Grout Placement Submittal must adequately describe all of his grouting procedures, details, and equipment.

3.4.2 Sonic Testing Procedure

The Contractor must provide sonic testing of the grout using divers to operate the equipment to verify that all voids below the Precast Cofferdam

Segments A, B, and C have been grouted solid. Details of the proposed testing procedures and equipment must be submitted for approval prior to grouting.

3.5 CURING AND PROTECTION

3.5.1 Curing

No specific measures are required to cure underwater concrete.

3.5.2 Protection

Concrete shall be protected from damage from flowing water and subsequent construction operations. Underwater operations near the concrete placements shall be suspended until the concrete has achieved a field-cured compressive strength of 2,000 psi.

3.6 FORMWORK

3.6.1 Design

Amend R0004

The design and engineering of the formwork, as well as its construction, shall be the responsibility of the Contractor. The formwork shall be designed for loads, lateral pressure, and allowable stresses in accordance with standard engineering practices and the American Concrete Institute. Forms shall have sufficient strength to withstand the pressure resulting from placement of the concrete and shall have sufficient rigidity to maintain specified tolerances. Forms shall prevent the flow of concrete beyond the perimeter of the placement area. The Contractor shall submit a sealed design by a registered Engineer for all formwork in conformance to Section 03100a, STRUCTURAL CONCRETE FORMWORK.

****

3.6.2 Materials

Forms shall be of steel, or other approved material. The type, size, shape, quality, and strength of all materials of which the forms are made shall be the Contractor's responsibility. Forms may also be non-traditional materials such as sandbags, pillows, or other form system the contains the concrete and does not inhibit the function of the intake structures and cofferdam, damage the structures, or compromises the long-term performance of the final concrete.

3.6.3 Construction

The top surface of the forms shall be true to line and grade, and sufficiently rigid to prevent excessive deformation under load.

3.6.4 Coating

No form release agent shall be used.

3.6.5 Placement Authorization

Prior to batching any of concrete for any placement, the Contracting Officer will authorize the placement of concrete.

3.6.6 Removal

Amend R0004

Forms that are not permanent shall not be removed until the concrete has attained a compressive strength of at least ~~2,000~~3,000 psi as determined by testing of field cast and cured cylinders.

****

3.7 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control program to show compliance with contract requirements and to maintain records of his quality control operations. Unless otherwise stated in this Technical Specification, all test results and computations for Contractor Quality Control performed prior to placement of the concrete shall be reported and delivered to a designated representative of the Contracting Officer prior to beginning placement of the concrete. Unless otherwise stated in this Technical Specification, all test results and computations for Contractor Quality Control performed during concrete placement or after placement of the concrete shall be reported and delivered within 24 hours to a designated representative of the Contracting Officer.

3.8 Placement Soundings

The Contractor shall maintain a log of the concrete elevations for each placement area when concrete is deposited under water. Soundings of the concrete level shall be taken continuously at a time interval less than 1 hour during placement and a distance interval of 5 feet using methods described in 3.3.12, paragraph: Placing Controls. Sounding shall be spaced to cover the entire area, plus corners and at the discharges of tremie pipes or pump lines. At completion of the concrete placement, a post placement sounding inspection shall be made to establish the final surface elevation of the concrete.

-- End of Section --

This page is intentionally left blank.

SECTION 05055

METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA SAS-30	(1986) Aluminum Structures Construction Manual Series - Section 1 Specifications for Aluminum Structures

Amend R0004

AISC ASD Manual	(1989) Manual of Steel Construction Allowable Stress Design
AISC Pub No. S303	(1992) Code of Standard Practice for Steel Buildings and Bridges

****

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

Amend R0004

ASTM A 6/A 6M	(1998a) General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

****

ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 325	(1997) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 380	(1994a) Cleaning and Descaling Stainless Steel Parts, Equipment, and Systems
ASTM A 490	(1997) Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
ASTM A 514/A 514M	(1994a) High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding

ASTM A 780	(1993a) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM D 962	(1981; R 1999) Aluminum Powder and Paste Pigments for Paints
ASTM E 165	(1995) Liquid Penetrant Examination Inspection Method
ASTM E 709	(1995) Magnetic Particle Examination

ASME INTERNATIONAL (ASME)

ASME B4.1	(1967; R 1994) Preferred Limits and Fits for Cylindrical Parts
ASME B46.1	(1995) Surface Texture (Surface Roughness, Waviness, and Lay)
ASME BPV IX	(1995) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1998) Structural Welding Code - Steel
AWS D1.2	(1990) Structural Welding Code - Aluminum

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS 3110	(1992; Rev G) Primer Zinc Chromate
SAE AMS 3132	(1994; Rev F) Varnish, Phenolic Resin Corrosion-Preventive

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G

Detail drawings for metalwork and machine work shall be submitted and approved prior to fabrication.

SD-03 Product Data

Welding of Structural Steel; G

Copies of welding procedure specifications, procedure qualification test records , and schedules of welding procedures for steel structures shall be submitted and approved prior to

commencing fabrication.

Welding of Aluminum; G

Schedules of welding processes for aluminum fabrications shall be submitted and approved prior to commencing fabrication.

Structural Steel Welding Repairs; G

Welding repair plans for steel shall be submitted and approved prior to making repairs.

Materials Orders

Copies of purchase orders, mill orders, shop orders and work orders for materials shall be submitted prior to the use of the materials in the work.

Materials List

Materials list for fabricated items shall be submitted at the time of submittal of detail drawings.

Shipping Bill

Shipping bill shall be submitted with the delivery of finished pieces to the site.

SD-06 Test Reports

Tests, Inspections, and Verifications

Certified test reports for materials shall be submitted with all materials delivered to the site.

SD-07 Certificates

Qualification of Welders and Welding Operators

Certifications for welders and welding operators shall be submitted prior to commencing fabrication.

Application Qualification for Steel Studs; G

Certified reports for the application qualification for steel studs shall be submitted and approved prior to commencing fabrication.

Welding of Aluminum

Certified report for aluminum welding qualification tests shall be submitted and approved prior to commencing welding.

1.3 DETAIL DRAWINGS

Detail drawings for metalwork and machine work shall include catalog cuts, templates, fabrication and assembly details and type, grade and class of material as appropriate. Elements of fabricated items inadvertently omitted on contract drawings shall be detailed by the fabricator and

indicated on the detail drawings.

1.4 QUALIFICATION OF WELDERS AND WELDING OPERATORS

The Contractor shall certify that the qualification of welders and welding operators and tack welders who will perform structural steel welding have been qualified for the particular type of work to be done in accordance with the requirements of AWS D1.1, Section 5, or prior to commencing fabrication. The certificate shall list the qualified welders by name and shall specify the code and procedures under which qualified and the date of qualification. Prior qualification will be accepted if welders have performed satisfactory work under the code for which qualified within the preceding three months. The Contractor shall require welders to repeat the qualifying tests when their work indicates a reasonable doubt as to proficiency. Those passing the requalification tests will be recertified. Those not passing will be disqualified until passing. All expenses in connection with qualification and requalification shall be borne by the Contractor.

1.5 WELDING PROCEDURE QUALIFICATIONS

1. General. Except for prequalified (per AWS D1.1) and previously qualified procedures, each Contractor performing welding shall record in detail and shall qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Qualification of welding procedures shall conform to AWS D1.1 and to the specifications in this section. Copies of the welding procedure specification and the results of the procedure qualification test for each type of welding which requires procedure qualification shall be submitted for approval. Approval of any procedure, however, will not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the requirements of these specifications. This information shall be submitted on the forms in Annex E of AWS D1.1. Welding procedure specifications shall be individually identified and shall be referenced on the detail drawings and erection drawings, or shall be suitably keyed to the contract drawings. In case of conflict between this specification and AWS D1.1, this specification governs.

2. Previous Qualifications. Welding procedures previously qualified by test may be accepted for this contract without requalification if the following conditions are met:

a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

3. Prequalified Procedures. Accepted without further qualification. The Contractor shall submit for approval a listing or an annotated drawing to indicate the joints not prequalified. Procedure qualification shall be required for these joints.

4. Retests. If welding procedure fails to meet the requirements of AWS

D1.1, the procedure specification shall be revised and requalified, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1. If the welding procedure is qualified through retesting, all test results, including those of test welds that failed to meet the requirements, shall be submitted with the welding procedure.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Materials Orders

The Contractor shall furnish 5 copies of purchase orders, mill orders, shop orders and work orders for all materials orders and items used in the work. Where mill tests are required purchase orders shall contain the test site address and the name of the testing agency.

2.1.2 Materials List

The Contractor shall furnish a materials list of the materials to be used in the fabrication of each item.

2.1.3 Shipping Bill

The Contractor shall furnish a shipping bill or memorandum of each shipment of finished pieces or members to the project site giving the designation mark and weight of each item, the number of items, the total weight, and the car initial and number if shipped by rail in carload lots.

2.2 FABRICATION

Amend R0004

Fabrication shall be in accordance with the applicable provisions of AISC ASD Manual, unless otherwise noted. Fabrication and assembly shall be done in the shop to the greatest extent possible. Fabrication and mill tolerances shall generally follow ASTM A 6/A 6M, AISC Pub No. S303 and the AISC ASD Manual, unless noted otherwise.

All exposed steel other than stainless steel shall be painted as specified in Section 09965A, PAINTING: HYDRAULIC STRUCTURES after fabrication, unless otherwise noted.

****

2.2.1 Structural Fabrication

Material must be straight before being laid off or worked. If straightening is necessary it shall be done by methods that will not impair the metal. Sharp kinks or bends shall be cause for rejection of the material. Material with welds will not be accepted except where welding is definitely specified, indicated or otherwise approved. Bends shall be made by approved dies, press brakes or bending rolls. Where heating is required, precautions shall be taken to avoid overheating the metal and it shall be allowed to cool in a manner that will not impair the original properties of the metal. Proposed flame cutting of material other than structural steel shall be subject to approval and shall be indicated on detail drawings. Shearing shall be accurate and all portions of the work shall be neatly finished. Corners shall be square and true unless

otherwise shown. Re-entrant cuts shall be filleted to a minimum radius of 3/4 inch unless otherwise approved. Finished members shall be free of twists, bends and open joints. Bolts, nuts and screws shall be tight.

2.2.1.1 Dimensional Tolerances for Structural Work

Amend R0004

Dimensions shall be measured by an approved calibrated steel tape of approximately the same temperature as the material being measured. The overall dimensions of an assembled structural unit shall be within the tolerances indicated on the drawings or as specified in the particular section of these specifications for the item of work. Where tolerances are not specified in other sections of these specifications or shown, an allowable variation of 1/32 inch is permissible in the overall length of component members with both ends milled and component members without milled ends shall not deviate from the dimensions shown by not more than 1/16 inch for members 30 feet or less in length and by more than 1/8 inch for members over 30 feet in length. Assemblies of component members have the same overall length tolerance as its component members, unless otherwise noted.

Squareness:

a. General: Out-of-squareness shall be determined by the difference in length between diagonals measured from identical respective corner locations on each respective fabricated assembly not otherwise indicated on the drawings.

b. Stoplogs: Out-of-squareness not to exceed 1/8 inch.

c. Trashracks: Out-of-squareness not to exceed 1/8 inch.

Parallel:

a. General: Out-of-parallel shall be determined by the difference in distance between top and bottom or between sides at any selected points, all measurements shall be made at equal distances apart from the level or plumb positions as applicable.

b. Stoplogs: Out-of-parallelness not to exceed 1/8 inch vertically or horizontally at any point.

c. Trashracks: Out-of-parallelness not to exceed 1/8 inch vertically or horizontally at any point.

Warp or Twist:

a. General: Warp or twist of stoplogs shall be determined by measurement of difference of distance from diagonals located parallel to the skin plate surface or work line plane, as applicable.

b. Stoplogs: Warp not to exceed 1/8 inch at bearing surface plane side of assembly.

See the contract drawings for stoplog fabrication tolerance diagrams.

****

2.2.1.2 Structural Steel Fabrication

Structural steel may be cut by mechanically guided or hand-guided torches, provided an accurate profile with a surface that is smooth and free from cracks and notches is obtained. Surfaces and edges to be welded shall be prepared in accordance with AWS D1.1, Subsection 3.2. Where structural steel is not to be welded, chipping or grinding will not be required except as necessary to remove slag and sharp edges of mechanically guided or hand-guided cuts not exposed to view. Hand-guided cuts which are to be exposed or visible shall be chipped, ground or machined to sound metal.

2.2.1.3 Structural Aluminum Fabrication

Laying out and cutting of aluminum shall be in accordance with the AA SAS-30, Section 6.

2.2.2 Welding

2.2.2.1 Welding of Structural Steel

a. Welding Procedures for Structural Steel - Welding procedures for structural steel shall be prequalified as described in AWS D1.1, Subsection 5.1 or shall be qualified by tests as prescribed in AWS D1.1, Section 5. Properly documented evidence of compliance with all requirements of these specifications for previous qualification tests shall establish a welding procedure as prequalified. For welding procedures qualified by tests, the test welding and specimen testing must be witnessed and the test report document signed by the Contracting Officer. Approval of any welding procedure will not relieve the Contractor of the responsibility for producing a finished structure meeting all requirements of these specifications. The Contractor will be directed or authorized to make any changes in previously approved welding procedures that are deemed necessary or desirable by the Contractor Officer. The Contractor shall submit a complete schedule of welding procedures for each steel structure to be welded. The schedule shall conform to the requirements specified in the provisions AWS D1.1, Sections 2, 3, 4, 7 and 9 and applicable provisions of Section 10. The schedule shall provide detailed procedure specifications and tables or diagrams showing the procedures to be used for each required joint. Welding procedures must include filler metal, preheat, interpass temperature and stress-relief heat treatment requirements. Each welding procedure shall be clearly identified as being prequalified or required to be qualified by tests. Welding procedures must show types and locations of welds designated or in the specifications to receive nondestructive examination.

b. Welding Process - Welding of structural steel shall be by an electric arc welding process using a method which excludes the atmosphere from the molten metal and shall conform to the applicable provisions of AWS D1.1, Sections 1 thru 7, 9, 10 and 11. Welding shall be such as to minimize residual stresses, distortion and shrinkage.

c. Welding Technique

(1) Filler Metal - The electrode, electrode-flux combination and grade of weld metal shall conform to the appropriate AWS specification for the base metal and welding process being used or shall be as shown where a specific choice of AWS specification

allowables is required. The AWS designation of the electrodes to be used shall be included in the schedule of welding procedures. Only low hydrogen electrodes shall be used for manual shielded metal-arc welding regardless of the thickness of the steel. A controlled temperature storage oven shall be used at the job site as prescribed by AWS D1.1, Subsection 4.5 to maintain low moisture of low hydrogen electrodes.

(2) Preheat and Interpass Temperature - Preheating shall be performed as required by AWS D1.1, Subsection 4.2 and 4.3 or as otherwise specified except that the temperature of the base metal shall be at least 70 degrees F. The weldments to be preheated shall be slowly and uniformly heated by approved means to the prescribed temperature, held at that temperature until the welding is completed and then permitted to cool slowly in still air.

(3) Stress-Relief Heat Treatment - Where stress relief heat treatment is specified or shown, it shall be in accordance with the requirements of AWS D1.1, Subsection 4.4 unless otherwise authorized or directed.

d. Workmanship - Workmanship for welding shall be in accordance with AWS D1.1, Section 3 and other applicable requirements of these specifications.

(1) Preparation of Base Metal - Prior to welding the Contractor shall inspect surfaces to be welded to assure compliance with AWS D1.1, Subsection 3.2.

(2) Temporary Welds - Temporary welds required for fabrication and erection shall be made under the controlled conditions prescribed for permanent work. Temporary welds shall be made using low-hydrogen welding electrodes and by welders qualified for permanent work as specified in these specifications. Preheating for temporary welds shall be as required by AWS D1.1 for permanent welds except that the minimum temperature shall be 120 degrees F in any case. In making temporary welds arcs shall not be struck in other than weld locations. Each temporary weld shall be removed and ground flush with adjacent surfaces after serving its purpose.

(3) Tack Welds - Tacks welds that are to be incorporated into the permanent work shall be subject to the same quality requirements as the permanent welds and shall be cleaned and thoroughly fused with permanent welds. Preheating shall be performed as specified above for temporary welds. Multiple-pass tack welds shall have cascaded ends. Defective tack welds shall be removed before permanent welding.

2.2.2.2 Welding of Steel Castings

Unsound material shall be removed from the surfaces of steel castings to be incorporated into welded connections by chipping, machining, air-arc gouging or grinding. Major connections designed for transfer of stresses shall not be welded if the temperature of the casting is lower than 100 degrees F. Castings containing over 0.35 percent carbon or over 0.75 percent manganese shall be preheated to a temperature not to exceed 450 degrees F and welding shall be accomplished while the castings are maintained at a temperature above 350 degrees F. Welding will not be

permitted on castings containing carbon in excess of 0.45 percent except on written authorization. Castings requiring welding repairs after the first annealing and castings involving welding fabrication shall be stress-relieved annealed prior to receiving final machining unless otherwise permitted.

2.2.2.3 Welding of Aluminum

Welding of aluminum shall conform to AA SAS-30 or AWS D1.2, Sections 1 through 7, 9 and 10. The welding process and welding operators shall be prequalified as required by AWS D1.2, Section 5 or AA SAS-30, Subsection 7.2.4 in accordance with the methods described in ASME BPV IX, Section IX. A certified report giving the results of the qualifying tests shall be furnished for approval. A complete schedule of the welding process for each aluminum fabrication to be welded shall be furnished for approval.

2.2.2.4 Welding of Steel Studs

The procedures for welding steel studs to structural steel, including mechanical, workmanship, technique, stud application qualification, production quality control and fabrication and verification inspection procedures shall conform to the requirements of AWS D1.1, Section 7, except as otherwise specified.

a. Application Qualification for Steel Studs - As a condition of approval of the stud application process, the Contractor shall furnish certified test reports and certification that the studs conform to the requirements of AWS D1.1, Subsections 7.2 and 7.3, certified results of the stud manufacturer's stud base qualification test, and certified results of the stud application qualification test as required by AWS D1.1, Subsection 7.6, except as otherwise specified.

b. Production Quality Control - Quality control for production welding of studs shall conform to the requirements of AWS D1.1, Subsection 7.7, except as otherwise specified. Studs on which pre-production testing is to be performed shall be welded in the same general position as required on production studs (flat, vertical, overhead or sloping). If the reduction of the length of studs becomes less than normal as they are welded, welding shall be stopped immediately and not resumed until the cause has been corrected.

2.2.3 Bolted Connections

2.2.3.1 Bolted Structural Steel Connections

Bolts, nuts and washers shall be of the type specified or indicated. All nuts shall be equipped with washers except for high strength bolts. Beveled washers shall be used where bearing faces have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Where the use of high strength bolts is specified or indicated the materials, workmanship and installation shall conform to the applicable provisions of ASTM A 325 or ASTM A 490.

a. Bolt Holes - Bolt holes shall be accurately located, smooth, perpendicular to the member and cylindrical.

(1) Holes for regular bolts shall be drilled or subdrilled and reamed in the shop and shall not be more than 1/16 inch larger than the diameter of the bolt.

(2) Holes for fitted bolts shall be match-reamed or drilled in the shop. Burrs resulting from reaming shall be removed. The threads of bolts shall be entirely outside of the holes. The body diameter of bolts shall have tolerances as recommended by ASME B4.1 for the class of fit specified. Fitted bolts shall be fitted in reamed holes by selective assembly to provide an LN-2 fit.

(3) Holes for high strength bolts shall have diameters of not more than 1/16 inch larger than bolt diameters. If the thickness of the material is not greater than the diameter of the bolts the holes may be punched. If the thickness of the material is greater than the diameter of the bolts the holes may be drilled full size or subpunched or subdrilled at least 1/8 inch smaller than the diameter of the bolts and then reamed to full size. Poor matching of holes will be cause for rejection. Drifting occurring during assembly shall not distort the metal or enlarge the holes. Reaming to a larger diameter of the next standard size bolt will be allowed for slight mismatching.

2.2.3.2 Bolted Aluminum Connections

Punching, drilling, reaming and bolting for bolted aluminum connections shall conform to the requirements of AA SAS-30, Section 6.

2.2.4 Machine Work

Tolerances, allowances and gauges for metal fits between plain, non-threaded, cylindrical parts shall conform to ASME B4.1 for the class of fit shown or required unless otherwise shown on approved detail drawings. Where fits are not shown they shall be suitable as approved. Tolerances for machine-finished surfaces designated by non-decimal dimensions shall be within 1/64 inch. Sufficient machining stock shall be allowed on placing pads to ensure true surfaces of solid material. Finished contact or bearing surfaces shall be true and exact to secure full contact. Journal surfaces shall be polished and all surfaces shall be finished with sufficient smoothness and accuracy to ensure proper operation when assembled. Parts entering any machine shall be accurately machined and all like parts shall be interchangeable except that parts assembled together for drilling or reaming of holes or machining will not be required to be interchangeable with like parts. All drilled holes bolts shall be accurately located.

2.2.4.1 Finished Surfaces

Surface finishes indicated or specified shall be in accordance with ASME B46.1. Values of required roughness heights are arithmetical average deviations expressed in microinches. These values are maximum. Lesser degrees will be satisfactory unless otherwise indicated. Compliance with surface requirements shall be determined by sense of feel and visual inspection of the work compared to Roughness Comparison Specimens in accordance with the provisions of ASME B46.1. Values of roughness width and waviness height shall be consistent with the general type of finish specified by roughness height. Where the finish is not indicated or specified it shall be that which is most suitable for the particular surface, provide the class of fit required and be indicated on the detail drawings by a symbol which conforms to ASME B46.1 when machine finishing is provided. Flaws such as scratches, ridges, holes, peaks, cracks or checks which will make the part unsuitable for the intended use will be cause for

rejection.

2.2.4.2 Unfinished Surfaces

All work shall be laid out to secure proper matching of adjoining unfinished surfaces unless otherwise directed. Where there is a large discrepancy between adjoining unfinished surfaces they shall be chipped and ground smooth or machined to secure proper alignment. Unfinished surfaces shall be true to the lines and dimensions shown and shall be chipped or ground free of all projections and rough spots. Depressions or holes not affecting the strength or usefulness of the parts shall be filled in an approved manner.

2.2.4.3 Pin Holes

Pin holes shall be bored true to gauges, smooth, straight and at right angles to the axis of the member. The boring shall be done after the member is securely fastened in position.

2.2.4.4 Shafting

All shafting shall be turned or ground hot-rolled or cold-rolled steel as required unless otherwise specified or authorized. Fillets shall be provided where changes in section occur. Cold-finished shafting may be used where keyseating is the only machine work required.

2.2.5 Miscellaneous Provisions

2.2.5.1 Metallic Coatings

a. Zinc Coatings - Zinc coatings shall be applied in a manner and of a thickness and quality conforming to ASTM A 123. Where zinc coatings are destroyed by cutting, welding or other causes the affected areas shall be regalvanized. Coatings 2 ounces or heavier shall be regalvanized with a suitable low-melting zinc base alloy similar to the recommendations of the American Hot-Dip Galvanizers Association to the thickness and quality specified for the original zinc coating. Coatings less than 2 ounces shall be repaired in accordance with ASTM A 780.

2.2.5.2 Cleaning of Corrosion-Resisting Steel

Oil, paint and other foreign substances shall be removed from corrosion-resisting steel surfaces after fabrication. Cleaning shall be done by vapor degreasing or by the use of cleaners of the alkaline, emulsion or solvent type. After the surfaces have been cleaned they shall be given a final rinsing with clean water followed by a 24 hour period during which the surfaces are intermittently wet with clean water and then allowed to dry for the purpose of inspecting the clean surfaces. The surfaces shall be visually inspected for evidence of paint, oil, grease, welding slag, heat treatment scale, iron rust or other forms of contamination. If evidence of foreign substance exist the surface shall be cleaned in accordance with the applicable provisions of ASTM A 380. The proposed method of treatment shall be furnished for approval. After treatment the surfaces shall be visually reinspected. Brushes used to remove foreign substances shall have only stainless steel or nonmetallic bristles. Any contamination occurring subsequent to the initial cleaning shall be removed by one or more of the methods indicated above.

2.2.5.3 Lubrication

The arrangement and details for lubrication shall be as shown. Before erection or assembly all bearing surfaces shall be thoroughly cleaned and lubricated with an approved lubricant.

2.2.6 Shop Assembly

Each machinery and structural unit furnished shall be assembled in the shop to determine the correctness of the fabrication and matching of the component parts unless otherwise specified. Tolerances shall not exceed those shown. Each unit assembled shall be closely checked to ensure that all necessary clearances have been provided and that binding does not occur in any moving part. Assembly in the shop shall be in the same position as final installation in the field unless otherwise specified. Assembly and disassembly work shall be performed in the presence of the Contracting Officer unless waived in writing. Errors or defects disclosed shall be immediately remedied by the Contractor without cost to the Government. Before disassembly for shipment each piece of a machinery or structural unit shall be match-marked to facilitate erection in the field. The location of match-marks shall be indicated by circling with a ring of white paint after the shop coat of paint has been applied or as otherwise directed.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

The Contractor shall have required material tests and analyses performed and certified by an approved laboratory to demonstrate that materials are in conformity with the specifications. These tests and analyses shall be performed and certified at the Contractor's expense. Tests, inspections, and verifications shall conform to the requirements of the particular sections of these specifications for the respective items of work unless otherwise specified or authorized. Tests shall be conducted in the presence of the Contracting Officer if so required. The Contractor shall furnish specimens and samples for additional independent tests and analyses upon request by the Contracting Officer. Specimens and samples shall be properly labeled and prepared for shipment.

2.3.1 Nondestructive Testing

Material parts may be subjected to any form of nondestructive testing determined by the Contracting Officer. This may include ultrasonic, magnaflux, dye penetrant, x-ray, gamma ray or any other test that will thoroughly investigate the part in question. The cost of such investigation will be borne by the Contractor. Any defects will be cause for rejection and rejected parts shall be replaced and retested at the Contractor's expense. The frequency of testing shop and field welds is stated in paragraph 2.3.3.2.

2.3.2 Tests of Machinery and Structural Units

The details for tests of machinery and structural units shall conform to the requirements of the particular sections of these specifications covering these items. Each complete machinery and structural unit shall be assembled and tested in the shop in the presence of the Contracting Officer unless otherwise directed. Waiving of tests will not relieve the Contractor of responsibility for any fault in operation, workmanship or material that occurs before the completion of the contract or guarantee. After being installed at the site each complete machinery or structural

unit shall be operated through a sufficient number of complete cycles to demonstrate to the satisfaction of the Contracting Officer that it meets the specified operational requirements in all respects.

2.3.3 Inspection of Structural Steel Welding

The Contractor shall maintain an approved inspection system and perform required inspections in accordance with Contract Clause CONTRACTOR INSPECTION SYSTEM. Welding shall be subject to inspection to determine conformance with the requirements of AWS D1.1, the approved welding procedures and provisions stated in other sections of these specifications. Nondestructive examination of designated welds will be required. Supplemental examination of any joint or coupon cut from any location in any joint may be required.

2.3.3.1 Visual Examination

All visual examination of completed welds shall be cleaned and carefully examined for insufficient throat or leg sizes, cracks, undercutting, overlap, excessive convexity or reinforcement and other surface defects to ensure compliance with the requirements of AWS D1.1, Section 3 and Section 9, Part D.

2.3.3.2 Nondestructive Examination

The nondestructive examination of shop and field welds shall be performed as designated or described in the sections of these specifications covering the particular items of work.

a. Testing Agency - The nondestructive examination of welds and the evaluation of examination tests as to the acceptability of the welds shall be performed by a testing agency adequately equipped and competent to perform such services or by the Contractor using suitable equipment and qualified personnel. In either case written approval of the examination procedures is required and the examination tests shall be made in the presence of the Contracting Officer. The evaluation of examination tests shall be subject to the approval and all records shall become the property of the Government.

b. Examination Procedures - Examination procedures shall conform to the following requirements.

(1) Ultrasonic Testing - Making, evaluating and reporting ultrasonic testing of welds shall conform to the requirements of AWS D1.1, Section 6, Part C. The ultrasonic equipment shall be capable of making a permanent record of the test indications. A record shall be made of each weld tested.

(2) Radiographic Testing - Making, evaluating and reporting radiographic testing of welds shall conform to the requirements of AWS D1.1, Section 6, Part B.

(3) Magnetic Particle Inspection - Magnetic particle inspection of welds shall conform to the applicable provisions of ASTM E 709.

(4) Dye Penetrant Inspection - Dye penetrant inspection of welds shall conform to the applicable provisions of ASTM E 165.

c. Acceptability of Welds - Welds shall be unacceptable if shown to

have defects prohibited by AWS D1.1, Subsection 9.25 or possess any degree of incomplete fusion, inadequate penetration or undercutting.

d. Nondestructive Examination of shop and field welds shall be as follows:

(1) 10 percent of the full penetration welds shall be inspected by ultrasonic testing.

(2) 10 percent of the groove welds shall be inspected by ultrasonic testing.

(3) 10 percent of the fillet welds shall be inspected by magnetic particle testing or liquid penetrate testing.

(4) The samples shall be randomly selected and shall be representative of the welds on the weldment. Stainless steel welding shall be visually inspected as a minimum.

(5) 100 percent of designed fracture critical welds shall be ultrasonic tested.

2.3.3.3 Test Coupons

The Government reserves the right to require the Contractor to remove coupons from completed work when doubt as to soundness cannot be resolved by nondestructive examination. Should tests of any two coupons cut from the work of any welder show strengths less than that specified for the base metal it will be considered evidence of negligence or incompetence and such welder shall be removed from the work. When coupons are removed from any part of a structure the members cut shall be repaired in a neat manner with joints of the proper type to develop the full strength of the members. Repaired joints shall be peened as approved or directed to relieve residual stress. The expense for removing and testing coupons, repairing cut members and the nondestructive examination of repairs shall be borne by the Government or the Contractor in accordance with the Contract Clauses INSPECTION AND ACCEPTANCE.

2.3.3.4 Supplemental Examination

When the soundness of any weld is suspected of being deficient due to faulty welding or stresses that might occur during shipment or erection the Government reserves the right to perform nondestructive supplemental examinations before final acceptance. The cost of such inspection will be borne by the Contractor.

2.3.4 Structural Steel Welding Repairs

Defective welds in the structural steel welding repairs shall be repaired in accordance with AWS D1.1, Subsection 3.7. Defective weld metal shall be removed to sound metal by use of air carbon-arc or oxygen gouging. Oxygen gouging shall not be used on ASTM A 514/A 514M steel. The surfaces shall be thoroughly cleaned before welding. Welds that have been repaired shall be retested by the same methods used in the original inspection. Except for the repair of members cut to remove test coupons and found to have acceptable welds costs of repairs and retesting shall be borne by the Contractor.

2.3.5 Inspection and Testing of Steel Stud Welding

Fabrication and verification inspection and testing of steel stud welding shall conform to the requirements of AWS D1.1, Subsection 7.8 except as otherwise specified. The Contracting Officer will serve as the verification inspector. One stud in every 100 and studs that do not show a full 360 degree weld flash, have been repaired by welding or whose reduction in length due to welding is less than normal shall be bent or torque tested as required by AWS D1.1, Subsection 7.8. If any of these studs fail two additional studs shall be bent or torque tested. If either of the two additional studs fail all of the studs represented by the tests shall be rejected. Studs that crack under testing in either the weld, base metal or shank shall be rejected and replaced by the Contractor at no additional cost.

PART 3 EXECUTION

3.1 INSTALLATION

All parts to be installed shall be thoroughly cleaned. Packing compounds, rust, dirt, grit and other foreign matter shall be removed. Holes and grooves for lubrication shall be cleaned. Enclosed chambers or passages shall be examined to make sure that they are free from damaging materials. Where units or items are shipped as assemblies they will be inspected prior to installation. Disassembly, cleaning and lubrication will not be required except where necessary to place the assembly in a clean and properly lubricated condition. Pipe wrenches, cold chisels or other tools likely to cause damage to the surfaces of rods, nuts or other parts shall not be used for assembling and tightening parts. Bolts and screws shall be tightened firmly and uniformly but care shall be taken not to overstress the threads. When a half nut is used for locking a full nut the half nut shall be placed first and followed by the full nut. Threads of all bolts except high strength bolts, nuts and screws shall be lubricated with an approved lubricant before assembly. Threads of corrosion-resisting steel bolts and nuts shall be coated with an approved antigalling compound. Driving and drifting bolts or keys will not be permitted.

3.1.1 Alignment and Setting

Each machinery or structural unit shall be accurately aligned by the use of steel shims or other approved methods so that no binding in any moving parts or distortion of any member occurs before it is fastened in place. The alignment of all parts with respect to each other shall be true within the respective tolerances required. Machines shall be set true to the elevations shown.

3.1.2 Blocking and Wedges

All blocking and wedges used during installation for the support of parts to be grouted in foundations shall be removed before final grouting unless otherwise directed. Blocking and wedges left in the foundations with approval shall be of steel or iron.

3.1.3 Foundations and Grouting

Concreting of subbases and frames and the final grouting under parts of machines shall be in accordance with the procedures as specified in Section 03301a, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

3.1.4 Special Workmanship Requirements

The fish transport water passages shall be inspected after installation. All welds and joints shall be smooth. Special grinding shall be required to remove all burrs, sharp- edges or protrusions into the fish water transportation passages, including the trashrack beams and columns. Caulking of wide joints with an approved sealant shall be required for all voids that exceed 3/16 inch in width. These smooth transitions shall be required at all steel surfaces that fish will pass by.

3.2 PROTECTION OF FINISHED WORK

3.2.1 Machined Surfaces

Machined surfaces shall be thoroughly cleaned of foreign matter. All finished surfaces shall be protected by suitable means. Unassembled pins and bolts shall be oiled and wrapped with moisture resistant paper or protected by other approved means. Finished surfaces of ferrous metals to be in bolted contact shall be washed with an approved rust inhibitor and coated with an approved rust resisting compound for temporary protection during fabrication, shipping and storage periods. Finished surfaces of metals which shall be exposed after installation except corrosion resisting steel or nonferrous metals shall be as shown. Reference Section 09965A, PAINTING: HYDRAULIC STRUCTURES.

3.2.2 Lubrication After Assembly

After assembly all lubricating systems shall be filled with the lubricant specified and additional lubricant shall be applied at intervals as required to maintain the equipment in satisfactory condition until acceptance of the work.

3.2.3 Aluminum

Aluminum that shall be in contact with grout or concrete shall be protected from galvanic or corrosive action by being given a coat of zinc-chromate primer and a coat of aluminum paint. Aluminum in contact with structural steel shall be protected against galvanic or corrosive action by being given a coat of zinc-chromate primer and a coat of aluminum paint. The zinc-chromate primer shall conform to SAE AMS 3110. The aluminum paint shall consist of a aluminum paste conforming to ASTM D 962, spar varnish conforming to SAE AMS 3132 and thinner compatible with the varnish. The aluminum paint shall be field mixed in proportion of 2 pounds of paste, not more than one gallon of spar varnish and not more than one pint of thinner.

3.3 TESTS

3.3.1 Workmanship

Workmanship shall be of the highest grade and in accordance with the best modern practices to conform with the specifications for the item of work being furnished.

3.3.2 Production Welding

Production welding shall conform to the requirements of AWS D1.1 or AWS D1.2 as applicable. Studs on which pre-production testing is to be performed shall be welded in the same general position as required on production items (flat, vertical, overhead or sloping). Test and production stud welding will be subjected to visual examination or inspection. If the

reduction of the length of studs becomes less than normal as they are welded, welding shall be stopped immediately and not resumed until the cause has been corrected.

-- End of Section --

This page is intentionally left blank.

SECTION 05616

STOPLOGS AND LIFTING BEAM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 153/A 153M	(1995) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 276	(2000) Stainless Steel Bars and Shapes
ASTM A 307	(1998) Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength
ASTM A 325	(1997) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 572/A 572M	(1999) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM B 505/B 505M	(1996) Copper-Base Alloy Continuous Castings
ASTM D 395	(1989; R 1994) Rubber Property - Compression Set
ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 413	(1982; R 1993) Rubber Property - Adhesion to Flexible Substrate
ASTM D 471	(1995) Rubber Property - Effect of Liquids
ASTM D 572	(1988; R 1994) Rubber - Deterioration by Heat and Oxygen
ASTM D 2240	(1995) Rubber Property - Durometer Hardness

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be

submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G

Detail drawings shall be submitted as specified in Section 05055a METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

Amend R0004

Detail drawings shall be submitted for each stoplog and for the lifting beam. The detail drawings for the lifting beam shall fully detail the mechanical linkages required for smooth operation of the lifting beam. The Contractor shall design and detail the final mechanical latching mechanism and mechanical linkages required based on the provided criteria and schematic layout. The submitted design of the mechanical latching mechanism and mechanical linkages shall be sealed by a registered professional engineer.

****

SD-03 Product Data

Welding; G

Schedules of welding procedures for structural steel shall be submitted as specified in Section 05055a METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

Materials

Materials orders, materials lists and materials shipping bills shall be submitted as specified in Section 05055a METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

Materials Disposition Records

A system of identification which shows the disposition of specific lots of approved materials and fabricated items in the work shall be established and submitted before completion of the contract.

SD-06 Test Reports

Tests, Inspections, and Verifications

Certified test reports for material tests shall be submitted with all materials delivered to the site.

1.3 QUALIFICATION OF WELDERS AND WELDING OPERATORS

Qualification of welders and welding operators shall conform to the requirements of Section 05055a METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

1.4 DELIVERY, STORAGE AND HANDLING

Delivery, handling and storage of materials and fabricated items shall conform to the requirements specified herein and in Section 05055a METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS. Materials and equipment delivered to the site by the Contracting Officer, including the Government provided lifting beam,shall be unloaded by the Contractor. The Contractor shall verify the condition and quantity of the items delivered by the Contracting Officer and acknowledge receipt and condition thereof in writing to the Contracting Officer. If delivered items are damaged or a shortage is determined, the Contractor shall notify the Contracting Officer of such in writing within 24 hours after delivery.

1.4.1 Rubber Seals

Rubber seals shall be stored in a place which permits free circulation of air, maintains a temperature of 70 degrees F or less, and prevents the rubber from being exposed to the direct rays of the sun. Rubber seals shall be kept free of oils, grease, and other materials which would deteriorate the rubber. Rubber seals shall not be distorted during handling.

PART 2 PRODUCTS

2.1 MATERIALS

Materials orders, materials lists and materials shipping bills shall conform to the requirements of Section 05055a METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.1.1 Metals

Structural steel and other metal materials sections and standard articles shall be as shown and as specified herein and in Section 05120a Structural Steel

2.1.1.1 Structural Steel

Structural steel shall conform to ASTM A 572/A 572M, Grade 50 ksi unless otherwise noted.

2.1.1.2 Bronze

All Bronze shall confrom to ASTM B 505/B 505M, Copper Alloy UNS C93200.

2.1.2 Rubber Seals

Rubber seals shall be fluorocarbon (Teflon) clad rubber seals of the mold type only, shall be compounded of natural rubber, synthetic polyisoprene, or a blend of both, and shall contain reinforcing carbon black, zinc oxide, accelerators, antioxidants, vulcanizing agents, and plasticizers. However, horizontal seals need not be fluorocarbon (Teflon) clad. Physical characteristics of the seals shall meet the following requirements:

PHYSICAL TEST	TEST VALUE	TEST METHOD SPECIFICATION
Tensile Strength	2,500 psi (min.)	ASTM D 412
Elongation at Break	450% (min.)	ASTM D 412

PHYSICAL TEST	TEST VALUE	TEST METHOD SPECIFICATION
300% Modulus	900 psi (min.)	ASTM D 412
Durometer Hardness (Shore Type A)	60 to 70	ASTM D 2240
*Water Absorption	5% by weight (max.)	ASTM D 471
Compression Set	30% (max.)	ASTM D 395
Tensile Strength (after aging 48 hrs)	803500f tensile strength (min.)	ASTM D 572

* The "Water Absorption" test shall be performed with distilled water. The washed specimen shall be blotted dry with filter paper or other absorbent material and suspended by means of small glass rods in the oven at a temperature of 70 degrees plus/minus 2 degrees C for 22 plus/minus 1/4 hour. The specimen shall be removed, allowed to cool to room temperature in air, and weighed. The weight shall be recorded to the nearest 1 mg as W1 (W1 is defined in ASTM D 471). The immersion temperature shall be 70 degrees plus/minus 1 degree C and the duration of immersion shall be 166 hours.

2.1.2.1 Fabrication

Vertical rubber seals shall have a fluorocarbon film vulcanized and bonded to the sealing surface of the bulb. Horizontal seals need not have the fluorocarbon film. The film shall be 0.060 inch thick Huntington Abrasion Resistant Fluorocarbon Film No. 4508, or equal, and shall have the following physical properties:

Tensile strength ..... 2,000 psi (min.)

Elongation ..... 250 percent (min.)

The outside surface of the bonded film shall be flush with the surface of the rubber seal and shall be free of adhering or bonded rubber. Strips and corner seals shall be molded in lengths suitable for obtaining the finish lengths shown and with sufficient excess length to provide test specimens for testing the adequacy of the adhesion bond between the film and bulb of the seal. At one end of each strip or corner seal to be tested, the fluorocarbon film shall be masked during bonding to prevent a bond for a length sufficient to hold the film securely during testing.

2.2 MANUFACTURED UNITS

2.2.1 Bolts, Nuts and Washers

High-strength bolts, nuts, and washers shall conform to ASTM A 325, Type 1, hot-dip galvanized. Bolts, nuts, studs, stud bolts and bolting materials other than high-strength shall conform to ASTM A 307, Grade A, hot-dip galvanized. Bolts 1/2 inch and larger shall have heavy hexagon heads. The finished shank of bolts shall be long enough to provide full bearing. Washers for use with bolts shall conform to the requirements specified in the applicable specification for bolts.

2.2.2 Screws

Screws shall be of the type indicated.

2.2.3 Lifting Beam for Stoplogs

The lifting beam for the stoplogs shall be fabricated by the Contractor in the same fabrication shop used to fabricate the stoplogs prior to being needed for lifting and placing the stoplogs.

2.2.3.1 Bearings

All bearing-to-housing press fit shall be in accordance with Bearing Manufacturer's recommendations.

2.2.3.2 Hardware

All hardware specified as galvanized shall conform to ASTM A 153/A 153M.

2.3 FABRICATION

2.3.1 Detail Drawings

Detail drawings of stoplogs and lifting beam and appurtenant shop fabricated items, including fabrication drawings, shop assembly drawings, delivery drawings, and field installation drawings, shall conform to the requirements specified and in Section 05055a METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.3.1.1 Fabrication Drawings

Fabrication drawings shall show complete details of materials, tolerances, connections, and proposed welding sequences which clearly differentiate shop welds and field welds.

2.3.1.2 Shop Assembly Drawings

Shop assembly drawings shall provide details for connecting the adjoining fabricated components in the shop to assure satisfactory field installation.

2.3.1.3 Delivery Drawings

Delivery drawings shall provide descriptions of methods of delivering components to the site, including details for supporting fabricated components during shipping to prevent distortion or other damages.

2.3.1.4 Field Installation Drawings

Field installation drawings shall provide a detailed description of the field installation procedures. The description shall include the location and method of support of installation and handling equipment; provisions to be taken to protect concrete and other work during installation; method of maintaining components in correct alignment; and methods for installing appurtenant items.

2.3.2 Structural Fabrication

Structural fabrication shall conform to the requirements specified and in Section 05055a METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.3.3 Welding

Welding shall conform to the requirements specified in Section 05055a METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.3.4 Bolted Connections

Bolted connections shall conform to the requirements specified in Section 05055a METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.3.5 Machine Work

Machine work shall conform to the requirements specified in Section 05055a METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.3.6 Miscellaneous Provisions

Miscellaneous provisions for fabrication shall conform to the requirements specified and in Section 05055a METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS. Zinc coating of hardware items shall conform to ASTM A 153/A 153M.

2.3.7 Fabrications

2.3.7.1 Stoplogs

Stoplogs shall be fabricated of structural steel conforming to ASTM A 572/A 572M, Grade 50 ksi, unless otherwise noted.

2.3.7.2 Stoplog Guides

Stoplog guides shall be fabricated of stainless steel conforming to ASTM A 276, Type 304, unless otherwise noted.

2.3.7.3 Miscellaneous Embedded Metals

Corner protection angles, frames, base plates, and other embedded metal items required for complete installation shall conform to the details shown, and shall conform to ASTM A 276, Type 304 stainless steel, unless otherwise noted.

2.3.8 Seal Assemblies

Seal assemblies shall consist of rubber seals, stainless steel retainer and spacer bars, and fasteners. Rubber seals shall be continuous over the full length. Seals shall be accurately fitted and drilled for proper installation. Bolt holes shall be drilled in the rubber seals by using prepared templates or the retainer bars as templates. Splices in seals shall be fully molded, develop a minimum tensile strength of 50 percent of the unspliced seal, and occur only at locations shown. All vulcanizing of splices shall be done in the shop. The vulcanized splices between molded corners and straight lengths shall be located as close to the corners as practicable. Splices shall be on a 45 degree bevel related to the "thickness" of the seal. The surfaces of finished splices shall be smooth and free of irregularities. Stainless steel retainer bars shall be field-spliced only where shown and machine-finished after splicing.

2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

Tests, inspections, and verifications for materials shall conform to the requirements specified in Section 05055a METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS. The lifting beam shall be tested in the shop with a stoplog to ensure the lifting mechanism and all linkages work correctly prior to delivery to the site.

2.4.1 Testing of Rubber Seals

The fluorocarbon film of rubber seals shall be tested for adhesion bond in accordance with ASTM D 413 using either the machine method or the deadweight method. A 1 inch long piece of seal shall be cut from the end of the seal which has been masked and subjected to tension at an angle approximately 90 degrees to the rubber surface. There shall be no separation between the fluorocarbon film and the rubber when subjected to the following loads:

THICKNESS OF FLUOROCARBON FILM	MACHINE METHOD AT 2 INCHES PER MINUTE	DEADWEIGHT METHOD
0.060 inch	30 pounds per inch width	30 pounds per inch width

Failure of any specimen to meet the requirements of the test used will be cause for rejection of the piece from which the test specimen was taken.

2.4.2 Testing of Lifting Beam Mechanism

The lifting beam mechanism shall be tested in the fabrication yard prior to shipping to the job site. The test shall consist of the lifting beam mechanism fully engaging and releasing a stop log.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall conform to the requirements specified and in Section 05055a METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

3.1.1 Embedded Metals

Corner protection angles, frames, base plates, and other embedded metal items required for complete installation shall be accurately installed to the alignment and grade required to ensure accurate fitting and matching of components. Embedded metals shall be given a primer coat of the required paint on all surfaces prior to installation in concrete forms. Anchors for embedded metals shall be installed as shown. Items requiring two concrete pours for installation shall be attached to the embedded anchors after the initial pour, adjusted to the proper alignment, and concreted in place with the second pour.

3.1.2 Seal Assemblies

Rubber seal assemblies shall be installed after the embedded metal components have been concreted in place and the gate installation, including painting, completed. Rubber seals shall be fastened securely to metal retainers. Before operating the gate(s), a suitable lubricant shall be applied to the rubber seal rubbing plates to protect the rubber.

3.1.3 Painting

3.1.3.1 Painting Stoplogs

Exposed parts of stoplogs and appurtenances except machined surfaces, corrosion-resistant surfaces, surfaces of anchorages embedded in concrete, rubber seals, and other specified surfaces shall be painted as specified in Section 09965A PAINTING: HYDRAULIC STRUCTURES.

3.1.3.2 Painting Lifting Beam

All steel surfaces shall be painted except galvanized corrosion resistant steel and machined surfaces. All painted surfaces shall be cleaned and painted in accordance with specification 09965A PAINTING: HYDRAULIC STRUCTURES.

3.1.4 Lubrications

All items of the Lifting Beam to be lubricated shall be lubricated with Molylube Alloy 777 waterproof grease.

3.2 PROTECTION OF FINISHED WORK

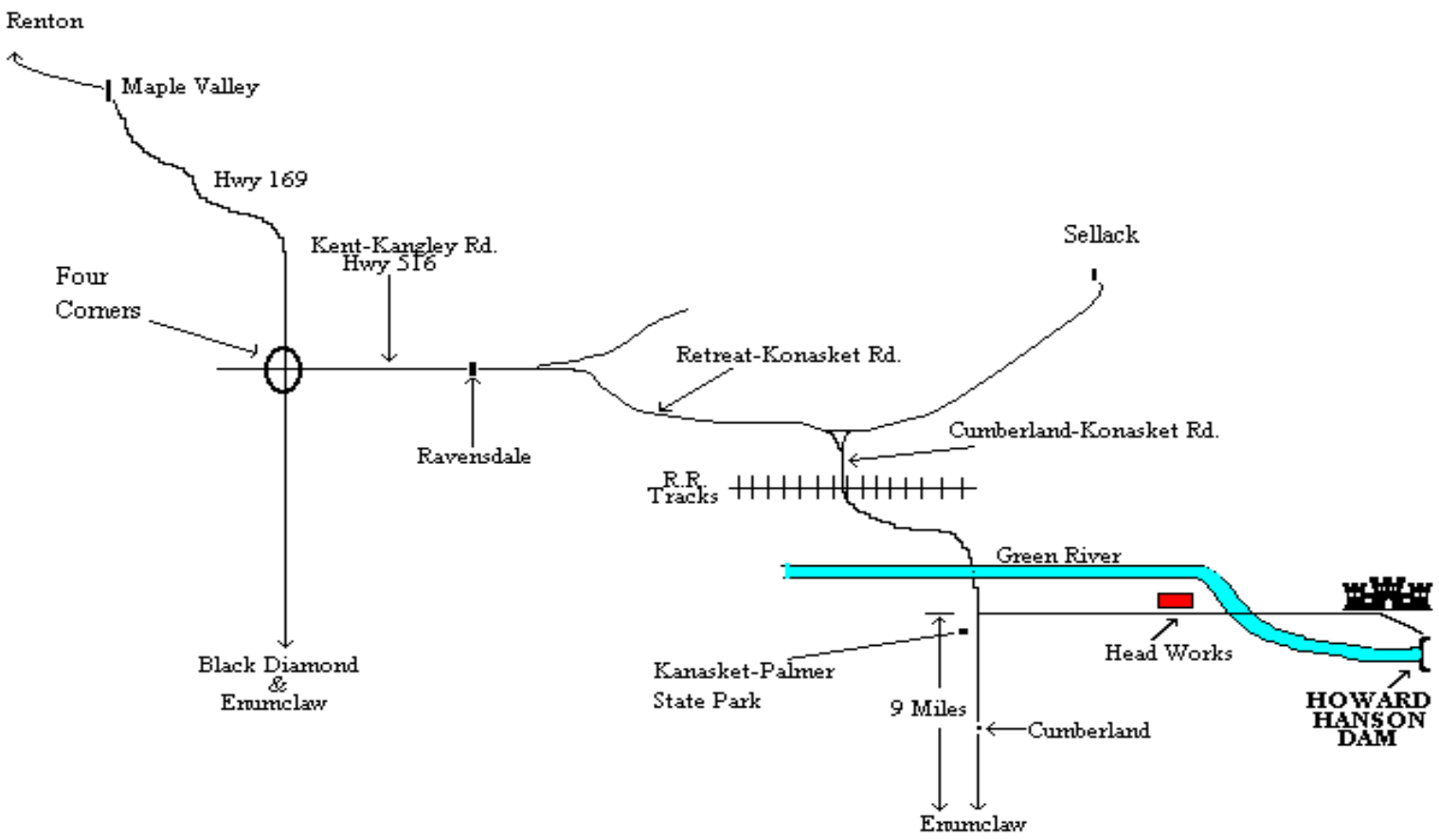
Protection of finished work shall conform to the requirements specified in Section 05055a METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

3.3 ACCEPTANCE TRIAL OPERATION

After completion of installation, the Contracting Officer will examine the stoplog installation for final acceptance. The individual components of the stoplog installation will be examined first to determine whether or not the workmanship conforms to the specification requirements. The Contractor will be required to place the stoplogs in the guides with the lifting beam a sufficient number of times to demonstrate that the stoplogs fit properly, seat uniformly and the lifting beam mechanism operates smoothly. Required repairs or replacements to correct defects, shall be made at no cost to the Government. The trial operation shall be repeated after defects are corrected.

-- End of Section --

MAP TO HOWARD A. HANSON DAM



*** FROM ENUMCLAW**, FOLLOW SIGNS TO KANASKET-PALMER STATE PARK & LOOK FOR THE TACOMA HEADWORKS SIGN ON THE RIGHT

*** FROM I-5 SOUTHBOUND**, TAKE 405 TOWARDS RENTON

* FROM 405, TAKE ENUMCLAW / MAPLE VALLEY EXIT TO HWY 169

* HEAD TOWARDS MAPLE VALLEY, BLACK DIAMOND, ENUMCLAW ON HWY 169

* AT "FOUR CORNERS", TAKE A LEFT ONTO KENT-KANGLEY ROAD(SE 272nd)

* FOLLOW MAP FROM THERE(or signs to Palmer/Kanasket State Park) , TURNING RIGHT ON RETREAT-KANASKET RD., THEN RIGHT ON CUMBERLAND-KANASKET RD., THEN AFTER YOU CROSS THE BRIDGE OVER GREEN RIVER, TAKE THE FIRST LEFT ON TOP OF THE HILL TO THE TACOMA HEADWORKS FACILITY.

* STOP AT TACOMA HEADWORKS GATE & THEY WILL CALL US ON YOUR ARRIVAL.

DACW67-03-R-0001

This page intentionally blank

PREPROPOSAL CONFERENCE

HOWARD HANSON DAM SITE VISIT

HOWARD HANSON DAM

WEDNESDAY, OCTOBER 8, 2003

PALMER, WASHINGTON

Reported by: Barbara Jacobson, CCR

License No. 29906

MR. PADILLA: What we're going to do is just -- we wanted to go through the selection criteria just so you can kind of understand where we're coming from. It's in the specs, but Alex is going to go through that real quick. Then we're going to open it up for questions. When we do the questions, what I'd like you to do is one at a time say what your name is and state what your question is. We have a court reporter here that's recording it all, and it's to try to ensure fairness. So hold your questions for a couple more minutes. Alex is going to talk about the selection criteria real quick, and we'll go from there.

MR. SMITH: I'm Alex Smith. I'm the contract specialist for this project. And what I'm going to talk about real shortly is amendment one to this RFP. Included -- section 110, selection 110, contains source selection criteria. This is a best value. You need to read up so you understand this, but we're going to evaluate the criteria that you submit to us and give ratings. Then based on that, after all that's done, then secondary is the price that's considered. The evaluation, the two factors that we're considering are the technical and the price. The technical evaluation criteria -- and I'm not going to read all this; you're going to need to go back and read it and see your minimum requirements that you need to provide to us. Technical evaluation criteria -- number one is relevant experience of the offeror's construction team. Number two is qualifications of key team members. Number three is your past performance. Number four is proposed schedule. Five is proposal for protection of existing structures. Six is proposal for water quality protection. Seven is proposal for working in fluctuating conditions of the reservoir. Number eight is proposal for permanent structure foundation. And the last one is past performance in implementing subcontracting plans.

And the way the ratings for each of these -- and I'll tell you a little bit -- this will be a technical evaluation team that sits down, a group of professionals that'll do the ratings on these and evaluate what you've sent in. And as you read this you'll find your ratings. The rating are outstanding, above average, satisfactory is neutral, marginal and unsatisfactory. You need to read what each of these mean so you know when you're turning in your information you're filling out, that you know what you have to have to get the best possible rating for this so when we're doing -- and I won't do it, but when the team is doing the evaluation, that, you know, you get the best evaluation that you can get. Again, this is something that I suggest that you read from front to back so you know. There's also a section of submittals that -- your basic submittals

that's in the RFP. And some of them are repetitious that are put in here, but it's for you to remember to make sure that you submit your 1442 and all the other information, your bid bond and that type stuff. So now I'm going to turn it back over to Mike for questions.

MR. SMITH: Let me say this. We're going to try to answer the questions -- or they are. If we don't get the question answered, then we're going to take it back and we'll get an answer. We're going to incorporate the minutes of this site visit by amendment so everybody has all the information and

everybody's on the same playing field.

MR. PADILLA: If you would -- if you have a question, just say what your name is. The court reporter is going to start taking this information down. So if you just state your name and then your question, we'll try to get it answered for you.

UNIDENTIFIED SPEAKER: Is this is only opportunity for questions?

MR. PADILLA: We do have the ability to use the system --

MR. SMITH: Doctor Checks.

MR. PADILLA: -- that we have in there called Doctor Checks. It's kind of a strange name, but it's a computer program that goes with the solicitation where if you have a question, you can go in there, ask the question; we respond to that question. And the whole idea behind this computer program is that all the bidders can see every question and all the answers,

okay, so it's fair. So, no, there -- you do have the ability to ask questions beyond this point.

CONTRACTOR NOTE: This statement is partially incorrect. The questions a contractors submits will not be displayed for all to view. Only the contractor will be responded to with an answer. Any question that requires a material change shall be addressed by amendment to the solicitation.

UNIDENTIFIED SPEAKER: Can you say that name again?

MR. PADILLA: It's called Doctor Checks, and it's in the solicitation of what you have to do. I think it comes down to you get registered for it.

MR. SMITH: When you go onto the Internet site, our home page where you found this, at the very bottom under my name you'll see where it says Doctor Checks (Prognet) for bid inquiries. Click on that and it'll take you to where you're suppose to go and you can get in that and sign in and ask your questions. And then like he said, it'll come back.

MR. PADILLA: We check it every day, so we'll try to get the answers turned around as quickly as possible

UNIDENTIFIED SPEAKER: And are the questions answered in there?

MR. PADILLA: The questions are answered in there also.

UNIDENTIFIED SPEAKER: So if you want to know if questions have been asked, you need to go in there and check it?

MR. PADILLA: Yeah. What you need to do -- I think the prudent thing to do is go in there and check it. If you have a question, put it in there and then come back and check it the next day. And then when you're also in there,
you can see anybody else's questions and their answers also. CONTRACTOR NOTE: This statement is partially incorrect. The questions a contractors submits will not be displayed for all to view. Only the contractor will be responded to with an answer. Any question that requires a material change shall be addressed by amendment to the solicitation. There will be a little time lag while we get the answer together unless we know the answer right off the bat.

MR. IVANETICH: Ken Ivanetich with Hayward Baker. What is the cutoff date for questions?

MR. PADILLA: I believe it'll be the day that the solicitations are due. We can take them right up through that day. I don't think we have provisions for saying that we'll answer your questions -- any sort of cutoff time.

MR. SMITH: No, we're going to try to answer them all the way up until the day of.

MR. PADILLA: Do we need to get a cutoff time in there?

MR. SMITH: If we do, I will talk to the chief of the branch and we'll get a clarification on that and we'll incorporate it by amendment. CONTRACTORS NOTE: Cut off date for questions is 5 days before proposals are due.

MR. JAMIESON: My name is Bruce Jamieson with Traylor Pacific. Who is the evaluation team for the technical proposals and how long will it take them to make their --

MR. PADILLA: The evaluation team includes Corps employees, and they all have a long history with this job and with the preparation of the contract. One thing also, the firm Inca, Inca Incorporated, did the design, and they will probably assist us, but they don't -- all they can do is give us advice. The government has to make the final decision. They give us the advice. As far as how long it takes, that's a good question because it really varies. It depends -- one of the things about an RFP is that in there you'll read in that section
110 that there is a situation that we could get in where we do have the ability to ask questions of the offeror as opposed to a low bid. And if you read that, you'll see what the details are. But we do have the ability to go back. CONTRACTOR NOTE: Government shall only contact contractors that meet the competitive range for questions. If that occurred, it could take a little bit longer. But I think in general we are scheduling it to be around two weeks, I believe. But, again, that's just a placeholder time.

MR. GOSS: That will also depend on the number of proposals too.

MR. COLLINS: Dan Collins with Traylor. Is there any requirements or what are the requirements in the bid, if any, to maintain the haul road between the dam site and the disposal site?

MR. PADILLA: Right now we have something in there, in the division one specs, about that. Tacoma has contracts underway for repair of those roads. There's a provision in there where you have to pay Tacoma a certain amount per trip, and it's because they're the ones that have to maintain it. And it's in that. It's very explicit. It's right in the specs. So just go in there and somewhere in division one -- I was going to say it's 1050, but I'm not sure. It's ten something. I'll just have to look in there.

MR. COLLINS: So we pay a trip fee and they maintain it?

MR. PADILLA: Yes.

MR. COLLINS: Are there any plans right now to postpone the bid date?

MR. PADILLA: There are no plans at this point to postpone the bid date. Usually IFBs, invitations for bids, are 30 days; and the RFPs are 15 days longer, which is 45, which is what we added in for this one. o at this point in time there are no plans to extend that.

MR. COLLINS: We'd like to request at least an additional month, especially in light of the extensive technical proposal. Would you like that in writing or is a question --

MR. SMITH: Yes, you need to put it in writing.

MR. KIRSCH: Erik Kirsch with Barnard Construction. Is it possible to get some AutoCAD drawings or perhaps some MicroStation drawings of the contract?

MR. RICHARD SMITH: Everything's in CALS.

MR. PADILLA: Everything's in CALS It's just that it's a fairness issue. If some people don't have AutoCAD and some people don't have MicroStation, then it might cause some sort of a fair -- so I think I need to defer that question until later. But I can answer that question. Can you write that one down, please.

MR. STEPHENS: Gary Stephens with Traylor. Is there any additional information not in the plans or specs that are available to the contractors as far as quantities?

MR. PADILLA: We know an amendment is coming out.

MR. SMITH: The answer to that is we plan on posting the fourth amendment the middle to the end of next week. And I don't have the information on exactly what it is. I know it's technical in nature.

MR. PADILLA: Well, there are -- there's going to be a technical amendment the middle to end of next week that's going to include a little more information on quantities and some other geometrical information, and it's technical information to help with the bids. I think in general it's some detail stuff that – there isn't anything really major in there that's going to change.

It's more just clarifications of details. But, there is going to be some information on quantities in there.

MR. TONEY: Kevin Toney, McCallum Rock Drilling. Will there be an opportunity to come back up to the site before the bid date?

MR. SMITH: That's your decision as to whether you schedule --

MR. PADILLA: I think if -- in general I think- you know, I think it'd be worthwhile, you can -- we11 can stay up here as long as you want today, you know, within reason. We could probably schedule another date, but I guess it would have to be more of a -- I'd have to see a lot of requests for that.

MR. TONEY: The reason I ask is I'll be working on the shot design for the blasting operations. As I start putting stuff together and run scale distances and estimations on peak particle velocity, my plan's going to get adjusted quite a bit between now and the bid date where I might need to take some actual distances from the existent concrete. I guess more stuff than what I could actually, you know, facilitate today, there's going to be things that come up.

MR. PADILLA: I think most of the time what we -- we just have, you know, the idea of fairness that we do whatever we can to avoid bid protests. So I think if it becomes apparent that it would be in the best interest of the project to have another site visit closer to he end time, I think we could look at that. But you can understand that one person asking me that doesn't really do it for me. I'd probably have to see several requests through the Doctor Checks system we talked about. I'll have to say there's a possibility we could do that, but I'll have to defer that answer until later.

MR. TONEY: All right.

MR. PADILLA: Anybody else? I guess I have a question for you. Do you want to take some more time to look around a little bit? Okay. And, again, the facilities here are -- they're not -- there's usually only three or four people up here for the past 40 years, so we only really have one bathroom back on the other side. We can go back over there if you want to use the facilities over there. Then we can look around a little bit, but I think maybe we should decide right now how long we're going to allow people to look around. Do you want to go to?

MR. SMITH: Once we leave here and we -- if you decide to go look around, then we're not doing any more questions. You'll have to submit those questions through Doctor Checks. So, you know -- because that way we've got to have everything on record.

MR. PADILLA: Would another hour do it if you guys want to look around some more? Would that do it or --

UNIDENTIFIED SPEAKER: Can you bring a group down earlier, like right now?

MR. RICHARD SMITH: Bring a separate group that doesn't want to hang around here with all of us, and then come back up and get these guys.

MR. PADILLA: Yeah, that's fine.

MR. GOSS: Who's interested in sticking around? Nobody. Okay.

MR. PADILLA: You know, if nobody wants – if you've seen enough, that's fine. That's fine. You know, we don't need to wait around.

UNIDENTIFIED SPEAKER: Can we make one stop on the top of that crest going out just for a shot back on the other side?

MR. PADILLA: Yeah. And I was going to mention also that there is an access that I wanted to point out, and I may stop with -- on the bus as we're going back around. You don't have to get out of the bus. But the trash rack cleaning can be done by barge, and the barge would go around that knoll, that rocky outcropping. Then there's an area where we did the -- kind of
come up and around there. If you go straight down there, that road could be improved to allow a truck to get the --to unload the barge and haul that material away. So I did want to point that out. I think that probably will be in the technical amendment that's going to come out next week, but you
probably want to get a good -- a look at that.

MR. COLLINS: Question. Dan Collins with Traylor. Could we get a copy of the sign-in sheet before we leave or at least --

MR. SMITH: No. But what I will do I intend on incorporating it into the amendment where everybody will have it. Because I don't have a way of making copies for everybody right now.

MR. PADILLA: And we'll get that out right away. If we need to put it -- we know there's a technical amendment. If we need to put out a real short one just so you can get going on it, we can do that. But we'll get you

that information.

MR. STUART: Yeah. Jon Stuart with RCI. Has the Corps considered making gate adjustments during certain phases of the job, for example, installation of the water quality barrier and removal of debris in front of the existing trash rack, to a minimum flow during those activities?

MR. PADILLA: Well, we do have a lot of information in the H and H baseline report about what we can and cannot do. I think when it comes to gate changes, we really are limited. You know, we're very much constrained here. We have to, you know -- if it was up to me, we would shut the river down, do the work and go down, but we can't do that. We've got to do flood control; we've got to do water quality for Tacoma. Those are the two main missions. And we -- our mission of building this is really tertiary to those two. Jon, what can we say about that?

MR. OLSON: Well, and the other -- we're missing a third one, too, and that's environmental with the fish and things and the river as well. What our job is to protect the Auburn, Kent, Renton valleys. But we can flow inflows up to a certain extent. We have to impede water when it comes to where the local inflows are more than what the valley can handle. That's why we're here.

So we will flow inflows coming into the project. We will let out as well as -- all the other hydrological data that comes in prevents us from coming downstream with any more water.

MR. PADILLA: I can tell you that we are going to -- we're going to amend the H and H baseline report to try to get a little bit more specific. What you see in the baseline report is historical data. We will operate the dam slightly differently because we know we have a construction contractor in the water. But somehow we're trying to communicate to you that we still are very limited as to what we can do. We just can't unilaterally make gate changes and make changes that -- they're within a narrow range, and it's in that baseline report. I think a big part of this project is going in there and doing -- evaluating how much time, you know, in general you're going to have to work in that low pool.

MR. OLSON: Would it be fair to say, Mike, that whenever there is any work being done, for instance, in the trash rack area and where there is contractors working that area, there will be an actual operator here from operations --

MR. PADILLA: Yeah, there will be.

MR. OLSON: -- at the project?

MR. PADILLA: I think you'll probably -- if you look at the historical data -- and we're trying to provide a little more in this amendment coming up -- you'll probably notice that on Monday there was adjustments made because no one was here over the weekend. Well, that won't be the case with this job. We'll be a little bit tighter. But you can probably understand the government's problem that we can't promise the world to you because we're very constrained as to what we can do. So part of that is the selection criteria. Tell us how you intend to work in the conditions of the reservoir. We do have the ability with proposals to ask for clarifications. And if you read that section, 110, you'll see that. So if we get back some proposals and we think it may be worthwhile going back for another -- you know, giving more information and asking for another round, we have the ability to do that. And I advise you to look at 110. So that's where it's all --

MR. JAMIESON: Bruce Jamieson, Traylor. Is there a recent structural evaluation or condition report on the existing 19-foot tunnel?

MR. PADILLA: Where's Paul?

MR. NOYSE: Well, we have the Shannon & Wilson report.

MR. PADILLA: Yeah. I guess I'm not sure what the nature of your question is in terms of are you –

MR. JAMIESON: Well, its proximity to the excavation, there becomes a concern with damage to the tunnel through blasting. I'd like to know what the tunnel condition is now in order to address those concerns.

MR. PADILLA: I don't know. Paul, what --

MR. NOYSE: I think -- do the reference drawings show the tunnel -- right, the tunnel liner and --

MR. PADILLA: Yeah. I think the -- I think we've tried to address that through the restrictions and blasting lift sizes and peak particle velocity in the tunnel.

MR. RICHARD SMITH: What we have is we have the As-Built from construction of how the tunnel was built. And then we had a recent inspection that Shannon & Wilson did when they put the -- we have instrumentation in the tunnel now that was put there specifically to monitor this construction event. And there was an evaluation done, essentially just looking for cracks and that sort of thing to see what was there. But I'm trying to remember if that drawing ended up in the specs or not. I don't remember. It might be one of the instrumentation drawings.

MR. PADILLA: Yeah, can you make a note of that and

MR. RICHARD SMITH: I'll make a note.

MR. PADILLA: We'll see if we can get -- try to get a little bit more information on that for you.

MR. JAMIESON: Yeah. Why don't you get back to me.

MR. PADILLA: Yeah. I do know that the amendment that's coming out next week is going to clarify a few things that may make that a moot point. So we'll see. Any other questions at all? Okay. I think in general, then, it seems like everybody is ready to go then. If there's a couple people, I think we can probably make arrangements for you to go down and get your vehicle and come back perhaps, if you really want to come back. Could we do that, Jon? You don't want to do that? Well, I guess it seems like --

MR. OLSON: I guess the only problem with that is that, yeah, you guys can go wander around, do whatever aimlessly, what you want to do, but we're in the Tacoma watershed and this is a water supply, and we have to account for everything that happens up here.

MR. PADILLA: I guess everybody's ready to go pretty much. So we'll pile on the bus. I want to show you that little access road that if you use the barge to clean off the trash rack you could go. We'll stop if you want to use the facilities, and then we're going to head on downstream. And thank you very much for coming, and good luck on the bids.

(Conference concluded.)

This page was intentionally left blank for duplex printing.

	NAME	NAME OF COMPANY	PHONE	EMAIL
1				
2	~~ASIRCC INC~~ JEFF SCHMITT	ASIRCC INC	719 395 8625	JEFFS@ASIRCC.COM
3	JESS SPENCER	TALISMAN CONST. SVCS	509 487-1292	TALISMANSERVICES@COMCAST.NET
4	Kevin Toney	McCallum Rock Drilling, Inc. Chehalis, WA	(360) 748-7259	Ktoney6@CS.COM
5	ERIC HANSEN	BREMMEYER LOGGING	(425) 432-9310	
6	Jason West	Westway Const	(509) 466-8535	jwest@westway.cc
7	ALLAN SCHULZ	ADVANCED COMMS DIVERS	425-246-2120	ACOMSE@MSN.COM
8	George Lulham	Black water marine llc	425-828 6439	glulham@offshore systems inc.com
9	Paul Franzen	Barnard Const Co.	406-586-1995	
10	Greg Schletning	Barnard Constr Co Inc	406-586-1995	GREG.Schleining@Barnard-inc.com
11	DAN SCHALL	BARNARD Const.	406-586-1995	dan.schall@barnard-inc.com

12	STUART BROWN	PETER KIEWIT SONS	604-278-3331	stuart.brown@kiewit.ca
13	DARREN HAMLIN	HAYWARD BAKER INC	206 223 1732	dehamlin@haywardbaker.com
14	Lyle McClellan	Barnard Construction	406 586-1995	lylemcclellan@barnard-inc.com
15	DAN HERTEL	BARNARD CONSTRUCTION	406 586-1995	dan.hertel@barnard-inc.com
16	CHUCK NELSON	KPC	360-693-1478	
17	DANI Hubbs	KIEWIT PACIFIC Co	3606931478	dani.hubbs@kpc.kiewit.com
18	ERIK KIRSCH	BARNARD CONST.	(406) 586-1995	
19	TODD PITTMAN	JAMES W FOWLER CO.	(503) 623-5373	TODDP@JW FOWLER.COM
20	Tim Lutman	SLEAD Construction	253 531 2409	Tim@Slead-dewatering.com
21	Mike Hamilton	RCI Group	253 863 6200	mhamilton@rci-group.com
22	JON STUART	RCI GROUP	253 863 5200	JSTUART@RCI-GROUP.COM

23	Chris Zepernick	Balfour Beatty	253/863-8160	BBCICGZC Yahoo.com
24	Carl Jonsson	Balfour Beatty	253/863-8164	BBCICFJ@Yahoo.com
25	Eric Benton	J.R. Hayes & Sons	426-392-5722	ebenton@jrhayes.com
26	Dan Collins	Traylor Pacific	948-425-4949	dcollins@traylorpacific.com
27	Bruce Jamieson	Traylor Pacific	206-255-0808	bjamieson@Traylor.com
28	GARY STEPHENS	TRAYLOR PACIFIC	503-579-8450	gstephens@traylorpacific.com
29	ERIC DYBEVIK	CONDON-JOHNSON	206 575 8243	edybevik@condon-johnson.com
30	Jim Porterfield	DBM Contractors	253-838-1402	jimp@dbmcm.com
31	KEN IVANETICH	HAYWARD BAKER INC	925-825-5056	Kbivanetich@haywardbaker.com
32	Fermon Carroll	Stellar J Corp.	360-225-7996	
33	Bis Kinghorn	" " "	"	Kinghorn@stellarj.com
34	Steve Story	Layne GeoConstruction	253 536-1161	SLSTORY@LAYNECHRISTENSEN.COM
35	Karl Pankaskie	COE - Walla Walla	(509) - 527-7517	karl.w.pankaskie@usace.army.mil
(36)	David Oliver	Morgan Oswood Constr	(406) 761-1420	

DACW67-03-R-0001
Oct 08 2003

Fish Passage Facility Cofferdam and Excavation, HHD

37	Bill Goss	US Army Corps of Engineers	206-764-3267
38	Mike Padilla	US Army Corps of Engineers	206-764-6734
39	Richard Smith	US Army Corps of Engineers	206-764-3309
40	Jon Olson	US Army Corps of Engineers	206-764-6975
41	Alex Smith	US Army Corps of Engineers	206-764-6804
42	Dave Wright	US Army Corps of Engineers	206-764-4460
43	James Parker	US Army Corps of Engineers	206-764-4460
44			
45			
46			
47			
48			
49			