

CONTRACT DOCUMENTS

FOR THE CONSTRUCTION OF

SPANISH FORK CITY JOHNSON PROPERTY WATERLINE PROJECT

**Volume 1 OF 2
Specifications**



Spanish Fork City

For Information Regarding this Project Contact:

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June 2024

JOHNSON PROPERTY WATERLINE

June 2024

OWNER

SPANISH FORK CITY
40 S. Main Street
Spanish Fork, UT 84660

ENGINEER



**154 East 14075 South
Draper, Utah 84020**

SECTION 00 01 07
SEALS PAGE



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(STRUCTURES AND CITY IMPROVEMENTS) NORTHEAST OF 700 WEST AND 2140 NORTH,
SPANISH FORK, UTAH – GSH GEOTECHNICAL, INC., SEPTEMBER 1, 2023, ALAN SPILKER, P.E.**

VOLUME 2 - DRAWINGS

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END OF SECTION



Special Provisions

JOHNSON PROPERTY WATERLINE PROJECT

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A **mandatory** pre-bid meeting shall be scheduled at the Spanish Fork City Engineering Office Building (775 N Main Street, Spanish Fork, Engineering Conference Room) for **Tuesday, JuLY 16, 2024 at 2:30 PM MDT**.

1. DEFINITIONS

CITY

The City of Spanish Fork.

CONTRACTOR

The Contractor shall be the company, with appropriate state licenses, contracted with by the City, by the competitive bid process to construct this project. Contractor is to read and understand the Special Conditions, plan drawings, and City Standards.

SUB-CONTRACTOR

A person or company hired by the Contractor to perform construction for the City, having appropriate state licenses to perform said work.

Sub-contractor shall provide the contractor with proof of receipt for e-verification, and submit it to the City.

CITY STANDARDS

The Spanish Fork City, most recent Construction Standards, approved by the Spanish Fork City Council.

BONDS AND DOCUMENTATION

All required documentation is due by the bid opening. Bids submitted incomplete may be rejected. A 5% Bid bond and payment and performance bonds shall be required as part of this project. A cashier's check may be submitted to the City in lieu of a bid bond.

UDOT & UTAH COUNTY PERMITS

Contractor is responsible for any and all permits required to work in the UDOT and or Utah County Right-of-Way. The cost of permits shall be included in the mobilization line item.

START OF WORK AND COMPLETION DATE

Work may be started as soon as Notice to Proceed is issued by the City. This project shall be completed by **November 1, 2024**.

2. MOBILIZATION (Item 1)

MOBILIZATION

Includes mobilizing all necessary equipment, to do the work, all labor, materials and equipment to set up temporary offices, facilities, signs and utilities, all premiums on bonds and insurance and the removal of all equipment and temporary facilities, and provide Project Management and Supervision. Also includes modifying and maintaining project sponsorship signs, and all necessary permits from Spanish Fork City, Utah County, and

bringing all necessary construction equipment to the site, and utility coordination. Includes all needed coordination with the public and affected property owners, including construction updates, utility outage notifications, responding to public questions and concerns, and coordinating with City staff. Includes getting the building permit and receiving C of O from the building department. Includes SWPPP installation and maintenance throughout the project and NOI (silt fencing, construction entrance, etc.). Includes Demolition as described below.

DEMOLITION/ CLEARING & GRUBBING

The site demolition and site clearing shall be included in the demolition line item. Work includes the removal and disposal of road base, pipe removal and disposal, concrete, subgrade material to finish subgrade, debris removal, earthwork, and any other item that is otherwise affected by the demolition for the project. Demolition also includes all necessary saw cutting, removal and disposal. See City Standards, Plans, detailed drawings, and any other document that is relevant to the demolition/ clearing and grubbing line item.

EXCAVATION

These items shall include the removal and disposal of any existing material, including but not limited to: concrete, cross-gutter, boxes, soil, and sub-grade material required to construct the curb, gutter, and sidewalk, sewer main, water main, storm drain, and full road reconstruct according to the plans, detail drawings, and City standards.

PAYMENT

Payment shall be on a lump sum contract unit price basis and paid based on the prorated percentage of work completed at the time the pay estimate is prepared.

3. CLEARING AND GRUBBING SITE, EARTHWORK (Item 2)

Includes all costs associated with labor, materials, and equipment required to clear and grub the site; stripping and storing the topsoil for re-installation; fence removal and re-installation; ditch repair; remove existing trees or stumps; removing the vegetation and deleterious materials on the site per the recommendations in the geotechnical study; dewatering; excavation; hauling of materials off-site and disposing of materials and any other clearing needs in accordance with the requirements of the Contract Documents.

PAYMENT

Payment shall be on a lump sum contract unit price basis.

4. DEWATERING (Item 3)

Includes all work and materials incidental to the work including labor, materials, and equipment required to provide continuous dewatering for the project throughout the time necessary to install the pipeline, etc.; provide a dewatering plan; and all other work required to complete the work as required in the Contract Documents.

PAYMENT

Payment shall be on a lump sum contract unit price basis.

5. 12" C-900 WATERLINE (Item 4)

Includes all work and materials incidental to the work of installing the 12" C-900 WATERLINE including; labor, materials, fittings, Megalug joint restraints or approved equivalent, tracer wire, magnetic warning tape, saw cutting, excavation, installation of trench plugs, concrete, imported pipe bedding, pipe, thrust restraints, connections, bends, trench plates, cutting, pressure testing, disinfection, clean up, disposal of excess materials, any other utility restoration, and the restoration of any other existing improvements not heretofore noted that have been adversely impacted, damaged, destroyed, or made inoperable by and incidental to the 12" C-900 WATERLINE. Because of the shallow ground water and unstable soils, it will be required to over excavate the trench by 12". This area will be filled with a stabilization rock as recommended by the Geotechnical Engineer.

EXCAVATION

These items include the removal and disposal of all existing material required to excavate trenches. These items shall include potholing and locating existing structures and utilities as revealed by a bluestake. All pipes shall have a minimum of 6 inches of separation from structures or utilities. Contractor shall be responsible for planning the grade to provide this separation before laying the pipe. There will be no change orders for minor adjustments of a pipe's horizontal or vertical alignment. All excavation costs shall be included in the cost of the pipe.

BACKFILL AND COMPACTION

All backfill shall be compacted according to City standards. A minimum of 12" of topsoil shall be installed in unimproved areas, and a minimum of 8" of untreated base course or gravel materials to match existing shall be used in traffic areas.

ENGINEERING FILL AND BEDDING MATERIAL

All engineered fill and bedding material shall be placed according to City standards. Course sand shall be placed and compacted around the pipe zone with a minimum cover of 1 foot over the pipe. This item shall include all equipment and labor required to excavate and dispose of all existing material necessary to construct the project according to the plans, specifications and City Standards. This item also includes trench stabilization if needed.

PAYMENT

Payment shall be on a contract unit price per linear foot basis.

6. 12" BUTTERFLY VALVE (Item 5)

Includes all work and materials incidental to the work including parts, valve boxes, lids, connections, labor, excavation, concrete, cutting, wrapping, and any other items necessary to install the 12" BUTTERFLY VALVE according to City Standards and plans. All fittings are to be greased, poly-wrapped, and taped to protect against corrosion. Concrete collars shall not be required on the 12" butterfly valves.

PAYMENT

Payment shall be on a contract unit price per each basis.

7. STORMWATER POLLUTION PREVENTION PLAN (SWPPP)

ABSOLUTELY NO WORK SHALL COMMENCE UNTIL A SWPPP HAS BEEN SUBMITTED AND APPROVED. SWPPP shall be required to be stamped and approved by a Utah licensed professional engineer.

Includes Storm Water Pollution Prevention Plan (SWPPP) (SWPPP Plan Submittal Required). Submittal plan and report shall include detailed protection of sediment erosion control - on and off site, inlet protection measures, dust control, etc. Report shall conform to the State of Utah's requirements. Report shall state that all entrances and exits to the construction area will be free from tracking and methods by which tracking will be eliminated. Report shall state that all concrete washout areas will be properly contained and detail how it will be accomplished. Report and plan shall show clearly which inlets or other features will be protected and the methods used to accomplish the protection. Report shall state that ALL fabric/fiber rolls shall be inspected daily and replaced when ineffective or at minimum every 2 weeks or when a storm is reported to have accumulated 1/2" of rain in a 24-hour period as measured by the nearest rain gauge station. Report shall state that at least one dewatering bag shall be onsite for the duration of the project and more will be used if an incident requires the use of more than one. The daily reporting log shall be submitted to the Project Manager weekly. Report shall state that the roadway shall be kept clean and free from excessive dust and debris and a detailed accounting of the means by which this will be accomplished. Report shall be submitted ONE WEEK PRIOR to the Preconstruction Meeting to the Project Engineer. Failure to submit weekly SWPPP Reports shall result in a \$500 deduction per month from the mobilization line item.

PAYMENT

50% of this item will be paid when the plan is submitted and approved. The remainder will be paid by percentage of project completion.

8. CONSTRUCTION CONTINGENCY

The Construction Contingency line item is a non-bid item, and is not a pay item. The Construction Contingency is not a guaranteed payment. It is included in the project budget for administrative purposes, and will only be used for work approved through a Contingency request. The request must be submitted and approved prior to undertaking the work. The remaining amount in the construction contingency will go back to the City and is not paid to the Contractor.

9. CONSTRUCTION SCHEDULE, AND TRAFFIC CONTROL,

A construction schedule and traffic control plan for the construction shall be submitted to and approved by the City. All traffic control shall meet the requirements of the MUTCD. Schedules Shall be submitted to the City representative bi-weekly until final completion.

WORK HOURS

Working hours shall be Monday through Friday 7 AM to 7 PM in residential areas unless otherwise specified. Spanish Fork City must be notified two business days prior to working on a holiday, weekend, or weekday before 7 AM or after 7 PM.

RESIDENTIAL AND BUSINESS ACCESS

Access shall be maintained to all homes and businesses during construction. Access plans shall be coordinated with the home owners and the City. Closures to home accesses for trenches or paving may be in place for no longer than two and a half hours. The City and affected home owners shall be notified of such closures a minimum of 24 hours in advance. At no time may accesses to businesses be closed.

10. PLANS

A copy of the plans and bid books must be on site with each contractor crew or sub-contractor crew when any work is being done on the project. The City shall provide two sets of plans (11" x 17") to the contractor. Any and all other sets of plans or documents related to this project are the responsibility of the contractor.

11. SURVEY

All construction staking is the responsibility of the contractor.

12. PAYMENT

Payments shall be made on the 10th of each month for the work done in the previous month. The contractor must follow-up to ensure that everything is being done properly to receive payment.

13. PAYMENT REQUESTS

Once a month, the contractor must submit a pay request to the City. This shall detail how much of each item the City has paid to date and how much work has been done since the last pay request. The City will verify the request by the end of the month.

14. RETAINED PAYMENT

The City will not retain any part of an approved pay request. However, once 85% of the work on a project is completed only one more pay request will be processed for that project. This last pay request will be processed upon completion of the final inspection checklist.

15. FINAL INSPECTION

When the contractor feels a project is completed, an appointment for a final inspection will be requested by the contractor with the engineering secretary (801) 804-4595. At this final inspection, a punch list will be made and a copy given to the contractor. The contractor must finish the punch list by the given completion date of the project or liquidated damages will be charged.

When the punch list is finished the contractor shall set an appointment with the Public Works Inspector through the engineering secretary. The inspector will then measure up every item with the contractor and a final pay request will be filled out and signed by both the contractor and the City.

16. CHANGE ORDERS OR CONTINGENCY REQUEST

Work on all change orders or contingency requests shall not commence until a signed change order (or contingency requests) form is in place, unless an emergency occurs endangering the public. If extra work is done without a change order or contingency requests in place then the work will not extend the contractor's completion deadline and

payment amounts, if any, will be determined by the City.

17. COMPLETION INCENTIVE

The project shall only be accepted after all punch list items are completed, landscape restoration, and the restoration of any and all improvements that have been adversely impacted, damaged, or destroyed by the construction of this project. The deadline for the Completion Incentive shall not be extended for any reason, including weather, or any other unforeseen events or items unless approved by the city council to extend the completion incentive deadline.

Completion incentive amounts shall be set to the following table using the Completion Incentive Form. 10% will be taken off the Completion Incentive each day past the completion incentive date. Liquidated damages will begin accruing 10 calendar days after the completion deadline. Liquidated damages shall be set according to the following table and be deducted from the final payment.

Completion Incentive Table			
Project Estimate	Max Completion Incentive Percent	Max Completion Incentive	Liquidated Damages per Business Day
\$5,000	10.00%	\$500	\$100
\$100,000	8.00%	\$8,000	\$200
\$250,000	6.00%	\$15,000	\$300
\$500,000	5.00%	\$25,000	\$400
\$1,000,000	4.00%	\$40,000	\$500
\$2,000,000	2.50%	\$50,000	\$500
\$3,000,000	2.00%	\$60,000	\$500
\$4,000,000	1.75%	\$70,000	\$500
\$5,000,000	1.60%	\$80,000	\$500

18. LINE ITEMS

The City reserves the right to eliminate any or all items from the scope of this project. This will be done with a change order set in place before the work on the item is commenced by the contractor. Change orders in favor of the City or deletion of line items and quantities shall not require the contractor's approval.

19. WORK ZONE

The work zone will be kept in an orderly manner and cleaned daily. The work zone will be watered and or swept as needed, or at the City's request, to control dust or debris. A self-propelled street sweeping broom shall be kept on site at all times. Contractor shall be responsible to secure work zone during construction to prevent unauthorized vehicular access.

20. PRE-CONSTRUCTION MEETING

A pre-construction meeting will be held with the contractor and all subcontractors and the City prior to commencement of work on this project. At this meeting a time will be set for a weekly progress meeting which will be held to discuss the progress of the project. Contractor will make an appointment with the engineering secretary for this meeting.

21. SPANISH FORK CITY STANDARDS

Any item not discussed in this document shall be determined by the City standards, Project Engineer, or the City Engineer.

22. PRE-CONSTRUCTION VIDEO

At the preconstruction meeting contractor shall submit a video of the existing condition of the project site area. This video will be used to resolve disputes over damaged property. Recording shall have video footage of any and all utility or improvements such as but not limited to: concrete, landscaping, ditches, culverts, fencing, etc. in the project area at a close enough range to show existing conditions and or damage.

23. RESTORATION OF SURFACE IMPROVEMENTS

All surface improvements disrupted as a course of construction shall be restored to the original type of surface condition. This includes landscaping, pavement sections, gravel shoulders, trails, and concrete. All restoration work shall be done according to the City standards.

EXISTING CONDITIONS

The Contractor shall be responsible to visually inspect all existing surface improvements and include the restoration of these improvements in each individual line item which would disrupt the improvements in the course of construction.

LANDSCAPING

All landscaping shall be restored to the original type of landscaping with new material. Sod shall be used to restore grass areas.

PAVEMENT SECTIONS

Saw-cutting or milling pavement and all other requirements of the City standards shall be included in the cost of the individual items. Three inches of bituminous surface course shall be placed back in paved areas. Trenches shall be paved back at the end of each week.

GRAVEL SHOULDERS

Gravel shoulders shall be restored with a minimum of 8 inches of untreated base course compacted to the City standards.

CONCRETE

All concrete shall be restored to match existing concrete. Any utility crossing under the sidewalk, cross gutter, curb and gutter, etc. will require at least ten (10) LF of replacement. All forms must be inspected by Spanish Fork City before concrete may be poured.

PAYMENT

There will be no payment for the restoration of surface improvements. The cost for the restoration of surface improvements shall be included in the cost for each individual item causing the disruption of the surface improvements. The Contractor shall be responsible to visually inspect all existing surface improvements that will need to be restored during construction before bidding and include the cost of their restoration in their bids.

24. EXISTING GAS, ELECTRICAL, AND COMMUNICATION LINES

Contractor shall notify Dave Wilkey at 801-853-6543 with Dominion Energy Gas 2 to 3 business days before crossing a gas main or lateral and notify them of a possible conflict. Contractor shall coordinate construction with Dominion Energy and allow them time to loop gas lines as necessary. The cost to coordinate this shall be included in the cost of the pipe.

Contractor shall pothole all electrical and communication lines to provide utility companies enough time to loop lines ahead of construction. The cost to pothole lines to plan grade shall be included in the cost of these pipe items.

25. INSPECTION AND TESTING

All work must meet requirements set forth in the plans, detail drawings and Spanish Fork City development standards. Inspections of items before they are buried will also include the City GPS crew surveying the exact location of utility.

DENSITY TESTING

Spanish Fork City will contract with a certified lab or engineering firm to test for compaction of all road base, sub-base, and trench backfill installed. Density tests will be taken on the road-base under every 50 feet on sidewalk, curb and gutter, and curb wall and every 100 feet in trenches and in the road. At least one test must be done on each separate area of compacted material. No pipe or concrete work shall be paid for until certification of compaction of the base and backfill material under or around these items is obtained. No pipe shall be paid for until all required tests on the pipe are passed.

CONCRETE TESTING

Spanish Fork City will contract with a certified lab or engineering firm to test concrete. Certification of slump, air entrainment and cylinder strength shall be obtained for every 50 cubic yards of concrete placed or each separate pour. No concrete work shall be paid for until these certifications are submitted to Spanish Fork City.

NOTIFICATION

Contractor must call the City or testing lab for required inspections and tests 1 business day before test is ready to be done.

26. WATER SHUT-OFFS

Contractor will notify in writing the City and all affected residents and business' about water shut-offs 2 business days prior to shut-off and designate time of shut-off and duration. Shutoffs may not exceed 6 hours in length or be between the hours of 5 pm and 10 pm or 6 am and 9 am unless otherwise specified.

27. PERSONAL PROTECTIVE EQUIPMENT (PPE)

Contractor shall be responsible for the safety of its employees and subcontractors. Contractor shall require PPE that is applicable to the job, minimum of safety glasses; hard hat and steel toe boots shall be required.

28. QUALIFICATIONS OF BIDDERS

Bidders shall meet the minimum requirements under specification 00 45 13 (Bidders Qualifications) to be considered for award of this project.

29. PRE-BID MEETING

- 30.** A **mandatory** pre-bid meeting shall be scheduled at the Spanish Fork City Engineering Office Building (775 N Main Street, Spanish Fork, Engineering Conference Room) for **Tuesday, July 16, 2024 at 2:30 PM MDT**.

31. BID OPENING

A public bid opening shall be held on **Tuesday, July 30, 2024 at 2:30 PM MDT** at the Spanish Fork City Engineering Office Building (775 N Main Street, Spanish Fork, Engineering Conference Room).

32. ENGINEERS ESTIMATE

The engineers estimated range for this project is \$150,000.

All questions concerning this project shall be asked on bidsync.com. Under no circumstance shall the contractor contact the City. Any contractor that contacts the City may be disqualified from bidding on this project.

**SECTION 00 41 00
BID FORM**

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Johnson Property Waterline Project

ARTICLE 1 – BASIS OF BID

1.01 Bidder will complete the Work in accordance with the Contract Documents for the following unit price(s):

Item No.	Classification of Unit Price Work	Qty	Unit	Unit Price	Amount
1	Mobilization/Demobilization	1	LS	\$	\$
2	Clearing and Grubbing, Earthwork	1	LS	\$	\$
3	Dewatering	1	LS	\$	\$
4	12" C-900 Waterline	1,370	LF	\$	\$
5	12" Butterfly Valve	3	EA	\$	\$

* Quantity of materials shown on the bid schedule may be higher than the quantity shown on the drawings.

Bid Schedule Total: _____

Bid Schedule Total in Words: _____

Bidder acknowledges that (1) each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and (2) estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

ARTICLE 2 – BIDDER'S ACKNOWLEDGEMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, AND RECEIPT OF ADDENDA

2.01 Bid Acceptance Period

- A. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period that Bidder may agree to in writing upon request of Owner.

2.02 Instructions to Bidders

- A. Bidder accepts all the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security.

2.03 Receipt of Addenda

- A. Bidder hereby acknowledges receipt of the following Addenda:

Addendum Number	Addendum Date

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**SECTION 00 45 13
BIDDER'S QUALIFICATIONS**

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ARTICLE 1 – GENERAL INFORMATION

1.01 Provide contact information for the Business:

Legal Name of Business:			
Corporate Office			
Name:		Phone number:	
Title:		Email address:	
Business address of corporate office:			
Local Office			
Name:		Phone number:	
Title:		Email address:	
Business address of local office:			

1.02 Provide information on the Business' organizational structure:

Form of Business:	☐ Sole Proprietorship ☐ Partnership ☐ Corporation		
☐ Limited Liability Company ☐ Joint Venture comprised of the following companies:			
1.			
2.			
3.			
Provide a separate Qualification Statement for each Joint Venturer.			
Date Business was formed:		State in which Business was formed:	
Is this Business authorized to operate in the Project location?		☐ Yes ☐ No ☐ Pending	

1.03 Identify all businesses that own Business in whole or in part (25% or greater), or that are wholly or partly (25% or greater) owned by Business:

Name of business:		Affiliation:	
Address:			
Name of business:		Affiliation:	
Address:			
Name of business:		Affiliation:	
Address:			

1.04 Provide information regarding the Business' officers, partners, and limits of authority.

Name:		Title:	
Authorized to sign contracts: ☐ Yes ☐ No		Limit of Authority:	\$
Name:		Title:	

Authorized to sign contracts: ☐ Yes ☐ No		Limit of Authority: \$	
Name:		Title:	
Authorized to sign contracts: ☐ Yes ☐ No		Limit of Authority: \$	
Name:		Title:	

ARTICLE 2 – LICENSING

2.01 *Provide information regarding licensure for Business:*

Name of License:			
Licensing Agency:			
License No:		Expiration Date:	
Name of License:			
Licensing Agency:			
License No:		Expiration Date:	

ARTICLE 3 – DIVERSE BUSINESS CERTIFICATIONS

3.01 *Provide information regarding Business’ diverse Business Certification, if any. Provide evidence of current certification.*

Certification	Certifying Agency	Certification Date
☐ Disadvantaged Business Enterprise		
☐ Minority Business Enterprise		
☐ Woman-Owned Business Enterprise		
☐ Small Business Enterprise		
☐ Disabled Business Enterprise		
☐ Veteran-Owned Business Enterprise		
☐ Service-Disabled Veteran-Owned Business		
☐ HUBZone Business (Historically Underutilized) Business		
☐ Other		
☐ None		

ARTICLE 4 – SAFETY

4.01 *Provide information regarding Business’ safety organization and safety performance*

Name of Business’s Safety Officer:		
Safety Certifications		
Certification Name	Issuing Agency	Expiration

- 4.02 *Provide Worker's Compensation Insurance Experience Modification Rate (EMR), Total Recordable Frequency Rate (TRFR) for incidents, and Total Number of Recorded Manhours (MH) for the last 3 years and the EMR, TRFR, and MH history for the last 3 years of any proposed Subcontractor(s) that will provide Work valued at 10% or more of the Contract Price. Provide documentation of the EMR history for Business and Subcontractor(s).*

Year									
Company	EMR	TRFR	MH	EMR	TRFR	MH	EMR	TRFR	MH

ARTICLE 5 – FINANCIAL

- 5.01 *Provide information regarding the Business's financial stability. Provide the most recent audited financial statement, and if such audited financial statement is not current, also provide the most current financial statement.*

Financial Institution:			
Business address:			
Date of Business's most recent financial statement:		☐ Attached	
Date of Business's most recent audited financial statement:		☐ Attached	
Financial indicators from the most recent financial statement			
Contractor's Current Ratio (Current Assets ÷ Current Liabilities)			
Contractor's Quick Ratio ((Cash and Cash Equivalents + Accounts Receivable + Short Term Investments) ÷ Current Liabilities)			

ARTICLE 6 – SURETY INFORMATION

- 6.01 *Provide information regarding the surety company that will issue required bonds on behalf of the business, including but not limited to performance and payment bonds.*

Surety Name:			
Surety is a corporation organized and existing under the laws of the state of:			
Is surety authorized to provide surety bonds in the Project location?		☐ Yes ☐ No	
Is surety listed in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" published in Department Circular 570 (as amended) by the Bureau of the Fiscal Service, U.S. Department of the Treasury? ☐ Yes ☐ No			
Mailing Address (Principal place of business):			

Physical Address (Principal place of business):			
Phone (main):		Phone (claims):	

ARTICLE 7 – INSURANCE

7.01 *Provide information regarding Business' insurance company(s), including but not limited to its Commercial General Liability carrier. Provide information for each provider.*

Name of insurance provider, and type of policy (CLE, auto, etc.):			
Insurance Provider		Type of Policy (Coverage Provided)	
Are providers licensed or authorized to issue policies in the Project location?			☐ Yes ☐ No
Does provider have an A.M. Best Rating of A-VII or better?			☐ Yes ☐ No
Mailing Address (Principal place of business):			
Physical Address (Principal place of business):			
Phone (main):		Phone (claims):	

ARTICLE 8 – CONSTRUCTION EXPERIENCE

8.01 *Provide information that will identify the overall size and capacity of the Business.*

Average number of current full-time employees:	
Estimate of revenue for the current year:	
Estimate of revenue for the previous year:	

8.02 *Provide information regarding the Business's previous contracting experience.*

Years of experience with projects like the proposed project:				
As a general contractor:		As a joint venturer:		
Has Business, or a predecessor in interest, or an affiliate identified in Paragraph 1.03:				
Been disqualified as a bidder by any local, state, or federal agency within the last 5 years? ☐ Yes ☐ No				
Been barred from contracting by any local, state, or federal agency within the last 5 years? ☐ Yes ☐ No				
Been released from a bid in the past 5 years? ☐ Yes ☐ No				
Defaulted on a project or failed to complete any contract awarded to it? ☐ Yes ☐ No				

Refused to construct or refused to provide materials defined in the contract documents or in a change order? ☐ Yes ☐ No
Been a party to any currently pending litigation or arbitration? ☐ Yes ☐ No
Provide full details in a separate attachment if the response to any of these questions is Yes.

- 8.03 *List all projects currently under contract in Schedule A and provide indicated information.*
- 8.04 *List a minimum of three and a maximum of six projects (attach additional forms if necessary) completed in the last 10 years in Schedule B and provide indicated information to demonstrate the Business's experience with projects similar in type and cost of construction.*
- 8.05 *In Schedule B, provide information on key individuals (Project Manager and Project Superintendent) whom Business intends to assign to the Project. Provide resumes for those individuals included in Schedule B. To be considered for award, the construction company, superintendent and project manager shall have a minimum 10 years' experience and completed, within the last ten years a minimum of three culinary water pipeline projects that include 8" minimum diameter C900 PVC piping.*

ARTICLE 9 – REQUIRED ATTACHMENTS

- 9.01 *Provide the following information with the Statement of Qualifications:*
- A. If Business is a Joint Venture, separate Qualifications Statements for each Joint Venturer, as required in Paragraph 1.02.
 - B. Diverse Business Certifications if required by Paragraph 3.01.
 - C. Certification of Business's safety performance if required by Paragraph 4.02.
 - D. Financial statements as required by Paragraph 5.01.
 - E. Attachments providing additional information as required by Paragraph 8.02.
 - F. Schedule A (Current Projects) as required by Paragraph 8.03.
 - G. Schedule B (Previous Experience with Similar Projects and key individuals) as required by Paragraphs 8.04 and 8.05.
 - H. Additional items as pertinent.

END OF SECTION

This Statement of Qualifications is offered by:

Business:

(typed or printed name of organization)

By:

(individual's signature)

Name:

(typed or printed)

Title:

(typed or printed)

Date:

(date signed)

(If Business is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:

(individual's signature)

Name:

(typed or printed)

Title:

(typed or printed)

Address for giving notices:

Designated Representative:

Name:

(typed or printed)

Title:

(typed or printed)

Address:

Phone:

Email:

Schedule A—Current Projects

Name of Organization					
Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Schedule B—Previous Experience with Similar Projects

Note: To be considered for award, the construction company, superintendent and project manager shall have a minimum 10 years' experience and completed, within the last ten years a minimum of three culinary water pipeline projects that include 8" minimum diameter C900 PVC piping.

Bidder shall identify the contractor, project superintendent, and project manager with the qualifying experience that will perform the work on the Johnson Property Waterline Project in the work experience forms for each type of required experience below. Provide additional work experience tables as necessary to display construction company, superintendent, and project manager experience. Upon receipt of the completed work experience forms, Spanish Fork City may ask for additional information deemed relevant.

CONTRACTOR CULINARY WATER WORK EXPERIENCE

Contractor Name:

Number of Years Construction Company Has Been In Business:

List past projects and completion dates performed by the Contractor:

	Project No. 1	Project No. 2	Project No. 3
Project Name			
Owner			
Bid Price			
Final Construction Cost			
Construction Time (days)			
Owner's Representative			
Owner's Telephone Number			
Completion Date			
Completed on Time? ¹			
Claims or Disputes Filled? ²			
PVC C900 Water Line (Y/N)			
PVC C900 Water Line (Dia)			
PVC C900 Water Line (ft)			

1 If no, provide a detailed explanation of the facts and circumstances causing any delay.

2 If yes, provide a detailed explanation of the facts and circumstances of each claim or dispute, and if a legal action, was filed, provide the name of the parties, the court in which the case was filed and the case number of the claim or dispute.

PROJECT MANAGER WORK EXPERIENCE

Project Manager Name:

Project Manager Number of Years of Experience:

List past projects and completion dates performed by Project Manager:

	Project No. 1	Project No. 2	Project No. 3
Project Name			
Owner			
Bid Price			
Final Construction Cost			
Construction Time (days)			
Owner's Representative			
Owner's Telephone Number			
Completion Date			
Completed on Time? ¹			
Claims or Disputes Filled? ²			
Dewatering (Y/N)			
PVC C900 Water Line (Y/N)			
PVC C900 Water Line (Dia)			
PVC C900 Water Line (ft)			

1 If no, provide a detailed explanation of the facts and circumstances causing any delay.

2 If yes, provide a detailed explanation of the facts and circumstances of each claim or dispute, and if a legal action, was filed, provide the name of the parties, the court in which the case was filed and the case number of the claim or dispute.

PROJECT SUPERINTENDENT WORK EXPERIENCE

Superintendent Name:

Superintendent Number of Years of Experience:

List past projects and completion dates performed by Superintendent:

	Project No. 1	Project No. 2	Project No. 3
Project Name			
Owner			
Bid Price			
Final Construction Cost			
Construction Time (days)			
Owner's Representative			
Owner's Telephone Number			
Completion Date			
Completed on Time? ¹			
Claims or Disputes Filled? ²			
Dewatering (Y/N)			
PVC C900 Water Line (Y/N)			
PVC C900 Water Line (Dia)			
PVC C900 Water Line (ft)			

1 If no, provide a detailed explanation of the facts and circumstances causing any delay.

2 If yes, provide a detailed explanation of the facts and circumstances of each claim or dispute, and if a legal action, was filed, provide the name of the parties, the court in which the case was filed and the case number of the claim or dispute.

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DIVISION 02
EXISTING CONDITIONS

SECTION 02 41 00
DEMOLITION, SALVAGE, AND RECONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

- A. The Contractor shall demolish, salvage and reconstruct existing civil, landscaping, structural, architectural, mechanical, HVAC, electrical, and instrumentation facilities as indicated, in accordance with the Contract Documents.

1.2 COORDINATION

- A. The Contractor shall carefully coordinate the Work in areas where existing facilities are interconnected with new facilities and where existing facilities remain operational. The Work as indicated is not all inclusive, and the Contractor shall be responsible to perform the reconstruction indicated plus that which can be reasonably inferred from the Contract Documents as necessary to complete the Project. The Specifications and Drawings identify the major facilities that shall be demolished and reconstructed, but auxiliary utilities such as water, air, chemicals, drainage, lubrication, fluid power, electrical wiring, controls, and instrumentation are not necessarily shown.
- B. The Contractor shall note that the Drawings used to indicate demolition and reconstruction are based on record drawings of the existing facilities. These record drawings have been reproduced to show existing conditions and to clarify the scope of Work as much as possible. Prior to bidding, the Contractor shall conduct a comprehensive survey at the Site to verify the correctness and exactness of the Drawings, the scope of Work, and the extent of auxiliary utilities. A complete set of record drawings is available for review at the Project site.
- C. While demolition and reconstruction are being performed, the Contractor shall provide adequate access for the continued operation and maintenance of equipment and treatment processes. The Contractor shall erect and maintain fences, warning signs, barricades, and other devices around the reconstruction as required for the protection of the Contractor's employees and the Owner's personnel at the plant. The Contractor shall remove such protection when reconstruction activities are complete, or as work progresses, or when directed by the Engineer.

1.3 CONTRACTOR SUBMITTALS

- A. Demolition and reconstruction activities and procedures, including operational sequence, shall be submitted to the Engineer for approval. The procedures shall provide for safe conduct of the Work, careful removal and disposition of materials and equipment, protection of existing facilities which are to remain undisturbed, coordination with existing facilities to remain in service, and timely disconnection and reconnection of utility services. The procedures shall include a detailed description and time schedule of the methods and equipment to be used for each operation and the sequence of operation. A storage plan for salvaged items shall be included.

1.4 DEMOLITION AND ABANDONMENT

- A. Existing pavement, concrete, retaining walls, curb and gutter, sidewalks, buildings, yard structures, equipment, piping, valves, ductwork, duct banks, electrical gear, instrumentation, utilities, and related appurtenances such as anchors, supports, and hardware indicated or required to be demolished as part of the Work shall be removed and disposed of unless otherwise indicated. Removal of buried structures, utilities, and appurtenances includes the related excavation and backfill as required. Removed items shall be disposed of offsite by the Contractor.

1.5 SALVAGE

- A. Items of existing equipment, piping, valves, electrical gear, instrumentation, utilities, and appurtenances indicated to be salvaged shall be removed without any degradation in condition from that prior to removal. Salvaged items shall be stockpiled and protected on the Site at a location directed by the Engineer. The Contractor shall be responsible to properly safeguard the salvaged items against damage and loss during removal and handling.

1.6 RELOCATION

- A. Items of existing equipment, piping, valves, electrical gear, instrumentation, utilities, and appurtenances required to be relocated shall be removed without any degradation in condition from that prior to removal. The Contractor shall be responsible to properly safeguard the relocated items against damage and loss during removal, handling, storage, and installation in the new location.

1.7 REHABILITATION

- A. Existing civil, landscaping, structural, architectural, mechanical, HVAC, electrical, and instrumentation Work disturbed or damaged by reconstruction activities shall be repaired and rehabilitated as indicated.
- B. Damaged items shall be repaired or replaced with new items to restore items or surfaces to a condition equal to and matching that existing prior to damage.

1.8 DISPOSAL

- A. The Contractor shall be responsible for the offsite disposal of debris resulting from reconstruction in compliance with local, state, and federal codes and requirements.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

- A. GENERAL
- B. The Contractor shall coordinate demolition and reconstruction Work with the Owner and Engineer. Unless otherwise indicated, the Contractor shall be responsible for the sequence

of activities. Work shall be performed in accordance with applicable safety rules and regulations.

- C. The Contractor shall verify that any utilities connected to structures, equipment, and facilities to be removed, relocated, salvaged, replaced, or abandoned are rendered inoperable, replaced with new utilities, or adequately bypassed with temporary utilities before proceeding with demolition and reconstruction.
- D. The Contractor shall take precautions to avoid damage to adjacent facilities and to limit the Work activities to the extent indicated. If reconstruction beyond the scope indicated is required, the Contractor shall obtain approval from the Engineer prior to commencing.

3.2 PROTECTION OF EXISTING FACILITIES

- A. Before beginning any reconstruction, the Contractor shall carefully survey the existing facilities and examine the Specifications and Drawings to determine the extent of reconstruction and coordination with the Work. Existing facilities not subject to reconstruction shall be protected and maintained. Damaged existing facilities shall be repaired to the previous condition or replaced.
- B. Persons shall be afforded safe passages around areas of demolition.
- C. Structural elements shall not be overloaded. The Contractor shall be responsible for shoring, bracing, or adding new supports as may be required for adequate structural support as a result of Work performed under this Section. The Contractor shall remove temporary protection when the Work is complete or when so authorized by the Engineer.
- D. The Contractor shall carefully consider bearing loads and capacities before placement of equipment and material on Site. In the event of any questions as to whether an area to be loaded has adequate bearing capacity, the Contractor shall consult with the Engineer prior to the placement of such equipment or material.

3.3 DEMOLITION, SALVAGE, AND RELOCATION

- A. The Contract Documents indicate existing facilities to be demolished, salvaged, and/or relocated. Auxiliary utilities including such services as water, air, chemicals, drainage, lubrication, fluid power, electrical wiring, controls, and instrumentation are not necessarily indicated. The Contractor shall verify the scope of the Work to remove the equipment indicated; coordinate its shutdown, removal, replacement, or relocation; and submit an outage plan. The removal of existing facilities for demolition, salvage, and relocation shall include the following requirements:
 - 1. Equipment supports, including concrete pads, baseplates, mounting bolts, and support hangers, shall be removed. Damage to the existing structure shall be repaired as indicated.
 - 2. Exposed piping including vents, drains, and valves shall be removed. Where exposed piping penetrates existing floors and walls, the piping, including wall thimbles, shall be removed to a minimum depth of 2-inches. Resultant openings in the structure shall be repaired as indicated.
 - 3. Electrical control panels, junction boxes, motor control centers, and local switches and pushbuttons shall be removed.

4. Exposed electrical conduits and associated wiring shall be removed. Resultant openings in structures shall be repaired as indicated.
 5. Connections to embedded electrical conduits shall be removed a minimum of 2-inches inside the finished surface of the existing structure. Wiring shall be removed and the resulting openings shall be repaired as indicated.
 6. Associated instrumentation devices shall be removed.
 7. Auxiliary utility support systems shall be removed.
 8. The area shall be thoroughly cleaned such that little or no evidence of the previous equipment installation will remain.
 9. Asphalt and concrete pavement, curbs, and gutters shall be removed as necessary to perform reconstruction. The limits of removal shall be sawcut. When the required improvements have been constructed, new asphalt and concrete pavement, curbs, and gutters shall be placed to match the original unless otherwise indicated.
 10. Footings, foundation walls, below-grade construction and concrete slabs on grade shall be demolished and removed to a depth, which will not interfere with new construction, but not less than 36-inches below existing ground surface or future ground surface, whichever is lower.
 11. Below-grade areas and voids resulting from demolition of structures shall be completely filled. Fill and compaction shall be in accordance with the Spanish Fork City, most recent Construction Standards. After fill and compaction, surfaces shall be graded to meet adjacent contours and to provide flow to surface drainage structures, or as indicated.
 12. When existing pipe is removed, the Contractor shall plug the resulting open ends whether or not so indicated. Where removed piping is exposed, the remaining piping shall be blind-flanged or fitted with a removable cap or plug.
 13. When existing piping is removed from existing structures, the Contractor shall fill resulting openings in the structures and repair any damage such that the finished rehabilitated structure shall appear as a new homogeneous unit with little or no indication of where the new and old materials join. The openings in water-bearing structures shall be filled with non-shrink grout to be watertight and reinforced as required or indicated. In locations where the surface of the grout will be exposed to view, the grout shall be recessed approximately 1/2-inch and the recessed area filled with cement mortar grout.
 14. Electrical reconstruction shall be conducted by the Contractor in a safe and proper manner to avoid injury from electrical shock to the Owner's and Contractor's personnel. Electrical equipment to be shut off for a period of time shall be tagged, locked out, and sealed with a crimped wire and lead seal and made inoperable. At no time shall electrical wiring or connections, which are energized or could become energized be accessible to Contractor, Owner, or other personnel without suitable protection or warning signs.
- B. The Contractor shall perform a functional test of existing equipment that is relocated and reinstalled to ensure the equipment functions in the manner documented during the initial inspection. The Contractor shall inform the Engineer in writing a minimum of 5 Days prior to the functional testing in order for the Owner and Engineer to witness the test. If, in the opinion of the Engineer, the relocated equipment does not function in a satisfactory manner, the Contractor shall make repairs and modifications necessary to restore the equipment to its original operating condition at no additional cost to the Owner.

3.4 ABANDONMENT

- A. Existing facilities to be abandoned shall be prepared as indicated. Where existing buried piping is to be abandoned, the Contractor shall remove the abandoned pipe for a distance of 5-feet from any connecting structures. Openings at the existing structures shall be repaired. The remaining pipe shall be capped at both ends prior to backfill. Buried piping, 12-inches diameter or greater shall be completely sand-filled prior to closure of the piping ends.

3.5 REHABILITATION

- A. Certain areas of existing structures, piping, conduits, and the like will be affected by Work necessary to complete modifications under this Contract. The Contractor shall be responsible to rehabilitate those areas affected by its construction activities.
- B. Where new rectangular openings are to be installed in concrete or concrete masonry walls or floors, the Contractor shall score the edges of each opening (both sides of wall or floor slab) by saw-cutting clean straight lines to a minimum depth of 1-inch and then chipping out the concrete. Alternately, the sides of the opening (not the corners) may be formed by saw cutting completely through the slab or wall. Saw cuts deeper than 1-inch (or the depth of cover over existing reinforcing steel, whichever is less) shall not be allowed to extend beyond the limits of the opening. Corners shall be made square and true by a combination of core drilling and chipping or grinding. Necessary precautions shall be taken during removal of concrete to prevent debris from falling into or entering adjacent tanks in service or from damaging adjacent equipment or piping. Saw cuts allowed to extend beyond the opening shall be repaired by filling with non-shrink grout. The concrete around any exposed reinforcement steel shall be chipped back and exposed reinforcement steel cut a minimum of 2-inches from the finished face of the new opening and be painted with epoxy paint. The inside face of the new opening shall be grouted with an epoxy cement grout to fill any voids and cover the exposed aggregate and shall be trowel-finished to provide a plumb and square opening.
- C. Where new piping is installed in existing structures, the Contractor shall accurately position core-drilled openings in the concrete as indicated or otherwise required. Openings shall be of sufficient size to permit a final alignment of pipelines and fittings without deflection of any part and to allow adequate space for satisfactory packing where pipe passes through the wall to provide watertightness around openings so formed. The boxes or cores shall be provided with continuous keyways to hold the filling material in place, and they shall have a slight flare to facilitate grouting and the escape of entrained air during grouting. Before placing the non-shrink grout, concrete surfaces shall be sandblasted, thoroughly cleaned of sand and any other foreign matter, and coated with epoxy bonding compound.
- D. Pipes, castings, or conduits shall be grouted in place by pouring in grout under a head of at least 4-inches. The grout shall be poured or rammed or vibrated into place to fill completely the space between the pipes, castings, or conduits, and the sides of the openings so as to obtain the same watertightness as through the wall itself. The grouted casings shall then be water cured.
- E. In locations where the surface of the grout will be exposed to view, the non-shrink grout shall be recessed approximately 1/2-inch and the recessed area filled with cement mortar grout.

- F. When new piping is to be connected to existing piping, the existing piping shall be cut square and ends properly prepared for the connection. Any damage to the lining and coating of the existing piping shall be repaired. Dielectric insulating joints shall be installed at interconnections between new and existing piping.
- G. Where existing equipment, piping, and supports, electrical panels and devices, conduits, and associated appurtenances are removed, the Contractor shall rehabilitate the affected area such that little or no evidence of the previous installation remains. Openings in concrete floors, walls, and ceilings from piping, conduit, and fastener penetrations shall be filled with non-shrink grout and finished to match the adjacent area. Concrete pads, bases associated with equipment, supports, and appurtenances shall be removed by chipping away concrete and cutting any exposed reinforced steel and anchor bolts a minimum of 2-inches below finished grade and be painted with epoxy paint. The area of concrete to be rehabilitated shall be scored by saw cutting clean, straight lines to a minimum depth of 1-1/2 inches, and concrete within the scored lines removed to a depth of 1-1/2 inches (or the depth of cover over reinforcing steel, whichever is less). The area within the scored lines shall be patched with non-shrink grout to match the adjacent grade and finish. Abandoned connections to piping and conduits shall be terminated with blind flanges, caps, and plugs suited for the material, type, and service of the pipe or conduit.
- H. Existing reinforcement to remain in place shall be protected, cleaned, and extended into new concrete. Existing reinforcement not to be retained shall be cut-off as follows:
 - 1. Where new concrete joins existing concrete at the removal line, reinforcement shall be cut-off flush with the concrete surface at the removal line.
 - 2. Where the concrete surface at the removal line is the finished surface, the reinforcement shall be cut back 2-inches below the finished concrete surface, the ends painted with epoxy paint and the remaining holes patched with a cement mortar grout.
- I. Where existing handrailing is removed, post embedments and anchors shall be removed and post holes shall be filled with non-shrink grout flush to the floor surface. At the point of continuation of existing handrailing, a new post with rail connections matching the existing handrailing system shall be installed. New posts in existing concrete floors shall be installed in core-drilled socket holes and the annular space between the post and hole filled with non-shrink grout.
- J. Where reconstruction activities damage the painting and coating of adjacent or nearby facilities, the damaged areas shall be surface prepared and coated in accordance with specifications to match the original painting and coating with a compatible system. Surfaces of equipment items that are to be relocated shall be prepared and be coated in accordance with specifications.

3.6 DISPOSAL

- A. Demolition and removal of debris shall minimize interference with roads, streets, walks, and other adjacent occupied or used facilities, which shall not be closed or obstructed without permission from the Owner. Alternate routes shall be provided around closed or obstructed traffic ways.

- B. Site debris, rubbish, and other materials resulting from reconstruction operations shall be legally removed and disposed of. Structures and equipment to be demolished shall be cleaned prior to demolition and the wash water properly disposed of. No trace of these structures shall remain prior to placing of backfill in the areas from which structures were removed.
- C. Refuse, debris, and waste materials resulting from demolition and clearing operations shall not be burned.

3.7 OCCUPANCY AND POLLUTION CONTROL

- A. Water sprinkling, temporary enclosures, chutes, and other suitable methods shall be used to limit dust and dirt rising and scattering in the area. The Contractor shall comply with government regulations pertaining to environmental protection.
- B. Water shall not be used if it creates hazardous or objectionable conditions such as ice, flooding, or pollution.

3.8 CLEANING

- A. During and upon completion of Work, the Contractor shall promptly remove tools and equipment, surplus materials, rubbish, debris, and dust and shall leave areas affected by Work in a clean, approved condition.
- B. Adjacent structures shall be cleaned of dust, dirt, and debris caused by reconstruction, as directed by the Engineer or governing authorities, and adjacent areas shall be returned to condition existing prior to start of Work.

END OF SECTION

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DIVISION 09
FINISHES

**SECTION 09 90 00
PROTECTIVE COATINGS AND LININGS**

PART 1 GENERAL

1.01 WORK INCLUDED

- A. This section covers surface preparation, furnishing, and application of protective coatings, complete.
- B. It is the intent of this specification that all new or existing expose metal surfaces, shall be coated with a protective coating, unless specifically excluded.
- C. Shop or existing surface preparation methods, cleanliness, and existing paint, rust, and mill scale removal is not known nor documented. Contractor shall be solely responsible for determining work effort, abrasive blast requirements, and any other factors that may affect work productivity as required to provide the specified surface preparation cleanliness; regardless of prior system preparation or coating application.
- D. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

1.02 GENERAL:

- A. See section GENERAL CONDITIONS, which contain information and requirements that apply to the work specified and are mandatory for this project.

1.03 ABBREVIATIONS

ANSI	American National Standards Institute
AWWA	American Water Works Association
MDFT	Minimum Dry Film Thickness
MDFTPC	Minimum Dry Film Thickness Per Coat
mil	Thousandths of an Inch
OSHA	Occupational Safety and Health Act
PSDS	Paint System Data Sheet
SFPG	Square Feet Per Gallon
SFPGPC	Square Feet Per Gallon Per Coat
SP	Surface Preparation
SSPC	Steel Structures Painting Council

1.04 REFERENCE STANDARDS

- A. This specification recognizes AWWA, NACE, and SSPC standards as minimum industry standards and they are referenced for purpose of conformance, except where modified in this section. The requirements of this specification section have been written to a

higher design standard with the intent of achieving a long-term coating performance of 100 years.

NACE SP0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
NACE RP-0274	High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation.
SSPC-SP-1	Solvent Cleaning Surface Preparation
SSPC-SP-2	Hand Tool Cleaning Surface Preparation
SSPC-SP-3	Power Tool Cleaning Surface Preparation
SSPC-SP-5	White metal Abrasive Blast Surface Preparation
SSPC-SP-6	Commercial Abrasive Blast Surface Preparation
SSPC-SP-10	Near White Metal Abrasive Blast Surface Preparation
SSPC-SP-11	Power Tool Cleaning to Bare Metal
SSPC-SP-13	Surface Preparation of Concrete

1.05 SUBMITTAL REQUIREMENTS

- A. Contractor submittals shall be made in accordance with this Section of these Specifications.
- B. Shop Drawings: Catalog cuts and other information for all products proposed. Provide copy of approved coating system submittals to the coating applicator.
- C. Quality Control Submittals: Furnish the following:
 - 1. Applicator's Experience with list of references substantiating compliance.
 - 2. Coating manufacturer's certification stating the individual coating applicators have met the qualification certification requirements as specified this section.
 - 3. Coating manufacturer shall provide a copy of the manufacturer's coating application quality assurance manual.
 - 4. If the manufacturer of field-applied coating differs from that of the shop applied primer, provide written confirmation from both manufacturers' that the two coating materials are compatible.
- D. Product Data: Furnish the following Data Sheets:
 - 1. For each paint system used herein, furnish a Paint System Data Sheet (PSDS), Technical Data Sheets, and paint colors available (where applicable) for each product used in the paint system, except for products applied by equipment manufacturers. A sample PSDS form is appended at the end of this section.
 - 2. The required information shall be submitted on a system-by-system basis.
 - 3. The Contractor shall also provide copies of the paint system submittals to the coating applicator.
 - 4. Indiscriminate submittal of manufacturer's literature only is not acceptable.
- E. Where ANSI/NSF Standard 60 and 61 approvals is required, submit ANSI/NSF certification letter for each coating in the system indicating product application limits on size of tank or piping, dry film thickness, number of coats, specific product tested, colors certified, and approved additives.
- F. Provide TCLP test data for lead and other regulated heavy metals in non-recyclable, slag type abrasive blast media to be used on the project. Acceptable abrasive test data

shall indicate the abrasive manufacturer, location of manufacture, and media gradation and type. Surface preparation will not be permitted to begin until acceptable test data has been submitted.

1.06 QUALITY ASSURANCE

- A. Coating Applicator's Experience and Certification:
 - 1. Coating Application Company and coating application supervisor (Certified Applicator) shall have a minimum of 5 years' experience applying the specified coating system.
 - 2. Coating application personnel, whom have direct coating application responsibility, shall have a minimum of 2 years practical experience in application of the indicated coating system.
 - 3. Coating applicator shall be certified by the coating manufacturer as an approved applicator.
- B. Continuity of Contractor: Contractor's site supervisor shall be coordinated with the Engineer. Any replacement of the supervisor on site will require notification of Engineer 72 hours in advance and will be subject to approval by the Owner.
- C. Coating and/or lining manufacturer shall provide a technical representative to visit the jobsite at intervals during surface preparation and painting as may be required for product application quality assurance, and to determine compliance with manufacturer's instructions and these Specifications, and as may be necessary to resolve field problems attributable to, or associated with, the manufacturer's products furnished under this Contract. Sales representatives are not acceptable as a technical representative unless written authorization from the coating manufacturer is provided which states the sales representative has full authority to act on the behalf of the coating manufacturer.

1.07 WARRANTY

- A. The Contractor and coating manufacturer shall jointly and severally warrant to the Owner and guarantee the work under this section against defective workmanship and materials for a period of 2 year(s) commencing on the date of final acceptance of the work.

1.08 ENGINEER OBSERVATIONS

- A. The Contractor shall give the Owner Representative notice a minimum of 14 days prior to start of work for scheduling shop or field observation.
- B. Provide Owner Representative a minimum 3 days' notice for actual start of surface preparation and coating application work.
- C. Provisions shall be made to allow Owner's representative full access to facilities and appropriate documentation regarding coating application.
- D. Observation by the Owner's representative or the waiver of observation of any portion of the work shall not be construed to relieve the Contractor of his responsibility to perform the work in accordance with these Specifications.

- E. Materials shall be subject to testing for conformance with this specification as the Owner's representative may elect, prior to or during incorporation into the work.
- F. Perform work in the presence of ENGINEER or Owner Representative, unless prior approval to perform such work is granted. Approval to perform work is limited to the current day unless specifically noted to extend beyond the completion of the workday.

PART 2 PRODUCTS

2.01 GENERAL

- A. Coatings and linings will be stored and handled per manufacturer's written directions.
- B. All metallic surfaces shall be prepared and coated in accordance with referenced standards, written instructions of the coating or lining manufacturer, and these specifications, whichever is more stringent, unless specified otherwise.
- C. Coatings shall be the product of a single manufacturer. Product substitutions during the project will not be permitted, without ENGINEER approval.

2.02 PAINT DELIVERY, STORAGE, AND HANDLING

- A. Delivered paint to the project site in unopened containers that plainly show, at the time of use, the designated name, date of manufacture, color, and name of manufacturer.
- B. Stored paints in a suitable protected area that is heated or cooled as required to maintain temperatures within the range recommended by the paint manufacturer.
- C. Shipping:
 - 1. Where shop finish coated or primed items are to be shipped to the jobsite, protect coating from damage. Batten coated items to prevent abrasion.
 - 2. Use nonmetallic or padded slings and straps in handling.
 - 3. Items will be rejected for excessive damage.

2.03 PAINT AND COATINGS MANUFACTURERS

- A. A manufacturer letter code as follows will be found following the generic descriptions of materials outlined in the Specifications. Address is that of the general offices. Contact these offices for information regarding the location of representative nearest the project site.
- B. MANUFACTURER CODE A - COATINGS MANUFACTURERS (Able to supply most heavy-duty industrial coatings and architectural paints):
 - 1. Carboline Coatings Company, St. Louis, MO.
 - 2. ICI Devoe Coatings Company, Louisville, KY.
 - 3. International Coatings,
 - 4. Pittsburgh Paints (PPG), Pittsburgh, PA.

5. Sherwin Williams, Cleveland, OH
6. Themec Coatings, Kansas City, MO

2.04 PAINT MATERIALS

- A. Products shall meet federal, state, and local requirements limiting the emission of volatile organic compounds. Specific information may be secured through the local office of the Air Pollution Control Officer.
- B. Materials Including Primer and Finish Coats: Produced by same paint manufacturer.
- C. Thinners, Cleaners, Driers, and Other Additives: As recommended by paint manufacturer of the coating system. Where coatings are required to meet ANSI/NSF Standard 60 and 61, addition of thinners, driers, and other paint additives not approved under the ANSI/NSF certification letter will not be permitted without written approval from the Engineer.
- D. Paint products are listed according to their approximate order of appearance in the paint systems. The letter designating the manufacturer code refers to Article PAINT AND COATING MANUFACTURERS.

Products	Description
Epoxy, NSF	Amine or polyamine epoxy coating, two parts, suitable for immersion service, 75% volume solids minimum, capable of 4 to 8 MDFT per coat, approved for potable water contact in conformance to ANSI/NSF Standard 60 and 61, and suitable for the application temperatures and conditions. MANUFACTURER CODE: A
Epoxy	Polyamine or polyamide epoxy, two parts, suitable for immersion service, 75% volume solids minimum, capable of 4 to 8 MDFT per coat, and suitable for the application temperatures and conditions. MANUFACTURER CODE: A
Polysiloxane	Acrylic polysiloxane hybrid coating, single component, suitable for shop or field application at 32 degrees F, minimum, recoat window of not less than 12 months with preference for products with unlimited overcoat capability, solids content of 85% minimum, high gloss, and tintable colors. Tinted colors shall be capable of storage for 30 days or longer prior to application. Coating shall be capable of spray, roller, or brush application on all metal substrates and specified prime and intermediate coats. MANUFACTURER CODE: A
Inorganic Zinc Primer	Solvent or water based, 14 lbs. metallic zinc content per gallon minimum; unlimited recoat window, conform to manufacturer's recommended top coats as specified herein. MANUFACTURER CODE: A
Wash Primer	Vinyl butyral acid or equivalent coating for enhancing finish coat adhesion to galvanized steel surfaces. MANUFACTURER CODE: A

Polyurethane Enamel

Two-component, aliphatic or acrylic based polyurethane; high gloss finish, suitable for continuous dry service at 200 degrees F without discoloration or peeling. MANUFACTURER CODE: A

2.05 COLORS

- A. Provide as selected by the Owner.
- B. Formulated with colorants free of lead, lead compounds, or other materials which might be affected by the presence of hydrogen sulfide or other gas likely to be present at the project.
- C. Proprietary identification of colors is for identification only. Any authorized manufacturer may supply matches.
- D. Equipment Colors:
 - 1. Equipment shall be meant to include the machinery or vessel itself plus the structural supports and fasteners and attached electrical conduits.
 - 2. Paint non-submerged portions of equipment in the same color as the process piping it serves, except as itemized below:
 - a. Dangerous parts of equipment and machinery: OSHA Orange
 - b. Fire protection equipment and Apparatus: OSHA Red
 - c. Radiation hazards: OSHA Purple
 - d. Physical hazards in normal operating area: OSHA Yellow
 - 3. Fiberglass reinforced plastic (FRP) equipment with an integral colored gel coat does not require painting, provided the color is as specified.
- E. Pipe Identification Painting:
 - 1. Color code non-submerged metal piping except electrical conduit. Paint fittings and valves the same color as the pipe.
 - 2. Piping color coding: In accordance with the Piping Schedule as shown.
 - 3. On exposed stainless steel piping, apply color 24 inches in length along pipe axis at all connections to equipment, valves, or branch fittings, at wall boundaries, and at intervals along the piping not greater than 9 feet on center, with identification labels applied to each exposed run of pipe as specified herein.
 - 4. Pipe supports: Mild steel, painted No. 70 light gray as specified in ANSI Z35.1.
 - 5. Fiberglass reinforced plastic (FRP) pipe and polyvinyl chloride (PVC) pipe located outside of buildings and enclosed structures will not require painting, except as noted.
- F. Labels for Piping:
 - 1. Identification labels shall bear the full piping system name as specified in the Piping Schedule shown.
 - 2. Install separate flow directional arrows with each label.
 - 3. Include black lettering on OSHA safety yellow self-adhesive vinyl or vinyl cloth.
 - 4. Lettering height: Meet ANSI A13.1.
 - 5. Label and Adhesive: Long lasting, resistant to moisture, oils, solvents, and weathering, meeting OSHA requirements.
 - 6. Locate labels at all connections to equipment, valves, or branch fittings, at wall boundaries, and at intervals along the piping not greater than 18 feet on center, with at least one label applied to each exposed run of pipe.

7. Manufacturers:
 - a. W. H. Brady Co., Milwaukee, WI
 - b. Seton Nameplate Corp., New Haven, CT
 - c. or Equal.

2.06 QA/QC TESTING AND INSPECTION

A. General

1. Applicator shall inspect and test the coating system in accordance with referenced standards and these specifications, whichever is more stringent.
2. Quality control testing as specified in AWWA standards are minimum industry standards and it is the intent of this specification to provide a higher level of quality control for the objective of achieving maximum coating performance.
3. If any conflict between this specification and referenced standards occurs, the more stringent requirement shall apply and any interpretation of this requirement or results shall be with the objective of achieving maximum coating performance.
4. The frequency of the testing shall be determined by the applicator but shall not be less than the requirements of this specification.

B. Surface Profile Testing

1. Surface profile of abrasive blasted surfaces to be tested with "Press-O-Film" tester tape or equivalent in accordance with NACE RP287.
2. Tester tape shall be suitable for the intended profile height.
3. Profile shall be measured to a minimum tolerance of 0.1 mils, maximum.
4. Electronic surface profilometer shall be used, where deemed necessary, to verify tester tape measurements.

C. Adhesion testing: As specified in Section 09 90 10, where directed by the Engineer for assessing coating application problems.

D. Holiday Testing

1. Holiday tests on polyurethane coatings or linings will be conducted on the completed coating or lining after cure or 24-hours, whichever is less, using a high voltage spark test in accordance with NACE SP-0188 and these specifications.
2. Coating thickness used for high voltage holiday testing setting shall be the average dry coating thickness.

E. Dry Film Thickness Testing

1. Coatings shall be tested for dry film thickness using a properly calibrated magnetic pull off, eddy current, or ultrasonic equipment.
2. Coating thickness measurements shall be conducted as necessary and without limitation. Testing conformance to the requirements of SSPC PA-2 is specifically excluded from this specification.

PART 3 EXECUTION

3.01 GENERAL

- A. The intention of this specification is for all existing and new, interior and exterior surfaces are painted, whether specifically mentioned or not, except as modified herein.

Concealed structural steel surfaces shall receive prime coat only unless modified herein. Exterior concrete surfaces will not be painted unless specifically indicated hereinafter.

- B. Surface preparation and coating application shall be in conformance with these specifications and the coating manufacturer's written product data sheets and written recommendations of the manufacturer's technical representative. Where conflicts occur between the manufacturer's recommendations and these specifications, the more stringent of the two shall apply unless otherwise approved by the Engineer.
- C. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer's written instructions for these requirements. Do not immerse coating for any purpose until completion of curing cycle.

3.02 REGULATORY REQUIREMENTS

- A. Meet federal, state, and local requirements limiting the emission of volatile organic compounds and worker exposures.
- B. Protect workers and comply with applicable federal, state, and local air pollution and environmental regulations for surface preparation, blast cleaning, disposition of spent aggregate and debris, coating application and dust prevention including, but not limited to the following Acts, Regulations, Standards, and Guidelines:
 - 1. Clean Air Act
 - 2. National Ambient Air Quality Standard
 - 3. Resource Conservation and Recovery Act (RCRA)
- C. Comply with applicable federal, state, and local regulations for confined space entry.
- D. Provide and operate equipment that meets explosion proof requirements.

3.03 ENVIRONMENTAL CONDITIONS

- A. Do not perform abrasive blast cleaning whenever the relative humidity exceeds 85 percent, whenever surface temperature is less than 5 degrees F above the dew point of the ambient air.
- B. Surface preparation power tools and blast equipment shall contain dust collection equipment that will prevent discharge of dust particles into the atmosphere.
- C. Do not apply paint when:
 - 1. Surface temperatures exceeds the maximum or minimum temperature recommended by the paint manufacturer,
 - 2. In dust, smoke-laden atmosphere, damp or humid weather, or under conditions which could cause icing on the metal surface.
 - 3. When it is expected that surface temperatures will drop below 5 degrees above dew point within 8 hours after application of coating.

3.04 DEHUMIDIFICATION

- A. Where environmental conditions cannot be met or controlled, Contractor shall provide and operate desiccant dehumidification equipment to maintain environmental conditions for 24 hours a day during abrasive blasting and coating application and cure. Liquid, granular, or loose lithium chloride drying systems will not be acceptable.
- B. Contractor shall provide dehumidification equipment sized to maintain dew point temperature 17 degrees or more below surface temperature of metal surfaces to be cleaned and coated. System shall provide ventilation within the environmentally controlled areas as required for the following requirements:
 - 1. One air exchange per hour, minimum,
 - 2. Maintenance of personnel exposures limits (PEL) at 50 percent of OSHA PEL limits for all chemicals used in the performance of the work, and
 - 3. Maintenance of lower explosive limits (LEL) to less than 50 percent of the most volatile solvent used in the performance of the work.
- C. Dehumidification equipment type, size, air flow, and power requirements shall be designed by a qualified company knowledgeable in dehumidification equipment, and its operation based on project requirements and anticipated seasonal weather conditions for the project schedule. Design to include evaluation of existing conditions, humidity, and temperature, proper air exchange requirements, ventilation requirements, ducting requirements for adequate air flow, and any other issues necessary to achieve the specified performance and environmental conditions throughout the duration of the project.
- D. Contractor to submit written recommendations from dehumidification subcontractor for bulkhead locations, bulkhead venting, duct work for each bulkhead section, any secondary ventilation requirements for coating cure, dust collection equipment CFM requirements, and drying requirements for blast hose compressed air necessary to maintain environmental control as specified herein.
- E. Dehumidification subcontractor shall either operate the equipment or provide training to Contractor on the proper operation and setup of dehumidification equipment. Dehumidification subcontractor shall provide a technical representative on site for a minimum of two 8-hour days to ensure proper operation of the equipment, achievement of desired environmental control, and to insure Contractor can properly setup, operate, monitor, and maintain the equipment.
- F. Dehumidification shall be operated in a manner that prevents all condensation or icing throughout surface preparation and coating application and cure.
- G. Reblasting of flash rusted metal surfaces or removal of damaged coatings, as a result of equipment malfunction, shutdown, or other events that result in the loss of environmental control, will be at the sole expense of the Contractor. Cleaned metal surfaces subject to flash rusting shall be cleaned to the same cleanliness as prior to the flash rust formation and shall be approved by the Engineer.
- H. Contractor shall monitor ambient temperature, humidity, dew point temperature, and pipe surface temperature both outdoors and within the work area at the start, midpoint, and end of each work shift, minimum, but not greater than 5 hours between measurements.

- I. Daily environmental condition monitoring and maintenance of the equipment shall be documented in writing and posted near the equipment for review by the Engineer.

3.05 VENTILATION AND ILLUMINATION

- A. Adequate illumination shall be provided while work is in progress. Whenever required by the inspector, the Contractor shall provide additional illumination and necessary supports to cover all areas to be inspected. The level of illumination for inspection purposes shall be determined by the inspector.
- B. Ventilation shall be used to control potential dust and hazardous conditions within the tank. Ventilation flow rates shall be in accordance with OSHA regulations and as required to reduce air contamination to nonhazardous conditions.

3.06 SURFACES NOT REQUIRING PAINTING

- A. Unless otherwise stated herein or shown, the following areas or items will not require painting:
 - 1. Concrete and masonry surfaces
 - 2. Nonferrous and corrosion-resistant ferrous alloys such as copper, bronze, monel, aluminum, chromium plate, atmospherically exposed weathering steel, and stainless steel, except where:
 - a. Required for electrical insulation between dissimilar metals.
 - b. Aluminum and stainless steel are embedded in concrete or masonry, or aluminum is in contact with concrete or masonry.
 - c. Color coding of equipment and piping is required.
 - 3. Nonmetallic materials such as glass, PVC, wood, porcelain, and plastic (FRP) except as required for architectural painting or color coding.
 - 4. Prefinished electrical and architectural items such as motor control centers, switchboards, switchgear, panel boards, transformers, disconnect switches, acoustical tile, cabinets, elevators, building louvers, wall panels, etc.; color coding of equipment is required.
 - 5. Non-submerged electrical conduits attached to unpainted concrete surfaces.
 - 6. Cathodic protection anodes.
 - 7. Items specified to be galvanized after fabrication unless specifically required elsewhere or subject to immersion.
 - 8. Insulated piping and/or insulated piping with jacket will not require exterior coating, except as required for architectural painting or color coding.

3.07 PREPARATION OF SURFACES

- A. Surface Preparation Inspection:
 - 1. Inspect and provide substrate surfaces prepared in accordance with these Specifications and the printed directions and recommendations of paint manufacturer whose product is to be applied.
 - 2. Provide Engineer minimum 3 days' notice prior to start of surface preparation work or coating application work.
 - 3. Perform such work only in the presence of Engineer, unless Engineer grants prior approval to perform such work in Engineer's absence.
- B. Metal Surface Preparation:

1. General:
 - a. Do not perform a surface preparation blast prior to submission of samples. Workmanship for metal surface preparation as specified shall meet current Steel Structures Painting Council (SSPC) Specifications as follows:
 - (1) Solvent Cleaning: SP 1
 - (2) Hand Tool Cleaning: SP 2
 - (3) Power Tool Cleaning: SP 3
 - (4) White Metal Blast Cleaning: SP 5
 - (5) Commercial Blast Cleaning: SP 6
 - (6) Brush-Off Blast Cleaning: SP 7
 - (7) Pickling: SP 8
 - (8) Near-White Blast Cleaning: SP 10
 - (9) Bare Metal Power Tool Cleaning: SP 11
 - b. All surface preparation shall be assumed to be on a SSPC Grade A steel surface condition, unless specifically noted otherwise.
 - c. Wherever the words "solvent cleaning", "hand tool cleaning", "wire brushing", or "blast cleaning", or similar words of equal intent are used in these Specifications or in paint manufacturer's specifications, they shall be understood to refer to the applicable SSPC Specifications listed above.
 - d. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers' recommendations for wet blast additives and first coat application shall apply. Wet blasting methods shall be approved by the Engineer.
 - e. Hand tool clean areas that cannot be cleaned by power tool cleaning.
2. Welds and adjacent areas:
 - a. Prepared such that there is:
 - (1) No undercutting or reverse ridges on the weld bead.
 - (2) No weld spatter on or adjacent to the weld or any other area to be painted.
 - (3) No sharp peaks or ridges along the weld bead.
 - b. Grind embedded pieces of electrode or wire flush with the adjacent surface of the weld bead.
3. Preblast Cleaning Requirements:
 - a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
 - b. Cleaning methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
 - c. Clean small isolated areas as above or solvent cleaned with suitable solvents and clean cloths.
 - d. Round or chamfered all sharp edges and grind smooth burrs, jagged edges, and surface defects.
4. Blast Cleaning Requirements:
 - a. General:
 - (1) Type of Equipment and Speed of Travel: Designed to obtain specified degree of cleanliness.
 - (2) Select type and size of abrasive to produce a surface profile that meets the coating manufacturer's recommendations for the particular coating to be applied or not less than 20 percent of the specified coating thickness, whichever is more stringent.
 - (3) Meet applicable federal, state, and local air pollution control regulations for blast cleaning and disposition of spent aggregate and debris.

- (4) Do not reuse abrasive, unless abrasive is recyclable steel grit or shot abrasive.
 - b. Shop Blasting
 - (1) Notify Engineer at least 7 days prior to start of shop blast cleaning to allow for inspection of the work during surface preparation and shop application of paints. Work shall be subject to the Engineer's approval before shipment to the jobsite.
 - (2) Items such as structural steel, metal doors and frames, metal louvers, and similar items as reviewed by the Engineer may be shop prepared and primed. Centrifugal wheel blast cleaning is an acceptable alternate to shop blast cleaning. Blast clean and prime in accordance with these Specifications.
 - c. Field Blasting
 - (1) Perform sandblasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed. Materials, equipment, procedures, shall meet requirements of Steel Structures Painting Council.
 - (2) Field blasting in areas with electrical or mechanical equipment, within buildings, or on coated surfaces with lead paint greater than 2,000 mg/L total lead shall be performed with dustless abrasive systems such as "Sponge-Jet", dry ice abrasive blasting.
- 5. Post-Blast Cleaning and Other Cleaning Requirements:
 - a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wiped with a tack cloth.
 - b. Paint surfaces the same day they are sandblasted. Reblast surfaces that have started to rust before they are painted.
- C. Concrete Surface Preparation:
 - 1. Do not begin until 30 days after the concrete has been placed.
 - 2. Remove grease, oil, dirt, salts or other chemicals, loose materials or other foreign matter by solvent, detergent, or other suitable cleaning methods.
 - 3. Clean concrete using mechanical or chemical methods for the degree of cleaning specified for the coating system in accordance with SSPC SP-13, Surface preparation of Concrete.
 - 4. Unless otherwise required for proper adhesion, ensure surfaces are dry prior to coating.
 - 5. Bug holes, air pockets, and other voids in the concrete will be filled or patched in chemical exposure areas, secondary containment, and where specifically required.
 - 6. Concrete Surface Preparation Inspection:
 - a. Adhesion Testing:
 - (1) Tensile testing of the surface preparation shall be performed by the Engineer as necessary using Type 4 or Type 5 pneumatic adhesion testing equipment in accordance with ASTM D4541 using 2-inch diameter dollies for concrete surface adhesion testing.
 - (2) Applied coating greater than 20 mils in thickness or with a tensile strength greater than 2,500 psi shall be scored for concrete adhesion testing.

- (3) Adhesive failure greater than 50 percent of the dolly surface area shall indicate inadequate surface preparation.
 - (4) Cohesive failures which results in loss of sound concrete will be acceptable provided the loss is greater than 50 percent of the dolly surface area.
 - (5) Low adhesion cohesive failures with a thin layer of concrete due to weak concrete or laitance over 50 percent of the dolly surface will be rejected.
 - b. Concrete Soundness:
 - (1) Concrete soundness shall be determined using the scratching or hammer impact methods as defined in SSPC SP-13.
 - c. Moisture Content:
 - (1) Moisture shall be tested as Specified in SSPC SP-13 and shall not exceed the moisture content recommended by the coating manufacturer.
- D. Brush-off Blast Cleaning:
 - 1. Equipment, procedure, and degree of cleaning shall meet SSPC-SP 7, Brush-off Blast Cleaning and shall achieve a profile on the coating equivalent to 80 grit sandpaper with no exposed metal. Profile shall be uniform over the surface with no glossy areas visible.
 - 2. Where metal substrate is exposed, Contractor shall apply full coating system as specified for new metal surfaces.
 - 3. Repair or replace surfaces damaged by blast cleaning, where damage is defined as visible metal substrate. If less than 5 percent of prepared surface has the metal substrate visible, the coating shall be repaired by application of a brush applied intermediate coat. If greater than 5 percent the coating shall be fully removed to meet the specified surface cleanliness and recoated with the specified coating system.
 - 4. Abrasive: Either conventional abrasive blasting with sand, grit, or nut shells or specialized abrasive blasting. Abrasives shall be 60 mesh grit, maximum.
 - 5. Select various surface preparation parameters such as size and hardness of the abrasive, nozzle size, air pressure, and nozzle distance from the surface such that the surface is cleaned without pitting, chipping, or other damage.
 - 6. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.
 - 7. The Engineer shall approve trial blast cleaned area and shall use area as a representative sample of surface preparation.
- E. Solvent Cleaning:
 - 1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods which involve a solvent or cleaning action.
 - 2. Method meets SSPC-SP 1.

3.08 PROTECTION OF MATERIALS NOT TO BE PAINTED

- A. Remove, mask, or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted.

- B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.
- C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.
- D. Mask openings in motors to prevent paint and other materials from entering the motors.

3.09 PAINT MIXING

- A. Multiple-component coatings:
 - 1. Prepare using all the contents of the container for each component as packaged by the paint manufacturer.
 - 2. No partial batches will be permitted.
 - 3. Do not use multiple-component coatings that have been mixed shall not be used beyond their pot life.
 - 4. Provide small quantity kits for touchup painting and for painting other small areas.
 - 5. Mix only components specified and furnished by the paint manufacturer.
 - 6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.
 - 7. Fast set or plural component products shall be applied using an appropriate multipart pump that properly mixes both components at the recommended ratio using equipment recommended by the coating manufacturer. Hot mixing of fast set or plural component products will not be permitted.
- B. Keep paint materials sealed when not in use and provide nitrogen blanket on fast set, plural, or moisture cured coatings on opened product containers when stored or not in use more than 8 hours.
- C. Where more than one coat of a material is applied within a given system, alternate color to provide a visual reference that the required number of coats have been applied.

3.10 APPLICATION OF PAINT

- A. General:
 - 1. Inspection: Schedule with Engineer in advance for cleaned surfaces and all coats prior to the succeeding coat.
 - 2. Apply coatings in accordance with the paint manufacturer's recommendations. Allow sufficient time between coats to assure thorough drying of previously applied paint.
 - 3. Fusion Bonded Coatings Method Application: Electrostatic, fluidized bed, or flocking.
 - 4. Paint units to be bolted together and to structures prior to assembly or installation.
 - 5. Shop Primed or Factory Finished Surfaces:
 - a. Inspection: Schedule with Engineer in advance for shop primed or factory-finished items delivered to jobsite for compliance with these Specifications.

- b. Hand or power sand areas of chipped, peeled, or abraded coating, feathering the edges. Follow with a spot primer using specified primer.
 - c. For two-package or converted coatings, consult the coatings manufacturer for specific procedures as relates to top coating of these products.
 - d. Prior to application of finish coats, clean shop primed surfaces of dirt, oil, and grease, and apply a mist coat of specified primer, 1.0 mil dry film thickness.
 - e. After welding, prepare and prime holdback areas as required for the specified paint system. Apply primer in accordance with manufacturer's instructions.
 - 6. Manufacturer Applied Paint Systems:
 - a. Repair abraded areas on factory-finished items in accordance with the equipment manufacturer's directions.
 - b. Carefully blend repaired areas into the original finish.
- B. Application Safety
- 1. Performed painting in accordance with recommendations of the following:
 - a. Paint manufacturer's instructions.
 - b. NACE contained in the publication, Manual for Painter Safety.
 - c. Federal, state, and local agencies having jurisdiction.
 - 2. Contractor will be solely and completely responsible for condition of the project site, including safety of all persons (including employees) and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours. Safety provisions will conform to U.S. Department of Labor, Occupational Safety and Health Act, any equivalent state law, and all other applicable federal, state, county, and local laws, ordinances, and codes.
 - 3. Contractor will comply with all safety-training requirements promulgated or required for this project.
- C. Film Thickness:
- 1. Coverage is listed as either total minimum dry film thickness in mils (MDFT) or the spreading rate in square feet per gallon (SFPG). Per coat determinations are listed as MDFTPC or SFPGPC.
 - 2. Applied coating system film thickness per coat shall be applied at the specified coating thickness or the manufacturer's recommended minimum thickness, whichever is greater. Where the manufacturer has not specified a minimum coating thickness on the product data sheets, the minimum recommended coating application thickness shall apply.
 - 3. Maximum film build per coat shall not exceed the coating manufacturer's recommendations.
- D. Stripe Coats:
- 1. Surfaces that are subject to immersion, condensing environments, or where specifically specified shall be stripe coated on all angles, edges, corners, threads, welds, and similar type surfaces.
 - 2. Stripe coat shall be an extra coat of the intermediate coating material and shall be applied between the prime and intermediate coats.
 - 3. The stripe coat shall be a separate coat from coats specified under the coating system.
 - 4. Stripe coats shall be alternated in color like a full coat.

- E. Number of coats:
 - 1. Apply specified number of coats, minimum, irrespective of the coating thickness.
 - 2. Additional coats may be required to obtain the minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.
- F. Porous Surfaces, Such as Concrete, Masonry:
 - 1. Prime Coat:
 - a. May be thinned to provide maximum penetration and adhesion.
 - b. Type and Amount of Thinning: Determined by the paint manufacturer and is dependent on surface density and type of coating.
 - c. Surfaces Specified to Receive Water Base Coating: Damp, but free of running water, just prior to application of the coating.
- G. Existing Coated Surfaces:
 - 1. General:
 - a. Equipment or components with shop primer or shop finish coated surfaces shall be reviewed with the Engineer to determine coating damage, repair methods, surface preparation requirements, and conformance with color uniformity, where required.
 - b. All shop primed or finished coated surfaces shall be verified to be chemically compatible with field applied finish coats.
 - c. If a cured epoxy, polyurethane, or plural-component material is to be top coated, contact the coating manufacturer for additional surface preparation requirements. Existing coated surfaces shall be prepared as follows"
 - (1) Existing coated surfaces shall be brush-off blasted as specified herein to remove all gloss and provide a uniform profile on existing coating for adhesion of subsequent coats.
 - (2) Power or hand sanding will not be allowed as a surface preparation procedure for existing coatings, unless reviewed and approved by the Engineer.
 - (3) Where coating manufacturer surface preparation recommendations conflict with this section, the more stringent requirements shall apply.
 - (4) Profile shall be as specified for by the manufacturer or equivalent of 80 grit sandpaper; whichever is more stringent. Profile shall be visible and uniform over existing coated surfaces.
 - d. All existing coated surfaces, where demolition of equipment was specified or required, shall be surface prepared, touch-up coating repairs completed, and a cosmetic overcoat applied using the specified coating system on all existing coated surfaces associated with the demolition work, unless otherwise specified.
 - e. Existing coatings on immersed equipment shall be removed to bare metal and recoated with the specified coating system where demolition work was specified.
 - f. Apply sealer/primer where recommended by coating manufacturer for coating compatibility.
 - 2. To be Recoated or Final Coated:
 - a. Detergent wash and freshwater rinse.
 - b. Perform touch-up repairs of existing coating.
 - c. Asphaltic varnish coated ductile iron pipe will require an application of a seal coat prior to the application of a cosmetic finish coat.

3. Touch-up Repairs:
 - a. Clean loose, abraded, or damaged coatings to substrate by Power Tool (SP 3).
 - b. Feather surrounding intact coating.
 - c. Apply one spot coat of the specified primer to bare areas overlapping the prepared existing coating.
 - d. Apply one full finish coat of the specified primer or finish coat(s) overall.
 4. Application of a Cosmetic Coat:
 - a. The exact nature of shop-applied coatings is not known in all cases.
 - b. Check compatibility by application to a small area prior to starting the coating.
 - c. If lifting or other problems occur, request disposition from the Engineer.
 - d. Cured epoxy, polyurethane, plural component materials or any other coating system that has exceeded its maximum recoat window shall be prepared as specified this section.
- H. Damaged Coatings, Pinholes, and Holidays:
1. Feather edges and repaired in accordance with the recommendations of the paint manufacturer.
 2. Repair fusion bonded coatings to be as recommended by the original applicator. Applicator shall provide liquid repair kits for this purpose as recommended by the coating manufacturer.
 3. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.
- I. Unsatisfactory Application:
1. If the item has an improper finish color, or insufficient film thickness, clean and topcoat surface with specified paint material to obtain the specified color and coverage. Obtain specific surface preparation information from the coating manufacturer.
 2. Hand or power sand visible areas of chipped, peeled, or abraded paint and feather the edges. Follow with primer and finish coat in accordance with the Specifications. Depending on the extent of repair and its appearance, a finish sanding and topcoat may be required.
 3. Evidence of runs, bridges, shiners, laps, or other imperfections shall be cause for rejection.
 4. Repair defects in coating system per written recommendations of coating manufacturer.
 5. Leave all staging up until the Engineer has inspected the surface or coating. Replace staging removed prior to approval by Engineer.

3.11 COATING INSPECTION

- A. General
1. Film thickness measurements and electrical inspection of the coated surfaces:
 2. Perform with properly calibrated instruments.
 3. Recoat and repair as necessary for compliance with the Specifications.
 4. All coats will be subject to inspection by the Engineer and the coating manufacturer's representative.
 5. Visually inspect concrete, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained.

6. Give particular attention to edges, angles, flanges, and other areas where insufficient film thicknesses are likely to be present and ensure proper milage in these areas.
- B. Coating Thickness Testing:
1. Engineer shall conduct coating thickness testing as necessary and without limitation. Testing conformance to the requirements of SSPC PA-2 is specifically excluded from this specification.
 2. Measure coating thickness specified in mils with a magnetic type dry film thickness gauge as specified.
 3. Check each coat for the correct milage. Do not make measurement before a minimum of 8 hours after application of the coating.
 4. Tests for concrete coating thickness shall be with a Tooke Gauge, a destructive test. Contractor shall repair coating after thickness testing.
- C. Coating Continuity Testing
1. Holiday detect coatings with high voltage units in accordance with NACE SP-0188. High voltage detector shall have adjustable voltages in 100 volt increments and shall be operated in accordance with the manufacturer's instructions and the specified standard.
 2. Use of an electrical holiday detector, low voltage, wet sponge type holiday detector will be permitted for coating systems less than 20 mils total dry film thickness and are not for immersion or condensing environments.
 3. Holiday detect coatings on pipe for buried application with high voltage spark tester in accordance with NACE RP0274.

3.12 CLEANUP

- A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroyed at the end of each day.
- B. Upon completion of the work, remove staging, scaffolding, and containers from the site or destroyed in a legal manner.
- C. Completely remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.
- D. Damages due to over spray on buildings, vehicles, trees, or other surfaces not specified to be painted would be the responsibility of the Contractor.

3.13 MANUFACTURER' SERVICES

- A. Furnish paint manufacturer's representative to visit jobsite at intervals during surface preparation and painting as may be required for product application quality assurance, and to determine compliance with manufacturer's instructions and these specifications, and as may be necessary to resolve field problems attributable to, or associated with, manufacturer's products furnished under this Contract.

3.14 PROTECTIVE COATING SYSTEMS AND APPLICATION SCHEDULE:

- A. Unless otherwise shown or specified in these Specifications painted or coated the work in accordance with the following application schedule.
- B. In the event of discrepancies or omissions in the following, request clarification from the Engineer before starting the work in question.

System No.	Title
1	SUBMERGED METAL - IMMERSION
8	BURIED METAL - MISCELLANEOUS
29	FUSION BONDED COATING

- C. System No. 1 - Submerge Metal, Immersion

1. Surface Preparation and Coating System

Surface Prep.	Coating Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 5) Cement Mortar Prep: see Interior Linings, this section	Epoxy, NSF	3 coats, 16 MDFT

2. Application:
 - a. All metal surfaces subject to immersion or contact with potable water.
 - b. Use on the following areas:
 - (1) Coat the exposed portion of pipe ends at flexible pipe couplings with high solids epoxy lining, this section.
 - (2) Access manhole interior surfaces.
 - (3) All steel pipe without a cement mortar lining.
3. Material Requirements:
 - a. Polyamide Epoxy: Amine or polyamine epoxy coating, two parts, suitable for immersion, application temperatures, and environmental exposures and conditions, 75% volume solids minimum, capable of 4 to 8 MDFT per coat.
 - b. Epoxy coating shall be NSF certified for potable water contact in conformance to ANSI/NSF Standard 60 and 61.
4. Special Requirements:
 - a. Epoxy coating applied to immersed surfaces that contact potable water shall be NSF certified for potable water contact.
 - b. NSF certified fusion bonded epoxy linings will be permitted as alternative lining for small diameter pipes, valves, and couplings. FBE coating to be applied as specified for FBE coatings this section and in accordance with the manufacturer's recommendations.
 - c. All welds, angles, edges, and bolted connections shall be stripe coated as specified this section.

- B. System No. 8 - Buried Metal, General:

1. Surface Preparation and Coating System

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast or Centrifugal Wheel Blast (SP 10)	Wax Tape Coating	Wax tape as specified in Section 09 90 10, Pipeline Coating and Lining

2. Application:

- a. All buried miscellaneous pipe, joints, fittings, and other pipe appurtenances shall be coated as specified under Section 09 90 10, Pipeline Coatings and Linings.
- b. All buried, below grade portions of steel items, except buried stainless steel or ductile iron, unless otherwise specified.

3. Special Requirements:

- a. Metallic air vent pipe, buried, may be coated with System No. 1 at Contractor's option.

C. System No. 29 Fusion Bonded Coating:

1. Surface Preparation and Coating System

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 10) or Acid Pickling (SP 8)	Fusion Bonded 100% solids Epoxy or Polyurethane	1 or 2 coats, 10 MDFT

2. Application:

- a. Use where specified.
- b. Use on the following items or surfaces:
 - (1) Concrete embedded anchor bolts, except threads.
 - (2) Valves

3. Special Requirements:

- a. System 1 may be used as alternative coating system at Contractor's option

(See PSDS form following this section)

PAINT SYSTEM DATA SHEET

Attached products' Technical Data Sheet (if applicable) to this sheet for each paint system submittal.

Paint System Number (from spec.):		
Paint System Title (from spec.):		
Coatings Manufacturer:		
Representative:		
Surface Preparation:		
Paint Material (Generic)	Product Name/Number Proprietary)	Min. Coats, Coverage

Additional Information Required (check applicable items):

- ☐ ANSI/NSF Certification letter for each paint material listed above requiring ANSI/NSF Standard 60 and 61 approvals.
- ☐ Manufacturer's minimum and maximum recommended coating thickness per coat and for total coating system.
- ☐ Immersion coating cure requirements from minimum coating application temperature to 100 degrees in 15-degree temperature increments.

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SECTION 09 97 01
PIPELINE COATINGS AND LININGS

PART 1 GENERAL

1.1 WORK RESULTS

- A. This section covers the work necessary to apply external coating and internal lining on steel pipe, field coating of joints, and shop and field repair of coating damage, complete.
- B. Exposed steel pipe will be shop coated as specified in Section 09 90 00, Protective Coatings and Linings.

1.2 RELATED SECTIONS:

- A. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
- B. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
- C. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - 1. Section 09 90 00 – Protective Coatings and Linings

1.3 GENERAL:

- A. See section GENERAL CONDITIONS, which contain information and requirements that apply to the work specified and are mandatory for this project.

1.4 SUBMITTAL REQUIREMENTS

- A. Contractor submittals shall be made in accordance with Spanish Fork City requirements.
- B. Shop Drawings: Catalog cuts and other information for all products proposed. Provide copy of approved coating system submittals to the coating applicator.
- C. Quality Control Submittals: Furnish the following:
 - 1. Applicator's Experience with list of references substantiating compliance.
 - 2. Coating manufacturer's certification stating the individual coating applicators have met the qualification certification requirements as specified this section.

3. Coating manufacturer shall provide a copy of the manufacturer's coating application quality assurance manual.
4. If the manufacturer of field-applied coating differs from that of the shop applied primer, provide written confirmation from both manufacturers' that the two coating materials are compatible.

1.5 QUALITY ASSURANCE

A. Coating Applicator's Experience and Certification:

1. Coating Application Company and coating application supervisor (Certified Applicator) shall have a minimum of 5 years' experience applying the specified coating system.
2. Coating application personnel, whom have direct coating application responsibility, shall have a minimum of 2 years practical experience in application of the indicated coating system.
3. Coating applicator shall be certified by the coating manufacturer as an approved applicator.

B. Coating and/or lining manufacturer technical representative shall be present for a minimum of three days technical assistance and instruction at the start of coating and/or lining operations within the shop. During this visit, the technical representative shall observe surface preparation and coating application and conduct tests of the coating to insure conformance with application instructions, recommended methods, and conditions.

C. Coating and/or lining manufacturers technical representative shall be onsite for three working days, minimum, at the start of each construction season to inspect coating application and procedures in the field. During this visit, the technical representative shall observe surface preparation and coating application and conduct tests of the coating to insure conformance with application instructions, recommended methods, and conditions.

D. Coating and/or lining manufacturer shall include 8 hours per month of field or shop coating technical support when requested by the Engineer.

E. Technical representative shall provide a written report to the Engineer for each visit. Report shall include copies of test data collected, description of observations, and all recommended corrective actions. Report shall be submitted within 5 working days after the visit. When deemed necessary by the Engineer, work will not be permitted to proceed until the recommended corrective actions have been implemented. After all corrective recommendations have been completed; the manufacturer representative shall return and certify that the application complies with the manufacturer's coating application recommendations.

F. Additional visits by the manufacturer's representative shall be made at sufficient intervals during surface preparation and coating or lining as may be required for product application quality assurance, and to determine compliance with

manufacturer's instructions, and as may be necessary to resolve problems attributable to, or associated with, manufacturer's products furnished for this project.

1.6 ABBREVIATIONS

MDFT	Minimum Dry Film Thickness
mil	Thousandths of an Inch

1.7 DEFINITIONS

- A. **MANUFACTURER'S REPRESENTATIVE:** Employee of coating manufacturer who is factory trained and knowledgeable in all technical aspects of their products and systems. Sales representatives are not acceptable as a technical representative unless written authorization from the coating manufacture is provided which states the sales representative has full authority to act on the behalf of the coating manufacturer.
- B. **SPECIALS FITTINGS AND CONNECTIONS:** Defined as any joint of pipe with turnout, blowoff, fabricated tee, cross, wye, manhole, mitered angles or elbows, crotch plates, butt straps, or fabricated pipe that cannot be coated using through put or straight pipe coating application equipment and the following specific items:
1. All pipe joint sections entering a structure.
 2. Pipe joints with weld lead pass through holes.
- C. **SHOP:** A shop is defined as a permanent, fully enclosed building with a concrete floor that can be power washed with a potable water supply and floor drains.

1.8 REFERENCE STANDARDS

- A. This specification recognizes AWWA, NACE, and SSPC standards as minimum industry standards and they are referenced for purpose of conformance, except where modified in this section. The requirements of this specification section have been written to a higher design standard with the intent of achieving a long-term coating performance of 100 years.

AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe-4-inch and Larger- Shop Applied.
AWWA C210	Liquid-Epoxy Coating Systems for Steel Water Pipelines.
AWWA C214	Tape Coating Systems for the Exterior of Steel Water Pipe.
AWWA C215	Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines.
AWWA C216	Heat-shrinkable Cross-linked Polyolefin Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines.
AWWA C217	Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines.
NACE SP0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
NACE RP-0274	High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation.

NACE RP0303	Field-Applied Heat-Shrinkable Sleeves for Pipelines: Application, Performance, and Quality Control
NACE SP0394	Application, Performance and Quality Control for Plant Applied Single Layer Fusion-Bonded Epoxy External Pipe Coating.
SSPC-SP-1	Solvent Cleaning Surface Preparation
SSPC-SP-2	Hand Tool Cleaning Surface Preparation
SSPC-SP-3	Power Tool Cleaning Surface Preparation
SSPC-SP-5	White metal Abrasive Blast Surface Preparation
SSPC-SP-6	Commercial Abrasive Blast Surface Preparation
SSPC-SP-10	Near White Metal Abrasive Blast Surface Preparation
SSPC-SP-11	Power Tool Cleaning to Bare Metal

1.9 SPECIAL WARRANTY REQUIREMENTS

- A. The Contractor and coating applicator shall warrant to the Owner and guarantee the work under this section against defective workmanship and materials for a period of two (2) years commencing on the date of final acceptance of the work.

1.10 OBSERVATION OF WORK

- A. The Contractor shall give the Owner Representative notice a minimum of 14 days prior to start of work for scheduling shop or field observation.
- B. Provide Owner Representative a minimum 3 days' notice for actual start of surface preparation and coating application work.
- C. Provisions shall be made to allow Owner's representative full access to facilities and appropriate documentation regarding coating application.
- D. Observation by the Owner's representative or the waiver of observation of any portion of the work shall not be construed to relieve the Contractor of his responsibility to perform the work in accordance with these Specifications.
- E. Materials shall be subject to testing for conformance with this specification as the Owner's representative may elect, prior to or during incorporation into the work.

PART 2 MATERIALS

2.1 GENERAL

- A. Coatings and linings will be stored and handled per manufacturer's written directions.
- B. Exterior and interior pipe and fitting surfaces shall be prepared and coated in accordance with referenced standards, written instructions of the coating or lining manufacturer, and these specifications, whichever is more stringent.
- C. Pipeline coating or lining shall be the product of a single manufacturer. Product substitutions during the project will not be permitted, without Engineer approval.

2.2 SHOP-APPLIED, BURIED PIPE COATINGS

A. General

1. Buried steel pipe, consisting of straight lengths of pipe, shall be coated with one of the following coating systems at the Contractors option, except where noted otherwise.
 - a. Polyethylene Tape Wrap and cement overcoat (AWWA C214 and C205)
 - b. Plural Component Epoxy (AWWA C210)
 - c. Cement Mortar (AWWA C205), only where indicated on Drawings
2. Buried Steel pipe specials, fittings, and other complex shapes, shall be coated with one of the following coating systems.
 - a. Plural Component Epoxy (AWWA C210)
 - b. Cement Mortar (AWWA C205), only where indicated on Drawings.
3. Vault or manhole piping and miscellaneous pipeline components, such as coupling plain ends, access manholes, blowoff piping, or piping less than 12-inches in diameter, shall be coated as specified under Shop Applied, Atmospheric and Immersion Coatings, this section.
4. Mortar over coat shall be provided over tape wrap coating system and where specified. Cement mortar overcoat shall be shop-applied and 1-inch thick, $\pm 1/4$ -inch, as specified herein.
5. Buried dielectrically coated pipe and fittings passing through a concrete structure wall or floor shall be dielectrically coated for a minimum of four (4) inches beyond the interior wall or floor surface.
6. Exterior surfaces of all butt straps shall be prepared to SP-5, white metal, and coated with inorganic zinc suitable for temperatures over 750 degrees as specified for holdback corrosion protection.

B. Polyethylene Tape Wrap:

1. General Coating Requirements:
 - a. Tape wrap coating system shall be machine applied. Hand applied tape coatings will not be permitted.
 - b. Tape width shall be 12-inches maximum. Wider tape will be conditionally allowed if the coating applicator can demonstrate that proper maintenance of tension and prevention of mechanical wrinkling throughout the coating application. If at any time during the pipe fabrication tape quality becomes inconsistent with wider tape, the Engineer can require the remainder of the pipe to be coated using the maximum specified tape width.
 - c. Tape layers shall have adhesive for the full width of the tape. Adhesive shall have the ability to stick to itself and to the proceeding tape layer or pipe.
 - d. Each layer shall be a different color or shade with the outer layer white.

- e. Outer wrap shall be white and have sufficient ultraviolet (UV) inhibitors to resist above grade exposure for a minimum of 12 months or the proposed storage and construction time, whichever is greater.
- 2. Steel Pipe:
 - a. Surface Preparation:
 - (1) Comply with salt contamination and surface cleanliness (dust) requirements as specified for Quality Control testing.
 - (2) Steel Pipe: SSPC-SP5, White Metal blast, 2.5 mils blast profile, minimum.
 - b. Coating System
 - (1) Pipe shall be coated with an 80 mil (nominal), tape-coating systems applied in accordance with AWWA C214, except as modified herein.
 - (2) Steel pipe with cement mortar overcoat shall be coated with 50 mil (nominal), tape-coating systems applied in accordance with AWWA C214, except as modified herein.
 - (3) Primer: Polyken 1019, 1027, 1029, or as recommended by the coating manufacturer.
 - (4) Weld Stripe Tape: Polyken 931 (no backing), 25 mils nominal, 4-inches wide minimum.
 - (5) Inner Wrap: Polyken 989 YGIII, 20 mils nominal, corrosion protection layer.
 - (6) Outer Wrap: Polyken 956 YGIII, 30 mils nominal, mechanical protection layer.
 - (7) Mechanical Protection: Cement mortar overcoat in accordance with AWWA C205, except as modified herein.

C. Plural Component Epoxy:

- 1. General:
 - a. Plural component, epoxy coating system shall be applied in accordance with AWWA C210, and as modified herein.
 - b. All steel pipe specials, fittings, complex shapes, and other surfaces that are not suitable for machine applied tape wrap coating application and are below finished grade or concrete encased shall be coated with this coating system.
 - c. Plural component epoxy coating system is not suitable for interior of pipe or where contact with potable water may occur, see Section 09 90 00, Protective Coatings and Linings, for applicable protective coating systems.
- 2. Shop Surface Preparation:
 - a. Steel pipe:
 - (1) Comply with salt contamination and surface cleanliness requirements as specified for Quality Control Testing.
 - (2) SSPC-SP5, White Metal blast, 3.00 mil profile, minimum, or as required by the manufacturer, whichever is greater.
- 3. Shop Applied Coating Requirements:
 - a. Thickness: One coat, 35 mils total dry film thickness, minimum, or as required to meet limits specified for holiday and coating defects, this section.
 - b. Cement Mortar Overcoat:
 - (1) Apply cement mortar overcoat on epoxy coated specials when used in conjunction with tape wrapped steel pipe as specified this section.
 - (2) Ductile iron pipe does not require a cement mortar overcoat.

4. Product Acceptance:
 - a. Self-priming, plural component, 100 percent solids, non-extended epoxy, suitable for burial or immersion, and meeting the requirements of AWWA C210 and the following, whichever is more stringent:
 - 1) Resistance to Water Immersion (ASTM D870) or Wet Adhesion
 - a) Acceptance criteria:
 - (1) Not greater than 10 percent loss of substrate adhesion when compared to substrate adhesion in an unexposed area of the same sample with adhesion tests completed within 12 to 24 hours after test termination. Average of three pulls per exposure area.
 - (2) No blistering or underfilm corrosion when viewed at 10x magnification.
 - b) Adhesion Testing:
 - (1) Method: ASTM D4541, Method E
 - (2) Equipment: Type V, Delfesko Automatic AT Positest
 - (3) Dollies: 20 mm and 14 mm, scored to metal substrate
 - (4) Test Speed: 100 psi per second (both 14 and 20 mm)
 - c) Test Duration: 30 and 60 days
 - 2) Cathodic Disbondment (ASTM G95)
 - a) Acceptance criteria: 8 mm, maximum
 - b) Potential: -3.00 volts
 - c) Test Duration: 28 days
 - d) Evaluation: Measured from original holiday radius to edge of staining on metal surface.
 - 3) Water Absorption (ASTM D570)
 - a) Acceptance Criteria: 1.80 percent, maximum
 - b) Test Duration: 30 day and 60 day
 - b. Shall be one of the following products:
 - (1) Tnemec Series 431, Kansas City, MO
 - (2) Or Engineer approved equal

D. Cement Mortar Coating or Cement Mortar Overcoat

1. Apply cement mortar coating system on steel pipe, where specifically shown on the Drawings, in accordance with AWWA C205, except as modified herein.
2. Cement mortar overcoat shall be applied over dielectric coating system on all steel pipe and fittings in accordance with AWWA C205, except as modified herein.
3. Holdback:
 - a. Mortar overcoat shall be held back of dielectric coating a minimum of 3 inches for overlap of field applied joint coating onto dielectric coating system.
4. Shop Applied Coating System:
 - a. Cement: Conform to ASTM C150, Type II.
 - b. Aggregate shall be silica sand or other aggregate that is not subject to leaching. Conform to ASTM C33.
 - c. Cement mortar mixture shall consist of 1-part cement to not more than 3 parts aggregate.

- d. Water for cement mortar: Clean and free from organic matter, strong alkalis, vegetable matter, and other impurities. Use no more than 4-1/2 gallons of water per sack of cement.
- e. Cement mortar coating: Nominal 1-inch thick coating with permitted tolerance of $\pm 1/4$ -inch.
- 5. Joint Coating:
 - a. Joints shall be cement mortar overcoated after application of heat shrink sleeve joint coating system.
 - b. Joints of cement mortar overcoat dielectrically coated pipe do not require field application of cement mortar overcoat when properly coated with heat shrink sleeve joint coating system.

2.3 SHOP-APPLIED INTERIOR LININGS

A. General

- 1. Clean and cement mortar line steel pipe and fittings 6-inches or greater in diameter in accordance with AWWA C205.
- 2. Cement mortar line ductile iron pipe and fittings in accordance with C104, provide double thickness lining. Do not seal coat the cement lining.
- 3. Apply liquid epoxy coating over cement mortar lining at insulating joints as specified this section.
- 4. Epoxy line pipe 12-inches diameter or smaller per System No. 1 or fusion bonded epoxy lining at contractor's option. Fusion bonded epoxy lining shall be NSF certified.

B. Cement Mortar Lining:

- 1. Cement: Conform to ASTM C150, Type II.
- 2. Shop applied cement mortar lining shall be uniform in thickness over the full length of the pipe joint.
- 3. Aggregate shall be silica sand or other aggregate that is not subject to leaching. Conform to ASTM C33.
- 4. Water for cement mortar: Clean and free from organic matter, strong alkalis, vegetable matter, and other impurities.

C. Liquid Applied Epoxy Coating:

1. Epoxy Overcoat of Cement Mortar Lining:

- a. Provide liquid epoxy primer and lining in all cement mortar lined metallic pipe at insulating joints for a minimum of one pipe diameters on each side of the insulated joint. If other side of joint is an existing pipe, apply epoxy lining for two pipe diameters in fabricated pipe only.
- b. Epoxy lining shall be polyamine or polyamide cured, NSF approved for potable water contact in accordance with ANSI/NSF Standards 60 and 61, and capable of achieving full cure before placement in service or exposure to water.
- c. Application:
 - (1) Apply in two coats at equivalent spread rate for 6 mils dry film thickness per coat.

- (2) Epoxy shall be applied over the cement mortar lining where specified for the pipeline lining material.
- (3) Cement mortar shall be allowed to cure for a minimum of 15 days prior to surface preparation and coating application or 7 days with steam curing. Mortar lining shall be dry when epoxy lining is applied.
- (4) Prepare the cement mortar lining by abrasive blasting to remove all laitance and provide a surface profile equivalent to 80 grit sandpaper.
- d. Acceptable manufacturers:
 - (1) Carboline
 - (2) ICI Devoe
 - (3) Tnemec
 - (4) Sherwin Williams
 - (5) Or approved equal

2.4 SHOP APPLIED, ATMOSPHERIC OR IMMERSION COATINGS

A. General

- 1. All atmospherically exposed or vault piping shall be shop primed and field coated with the applicable Exposed Metal coating system as specified in Section 09 90 00, Protective Coatings and Linings.
- 2. Interior of pipe or surfaces in contact with potable water shall be coated with System No. 1.
- 3. Shop applied inorganic zinc primer shall not be applied at thickness greater than recommended by manufacturer. Excess primer to be removed using method recommended by coating manufacturer.
- 4. Intermediate and finish coats shall be applied in the field after installation, except where metal surfaces will be concealed after installation.
- 5. All concealed surfaces of bolted or mechanically secured surfaces shall be finished coated in the shop.
- 6. Manufacturer of shop-applied primer shall be coordinated with field application to provide a completed system by a single manufacturer. Engineer approval of a coating system with two or more coating manufacturers' will require written approval from all coating manufacturers as to compatibility and acceptance under warranty.

2.5 FIELD APPLIED COATING SYSTEMS

A. General

- 1. Miscellaneous Metals
 - a. All buried miscellaneous metal components installed on the pipeline and that is supplied bare or with a shop coating system that is not equal to the specified pipeline coating shall be coated in the field with one of the following coating systems.
 - (1) Petrolatum or Wax Tape Coating
 - (2) Heat Shrink Sleeve
 - b. Miscellaneous metal components shall include, but not be limited too, all exposed metals surfaces, including bolts, couplings, flanges, valves, adapters, pipe spools, and other miscellaneous metal components.

- c. Coating system applied shall conform to the manufacturer's requirements and shall be applied in accordance with the application requirements of the coating system.
 - d. Filler material shall be applied for all field applied coating systems to provide sufficient transition at welds and other dimensional changes to prevent all tenting or voids under the applied coating, regardless of manufacturer's recommendations.
- 2. Pipe Joints General:
 - a. Pipe joints shall be field coated after pipe assembly with one of the following coating systems as specified.
 - (1) Petrolatum or wax tape coating system
 - (2) Heat Shrink Sleeves.
 - b. Steel pipe joints shall be coated with a heat shrink coating, unless specified otherwise.
 - c. Ductile iron push-on bell and spigot joints may be heat shrink sleeve coated, provided filler mastic is used to prevent tenting or voids under the sleeve.
 - d. Joints of cement mortar overcoated tape wrap steel pipe shall be cement mortar overcoated after application of the specified field applied joint coating, unless specified otherwise.
 - e. Flanges, couplings, ductile iron pipe joints, and all bolted or threaded joints are classified as complex shapes and shall be wax tape coated with filler material to ensure completed encapsulation and filling of all bolts, crevices, gaps, and dimensional transitions as required to prevent tenting of the finished coating.
- B. Petroleum or Wax Tape Coating:
 - 1. Application:
 - a. Coating shall be applied in accordance with AWWA C217, except as modified herein.
 - b. Wax tape coatings shall be field applied on all buried couplings, thrust restraint rods and brackets, valves, and on joints, fittings, or irregular shapes or complex configurations that could cause tenting of heat shrink coating system.
 - c. Provide wax filler material for all complex shapes, bolts, flanges, gaps, and dimensional transitions to completely fill and encapsulate the metal surfaces and prevent tenting of the applied tape coating.
 - d. Buried wax tape coated surfaces shall be overcoated with plastic shrink film as recommended by the manufacturer.
 - e. Do not use wax tape coating systems on vault piping, atmospherically exposed piping and appurtenances, or where subject to UV exposures.
 - f. Use sand backfill to protect wax coating from damage.
 - 2. Surface Preparation: SP11 Power Tool to Bare Metal or SSPC-SP10, near white abrasive blast.
 - 3. Coating System:
 - a. Primer: petroleum or petrolatum wax, suitable for wet surfaces.
 - b. Filler Material:

- (1) Filler materials shall be petroleum or petrolatum wax sealer/filler with closed cell plastic filler
 - (2) Provide filler material to fill and smooth all irregular surfaces, such that no tenting or voids remain under the applied wax tape.
 - c. Inner Tape: Petroleum or petrolatum wax impregnated fabric, 6-inch width maximum, 40 mils thick
 - d. Outer Wrap: PVC or tape suitable for application to inner tape.
 - 4. Manufacturers: Wax tape coating system shall be as manufactured by:
 - a. Denso North American
 - b. Trenton
 - c. Or approved equal.
- C. Heat Shrink Sleeves:
- 1. Application:
 - a. Heat shrink sleeves are restricted to pipeline joints and couplings under buried or concrete encased applications only.
 - b. Application inside vaults or where exposed to the weather will not be allowed.
 - c. Provide filler material for all welded joints, rolled or Carnegie joints, and at all dimensional changes that could result in tenting or voids under the applied heat shrink sleeve.
 - d. Pipe joints that have been shop prepared as specified for heat shrink sleeves and shop coated with holdback primer as specified this section, shall be field prepared in accordance with SSPC-SP1, solvent cleaning, and SP3, Power tool cleaning, to remove all dirt, mud, oil, and grease prior to application of heat shrink sleeve.
 - e. Filler material shall be applied in a manner and of sufficient thickness that no tenting or voids remain under the heat shrink sleeve.
 - f. Contractor to consider sleeve shrinkage and joint profile in determining sleeve width required. Overlapping of two or more heat shrink sleeves to achieve the necessary width on pipe joints will not be permitted without Engineer approval.
 - 2. Surface preparation: As specified for pipe joint surface preparation.
 - 3. Coating System:
 - a. Filler Material:
 - (1) Filler material shall adhere to the pipe and heat shrink sleeve. Size and type shall be as recommended by the sleeve manufacturer for type of pipe and joint.
 - (2) Filler materials shall be applied as necessary to prevent all tenting or voids under the applied heat shrink sleeve, regardless of manufacturer's written recommendations.
 - (3) Filler mastic for joints subject to weld after backfill shall have a melt temperature exceeding 500 degrees F.
 - b. Heat Shrink Sleeve:
 - (1) Heat shrink, cross-linked polyolefin sleeve with a mastic sealant, 85-mil nominal thickness or greater, suitable for pipeline operating temperature, as recommended by the manufacturer.

- (2) Provide standard recovery sleeve for welded or bell and spigot steel pipe joints. High recovery sleeves shall be provided for mechanical or bell and spigot ductile iron pipe, flange joints, and coupling style joints.
 - (3) Width of heat shrink sleeves shall be sufficient to overlap existing coating 2-inches minimum, except extruded polyolefin coated pipe shall have a minimum overlap of 3-inches. Overlap on tape coated steel pipe shall be based on a sequential 2-inch wide step from outer wrap to middle wrap to inner wrap.
 - (4) Sleeve shall meet requirements for "Well After Backfill" when procedure is allowed and approved by Engineer.
 - 4. Coating Manufacturer's:
 - a. Canusa,
 - b. Raychem-Covalence,
 - c. Or equal.
- D. Epoxy Coating:
 - 1. Application:
 - a. Epoxy coatings shall be NSF approved and suitable for water contact in accordance with ANSI/NSF Standards 60 and 61, unless otherwise approved by the Engineer.
 - b. Contractor shall ensure that epoxy coating selected is suitable for the application temperatures anticipated and that project schedule will allow adequate cure time before backfilling or immersion based on surface temperatures at the time of application.
 - c. Epoxy coating shall be used to coat concrete embedded pipe penetrations for 6 inches outside of interior and exterior surfaces of concrete walls or floors. Epoxy coating at concrete penetrations shall be a minimum of 16 mils dry film thickness.
 - d. Buried transitions from epoxy to tape wrap coating systems shall be coated with Heat Shrink Sleeve as specified below. Heat shrink sleeves shall be buried within 72-hours of application to prevent thermal creep of sleeve. Sleeves subject wrinkling due to thermal exposure shall be removed and replaced by the Contractor.
 - 2. Surface Preparation: SP11 Power Tool to Bare Metal or SSPC-SP10, near white abrasive blast.
 - 3. Coating System:
 - a. Primer: As required by the coating manufacturer.
 - b. High Build Epoxy Coating:
 - (1) Two component, high build polyamide or polyamine cured epoxy coating, suitable for direct burial or immersion, dries to touch in 2 or more hours, suitable for immersion or burial after full cure of coating.
 - (2) Acceptable manufacturers:
 - (a) ICI Devoe
 - (b) Sherwin Williams
 - (c) Carboline
 - (d) Or approved equal
 - c. Fast Cure Epoxy Coating:

- (1) Two components, 100% solids by volume, fast cure epoxy coating suitable for direct burial or immersion, dry to touch in less than 1 hour at 72 degrees, capable of curing while immersed or buried.
4. Manufacturers:
 - a. TC 7010, Tapecoat Inc
 - b. Protal 7125 or Protal 7200, North American Denso
 - c. Or approved equal.
- E. Cement Mortar Coating or Overcoat:
 1. Joints of cement mortar coated or cement mortar overcoated steel pipe shall be mortar coated as specified herein after application of the specified joint coating materials, where applicable.
 2. Polyethylene foam-lined fabric with steel strapping of sufficient strength to hold the fresh mortar, resist rodding of the mortar and allow excess water to escape.
 - a. 100 percent closed-cell
 - b. Chemically inert, insoluble in water, resistant to acids, alkalis, and solvents.
 - c. Manufacturer and Product: Dow Chemical Company; Ethafoam 222.
 3. Fabric Backing:
 - a. Cut and sewn into strips wide enough to overlap shop-coated areas by 4 inches on either side.
 - b. Strips shall have slots for steel strapping on outer edges.
 4. Joint Coating:
 - a. Joints of cement mortar overcoat dielectrically coated pipe do not require field application of cement mortar overcoat when properly coated with heat shrink sleeve or wax tape joint coating system.

2.6 FIELD APPLIED INTERIOR JOINT LINING

- A. Epoxy Lining:
 1. Surface preparation and field lining of pipe joints shall be with the same coating system as the shop-applied lining.
 2. Field application shall be performed by a qualified contractor with equipment that meets the application requirements of the coating system and personnel trained and certified by the coating system manufacturer on the proper application of the coating system. Qualified field applicator shall have completed at least three other projects of similar size and magnitude within the last three years using the same or similar coating system.
 3. Coating applicator that does not meet the qualifications requirements can be rejected by the Engineer.
 4. Field coating application requirements shall be the same as the shop-applied coating requirements. Provide heating and/or dehumidification equipment as required to meet the environmental conditions necessary for proper coating application.
- B. Mortar Lining:
 1. After the backfill has been completed to final grade, the interior joint recess shall be filled with grout. The grout shall be tightly packed into the joint recess and trowelled flush with the interior surface. Excess shall be removed.

2. At no point shall there be an indentation or projection of the mortar exceeding 1/16-inch.
3. With pipe smaller than 24-inches in diameter, before the spigot is inserted into the bell, the bell shall be daubed with grout. The joint shall be completed and excess mortar on the inside of the joint shall be swabbed out.

2.7 REPAIR OF COATINGS AND LININGS

A. General

1. Coating or lining repair materials shall be compatible with the shop-applied coating or lining system and shall be approved by the coating or lining manufacturer.
2. Coating repair materials shall be as required for the coating system and repair classification as defined this section.

B. Coating Repair Materials

1. Heat Shrink Sleeves (major repair):
 - a. Filler Mastic: Provide mastic filler to fill tape void as required.
 - b. Shrink Sleeve: See Field Applied Coatings, Heat Shrink Sleeves, this section.
2. Heat-Applied Patches (minor repair)
 - a. Heat applied adhesive, polyolefin backed, mastic coated tape, 12-inches maximum size.
 - b. Patch shall provide a minimum of 2 inches overlap onto intact pipe coating; except for extruded polyolefin coated pipe shall have a minimum overlap of 3-inches in the circumferential direction.
 - c. CRP patch as manufactured by Canusa, PERP patch as manufactured by Raychem (Polyken), or equal.
3. Plural Component Epoxy Coating or Lining
 - a. Major Repairs:
 - (1) Shop repairs shall be completed using the same material as the pipe coating. Coating shall be reapplied using plural component spray equipment in accordance with manufacturer's written requirements.
 - (2) Field repairs shall be completed using heat shrink sleeves as specified for field applied coatings, this section.
 - (3) Shop or field major repairs to NSF linings shall be with single use kits matching the existing lining.
 - b. Minor Repairs:
 - (1) Shop minor repairs shall be single use kits matching the existing coating. Pinholes, holidays, or adhesion test repairs are classified as minor repairs.
 - (2) Field minor repairs shall be with fast cure epoxy, such as Protal 7125 as manufactured by North American Denso, Inc.
 - (3) Shop or field minor repairs to NSF linings shall be with single use kits matching the existing lining.

2.8 HOLDBACK CORROSION PROTECTION

- A. Primer for corrosion protection of cutbacks or holdbacks shall be compatible with the specified joint coating system and high heat resistant or weld after backfill requirements, where applicable.
- B. Approved holdback primers are:
 - 1. Tnemec Omnithane – Suitable for all joints, except joints subject to high heat resistant or weld after backfill
 - 2. Tnemec 90E-92 Ethyl Silicate Inorganic Zinc Primer – suitable for all joints, including high heat resistant or weld after backfill joints.
 - 3. ICI Devoe Cathacoat 304V Ethyl Silicate Inorganic Zinc Primer – suitable for all joints including high heat resistant or weld after backfill joints.
 - 4. Polyken Tape Primers – Not allowed
- C. Primer shall not result in running or melting of the coating or cause toxic fumes when heated during welding of “weld after backfill” joints.
- D. Application and thickness of holding primer shall be in accordance with the coating manufacturer’s recommendations, but shall not impair the clearances required for proper joint installation.
- E. Holdback requirements shall be as specified this section.

PART 3 EXECUTION

3.1 ENVIRONMENTAL LIMITATIONS

- A. General
 - 1. Products shall comply with federal, state, and local requirements limiting the emission of volatile organic compounds and worker exposure.
 - 2. Comply with applicable federal, state, and local, air pollution and environmental control regulations for surface preparation, blast cleaning, disposition of spent aggregate and debris, and coating application.
 - 3. Do not perform abrasive blast cleaning whenever the relative humidity exceeds 85 percent, whenever surface temperature is less than 5 degrees above the dew point of the ambient air.
 - 4. Do not apply coatings when:
 - a. Surface and ambient temperatures exceed the maximum or minimum temperatures recommended by the coating manufacturer or these specifications,
 - b. In dust or smoke-laden atmosphere, blowing dust or debris, damp or humid weather, or under conditions that could cause icing on the metal surface.
 - c. When it expected that surface temperatures would drop below 5 degrees above dew point within 4 hours after application of coating.
 - d. Whenever relative humidity exceeds 85 percent.
 - 5. Where weather conditions or project requirements dictate, Contractor shall provide and operate heaters and/or dehumidification equipment to allow pipe surfaces to be abrasive blasted and coated as specified and in accordance with the manufacturers coating application recommendations.

6. Work activities can be restricted by the Engineer until adequate temperature and humidity controls are in place and functioning within the environmental limits specified.
 7. Coating applicator shall provide a monitoring system approved by the coating manufacturer that constantly records pipe and coating conditions during coating application. Recorded monitoring parameters shall include pipe temperature, line speed, holiday test and other parameters applicable to the type of coating.
- B. Temperature Control
1. In cold weather or if moisture collects on the pipe, preheat pipe to a temperature between 45 and 90 degrees or 5 degrees above dew point, whichever is greater.
 2. When temperatures are above or below the coating manufacturers recommended application temperatures, the Contractor will provide temperature controls as necessary to permit work to precede within the manufacturer's temperature limitations.
 3. Provide tenting, insulating blankets, baffles, or bulkheads as required to zone and control heating or cooling effectiveness.
 4. Heating shall be with indirect fired heaters that do not increase humidity levels within the work area. Heaters shall be sized for the area to be heated.
- C. Dehumidification
1. Contractor shall provide and operate desiccant dehumidification equipment to maintain environmental conditions during abrasive blasting and coating application and cure. Liquid, granular, or loose lithium chloride drying systems will not be acceptable.
 2. Contractor shall provide dehumidification equipment sized to maintain dew point temperature 17 degrees or more below surface temperature of metal surfaces to be cleaned and coated. System shall provide ventilation within the environmentally controlled areas to meet the following requirements:
 - a. Two air exchanges per hour, minimum,
 - b. Maintenance of personnel exposure limits (PEL) at 50 percent of OSHA PEL limits for all chemicals used in the performance of the work, and
 - c. Maintenance of lower explosive limits (LEL) to less than 50 percent of the most volatile solvent used in the performance of the work.
 3. Dehumidification equipment type, size, air flow, and power requirements shall be designed by a qualified company knowledgeable in dehumidification equipment, and its operation based on project requirements and anticipated seasonal weather conditions for the project schedule. Design to include evaluation of existing conditions, humidity, and temperature, proper air exchange requirements, ventilation requirements, ducting requirements for adequate air flow, and any other issues necessary to achieve the specified performance and environmental conditions throughout the duration of the project.
 4. Contractor to submit written recommendations from dehumidification subcontractor for enclosure work area size, bulkhead venting, duct work for each bulkhead section, any secondary ventilation requirements for coating cure, dust collection equipment CFM requirements, and drying requirements for blast hose compressed air necessary to maintain environmental control as specified herein.
 5. Dehumidification subcontractor shall either operate the equipment or provide training to Contractor on the proper operation and setup of dehumidification

equipment. Dehumidification subcontractor shall provide a technical representative on site for a minimum of two 8 hour days to insure proper operation of the equipment, achievement of desired environmental control, and to insure Contractor can properly setup, operate, monitor, and maintain the equipment.

6. Dehumidification shall be operated in a manner that prevents all condensation or icing throughout surface preparation, coating application, and coating cure.
7. Reblasting of flash rusted metal surfaces or removal of damaged coatings, because of equipment malfunction, shutdown, or other events that result in the loss of environmental control, will be at the sole expense of the Contractor. Cleaned metal surfaces subject to flash rusting shall be cleaned to the same cleanliness as prior to the flash rust formation and shall be approved by the Engineer.
8. Contractor shall monitor ambient temperature, humidity, dew point temperature, and pipe surface temperature (work area only) both outdoors and within the work area at the start, midpoint, and end of each work shift, minimum, but not greater than 5 hours between measurements.
9. Daily environmental condition monitoring and maintenance of the equipment shall be documented in writing and posted near the equipment for review by the Engineer.

3.2 SURFACE PREPARATION

A. General

1. Inspect and provide substrate surfaces prepared in accordance with these Specifications and the printed directions and recommendations of coating manufacturer whose product is to be applied.
2. Visible oil, grease, dirt, and contamination shall be removed in accordance with SSPC-SP1, solvent cleaning.
3. Surface imperfections such as metal slivers, burrs, weld splatter, gouges, or delaminations in the metal shall be removed by filing or grinding prior to abrasive surface preparation.
4. Protect prepared pipe from humidity, moisture, and rain. All flash rust, imperfections, or contamination on cleaned pipe surface shall be removed by blasting.
5. Priming and coating of pipe shall be completed the same day as surface preparation.

B. Weld Surface Preparation

1. Requirements:
 - a. Spray applied coating systems do not require weld grinding.
 - b. Grind welds flush on extruded polyolefin coated pipe as specified herein.
 - c. Welds on tape wrap coated pipe shall be either ground flush or a weld stripe tape applied over the weld, at the pipe fabricator's option, unless otherwise specified.
2. Weld Grinding:
 - a. Under the weld grinding option, welds higher than 1/32 inch above pipe surface shall be ground to a tolerance of +1/32 inch to 0-inch above the pipe surface as measured on the lowest side of the weld.
3. Weld Stripe Tape:

- a. Weld stripe tape will be applied to primed metal.
 - b. Tape will either have no polyethylene backing or will be double sided adhesive tape to permit adhesion of the inner corrosion protection layer to the weld stripe tape.
 - c. Apply tape with a pressure roller to fully conform the tape to the weld surface.
 - d. Adhesion of the weld stripe tape shall be as specified for the coating system.
- C. Salt Contamination Removal
 1. All bare or shop coated or primed surfaces that will be coated in the field shall be pressure washed with potable water not greater than 8 hours before coating application, including pipeline joints.
 2. Residual soluble salt contamination (SSC) shall be tested as specified under Quality Control testing.
 3. Surfaces to be Abrasive Blasted:
 - a. Surfaces that fail the soluble salt contamination test prior to abrasive blasting shall be cleaned by pressure washing and/or abrasive blasting and retested.
 - b. Surfaces that fail the SSC test after surface preparation shall be recleaned and/or abrasive blasting and retested.
 - c. Surfaces which still exceed the specified SSC level after recleaning shall be subject to determination by the Engineer if additional work will be required.
 - d. Contractor shall remove all surface rust caused by SSC testing in accordance with SP-11, Power Tool to Bare Metal or abrasive blasting to the specified cleanliness.
 4. Existing or Shop Primed Surfaces:
 - a. All previously coated surfaces shall be tested for SCC prior to application of additional coats.
 - b. Surfaces exceeding the specified SSC level after pressure washing shall be subject to additional cleaning as determined by the Engineer.
 - c. Any coating applied before SCC testing is completed and accepted by the Engineer will be rejected and removed.
- D. Steel Surface Preparation
 1. Surface preparation of steel pipe shall be in accordance with SSPC surface preparation standards utilizing the degree of cleanliness specified for the coating system to be applied or as specified herein, whichever is more stringent.
 2. Grit and/or shot abrasive mixture and gradation shall be as required to achieve the degree of cleanliness and coating adhesion specified.
 3. Pipe cleaned by abrasive blasting with recyclable steel grit and/or shot or other abrasive shall be cleaned of debris and spent abrasive in an air wash separator.
 4. Epoxy coated steel shall have a sharp angular surface profile of the minimum depth specified.
 5. After abrasive blasting surfaces and before coating application, the metal surface shall be cleaned of residual dust to a minimum of Grade 2 per ISO Standard 8502-3, Test for the Assessment of Surface Cleanliness.
 6. Work shall be performed in a manner that does not permit the cleaned metal surface to rust back or flash rust.
 7. Rust back or flash rust shall be fully removed with the steel surface cleanliness equal to the metal surface cleanliness prior to rust back or flash rusting.

Determination of the equivalent surface cleanliness shall be at the Engineer's sole discretion.

E. Concrete Surface Preparation:

1. Cement Mortar or Concrete Cure:

- a. Cement mortar linings shall be allowed to cure for a minimum of 15 days prior to surface preparation and coating application or 7 days with steam curing.
- b. Concrete surfaces shall be cured 30 days.

2. Preparation Requirements:

- a. Remove grease, oil, dirt, salts or other chemicals, loose materials or other foreign matter by solvent, detergent, or other suitable cleaning methods.
- b. Clean concrete using mechanical or chemical methods for the degree of cleaning specified for the coating system in accordance with SSPC SP-13, Surface preparation of Concrete.
- c. Abrasive blast to remove all laitance and provide a surface profile equivalent to 80 grit sandpaper.
- d. Unless otherwise required for proper adhesion, ensure surfaces are dry prior to coating.

3. Inspection:

- (1) Concrete Soundness: Determined using scratching or hammer impact methods as defined in SSPC SP-13.
- (2) Moisture Content: Moisture shall be tested as Specified in SSPC SP-13 and shall not exceed the moisture content recommended by the coating manufacturer.

3.3 SHOP -APPLIED COATING APPLICATION

A. Tape Wrap Coating

1. Applicator shall provide a monitoring system approved by the tape manufacturer that constantly records pipe and tape conditions during coating application. Recorded monitoring parameters shall include, but not be limited too, pipe temperature; line speed, primer and tape roll body temperature, and tape tension.
2. Pipe surface temperature shall be between 45 and 120 degrees and 5 degrees above dew point, whichever is greater.
3. Tape roll temperature shall be in accordance with the manufacturer's recommendations, but shall not be less than 55 degrees for the inner wrap and 65 degrees for the outer wraps.
4. Apply a uniform coat of primer as recommended by the manufacturer without skips, runs, or sags. Allow to properly dry prior to applying the tape as required by the tape manufacturer and as necessary to achieve maximum tape adhesion. Rug type application will not be allowed.
5. If welds are not ground flush, apply a weld stripe tape to longitudinal or spiral pipe welds prior to application of the inner wrap.
6. Tape layers shall be applied continuously with the use of hydro-tension tape stands. Tension shall be maintained between the manufacturer's minimum and maximum tension recommendations or as required to achieve approximately 2.0 percent reduction in tape width.

7. Inner tape wrap shall adhere tightly to the pipe surface. Coating shall be 100 percent adhering to the metal surface and shall not have any visible damage, wrinkles, voids, disbondment, contamination, or holidays.
8. Tape coating adhesion testing shall be performed on the pipe as specified this section.
9. Holidays testing shall be conducted on the inner layer tape prior to proceeding with subsequent tape layers. All holidays detected shall be primed and patch using coating repair procedures specified herein.
10. Perform coating and lining repairs as specified in this section.

B. Plural Component Epoxy Coating

1. Applicator Qualifications:
 - a. Equipment will be certified by the coating manufacturer to meet the requirements for material mixing, temperature control, application rate, and ratio control for multi-part coatings.
 - b. Equipment not meeting the written requirements of the coating manufacturer shall be rejected for coating application until repairs or replacement of the equipment is made to the satisfaction of the Engineer.
 - c. Personnel responsible for the application of the coating system shall have certification of attendance at the coating manufacturer's training class within the last three years. The certified applicator shall be present during all coating application work and shall have responsibility for controlling all aspects of the coating application.
2. Pipe surface temperature shall be between 50 and 100 degrees or 5 degrees above dew point, whichever is greater.
3. Coating application shall be performed in an environmentally controlled shop area that meets or exceeds the written environmental application requirements of the coating manufacturer. Application in outdoor conditions will not be acceptable without adequate environmental shelter, environmental controls, and/or dehumidification.
4. Coating adhesion and holidays testing shall be tested as specified this section except adhesion testing is not required on overcoated CCP.
5. Coating manufacturer shall provide to the Engineer a copy of the manufacturer's coating application quality assurance manual prior to beginning coating application. Strict conformance to the requirements of the manual will be required. Deviation from the requirements of the manual will be grounds for the Engineer to reject the applied coating.
6. Unacceptable Coating Application
 - a. Coating applied under improper environmental conditions will be rejected.
 - b. Pipes that exceed the allowable quantity of coating defects, regardless of size or cause, shall be rejected.
 - c. Coating which fails the adhesion or holiday testing as specified this section shall be rejected.
 - d. Pipe coating that is subject to off ratio application, blistering, or is not applied in conformance with the coating manufacturer's written instructions or recommendations shall be rejected.
7. Rejected coating shall be removed from the full length of the pipe to bare metal and reapplied using proper application methods in accordance with the coating manufacturer's written instruction and the requirements of these specifications.

8. Perform coating and lining repairs as specified in this section.
- C. Cement Mortar Coatings
1. Steel pipe shall have a cement mortar coating applied in accordance with AWWA C205, except as modified herein.
 2. Tape wrap coated steel pipe shall have a cement mortar overcoat applied over the tape wrap or epoxy coating in accordance with AWWA C205, except as modified herein.
 3. Cement Mortar Coating:
 - a. Reinforcement:
 - (1) For pipe and specials smaller than 48 inches in diameter, reinforce coating with spirally-wound No. 12 gage steel wire spaced at 1-inch centers or with No. 14 gage steel wire at 1/2-inch centers positioned approximately in center of mortar coating.
 - (2) For pipe and specials 48 inches in diameter and larger, reinforce coating with 2 layers of spirally-wound No. 12 gage wire spaced at 1-inch centers or with No. 14 gage steel wire spaced at 1/2-inch centers positioned at the third points of mortar coating.
 - (3) Lap ends of reinforcement strips 4 inches and tie or loop free ends to assure continuity of reinforcement.
 - (4) All steel wire reinforcement placed in the mortar coating shall be electrically isolated from the pipe. Electrical isolation will be tested using high voltage spark test by the manufacturer prior to shipment to the project site. Provide certification that electrical isolation of reinforcement wire from steel pipe.
 - b. Special Fittings:
 - (1) Coating for steel plate specials may be reinforced with 2-inch by 4-inch No. 13 gage welded wire mesh in lieu of reinforcing specified above.
 - (2) One layer of mesh shall be positioned approximately in center of coating for specials smaller than 48 inches in diameter; 2 layers of mesh shall be positioned at the third points of coating for specials 48 inches in diameter and larger.
 - c. Coating Defects:
 - (1) Coating defects shall be repaired as specified in AWWA C205, except as specified this section.
 4. Cement Mortar Overcoat:
 - a. Cement mortar overcoat tape wrapped coated steel pipe as specified in AWWA C205, except mortar coating shall be applied over exterior pipe coating.
 - b. Mortar coating shall be held back 3 inches, minimum, behind dielectric coating system cut back at joints.
 - c. Cement mortar overcoat holdback shall be increased with extruded polyethylene coating as required to for coating shrinkage and as required to maintain the minimum overlap specified for joint coating application.
 - d. Coating Defects:
 - (1) Cracking in the mortar "armor" coat less than 1/8-inch in width will be acceptable.

- (2) Disbondment of the cement coating over a dielectric coating system should be anticipated and will not be grounds for repair or rejection of the pipe.
- (3) Losses of cement mortar coating due to impact, movement, or shipping damage shall be repaired in accordance with C205.
- e. Joint Coating:
 - (1) Joints of cement mortar overcoat dielectrically coated pipe do not require field application of cement mortar overcoat when properly coated with heat shrink sleeve joint coating system.

3.4 SHOP-APPLIED LINING APPLICATION

- A. Shop-applied Cement Mortar Lining:
 - 1. Place mortar lining used in steel piping and steel plate specials in pipe to thickness below.

Pipe Diameter, Inches	Lining Thickness, Inches	Tolerances, Inches
4 through 10	3/8	-1/16, +1/8
11 through 24	5/16	-1/16, +1/8
24 through 36	3/8	-1/16, +1/8
Greater than 36	1/2	-1/16, +3/16

- 2. Centrifugally line straight sections of pipe. Lining of special pieces or fittings shall be by mechanical, pneumatic, or hand placement. Provide cement mortar lining of uniform thickness. Finish to a smooth dense surface.
 - a. Steel plate specials larger than 16 inches in diameter shall have lining reinforced with 2-inch by 4-inch No. 13-gage welded steel wire mesh.
 - b. Brace and support pipe during lining application to minimize pipe distortion or vibration. Bracing and supports shall not damage the pipe, coating, or lining.
 - c. Tightly close ends of pipe and fittings with plastic sheet caps. Plastic end caps shall be of sufficient thickness and strength to resist shipping, handling, and storage stresses.
 - d. Damage to the cement mortar lining, including disbondment, cracking, or blistering, caused by improper curing, shipping, handling, or installation shall be repaired in accordance with AWWA specifications and to the satisfaction of the Engineer.
- 3. Other requirements of mortar lining materials and processes: As specified in AWWA C205.

- B. Liquid Epoxy Lining:
 - 1. Pipe Lining, Direct to Metal
 - a. Where epoxy lining on steel pipe is specified or shown on drawings or where the pipe is not cement mortar lined, an epoxy lining shall be applied directly

to the steel surface as specified in Section 09 90 00, Protective Coatings and Linings.

- b. Immersion System specified in Section 09 90 00, shall be modified to three coats, minimum, at a total coating thickness of 20 mils dry film thickness.
- 2. Pipe Lining, Insulating Joints:
 - a. Coating applied over cement mortar lining shall be applied in a manner that will minimize gassing and pinholes in the completed lining.
 - b. Clean and coat the interior of cement mortar lined pipe at insulating joints with two coats of epoxy coating.
 - c. Epoxy coating applied at insulating joints shall be applied to both sides of the insulating joint for a minimum of one pipe diameter. If only one side of the joint can be coated the coating shall be applied for a minimum of two pipe diameters.
 - d. Mortar lining shall be allowed to cure 15 days or steam cured not less than 7 days prior to surface preparation of the mortar and epoxy coating application. Hand applied mortar lining shall be allowed to cure a minimum of 15 days or as required to meet the coating manufacturer's requirements for application on cement or concrete, whichever is greater.
 - e. Prepared mortar lining by abrasive blasting to remove all laitance and create a suitable anchor profile
 - f. Mortar lining shall be dry during epoxy lining application.

3.5 COATING AND LINING HOLDBACK

- A. All coating and lining holdback areas shall be prepared as specified for the pipeline coating and protected from corrosion during storage and installation with a specified holdback coating system.
- B. Internal holdback for cement mortar lined pipe shall be left unprepared and unprimed.
- C. Internal holdbacks for dielectrically lined pipe shall be left bare and prepared and lined in the field as specified for field lining of joints after joint assembly.
- D. External holdbacks shall be as listed below with all dimensions based on end of bell or spigot. Pipe manufacturer may adjust holdback limits as required for special joint assemblies, and with consideration for the joint coating provided and joint welding requirements. All dimensions from end of pipe.

Tape wrap coating	
Push-on joint, spigot	1-inch, minimum after centerline of gasket.
Push-on, bell	Flush with bell end
Welded, spigot	1 inches, minimum
Welded, Bell	Stab Depth + 2-inches, minimum

Epoxy coating	
Push-on joint, spigot	1-inch after centerline of gasket
Push-on, bell	Flush with bell end
Welded, spigot	3 inches, minimum
Welded, Bell	Stab Depth + 2-inches, minimum
Extruded polyolefin	
Welded joints, spigot	3-inch Minimum
Welded joints, Bell	Stab Depth + 2-inches, Minimum
Push-on joints	Not applied to bell or spigot

- E. Coating holdbacks shall be straight and cut through the full thickness of the coating.
- F. Cutbacks shall be completed in a manner that permits field coating of joints in accordance with the manufacturer's recommendations and as specified herein.

3.6 FIELD COATING JOINTS

- A. General:
 - 1. Joint bonds shall be installed before application of joint coating as specified in Section 26 42 14, CORROSION MONITORING.
 - 2. Joint bonds shall be low profile bonds and all gaps and crevices around the bonds shall be filled with filler mastic.
 - 3. Filler mastic shall be placed under copper strap bonds and extended ½ inch minimum beyond edges of bond to allow for sealing with heat shrink sleeve.
 - 4. Contractor to electrically test completed joint coating for holidays with high voltage spark tester at Engineer's direction or if damage to the joint coating occurs.
- B. Field Surface Preparation:
 - 1. Pipe joints with hold back corrosion protection:
 - a. Perform salt contamination removal as specified under Surface Preparation.
 - b. Field prepare joint in accordance with SSPC-SP1, solvent cleaning, and SP3, Power tool cleaning, to remove all dirt, mud, oil, and grease prior to application of heat shrink sleeve.
 - c. Any visible rusting areas shall be spot prepared in accordance with SP-11, power tool to bare metal.
 - 2. Pipe joints without hold back corrosion protection:
 - a. Perform salt contamination removal as specified under Surface Preparation.
 - b. Abrasively blast joint in field in accordance with SSPC-SP5, white metal blast.
 - c. Sweep blast epoxy coating for 2-inches for 80-grit sandpaper equivalent profile for coating adhesion.
 - 3. All loose or damage coating shall be removed and repaired per specified coating repair procedures.

- C. Weld After Backfill' Joint Requirements:
1. Post-welded or 'Weld after Backfill' joints are defined as welded pipe joints that have been coated and backfilled prior to completing interior welds.
 2. Post welded joints shall be coated and protected as follows:
 - a. Joint coating shall be heat shrink joint sleeves only with a minimum coating thickness over the weld heat affected zone of not less than 120 mils before welding. Tape wrapped joints or heat resistant tape will not be acceptable.
 - b. Manufacturer's recommendations for heat shrink sleeves selection and application and this specification shall govern WAB joints. If a conflict occurs, the more stringent requirement shall apply.
 - c. Hold back primer shall be suitable for post weld conditions as specified this section and shall not exhibit any binder breakdown in the heat affected zone that causes loss of joint coating adhesion to the holdback primer.
 - d. Filler mastic materials shall be high temperature material with 500 degree F melting point.
 - e. Joints shall be fully buried prior to welding, with not less than 12-inch soil cover or flowable fill material on all sides. Sand or flowable fill backfill is preferred for weld after backfill joints. Crush rock or angular gravel backfill can be detrimental to the heat shrink sleeve when using WAB procedures.
 - f. Heat shrink sleeves after WAB shall exhibit no holidays, burn through of coating, creasing, carbonization of the sleeve adhesive, or disbondment of the sleeve or holdback primer.
 3. Welding of the joints shall be in conformance with Section 33 11 11, Steel Pipe, and as modified herein:
 - a. All welding shall be with two or more weld passes as required to meet the specified AWS qualified welding procedures and maximum coating temperature limitations. 'Weld after Backfill' procedures on wall thicknesses of 1/4 inch or less must be approved by the Engineer based on field testing demonstrating the welding procedures can comply with the requirements of this specification.
 - b. Welding speed, amperage, and voltage shall be as required to maintain a maximum heat input of 23,000 joules or a maximum surface temperature at the coating/steel interface of 750 degrees F, whichever is least.
 - c. Maximum weld temperature and duration shall not result in carbonization of the joint coating adhesive. Carbonization is defined as the loss of volatile organic compounds that result in loss of tackiness, adhesion to the steel, and corrosion protection properties.
 - d. Finished joint coating shall not have any visual creases or folds in the joint coating backing material that extends through both the inner protective layer and outer joint sleeve.
 4. If Contractor elects to post-weld any joints, Contractor shall demonstrate that the joint welding procedures will not significantly damage the coating by fully excavating the first two joints for evaluation of the joint coating condition. Engineer will randomly select up to three additional post-welded joints for excavation by Contractor for evaluation of joint coating condition. Joint coating will be destructively evaluated by the Engineer. Contractor will remove and replace joint heat shrink sleeve upon completion of the evaluation.
 5. If any excavated post welded joint exhibits any heat related damage as defined herein, Contractor shall modify and test a new post welding procedure prior to

completing any additional post-welded joints. Contractor shall demonstrate that the revised joint welding procedure will not significantly damage the coating by repeating the weld after backfill evaluation requirements defined this Section, including excavation of the three additional randomly selected joints for destructive evaluation.

D. Heat Shrink Sleeve Joint Coating:

1. Store, handle, and apply field heat shrink sleeve coatings in accordance with AWWA C216 and these specifications.
2. Store sleeves in shipping box until use is required. Keep dry and sheltered from exposure to direct sunlight. Store off the ground or concrete floors and maintain at a temperature between 60 and 100 degrees as recommended by the sleeve manufacturer.
3. Joint shall be prepared as specified in Pipe Joint Surface Preparation.
4. Preheat pipe uniformly as recommended by the sleeve manufacturer. Monitor pipe temperature using a surface temperature gauge, infrared thermometer, or color changing crayons. Protect preheated pipe from rain, snow, frost, or moisture with tenting or shields and do not permit the joint to cool.
5. Apply filler material as specified in Field Applied Coating Systems.
6. Apply heat shrink sleeve when sleeve has a minimum temperature of 60 degrees and while maintaining the pipe temperature above the preheat temperature specified. Apply sleeve in accordance with the manufacturer's instructions and center the sleeve over the joint to provide a minimum 2-inch overlap onto the existing pipe coating.
7. Acceptable joint sleeve installations shall meet the following requirements:
 - a. Shall be fully bonded to the pipe and existing coating surface without tenting or voids.
 - b. Mastic beading shall be visible along the full circumference of the sleeve.
 - c. There shall be no wrinkling or excessive burns on the sleeves.
8. Sleeves that do not meet these requirements shall be removed and the joint recoated as directed by the Engineer. Minor repairs may be repaired using heat applied patch material specified for minor coating repairs.
9. Allow the sleeve to cool before backfilling. Water quenching will be allowed if permitted by the sleeve manufacturer.
10. Heat shrink joint coatings which have become wrinkled or disbonded because of prolonged exposure to UV light or thermal cycling shall be removed and replaced.
11. Double coating of defective or damaged heat shrink coatings will not be permitted. Any double coated heat shrink sleeves shall be immediately rejected and Contractor shall remove the existing coating and recoat the joint.

E. Cement Mortar Overcoat Coating:

1. Joints of cement mortar coated pipe shall be cement mortar coated in accordance with AWWA C205.
2. Polyethylene Foam Joint Diapers:
 - a. Cut into strips wide enough to match uncoated field joint area.
 - b. Slit to thickness of 1/4 inch that will expose a hollow or open cell surface on one side.
 - c. Foam liner shall be attached to fabric backing with open or hollow cells facing towards pipe.

- d. Foam strip shall cover full interior circumference of grout band with sufficient length to permit 8-inch overlap of foam at or near top of joint.
 - e. Splices to provide continuity of material will be permitted.
 - f. Protect polyethylene foam material from direct sunlight.
3. Field repair cement mortar coating in accordance with AWWA C205.

3.7 FIELD APPLIED INTERIOR JOINT LINING

- A. Mortar Lining:
- 1. After backfilling pipe, interior joint recess shall be filled with grout.
 - 2. The grout shall be tightly packed into the joint recess and troweled flush with the interior surface. Excess material shall be removed from pipe.
 - 3. At no point shall there be an indentation or projection of the mortar exceeding 1/16-inch.
 - 4. On pipe smaller than 24-inches in diameter, bell shall be daubed with grout before the spigot is inserted into the bell. The joint shall be completed and excess mortar on the inside of the joint shall be swabbed.

3.8 REPAIR OF COATING AND LININGS

- A. General:
- 1. All areas where holidays are detected or coating is visually damaged, such as blisters, tears, rips, bubbles, wrinkles, cuts, or other defects, shall be repaired. Areas where no holidays are detected, but are visually damaged shall also be repaired.
 - 2. Maximum defects allowable shall be as specified herein for the coating system.
- B. Tape Wrap Coating Repairs:
- 1. General:
 - a. No more than five repairs per joint of pipe will be permitted with tape wrap coating, excluding adhesion test damage. The coating on any pipe with more than five coating repairs or with more than two areas of coating damage greater than five square feet will be rejected.
 - b. Pipes exceeding the maximum number or size of coating defects shall be stripped, reblasted, and recoated.
 - c. Pipe arriving in the field with defects or repairs exceeding the maximum number or size of coating defects will be returned to the shop for recoating at the Contractor's expense.
 - d. The number of layers and total thickness of the tape repair coating shall be the same as the shop-applied coating; unless heat applied coating materials is used.
 - e. Wipe the area to be repaired with solvent for a minimum distance of 4 inches outside the damaged area.
 - 2. Defect Size:
 - a. Minor repairs - repairs that are less than 8 inches in the greatest dimension, measured after cutout of damaged tape layers. Damage to the inner tape layer will be considered minor only if repairs are made using heat applied patch materials.

- b. Major repairs - repairs that exceed 8-inches in the greatest dimension or where damage to the inner tape layer has occurred and hand applied tape repairs will be used.
- 3. Minor Repairs:
 - a. Complete minor repairs using a heat applied coating patch material.
 - b. Cut patch material to overlap onto the undamaged coating a minimum of 2 inches on all sides with 1-inch radius on each corner of the patch.
 - c. Carefully remove damaged layers by cutting the coating with a sharp knife without cutting or damaging the inner wrap.
 - d. Cut middle and outer layers in stepped fashion to expose 1-inch or more of the underlying tape layer for the circumference of the repair.
- 4. Major Repairs (Over 24-inches Diameter):
 - a. Cigarette wrap coating repairs shall be with heat shrink sleeves as specified for joints.
 - b. Carefully remove damaged layers by cutting the coating with a sharp knife without cutting or damaging the inner wrap.
 - c. Holiday test the inner wrap and if a holiday is detected cut outer layers back to fully exposed the holiday(s) and retest for holidays.
 - d. Cut middle and outer layers in stepped fashion to expose 1-inch or more of the underlying tape layer for the circumference of the repair.
 - e. Width of sleeve shall be the width of the damaged area plus 4-inch overlap. Multiple sleeves may be used for larger repairs, but must be overlapped a minimum of 2 inches.
- 5. Major Repairs (24-inch Diameter or Less)
 - a. Cigarette wrap repairs on pipe less than 24-inches with either hand applied tape wrap or heat shrink sleeves as specified at the Contractor's option.
 - b. Carefully remove damaged layers by cutting the coating with a sharp knife without cutting or damaging the inner wrap.
 - c. Holiday test the inner wrap and if a holiday is detected apply one extra layer of repair tape.
 - d. Clean surfaces by solvent wiping and applying primer over the inner tape layer for a minimum of 6-inches onto the outer wrap in all directions.
 - e. Apply first layer of repair coating, over lapping 1-inch or more onto undamaged coating in all directions. On larger areas, lap the repair tape within a minimum of 1-inch overlap, offsetting the overlap from the previous layer overlap, until the area is properly covered.
 - f. Repeat for each tape layer damaged with each succeeding layer applied at 90 degrees to the preceding layers and overlapping onto the undamaged coating a minimum of 2-inches.
 - g. Apply the last tape layer, use the cigarette wrap method for the full pipeline circumference covering all previous repair layers and overlapping a minimum of 2-inches onto undamaged coating. The ends of the cigarette wrap shall be pointed downward.

C. Epoxy Coating or Lining Repairs

1. General

- a. Complete coating or lining repairs in accordance with the coating manufacturers written instructions and these specifications, whichever is stricter.

2. Defect Size:
 - a. Minor repairs - repairs that are less than 8-inches in the greatest dimension.
 - b. Major repairs - repairs that exceed 8-inches in the greatest dimension.
3. Maximum Quantity of Defects Allowed:
 - a. Coating or lining repairs on any joint of pipe shall not exceed 1.5 per 100 square feet of surface area.
 - (1) Two or more minor repairs within a 8-inches diameter circle will be considered a single repair.
 - (2) Repairs for adhesion testing will not be included in the total number of repairs.
 - b. Major repairs shall not exceed three per pipe joint and the combined area shall not be greater than 30 percent of the pipe.
 - c. Pipes exceeding the maximum number or size of coating defects shall be stripped of coating, reblasted, and recoated.
 - d. Pipe arriving in the field with defects or repairs exceeding the maximum number or size of coating defects will be returned to the shop for recoating at the contractor's expense.
4. Minor Repairs:
 - a. Minor repairs
 - (1) Surface Preparation: Clean and feather the defect by power tool sanding with 80 grit or coarser sandpaper to roughen the existing coat and feather the edges of the defect for a minimum of 2-inches around the defect.
 - (2) Shop repair Materials:
 - (a) Single use coating kits to match the pipe coating.
 - (b) Two component, fast cure epoxy coating, in controlled mix ratio packaging.
 - a) Protal 7125, North American Denso Inc, or equal
 - b) Or equal.
 - (c) Coating Manufacturer's coating repair products are subject to Engineer approval.
 - (3) Field Repair Materials:
 - (a) Heat applied coating materials; CRP Patch, Canusa; PERP Patch, Tyco Adhesives, or approved equal.
 - (b) Two component, fast cure epoxy coating, in controlled mix ratio packaging.
 - a) Protal 7125, North American Denso, Inc,
 - b) Or equal.
 - (c) Single use coating kits to match pipe coating.
 - (d) Coating Manufacturer's coating repair products are subject to Engineer approval.
 - (4) Clean and feather the defect by power tool sanding with 80 grit or coarser sandpaper to roughen the existing coating and feather defect edges minimum of 2-inches.
 - (5) Apply a single coat of the specified patch coating material at the specified coating thickness.
 - (6) Repair coating adhesion shall be 50 percent of the specified coating adhesion.
5. Major Repairs:

- a. Major repairs:
 - (1) Surface Preparation:
 - (a) The metal surface and surrounding coating shall be abrasively blasted in accordance with SSPC-SP10, near white metal, or to equal in cleanliness and profile as the original surface preparation.
 - (b) Existing coating shall be feathered and roughened to the equivalent of 40 grit sandpaper.
 - (2) Shop Repair Materials:
 - (a) Same material as the pipeline coating or lining and shall be applied by using plural component spray equipment.
 - (3) Field Repair Materials:
 - (a) Same material as the pipeline coating or lining and shall be applied by using plural component spray equipment.
 - (b) Heat shrink sleeves as specified for pipeline joints.
 - b. One coat of the specified original coating material shall be applied over the repaired surface at the specified thickness.
 - c. Repair adhesion shall be equal to the specified coating adhesion.
- D. Cement Mortar Coating
- 1. Cement mortar coating that is cracked or disbonded shall be repaired in accordance with AWWA C205, except for mortar overcoat on tape wrapped steel.
 - 2. Disbonded mortar coating shall be removed and patched.
 - 3. Mortar coating with disbondment greater than 25 percent of the pipe surface shall be rejected and recoated.
 - 4. Cracks in mortar coating shall be repaired in accordance with AWWA C205.

3.9 QUALITY CONTROL TESTING AND INSPECTION

- A. General
 - 1. Applicator shall inspect and test the coating system in accordance with referenced standards and these specifications, whichever is more stringent.
 - 2. Quality control testing as specified in AWWA standards are minimum industry standards and it is the intent of this specification to provide a higher level of quality control for the objective of achieving maximum coating performance. If any conflict between this specification and referenced standards occurs, the more stringent requirement shall apply and any interpretation of this requirement or results shall be with the objective of achieving maximum coating performance.
 - 3. The frequency of the testing shall be determined by the applicator, but shall not be less than the requirements of this specification.
- B. Soluble Salt Contamination (SSC) Testing
 - 1. Residual soluble salt contamination (SSC) shall be verified using an Elcometer Model E130-TC Salt Contamination Meter before and after surface preparation.
 - 2. Testing after blasting is not required if the preblast test passes the maximum soluble salt contamination criteria.
 - 3. Maximum soluble salt contamination levels shall be:
 - a. 2.0 $\mu\text{g}/\text{cm}^2$ – Immersion or buried
 - b. 5.0 $\mu\text{g}/\text{cm}^2$ – non-immersion

4. Compliance with SSC limits shall be based on the average of three tests at three locations, which can be on multiple pipes or components at the Engineer's discretion.
- C. Surface Profile Testing
1. Surface profile of abrasive blasted surfaces to be tested with "Press-O-Film" tester tape or equivalent in accordance with NACE RP287.
 2. Tester tape shall be suitable for the intended profile height.
 3. Profile shall be measured to a minimum tolerance of 0.1 mils, maximum.
 4. Electronic surface profilometer shall be used, where deemed necessary, to verify tester tape measurements.
- D. Adhesion Testing
1. General
 - a. Adhesion testing shall be conducted at the shop prior to shipment. Pipe shipped without adhesion testing will be field-tested. Pipe rejected in the field will be returned to the shop for repair at the sole expense of the Contractor.
 - b. Coating adhesion testing shall be conducted on each pipe lot coated. The quantity of coating adhesion tests shall be the greater of the following:
 - (1) Two pipes will be tested for the first 3,000 square feet of coating application plus on additional pipe for each. increment of 2,000 square feet of coating application in excess of the first 3,000 square feet
 - (2) Not less than 33 percent of each pipe produced within a lot.
 - c. A pipe lot is defined as the quantity of pipe that is coated by a single crew within a 12 hour or less work shift.
 - d. The pipe coating applicator shall repair all coating damage from shop adhesion testing. Contractor shall be responsible for coating repairs for all field adhesion testing.
 - e. Adhesion tests will be performed not less than 24 hours after coating application. Tests conducted prior to 24-hours will be acceptable only if the test meets or exceeds the adhesion criteria specified and the test was requested by the pipe fabricator.
 - f. Pipe will be randomly selected for adhesion testing.
 - g. Owner or the Owner's Representative has the right to conduct additional adhesion testing as deemed necessary to assure the pipe meets or exceeds the requirements of this specification at any time and location.
 - h. Prior to beginning any QA/QC testing, the pipe fabricator, coating manufacturer, and Engineer shall review dolly attachment procedures, adhesion test procedures, and data recording requirements for the project and ensure that test personnel are qualified and capable of performing the testing in accordance with required test standards and these specifications.
 2. Rejection of Pipeline Coating or Lining
 - a. Each pipe that fails the adhesion criteria, as defined this section, shall be rejected.
 - b. If any pipe within a lot that fails to meet the adhesion criteria specified for the coating type, the pipe coating will be rejected and all pipes within the lot will be classified as rejected. Each remaining pipe within the rejected pipe lot will then be individually tested and rejected on a pipe-by-pipe basis in

- conformance with the test procedures and criteria specific to the coating type.
- c. All rejected pipe shall have the coating fully removed from the pipe and the pipe abrasive blasted and recoated.
3. Tape Coating Adhesion Testing:
- a. Adhesion Acceptance Criteria:
 - (1) Inner tape coating shall have an adhesion to substrate of 20 pounds per inch width, minimum, for steel pipe when tape is pulled in a continuous manner at an angle of 180 degrees to the pipe surface.
 - (2) Inner tape coating shall have an adhesion to substrate of 15 pounds per inch width, minimum, for ductile iron pipe when tape is pulled in a continuous manner at an angle of 180 degrees to the pipe surface.
 - (3) extruded polyolefin coating shall have an adhesion to substrate of 30 pounds per inch width, minimum, when coating is pulled in a continuous manner at an angle of 180 degrees to the pipe surface. Adhesion testing for extruded polyolefin shall be performed as specified for tape wrap coating.
 - b. Test Procedures
 - (1) Adhesion testing shall be conducted prior to application of the cement mortar overcoat, where applicable. Pipe that has been mortar coated prior to adhesion testing shall have the mortar coating removed by the Contractor as directed by the Engineer and of sufficient dimensional area to permit the adhesion test to be conducted.
 - (2) Adhesion tests shall be conducted at temperatures above 60 degrees and less than 75 degrees.
 - (3) Pulling tension shall be continuous, without stopping, and monitored throughout the length of the pull, which shall be not less than 12-inches in length.
 - (4) Adhesion test shall be prepared by making two parallel cuts through the coating, 1-inch apart, of sufficient length for the test pull. Peel the coating back at one end and attach the tension scale to the coating with a suitable clamp. Mark the coating at one (1) inch increments from 0 to 12-inches.
 - (5) The pull tension shall be recorded for each inch of pull. The two highest and two lowest readings shall be discarded and the remaining values averaged. Pull speed shall be not less than 5 seconds per inch or greater than 10 seconds per inch. If significant elongation of the tape backing occurs, pull speeds may exceed 10 seconds per inch provided the minimum adhesion rating can still be achieved.
 - c. Adhesion Pull Records and Evaluation
 - (1) Failure shall be by cohesive failure of the adhesive only. Delamination failure, defined as separation of the adhesive from the backing material, will result in rejection of the tape lot.
 - (2) Intermittent skip failures will be counted as zero pounds of adhesion and included in the calculations for average coating adhesion.
 - (3) Adhesive failure, defined as separation of the adhesive from the metal substrate, will be rejected.
 - (4) Pipe that fails the test by delamination will be retested on two other pipes within the same lot of coated pipe. Failure of any two pipes within

the lot will result in rejection of all pipes coated with the rejected tape lot.

4. Plural Component Epoxy Adhesion Testing:
 - a. Adhesion testing shall be performed in accordance with this specification section. Adhesion testing procedures and evaluations per AWWA C210 or C222 are specifically excluded under this specification.
 - b. Test Procedures
 - (1) Coating adhesion testing shall be with self-aligning pneumatic pull off equipment, such as the Delfesko Positest AT-A, and test procedures in accordance with ASTM D4541, except as modified in this section.
 - (a) All adhesion tests shall be performed at an applied load rate of 100 psi per second, plus or minus 10 psi. Automatic adhesion test equipment shall be used.
 - (b) Tests shall be performed to coating or glue failure or maximum test load, whichever is greater.
 - (c) Adhesion tests shall be based on the ASTM D4541 using standard 20 mm dollies.
 - (d) Adhesion testing shall be based on three tests. All three tests shall be conducted by the same person, test equipment, and test procedure, and must be completed within a 30 minute period.
 - (e) All adhesion tests shall be conducted within an area not to exceed 6-inches by 6-inches.
 - (f) All coatings with more than 10 percent elongation or 25 mils thick shall be scored around dolly to metal substrate using manual methods and tools, normal to the pipe surface, and in a manner that does not stress or over heat the coating.
 - (g)
 - (h) All adhesion tests shall be performed to coating or glue failure or test termination, whichever comes first.
 - (2) Dollies for adhesion testing shall attached to the coating surface using an two part epoxy or cyanoacrylate glue and allowed to cure for a minimum of 12 hours before testing or until full cure, whichever is greater. Glue type used shall be determined by the pipe fabricator and coating manufacturer for the pipe diameter, temperatures, and environmental conditions.
 - (3) Adhesion testing shall be performed at temperatures between 55 and 90 degrees F or at temperatures as recommended by the coating manufacturer. Testing up to 115 degrees F or below 55 degrees will be permitted if tests can demonstrate no statistically detectable effect on test results and with coating manufacturer and Engineer approval.
 - c. Epoxy Coating and Lining Adhesion Criteria
 - (1) Coating is acceptable if first dolly pull test exceeds 1,750 psi, minimum.
 - (2) If first dolly pull is less than 1,750 psi, two additional tests shall be performed with acceptance based on "Best of Three" evaluation method as defined herein.
 - d. Pipe Lot Performance Criteria:
 - (1) Each lot of coated pipe shall be evaluated for general coating application based on a median value for all coating or lining adhesion tests performed on a lot of pipe, which shall be greater than 2,000 psi.

- (2) Any pipe lot failing the Pipe Lot Performance Criteria shall be classified as rejected until 100 percent of the pipe within the pipe lot has been tested for adhesion. Each pipe that fails the coating adhesion criteria shall be rejected.
- e. Adhesion Test Evaluation and Records
 - (1) The “Best of three” evaluation method shall be defined as two of three test values less than the Acceptance Criteria, which shall result in rejection of the pipe coating.
 - (2) All adhesion tests shall be considered as valid and suitable for acceptance or rejection of the coating, except where retesting is allowed.
 - (3) Adhesion test failure shall be by adhesive or substrate and cohesive failure as defined below:
 - (a) Adhesive or substrate failure is defined as a percentage of separation of the coating from the steel substrate or between distinct coating layers.
 - (b) Cohesive failure is defined as a percentage of failure within the coating, resulting in coating remaining both on the steel substrate and test dolly.
 - (4) Retesting of coating adhesion tests will be allowed when any test is glue failure at 25 percent or more of dolly surface area and the test value is less than the Acceptance Criteria or the Minimum Criteria.
 - (5) All coating adhesion retesting shall be within the same 6-inch by 6-inch test area as the original adhesion testing.
 - (6) Disputed adhesion tests shall be retested as defined for adhesion retesting. Dolly attachment and adhesion retesting shall be witnessed by the Owner’s representative.
 - (7) Adhesion tests will be conducted on pipe coating and lining independently and will be accepted or rejected independently.
 - (8) Records of all adhesion tests shall be maintained in an electronic spreadsheet that includes the following information:
 - (a) Pipe identification,
 - (b) Pipe coating date,
 - (c) Adhesion test date,
 - (d) Surface tested (interior or exterior),
 - (e) Surface temperature at time of test,
 - (f) Coating thickness,
 - (g) tensile force applied,
 - (h) Applied load rate per second,
 - (i) Mode of failure, and
 - (j) Percentage of failure types, previously defined, relative to dolly surface area,
 - (k) Dolly size and attachment glue used.
 - (l) If different coatings are tested, the records shall include coating manufacturer and product number.
- f. Adhesion Test Repairs
 - (1) Fabricator or contractor to complete adhesion repairs as specified this section.
 - (2) Repair patches on epoxy coating shall be randomly selected for adhesion testing in a manner as described herein and at the discretion of the

coating inspector conducting the adhesion tests. Adhesion of repairs shall be as specified for the type of repair.

E. Holiday Testing

1. Holiday test the inner layer of tape wrap coatings after application and prior to subsequent tape layer in accordance with AWWA C214 and NACE RP-0274.
2. Holiday test extruded polyolefin coating after application in accordance with AWWA C215 and NACE Standard RP-0274, whichever is more stringent.
3. Holiday tests on epoxy coatings or linings over 15 mils DFT shall be conducted on the completed coating or lining after cure or 24-hours, whichever is less, using a high voltage spark test in accordance with NACE SP0274 and these specifications.
4. Holiday testing on epoxy coatings or linings less than 15 mils DFT shall be high voltage spark tested in accordance with NACE SP0188, except as modified herein.
5. High voltage setting shall be the average measured coating thickness in mils times 125 volts, minimum.
6. Wet sponge or low voltage holiday testing will not be permitted.

F. Dry Film Thickness Testing

1. Coatings shall be tested for dry film thickness using a properly calibrated magnetic pull off, eddy current, or ultrasonic equipment.
2. Coating thickness measurements shall be conducted as necessary and without limitation. Testing conformance to the requirements of SSPC PA-2 is specifically excluded from this specification.

G. Salt Contamination Testing

1. Engineer shall perform salt contamination testing with an Elcometer Model E130-TC Salt Contamination meter as defined under Surface Preparation.
2. Quantity of tests performed shall be determined the Engineer based on prevailing field conditions.
3. Objective is to assess and remove wind borne salts contamination on surfaces to be coated. Because wind and environmental conditions can change the frequency and location of testing may need to be varied.
4. At a minimum, tests should be performed daily before and after pressure washing of surfaces to be coated.
5. Surfaces identified to be excessively contaminated shall be cleaned by the Contractor to meet the acceptance criteria specified under Surface Preparation.

3.10 HANDLING, TRANSPORTATION, AND STORAGE

- A. Pipe shall be handled in such a manner as to protect the pipe and coating from damage.
- B. Coated pipe shall not be shipped or installed until coating has developed full adhesion and cure.
- C. During coating application, storage, loading, transportation, unloading, laying and installation, every precaution shall be taken to protect and prevent damage to pipe, lining, and coating. Forklift equipment shall have all bearing surfaces padded with suitable padding material. Lift pipe with web slings a minimum of 12-inch wide and of

a type that will not damage the coating. Metal chains, cable, tongs, forklifts or other equipment likely to damage the coating will not be permitted. Dragging or skidding of pipe on grade or in the trench will not be permitted.

- D. Provide transportation vehicles with padded bolsters between each layer of pipe and heavy padding under load ties. Bolsters shall be curved to fit the outside of the pipe and 12 inches wide, minimum. All pipe contact locations shall be heavily padded with carpet and strips of the outer tape wrap material (adhesive side against the carpet) during shipment to the project site and from the storage yard to the point of installation.
- E. Pipe shall not be stored on rocks, gravel, or other hard materials that might damage the coating. Provide padded 12-inch wide skids and chucks, sand bags, select loamy or sand berms, or suspended from cutback ends, where possible, to minimize coating damage. Pipe shall not be laid on asphalt without suitable padding at all contact points.
- F. Pipe shall be inspected by the Contractor at the project site for damage. Any damage to the pipe, lining, or coating shall be repaired as directed if, in the opinion of the Engineer, a satisfactory repair can be made; otherwise, the damaged section shall be replaced at the sole expense to the Contractor.
- G. No metal tools or heavy objects shall be permitted to come into contact unnecessarily with the finished coating. Workmen shall not be permitted to walk on the coating except when necessary and approved by the Engineer. When permitted, shoes with rubber or composition soles and heels or other suitable footwear that will not damage coating shall be used.
- H. Long-term Exposure:
 - 1. Pipe shall either be provided with UV inhibitor for lengthy of above grade exposure or covered to prevent UV degradation of outer wrap.
 - 2. Amount of UV stabilizers required will depend on the project location, laying schedule, anticipated length of exposure, and type of coating.
 - 3. Manufacturer shall be consulted for recommended UV inhibitors requirements.
 - 4. Protective covering can be colored plastic sheeting, canvas, or other UV blocking material. Clear plastic sheets are not acceptable.
 - 5. Areas of coating that display UV degradation shall be removed and repaired at sole cost of the Contractor.

END OF SECTION

DIVISION 11
EQUIPMENT

SECTION 11 00 00
EQUIPMENT GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. The Contractor shall provide all tools, supplies, materials, equipment, and all labor necessary for the furnishing, construction, installation, testing, and operation of all equipment and appurtenant Work, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section shall apply to all equipment specified and where referred to, except where otherwise indicated.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Commercial Standards: All equipment, products, and their installation shall be in accordance with the following standards, as applicable, and as indicated in each Section of these Specifications:

American Gear Manufacturers Association (AGMA).

American Society for Testing and Materials (ASTM).

American Public Health Association (APHA).

American National Standards Institute (ANSI).

American Society of Mechanical Engineers (ASME).

American Water Works Association (AWWA).

American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).

Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA).

Mechanical Power Transmission Association (MPTA).

American Welding Society (AWS).

National Fire Protection Association (NFPA).

Federal Specifications (FS).

National Electrical Manufacturers Association (NEMA).

Manufacturer's published recommendations and specifications.

General Industry Safety Orders (OSHA).

Rubber Manufacturers Association (RMA).

B. The following standards have been referred to in this Section of the Specifications:

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy, and Other Special Alloys
ANSI B46.1	Surface Texture
ANSI S12.6	Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors
ANSI/ASME B1.20.1	General Purpose Pipe Threads (Inch)
ANSI/ASME B31.1	Power Piping
ANSI/AWWA D100	Welded Steel Tanks for Water Storage
AWWA C206	Field Welding of Steel Water Pipe
ASTM A 48	Specification for Gray Iron Castings
ASTM A 108	Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality

1.3 CONTRACTOR SUBMITTALS

- A. Shop Drawings: The Contractor shall furnish complete shop drawings for all equipment specified in the various Sections, together with all piping, valves, and controls for review by the Engineer in accordance with Spanish Fork City requirements.
- B. Tools: The Contractor shall supply one complete set of special wrenches and other special tools necessary for the assembly, adjustment, and dismantling of the equipment. All tools shall be of best quality hardened steel forgings with bright, finish wrench heads shall have work faces dressed to fit nuts. All tools shall be suitable for professional work and manufactured by a recognized supplier of professional tools such as Snap On, Crescent, Stanley, or equal. The set of tools shall be neatly mounted in a labeled tool box of suitable design provided with a hinged cover. For each microprocessor-based equipment system requiring a handheld device for configuration, furnish one handheld device.
- C. Spare Parts: The Contractor shall obtain and submit from the manufacturer a list of suggested spare parts for each piece of equipment. After approval, Contractor shall furnish such spare parts suitably packaged, identified with the equipment number, and labeled. Contractor shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment. All spare parts are intended for use by the OWNER only, after expiration of the guaranty period.

- D. Torsional Analysis: The Contractor shall submit to the Engineer a torsional and lateral vibration analysis of the following equipment, in accordance with Spanish Fork City requirements. The analysis has to be performed by a specialist experienced in this type of Work and approved by the Engineer.
1. All engine drives.
 2. All blowers and compressors with drives of 100 horsepower and over.
 3. All vertical pumps with universal joints and extended shafts.
 4. All other equipment where indicated.
 5. The torsional natural frequency of the drive train must be avoided by plus and minus 25 percent by any exciting frequency of the equipment, throughout the entire operating range.
- E. Vibration Analysis: In the bid price the Contractor shall include at least two site visits of the above mentioned specialist, during construction and testing of the equipment, to analyze and measure the amount of equipment vibration and make his written recommendation for keeping the vibration at a safe limit.
- F. Operation and Maintenance Manuals: Submit in accordance with Spanish Fork City requirements.

1.4 QUALITY ASSURANCE

- A. Inspection, Startup, and Field Adjustment: The Contractor shall demonstrate that all equipment meets the specified performance requirements. Contractor shall provide the services of an experienced, competent, and authorized service representative of the manufacturer of each item of major equipment who shall visit the site to perform the following tasks:
1. Assist the Contractor in the installation of the equipment.
 2. To inspect, check, adjust if necessary and approve the equipment installation.
 3. To start-up and field-test the equipment for proper operation, efficiency, and capacity.
 4. To perform necessary field adjustments during the test period until the equipment installation and operation are satisfactory to the Engineer.
 5. To instruct the Owner's personnel in the operation and maintenance of the equipment. Instruction shall include step-by-step trouble shooting procedures with all necessary test equipment.
- B. Costs: The costs of all inspection, startup, testing, adjustment, and instruction Work performed by said factory-trained representatives shall be borne by the Contractor. The Owner will pay for costs of power and water. When available, the Owner's operating personnel will provide assistance in the field testing.
- C. Public Inspection: It shall be the responsibility of the Contractor to inform the local authorities, such as building and plumbing inspectors, Fire Marshall, OSHA inspectors, and others, to witness all required tests for piping, plumbing, fire protection systems, pressure vessels, and safety systems to obtain all required permits and certificates, and pay all fees.
- D. Tolerances: Tolerances and clearances shall be as shown on the shop drawings and shall be closely adhered to. Machine Work shall in all cases be of high-grade workmanship and finish,

with due consideration to the special nature or function of the parts. Members without milled ends and which are to be framed to other steel parts of the structure may have a variation in the detailed length of not greater than 1/16-inch for members 30 feet or less in length, and not greater than 1/8-inch for members over 30 feet in length.

- E. Machine Finish: The type of finish shall be the most suitable for the application and shall be shown in micro-inches in accordance with ANSI B46.1. The following finishes shall be used:
 - 1. Surface roughness not greater than 63 micro-inches shall be required for all surfaces in sliding contact.
 - 2. Surface roughness not greater than 250 micro-inches shall be required for surfaces in contact where a tight joint is not required.
 - 3. Rough finish not greater than 500 micro-inches shall be required for other machined surfaces.
 - 4. Contact surfaces of shafts and stems which pass through stuffing boxes and contact surfaces of bearings shall be finished to not greater than 32 micro-inches.
- F. Manufacturer's Experience: Unless otherwise directed by the ENGINEER, all equipment furnished shall have a record of at least 5 years of successful, trouble free operation in similar applications, from the same manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. High Noise Level Location: The Contractor shall provide one personal hearing protection station, as indicated herein, at each high noise level location. Said locations are defined as follows:
 - 1. Outdoor Location: Any single equipment item or any group of equipment items that produce noise exceeding OSHA noise level requirements for a 2-hour exposure. Where such equipment is separated by a distance of more than 20 feet, measured between edges of footings, each group of equipment shall be provided with a separate hearing protection station.
 - 2. Indoor Location
 - a. Any single equipment item, or any group of equipment items, located within a single room not normally occupied, that produces noise exceeding OSHA noise level requirements for a 2-hour exposure.
 - b. Any single equipment item, or any group of equipment items, located within a single room normally occupied by workers, that produces noise exceeding OSHA noise level requirements for an 8-hour exposure.
 - 3. Personal Hearing Protection: The Contractor shall supply, in their original unopened packaging, three pairs of high attenuation hearing protectors. The ear protectors shall be capable of meeting the requirements of ANSI S12.6 and shall produce a noise level reduction of 25 dBA at a frequency of 500 Hz. The hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband. The protectors shall be stored in a weatherproof, labeled, steel cabinet, furnished by the Contractor and mounted in an approved location near the noise protection station.

- B. Service Factors: Service factors shall be applied in the selection or design of mechanical power transmission components.
- C. Welding: Unless otherwise indicated, all welding shall conform to the following:
 - 1. Latest revision of ANSI/AWWA D100.
 - 2. Latest revision of AWWA C206.
 - 3. All composite fabricated steel assemblies which are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds to prevent entrance of air or moisture.
- D. All welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.
- E. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. All sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.
- F. Protective Coating: All equipment shall be painted or coated in accordance with Section 09 90 00 – Protective Coatings and Linings, unless otherwise indicated. Nonferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.
- G. Protection of Equipment: All equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage by methods recommended by the manufacturer. All equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weathertight storage facilities prior to installation. For extended storage periods, plastic equipment wrappers should be avoided, to prevent accumulation of condensate in gears and bearings.
- H. Identification of Equipment Items: Each item of equipment shipped shall have a legible identifying mark corresponding to the equipment number indicated for the particular item.
- I. Shop Fabrication: Shop fabrication shall be performed in accordance with the Contract Documents and the Engineer-approved shop drawings.

2.2 FLANGES AND PIPE THREADS

- A. All flanges on equipment and appurtenances provided under this Section shall conform to ANSI B16.1, Class 125; or B16.5, Class 150, unless otherwise indicated. All pipe threads shall be in accordance with ANSI/ASME B1.20.1, and with requirements of Section 40 05 00 - Piping, General.

2.3 COUPLINGS

- A. Flexible couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to cushion shock loads. Where required for vertical shafts, 3-piece spacer couplings or universal type couplings for extended shafts shall be installed.
- B. The CONTRACTOR shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.

2.4 INSULATING CONNECTIONS

- A. General: Insulating bushings, unions, couplings, or flanges, as appropriate, shall be used in accordance with the requirements of the Section 40 05 00 - Piping, General.

2.5 GASKETS AND PACKINGS

- A. Gaskets shall be in accordance with the requirements of Section 40 05 00 - Piping, General.
- B. Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron-type "V" packing shall be Garlock No. 432, John Crane "Everseal," or equal.
- C. Packing around rotating shafts (other than valve stems) shall be "O"-rings, stuffing boxes, or mechanical seals, as recommended by the manufacturer and approved by the ENGINEER, in accordance with Section 43 20 10 - Pumps, General.

2.6 SAFETY REQUIREMENTS

- A. Where Work areas are located within a flammable or toxic gas environment, suitable gas detection, ventilating, and oxygen deficiency equipment shall be provided. Workers shall be equipped with approved breathing apparatus.

PART 3 - EXECUTION

3.1 COUPLINGS

- A. The Contractor shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application; installation shall be per equipment manufacturer's printed recommendations.

3.2 INSULATING CONNECTIONS

- A. All insulating connections shall be installed in accordance with the manufacturer's printed instructions.

END OF SECTION

DIVISION 31
EARTHWORK

**SECTION 31 10 00
SITE PREPARATION**

PART 1 - GENERAL

1.1 SUMMARY

- A. The Contractor shall perform all site preparation indicated and required for construction of the Work, complete and in place, in accordance with the Contract Documents. All site preparation shall conform to the most recent Construction Standards for Spanish Fork City. If any discrepancies exist between the Spanish Fork City Construction Standards and this specification, the Contractor shall adhere to Spanish Fork City requirements.
- B. The Work of this Section includes all those measures required during the Contractor's initial move onto the site to protect existing fences, structures and associated improvements, streets, and utilities downslope of construction areas from damage due to boulders, trees or other objects dislodged during the construction process: clearing, grubbing and stripping; and regrading of areas to receive embankment fill.
- C. The Contractor is required to protect and preserve all things designated to remain. Where Contractor's operation causes damage or injury to trees and plants designated to remain, an arborist or other qualified professional shall be employed by the Contractor, at no additional cost to the Owner, to repair the damage or provide adequate replacement to the Owner's satisfaction where damage is beyond repair.

1.2 SITE INSPECTION

- A. Prior to moving onto the Project site, the Contractor shall inspect the site conditions and review maps of the existing site and off-site pipeline routes and facilities delineating the Owner's property and right-of-way lines.
- B. Contractor shall submit photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site preparation.
- C. The Contractor shall identify and accurately locate utilities and other subsurface structural, electrical, and mechanical conditions. Existing conditions shall be incorporated into the record drawings for the project.

1.3 DEFINITIONS

- A. The following definitions apply to the Work of this Section:
 - 1. Clearing is defined as cutting trees, removing fences and posts, removing curbs and other improvements to prepare the site for grubbing and stripping.
 - 2. Grubbing is defined as the below grade part of clearing to remove roots, small piping, irrigation systems, etc., to prepare the site for stripping.
 - 3. Stripping is defined as removing a surface layer of soil and organic material, sod, topsoil, and other unsuitable material as defined in Section 31 23 00 – Earthwork, to a depth that earthwork can proceed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Locate and clearly flag trees and vegetation to remain or to be relocated.
- D. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 - 1. Owner will arrange to shut off indicated utilities when requested by Contractor.
 - 2. Arrange to shut off indicated utilities with utility companies.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Engineer not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Engineer's written permission.
- C. Excavate for and remove underground utilities indicated to be removed.

3.3 CLEARING, GRUBBING, AND STRIPPING

- A. All construction areas shall be cleared of grass and weeds to at least a depth of six inches and cleared of structures, concrete or masonry debris, trees, logs, upturned stumps, loose boulders, and any other objectionable material of any kind which would interfere with the performance or completion of the Work, create a hazard to safety, or impair the Work's subsequent usefulness or obstruct its operation. Loose boulders within 10 feet of the top of cut lines shall be incorporated in landscaping or removed from the site. Trees and other natural vegetation outside the actual lines of construction shall be protected from damage during construction, as directed by the Engineer.
- B. Within the limits of clearing, the areas below the natural ground surface shall be grubbed to a depth necessary to remove all stumps, roots, buried logs, and all other objectionable material. Debris or waste shall be totally removed if they are found on the site. All objectionable material from the clearing and grubbing process shall be removed from the site and wasted in approved safe locations in compliance with state and federal regulations.

- C. The area to be affected by construction that have not been pre-excavated to the subgrade elevation shall be removed and placed in the designated stockpile areas, and/or incorporated into landscaped areas or other nonstructural embankments.
- D. For all areas that have not been previously disturbed, including staging areas and temporary construction easements, topsoil-salvaging operation shall immediately follow clearing operations. The area shall be stripped of topsoil to a depth of 8 inches. Unsuitable materials, specified in Section 31 23 00, shall not be considered topsoil. The Contractor shall strip to the depth indicated regardless of the material encountered. All stripped topsoil shall be stockpiled within stripped areas in stockpiles not to exceed 15 feet in height. Vegetation shall be ground or chipped to a mulching consistency and mixed with the stripped soil. Stockpiles shall be placed away from high construction traffic areas and shall be fenced and signed to prevent accidental use as fill prior to topsoil replacement.
- E. Upon completion of Work within the construction areas stripped of topsoil, the stored topsoil shall be respread over the disturbed areas. Topsoil shall be spread in about a 6-inch layer. Respread topsoil shall match the existing terrain as much as possible. Interfaces between restored disturbed areas and undisturbed areas shall be chain dragged to eliminate obvious edges. All tracks and equipment marks shall be chain dragged or hand raked away. Replaced topsoil shall be thoroughly watered for dust control upon completion of the respreading operations. Once topsoil replacement has been completed, no vehicles or other motorized equipment shall be allowed to travel on the finished surface.
- F. Unless otherwise indicated, native trees larger than three inches in diameter at the base shall not be removed without the Engineer's approval. The removal of any trees, shrubs, fences, or other improvements outside of rights-of-way, if not necessary for the Contractor's choice of means and methods, shall be arranged with the property owner and be removed and replaced at no increased cost to the Owner.
- G. Except in areas to be excavated, holes and other holes resulting from Work of this section shall be backfilled with suitable material in accordance with Section 31 23 00 – Earthwork.

3.4 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincides with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

3.5 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION

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**SECTION 31 23 00
EARTHWORK**

PART 1 - GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall perform all earthwork indicated and required for construction of the Work, complete and in place, in accordance with the Contract Documents. All earthwork shall conform to the most recent Construction Standards for Spanish Fork City. If any discrepancies exist between the Spanish Fork City Construction Standards and this specification, the Contractor shall adhere to Spanish Fork City requirements.
- B. The Contractor shall perform all earthwork indicated and required for construction of the Work, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

29 CFR 1926	OSHA Safety and Health Regulations for Construction
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM D 422	Method for Particle-Size Analysis of Soils
ASTM D 1556	Test Method for Density of Soil in Place by the Sand-Cone Method
ASTM D 1557	Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³) (2,700 kN-m/m ³)
ASTM D 1633	Test Method for Compressive Strength of Molded Soil-Cement Cylinders
ASTM D 2419	Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 2487	Classification of Soils for Engineering Purposes
ASTM D 2901	Test Method for Cement Content of Freshly Mixed Soil Cement
ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods
ASTM D 4253	Test Methods for Maximum Index Density of Soils using a Vibratory Table

ASTM D4254	Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D 4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4832	Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders
ASTM D 5971	Practice for Sampling Freshly Mixed Controlled Low Strength Material (CLSM)
ASTM D 6023	Test Method for Unit Weight, Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low Strength Material (CLSM)
ASTM D 6024	Test Method for Ball Drop on Controlled Low Strength Material (CLSM) to Determine Suitability for Load Application
ASTM D 6103	Test Method for Flow Consistency of Controlled Low Strength Material (CLSM)

1.3 CONTRACTOR SUBMITTALS

- A. The Contractor's attention is directed to the provisions of Subpart P, 29 CFR 1926 of the OSHA Safety and Health Standards for Construction, which relate to protection of employees in excavations. The Contractor shall submit, for information to the Engineer, the project excavation plan and the name of the Contractor's competent person, prior to commencing any excavation.
- B. Submit samples of all materials proposed to be used in the work in accordance with the requirements in Section 01 33 20 – Submittal Procedures. Sample sizes shall be as determined by the testing laboratory.
- C. Submit dewatering and water removal plan prior to performing any dewatering or water removal.

PART 2 - PRODUCTS

2.1 SUITABLE FILL AND BACKFILL MATERIAL REQUIREMENTS

- A. General: Fill, backfill, and embankment materials shall be suitable material.
- B. Suitable Materials: Suitable material is defined as selected or processed clean, well graded earth material, sands and gravels free of excessive fines, less than 20 percent rock and boulders larger than 4 inches, grass, roots, brush, vegetation, or other deleterious materials.
- C. Fill and backfill materials within 6 inches of any structure or pipe shall be smaller than 1 inch in any dimension.

1. Suitable materials may be obtained from onsite excavations, may be processed onsite materials, or may be imported. If imported materials are required by this Section or to meet the quantity requirements of the Project, provide the imported materials at no additional expense to the Owner, unless a unit price item is included for imported materials in the bidding schedule. Onsite materials shall be stockpiled and segregated prior to use.

2. The following types of suitable materials are defined:

Type A (Granular Backfill): Crushed rock or gravel, and sand well graded and readily compacted, non-plastic, meeting the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing</u>
1-inch	100
No. 40	15 - 60
No. 200	0 - 15

Type B (Crushed Rock): Manufactured angular, crushed rock, non-plastic, meeting the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing</u>
3/8-inch	100
No. 4	30 - 50
No. 200	0 - 5

Type C (Sand Backfill): Sand non-plastic, meeting the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing</u>
3/4-inch	100
No. 4	80 - 100
No. 10	30-50
No. 40	10-30
No. 200	7 - 15

Squeegee is not acceptable as sand backfill.

Type D (Select Backfill): Suitable material that can be readily compacted and meets the requirements of AASHTO M 145 classification A-1-a, non-plastic, well graded with a maximum particle size of 2 inches.

<u>Sieve Size</u>	<u>Percentage Passing</u>
2-inch	100
No. 10	30-50
No. 40	15-30
No. 200	0 - 15

Type E (Pea Gravel Backfill): Crushed rock or gravel with 100 percent passing a 1/2-inch sieve and not more than 10 percent passing a No. 4 sieve.

Type F (Drainrock): Crushed rock or gravel conforming to one of the following gradation requirements, as shown on the Drawings or approved by the Engineer:

Percentage Passing

<u>Sieve Size</u>	<u>3-inch Max.</u>	<u>2-inch Max.</u>	<u>3/4-inch Max.</u>
3-inch	100	-	-
2-inch	90 - 100	100	-
1-1/2 inch	70 - 100	90 - 100	-
3/4 inch	0 - 50	0 - 15	100
1/2-inch	-	-	95 - 100
3/8-inch	0 - 10	0 - 5	70 - 100
No. 4	0 - 25	-	-
No. 8	0 - 5	-	-
No. 200	0 - 3	-	0 - 3

Type G (Type II Aggregate Base): Well-graded, clean, hard, tough, durable, and sound mineral aggregates consisting of crushed stone, or crushed gravel, free of organic matter and contamination from chemical or petroleum products meeting State specification requirements and conforming to the following Table and gradations:

Aggregate Properties			
	Aggregate Class		
	A	B	
Dry Rodded Unit Weight	Not less than 75 lb/ft ³		AASHTO T 19
Liquid Limit/Plastic Index	Non-plastic	PI ≤ 6	AASHTO T 89 AASHTO 90
Aggregate Wear	Not to exceed 50 percent		AASHTO T 96
Gradation	Table 2		AASHTO T 11 AASHTO T 27
CBR with a 10 lb surcharge measured at 0.20 inch penetration	70% Minimum	N/A	AASHTO T 193
Two Fractured Faces	50% Min	N/A	AASHTO T 335

<u>Sieve Size</u>	<u>Percentage Passing</u>
1 ½ -inch	100
1-inch	90 - 100
3/4-inch	70 - 85
1/2-inch	65 - 80
3/8-inch	55 - 75
No. 4	40 - 60
No. 16	25 - 40
No. 200	8 - 13

Type H (Graded Drainrock): Graded drainrock shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting and drying. The material shall be uniformly graded and shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing</u>
1-inch	100
3/4 inch	90 - 100
3/8-inch	40 - 100
No. 4	25 - 40

No. 8	18 - 33
No. 30	5 - 15
No. 50	0 - 7
No. 200	0 - 3

Type I: (Levee Material): Clayey sand to sandy clay obtained from off-site borrow sources or from onsite excavations, processed to the extent required to produce a material with a maximum size of 4 inches, well-graded from coarse to fine, and free from roots, sticks, organic matter, concrete, asphalt and other deleterious material. Levee material shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing</u>
4-inch	100
No. 4	50 - 70
No. 200	30 - 50

Type J (Cement-Treated Backfill): Material which consists of Type F material, or any mixture of Types B, C, G, and H materials which has been cement-treated so that the cement content of the material is not less than 5 percent by weight when tested in accordance with ASTM D 2901. The ultimate compressive strength at 28 days shall be not less than 400 psi when tested in accordance with ASTM D 1633.

Type K (Topsoil): Stockpiled topsoil material which has been obtained at the site by removing soil to a depth as defined in Section 31 10 00 - Site Preparation. Removal of the topsoil shall be done after the area has been stripped of vegetation and debris.

Type M (Aggregate Subbase): Crushed rock aggregate subbase material non-plastic that can be compacted readily by watering and rolling to form a stable base. The sand equivalent value shall not be less than 18 and shall meet one of the following gradation requirements, as shown on the Drawings or approved by the Engineer:

<u>Sieve Size</u>	<u>Percentage Passing</u>	
	<u>3-inch Max.</u>	<u>2-inch Max.</u>
3-inch	100 -	
2-inch	90 - 100	100
1-1/2 inch	-	95 - 100
1-inch	70 - 90	-
No. 4	30 - 65	30 - 65
No. 16	15 - 40	15 - 40
No. 200	2 - 12	2 - 12

Type N (trench plug): Low permeable fill material, a nondispersable clay material having a minimum plasticity index of 10.

Type O (Controlled Low Strength Material (CLSM)): CLSM shall consist of a mixture of portland cement, aggregate, fly ash, water, and approved admixtures conforming to the following requirements:

3. Blended Hydraulic Cement: Comply with ASTM C595, Type IL (10) (MS), grey color.

4. Aggregate: Clean imported sand and gravel or selected material from the excavation, imported material, or a combination thereof as approved by the Engineer. Maximum aggregate size shall be 1 to 3 inches. The soluble sulfate content of aggregate in the mixture shall not exceed 0.3 percent by dry weight.
5. Water: Potable quality.
6. Fly Ash: Class C, ASTM C 618 or approved alternate.
7. The minus 200 sieve fraction shall be nonplastic, as defined by ASTM D 4318. By this standard, a soil is considered nonplastic if either the liquid or plastic limit cannot be determined, or if the plastic limit is equal to or greater than the liquid limit.
8. Proportion the CLSM to be a flowable, nonsegregating, self-consolidating low shrink slurry. The Contractor shall determine the materials and proportions used to meet the requirements of these Specifications.
9. The unconfined compressive strength at 7 days shall be a minimum of 100 psi and a maximum of 300 psi. Contractor shall form a minimum of six test cylinders with proposed materials to confirm design strength and mix design. Four of the cylinders shall be broken at 7 days in conformance with applicable concrete cylinder specifications and results provided to Engineer. The remaining two cylinders shall be broken by Contractor at discretion of Engineer. Initial mix design and cylinder breaks shall be completed at least 21 days prior to use of the material on the jobsite. Final mix approval and use of the material shall not occur prior to confirmation of strength by the cylinder breaks.
10. The temperature of the CLSM discharged into the trench shall be below 90 degrees F.
11. CLSM backfill under concrete structures shall be protected during curing as specified Section 03 30 00 - Cast-in-Place Concrete.
12. CLSM shall be tested in accordance with ASTM D 4832, ASTM D 5971, ASTM D 6023, and ASTM D6103

Type P: (Suitable Trench Backfill): Suitable material that can be readily compacted, with less than 35 percent passing the No. 200 sieve and a plasticity index of 10 or less.

2.2 UNSUITABLE MATERIAL

- A. Unsuitable materials include but are not limited to the materials listed below.
 1. Soils which, when classified under ASTM D 2487 - Classification of Soils for Engineering Purposes, fall in the classifications of Pt, OH, CH, MH, or OL.
 2. Soils which cannot be compacted sufficiently to achieve the density indicated for the intended use.
 3. Materials that contain hazardous or designated waste materials including petroleum hydrocarbons, pesticides, heavy metals, slag, and any material which may be classified as hazardous or toxic according to applicable regulations.
 4. Soils that contain greater concentrations of chloride or sulfate ions, or have a soil resistivity or pH less than the existing onsite soils.
 5. Topsoil, except as allowed below.
- B. All unsuitable excavated material shall be disposed off site.

2.3 USE OF FILL, BACKFILL, AND EMBANKMENT MATERIAL TYPES

- A. Use the types of materials as designated herein for all required fill, backfill, and embankment construction hereunder.
- B. Where these Specifications conflict with the requirements of any local agency having jurisdiction or with the requirements of a pipe material manufacturer, notify the Engineer immediately. In case of conflict between types of pipe embedment backfills, use the agency-specified backfill material if that material provides a greater degree of support to the pipe, as determined by the Engineer. In case of conflict between types of trench or final backfill types, use the agency-specified backfill material if that material provides the greater in-place density after compaction.
- C. Fill and backfill types shall be used in accordance with the following provisions:
 - 1. Embankment fills shall be constructed of Type P material, as defined herein, or any mixture of Type P and Type A through Type F materials.
 - 2. Pipe zone backfill, as defined under "Pipe and Utility Trench Backfill" below, shall consist of the following materials for each pipe material listed below.
 - a. Mortar coated pipe, concrete pipe, and uncoated ductile iron pipe shall be provided with Type A or C material in the pipe zone.
 - b. Coal tar enamel coated pipe, polyethylene encased pipe, tape wrapped pipe, and other nonmortar coated pipe shall be backfilled with Type C material in the pipe zone.
 - c. Plastic pipe and vitrified clay pipe shall be backfilled with Type C material in the pipe zone.
 - d. Where pipelines are installed on grades exceeding 4 percent, and where backfill materials are graded such that there is less than 10 percent passing a No. 4 sieve, trench plugs of Type J or N material shall be provided at maximum intervals of 200 feet unless indicated otherwise.
 - e. Type O material shall be used in the pipe zone where shown on plans, specified, or required by the Engineer for special crossings or other locations, or where otherwise approved.
 - f. Type E material will not be allowed for backfill within the pipe zone.
 - 3. Trench zone backfill for pipelines as defined under "Pipe and Utility Trench Backfill" shall be Type D backfill material.
 - 4. Final backfill material for pipelines under paved areas, as defined under "Pipe and Utility Trench Backfill" shall be Type G backfill material. Final backfill under areas not paved shall be the same material as that used for trench backfill.
 - 5. Trench backfill and final backfill for pipelines under structures shall be Type A or B, except where concrete encasement is required by the Contract Documents.
 - 6. Aggregate base materials under pavements shall be Type G material constructed to the thicknesses indicated. Aggregate subbase shall be Type M material.
 - 7. Backfill around structures shall be Type P material, or Types A through Type F materials, or any mixture thereof, except as shown.
 - 8. Backfill materials beneath structures shall be as follows:
 - a. Drainrock materials under hydraulic structures or other water retaining structures with underdrain systems shall be Type H material.
 - b. Under concrete hydraulic structures or other water retaining structures without underdrain systems, Types F, G or H materials shall be used.

- c. Under structures where groundwater must be removed to allow placement of concrete, Type F material shall be used. Before the Type F material is placed, filter type geotextile fabric shall be placed over the exposed foundation.
 - d. Under all other structures, Type F, G or H material shall be used.
- 9. Backfill used to replace pipeline trench overexcavation shall be a layer of Type F material with a 6-inch top filter layer of Type E material or filter fabric to prevent migration of fines for wet trench conditions or the same material as used for the pipe zone backfill if the trench conditions are not wet.

2.4 PIPELINE MARKING TAPE

- A. **Metallic Tape:** Tape shall be minimum 5.5 mils thick aluminum foil imprinted on one side, encased in high visibility inert polyethylene jacket. Tape shall be a minimum of 6 inches wide. Imprinted lettering shall be 1 inch tall, permanent black, as indicated. Joining clips shall be manufacturer's standard tin or nickel coated. Tape shall be as manufactured by Reef Industries (Terra "D"), Allen (Detectatape), or equal.
- B. **Plastic Tape:** Tape shall be minimum 4-mil thick polyethylene which is impervious to alkalis, acids, and chemicals and solvents which are likely in the soil. Tape shall be a minimum of 6 inches wide and lettering shall be 1-inch tall permanent black on a colored background. Tape shall be manufactured by Reef Industries (Terra Tape), Allen (Markline), or equal.
- C. **Warning Tape:** Warning tape manufactured for marking and identifying underground utilities continuously inscribed with a description of utility, colored as follows:
 - 1. Red; Electric.
 - 2. Yellow; Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water Systems.
 - 5. Green: Sewer Systems.

2.5 MATERIALS TESTING

- A. All soils testing of samples submitted by the Contractor will be done by a testing laboratory of the Owner's choice and at the Owner's expense. At its discretion, the Engineer may request that the Contractor supply samples for testing of any material used in the work.
- B. Particle size analysis of soils and aggregates will be performed using ASTM D 422 - Method for Particle-Size Analysis of Soils.
- C. Determination of sand equivalent value will be performed using ASTM D 2419 - Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
- D. **Unified Soil Classification System:** References in this Section to soil classification types and standards shall have the meanings and definitions indicated in ASTM D 2487. The Contractor shall be bound by all applicable provisions of said ASTM D 2487 in the interpretation of soil classifications.
- E. The testing for chloride, sulfate, resistivity, and pH will be done by a testing laboratory of the Owner's choice and at the Owner's expense.

PART 3 - EXECUTION

3.1 EXCAVATION – GENERAL

- A. General: Except when specifically provided to the contrary, excavation shall include the removal of all materials of whatever nature encountered, including rock and all obstructions of any nature that would interfere with the proper execution and completion of the Work. The removal of said materials shall conform to the lines and grades indicated or ordered. Unless otherwise indicated, the entire construction site shall be stripped of all vegetation and debris, and such material shall be removed from the site prior to performing any excavation or placing any fill. Furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations. Excavations shall be sloped or otherwise supported in a safe manner in accordance with safety requirements of the requirements of OSHA Safety and Health Standards for Construction (29CFR1926).
- B. Maximum Length of Open Trench: The maximum length of open trench in urban and rural areas shall not exceed 500-feet at each pipe installation heading beyond the end of the installed pipeline, or the requirements of the agency with jurisdiction, whichever is lesser.
- C. Construction Delays: In the case of any construction delay in excess of five calendar days, whether Contractor or Owner caused, the Contractor shall backfill the excavation, install temporary paving including temporary traffic markings, and restore traffic to pre-construction condition to minimize disruption to traffic and the community at no additional cost to the Owner.
- D. Removal and Exclusion of Water: Remove and exclude water, including storm water, groundwater, irrigation water, and wastewater, from all excavations. Dewatering wells, well points, sump pumps, or other means shall be used to remove water and continuously maintain groundwater at a level at least 2 feet below the bottom of excavations before the excavation work begins at each location. Water shall be removed and excluded until backfilling is complete and all field soils testing has been completed.

3.2 STRUCTURE, ROADWAY, AND EMBANKMENT EXCAVATION

- A. Excavation Beneath Structures and Embankments: Except where otherwise indicated for a particular structure or ordered by the Engineer, excavation shall be carried to the grade of the bottom of the footing or slab. Where indicated or ordered, areas beneath structures or fills shall be overexcavated. The subgrade areas beneath embankments shall be excavated to remove not less than the top 6 inches of native material and where such subgrade is sloped, the native material shall be benched. When such overexcavation is indicated, both overexcavation and subsequent backfill to the required grade shall be performed. When such overexcavation is not indicated but is ordered by the Engineer, such overexcavation and any resulting backfill will be paid for under a separate unit price bid item if such bid item has been established; otherwise payment will be made in accordance with a negotiated price. After the required excavation or overexcavation has been completed, the exposed surface shall be scarified to a depth of 6 inches, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density.

- B. Excavation Beneath Concrete Reservoirs: Excavation under reservoirs shall extend to the bottom of the drainrock layer. After such excavation has been completed, the exposed surface shall be rolled with heavy compaction equipment to 95 percent of maximum density and then graded to provide a reasonably smooth surface for placement of the drainrock. Areas under the reservoir upon which fill is to be placed shall be scarified to a depth of 6 inches, brought to optimum moisture content, and compacted to obtain 95 percent of maximum density with moisture content within plus and minus 2 percent of the optimum moisture content.
- C. Excavation Beneath Paved Areas: Excavation under areas to be paved shall extend to the bottom of the aggregate base or subbase, if such base is called for; otherwise it shall extend to the bottom of the paving thickness. After the required excavation has been completed, the top 12 inches of exposed surface shall be scarified, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density. The finished subgrade shall be even, self-draining, and in conformance with the slope of the finished pavement. Areas that could accumulate standing water shall be regraded to provide a self-draining subgrade.
- D. Notification of Engineer: Notify the Engineer at least 3 days in advance of completion of any structure excavation and allow the Engineer a review period of at least 1 day before the exposed foundation is scarified and compacted or is covered with backfill or with any construction materials.

3.3 PIPELINE AND UTILITY TRENCH EXCAVATION

- A. General: Unless otherwise indicated or ordered, excavation for pipelines and utilities shall be open-cut trenches with widths as indicated.
- B. Trench Bottom: Except when pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe zone. Excavations for pipe bells and welding shall be made as required.
- C. Open Trench: The maximum amount of open trench permitted in any one location shall be [500 feet, or the length necessary to accommodate the amount of pipe installed in a single day, whichever is greater]. All trenches shall be fully backfilled at the end of each day or, in lieu thereof, shall be protected in accordance with Section 01 71 50 – Protection of Existing Facilities. The Contractor shall provide temporary 6-foot chain link fencing panels for protection of all open excavations and trenches within public streets, residential areas, and all other locations with the exception of unimproved open areas where excavations and/or pipeline trenches that can be safely sloped in accordance with current OSHA standards to provide safe access without the use of shoring devices. Temporary fencing panels shall fully enclose open excavations and trenches, and shall remain in place during all non-working hours.
- D. Trench Overexcavation: Where trenches are indicated to be overexcavated, excavation shall be to the depth indicated, and backfill shall be installed to the grade of the bottom of the pipe bedding.
- E. Overexcavation: When ordered by the Engineer, whether indicated on the Drawings or not, trenches shall be overexcavated beyond the depth and/or width shown. Such overexcavation

shall be to the dimensions ordered. The trench shall then be backfilled to the grade of the bottom of the pipe bedding. Overexcavation less than 6 inches below the limits on the Drawings shall be done at no increase in cost to the Owner. When the overexcavation ordered by the Engineer is 6 inches or greater below the limits shown, or wider, additional payment will be made. Said additional payment will be made under separate unit price bid items for overexcavation if such bid items have been established; otherwise payment will be made in accordance with a negotiated price.

- F. Where pipelines are to be installed in embankments, fills, or structure backfills, the fill shall be constructed to a level at least one foot above the top of the pipe before the trench is excavated.
- G. If a moveable trench shield is used during excavation operations, the trench width shall be wider than the shield so that the shield is free to be lifted and then moved horizontally without binding against the trench sidewalls. If the trench walls cave in or slough, the trench shall be excavated as an open excavation with sloped sidewalls or with trench shoring, as indicated and as required by the pipe structural design.

3.4 OVEREXCAVATION NOT ORDERED OR INDICATED

- A. Any overexcavation carried below the grade ordered or indicated, shall be backfilled to the required grade with the indicated material and compaction. Such work shall be performed at no additional cost to the Owner.

3.5 BACKFILL – GENERAL

- A. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any structure until the concrete has attained sufficient strength to withstand the loads imposed. Backfill around water retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed. Structures shall not be constructed on CLSM backfill until the CLSM has obtained a 7-day minimum cure.
- B. Except for drainrock materials being placed in overexcavated areas or trenches, backfill shall be placed after all water is removed from the excavation, and the trench sidewalls and bottom have been dried to a moisture content suitable for compaction.
- C. If a moveable trench shield is used during excavation, pipe installation, and backfill operations, the shield shall be moved by lifting the shield free of the trench bottom or backfill and then moving the shield horizontally. Do not drag trench shields along the trench causing damage or displacement to the trench sidewalls, the pipe, or the bedding and backfill.
- D. Immediately prior to placement of backfill materials, the bottoms and sidewalls of trenches and structure excavations shall have all loose sloughing, or caving soil and rock materials removed. All materials disturbed from their intact condition that are 4 inches or larger in least dimension or aggregates of soil material thicker than 4 inches shall be removed from the excavation walls and base prior to placing pipe or any backfill material. Trench sidewalls shall consist of excavated surfaces that are in a relatively undisturbed condition before placement of backfill materials.

3.6 PLACING AND SPREADING OF BACKFILL MATERIALS

- A. Backfill materials shall be placed and spread evenly in layers. When compaction is achieved using mechanical equipment, the layers shall be evenly spread so that the depth of each uncompacted layer shall not exceed 8 inches of compacted thickness.
- B. During spreading, each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer. Pipe zone backfill materials shall be manually spread around the pipe so that when compacted the pipe zone backfill will provide uniform bearing and side support.
- C. Where the backfill material moisture content is below the optimum moisture content, water shall be added before or during spreading until the proper moisture content is achieved.
- D. Where the backfill material moisture content is too high to permit the indicated degree of compaction the material shall be dried or mixed with drier material until the moisture content is satisfactory.

3.7 COMPACTION OF EARTH FILL, BACKFILL, AND EMBANKMENT MATERIALS

- A. Each layer of Types A, B, C, G, H, I, and K backfill materials as defined herein, where the material is graded such that at least 10 percent passes a No. 4 sieve, shall be mechanically compacted to the indicated percentage of density. Equipment that is consistently capable of achieving the required degree of compaction shall be used and each layer shall be compacted over its entire area while the material is at the required moisture content.
- B. Each layer of Type E and J backfill materials shall be compacted by means of at least 2 passes from a flat plate vibratory compactor. When such materials are used for pipe zone backfill, vibratory compaction shall be used at the top of the pipe zone or at vertical intervals of 24 inches, whichever is the least distance from the subgrade.
- C. Fill on reservoir and structure roofs shall be deposited at least 30 days after the concrete roof slab has been placed. Equipment weighing more than 10,000 pounds when loaded shall not be used on a roof. A roller weighing not more than 8,000 pounds shall be used to compact fill on a roof.
- D. Pipe zone backfill materials that are granular, shall be compacted by using vibratory compactors.
- E. Equipment weighing more than 10,000 pounds shall not be used closer to structure walls than a horizontal distance equal to the depth of the fill at that time. Hand operated power compaction equipment shall be used where use of heavier equipment is impractical or restricted due to weight limitations.
- F. Backfill around and over pipelines that is mechanically compacted shall be compacted using light, hand operated, vibratory compactors and rollers. After completion of at least 2 feet of compacted backfill over the top of pipeline, compaction equipment weighing no more than 8,000 pounds may be used to complete the trench backfill.

- G. **Compaction Requirements:** The following compaction test requirements shall be in accordance with ASTM D 1557, method C. Compaction shall be obtained with the moisture content within plus or minus 2 percent of the optimum moisture content. Where agency or utility company requirements govern, the highest compaction standards shall apply.

Location or Use of Fill	Percentage of Maximum Density
Pipe embedment backfill for flexible pipe	90
Pipe bedding and overexcavated zones under bedding for flexible pipe, including trench plugs	90
Pipe embedment backfill for steel yard piping	---
Pipe embedment backfill for rigid pipe	90
Pipe zone backfill portion above embedment for rigid pipe	90
Pipe bedding and overexcavated zones under bedding for rigid pipe	90
Final backfill, beneath paved areas or structures	95
Final backfill, not beneath paved areas or structures	85
Trench zone backfill, beneath paved areas and structures, including trench plugs	95
Trench zone backfill, not beneath paved	

areas or structures, including trench plugs	90
Embankments and fills	90
Embankments and fills beneath paved areas or structures	95
Backfill beneath structures and hydraulic structures	95
Backfill and fill around structures on reservoir or structure roof	90
Topsoil (Type K material)	80
Aggregate base or subbase (Type G or M material)	95

3.8 PLACEMENT OF CLSM

- A. Following placement and anchoring of the pipe, remove all loose soil from trench walls and floor. Remove any unstable soil at the top of the trench, which might fall into the trench during placement of the CLSM.
- B. Prior to placement of CLSM, the pipeline steel temperature shall be controlled as specified in Section 02570 - Steel Pipe.
- C. Deliver the CLSM to the trench in ready mix trucks and utilize pump or chutes to place the CLSM in the trench. Direct CLSM to one side of the pipe, taking care not to displace the pipe at any time. Continue placing CLSM on one side of the pipe until CLSM has gone under the pipe and up the other side to a depth of 1.5 feet above the pipe bottom. Use at least two hand-held vibrators to continuously liquefy and move CLSM into all voids. Adjust water in mixture to maintain fluid consistency but maintain strength requirements. Continue placing CLSM on both sides of the pipe continuously using two vibrators for every 30 feet of pipe run.
- D. Maintain stability of pipe throughout CLSM placement. CLSM will likely require placement in lifts to prevent pipe flotation. No movement of the pipe caused by flotation will be allowed. If any movement occurs, the CLSM material shall be removed and the pipe placed back on line and grade. Any damage to the pipeline system caused by movement of the pipe shall be removed and/or repaired in full conformance with these Contract Documents at no

additional cost to the Owner. Remove all sloughed material or other debris from top of previously placed CLSM.

3.9 PIPE AND UTILITY TRENCH BACKFILL

A. Pipe Zone

1. The pipe zone is defined as that portion of the vertical trench cross-section lying between a plane 6 inches below the bottom surface of the pipe and a plane at a point 12 inches above the top surface of the pipe. The bedding is defined as that portion of pipe zone backfill material between the bottom of the trench and the bottom of the pipe. The embedment is defined as that portion of the pipe zone material between the bedding and a plane at a point 6 inches above the top surface of the pipe.
2. After compacting the bedding, perform a final trim using a string line for establishing grade, such that each pipe section when first laid will be continually in contact with the bedding along the extreme bottom of the pipe. Excavation for pipe bells and welding shall be made as required.
3. The pipe zone shall be backfilled with the indicated backfill material. Exercise care to prevent damage to the pipeline coating, cathodic bonds, and the pipe itself during the installation and backfill operations.
4. If a moveable trench shield is used during backfill operations the shield shall be lifted to a location above each layer of backfill material prior to compaction of the layer. Do not displace the pipe or backfill while the shield is being moved.

B. Trench Zone: After the pipe zone backfills have been placed, backfilling of the trench zone may proceed. The trench zone is defined as that portion of the vertical trench cross-section lying between a plane 12 inches above the top surface of the pipe and a plane at a point 18 inches below the finished surface grade, or if the trench is under pavement, 18 inches below the roadway subgrade.

C. Marking Tape Installation

1. Continuously install metallic marking tape along the pipe at a depth of 3 feet below finish grade.
2. Continuously install plastic marking tape along the pipe at the elevation indicated on the Drawings.

D. Final Backfill: Final backfill is all backfill in the trench cross-sectional area within 18 inches of finished grade, or if the trench is under pavement, all backfill within 18 inches of the roadway subgrade.

3.10 FILL AND EMBANKMENT CONSTRUCTION

A. The area where a fill or embankment is to be constructed shall be cleared of all vegetation, roots and foreign material. Following this, the surface shall be scarified to a depth of 6 inches, moisture conditioned, and rolled or otherwise mechanically compacted. Embankment and fill material shall be placed and spread evenly in approximately horizontal layers. Each layer shall be moistened or aerated, as necessary. Unless otherwise approved by the Engineer, the depth of each uncompacted layer shall not exceed 8 inches of compacted thickness. The embankment, fill, and the scarified layer of underlying ground shall be compacted to

95 percent of maximum density under structures and paved areas, and 90 percent of maximum density elsewhere.

- B. When an embankment or fill is to be made and compacted against hillsides or fill slopes steeper than 5H:1V, the slopes of hillsides or fills shall be horizontally benched to key the embankment or fill to the underlying ground. A minimum of 12 inches normal to the slope of the hillside or fill shall be removed and recompact as the embankment or fill is brought up in layers. Material thus cut shall be recompact along with the new material at no additional cost to the Owner. Hillside or fill slopes 5H:1V or flatter shall be prepared in accordance with Paragraph A, above.
- C. Where embankment or structure fills are constructed over pipelines, the first 4 feet of fill over the pipe shall be constructed using light placement and compaction equipment that does not damage the pipe.
- D. The finish graded surface of the drainrock immediately beneath hydraulic structures shall be stabilized to provide a firm, smooth surface upon which to construct reinforced concrete floor slabs. Where needed to protect slopes and prevent movement of the drainrock, spray asphalt on the finished drainrock surface in accordance with Section 02460 - A. C. Pavement and Base.

3.11 FIELD TESTING

- A. General: All field soils testing will be done by a testing laboratory of the Owner's choice at the Owner's expense except as indicated below.
- B. Where soil material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content will be determined in accordance with Method C of ASTM D 1557. Field density in-place tests will be performed in accordance with ASTM D 1556 or by such other means acceptable to the Engineer.
- C. In case the test of the fill or backfill show noncompliance with the required density, perform remedies as may be required to ensure compliance. Subsequent testing to show compliance shall be by a testing laboratory selected by the Owner, paid by the Contractor, at no additional cost to the Owner.
- D. Provide test trenches and excavations including excavation, trench support, and groundwater removal for the Owner's field soils testing operations. The trenches and excavations shall be provided at the locations and to the depths required by the Owner. All Work for test trenches and excavations shall be provided at no additional cost to the Owner.
- E. Frequency of Testing
 1. Backfill around structures and in embankments shall be tested every 300 square ft of each lift of placement.
 2. CLSM shall be tested each batch being placed or every 300 cubic yards that is placed.
 3. Pipe backfill shall have one test every 80 feet (2 joints) of backfill placed.

END OF SECTION

SECTION 31 23 19 DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Contractor shall perform all site dewatering indicated and required for construction of the Work, complete and in place, in accordance with the Contract Documents. All site dewatering shall conform to the most recent Construction Standards for Spanish Fork City. If any discrepancies exist between the Spanish Fork City Construction Standards and this specification, the Contractor shall adhere to Spanish Fork City requirements.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Spanish Fork City Requirements, apply to this Section.

1.2 SUMMARY

- A. This Section includes construction dewatering.

1.3 PERFORMANCE REQUIREMENTS

- A. The Contractor shall provide all labor, materials, and equipment necessary to dewater site excavations, in accordance with the requirement of the Contract Documents.
- B. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control ground-water flow into excavations and permit construction to proceed on dry, stable subgrades.
 - 1. Maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Accomplish dewatering without damaging existing buildings adjacent to excavation.
 - 4. Remove dewatering system if no longer needed.
- C. To complete this Work, the Contractor shall secure a Utah Pollution Elimination Discharge System (UPDES) General Permit for Construction Dewatering and Hydrostatic Testing prior to commencing any dewatering work.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with water disposal requirements of authorities having jurisdiction.

1.5 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated.

- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for dewatering.
 - 2. The geotechnical report is included elsewhere in the Project Manual.
- C. Survey adjacent structures and improvements, employing a qualified professional engineer or land surveyor, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
 - 1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Engineer if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS – (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
 - 1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
 - 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

3.2 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
- B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed, or until dewatering is no longer required.

- C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
 - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
- D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
 - 1. Maintain free water level below bottom of excavation during construction.
- E. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- F. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.
 - 1. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.
- G. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

END OF SECTION

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SECTION 31 32 19
GEOTEXTILES

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install geotextiles, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCES

- A. ASTM International (ASTM) standards, most recent editions:

ASTM D 4355	Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon-Arc Type Apparatus.
ASTM D 4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
ASTM D 4595	Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
ASTM D 4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile.
ASTM D 4833	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
ASTM D 4884	Standard Test Method for Strength of Sewn or Thermally Bonded Seams of Sewn Geotextiles.
ASTM D 4886	Standard Test Method for Abrasion Resistance of Geotextiles (Sand Paper/Sliding Block Method).

1.3 DEFINITIONS.

- A. Fabric: Geotextile, a permeable geosynthetic comprised solely of textiles.
- B. Minimum Average Roll Value (MinARV): Minimum of series of average roll values representative of geotextile provided.
- C. Maximum Average Roll Value (MaxARV): Maximum of series of average roll values representative of geotextile provided.

- D. Nondestructive Sample: Sample representative of finished geotextile, prepared for testing without destruction of geotextile.
- E. Overlap: Distance measured perpendicular from overlapping edge of one sheet to underlying edge of adjacent sheet.
- F. Seam Efficiency: Ratio of tensile strength across seam to strength of intact geotextile, when tested according to ASTM D 4884.
- G. Woven geotextile: A geotextile fabric composed of polymeric yarn interlaced to form a planar structure with uniform weave pattern.
- H. Nonwoven geotextile: A geotextile fabric composed of a pervious sheet of polymeric fibers interlaced to form a planar structure with uniform random fiber pattern.

1.4 SUBMITTALS

- A. Submit in accordance with Spanish Fork City requirements.
- B. Product Data.
 - 1. Manufacturer's material specifications and product literature.
 - 2. Installation drawings showing geotextile sheet layout, location of seams, direction of overlap, and sewn seams.
 - 3. Description of proposed method of geotextile deployment, sewing equipment, sewing methods, and provisions for holding geotextile temporarily in place until permanently secured.
- C. Samples.
 - 1. Geotextile: One-piece, minimum 18-inches long, taken across full width of roll of each type and weight of geotextile. Label each with brand name and furnish documentation of lot and roll number from which each sample was obtained.
 - 2. Field Sewn Seam: 5-foot length of seam, 12-inches wide with seam along center, for each type and weight of geotextile.
 - 3. Securing Pin and Washer: 1 each.
- D. Certificates.
 - 1. Certification from geotextile manufacturer that products satisfy the indicated requirements.
 - 2. Field seam efficiency test results.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver each roll with sufficient information attached to identify manufacturer and product name or number.
- B. Handle products in manner that maintains undamaged condition.
- C. Do not store products directly on ground. Ship and store geotextile with suitable wrapping for protection against moisture and ultraviolet exposure. Store geotextile in a way that

protects it from elements. If stored outdoors, elevate and protect geotextile with waterproof cover.

PART 2 - PRODUCTS

2.1 WOVEN GEOTEXTILE

- A. Woven geotextile shall be composed of polymeric yarn interlaced to form a planar structure with uniform weave pattern. Products shall be calendared or finished so that yarns will retain their relative position with respect to each other.
- B. Polymeric yarn shall be long-chain synthetic polymers (polyester or polypropylene) with stabilizers or inhibitors added to make filaments resistant to deterioration due to heat and ultraviolet light exposure.
- C. Sheet Edges: Selvaged and finished to prevent outer material from separating from sheet.
- D. Unseamed Sheet Width: Minimum 12 feet.
- E. Nominal Weight per Square Yard: 6 ounces.
- F. Physical Properties: Conform to physical property requirements below:

Property	Requirement	Test Method
Apparent Opening Size (AOS)	No. 10 to No. 100 U.S. Standard Sieve Size	ASTM D4751
Water Permittivity	0.02 to 3.34 Sec. ⁻¹ , MinARV	ASTM D4491 (Falling Head)
Vertical Water Flow Rate	10 to 150 gpm/sq ft, MinARV	
Wide Width Strip Tensile Strength	60 to 1,500 MinARV	ASTM D4595
Wide Width Strip Elongation	14 to 60 percent, MaxARV	ASTM D4595
Trapezoidal Tear Strength	30 to 200 lb, MinARV	ASTM D4533
Puncture Strength	50 to 250 lb, MinARV	ASTM D4833
Abrasion Resistance	5 to 25 percent loss, 250 cycles, MaxARV	ASTM D4886
Ultraviolet Radiation Resistance	70 to 90 percent strength retention, MinARV after 500 hours	ASTM D4355

2.2 NONWOVEN GEOTEXTILE

- A. Nonwoven geotextile shall be composed of a pervious sheet of polymeric fibers interlaced to form a planar structure with uniform random fiber pattern. Products shall be calendared or finished so that yarns will retain their relative position with respect to each other.

- B. Polymeric yarn shall be long-chain synthetic polymers (polyester, polypropylene, or polyethylene) with stabilizers or inhibitors added to make filaments resistant to deterioration due to heat and ultraviolet light exposure.
- C. Geotextile Edges: Selvaged or finished to prevent outer material from separating from sheet.
- D. Unseamed Sheet Width: Minimum 6 feet.
- E. Nominal Weight Per Square Yard: 8 ounces.
- F. Physical Properties: Conform to physical property requirements below:

<u>Property</u>	<u>Requirement</u>	<u>Test Method</u>
Apparent Opening Size (AOS)	Max No. 80 U.S. Standard Sieve Size	ASTM D4751
Water Permittivity	1.4 sec. ⁻¹ , MinARV	ASTM D4491 (Falling Head)
Vertical Water Flow Rate	95 gpm/sq ft, MinARV	
Grab Tensile Strength	205 MinARV	ASTM D4632
Grab Tensile Elongation	50 percent, MaxARV	ASTM D4632
Trapezoidal Tear Strength	80 lb, MinARV	ASTM D4533
CBR Puncture Strength	500 lb, MinARV	ASTM D6241
Ultraviolet Radiation Resistance	70 percent strength retention, MinARV after 500 hours	ASTM D4355

<u>Property</u>	<u>Requirement</u>	<u>Test Method</u>
Apparent Opening Size (AOS)	Max No. 40 U.S. Standard Sieve Size	ASTM D4751
Water Permittivity	0.70 sec. ⁻¹ , MinARV	ASTM D4491
Tensile Strength	180 lbs, MinARV	ASTM D4632
Elongation at failure (%) ¹	≥50	ASTM D4632
Puncture Strength	80 lb	ASTM D4833
Ultraviolet Radiation Resistance	70 percent strength retention, MinARV after 500 hours	ASTM D4355

1. Minimum average roll value (weakest principal direction)

2.3 SEWING THREAD

- A. Sewing thread shall be polypropylene, polyester, or Kevlar thread with durability equal to or greater than durability of geotextile sewn.

2.4 SECURING PINS

- A. Securing pins shall be steel rods or bars conforming to the following:
 - 1. 3/16-inch diameter.
 - 2. Pointed at one end; head on other end, sufficiently large to retain washer.
 - 3. Minimum Length: 12-inches.
- B. Steel Washers for Securing Pins:
 - 1. Outside Diameter: Not less than 1-1/2 inches.
 - 2. Inside Diameter: 1/4-inch.
 - 3. Thickness: 1/8-inch.
- C. Steel Wire Staples:
 - 1. U-shaped.
 - 2. 10-gauge.
 - 3. Minimum 6-inches long.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Laying Geotextile
 - 1. Notify the Engineer whenever geotextiles are to be placed. Do not place geotextile prior to obtaining Engineer's approval of underlying materials.
 - 2. Lay and maintain geotextile smooth and free of tension, folds, wrinkles, or creases.
- B. Orientation on Slopes
 - 1. Orient geotextile with long dimension of each sheet parallel to direction of slope.
 - 2. Geotextile may be oriented with long dimension of sheet transverse to direction of slope only if sheet width, without unsewn seams, is sufficient to cover entire slope and anchor trench and extend at least 18-inches beyond toe of slope.
- C. Joints.
 - 1. Unseamed Joints.
 - a. Overlap unseamed joints to the following dimensions unless otherwise indicated:
 - b. Foundation/Subgrade Stabilization: Minimum 18-inches.
 - c. Riprap: Minimum 18-inches.
 - d. Drain Trenches: Minimum 18-inches, except overlap shall equal trench width if trench width is less than 18-inches.
 - e. Other Applications: Minimum 12-inches.
 - 2. Sewn Seams.

- a. Use sewn seams wherever stress transfer from one geotextile sheet to another is necessary. Sewn seams, as approved by Engineer, also may be used instead of overlap at joints for applications that do not require stress transfer.
- b. Seam efficiency shall be minimum 70 percent.
- c. Type: "J" type seams are preferred, but flat or butterfly seams are acceptable.
- d. Stitch Count: Minimum 3 to maximum 7 stitches per inch.
- e. Stitch Type: Double-thread chain stitch, Type 401, Federal Standard No. 751a.
- f. Stitch Location: 2-inches from geotextile sheet edges, or more if necessary to develop required seam strength.
- g. Sewing Machines: Capable of penetrating 4 layers of geotextile.

D. Securing Geotextile.

1. Secure geotextile during installation as necessary with sand bags or other means approved by Engineer.
2. Securing Pins
 - a. Insert securing pins with washers through geotextile, midway between edges of overlaps and 6-inches from free edges.
 - b. Spacing:

Slope	Maximum Pin Spacing (Feet)
Steeper than 3:1	2
3:1 to 4:1	3
Flatter than 4:1	5

- c. Install additional pins across each geotextile sheet as necessary to prevent slippage of geotextile or to prevent wind from blowing geotextile out of position.
 - d. Push each securing pin through geotextile until washer bears against geotextile and secures it firmly to subgrade.
3. For underdrain applications (geotextile cushion over PVC or rubber waterproof membrane liner) do not use pins, staples or other securing methods that would damage waterproof membrane liner.

E. Placing Products over Geotextile.

1. Notify Engineer before placing material over geotextile. Do not cover installed geotextile prior to receiving authorization from the Engineer to proceed.
2. If tears, punctures, or other geotextile damage occurs during placement of overlying products, remove overlying products as necessary to expose damaged geotextile. Repair damage as indicated below.

F. Installing Geotextile in Trenches.

1. Place geotextile in a way that will completely envelope granular drain material to be placed in trench and with indicated overlap at joints. Overlap geotextile in direction of flow. Place geotextile in a way and with sufficient slack for geotextile to contact trench bottom and sides fully when trench is backfilled.
2. After granular drain material is placed to grade, fold geotextile over top of granular drain material, unless otherwise indicated. Maintain overlap until overlying fill or backfill is placed.

- G. Riprap Applications.
 - 1. Overlap geotextile at each joint with upstream sheet of geotextile overlapping downstream sheet. Sew joints where wave run-up may occur.
- H. Geotextile-Reinforced Earth Wall Applications.
 - 1. Sew exposed joints; extend sewn seams minimum 3-feet behind face of wall.
 - 2. Protect exposed geotextile from damage and deterioration until permanent facing is applied.
- I. Silt Fence Applications.
 - 1. Install geotextile in one piece or continuously sewn to make one piece, for full length and height of fence, including portion of geotextile buried in toe trench.
 - 2. Install bottom edge of sheet in toe trench and backfill in a way that securely anchors geotextile in trench.
 - 3. Securely fasten geotextile to a wire mesh backing and each support post in a way that will not result in tearing of geotextile when fence is subjected to service loads.
 - 4. Promptly repair or replace silt fence that becomes damaged.

3.2 REPAIRING GEOTEXTILE

- A. Repair or replace torn, punctured, flawed, deteriorated, or otherwise damaged geotextile. Repair damaged geotextile by placing patch of undamaged geotextile over damaged area plus at least 18-inches in all directions beyond damaged area. Remove interfering material as necessary to expose damaged geotextile for repair. Sew patches or secure them with pins and washers, as indicated above for securing geotextile, or by other means approved by Engineer.

3.3 REPLACING CONTAMINATED GEOTEXTILE

- A. Protect geotextile from contamination that would interfere, in Engineer's opinion, with its intended function. Remove and replace contaminated geotextile with clean geotextile.

3.4 FIELD QUALITY CONTROL

- A. Testing: Test seam efficiency by preparing and testing minimum of one set of nondestructive samples per acre of each type and weight of geotextile provided for the Work. Test according to ASTM D4884 and submit written results to Engineer.

END OF SECTION

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DIVISION 33
UTILITIES

SECTION 33 05 07
POLYVINYL CHLORIDE (PVC) PIPE (AWWA C900, MODIFIED)

PART 1 - GENERAL

1.1 SUMMARY

- A. The Contractor shall provide polyvinyl chloride (PVC) pressure pipe, complete in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ANSI/AWWA C104/A21.5	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
ANSI/AWWA C105/A21.5	Polyethylene Encasement for Ductile Iron Pipe
ANSI/AWWA C110/A21.10	Ductile-Iron and Gray-Iron Fittings 3-in Through 48-in for Water and Other Liquids
ANSI/AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
ANSI/AWWA C600	Installation of Ductile-Iron Water Mains and Appurtenances
ANSI/AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe 4-in Through 12-in for Water Distribution
ASTM D 2584	Test Method for Ignition Loss of Cured Reinforced Resins
PPI Technical Report TR 3/4	Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials
AWWA Manual M23	PVC Pipe - Design and Installation

1.3 CONTRACTOR SUBMITTALS

- A. Shop Drawings: The Contractor shall submit shop drawings of pipe, fittings, and appurtenances in accordance with Spanish Fork City requirements. Manufacturer's literature for metallic locating tape.
1. Showing dimensions and details of pipe joint fittings, fitting specials, valves and appurtenances.
 2. Detailed layout, spool or fabrication drawings showing pipe spools, spacers, adapters, connectors, fittings and pipe supports not indicated in the Contract Documents.
 3. Manufacturer's product data and samples of all materials proposed for use on the work.

- B. Certifications: A certified affidavit of compliance for pipe and other products or materials under this Section.
- C. Test Reports:
 - 1. Hydrostatic proof test reports.
 - 2. Sustained pressure test reports.
 - 3. Burst strength test reports.
- D. The Contractor shall be responsible for performing and paying for sampling and testing as necessary for the certifications.
- E. Owner's Manual
 - 1. Manufacturer's technical data and installation instructions.
 - 2. Manufacturer's certificates of compliance indicating that all materials provided under this Section meet the requirements of the Contract Documents.

1.4 QUALITY ASSURANCE

- A. Inspection: Pipe shall be subject to inspection at the place of manufacture.
- B. During manufacture of the pipe, the Engineer shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- C. Tests: Materials used in manufacture of the pipe shall be tested in accordance with the requirements of this Section and the referenced standards, as applicable.
- D. The Contractor shall perform said material tests. The Engineer shall have the right to witness testing; provided that the Contractor's schedule is not delayed for the convenience of the Engineer.
- E. In addition to those tests specifically required, the Engineer may request additional samples of any material for testing by the Owner. The additional samples shall be furnished as a part of the Work.

1.5 INSPECTION

- A. All pipe may be subject to inspection at the place of manufacture in accordance with the provisions of the referenced standards as supplemented by the requirements herein. The Contractor shall notify the District in writing of the manufacturing starting date not less than 14 calendar days prior to the start of any phase of the pipe manufacture.
- B. During the manufacture of the pipe, the District shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.

1.6 SOURCE QUALITY CONTROL

- A. Except as modified herein, pipe shall be tested in accordance with the requirements of this Section and AWWA C900.

1. The Contractor shall perform said material tests in accordance with the requirements of the Contract Documents. The Owner shall have the right to witness all testing conducted by the Contractor; provided, that the Contractor's schedule will not be delayed for the convenience of the Owner.
2. All expenses incurred in obtaining samples for testing shall be borne by the Contractor at no increased cost to the Owner.
3. In addition to those tests specifically required, the Owner may request additional samples of any material for testing by the Owner. The additional samples shall be furnished at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

- A. PVC pressure pipe (4-inch through 12-inch) shall conform to the applicable requirements of ANSI/AWWA C900 SDR-18 subject to additional requirements herein.
- B. Each piece of pipe and fitting shall be clearly labeled to identify its size, pressure class and manufacture date.

2.2 PIPE DESIGN CRITERIA

- A. General: PVC pressure pipe shall be designed in accordance with the requirements of ANSI/AWWA C900 SDR-18.
- B. Polyvinyl Chloride (PVC) pipe shall have outside diameter dimensions conforming to cast iron pipe and shall be the diameter and class indicated on the plans. The pipe shall meet the pressure class requirements indicated on the drawings, and shall meet the requirements of Table 2 of AWWA C900.
- C. PVC pipe shall be provided in standard 20 foot lengths, unless otherwise specified, detailed or required on the approved plans. Shorter lengths, up to 10 feet, will be permitted when authorized by the Engineer. Field cut lengths of pipe used as closures may not be shorter than 2 feet in length, and must be approved by the Engineer.

2.3 PIPE

- A. The pipe shall be of the diameter and pressure class specified or shown, shall be furnished complete with rubber gaskets, and all specials and fittings shall be provided as required in the Contract Documents. Unless otherwise noted, diameters shown in the Contract Documents shall refer to Cast-Iron Pipe Equivalent Outside Diameters (CIOD), conforming to the requirements of AWWA C900.
- B. Additives and Fillers: Unless otherwise allowed in alternate qualification procedures of PPI-TR3, compounds which have a Hydrostatic Design Basis (HDB) of 4000 psi at 73.4 degrees F and for water shall not contain additives and fillers that exceed the recommended values in Table 1, Part Y of PPI-TR3 (e.g., allowable content range for calcium carbonate is 0.0-5.0 parts per hundred of resin). If requested by the Engineer, the additive and filler content shall be determined using the pyrolysis method as specified in ASTM D 2584.

- C. Color: Pipe for use in potable or culinary water systems, or directly attached to potable or culinary water systems shall be white or blue. Pipe used in irrigation, reuse, utility water or any other non-potable use shall be purple.
- D. Joints: Except where specifically noted or where designated as "fusible PVC," joints for buried PVC pipe shall be either an integral bell manufactured on the pipe or a separate coupling both employing a rubber ring joint. The bell and coupling shall be the same thickness as of the pipe barrel, or greater thickness. The sealing ring groove in the coupling shall be of the same design as the groove in cast iron fittings and valves available from local water works supply distributors. No restrained joint PVC pipe will be allowed. When the spigot end of pipe is to be inserted into a mechanical joint fitting, the beveled end of the pipe shall be removed prior to insertion. Solvent weld joints are not permitted.
- E. Joint shall be sealed with an elastomeric gasket meeting the requirements of ASTM F 477 and ASTM D3139. Gaskets and lubricants shall be made from materials that are compatible with the plastic material and with each other when used together. They shall not support the growth of bacteria and shall not adversely affect the potable qualities of the water that is to be transported. One elastomeric gasket shall be furnished with each length of bell-end pipe.
- F. Joint Deflection: Deflection at the joint shall not exceed 1.5 degrees or the maximum deflection recommended by the manufacturer. No deflection of the joint shall be allowed for joints which are over-belled or not belled to the stop mark.

2.4 FITTINGS

- A. Fittings shall be ductile iron fittings meeting the requirements of Section 33 41 05 – Ductile Iron Pipe and of AWWA C110 and/or AWWA C153. Fittings shall be wrapped in polyethylene encasement per AWWA C-105 and all hardware shall be coated with a non-oxide grease.
- B. Where fabricated PVC fittings are specifically required:
 - 1. Fittings (4-inch through 12-inch) shall conform to the applicable requirements of ANSI/AWWA C900 subject to additional requirements herein.
- C. All ductile iron fittings shall be lined in accordance with Section 33 41 05 – Ductile Iron Pipe. Fittings shall be cement-mortar lined ductile, coated with a bituminous material and shall conform to the requirements of AWWA Standard C110 and C111 with a minimum rated working pressure of 250 psi. The cement lining shall conform to the requirements of AWWA Standard C104
- D. Each fitting shall be clearly labeled to identify its size and pressure class.
- E. All fittings and valves shall be restrained against thrust forces by concrete thrust blocks furnished and installed as indicated in the Drawings.

2.5 TRACER WIRE

- A. Tracer wire shall be N0. 12 AWG copper wire, PVC jacketed for underground services.

2.6 SERVICE SADDLES

- A. Bronze bodied saddles with double bronze straps or full circle body clamp double bolted to each side of the saddle shall be used on pipe sizes 4 inch through 12 inch. The saddle body shall be manufactured from cast bronze in accordance with ASTM B62 or B584 and AWWA C800. The single strap shall have double bolts on each end of the strap to connect it to the bronze saddle. The ears of the strap shall turn inward and rest against the inside of the strap. The gasket shall be Buna N. The saddle shall be threaded with 1 inch or 2 inch iron pipe threads.

PART 3 - EXECUTION

3.1 GENERAL

- A. Laying, jointing, testing for defects and for leakage shall be performed in the presence of the Engineer, and shall be subject to approval before acceptance. Material found to have defects will be rejected and the Contractor shall promptly remove such defective materials from the Site.
- B. Installation shall conform to the requirements of AWWA M23, instructions furnished by the pipe manufacturer, and to the supplementary requirements herein. Wherever the provisions of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.
- C. The Contractor shall install all the pipe closure sections, fittings, valves and appurtenances shown on the approved plans, including bolts, nuts, gaskets and joining materials.
- D. The Contractor shall excavate sufficiently in advance of pipe laying operations to enable the alignment and profile to be revised to clear existing utilities and to align with existing connection points.
- E. PVC pipe which has been gouged shall not be used. PVC pipe which has received minor scratches during handling may be used solely at the discretion of the Engineer.
- F. The Contractor shall maintain the interior of the pipe clean, sanitary and free from foreign materials. At all times when the work of installing pipe is not in progress, all openings into the pipe and the ends of the pipe in the trenches shall be kept tightly closed to prevent the entrance of animals and foreign materials. To prevent unwanted water intrusion, open ends of pipe shall be closed temporarily with a watertight bulkhead.
- G. Do not install any pipe contaminated with a petroleum product (inside or outside).
- H. Do not install any pipe that shows evidence of exposure to sunlight, age, surface deterioration, or other physical damage. The decision of the Engineer shall be final as to the acceptability of the pipe to be installed.

3.2 HANDLING AND STORAGE

- A. Handling: Pipe, fittings and accessories shall be carefully inspected before and after installation and those found defective shall be rejected. Pipe and fittings shall be free from fins and burrs. Before being placed in position, pipe, fittings, and accessories shall be cleaned, and shall be maintained in a clean condition. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings or any other material be dropped or dumped into trenches. The pipe shall be hoisted with mechanical equipment using a cloth belt sling or a continuous fiber rope which avoids scratching the pipe. A chain is not permitted. Pipes up to 6 inches in diameter can be lifted by hand.
- B. Storage: Pipe should be stored, if possible, at the Site in unit packages provided by the manufacturer. Caution should be exercised to avoid compression damage or deformation to bell ends of the pipe. Pipe shall be supported uniformly while being stored in such a way as to prevent sagging or bending and be protected from exposure to direct sunlight by covering with an opaque material while permitting adequate air circulation above and around the pipe. Gaskets should be stored in a cool, dark place out of the direct rays of the sun, preferably in original cartons.

3.3 TRENCHING AND BACKFILL

- A. Trench excavation and backfill shall conform to the requirements of Section 31 23 00 – Earthwork. Care shall be taken to ensure that pipe zone material is compacted and in full contact with the haunches of the pipe and that the pipe is fully supported.

3.4 INSTALLATION

- A. Bell-and-spigot pipe shall be laid with the bell end pointing in the direction of laying. Pipe shall be graded in straight lines, taking care to avoid the formation of any dips or low points. Pipe shall not be laid when the conditions of trench or weather are unsuitable. At the end of each day's work, open ends of pipe shall be closed temporarily with wood blocks or bulkheads.
- B. Pipe shall be supported at its proper elevation and grade, care being taken to secure firm and uniform support. Wood support blocking will not be permitted. The full length of each section of pipe and fittings shall rest solidly on the pipe bed, with recessed excavation to accommodate bells, joints, and couplings. Anchors and supports shall be provided where indicated and where necessary for fastening work into place. Fittings shall be independently supported.
- C. Short lengths of pipe shall be used in and out of each rigid joint or rigid structure. Piping that does not allow sufficient space for proper installation of jointing material shall be replaced by one of proper dimensions. Blocking or wedging between bells and spigots will not be permitted.
- D. Joints shall be installed according to manufacturer's recommendations. Trenches shall be kept free of water until joints have been properly made. The maximum combined deflection at any coupling shall be in accordance with the manufacturer's recommendations.

- E. Pipe shall be cut by means of saws, power driven abrasive wheels, or pipe cutters, which will produce a square cut. No wedge-type roller cutters will be permitted. After cutting, the end of the pipe shall be beveled using a beveling tool, portable type sander, or abrasive disc.
- F. Pipe end shall be secure at all times and care shall be taken to prevent any foreign object, dirt, rocks, debris, rubbish, tools, etc from entering the pipe. Pipe end shall be capped at the end of each days laying operations. Provided required minimum separation from adjacent utilities are satisfied.
- G. Install PVC pipe such that the indelible identification strip markings on each pipe section are continuously aligned for the total length of the pipeline being installed. Orient the strip marking upward to the 12 o'clock position (top) of the trench opening.
- H. Assemble the pipe joint using the lubricant supplied by the manufacturer. Ensure lubricant is NSF certified for use in potable water systems. Insert the spigot end into the bell or coupling to the proper insertion mark. Check that the elastomeric ring has not left the groove during assembly by passing a feeler gauge around the completed joint.
- I. Tapping saddles shall be installed a minimum of 5 feet from the edge of the saddle to any pipe joint or other saddle. Multiple taps of 6 inches or larger shall not be made in the same length of pipe without the approval of the Engineer.

3.5 INSTALLATION OF METALLIC LOCATING TAPE

- A. Polyvinyl chloride pipelines shall be provided with a metallic locating tape laid along the centerline of the pipe trench at a depth of 18 inches below finished grade **OR** above top of pipe. The Contractor shall furnish manufacturer's literature, completely describing the tape proposed to be furnished. No tape shall be used prior to receipt of written approval of the Engineer.

3.6 INSTALLATION OF LOCATOR WIRE

- A. Polyvinyl chloride pipelines shall be provided with locator wire secured to the pipe with surface connections provided at all valve boxes and hydrants and as required to maintain a maximum distance between connections of no greater than 500 feet. Tracer wire shall be laid along the top of the pipe and held in place with ties or hitches. The ties or hitches shall be spaced not more than 10 feet apart. The copper wire is to be used in the future as a means of locating the pipe with an electronic-type pipe locator.

3.7 FIELD TESTING AND DISINFECTION

- A. Field testing shall conform to the requirements of Section 33 13 00 – Water Pipeline Testing and Disinfection as applicable.

END OF SECTION

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**SECTION 33 13 00
WATER PIPELINE TESTING AND DISINFECTION**

PART 1 - GENERAL

1.1 SUMMARY

- A. The Contractor shall perform all water pipeline testing and disinfection indicated and required for construction of the Work, complete and in place, in accordance with the Contract Documents. All water pipeline testing and disinfection shall conform to the most recent Construction Standards for Spanish Fork City. If any discrepancies exist between the Spanish Fork City Construction Standards and this specification, the Contractor shall adhere to Spanish Fork City requirements.
- B. The Contractor shall perform flushing and testing of all pressure pipelines and appurtenant piping and disinfection of all pipelines and appurtenant piping for potable and fire water, complete.
- C. This specification applies to all pipelines requiring hydrostatic tests (water medium) regardless of the pipeline service medium.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ANSI/AWWA B300	Hypochlorites
ANSI/AWWA B301	Liquid Chlorine
ANSI/AWWA C206	Field Welding of Steel Water Pipe
ANSI/AWWA C651	Disinfecting Water Mains

1.3 CONTRACTOR SUBMITTALS

- A. A testing schedule, including proposed plans for water conveyance, control, disposal, and disinfection shall be submitted in writing for approval a minimum of 7 days before testing is to start.
- B. A copy of the Utah Pollutant Discharge Elimination System (UPDES) permit application shall be submitted a minimum of 30 days prior to the proposed date to start testing. A copy of the approved UPDES permit shall be submitted prior to the start of testing.
- C. Chlorine residual test data and bacteriological test data shall be submitted to document the results of the pipeline disinfection. Tests shall be conducted 24 hours after the start of disinfection.

PART 2 - PRODUCTS

2.1 MATERIALS REQUIREMENTS

- A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, or other water control equipment and materials shall be determined and furnished by the Contractor subject to the Engineer's review. No materials shall be used which would be injurious to the construction or its future function.
- B. Used pressure gauges shall be recertified prior to testing.
- C. Chlorine for disinfection shall be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets.
- D. Liquid chlorine shall be in accordance with the requirements of ANSI/AWWA B301. Liquid chlorine shall be used only:
 - 1. In combination with appropriate gas flow chlorinators and ejectors;
 - 2. Under the direct supervision of an experienced technician;
 - 3. When appropriate safety practices are observed.
- E. Sodium hypochlorite and calcium hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300 - Hypochlorite.

PART 3 - EXECUTION

3.1 GENERAL

- A. Water for testing and disinfecting water pipelines shall be furnished by the Contractor. The Contractor shall make all necessary provisions for conveying the water from the source to the points of use, and disposal of the water (and dechlorinating - where applicable).
- B. All pressure pipelines shall be tested. Disinfection shall be accomplished by chlorination for all pipelines providing potable water or connected to a potable water system. All chlorinating and testing operations shall be performed in the presence of the Engineer.
- C. Disinfection operations shall be scheduled as late as possible during the contract time period so as to assure the maximum degree of sterility of the facilities at the time the Work is accepted by the Owner. Samples for bacteriological testing shall be collected by the Contractor, and testing shall be performed by the Owner laboratory and at the expense of the Contractor. Results of the bacteriological testing shall be satisfactory with the State Department of Health or other appropriate regulatory agency.
- D. Pipeline pressure tests will include the following tests:
 - 1. Air test of double welded lap joints.
 - 2. Hydrostatic pressure test of the complete pipeline, in segments as required to match pipe pressure class.
 - 3. Contractor shall conduct the discharge in accordance with the Utah Pollutant Discharge Elimination System (UPDES) permit from the Utah Division of Environmental Quality (UDEQ). The Contractor shall apply a reducing agent to the

discharged water to neutralize the chlorine residual and meet the chlorine residual limit required under the permit. The Owner shall conduct the water quality sampling of the discharge as required by the permit. The Contractor shall notify local agencies, secure appropriate other permits and approvals, and provide erosion control measures for any releases as appropriate. Release of water after pipeline testing and disinfection have been completed shall be only if acceptable to the Engineer.

- E. Notification: Notify the Engineer at each of the following stages:
 - 1. Three working days prior to the start of filling the pipeline with water.
 - 2. Three working days prior to the start of chlorination.
 - 3. Twenty-four hours before withdrawing samples for bacteriological testing.
 - 4. Three working days prior to the start of flushing.

3.2 VISUAL INSPECTION

- A. All welds shall be 100% visually inspected in accordance with ANSI/AWS D1.1, Table 6.1; Visual Inspection Acceptance Criteria for Statically Loaded Non-Tubular Connections.

3.3 AIR TEST

- A. All double welded lap joint or double gasket Carnegie joint shall be pressure tested to a minimum of 40-psi air pressure for a period of 10 minutes per AWWA C206. No air leakage will be allowed.
- B. If the test pressure drops below 40 psi, paint the welds with a soap solution. Mark any leaks indicated by the escaping gas bubbles.
- C. Any joints which leak shall be repaired and retested.

3.4 HYDROSTATIC TESTING OF PIPELINES

- A. Prior to hydrostatic testing, all pipelines shall be flushed or blown out as appropriate. Test all pipelines either in sections or as a unit. No section of the pipeline shall be tested until all field-placed concrete or mortar has attained an age of 14 days. The test shall be made by closing valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. The Contractor shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to or movement of the adjacent pipe. Any unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test, to avoid movement and damage to piping and equipment. Provide sufficient temporary air tappings in the pipelines to allow for evacuation of all entrapped air in each pipe segment to be tested. After completion of the tests, such taps shall be permanently plugged. Care shall be taken to see that all air vents are open prior to and during filling.
- B. The pipeline shall be filled at a rate not to exceed 2-feet per second as calculated by using the cross-sectional area based on the inside diameter of the pipe and which will not cause any surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least 24 hours to allow the concrete or mortar lining, as applicable, to absorb what

water it will and to allow the escape of air from any air pocket. No personnel shall be within or enter any vault or confined space subject to flooding during the initial filling and for a 24 hour period. After the 24 hour period bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the Engineer shall be taken.

- C. The hydrostatic test shall consist of holding the test pressure on the pipeline for a period of 4 hours. The test pressure for distribution and transmission pipelines shall be 150 percent of the working pressure in the pipeline measured at the lowest point of the pipeline section being tested. The test pressure for yard piping shall be as indicated on the Piping Schedule measured at the lowest point of the pipeline section being tested. No pressure test will be required for a reservoir overflow line. All visible leaks shall be repaired in a manner acceptable to the Engineer.
- D. The maximum allowable leakage for distribution and transmission pipelines shall be 10 U.S. gallons per inch of diameter per mile of pipe per 24 hours for pipe with 40-foot or greater lengths between joints and with rubber-gasketed joints and 20 U.S. gallons per inch of diameter per mile of pipe per 24 hours for pipe with 20-foot or less lengths between joints and with rubber-gasketed joints. The maximum leakage for yard piping shall be as shown on the Piping Schedule. Pipe with welded joints shall have no leakage.
- E. In the case of pipelines that fail to pass the prescribed leakage test, determine the cause of the leakage, take corrective measures necessary to repair the leaks, and again test the pipelines at no additional cost to the Owner.
- F. The pipeline shall be drained after successful completion of the hydrostatic test.

3.5 DISINFECTING PIPELINES

- A. General: All potable water pipelines shall be disinfected in accordance with the requirements of ANSI/AWWA C651 - Disinfecting Water Mains as modified herein.
- B. Prior to disinfecting the pipeline for potable water services and before placing into service for other water pipelines, flush the pipeline to remove any debris, rocks, or other foreign material that may have entered the pipe. Flushing shall be carried out such that the velocities in the pipe exceed 2.5 feet per second. Provide all required material, labor and equipment to complete flushing. Contractor shall provide the water for flushing. Make appropriate provision and preparations for disposal of flushing water, satisfying all local, state and federal rules, laws, regulations and ordinances.
- C. Continuous Feed Method: Disinfect in accordance with ANSI/AWWA C651 except that:
 - 1. The water in the pipe shall contain 50 mg/l free chlorine.
 - 2. After 24 hours of disinfection, the residual free chlorine shall be at least 25 mg/l at the pipeline extremities.
- D. Slug Feed Method: Disinfect in accordance with ANSI/AWWA C651.
- E. Chlorinating Valves: During the process of chlorinating the pipelines, all valves and other appurtenances shall be operated while the pipeline is filled with the heavily chlorinated water.

- F. Final Flushing: After the applicable retention period, the heavily chlorinated water shall be flushed from the pipeline until chlorine measurements show that the concentration in the water leaving the pipeline is no higher than that generally prevailing in the system or is acceptable for domestic use. If there is any question that the chlorinated discharge will cause damage to the environment, a reducing agent shall be applied to the water to neutralize thoroughly the chlorine residual remaining in the water. See the appendix of AWWA C651 for acceptable neutralization methods for heavily chlorinated water.
- G. Sampling Ports: The Contractor shall provide sampling ports along the pipeline as defined in AWWA C651. Taps may be made at manways and air valves to help facilitate the spacing requirement.
- H. Bacteriological Testing: After final flushing and before the pipeline is placed in service, two consecutive sets of samples shall be collected at least 24 hours apart by the Contractor from the end of the line and at other locations as designated by the Engineer, and shall be tested by the Owner for bacteriological quality in accordance with the requirements of AWWA C651. For this purpose, the pipe shall be refilled with fresh potable water and left for a period of 24 hours before any samples are collected. If the initial disinfection fails to produce satisfactory bacteriological results or if other water quality is affected, the new main may be reflashed and shall be resampled. If check samples also fail to produce acceptable results, the main shall be rechlorinated by the continuous-feed or slug method until satisfactory results are obtained – that being two consecutive sets of acceptable samples taken 24 hours apart.

3.6 CONNECTIONS TO EXISTING SYSTEM

- A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before they are installed. Thorough flushing shall be started as soon as the connection is completed and shall be continued until discolored water is eliminated.

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SECTION 33 41 05
DUCTILE IRON PIPE (AWWA C151, MODIFIED)

PART 1 - GENERAL

1.1 SUMMARY

- A. The Contractor shall perform all ductile iron pipe indicated and required for construction of the Work, complete and in place, in accordance with the Contract Documents. All ductile iron pipe shall conform to the most recent Construction Standards for Spanish Fork City. If any discrepancies exist between the Spanish Fork City Construction Standards and this specification, the Contractor shall adhere to Spanish Fork City requirements.
- B. The Contractor shall furnish and install ductile iron pipe and all appurtenant Work, complete in place, all in accordance with the requirements of the Contract Documents.

1.2 REFERENCE STANDARDS

A. Commercial Standards:

ANSI/AWWA C104/A21.4	Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water
ANSI/AWWA C105/A21.5	Polyethylene Encasement for Ductile Iron Piping and Fittings for Water
ANSI/AWWA C110/A21.10	Ductile Iron and Gray Iron Fittings, 3-in. through 48-in. for Water and Other Liquids
ANSI/AWWA C111/A21.11	Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
ANSI/AWWA C115/A21.15	Flanged Ductile Iron and Gray-Iron Pipe with Threaded Flanges
ANSI/AWWA C150/A21.50	Thickness Design of Ductile Iron Pipe
ANSI/AWWA C151/A21.51	Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
ANSI/AWWA C153/A21.53	Ductile Iron Compact Fittings, 3-in. through 12-in. for Water and Other Liquids
AWWA C209	Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
AWWA C214	Tape Coating Systems for the Exterior of Steel Water Pipelines

ANSI/AWWA C600

Installation of Ductile Iron Water Mains and their Appurtenances

ASTM C150

Specification for Portland Cement

1.3 CONTRACTOR SUBMITTALS

- A. Shop Drawings: The Contractor shall submit shop drawings of pipe and fittings in accordance with the requirements of Spanish Fork City, the requirements of the referenced standards and the following supplemental requirements as applicable and specified herein.
1. Marking plan and details of standard pipe section showing dimensions, pipe joints, fitting and special fitting pressure rating and thickness, size, coating and lining data.
 2. Pipeline layout drawings showing the location of each pipe section, each special length, closure sections, location and angle of bends, outlets, location of valves, and other special fittings.
- B. Certifications: The Contractor shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section, as specified in the referenced standards and the following supplemental requirements:
1. Physical and chemical properties.
 - a. Hydrostatic Test Reports
- C. Sample Costs: All expenses incurred in making samples for certification of tests shall be borne by the Contractor.

1.4 QUALITY ASSURANCE

- A. Inspection: All pipe shall be subject to inspection at the place of manufacture, in accordance with the provisions of the referenced standards, as supplemented by the requirements herein. The Contractor shall notify the Engineer in writing of the manufacturing starting date not less than 14 calendar days prior to the start of any phase of the pipe manufacture.
- B. During the manufacture of the pipe, the Engineer shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- C. Test: Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.
- D. The Contractor shall perform said material tests at no additional cost to the Owner. The Engineer shall have the right to witness all testing conducted by the Contractor; provided, that the Contractor's schedule is not delayed for the convenience of the Engineer.
- E. In addition to those tests specifically required, the Engineer may request additional samples of any material including lining and coating samples for testing by the Owner. The additional samples shall be furnished at no additional cost to the Owner

PART 2 - PRODUCTS

2.1 GENERAL

- A. Standards: Mortar-lined and polyethylene-wrapped ductile iron pipe shall conform to ANSI/AWWA C151, C104, and C105, subject to the following supplemental requirements. The pipe shall be of the diameter and class shown, shall be furnished complete with rubber gaskets as indicated in the Contract Documents, and all flanges, specials and fittings shall be provided as required under the Contract Documents.
- B. Handling and Storage: The pipe shall be handled by devices acceptable to the Engineer, designed and constructed to prevent damage to the pipe coating/exterior. The use of equipment which might injure the pipe coating/exterior will not be permitted. Stockpiled pipe shall be suitably supported and shall be secured to prevent accidental rolling. All other pipe handling equipment and methods shall be acceptable to the Engineer.
- C. Finish: The pipe shall have smooth and dense interior surfaces, and shall be free from fractures, excessive interior surface crazing, and roughness.
- D. Closures and Correction Pieces: Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing shown on the Drawings. The locations of correction pieces and closure assemblies are shown on the Drawings. Any change in location or number of said items shall be acceptable to the Engineer.
- E. Pipe shall be new and recently manufactured. Refurbished pipe shall not be provided.

2.2 MATERIALS

- A. Polyethylene Sleeve: Material for the polyethylene sleeve shall conform to the requirements of ANSI/AWWA C105.

2.3 SPECIALS AND FITTINGS

- A. Fittings for ductile iron pipe shall conform to the requirements of ANSI/AWWA C153/A21.53 or ANSI/AWWA C110/A21.10 for diameters 3-inch through 48-inch and shall have a minimum pressure rating of 250 psi. Ductile iron fittings larger than 48-inch shall conform to the above-referenced standard with the necessary modifications for the larger size.

2.4 DESIGN OF PIPE

- A. General: The pipe furnished shall be ductile iron pipe, mortar-lined and polyethylene-wrapped with rubber-gasketed joints as shown.
- B. Manufacturing Requirements: The pipe shall be designed, manufactured, tested, inspected, and marked according to applicable requirements previously stated and, except as hereinafter modified, shall conform to ANSI/AWWA C151.
- C. Fitting Dimensions: The fittings shall be of the diameter and class shown.

- D. Joint Design: Ductile iron pipe and fittings shall be furnished with mechanical joints, push-on joints, flanged joints, and restrained joints as required.
1. Mechanical and push-on joints shall conform to ANSI/AWWA C111/A21.11.
 2. Restrained Joint:
 - a. Manufactured proprietary joint that mechanically restrains pipe to adjoining pipe without setscrews or devices with shoes or wedges activated by setscrews.
 - b. The use of devices utilizing setscrews shall not be allowed. Primary permanent restraint for all buried pipe fittings shall be accomplished using concrete thrust blocks. Temporary fitting restraint for testing of pipelines can be accomplished using mechanical thrust restraint utilizing multiple gripping wedges incorporated into a follower gland meeting the requirements of ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21/53. Temporary (or secondary) fitting restraint shall be in addition to primary permanent restraint. Permanent restraint for straight-run pipe joints can be accomplished using manufacturer's proprietary joint (e.g. Tyton Lock with Sure Stop gasket, or equal) or with mechanical joint restraints (e.g. EBAA Iron Megalug, or equal) utilizing multiple gripping wedges incorporated into a follower gland meeting the requirements of ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21/53.
 - c. Rated at minimum working pressure equal to or greater than that of the pipe class.
 - d. The use of field-lock, gripper ring type restraining devices shall be limited to only locations where unforeseen field conditions or closure places require the pipe to be field fit, cut, and joined, and as approved by the Engineer. Where field locking, gripper ring type restraining devices are used, the gripper ring shall be installed a minimum of one full pipe length away from the fitting or closure. The installation of gripper ring type restraining devices where used shall be in strict accordance with the manufacturer's installation instructions.
 - e. Field welding of ductile iron pipe and fitting shall not be allowed.
 3. Flanged joints shall conform to ANSI/AWWA C115/A21.15.
- E. Joint Clearances: For bell-and-spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket groove configuration and the gasket itself, will provide watertight joints under all operating conditions when properly installed. The Contractor shall require the pipe manufacturer to submit details complete with significant dimensions and tolerances and also to submit performance data indicating that the proposed joint has performed satisfactorily under similar conditions. In the absence of a history of field performance, the results of a test program shall be submitted.
- F. Coating and Linings Held Back: Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as shown, or as otherwise acceptable to the Engineer.

2.5 CEMENT-MORTAR LINING

- A. Cement-Mortar Lining for Shop Application: Except as otherwise provided herein, interior surfaces of all ductile iron pipe, fittings and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C104. During the lining operation and thereafter, the pipe shall be maintained in a round condition

by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at the delivery site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications.

- B. Lining Thickness: The minimum lining thickness shall be as follows:

Nominal Pipe Diameter (in)	Minimum Lining Thickness (in)
3-12	1/8
14-24	3/16
30-54	1/4

2.6 EXTERIOR COATING OF PIPE

- A. Exterior Coating of Exposed Piping: The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust-inhibitive primer conforming to the requirements of Section 09 90 00 – Protective Coatings and Linings.
- B. Exterior Coating of Buried Piping: The exterior coating shall be an asphaltic coating approximately one mil thick.

2.7 SOURCE QUALITY CONTROL

- A. Factory Tests: In accordance with AWWA C104, C105, C110, C111, C115, C150, C151, C153, and C606.

PART 3 - EXECUTION

3.1 GENERAL

- A. Laying, jointing, testing for defects and for leakage shall be performed in the presence of the Engineer, and shall be subject to approval before acceptance. Material found to have defects will be rejected and the Contractor shall promptly remove such defective materials from the Site.
- B. Installation shall conform to the requirements of AWWA C600, instructions furnished by the pipe manufacturer, and to the supplementary requirements herein. Wherever the provisions of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

3.2 INSTALLATION OF PIPE

- A. Handling and Storage: All pipe, fittings, etc., shall be carefully handled and protected against damage, impact shocks, and free fall. All pipe handling equipment shall be acceptable to the Engineer. Pipe shall not be placed directly on rough ground but shall be supported in a manner that will protect the pipe coating against injury whenever stored at the trench site or elsewhere. No pipe shall be installed where the lining or coating show defects that may be

harmful as determined by the Engineer. Such damaged lining or coating shall be repaired, or a new undamaged pipe shall be furnished and installed.

- B. Damaged Pipe: All pipe damaged prior to Substantial Completion shall be repaired or replaced by the Contractor.
- C. Contractor to Inspect Pipe: The Contractor shall inspect each pipe and fitting prior to installation to insure that there are no damaged portions of the pipe.
- D. Trench excavation and backfill shall conform to the requirements of Section 31 23 00 – Earthwork. Care shall be taken to ensure that pipe zone material is compacted and in full contact with the haunches of the pipe and that the pipe is fully supported.
- E. Clean Pipe: Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance, which may have collected thereon, and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the Work.
 - 1. Remove lumps, blisters, and excess asphaltic type coating from bell and spigot ends of each pipe. Wire brush outside of spigot and inside of bell and wipe clean, dry, and free from oil and grease before pipe is laid.
 - 2. Wipe ends of mechanical joint pipe and fittings and of rubber gasket joint pipe and fittings clean of dirt, grease, and foreign matter.
- F. Pipe Laying: The pipe shall be installed in accordance with ANSI/AWWA C600.
 - 1. Direction of Laying: Lay pipe with bell end facing in direction of laying. For lines on an appreciable slope, face bells upgrade at discretion of Engineer.
 - 2. Mechanical Joint, Push-On Joint, and Restrained Joint Pipe: After first length of pipe is installed in trench, secure pipe in place with approved backfill material tamped under and along sides to prevent movement. Keep ends clear of backfill. After each section is jointed, place backfill as specified to prevent movement. For restrained joint pipe and fittings, after each section is jointed and restraining devices are completely installed, fully extend the completed joint and place backfill as specified to prevent movement before installation of the next section of pipe or fitting.
 - 3. Take precautions necessary to prevent floating of pipe prior to completion of backfill operation.
 - 4. When using movable trench shield, take necessary precautions to prevent pipe joints from pulling apart when moving shield ahead.
 - 5. Do not allow foreign material to enter pipe while it is being placed in trench.
 - 6. Close and block open end of last laid section of pipe to prevent entry of foreign material or creep of gasketed joints when laying operations are not in progress, at close of day's work, or whenever workers are absent from job.
- G. Joining Push-On Joint Pipe and Mechanical Joint Fittings:
 - 1. Join pipe with push-on joints and mechanical joint fittings in strict accordance with manufacturer's recommendations.
 - 2. Provide special tools and devices, such as, special jacks, chokers, and similar items required for installation.
 - 3. Lubricate pipe gaskets using lubricant furnished by pipe manufacturer. No substitutes will be permitted.
 - 4. Clean ends of fittings of dirt, mud, and foreign matter by washing with water and scrubbing with a wire brush, after which, slip gland and gasket on plain end of pipe.

If necessary, lubricate end of pipe to facilitate sliding gasket in place, then guide fitting onto spigot of pipe previously laid.

- H. Founding Pipe: Pipe shall be laid directly on the Pipe Zone material. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.
- I. Unforeseen Obstructions: Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the Engineer may change the alignment and/or the grades. Such change shall be made by the deflection of joints, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum designed deflection recommended by the pipe manufacturer. No joint shall be misfit any amount that will be detrimental to the strength and water tightness of the finished joint.
- J. Except for short runs which may be permitted by the Engineer, pipes shall be laid uphill on grades exceeding 10 percent. Pipe which is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. All bends shall be properly installed as shown.
- K. Cold Weather Protection: No pipe shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation. No pipe shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.
- L. Pipe and Specials Protection: The openings of all pipe and specials shall be protected with suitable bulkheads to prevent unauthorized access by persons, animals, water or any undesirable substance. At all times, means shall be provided to prevent the pipe from floating.
- M. Pipe Cleanup: As pipe laying progresses, the Contractor shall keep the pipe interior free of all debris. The Contractor shall completely clean the interior of the pipe of all sand, dirt, mortar splatter and any other debris following completion of pipe laying, pointing of joints and any necessary interior repairs prior to testing and disinfecting the completed pipeline.
- N. Cutting Pipe: General: Cut pipe for inserting closure pieces in a neat and workmanlike manner without damaging pipe or lining and so as to leave a smooth end, at right angles to axis of pipe.
 - 1. Pipe: Cut pipe with milling type cutter or saw. Do not flame cut.
 - 2. Dressing Cut Ends: Dress cut ends of push-on joint pipe by beveling, as recommended by manufacturer.
- O. Field Installed Outlets: Field outlets may be installed with a saddle; however, the maximum nominal diameter of outlet for saddle shall be 2-inch. Opening in pipe shall be machine cut. Flame cut openings shall not be allowed.

3.3 RUBBER GASKETED JOINTS

- A. Rubber Gasketed Joints: Immediately before jointing pipe, the bell end of the pipe shall be thoroughly cleaned, and a clean rubber gasket, lubricated with an approved vegetable-based lubricant, shall be placed in the bell groove. The spigot end of the pipe shall be carefully cleaned and lubricated with a vegetable-based lubricant. The spigot end of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted.

3.4 CORROSION PROTECTION

- A. Polyethylene Encasement: Buried ductile iron pipe shall be polyethylene encased in accordance with the requirements of ANSI/AWWA C105/A21.5.
 1. Encase pipe, fittings, and valves in accordance with AWWA C105, Method A.
 2. Cut polyethylene tube approximately 2 feet longer than pipe length.
 3. Slip tube around pipe, centering to provide 1-foot overlap on each adjacent section.
 4. Pull encasement to take out slack and wrap snug around pipe.
 5. Secure overlap in place and fold at quarter points of pipe length.
 6. Wrap and tape encasement snug around fittings and valves.

3.5 INSTALLATION OF PIPE APPURTENANCES

- A. Protection of Appurtenances: Where the joining pipe is tape-coated, buried appurtenances shall be coated with cold-applied tape in accordance with ANSI/AWWA C209, Type II. Where pipe is encased in polyethylene sleeves, buried appurtenances shall also be encased in polyethylene.
- B. Installation of Valves: All valves shall be handled in a manner to prevent any injury or damage to any part of the valve. All joints shall be thoroughly cleaned and prepared prior to installation. The Contractor shall adjust all stem packing and operate each valve prior to installation to insure proper operation.
- C. Valve Installation: All valves shall be installed so that the valve stems are plumb and in the location shown on the Drawings.

3.6 INSTALLATION OF METALLIC LOCATING TAPE

- A. Buried pipelines shall be provided with a metallic locating tape laid along the centerline of the pipe trench at a depth of 18 inches below finished grade OR above top of pipe. The Contractor shall furnish manufacturer's literature, completely describing the tape proposed to be furnished. No tape shall be used prior to receipt of written approval of the Engineer.

3.7 FIELD TESTING AND DISINFECTION

- A. Field testing shall conform to the requirements of Section 33 13 00 – Water Pipeline Testing and Disinfection as applicable.

END OF SECTION

DIVISION 40
PROCESS INTEGRATION

**SECTION 40 05 00
PIPING, GENERAL**

PART 1 - GENERAL

1.1 SUMMARY

- A. The Contractor shall furnish and install all piping systems shown and specified, in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, seismic restraints, expansion joints, flexible connectors, valves, accessories, heat tracing, insulation, lining and coating, testing, disinfection, excavation, backfill and encasement, to provide a functional installation.
- B. The piping shown is intended to define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are not pipe construction or fabrication drawings. It is the Contractor's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, etc., for a complete and functional system.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ANSI/ASME B1.20.1	Pipe Threads, General Purpose (inch)
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys
ANSI/AWWA C207	Steel Pipe Flanges for Water Works Service, Sizes 4 in through 144 in.
ANSI/AWWA C606	Grooved and Shouldered Joints
ANSI/AWS D1.1	Structural Welding Code
ASTM A 307	Specification for Carbon Steel Bolts and Studs, 6,000 psi Tensile
ASTM A 325	Specification for High-Strength Bolts for Structural Steel Joints
ASTM D 792	Test Methods for Specific Gravity and Density of Plastics by Displacement
ASTM D 2000	Classification System for Rubber Products in Automotive Applications

1.3 CONTRACTOR SUBMITTALS

- A. Submit complete shop drawings and certificates, test reports, affidavits of compliance, of all piping systems, in accordance with the requirements of Spanish Fork City, and as indicated in the individual piping sections. The shop drawings shall include all necessary dimensions and details on pipe joints, fittings, fitting specials, valves, appurtenances, design calculations, and material lists. The submittals shall include detailed layout, spool, or fabrication drawings which show all pipe spools, spacers, adapters, connectors, fittings, and pipe supports and seismic restraints necessary to accommodate the equipment and valves provided in a complete and functional system.
- B. All expenses incurred in making samples for certification of tests shall be borne by the Contractor at no increased cost to the Owner.
- C. Submit as part of the shop drawings a statement from the pipe fabricator certifying that all pipes will be fabricated subject to a recognized Quality Control Program. An outline of the program shall be submitted to the Engineer for review prior to the fabrication of any pipe.

1.4 QUALITY ASSURANCE

- A. Inspection: All pipe shall be subject to inspection at the place of manufacture. During the manufacture of the pipe, the Engineer shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- B. Tests: Except where otherwise indicated, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable specifications and standards. Welds shall be tested as indicated. Perform all tests at no additional cost to the Owner.
- C. Welding Requirements: All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.
- D. Welder Qualifications: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, approved testing agency not more than 6 months prior to commencing Work on the pipeline. Machines and electrodes similar to those used in the Work shall be used in qualification tests. Furnish all material and bear the expense of qualifying welders at no increased cost to the Owner.
- E. NSF/ANSI 61 for Drinking Water System Components: All materials that will contact potable water shall comply with the requirements of the NSF/ANSI 61 Standard.

1.5 MANUFACTURER'S SERVICE REPRESENTATIVE

- A. Where the assistance of a manufacturer's service representative is advisable, in order to obtain perfect pipe joints, supports, or special connections, furnish such assistance at no additional cost to the Owner.

1.6 MATERIAL DELIVERY, STORAGE, AND PROTECTION

- A. All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground, to provide protection against oxidation caused by ground contact. All defective or damaged materials shall be replaced with new materials.

1.7 CLEANUP

- A. After completion of the Work, all remaining pipe cuttings, joining and wrapping materials, and other scattered debris, shall be removed from the site. The entire piping system shall be handed over in a clean and functional condition.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All pipes, fittings, and appurtenances shall be furnished in accordance with the requirements of the applicable Sections of Division 33 and this Section.
- B. Miscellaneous Small Pipes: Miscellaneous small pipes and fittings shall be provided by the Contractor in accordance with the requirements of Section 40 00 03 - Mill Piping - Exposed and Buried and this Section.
- C. Lining: All requirements pertaining to thickness, applications, and curing of pipe lining, are in accordance with the requirements of the applicable Sections of Division 33, unless otherwise indicated.
- D. Coating: All requirements pertaining to thickness, application, and curing of pipe coating, are in accordance with the requirements of the applicable Sections of Division 33, unless otherwise indicated. Pipes above ground or in structures shall be field-painted in accordance with Section 09 97 01 - Pipeline Coating or 09 99 90 - Coatings and Painting.
- E. Pressure Rating: All piping systems shall be designed for the maximum expected pressure as defined in Section 33 13 00 - Water Pipeline Testing and Disinfection, or as indicated on the piping schedule.
- F. Grooved Piping Systems: Piping systems with grooved joints and fittings may be provided, if approved by the Engineer, in lieu of screwed, flanged, welded, or mechanical joint systems for steel and ductile iron yard piping above and below ground within the property limits of pump stations, and similar installations. All grooved couplings on buried piping must be bonded. To assure uniform and compatible piping components, all grooved fittings, couplings, and valves shall be from the same manufacturer. The Contractor shall make the coupling manufacturer responsible for the selection of the correct style of coupling and gasket for each individual location.

2.2 PIPE FLANGES

- A. Flanges: Where the design pressure is 150 psi or less, flanges shall conform to either ANSI/AWWA C207 Class D or ANSI B16.5 150-pound class. Where the design pressure is greater than 150 psi, up to a maximum of 275 psi, flanges shall conform to either ANSI/AWWA C207 Class E, Class F, or ANSI B16.5 150-pound class. However, AWWA flanges shall not be exposed to test pressures greater than 125 percent of rated capacity. For higher test pressures, the next higher rated AWWA flange or an ANSI-rated flange shall be selected. Where the design pressure is greater than 275 psi up to a maximum of 700 psi, flanges shall conform to ANSI B16.5 300-pound class. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown. Attachment of the flanges to the pipe shall conform to the applicable requirements of ANSI/AWWA C207. Flanges for miscellaneous small pipes shall be in accordance with the standards specified for these pipes.
- B. Blind Flanges: Blind flanges shall be in accordance with ANSI/AWWA C207, or with the standards for miscellaneous small pipes. All blind flanges for pipe sizes 12 inches and over shall be provided with lifting eyes in form of welded or screwed eye bolts.
- C. Flange Coating: All machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.
- D. Flange Bolts: Contractor shall supply all bolts and nuts in conformance with Section 05 50 00 – Metal Fabrications. Studs and bolts shall extend through the nuts a minimum of 1/4 inch. All-thread studs shall be used on all valve flange connections, where space restrictions preclude the use of regular bolts.
- E. Insulating Flanges: Insulated flanges shall have bolt holes 1/4 inch diameter greater than the bolt diameter.
- F. Insulating Flange Sets: Insulating flange sets shall be provided by the Contractor where shown. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers and a steel washer. Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1/2 inches or smaller and shall be made of acetal resin. For bolt diameters larger than 1-1/2 inches, insulating sleeves and washers shall be two-piece and shall be made of polyethylene or phenolic. Steel washers shall be in accordance with ASTM A 325. Insulating gaskets shall be full-face.
- G. Insulating Flange Manufacturers, or Equal
 1. JM Red Devil, Type E
 2. Maloney Pipeline Products Co., Houston
 3. PSI Products, Inc., Burbank, California.
- H. Flange Gaskets: Contractor shall provide flange gaskets for all pipe flanges. Gaskets for flanged joints shall be full-faced, 1/16-inch thick compressed sheets of asbestos-free aramid fiber base, with nitrile binder and nonstick coating, suitable for temperatures to 700 degrees F, a pH of 1 to 11, and pressures to 1,000 psig. Blind flanges shall have gaskets covering the

entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets shall not be permitted.

- I. Flange Gasket Manufacturers, or Equal
 - 1. John Crane, Style 2160.
 - 2. Garlock, Style 3000
 - 3. Garlock, Style 3760 for drinking water applications

2.3 THREADED INSULATING CONNECTIONS

- A. General: Threaded insulating bushings, unions, or couplings, as appropriate, shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are involved.
- B. Materials: Threaded insulating connections shall be of nylon, Teflon, polycarbonate, polyethylene, or other nonconductive materials, and shall have ratings and properties to suit the service and loading conditions.

2.4 MECHANICAL-TYPE COUPLINGS (GROOVED OR BANDED PIPE)

- A. Construction: Cast mechanical-type couplings shall be provided where shown. The couplings shall conform to the requirements of ANSI/AWWA C606. Bolts and nuts shall conform to the requirements of Section 05 50 00 – Metal Fabrications. All gaskets for mechanical-type couplings shall be compatible with the piping service and fluid utilized, in accordance with the coupling manufacturer's recommendations. The wall thickness of all grooved piping shall conform with the coupling manufacturer's recommendations to suit the highest expected pressure. To avoid stress on equipment, all equipment connections shall have rigid-grooved couplings, or harness sets in sizes where rigid couplings are not available, unless thrust restraint is provided by other means. The Contractor shall have the coupling Manufacturer's service representative verify the correct choice and application of all couplings and gaskets, and the workmanship, to assure a correct installation.
- B. Couplings for Steel Pipe, Manufacturers, or Equal
 - 1. Victaulic Style 44 with Type D Heavy Duty Grooved Adaptor Ends.
- C. Ductile Iron Pipe Couplings, Manufacturers, or Equal
 - 1. Gustin-Bacon.
 - 2. Victaulic Style 31 (flexible or rigid grooving).
 - 3. Note: Ductile iron pipe couplings shall be furnished with flush seal gaskets.
- D. Couplings for PVC Pipe, Manufacturers, or Equal
 - 1. Gustin-Bacon.
 - 2. Victaulic Style 775.
 - 3. Note: Couplings for PVC pipe shall be furnished with radius cut or standard roll grooved pipe ends. Grooved end couplings shall be used on PVC pipe only for Schedule 80 vent piping at the vaults. Grooved end couplings shall not be used for PVC C905 water pipe.

2.5 SLEEVE-TYPE COUPLINGS

- A. Construction: Sleeve-type couplings shall be provided where indicated, in accordance with ANSI/AWWA C219 unless otherwise indicated, and shall be of steel with steel bolts, without pipe stop, and shall be of sizes to fit the pipe and fittings. The middle ring shall be not less than 1/4 inch in thickness and shall be either 5 or 7 inches long for sizes up to and including 30 inches and 10 inches long for sizes greater than 30 inches, for standard steel couplings, and 16 inches long for long-sleeve couplings. The followers shall be single-piece contoured mill section welded and cold-expanded as required for the middle rings. They shall be of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket. Bolts and nuts shall conform to the requirements of Section 05 50 00 – Metal Fabrication. Buried sleeve-type couplings shall be epoxy-coated at the factory.
- B. Pipe Preparation: The ends of the pipe, where indicated, shall be prepared for flexible steel couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12 inches from the ends of the pipe, with outside diameter not more than 1/64 inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to air test for porosity.
- C. Gaskets: Gaskets for sleeve-type couplings shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. Gaskets for wastewater and sewerage applications shall be Buna "N," grade 60, or equivalent suitable elastomer.
1. The rubber in the gasket shall meet the following specifications:
 - a. Color - Jet Black.
 - b. Surface - Nonblooming.
 - c. Durometer Hardness - 74 " 5.
 - d. Tensile Strength - 1,000 psi Minimum.
 - e. Elongation - 175 percent Minimum.
 2. The gaskets shall be immune to attack by impurities normally found in water or wastewater. All gaskets shall meet the requirements of ASTM D 2000, AA709Z, meeting Suffix B13 Grade 3, except as noted above. All gaskets shall be compatible with the piping service and fluid utilized.
- D. Insulating Couplings: Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a rubber sleeve of an insulating compound in order to obtain insulation of all coupling metal parts from the pipe.
- E. Restrained Joints: All sleeve-type couplings on pressure lines shall be harnessed unless thrust restraint is provided by other means. Harnesses shall be in accordance with the requirements of the appropriate reference standard, or as shown.
- F. Manufacturers, or Equal
1. Dresser, Style 38.
 2. Ford Meter Box Co., Inc., Style FC1 or FC3.
 3. Smith-Blair, Style 411.

4. Baker, Series 200

2.6 FLANGED END CONNECTORS

- A. Flanged coupling adapters, shall be in accordance with AWWA C219.
- B. Dismantling joints for connecting flanged pipe shall be AWWA C219 compliant. Provide studs and nuts to seal gasket separate and independent from tie-bar restraint system.
- C. All dismantling joints shall be the restrained type per AWWA M-11. Tie-bar restraint system shall conform to ASTM A193-B7 per AWWA M-11 and be designed to withstand the test pressure shown on the Drawings.
- D. All dismantling joints shall use standard flanges in accordance with AWWA C207. The thickness of the dismantling joint flanges shall be equal to or greater than the class of flange that is connected to as required by the test pressure as shown on the drawings. Buried flanges shall be wrapped with petroleum was tape per AWWA C217.
- E. Manufacturers, or Equal
 - 1. Smith-Blair, Style 972 or 975
 - 2. Baker, Series DJ

2.7 FLEXIBLE CONNECTORS

- A. Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment, and where shown. Flexible connectors for service temperatures up to 180 degrees F shall be flanged, reinforced Neoprene or Butyl spools, rated for a working pressure of 40 to 150 psi, or reinforced, flanged duck and rubber, as best suited for the application. Flexible connectors for service temperatures above 180 degrees F shall be flanged, braided stainless steel spools with inner, annular, corrugated stainless steel hose, rated for minimum 150 psi working pressure, unless otherwise shown. The connectors shall be 9 inches long, face-to-face flanges, unless otherwise shown. The final material selection shall be approved by the manufacturer. Submit manufacturer's shop drawings and calculations.

2.8 EXPANSION JOINTS

- A. All piping subject to expansion and contraction shall be provided with sufficient means to compensate for such movement, without exertion of undue forces to equipment or structures. This may be accomplished with expansion loops, bellow-type expansion joints, or sliding-type expansion joints. Expansion joints shall be of stainless steel, monel, rubber, or other materials, best suited for each individual service. Submit detailed calculations and manufacturer's shop drawings, guaranteeing satisfactory performance of all proposed expansion joints, piping layouts showing all anchors and guides, and information on materials, temperature and pressure ratings.

2.9 PIPE THREADS

- A. All pipe threads shall be in accordance with ANSI/ASME B1.20.1.

PART 3 - EXECUTION

3.1 GENERAL

- A. All pipes, fittings, and appurtenances shall be installed in accordance with the requirements of the applicable Sections of Division 33. The lining manufacturer shall take full responsibility for the complete, final product and its application. All pipe ends and joints at screwed flanges shall be epoxy-coated, to assure continuous protection.
- B. Where core drilling is required for pipes passing through existing concrete, core drilling locations shall be determined by radiograph of concrete construction to avoid damage to embedded raceways and rebars.
- C. Flanges shall be installed at least 6-inches from a wall. Fittings shall be installed with sufficient clearance for maintenance and removal and reinstallation.

3.2 FIELD TESTING

- A. All piping shall be tested in accordance with applicable standards and the contract documents.

END OF SECTION

SECTION 40 05 51
VALVES, GENERAL

PART 1 - GENERAL

1.1 SUMMARY

- A. The Contractor shall provide valves, actuators, and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 11 00 00 - Equipment General Provisions, apply to the Work of this Section.
- C. The provisions of this Section shall apply to all valves and valve actuators except where otherwise indicated. Valves and actuators in particular locations may require a combination of units, sensors, limit switches, and controls indicated in other Sections of the Specifications.
- D. Where a valve is to be supported by means other than the piping to which it is attached, the Contractor shall obtain from the valve manufacturer a design for support and foundation that satisfies the criteria in Section 11 00 00. The design, including drawings and calculations sealed by an engineer, shall be submitted with the Shop Drawings. When the design is approved, the support shall be provided.
- E. Unit Responsibility: A single manufacturer shall be made responsible for coordination of design, assembly, testing, and furnishing of each valve; however, the Contractor shall be responsible to the Owner for compliance with the requirements of each valve section. Unless indicated otherwise, the responsible manufacturer shall be the manufacturer of the valve.
- F. Single Manufacturer: Where two or more valves of the same type and size are required, the valves shall be furnished by the same manufacturer.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Spanish Fork City requirements.
- B. Shop Drawings: Shop Drawings shall contain the following information:
 - 1. Valve name, size, Cv factor, pressure rating, identification number (if any), and specification section number.
 - 2. Complete information on valve actuator, including size, manufacturer, model number, limit switches, and mounting.
 - 3. Cavitation limits for control valves.
 - 4. Assembly drawings showing part nomenclature, materials, dimensions, weights, and relationships of valve handles, handwheels, position indicators, limit switches, integral control systems, needle valves, and control systems.
 - 5. Data in accordance with Section 26 20 00 - Low Voltage AC Induction Motors for electric motor-actuated valves.
 - 6. Complete wiring diagrams and control system schematics.
 - 7. Valve Labeling: A schedule of valves to be furnished with stainless steel tags, indicating in each case the valve location and the proposed wording for the label.

- C. Technical Manual: The Technical Manual shall contain the required information for each valve.
- D. Spare Parts List: A Spare Parts List shall contain the required information for each valve assembly, where indicated.
- E. Factory Test Data: Where indicated, signed, dated, and certified factory test data for each valve requiring certification shall be submitted before shipment of the valve. The data shall also include certification of quality and test results for factory-applied coatings.

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. General: Valves and gates shall be new and of current manufacture. Shut-off valves 6-inches and larger shall have actuators with position indicators. Gate valves 18-inches and larger or where chain wheel is required, shall be furnished with spur gear and hand wheel. Buried valves shall be provided with valve boxes and covers containing position indicators and valve extensions. Manual shut-off valves mounted higher than 7-feet above working level shall be provided with chain actuators.
- B. Valve Actuators: Unless otherwise indicated, valve actuators shall be in accordance with Section 40 05 52 - Valve and Gate Actuators.
- C. Protective Coating: The exterior surfaces of all valves and the wet interior surfaces of ferrous valves of sizes 4-inches and larger shall be coated in accordance with Section 09 90 00 - Protective Painting and Linings. The valve manufacturer shall certify in writing that the required coating has been applied and tested in the manufacturing plant prior to shipment, in accordance with these Specifications. Flange faces of valves shall not be epoxy coated.
- D. Valve Labeling: Except when such requirement is waived by the construction manager in writing, a label shall be provided on shut-off valves and control valves except for hose bibbs and chlorine cylinder valves. The label shall be of 1/16-inch plastic or stainless steel, minimum 2-inches by 4-inches in size, as indicated in Section 41 05 02 - Piping Identification Systems, and shall be permanently attached to the valve or on the wall adjacent to the valve as directed by the construction manager.
- E. Valve Testing: As a minimum, unless otherwise indicated or recommended by the reference Standards, valves 3-inches in diameter and smaller shall be tested in accordance with manufacturer's standard and 4-inches in diameter and larger shall be factory tested as follows:
 - 1. Hydrostatic Testing: Valve bodies shall be subjected to internal hydrostatic pressure equivalent to twice the water rated pressure of the valve. Metallic valves rating pressures shall be at 100 degrees F and plastic valves shall be 73 degrees, or at higher temperature according to type of material. During the hydrostatic test, there shall be no leakage through the valve body, end joints, or shaft seals, nor shall any part of the valve be permanently deformed. The duration shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes.

2. Seat Testing: Valves shall be tested for leaks in the closed position with the pressure differential across the seat equal to the water rated pressure of the valve. The duration of test shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes. Leakage past the closed valve shall not exceed 1 fluid ounce per hour per inch diameter for metal seated valves and drop-tight for resilient seated valves.
 3. Performance Testing: Valves shall be shop operated from fully closed to fully open position and reverse under no-flow conditions in order to demonstrate the valve assembly operates properly.
- F. Certification: Prior to shipment, the Contractor shall submit for valves over 12-inches in size, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, or ASTM.
- G. Valve Marking: Valve bodies shall be permanently marked in accordance with MSS SP25 - Standard Marking Systems for Valves, Fittings, Flanges, and Unions.

2.2 MATERIALS

- A. General: Materials shall be suitable for the intended application. Materials in contact with potable water shall be listed as compliant with NSF Standard 61. Materials not indicated shall be high-grade standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended. Unless otherwise indicated, valve and actuator bodies shall conform to the following requirements:
1. Cast Iron: Close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 2. Ductile Iron: ASTM A 536 - Ductile Iron Castings, or to ASTM A 395 - Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
 3. Steel: ASTM A 216 - Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service, or to ASTM A 515 - Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service.
 4. Bronze: ASTM B 62 - Composition Bronze or Ounce Metal Castings, and valve stems not subject to dezincification shall conform to ASTM B 584 - Copper Alloy Sand Castings for General Applications.
 5. Stainless Steel: Stainless steel valve and operator bodies and trim shall conform to ASTM A 351 - Steel Castings, Austenitic, for High-Temperature Service, Grade CF8M, or shall be Type 316 stainless steel.
 6. PVC: Poly Vinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 12454.
 7. CPVC: Chlorinated Poly Vinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 23447.
 8. NSF Standard 61: Materials shall be listed for use in contact with potable water.

2.3 VALVE CONSTRUCTION

- A. Bodies: Valve bodies shall be cast, molded (in the case of plastic valves), forged, or welded of the materials indicated, with smooth interior passages. Wall thicknesses shall be uniform in agreement with the applicable standards for each type of valve, without casting defects, pinholes, or other defects that could weaken the body. Welds on welded bodies shall be done

by certified welders and shall be ground smooth. Valve ends shall be as indicated, and be rated for the maximum temperature and pressure to which the valve will be subjected.

- B. Valve End Connections: Unless otherwise indicated, valves 2-1/2 inches diameter and smaller may be provided with threaded end connections. Valves 3-inches and larger shall have flanged end connections.
- C. Bonnets: Valve bonnets shall be clamped, screwed, or flanged to the body and shall be of the same material, temperature, and pressure rating as the body. The bonnets shall have provision for the stem seal with the necessary glands, packing nuts, or yokes.
- D. Stems: Valve stems shall be of the materials indicated, or, if not indicated, of the best commercial material for the specific service, with adjustable stem packing, O-rings, Chevron V-type packing, or other suitable seal. Bronze valve stems shall conform to ASTM B 584, except that zinc content shall not exceed 16 percent.
- E. Stem Guides: Stem guides shall be provided, spaced 10-feet on centers unless the manufacturer can demonstrate by calculation that a different spacing is acceptable. Submerged stem guides shall be 304 stainless steel.
- F. Internal Parts: Internal parts and valve trim shall be as indicated for each individual valve. Where not indicated, valve trim shall be of Type 316 stainless steel or other best suited material.
- G. Nuts and Bolts: Nuts and bolts on valve flanges and supports shall be in accordance with Section 05 50 00 – Metal Fabrications.

2.4 VALVE ACCESSORIES

- A. Valves shall be furnished complete with the accessories required to provide a functional system.

2.5 SPARE PARTS

- A. The Contractor shall furnish the required spare parts suitably packaged and labeled with the valve name, location, and identification number. The Contractor shall also furnish the name, address, and telephone number of the nearest distributor for the spare parts of each valve. Spare parts are intended for use by the Owner, after expiration of the correction of defects period.

2.6 MANUFACTURERS

- A. Manufacturer's Qualifications: Valve manufacturers shall have a successful record of not less than 5 years in the manufacture of the valves indicated.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

- A. General: Valves, actuating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's written instructions and as indicated. Gates shall be adequately braced to prevent warpage and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe.
- B. Access: Valves shall be installed with easy access for actuation, removal, and maintenance and to avoid interference between valve actuators and structural members, handrails, or other equipment.
- C. Valve Accessories: Where combinations of valves, sensors, switches, and controls are indicated, the Contractor shall properly assemble and install such items so that systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on Shop Drawing submittals.

END OF SECTION

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**SECTION 40 05 52
VALVE AND GATE ACTUATORS**

PART 1 - GENERAL

1.1 SUMMARY

- A. The Contractor shall provide valve and gate actuators and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section shall apply to valves and gates except where otherwise indicated in the Contract Documents.
- C. Unit Responsibility: The valve or gate manufacturer shall be made responsible for coordination of design, assembly, testing, and installation of actuators on the valves and gates; however, the Contractor shall be responsible to the Owner for compliance of the valves, gates, and actuators with the Contract Documents.
- D. Single Manufacturer: Where 2 or more valve or gate actuators of the same type or size are required, the actuators shall be produced by the same manufacturer.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Spanish Fork City requirements and Section 40 05 51 - Valves, General.
- B. Shop Drawings: Shop Drawing information for actuators shall be submitted together with the valve and gate submittals as a complete package.
- C. Calculations: Selection calculations showing dynamic seating and unseating torques versus output torque of actuator.
- D. Technical Manuals: The Contractor shall furnish technical manuals for the butterfly valves, butterfly valve manual actuators, and butterfly valve electric motor actuators under one cover and in accordance with the requirements of Spanish Fork City requirements.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Unless otherwise indicated, shut-off and throttling valves and externally actuated valves and gates shall be provided with manual. The Contractor shall furnish actuators complete and operable with mounting hardware, handwheels, levers, chains, and extensions, as applicable. Actuators shall have the torque ratings equal to or greater than required for valve seating and dynamic torques, whichever is greater, and shall be capable of holding the valve in any intermediate position between fully-open and fully-closed without creeping or fluttering. Actuator torque ratings for butterfly valves shall be determined in accordance with AWWA

C504 - Rubber-Seated Butterfly Valves. Wires of motor-driven actuators shall be identified by unique numbers.

- B. Manufacturers: Where indicated, certain valves and gates may be provided with actuators manufactured by the valve or gate manufacturer. Where actuators are furnished by different manufacturers, the Contractor shall coordinate selection to have the fewest number of manufacturers possible.
- C. Materials: Actuators shall be current models of the best commercial quality materials and be liberally-sized for the required torque. Materials shall be suitable for the environment in which the valve or gate is to be installed.
- D. Actuator Mounting and Position Indicators: Actuators shall be securely mounted by means of brackets or hardware specially designed and sized for this purpose and be of ample strength. The word "open" shall be cast on each valve or actuator with an arrow indicating the direction to open in the counter-clockwise direction. Gear and power actuators shall be equipped with position indicators. Where possible, manual actuators shall be located between 48- and 60-inches above the floor or the permanent working platform.
- E. Standard: Unless otherwise indicated and where applicable, actuators shall be in accordance with AWWA C 540 - Power-Actuating Devices for Valves and Slide Gates.
- F. Functionality: Electric, pneumatic, and hydraulic actuators shall be coordinated with the power requirements of Division 26.
- G. Fasteners: Fasteners shall be in accordance with Section 05 50 00 - Miscellaneous Metalwork.
- H. Protective Coatings: Protective coatings shall be in accordance with Section 09 90 00 - Protective Coatings and Linings.

2.2 MANUAL ACTUATORS

- A. General: Unless otherwise indicated, valves and gates shall be furnished with manual actuators. Valves in sizes up to and including 4-inches shall have direct acting lever or handwheel actuators of the manufacturer's best standard design. Larger valves and gates shall have gear-assisted manual actuators, with an operating pull of maximum 60 pounds on the rim of the handwheel. Buried and submerged gear-assisted valves, gates, gear-assisted valves for pressures higher than 250 psi, valves 30-inches in diameter and larger, and where so indicated, shall have worm gear actuators, hermetically-sealed water-tight and grease-packed. Other valves 6-inches to 24-inches in diameter may have traveling nut actuators, worm gear actuators, spur or bevel gear actuators, as appropriate for each valve.
- B. Buried Valves: Unless otherwise indicated, buried valves shall have extension stems to grade, with square nuts or floor stands, position indicators, and cast-iron or steel pipe extensions with valve boxes, covers, and operating keys. Where so indicated, buried valves shall be in cast-iron, concrete, or similar valve boxes with covers of ample size to allow operation of the valve actuators. Covers of valve boxes shall be permanently labeled as required by the local Utility Company or the Engineer. Wrench nuts shall comply with AWWA C 500 - Metal - Seated Gate Valves for Water Supply Service.

- C. Chain Actuator: Manually-activated valves with the stem located more than 7-feet above the floor or operating level shall be provided with chain drives consisting of sprocket-rim chain wheels, chain guides, and operating chains provided by the valve manufacturer. The wheel and guide shall be of ductile iron, cast iron, or steel, and the chain shall be hot-dip galvanized steel or stainless steel, extending to 5-feet 6-inches above the operating floor level. The valve stem of chain-actuated valves shall be extra strong to allow for the extra weight and chain pull. Hooks shall be provided for chain storage where chains interfere with pedestrian traffic.
- D. Floor Stands: Valve actuator floor stands shall be cast iron or fabricated steel pedestals. The centerline of the actuator shall be approximately 42 to 48 inches above the base of the pedestal.
- E. Floor Boxes: Hot dip galvanized cast iron or steel floor boxes and covers to fit the slab thickness shall be provided for operating nuts in or below concrete slabs. For operating nuts in the concrete slab, the cover shall be bronze-bushed.
- F. Tee Wrenches: Buried valves with floor boxes shall be furnished with 2 operating keys or 1 key per 10 valves, whichever is greater. Tee wrenches sized so that the tee handle will be 2 to 4 feet above ground, shall fit the operating nuts.
- G. Manual Worm Gear Actuator: The actuator shall consist of a single or double reduction gear unit contained in a weather-proof cast iron or steel body with cover and minimum 12-inch diameter handwheel. The actuator shall be capable of 90 degree rotation and shall be equipped with travel stops capable of limiting the valve opening and closing. The actuator shall consist of spur or helical gears or worm gearing. The gear ratio shall be self-locking to prevent "back-driving." The spur or helical gears shall be of hardened alloy steel and the worm gear shall be alloy bronze. The worm gear shaft and the handwheel shaft shall be of 17-4 PH or similar stainless steel. Gearing shall be accurately cut with hobbing machines. Ball or roller bearings shall be used throughout. Output shaft end shall be provided with spline to allow adjustable alignment. Actuator output gear changes shall be mechanically possible by simply changing the exposed or helical gearset ratio without further disassembly of the actuator. Gearing shall be designed for a 100 percent overload. The entire gear assembly shall be sealed weatherproof. Manual worm gear actuators shall be Auma GS Series, Limitorque HBC Series, no "Or-Equals".
- H. Traveling-Nut Actuator: The actuator shall consist of a traveling-nut with screw (Scotch yoke) contained in a weatherproof cast iron or steel housing with spur gear and minimum 12-inch diameter handwheel. The screw shall run in 2 end bearings, and the actuator shall be self-locking to maintain the valve position under any flow condition. The screw and gear shall be of hardened alloy steel or stainless steel, and the nut and bushings shall be of alloy bronze. The bearings and gear shall be grease-lubricated by means of nipples. Gearing shall be designed for a 100 percent overload.
- I. Schedule for Manual Actuator Types: For a complete schedule of manual actuators required on project valves (4" diameter and larger), see Contract Drawing GM-10 and GM-11.

PART 3 - EXECUTION

3.1 SERVICES OF MANUFACTURER

- A. Field Adjustments: Field representatives of manufacturers of valves or gates with pneumatic, hydraulic, or electric actuators shall adjust actuator controls and limit-switches in the field for the required function.

3.2 INSTALLATION

- A. Valve and gate actuators and accessories shall be installed in accordance with Section 40 05 51 - Valves, General. Actuators shall be located to be readily accessible for operation and maintenance without obstructing walkways. Actuators shall not be mounted where shock or vibrations will impair their operation, nor shall the support systems be attached to handrails, process piping, or mechanical equipment.
- B. Inspection, Startup, and Field Adjustment: An authorized representative of the manufacturer shall visit the Site and witness the following:
 - 1. Installation of the equipment for not less than two (2) Work Days
 - 2. Inspection, checking, and adjusting the equipment for not less two (2) Work Days.
 - 3. Startup and field-testing for proper operation for not less than two (2) Work Days.
- C. Instruction of Owner's Personnel: The authorized service representative shall visit the Site for not less than 2 Days to instruct the Owner's personnel in the operation and maintenance of the equipment including step-by-step troubleshooting procedures with necessary test equipment.

END OF SECTION

SECTION 40 05 64 BUTTERFLY VALVES

This specification changes a portion of APWA Standard Specification Section 33 11 00 and Section 33 12 16. All other provisions of the Sections remain in full force and effect.

Add the additional Spanish Fork City requirements as follows.

1. General. Valve bodies shall be cast iron, ASTM A-126 Class B. Body ends shall be flanged with facing and drilling in accordance with ANSI B16.1, Class 125; or mechanical joint in accordance with AWWA C111. All mechanical joint end valves shall be furnished complete with joint accessories (bolts, nuts, gaskets, and glands). All valves shall conform to AWWA standard C-504, Table 3, laying lengths for flanged valves and minimum body shell thickness for all body types.
2. DISC. Valve disc shall be ductile iron ASTM A-536, Grade 65-45-12. Valve disc shall be of the offset design providing 360 degree uninterrupted seating.
3. SHAFT BEARINGS. Shaft bearings shall be contained in the integral hubs of the valve body and shall be self-lubricated sleeve type.
4. COATING. All valves shall be coated with epoxy in conformance to AWWA standard C-515, latest revision. interior wetted ferrous surfaces shall be coated a nominal 10 mils thick for long life; and body exterior shall have a minimum of 3 to 4 mils coating thickness in order to provide superior base for field-applied finish coats.

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APPENDIX A

**GEOTECHNICAL STUDY
PROPOSED GLH INDUSTRIAL PARK PHASE 1
(STRUCTURES AND CITY IMPROVEMENTS)
NORTHEAST OF 700 W AND 2140 N
SPANISH FORK, UTAH
GSH GEOTECHNICAL, INC.
SEPTEMBER 1, 2023
ALAN SPILKER, P.E.**

**REPORT
GEOTECHNICAL STUDY
PROPOSED GLH INDUSTRIAL PARK PHASE 1
(STRUCTURES AND CITY IMPROVEMENTS)
NORTHEAST OF 700 WEST AND 2140 NORTH
SPANISH FORK, UTAH**

Submitted To:

Tom Stuart Construction
259 South Riverbend Way, Suite 100
North Salt Lake, Utah 84054

Submitted By:

GSH Geotechnical, Inc.
473 West 4800 South
Salt Lake City, Utah 84123

September 1, 2023

Job No. 0213-119-23

September 1, 2023
Job No. 0213-119-23

Mr. Spencer Ward
Tom Stuart Construction
259 South Riverbend Way, Suite 100
North Salt Lake, Utah 84054

Mr. Ward:

Re: Report
Geotechnical Study
Proposed GLH Industrial Park Phase 1 (Structures and City Improvements)
Northeast of 700 West and 2140 North
Spanish Fork, Utah

1. INTRODUCTION

1.1 GENERAL

This report presents the results of our geotechnical study performed at the site of the proposed GLH Industrial Park Phase 1 (Structures and City Improvements) to be located northeast of 700 West and 2140 North in Spanish Fork, Utah. The general location of the site with respect to existing roadways, as of 2023, is presented on Figure 1, Vicinity Map. A more detailed layout of the site showing proposed facilities, existing roadways, and the borings drilled in conjunction with this study is presented on Figure 2, Site Plan.

1.2 OBJECTIVES AND SCOPE

The objectives and scope of the study were planned in discussions between Mr. Spencer Ward of Tom Stuart Construction and Mr. Robert Gifford of GSH Geotechnical, Inc. (GSH).

In general, the objectives of this study were to:

1. Define and evaluate the subsurface soil and groundwater conditions across the site.
2. Provide appropriate foundation, earthwork, pavement, and geoseismic recommendations to be utilized in the design and construction of the proposed facilities.

In accomplishing these objectives, our scope has included the following:

1. A field program consisting of the exploration, logging, and sampling of 41 borings.
2. A laboratory testing program.
3. An office program consisting of the correlation of available data, engineering analysis, and the preparation of this summary report.

1.3 AUTHORIZATION

Authorization was provided by returning a signed copy of the Professional Services Agreement No. 23-0340.rev3 dated July 28, 2023.

1.4 PROFESSIONAL STATEMENTS

Supporting data upon which our recommendations are based are presented in subsequent sections of this report. Recommendations presented herein are governed by the physical properties of the soils encountered in the exploration borings, projected groundwater conditions, and the layout and design data discussed in Section 2, Proposed Construction. If subsurface conditions other than those described in this report are encountered and/or if design and layout changes are implemented, GSH must be informed so that our recommendations can be reviewed and amended, if necessary.

Our professional services have been performed, our findings developed, and our recommendations prepared in accordance with generally accepted engineering principles and practices in this area at this time.

2. PROPOSED CONSTRUCTION

The project is to consist of the construction of three (3) office/warehouse/distribution structures with footprints totaling approximately 700,000 square feet and associated pavements. The structures are anticipated to be constructed with tilt-up concrete walls and supported upon conventional spread and continuous wall footings. The city improvements are to include the construction of new public roadways (700 West and 2140 North), a lift station with a 20-foot pit with separate 30-foot deep wet well, and a forcemain sewer alignment. GSH previously completed a preliminary geotechnical study for the site dated November 4, 2021¹ as well as a preliminary seismic study March 15, 2023².

¹ "Preliminary Geotechnical Study, Proposed Spanish Fork Development, Southwest of 4800 South and 600 West, Spanish Fork, Utah" prepared by GSH Geotechnical, Inc., GSH Job No. 2093-018-21.

² "Preliminary Site-Specific Seismic Study, Proposed Spanish Fork Development, Southwest of 4800 South and 600 West, Spanish Fork, Utah" prepared by GSH Geotechnical, Inc., GSH Job No. 0213-110-23.

Maximum real column and wall loads are anticipated to be on the order of up to 220 kips and 5 to 6 kips per lineal foot, respectively. Real loads are defined as the total of all dead plus frequently applied (reduced) live loads.

Paved parking areas, light- and heavy-duty drive lanes, and loading/unloading areas are planned around the structures. New public roadways are to be constructed along 700 West and 2140 North. Projected traffic in the parking areas is anticipated to consist of a light volume of automobiles and light trucks, occasional medium-weight trucks, and no heavyweight trucks. Proposed traffic in the light-duty drive lanes is anticipated to consist of a moderate volume of automobiles and light trucks, a light volume of medium-weight trucks, and occasional heavyweight trucks. Projected traffic in the heavy-duty drive lanes, loading/unloading areas, and public roadways is anticipated to consist of a moderate volume of automobiles, light trucks, and medium-weight trucks with a light volume of heavyweight trucks.

Site development will require some earthwork in the form of minor cutting and filling. At this time, we anticipate that maximum site grading cuts and fills, excluding utilities, will be on the order of 3 to 5 feet.

3. SITE INVESTIGATIONS

3.1 GENERAL

Subsurface conditions in unexplored locations or at other times may vary from those encountered at specific boring locations. If such variations are noted during construction or if project development plans are changed, GSH must review the changes and amend our recommendations, if necessary.

Boring locations were established by estimating distances and angles from site landmarks. If increased accuracy is desired by the client, we recommend that the boring locations and elevations be surveyed.

3.2 FIELD PROGRAM

To define and evaluate the subsurface soil and groundwater conditions across the site, 41 borings were completed within the accessible areas. These borings were completed to depths ranging from 5.0 to 51.5 feet with a truck-mounted drill rig equipped with hollow-stem augers. The approximate locations of the borings are presented on Figure 2.

The field portion of our study was under the direct control and continual supervision of an experienced member of our geotechnical staff. During the course of the drilling operations, a continuous log of the subsurface conditions encountered was maintained. In addition, samples of the typical soils encountered were obtained for subsequent laboratory testing and examination. The soils were classified in the field based upon visual and textural examination. These classifications were supplemented by subsequent inspection and testing in our laboratory. Graphical representation of the subsurface conditions encountered is presented on Figures 3A through 3AO,

Boring Logs. Soils were classified in accordance with the nomenclature described on Figure 4, Key to Boring Log (USCS).

3.25- and 3.0-inch outside diameter, 2.42-inch inside diameter (Dames & Moore) and a 2.0-inch outside diameter, 1.38-inch inside diameter drive sampler (SPT) were utilized at select locations and depths. The blow counts recorded on the boring logs were those required to drive the sampler 12 inches with a 140-pound hammer dropping 30 inches.

Following completion of exploration operations, 1.25-inch diameter slotted PVC pipe was installed in some of the borings to provide a means of monitoring the groundwater fluctuations. The borings were backfilled with auger cuttings.

3.3 LABORATORY TESTING

3.3.1 General

To provide data necessary for our engineering analysis, a laboratory testing program was performed. This program included moisture, density, partial gradation, Atterberg limits, consolidation, laboratory vane shear, CBR, and chemical tests. The following paragraphs describe the tests and summarize the test data.

3.3.2 Moisture and Density Tests

To provide index parameters and to correlate other test data, moisture and density tests were performed on selected samples. The results of these tests are presented on the boring logs, Figures 3A through 3AO.

3.3.3 Partial Gradation Tests

To aid in classifying the granular soils, partial gradation tests were performed. Results of the tests are tabulated below and presented on the boring logs, Figures 3A through 3AO:

Boring No.	Depth (feet)	Percent Passing No. 200 Sieve	Moisture Content Percent	Soil Classification
B-1	25.0	44.7	29.1	SM*
B-1	40.0	17.8	22.6	SM*
B-1	45.0	21.3	29.2	SM*
B-2	5.0	17.9	24.8	SM/SC
B-2	30.0	66.5	30.4	CL^
B-13	15.0	52.9	50.5	CL^

Boring No.	Depth (feet)	Percent Passing No. 200 Sieve	Moisture Content Percent	Soil Classification
B-20	15.0	35.2	25.6	SM*
B-22	15.0	52.3	26.0	CL^
B-23	10.0	86.8	33.1	CL^
B-1A	35.0	54.2	28.8	SM/SC*
B-1A	45.0	56.6	25.3	SM*
B-1A	50.0	45.9	23.9	SM/SC*
B-12A	5.0	58.2	26.6	CL^
B-12A	10.0	45.5	23.7	CL^
B-16A	10.0	31.4	29.5	SM*
B-16A	25.0	44.1	23.3	SM/SC*
B-17A	20.0	70.3	24.3	CL^

*sample contained layer of clay

^sample contained layer of sand

3.3.4 Atterberg Limits Tests

To aid in classifying the soils, Atterberg limits tests were performed on representative samples of the fine-grained cohesive soils. Results of the tests are tabulated below and presented on the boring logs, Figures 3A through 3AO:

Boring No.	Depth (feet)	Liquid Limit (percent)	Plastic Limit (percent)	Plasticity Index (percent)	Soil Classification
B-3	20.0	32	20	12	CL
B-1	50.0	36	23	13	CL

3.3.5 Consolidation Tests

To provide data necessary for our settlement analysis, consolidation testing was performed on 7 representative samples of the natural fine-grained clay soils encountered at the site. The results of these tests indicate that the samples tested were moderately over-consolidated and will exhibit moderate strength and compressibility characteristics under the anticipated loading. Detailed results of the tests are maintained within our files and can be transmitted to you, upon your request.

3.3.6 Laboratory Vane Shear Tests

To determine the undrained shear strength of the clay soils encountered at the site, laboratory vane shear tests were performed. The results of the tests are tabulated below:

Boring No.	Depth (feet)	Soil Type	In-Situ Moisture Content (percent)	Dry Density (pcf)	Ultimate Shear Strength (psf)
B-5	7.5	CL	18.8	103	1,750
B-6	5.0	CL	18.6	102	1,900
B-9	10.0	CL	24.0	95	900
B-16	10.0	CL	24.2	93	1,550
B-21	7.5	CL	22.2	98	1,000
B-24	5.0	CL	18.3	100	1,600
B-13A	10.0	CL	18.2	101	700
B-14A	2.5	CL	25.0	91	500
B-15A	7.5	CL	22.8	95	875
B-15A	10.0	CL	20.5	97	1,000

3.3.7 California Bearing Ratio (CBR) Test

A California Bearing Ratio (CBR) test is currently being performed on a representative sample of clay fill soils obtained from the site. The test is being performed in accordance with the Utah Department of Transportation Procedure 8-9-22 “California Bearing Ratio Soil” as presented in the Utah State Department of Highways Manual of Instruction, Part 8, Materials. The results of the CBR test are pending and may be transmitted when completed, upon your request.

3.3.8 Chemical Tests

A representative soil sample was collected and sent for laboratory analysis for pH and sulfate content. As of the date of this report, results are still pending and will be transmitted when available and with corresponding cement recommendations, if applicable.

4. SITE CONDITIONS

4.1 SURFACE

The site is located at northeast of 700 West and 2140 North in Spanish Fork, Utah. The site is currently vacant/undeveloped brush/grass with an abandoned creek running north to south through the western portion of the site. The areas of the proposed structure footprints have been stripped and grubbed of vegetation. The area of the proposed roadway improvements are currently dirt roads. The topography of the site is relatively flat, grading down to the north with a total relief of approximately 7 to 9 feet. Site vegetation consists of various weeds and brush/grass.

The site is bounded to the north by vacant/undeveloped brush land, 2700 North Street followed by Spanish Fork Municipal Airport runways along with similar vacant/undeveloped brush/grass land; to the east by 500 West Street followed by Spanish Fork Municipal Airport hangars and runways; to the south by 2140 North Street followed by similar vacant/undeveloped brush/grass land; and to the west by similar vacant/undeveloped brush land followed by 800 West Street.

4.2 SUBSURFACE SOIL

The following paragraphs provide generalized descriptions of the subsurface profiles and soil conditions encountered within the borings conducted during this study. As previously noted, soil conditions may vary in unexplored locations.

The borings were completed to depths ranging from 5.0 to 51.5 feet. The soil conditions encountered in each of the borings, to the depths completed, were generally similar across the boring locations.

- Approximately 6 to 8 inches of topsoil was encountered in Borings B-1, B-8 through B-15, B-18 through B-21, and B-1A. Topsoil thickness is frequently erratic and thicker zones of topsoil should be anticipated.
- Non-engineered fill soils were encountered in Borings B-4 through B-24 and B-2A through B-11A, to depths ranging from 2.5 to 8.5 feet beneath the existing ground surface. The non-engineered fill soils primarily consisted of clay with varying silt, sand, and gravel content as well as sand with varying clay, silt, and gravel content.
- Natural soils were encountered below the non-engineered fill or the ground surface in Borings B-1 through B-24 as well as B-1A, B-3A, B-4A, and B-12A through B-17A. The natural soils consisted primarily of clay with varying silt and sand content as well as sand and gravel with varying clay and silt content.

The natural clay soils were very soft to very stiff, slightly moist to saturated, gray, red, and brown in color, and moderately over-consolidated. The natural clay soils are anticipated to exhibit moderate strength and compressibility characteristics under the anticipated loading.

The natural sand soils were loose to medium dense, moist to saturated, and gray and brown in color. The natural sand soils are anticipated to exhibit moderately high strength and moderately low compressibility characteristics under the anticipated load range.

For a more descriptive interpretation of subsurface conditions, please refer to Figures 3A through 3AO, Boring Logs. The lines designating the interface between soil types on the boring logs generally represent approximate boundaries. In situ, the transition between soil types may be gradual.

4.3 GROUNDWATER

On August 29, 2023 (8 days following drilling), groundwater was measured within the PVC pipes installed as tabulated below:

Boring No.	Groundwater Depth (feet)
	August 29, 2023
B1	8.0
B-2	8.1
B-3	9.5
B-4	7.6
B-6	7.7
B-9	8.5
B-10	7.3
B-11	11.1
B-13	10.0
B-15	10.0
B-17	9.1
B-19	10.2
B-20	8.8
B-22	9.0
B-24	9.7
B-1A	9.0

Boring No.	Groundwater Depth (feet)
	August 29, 2023
B-12A	6.0
B-13A	2.5
B-14A	3.1
B-15A	4.5
B-16A	3.0
B-17A	5.4

Groundwater levels vary with changes in season and rainfall, construction activity, irrigation, snow melt, surface water run-off, and other site-specific factors.

5. DISCUSSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

The proposed structures may be supported upon conventional spread and continuous wall foundations supported upon suitable natural soils and/or structural fill extending to suitable natural soils.

The most significant geotechnical aspects at the site are:

1. The existing non-engineered fills across much of the site.
2. The relatively shallow depth to groundwater.

Prior to proceeding with construction, removal of any existing debris, surface vegetation, root systems, topsoil, non-engineered fill, and any deleterious materials from beneath an area extending out at least 5 feet from the perimeter of the proposed structure footprints and 3 feet beyond pavements and exterior flatwork areas will be required. All existing utility locations should be reviewed to assess their impact on the proposed construction and abandoned and/or relocated as appropriate.

Due to the developed nature of this site and the surrounding area, additional non-engineered fills may exist in unexplored areas of the site. Based on our experience, non-engineered fills are frequently erratic in composition and consistency. All surficial loose/disturbed soils and non-engineered fills must be removed below all footings, floor slabs, and pavements.

Some of the on-site non-engineered fill soils encountered were granular. On-site granular soils, including existing non-engineered fills, may be re-utilized as structural site grading fill if they meet the criteria for such, as stated later in this report.

Groundwater was measured as shallow as 2.5 feet below the ground surface. GSH recommends placing floor slabs no closer than 4 feet from the highest groundwater elevation. Site grading fill may be utilized to raise the overall grade to achieve the required separation between the floor slab and the highest groundwater elevation.

Proof rolling of the natural clay subgrade must not be completed if cuts extend to within 1 foot of the groundwater surface. In areas where cuts are to extend to within 1 foot of the groundwater surface, stabilization must be anticipated.

To reduce disturbance of the natural soils during excavation, it is recommended that low-impact, track-mounted equipment with smooth edge buckets/blades be utilized.

Detailed discussions pertaining to earthwork, foundations, pavements, and the geoseismic setting of the site are presented in the following sections.

5.2 EARTHWORK

5.2.1 Site Preparation

Initial site preparation will consist of the removal of any existing debris, non-engineered fills, surface vegetation, root systems, topsoil, and any deleterious materials from beneath an area extending out at least 5 feet from the perimeter of the proposed structure footprint and 3 feet beyond pavements and exterior flatwork areas. All existing utility locations should be reviewed to assess their impact on the proposed construction and abandoned and/or relocated as appropriate.

Subsequent to stripping and prior to the placement of floor slabs, foundations, structural site grading fills, exterior flatwork, and pavements, the exposed subgrade must be proof rolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. If excessively soft or otherwise unsuitable soils are encountered beneath footings, they must be completely removed. If removal depth required is greater than 2 feet below footings, GSH must be notified to provide further recommendations. In pavement, floor slab, and outside flatwork areas, unsuitable natural soils shall be removed to a maximum depth of 2 feet and replaced with compacted granular structural fill.

Subgrade preparation as described must be completed prior to placing overlying structural site grading fills.

Due to the relatively high groundwater, site grading cuts should be kept to a minimum. Cuts extending to within 1 foot of the groundwater elevation will likely disturb the natural clay soils

and proof rolling must not be completed. Stabilization must be anticipated in areas where cuts are to extend to within 1 foot of the groundwater surface.

To reduce disturbance of the natural soils during excavation, it is recommended that low-impact, track-mounted equipment with smooth edge buckets/blades be utilized.

GSH must be notified prior to the placement of structural site grading fills, floor slabs, footings, and pavements to verify that all loose/disturbed soils and non-engineered fills have been completely removed.

5.2.2 Temporary Excavations

Temporary excavations up to 8 feet deep in fine-grained cohesive soils, above or below the water table, may be constructed with sideslopes no steeper than one-half horizontal to one vertical (0.5H:1.0V). Excavations deeper than 8 feet are not anticipated at the site.

For granular (cohesionless) soils, construction excavations above the water table, not exceeding 4 feet, shall be no steeper than one-half horizontal to one vertical (0.5H:1.0V). For excavations up to 8 feet, in granular soils and above the water table, the slopes shall be no steeper than one horizontal to one vertical (1H:1V). Excavations encountering saturated cohesionless soils will be very difficult and will require very flat sideslopes and/or shoring, bracing, and dewatering.

To reduce disturbance of the natural soils during excavation, it is recommended that low-impact, track-mounted equipment with smooth edge buckets/blades be utilized.

The static groundwater table was encountered as shallow as 2.5 feet below the existing surface and may be shallower with seasonal fluctuations. Consideration for dewatering of utility trenches, excavations for the removal of non-engineered fill, installation of pits and wet wells, and other excavations below this level should be incorporated into the design and bidding process.

All excavations must be inspected periodically by qualified personnel. If any signs of instability or excessive sloughing are noted, immediate remedial action must be initiated.

5.2.3 Structural Fill

Structural fill is defined as all fill which will ultimately be subjected to structural loadings, such as imposed by footings, floor slabs, pavements, etc. Structural fill will be required as backfill over foundations and utilities, as site grading fill, and as replacement fill below footings. All structural fill must be free of surface vegetation, root systems, rubbish, topsoil, frozen soil, and other deleterious materials.

Structural site grading fill is defined as structural fill placed over relatively large open areas to raise the overall grade. For structural site grading fill, the maximum particle size shall not exceed 4 inches; although, occasional larger particles, not exceeding 8 inches in diameter, may be

incorporated if placed randomly in a manner such that “honeycombing” does not occur, and the desired degree of compaction can be achieved. The maximum particle size within structural fill placed within confined areas shall be restricted to 2 inches.

On-site soils, including existing non-engineered fills, may be re-utilized as structural site grading fill if they do not contain construction debris or deleterious material and meet the requirements of structural fill. Fine-grained soils will require very close moisture control and may be very difficult, if not impossible, to properly place and compact during wet and cold periods of the year.

Imported structural fill below foundations and floor slabs shall consist of a well graded sand and gravel mixture with less than 30 percent retained on the three-quarter-inch sieve and less than 20 percent passing the No. 200 Sieve (clays and silts).

To stabilize soft subgrade conditions (if encountered) or where structural fill is required to be placed closer than 2.0 feet above the water table at the time of construction, a mixture of coarse angular gravels and cobbles and/or 1.5- to 2.0-inch gravel (stabilizing fill) shall be utilized. It may also help to utilize a stabilization fabric, such as Mirafi 600X or equivalent, placed on the natural ground if 1.5- to 2.0-inch gravel is used as stabilizing fill.

5.2.4 Fill Placement and Compaction

All structural fill shall be placed in lifts not exceeding 8 inches in loose thickness. Structural fills shall be compacted in accordance with the percent of the maximum dry density as determined by the AASHTO³ T180 (ASTM⁴ D1557) compaction criteria in accordance with the following table:

Location	Total Fill Thickness (feet)	Minimum Percentage of Maximum Dry Density
Beneath an area extending at least 5 feet beyond the perimeter of the structure	0 to 5	95
	5 to 10*	100
Site grading fills outside area defined above	0 to 5	90
	5 to 10*	100
Utility trenches within structural areas	--	96
Road base	--	96

* For structural fill sequences greater than 5 feet thick and up to 10 feet thick, the entire fill sequence must be compacted to 100 percent of the maximum dry density and compaction shall be performed at 0- to 3-percent over the optimum moisture content.

³ American Association of State Highway and Transportation Officials

⁴ American Society for Testing and Materials

Structural fills greater than 10 feet thick are not anticipated at the site.

Subsequent to stripping and prior to the placement of structural site grading fill, the subgrade shall be prepared as discussed in Section 5.2.1, Site Preparation, of this report. In confined areas, subgrade preparation shall consist of the removal of all loose or disturbed soils.

Coarse angular gravel and cobble mixtures (stabilizing fill), if utilized, shall be end dumped, spread to a maximum loose lift thickness of 15 inches, and compacted by dropping a backhoe bucket onto the surface continuously at least twice. As an alternative, the stabilizing fill may be compacted by passing moderately heavy construction equipment or large self-propelled compaction equipment over the surface at least twice. Subsequent fill material placed over the coarse gravels and cobbles shall be adequately compacted so that the “fines” are “worked into” the voids in the underlying coarser gravels and cobbles. Where soil fill materials are to be placed directly over more than about 18 inches of clean gravel, a separation geofabric, such as Mirafi 140N or equivalent, is recommended to be placed between the gravel and subsequent soil fills.

Non-structural fill may be placed in lifts not exceeding 12 inches in loose thickness and compacted by passing construction, spreading, or hauling equipment over the surface at least twice.

5.2.5 Utility Trenches

All utility trench backfill material below structurally loaded facilities (footings, floor slabs, flatwork, pavements, etc.) shall be placed at the same density requirements established for structural fill. If the surface of the backfill becomes disturbed during the course of construction, the backfill shall be proof rolled and/or properly compacted prior to the construction of any exterior flatwork over a backfilled trench. Proof rolling shall be performed by passing moderately loaded rubber tire-mounted construction equipment uniformly over the surface at least twice. If excessively loose or soft areas are encountered during proof rolling, they shall be removed to a maximum depth of 2 feet below design finish grade and replaced with structural fill.

Many utility companies and City-County governments are now requiring that Type A-1a or A-1b (AASHTO Designation – granular soils with limited fines) soils be used as backfill over utilities. These organizations are also requiring that in public roadways, the backfill over major utilities be compacted over the full depth of fill to at least 96 percent of the maximum dry density as determined by the AASHTO T180 (ASTM D1557) method of compaction. GSH recommends that as the major utilities continue onto the site that these compaction specifications are followed.

Fine-grained soils, such as silts and clays, are not recommended for utility trench backfill in structural areas.

The static groundwater table was encountered as shallow as 2.5 feet below the existing surface and may be shallower with seasonal fluctuations. Dewatering of utility trenches, pits, wet wells, and other excavations below this level should be anticipated.

To reduce disturbance of the natural soils during excavation, it is recommended that low-impact, track-mounted equipment with smooth edge buckets/blades be utilized.

5.3 GROUNDWATER

On August 29, 2023 (8 days following drilling), groundwater was measured within the PVC pipes installed as tabulated below:

Boring No.	Groundwater Depth (feet)
	August 29, 2023
B1	8.0
B-2	8.1
B-3	9.5
B-4	7.6
B-6	7.7
B-9	8.5
B-10	7.3
B-11	11.1
B-13	10.0
B-15	10.0
B-17	9.1
B-19	10.2
B-20	8.8
B-22	9.0
B-24	9.7
B-1A	9.0
B-12A	6.0
B-13A	2.5
B-14A	3.1
B-15A	4.5

Boring No.	Groundwater Depth (feet)
	August 29, 2023
B-16A	3.0
B-17A	5.4

Based on the anticipated cuts necessary to reach design subgrades, we anticipate temporary and permanent dewatering will be necessary. Floor slabs must be placed a minimum of 4 feet from the stabilized groundwater elevation. Site grading fill may be utilized to raise the overall grade to achieve the required separation between the floor slab and the highest groundwater elevation.

The groundwater measurements presented are conditions at the time of the field exploration and may not be representative of other times or locations. Groundwater levels may vary seasonally and with precipitation, as well as other factors including irrigation. Evaluation of these factors is beyond the scope of this study. Groundwater levels may, therefore, be at shallower or deeper depths than those measured during this study, including during construction and over the life of the structure.

The extent and nature of any dewatering required during construction will be dependent on the actual groundwater conditions prevalent at the time of construction and the effectiveness of construction drainage to prevent run-off into open excavations.

5.4 SPREAD AND CONTINUOUS WALL FOUNDATIONS

5.4.1 Design Data

The results of our analysis indicate that the proposed structures may be supported upon conventional spread and continuous wall foundations established upon suitable natural soils and/or structural fill extending to suitable natural soils. Under no circumstances shall foundations be established over non-engineered fills, loose or disturbed soils, topsoil, surface vegetation, root systems, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. More heavily loaded footings will require a certain amount of granular structural replacement fill as specified in Section 5.4.3, Settlements, of this report. For design, the following parameters are provided:

Minimum Recommended Depth of Embedment for Frost Protection	- 30 inches
Minimum Recommended Depth of Embedment for Non-frost Conditions	- 15 inches

Recommended Minimum Width for Continuous Wall Footings	- 18 inches
Minimum Recommended Width for Isolated Spread Footings	- 24 inches
Recommended Net Bearing Capacity for Real Load Conditions	- 1,500 pounds per square foot
Bearing Capacity Increase for Seismic Loading	- 50 percent

The term “net bearing capacity” refers to the allowable pressure imposed by the portion of the structure located above lowest adjacent final grade. Therefore, the weight of the footing and backfill to lowest adjacent final grade need not be considered. Real loads are defined as the total of all dead plus frequently applied live loads. Total load includes all dead and live loads, including seismic and wind.

5.4.2 Installation

Under no circumstances shall the footings be installed upon non-engineered fills, loose or disturbed soils, topsoil, surface vegetation, root systems, rubbish, construction debris, or other deleterious materials. If unsuitable soils are encountered, they must be removed and replaced with compacted granular fill. If granular soils become loose or disturbed, they must be recompacted prior to pouring the concrete.

The width of structural replacement fill below footings shall be equal to the width of the footing plus one foot for each foot of fill thickness.

5.4.3 Settlements

Granular structural replacement fill will be required under more heavily loaded footings. For the required amount, refer to the table on the following page.

Foundations	Loading	Minimum Thickness of Replacement Structural Granular Fill (feet)
Wall	Up to 5 kips per lineal foot	0
	5 kips to 6 kips per lineal foot	1.0
Spread	Up to 60 kips	0
	60 kips to 100 kips	1.0
	100 kips to 150 kips	2.0
	150 kips to 220 kips	3.0

Based on column loadings, soil bearing capacities, and the foundation recommendations as discussed above, we expect primary total settlement beneath individual foundations to be less than one inch.

The amount of differential settlement is difficult to predict because the subsurface and foundation loading conditions can vary considerably across the site. However, we anticipate differential settlement between adjacent foundations could vary from 0.5 to 0.75 inch. The final deflected shape of the structure will be dependent on actual foundation locations and loading.

5.5 LATERAL RESISTANCE

Lateral loads imposed upon foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footings and the supporting soils. In determining frictional resistance, a coefficient of friction of 0.35 may be utilized for the footing interface with in-situ natural clay soils and 0.40 for footing interface with natural granular soils or granular structural fill. Passive resistance provided by properly placed and compacted granular structural fill above the water table may be considered equivalent to a fluid with a density of 300 pounds per cubic foot. Below the water table, this granular soil shall be considered equivalent to a fluid with a density of 150 pounds per cubic foot.

A combination of passive earth resistance and friction may be utilized provided that the friction component of the total is divided by 1.5.

5.6 LATERAL PRESSURES

Parameters, as presented within this section, are for backfills which will consist of drained soil placed and compacted in accordance with the recommendations presented herein.

The lateral pressures imposed upon subgrade facilities will, therefore, be basically dependent upon the relative rigidity and movement of the backfilled structure. For active walls, such as retaining walls which can move outward (away from the backfill), drained backfill may be considered

equivalent to a fluid with a density of 40 pounds per cubic foot in computing lateral pressures. For more rigid subgrade walls that are not more than 10 inches thick, granular backfill may be considered equivalent to a fluid with a density of 50 pounds per cubic foot. For very rigid non-yielding walls, granular backfill shall be considered equivalent to a fluid with a density of at least 60 pounds per cubic foot. The above values assume that the surface of the soils slope behind the wall is horizontal and that the granular fill within 3 feet of the wall will be compacted with hand-operated compacting equipment.

For seismic loading of below-grade walls, the uniform lateral pressures below, in pounds per square foot (psf), shall be added based on wall depth and wall case:

Uniform Lateral Pressures			
Wall Height (Feet)	Active Pressure Case (psf)	Moderately Yielding Case (psf)	At Rest/Non-Yielding Case (psf)
4	23	49	75
6	34	73	112
8	45	97	149
10	56	121	187
12	68	146	224
14	79	170	261
16	90	194	299
18	101	219	336
20	113	243	373

5.7 FLOOR SLABS

Floor slabs may be established upon suitable natural subgrade soils or structural fill extending to suitable natural soils. Under no circumstances shall floor slabs be established directly over non-engineered fills, loose or disturbed soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water.

Additionally, GSH recommends that floor slabs be constructed a minimum of 4.0 feet from the stabilized groundwater elevation. Site grading fill may be utilized to raise the overall grade to achieve the required separation between the floor slab and the highest groundwater elevation.

To facilitate curing of the concrete and to provide a capillary moisture break, it is recommended that floor slabs be directly underlain by at least 4 inches of “free-draining” fill, such as “pea” gravel or three-quarters to one inch minus clean gap-graded gravel.

Settlement of lightly loaded floor slabs designed according to previous recommendations (average uniform pressure of 200 pounds per square foot or less) is anticipated to be less than one-quarter of an inch.

5.8 PAVEMENTS

The natural clay soils and non-engineered fills will exhibit poor pavement support characteristics when saturated. All pavement areas must be prepared as previously discussed (see Section 5.2.1, Site Preparation). Under no circumstances shall pavements be established over non-engineered fills, loose or disturbed soils, topsoil, surface vegetation, root systems, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. With the subgrade soils, an estimated CBR of 6.5, and the estimated projected traffic provided via traffic study performed by Hales Engineering, the following pavement sections are recommended:

Parking Areas

(600 Automobiles and Light Trucks,
 24 Medium-Weight Trucks,
 and No Heavyweight Trucks)
 [13 equivalent 18-kip axle loads per day]

Flexible Pavements: (Asphalt Concrete)

3.0 inches	Asphalt concrete
8.0 inches	Aggregate base
Over	Properly prepared and stabilized natural subgrade soils and/or structural site grading fill extending to properly prepared and stabilized natural subgrade soils

Rigid Pavements: (Non-reinforced Concrete)

5.0 inches	Portland cement concrete (non-reinforced)
5.0 inches	Aggregate base

Over	Properly prepared and stabilized natural subgrade soils and/or structural site grading fill extending to properly prepared and stabilized natural subgrade soils
------	--

Light-Duty Drive Lanes

(600 Automobiles and Light Trucks,
 24 Medium-Weight Trucks,
 and 6 Heavyweight Trucks)
 [29 equivalent 18-kip axle loads per day]

Flexible Pavements:
 (Asphalt Concrete)

3.5 inches	Asphalt concrete
------------	------------------

9.0 inches	Aggregate base
------------	----------------

Over	Properly prepared and stabilized natural subgrade soils and/or structural site grading fill extending to properly prepared and stabilized natural subgrade soils
------	--

Rigid Pavements:
 (Non-reinforced Concrete)

6.0 inches	Portland cement concrete (non-reinforced)
------------	--

5.0 inches	Aggregate base
------------	----------------

Over	Properly prepared and stabilized natural subgrade soils and/or structural site grading fill extending to properly prepared and stabilized natural subgrade soils
------	--

Heavy-Duty Drive Lanes and Loading/Unloading Areas
for Building/Lot #1

(425 Automobiles, Light Trucks,
 14 Medium-Weight Trucks,
 And 94 Heavyweight Trucks)
 [253 equivalent 18-kip axle loads per day]

Flexible Pavements:
 (Asphalt Concrete)

4.5 inches	Asphalt concrete
9.0 inches	Aggregate base
9.5 inches*	Aggregate subbase
Over	Properly prepared and stabilized natural subgrade soils and/or structural site grading fill extending to properly prepared and stabilized natural subgrade soils

** Subbase may consist of granular site grading fills with a minimum California Bearing Ratio (CBR) of 30 percent.

Rigid Pavements:
 (Non-reinforced Concrete)

7.0 inches	Portland cement concrete (non-reinforced)
7.0 inches	Aggregate base
Over	Properly prepared and stabilized natural subgrade soils and/or structural site grading fill extending to properly prepared and stabilized natural subgrade soils

Heavy-Duty Drive Lanes and Loading/Unloading Areas
 for Buildings/Lots #2 and #3

(210 Automobiles, Light Trucks,
 7 Medium-Weight Trucks,
 And 47 Heavyweight Trucks)
 [127 equivalent 18-kip axle loads per day]

Flexible Pavements:
 (Asphalt Concrete)

4.0 inches	Asphalt concrete
8.0 inches	Aggregate base
8.0 inches*	Aggregate subbase
Over	Properly prepared and stabilized natural subgrade soils and/or structural site grading fill extending to properly prepared and stabilized natural subgrade soils

** Subbase may consist of granular site grading fills with a minimum California Bearing Ratio (CBR) of 30 percent.

Rigid Pavements:
 (Non-reinforced Concrete)

6.0 inches	Portland cement concrete (non-reinforced)
7.0 inches	Aggregate base
Over	Properly prepared and stabilized natural subgrade soils and/or structural site grading fill extending to properly prepared and stabilized natural subgrade soils

Public Roadways
(700 West and 2140 North)

(1,700 Automobiles, Light Trucks,
 54 Medium-Weight Trucks,
 And 376 Heavyweight Trucks)
 [1,013 equivalent 18-kip axle loads per day]

Flexible Pavements:
 (Asphalt Concrete)

6.0 inches	Asphalt concrete
11.0 inches	Aggregate base
12.0 inches*	Aggregate subbase
Over	Properly prepared and stabilized natural subgrade soils and/or structural site grading fill extending to properly prepared and stabilized natural subgrade soils

** Subbase may consist of granular site grading fills with a minimum California Bearing Ratio (CBR) of 30 percent.

For dumpster pads, we recommend a pavement section consisting of 8.0 inches of Portland cement concrete, 12.0 inches of aggregate base, over properly prepared natural subgrade or site grading structural fills. Dumpster pads shall not be constructed overlying non-engineered fills under any circumstances.

These rigid pavement sections are for non-reinforced Portland cement concrete. Concrete shall be designed in accordance with the American Concrete Institute (ACI) and joint details shall conform to the Portland Cement Association (PCA) guidelines. The concrete shall have a minimum 28-day unconfined compressive strength of 4,000 pounds per square inch and contain 6 percent $\pm$ 1 percent air-entrainment.

The crushed stone shall conform to applicable sections of the current Utah Department of Transportation (UDOT) Standard Specifications. All asphalt material and paving operations shall meet applicable specifications of the Asphalt Institute and UDOT. A GSH technician shall observe placement and perform density testing of the base course material and asphalt.

Please note that the recommended pavement section is based on estimated post-construction traffic loading. If the pavement is to be constructed and utilized by construction traffic, the above pavement section may prove insufficient for heavy truck traffic, such as concrete trucks or tractor-trailers used

for construction delivery. Unexpected distress, reduced pavement life, and/or premature failure of the pavement section could result if subjected to heavy construction traffic and the owner should be made aware of this risk. If the estimated traffic loading stated herein is not correct, GSH must review actual pavement loading conditions to determine if revisions to these recommendations are warranted.

5.9 CEMENT TYPES

A representative soil sample was collected and sent for laboratory analysis for pH and sulfate content. As of the date of this report, results are still pending and will be transmitted when available and with corresponding cement recommendations, if applicable.

5.10 GEOSEISMIC SETTING

5.10.1 General

Utah municipalities have adopted the International Building Code (IBC) 2021. The IBC 2021 code refers to ASCE 7-16 Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE 7-16) determines the seismic hazard for a site based upon mapping of bedrock accelerations prepared by the United States Geologic Survey (USGS) and the soil site class. The USGS values are presented on maps incorporated into the IBC code and are also available based on latitude and longitude coordinates (grid points). GSH concurrently conducted refraction microtremor (ReMi) testing to obtain the shear-wave velocities for the site. Results of the ReMi tests were used to determine the observed site class and site-specific ground motions. Results of these tests as well as the summary report will be included as Attachment 1, Site-Specific Seismic Study.

5.10.2 Faulting

Based on our review of available literature, no active faults pass through or immediately adjacent to the site. The nearest active mapped fault consists of the Provo Section of the Wasatch Fault, located about 3.0 miles to the northeast of the site.

5.10.3 Liquefaction

The site is located in an area that has been identified by the Utah Geological Survey (UGS) as being a “high” liquefaction potential zone. Liquefaction is defined as the condition when saturated, loose, granular soils lose their support capabilities because of excessive pore water pressure, which develops during a seismic event. Clayey soils, even if saturated, will generally not liquefy during a major seismic event.

Due to the clayey nature of the soils as well as the interbedded clay layers within the granular soil sequences, liquefaction is not anticipated to occur within the soils encountered at this site.

5.11 SITE VISITS

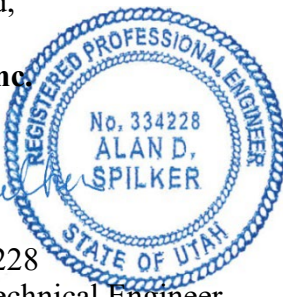
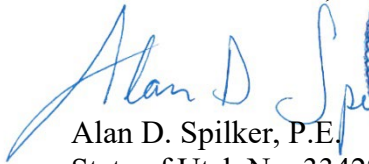
GSH must verify that all topsoil/disturbed soils, non-engineered fills, and any other unsuitable soils have been removed, and that suitable soils have been encountered prior to placing site grading fills, footings, slabs, and pavements. Additionally, GSH must observe fill placement and verify in-place moisture content and density of fill materials placed at the site.

6. CLOSURE

If you have any questions or would like to discuss these items further, please feel free to contact us at (801) 685-9190.

Respectfully submitted,

GSH Geotechnical, Inc.



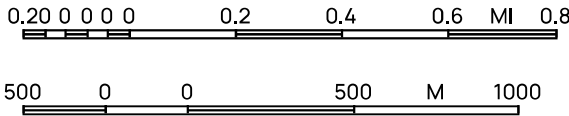
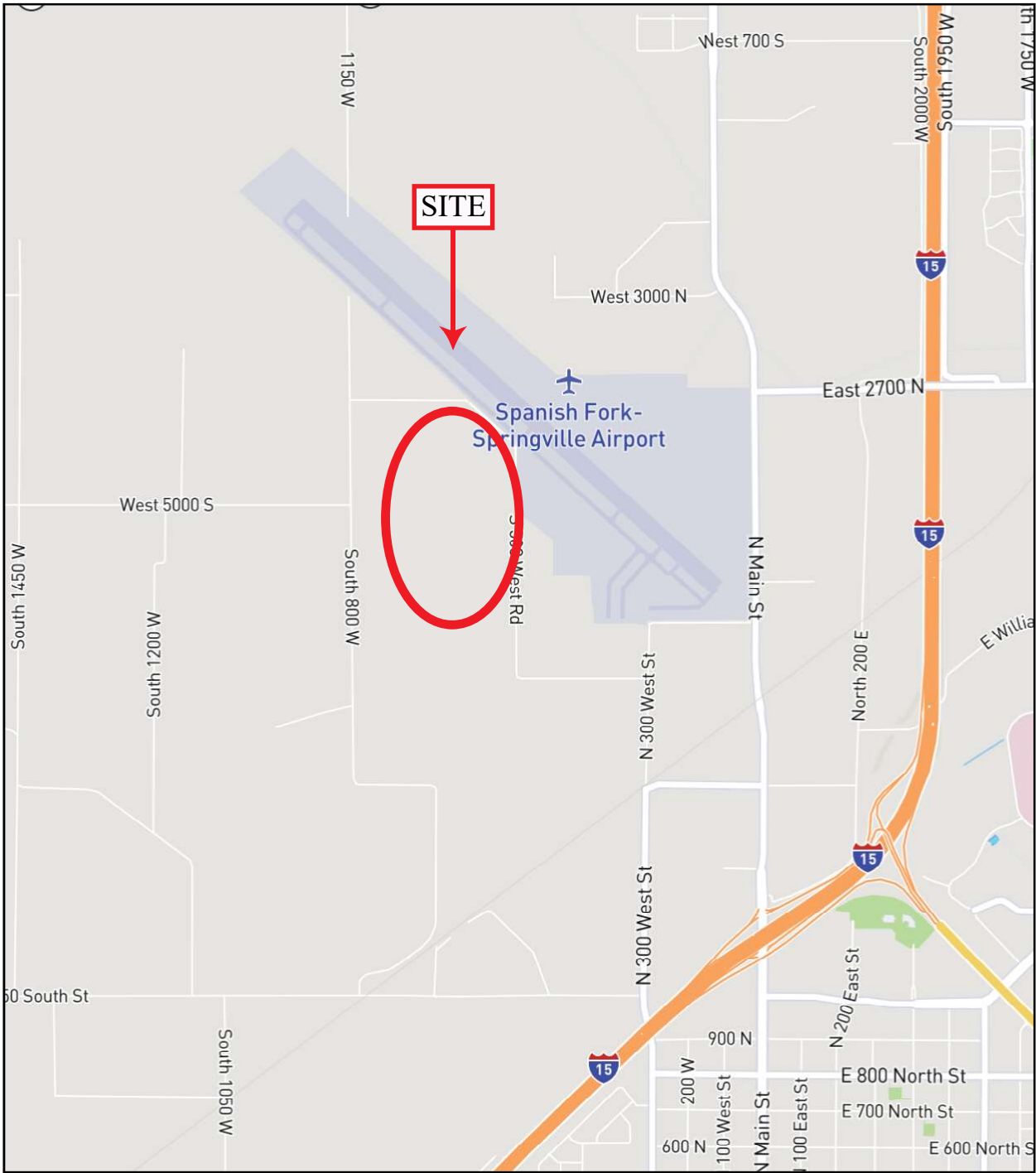
Alan D. Spilker, P.E.
State of Utah No. 334228
President/Senior Geotechnical Engineer

ADS:jmt

Encl. Figure 1, Vicinity Map
Figure 2, Site Plan
Figures 3A through 3AO, Boring Logs
Figure 4, Key to Boring Log (USCS)
Attachment 1, Site-Specific Seismic Study

Addressee (email)

cc: katie@tomstuart.com
eneil@bowencollins.com
katiez@tomstuart.com
Hennefer@yahoo.com



REFERENCE:
ALL TRAILS - NATIONAL GEOGRAPHIC TERRAIN
DATED 2023

FIGURE 1
VICINITY MAP
 GSH



APPROXIMATE SCALE IN FEET

150 0 150 300



GSH

BORING LOG

Page: 1 of 2

BORING: B-1

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements) DATE STARTED: 8/14/23 DATE FINISHED: 8/14/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 8.0' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
	CL	Ground Surface	0								slightly moist medium stiff
		SILTY CLAY with some fine to coarse sand; brown grades with some fine sand		6							
			5								very soft
				1							
				1							saturated
			10								
				2							
			15								
				2							
			20								medium stiff
				7							
			25								
	SM	SILTY FINE TO COARSE SAND with layers of silty clay up to 5" thick; brown									saturated medium dense

See Subsurface Conditions section in the report for additional information.

FIGURE 3A



GSH

BORING LOG

Page: 2 of 2

BORING: B-1

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements)

DATE STARTED: 8/14/23

DATE FINISHED: 8/14/23

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
			25								
				16		29.1		44.7			
	CL	SILTY CLAY with some fine to medium sand; brown									saturated medium stiff
			30								
				7							
			35								stiff
				10							
	SM	SILTY FINE TO MEDIUM SAND brown/black grades with layers of silty clay up to 1/2" thick									saturated medium dense
			40			22.6		17.8			
		grades with layers of silty clay up to 1" thick									
			45			29.2		21.3			
				14							
	CL	SILTY CLAY with trace fine sand; brown/gray									saturated very stiff
			50						36	13	
				19							
		End of Exploration at 50.5'. Installed 1.25" diameter slotted PVC pipe to 50.5'.									

See Subsurface Conditions section in the report for additional information.

FIGURE 3A
(continued)



GSH

BORING LOG

Page: 1 of 2

BORING: B-2

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements)

DATE STARTED: 8/14/23

DATE FINISHED: 8/14/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 8.1' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist medium stiff
	CL	SILTY CLAY with some fine to medium sand; brown		6							
	SM/ SC	SILTY/CLAYEY FINE TO MEDIUM SAND brown	5	4		24.8		17.9			moist loose
	CL	FINE SANDY CLAY brown	10	0							saturated saturated very soft
		grades with layers of fine to medium sand up to 2" thick	15	2							
		grades with trace sand	20	3							soft
		grades with trace fine to coarse sand	25								medium stiff

See Subsurface Conditions section in the report for additional information.

FIGURE 3B



GSH

BORING LOG

Page: 2 of 2

BORING: B-2

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements)

DATE STARTED: 8/14/23

DATE FINISHED: 8/14/23

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
			25								
				6							
		grades with layers of fine to coarse sand up to 4" thick and trace clay									
			30	15		30.4		66.5			stiff
	GP	FINE AND COARSE GRAVEL with fine to coarse sand; brown/gray									saturated very dense
			35	75							
		grades with trace sand									
			40	49							
		grades with layers of silty fine to coarse sand up to 2" thick	45	37							dense
		End of Exploration at 45.5'. Installed 1.25" diameter slotted PVC pipe to 45.5'.									
			50								

See Subsurface Conditions section in the report for additional information.

FIGURE 3B
(continued)



GSH

BORING LOG

Page: 1 of 2

BORING: B-3

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements)

DATE STARTED: 8/14/23

DATE FINISHED: 8/14/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 9.5' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist medium stiff
	CL	FINE SANDY CLAY brown		5							
		grades brown/red	5	3							soft
		grades silty clay with trace sand; brown	10	2							saturated
		grades fine sandy clay	15	3							
		grades silty clay with some fine sand	20	4					32	12	medium stiff
		grades with sand	25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3C



GSH

BORING LOG

Page: 2 of 2

BORING: B-3

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements)

DATE STARTED: 8/14/23

DATE FINISHED: 8/14/23

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
			25								
				6							
			30								
				6							
		grades with trace sand; brown/red									stiff
			35								
				9							
			40								
				12							
		GP/ GM FINE AND COARSE GRAVEL with fine to coarse sand and some silt; brown									saturated dense
			45								
				37							
		End of Exploration at 45.5'. Installed 1.25" diameter slotted PVC pipe to 45.5'.									
			50								

See Subsurface Conditions section in the report for additional information.

FIGURE 3C
(continued)



GSH

BORING LOG

Page: 1 of 1

BORING: B-4

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements)

DATE STARTED: 8/15/23

DATE FINISHED: 8/15/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 7.6' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist medium stiff
	CL FILL	FINE TO MEDIUM SANDY CLAY, FILL brown		9	⊗						
			5	4	⊗						moist soft
											saturated
			10	0	⊗						very soft
		grades fine sandy clay		4	⊗						soft
		End of Exploration at 15.5'. Installed 1.25" diameter slotted PVC pipe to 15.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3D



GSH

BORING LOG

Page: 1 of 1

BORING: B-5

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements) DATE STARTED: 8/15/23 DATE FINISHED: 8/15/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 6.0' (8/15/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist medium dense
	SM/ SC FILL	SILTY/CLAYEY FINE TO MEDIUM SAND, FILL with trace clay; brown		25							
	CL	FINE SANDY CLAY brown	5								moist medium stiff saturated
				9		18.8	103				
			10	0							very soft
		End of Exploration at 10.5'.									
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3E



GSH

BORING LOG

Page: 1 of 1

BORING: B-6

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements)

DATE STARTED: 8/15/23

DATE FINISHED: 8/15/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 7.7' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	FINE TO COARSE SANDY CLAY, FILL brown									dry medium stiff
	SM/ SC FILL	SILTY/CLAYEY FINE TO MEDIUM SAND, FILL brown		20							slightly moist loose
	CL	FINE SANDY CLAY brown	5	4		18.6	102				moist soft
		grades with layers of fine to coarse sand up to 1" thick	10	4							
		grades silty clay with layers of fine to medium sand up to 1/2" thick	15	5		36.2	82				medium stiff
		End of Exploration at 15.5'. Installed 1.25" diameter slotted PVC pipe to 15.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3F



GSH

BORING LOG

Page: 1 of 1

BORING: B-7

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements)

DATE STARTED: 8/15/23

DATE FINISHED: 8/15/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 9.0' (8/15/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist stiff
	SM/ SC FILL	SILTY/CLAYEY FINE TO COARSE SAND, FILL with some fine and coarse gravel and trace clay; brown		18							
			5								
	CL	FINE TO MEDIUM SANDY CLAY brown		18							moist stiff
			10	4		30.7	88				saturated soft
		End of Exploration at 11.0'.									
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3G



GSH

BORING LOG

Page: 1 of 1

BORING: B-8

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements)

DATE STARTED: 8/15/23

DATE FINISHED: 8/15/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 7.0' (8/15/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist loose moist soft saturated
	SM/ SC FILL	SILTY FINE TO COARSE SAND, FILL with some clay; brown		10							
	CL	SILTY CLAY with trace fine sand; brown	5	4							
			10	3							
			15	4							
		End of Exploration at 15.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3H



GSH

BORING LOG

Page: 1 of 1

BORING: B-9

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements)

DATE STARTED: 8/15/23

DATE FINISHED: 8/15/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 8.5' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist loose
	SM/ SC FILL	SILTY/CLAYEY FINE TO MEDIUM SAND, FILL with trace clay; brown		10	✕						
			5								
				16	✕						
	CL	SILTY CLAY with some fine to medium sand; brown	10	3	✕	24.0	95				saturated soft
			15	4	✕						
		End of Exploration at 15.5'. Installed 1.25" diameter slotted PVC pipe to 15.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 31



GSH

BORING LOG

Page: 1 of 1

BORING: B-10

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements) DATE STARTED: 8/15/23

DATE FINISHED: 8/15/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 7.3' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist loose
	SM/ SC FILL	SILTY FINE TO COARSE SAND, FILL with trace clay; brown		11							
	CL	FINE SANDY CLAY brown	5	4		33.6	89				very moist soft
											saturated
			10	0							very soft
		grades silty clay with trace fine sand; brown/red									
			15	0							
			20	4		29.4	93				soft
		End of Exploration at 20.5'. Installed 1.25" diameter slotted PVC pipe to 20.5'.									
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3J



GSH

BORING LOG

Page: 1 of 1

BORING: B-11

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements)

DATE STARTED: 8/15/23

DATE FINISHED: 8/15/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 11.1' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist loose
	SM/ SC FILL	SILTY/CLAYEY FINE TO COARSE SAND, FILL with trace clay; brown		24							moist medium stiff
	CL	FINE TO MEDIUM SANDY CLAY brown	5	9							
		grades fine to coarse sandy clay	10	3		25.8	100				soft saturated
			15	3							
		End of Exploration at 15.5'. Installed 1.25" diameter slotted PVC pipe to 15.5'.									

See Subsurface Conditions section in the report for additional information.

FIGURE 3K



GSH

BORING LOG

Page: 1 of 1

BORING: B-12

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements)

DATE STARTED: 8/16/23

DATE FINISHED: 8/16/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 8.0' (8/16/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist stiff
	CL FILL	FINE TO MEDIUM SANDY CLAY, FILL brown		20							
	CL	FINE SANDY CLAY brown	5								moist soft
				4		35.5	75				saturated
			10	4							
		End of Exploration at 11.0'.									
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3L



GSH

BORING LOG

Page: 1 of 1

BORING: B-13

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements)

DATE STARTED: 8/16/23

DATE FINISHED: 8/16/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 10.0' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist very stiff
	CL FILL	FINE TO MEDIUM SANDY CLAY brown									
				30							slightly moist stiff
	CL	SILTY CLAY with trace fine to medium sand; brown	5								
				10							
			10	3							soft saturated
		grades with layers of fine to coarse sand up to 6" thick									medium stiff
			15	9		50.5		52.9			
		End of Exploration at 15.5'. Installed 1.25" diameter slotted PVC pipe to 15.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3M



GSH

BORING LOG

Page: 1 of 1

BORING: B-14

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements)

DATE STARTED: 8/16/23

DATE FINISHED: 8/16/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 9.0' (8/16/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist loose
	SM/ SC FILL	SILTY/CLAYEY FINE TO MEDIUM SAND, FILL brown		23	⬥						slightly moist medium stiff
	CL FILL	SILTY CLAY, FILL with fine to coarse sand and some fine and coarse gravel; brown	5								
	CL	SILTY CLAY brown	8	8	⬥						
			10	0	⬥						saturated very soft
		End of Exploration at 10.5'.									
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3N



GSH

BORING LOG

Page: 1 of 1

BORING: B-15

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements) DATE STARTED: 8/16/23 DATE FINISHED: 8/16/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 10.0' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist stiff
	CL FILL	FINE TO MEDIUM SANDY CLAY, FILL with trace fine and coarse gravel; brown		16							
			5	16							stiff
	CL	SILTY CLAY brown									medium stiff
			10	5							saturated
	SM/ SC	SILTY/CLAYEY FINE TO MEDIUM SAND with some clay; brown									saturated loose
		grades with layers of silty clay up to 2" thick	15	6							
	CL	SILTY CLAY with trace fine to coarse sand; brown	20	6							saturated medium stiff
		End of Exploration at 20.5'. Installed 1.25" diameter slotted PVC pipe to 20.5'.									
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 30



GSH

BORING LOG

Page: 1 of 1

BORING: B-16

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements) DATE STARTED: 8/16/23 DATE FINISHED: 8/16/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 9.0' (8/16/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	SM/ SC FILL	SILTY/CLAYEY FINE TO MEDIUM SAND, FILL with trace clay; brown									slightly moist loose
				15	✕						
			5								
	CL	SILTY CLAY with layers of fine to coarse sand up to 2" thick; brown		15	✕						very loose saturated soft
			10	4	✕	24.2	93				
		End of Exploration at 10.5'.									
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3P



GSH

BORING LOG

Page: 1 of 1

BORING: B-17

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements)

DATE STARTED: 8/16/23

DATE FINISHED: 8/16/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 9.1' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	FINE TO MEDIUM SANDY CLAY brown		25							slightly moist very stiff
	CL	SILTY CLAY with some fine to coarse sand; brown	5	8							moist medium stiff
			10	7		35.1	85				saturated
	SP/ SM	FINE TO COARSE SAND with some silt; brown									saturated very loose
		grades with layers of silty clay up to 3" thick	15	3							
		End of Exploration at 15.5'. Installed 1.25" diameter slotted PVC pipe to 15.5'.	20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3Q



GSH

BORING LOG

Page: 1 of 1

BORING: B-18

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements) DATE STARTED: 8/16/23 DATE FINISHED: 8/16/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 8.0' (8/16/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist loose
	SM/ SC FILL	SILTY/CLAYEY FINE TO MEDIUM SAND, FILL brown		18							
			5								moist medium stiff
	CL	SILTY CLAY with trace fine sand; brown		7		32.9	90				
		grades with trace fine sand		4							saturated soft
		End of Exploration at 10.5'.	10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3R



GSH

BORING LOG

Page: 1 of 1

BORING: B-19

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements)

DATE STARTED: 8/16/23

DATE FINISHED: 8/16/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 10.2' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist stiff
	CL FILL	FINE TO MEDIUM SANDY CLAY, FILL brown		14							slightly moist medium stiff
	CL	FINE SANDY CLAY with silt; brown	5	7		24.5	98				
			10	6							saturated
		End of Exploration at 10.5'. Installed 1.25" diameter slotted PVC pipe to 10.5'.									
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3S



GSH

BORING LOG

Page: 1 of 1

BORING: B-20

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements)

DATE STARTED: 8/17/23

DATE FINISHED: 8/17/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 8.8' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist very stiff
	CL FILL	FINE TO COARSE SANDY CLAY, FILL brown		29							
	CL	FINE TO MEDIUM SANDY CLAY brown	5	7							moist medium stiff
		grades silty clay with trace fine sand	10	12							saturated stiff
	SM	SILTY FINE TO MEDIUM SAND with trace clay; brown	15	8		25.6		35.2			saturated loose
		grades with layers of silty clay up to 1/2" thick									
		End of Exploration at 15.5'. Installed 1.25" diameter slotted PVC pipe to 15.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3T



GSH

BORING LOG

Page: 1 of 1

BORING: B-21

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements) DATE STARTED: 8/11/20 DATE FINISHED: 8/11/20

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 8.0' (8/11/20)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	FINE TO MEDIUM SANDY CLAY, FILL brown		32							slightly moist very stiff
	CL	FINE SANDY CLAY brown		4							soft
			5								
		grades silty clay with trace fine sand									
				6		22.2	98				saturated medium stiff
			10	2							soft
		End of Exploration at 11.0'.									
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3U



GSH

BORING LOG

Page: 1 of 1

BORING: B-22

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements)

DATE STARTED: 8/13/20

DATE FINISHED: 8/13/20

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 9.0' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								dry very stiff
	CL FILL	FINE TO MEDIUM SANDY CLAY, FILL brown									
				30							moist medium stiff
	CL	SILTY CLAY with trace fine to medium sand; brown	5								
				8							
			10								saturated
				4		34.3	85				soft
		grades with layers of fine to medium sand up to 6" thick									
			15	4		26.0		52.3			
		End of Exploration at 15.5'. Installed 1.25" diameter slotted PVC pipe to 15.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3V



GSH

BORING LOG

Page: 1 of 1

BORING: B-23

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements) DATE STARTED: 8/13/20

DATE FINISHED: 8/13/20

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 8.0' (8/13/20)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								dry stiff
	CL FILL	FINE TO MEDIUM SANDY CLAY, FILL brown		14							moist stiff
	CL	FINE SANDY CLAY brown	5								
				15							saturated
		grades with layers of fine to medium sand up to 1/2" thick; brown/red	10	3		33.1		86.8			soft
		End of Exploration at 10.5'.									
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3W



GSH

BORING LOG

Page: 1 of 1

BORING: B-24

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119-23

PROJECT: Proposed GLH Industrial Park Phase 1 (Structures and City Improvements)

DATE STARTED: 8/13/20

DATE FINISHED: 8/13/20

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 9.7' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist very stiff
	CL FILL	FINE TO COARSE SANDY CLAY, FILL brown		23							
	CL	FINE SANDY CLAY brown	5	5		18.3	100				medium stiff
		grades silty clay with trace fine sand	10	6		34.2	87				saturated
		grades with layers of fine to medium sand up to 2" thick	15	6							
		End of Exploration at 15.5'. Installed 1.25" diameter slotted PVC pipe to 15.5'.	20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3X



GSH

BORING LOG

Page: 1 of 2

BORING: B-1A

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119A-23

PROJECT: Proposed GLH Industrial Park (Structures and City Improvements)

DATE STARTED: 8/18/23

DATE FINISHED: 8/18/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 9.0' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
	CL	Ground Surface	0								slightly moist stiff
		SILTY CLAY with trace fine to medium sand; major roots (topsoil) to 6"; brown		10							
			5	8							moist
			10	2							saturated soft
		grades with layers of fine to medium sand up to 1/2" thick	15	4							
		grades with layers of fine to medium sand up to 4" thick	20	2							
		grades fine to medium sandy clay; brown/red									
			25								medium stiff

See Subsurface Conditions section in the report for additional information.

FIGURE 3Y



GSH

BORING LOG

Page: 2 of 2

BORING: B-1A

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119A-23

PROJECT: Proposed GLH Industrial Park (Structures and City Improvements)

DATE STARTED: 8/18/23

DATE FINISHED: 8/18/23

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
			25	5	II						
		grades silty clay									
			30	2	II						soft
	SM/ SC	SILTY/CLAYEY FINE TO MEDIUM SAND with layers of silty clay up to 2"; brown									saturated medium dense
			35	12	II	28.8		54.2			
	CL	FINE TO MEDIUM SANDY CLAY brown									saturated medium stiff
			40	8	II						
	SM	SILTY FINE TO COARSE SAND with trace clay; brown/gray									saturated medium dense
		grades with layers of silty clay up to 2" thick									
			45	20	II	25.3		56.6			
	SM/ SC	SILTY/CLAYEY FINE TO COARSE SAND brown									saturated medium dense
		grades with layers of silty clay up to 1" thick									
			50	10	II	23.9		45.9			
		End of Exploration at 51.5'. Installed 1.25" slotted PVC pipe to 51.5'									

See Subsurface Conditions section in the report for additional information.

FIGURE 3Y
(continued)



GSH

BORING LOG

Page: 1 of 1

BORING: B-2A

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119A-23

PROJECT: Proposed GLH Industrial Park (Structures and City Improvements)

DATE STARTED: 8/18/23

DATE FINISHED: 8/18/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: Not Encountered (8/18/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	SP FILL	FINE TO COARSE SAND, FILL with fine and coarse gravel; brown									slightly moist medium dense
		End of Exploration at 5.0'. No groundwater encountered at time of drilling.	5								
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3Z



GSH

BORING LOG

Page: 1 of 1

BORING: B-3A

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119A-23

PROJECT: Proposed GLH Industrial Park (Structures and City Improvements)

DATE STARTED: 8/18/23

DATE FINISHED: 8/18/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: Not Encountered (8/18/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	SP FILL	FINE TO COARSE SAND, FILL with fine and coarse gravel; brown									slightly moist loose
	CL	SILTY CLAY brown									slightly moist medium stiff
		End of Exploration at 5.0'. No groundwater encountered at time of drilling.	5								
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3AA



GSH

BORING LOG

Page: 1 of 1

BORING: B-4A

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119A-23

PROJECT: Proposed GLH Industrial Park (Structures and City Improvements)

DATE STARTED: 8/18/23

DATE FINISHED: 8/18/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: Not Encountered (8/18/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	SP FILL	FINE TO COARSE SAND, FILL with fine and coarse gravel; brown									slightly moist loose
	CL	SILTY CLAY brown/red									moist medium stiff
		End of Exploration at 5.0'. No groundwater encountered at time of drilling.	5								
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3AB



GSH

BORING LOG

Page: 1 of 1

BORING: B-5A

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119A-23

PROJECT: Proposed GLH Industrial Park (Structures and City Improvements)

DATE STARTED: 8/18/23

DATE FINISHED: 8/18/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: Not Encountered (8/18/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	SILTY CLAY, FILL with fine to medium sand; brown/red									dry medium stiff
		End of Exploration at 5.0'. No groundwater encountered at time of drilling.	5								
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3AC



GSH

BORING LOG

Page: 1 of 1

BORING: B-6A

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119A-23

PROJECT: Proposed GLH Industrial Park (Structures and City Improvements)

DATE STARTED: 8/18/23

DATE FINISHED: 8/18/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: Not Encountered (8/18/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	SILTY CLAY, FILL with fine to medium sand; brown									slightly moist medium stiff
		End of Exploration at 5.0'. No groundwater encountered at time of drilling.	5								
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3AD



GSH

BORING LOG

Page: 1 of 1

BORING: B-7A

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119A-23

PROJECT: Proposed GLH Industrial Park (Structures and City Improvements)

DATE STARTED: 8/18/23

DATE FINISHED: 8/18/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: Not Encountered (8/18/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								moist medium stiff
	CL FILL	SILTY CLAY, FILL with fine to medium sand; brown									
		End of Exploration at 5.0'. No groundwater encountered at time of drilling.	5								
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3AE



GSH

BORING LOG

Page: 1 of 1

BORING: B-8A

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119A-23

PROJECT: Proposed GLH Industrial Park (Structures and City Improvements)

DATE STARTED: 8/18/23

DATE FINISHED: 8/18/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: Not Encountered (8/18/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								moist medium stiff
	CL FILL	SILTY CLAY, FILL with trace fine sand; brown									
		End of Exploration at 5.0'. No groundwater encountered at time of drilling.	5								
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3AF



GSH

BORING LOG

Page: 1 of 1

BORING: B-9A

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119A-23

PROJECT: Proposed GLH Industrial Park (Structures and City Improvements)

DATE STARTED: 8/18/23

DATE FINISHED: 8/18/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: Not Encountered (8/18/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								moist medium stiff
	CL FILL	SILTY CLAY, FILL with trace fine to coarse sand; brown									
		End of Exploration at 5.0'. No groundwater encountered at time of drilling.	5								
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3AG



GSH

BORING LOG

Page: 1 of 1

BORING: B-10A

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119A-23

PROJECT: Proposed GLH Industrial Park (Structures and City Improvements)

DATE STARTED: 8/18/23

DATE FINISHED: 8/18/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: Not Encountered (8/18/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	SILTY CLAY, FILL with trace fine to coarse sand; major roots (topsoil) to 6"; brown									moist medium stiff
		End of Exploration at 5.0'. No groundwater encountered at time of drilling.	5								
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3AH



GSH

BORING LOG

Page: 1 of 1

BORING: B-11A

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119A-23

PROJECT: Proposed GLH Industrial Park (Structures and City Improvements)

DATE STARTED: 8/18/23

DATE FINISHED: 8/18/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: Not Encountered (8/18/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	SILTY CLAY, FILL with trace fine to coarse sand; brown									slightly moist medium stiff
		End of Exploration at 5.0'. No groundwater encountered at time of drilling.	5								
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3AI



GSH

BORING LOG

Page: 1 of 1

BORING: B-12A

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119A-23

PROJECT: Proposed GLH Industrial Park (Structures and City Improvements)

DATE STARTED: 8/21/23

DATE FINISHED: 8/21/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 6.0' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist stiff
	CL	SILTY CLAY with trace fine to coarse sand; brown		10							moist medium stiff
	CL	FINE TO MEDIUM SANDY CLAY brown									
		grades with layers of fine to medium sand up to 2" thick	5	7		26.6	79	58.2			saturated
		grades with layers of fine to medium sand up to 3" thick	10	5		23.7		45.5			
		End of Exploration at 10.5'. Installed 1.25" diameter slotted PVC pipe to 10.5'.									

See Subsurface Conditions section in the report for additional information.

FIGURE 3AJ



GSH

BORING LOG

Page: 1 of 1

BORING: B-13A

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119A-23

PROJECT: Proposed GLH Industrial Park (Structures and City Improvements)

DATE STARTED: 8/21/23

DATE FINISHED: 8/21/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 2.5' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
	CL	Ground Surface	0								slightly moist soft
		SILTY CLAY with trace fine to medium sand; layers of fine to medium sand up to 1/2" thick; brown		3		32.8	84				saturated
		grades with fine to medium sandy clay	5								
				4							
			10	0							very soft
		End of Exploration at 10.5'. Installed 1.25" diameter slotted PVC pipe to 10.5'.									
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3AK



GSH

BORING LOG

Page: 1 of 1

BORING: B-14A

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119A-23

PROJECT: Proposed GLH Industrial Park (Structures and City Improvements)

DATE STARTED: 8/21/23

DATE FINISHED: 8/21/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 3.1' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist soft
		FINE SANDY CLAY brown		4							saturated
			5	2							
		grades silty clay with trace fine sand									
			10	2							
		grades with layers of fine to medium sand up to 1/2" thick									
			15	0		28.9	82				very soft
		End of Exploration at 15.5'. Installed 1.25" diameter slotted PVC pipe to 15.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3AL



GSH

BORING LOG

Page: 1 of 1

BORING: B-15A

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119A-23

PROJECT: Proposed GLH Industrial Park (Structures and City Improvements)

DATE STARTED: 8/21/23

DATE FINISHED: 8/21/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 4.5' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								moist stiff
	CL	SILTY CLAY with trace fine sand; brown		13		27.1	89				
			5								saturated
				3							soft
			10	0							very soft
		grades with layers of fine to coarse sand up to 2" thick									
			15	15							stiff
		End of Exploration at 15.5'. Installed 1.25" diameter slotted PVC pipe to 15.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3AM



GSH

BORING LOG

Page: 1 of 2

BORING: B-16A

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119A-23

PROJECT: Proposed GLH Industrial Park (Structures and City Improvements)

DATE STARTED: 8/21/23

DATE FINISHED: 8/21/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 3.0' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist medium stiff
	CL	FINE SANDY CLAY brown		6							saturated
			5	3							soft
	SM	SILTY FINE TO MEDIUM SAND brown									saturated very loose
		grades with layers of silty clay up to 1" thick	10	3		29.5		31.4			
	CL	SILTY CLAY with fine to medium sand; brown									saturated soft
			15	2							
			20	6							medium stiff
	SM/ SC	SILTY/CLAYEY FINE TO MEDIUM SAND with some clay; brown									saturated loose
		grades with layers of clay up to 1" thick	25	10		23.3		44.1			

See Subsurface Conditions section in the report for additional information.

FIGURE 3AN



GSH

BORING LOG

Page: 2 of 2

BORING: B-16A

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119A-23

PROJECT: Proposed GLH Industrial Park (Structures and City Improvements)

DATE STARTED: 8/21/23

DATE FINISHED: 8/21/23

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		grades with layers of clay up to 1" thick	25	10	▲	23.3		44.1			
		End of Exploration at 25.5'.									
			30								
			35								
			40								
			45								
			50								

See Subsurface Conditions section in the report for additional information.

FIGURE 3AN
(continued)



GSH

BORING LOG

Page: 1 of 1

BORING: B-17A

CLIENT: Tom Stuart Construction

PROJECT NUMBER: 0213-119A-23

PROJECT: Proposed GLH Industrial Park (Structures and City Improvements)

DATE STARTED: 8/21/23

DATE FINISHED: 8/21/23

LOCATION: Northeast of 700 West and 2140 North, Spanish Fork, Utah

GSH FIELD REP.: EC

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 5.4' (8/29/23)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								moist medium stiff
	CL	SILTY CLAY with fine sand; brown		9		24.7	95				
			5								saturated soft
				4		33.6	97				
			10	4							
			15	4							
	CL	FINE TO MEDIUM SANDY CLAY brown grades with layers of fine to medium sand up to 1" thick		9		24.3	104	70.3			saturated medium stiff
		End of Exploration at 20.5'. Installed 1.25" diameter slotted PVC pipe to 20.5'.	25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3AO

CLIENT: Tom Stuart Construction
 PROJECT: Proposed GLH Industrial Park (Structures and City Improvements)
 PROJECT NUMBER: 0213-119A-23

KEY TO BORING LOG

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫
COLUMN DESCRIPTIONS											
①	Water Level: Depth to measured groundwater table. See symbol below.										
②	USCS: (Unified Soil Classification System) Description of soils encountered; typical symbols are explained below.										
③	Description: Description of material encountered; may include color, moisture, grain size, density/consistency,										
④	Depth (ft.): Depth in feet below the ground surface.										
⑤	Blow Count: Number of blows to advance sampler 12" beyond first 6", using a 140-lb hammer with 30" drop.										
⑥	Sample Symbol: Type of soil sample collected at depth interval shown; sampler symbols are explained below.										
⑦	Moisture (%): Water content of soil sample measured in laboratory; expressed as percentage of dryweight of										
⑧	Dry Density (pcf): The density of a soil measured in laboratory; expressed in pounds per cubic foot.										
⑨	% Passing 200: Fines content of soils sample passing a No. 200 sieve; expressed as a percentage.										
⑩	Liquid Limit (%): Water content at which a soil changes from plastic to liquid behavior.										
⑪	Plasticity Index (%): Range of water content at which a soil exhibits plastic properties.										
⑫	Remarks: Comments and observations regarding drilling or sampling made by driller or field personnel. May include other field and laboratory test results using the following abbreviations:										
			CEMENTATION:		MODIFIERS:		MOISTURE CONTENT (FIELD TEST):				
			Weakly: Crumbles or breaks with handling or slight finger pressure.		Trace <5%		Dry: Absence of moisture, dusty, dry to the touch.				
			Moderately: Crumbles or breaks with considerable finger pressure.		Some 5-12%		Moist: Damp but no visible water.				
			Strongly: Will not crumble or break with finger pressure.		With > 12%		Saturated: Visible water, usually soil below water table.				
Descriptions and stratum lines are interpretive; field descriptions may have been modified to reflect lab test results. Descriptions on the logs apply only at the specific boring locations and at the time the borings were advanced; they are not warranted to be representative of subsurface conditions at other locations or times.											
UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)											
MAJOR DIVISIONS			USCS SYMBOLS	TYPICAL DESCRIPTIONS							
COARSE-GRAINED SOILS More than 50% of material is larger than No. 200 sieve size.	GRAVELS More than 50% of coarse fraction retained on No. 4 sieve.	CLEAN GRAVELS (little or no fines)	GW	Well-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines							
		GRAVELS WITH FINES (appreciable amount of fines)	GP	Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines							
			GM	Silty Gravels, Gravel-Sand-Silt Mixtures							
		SANDS More than 50% of coarse fraction passing through No. 4 sieve.	CLEAN SANDS (little or no fines)	SW	Well-Graded Sands, Gravelly Sands, Little or No Fines						
	SANDS WITH FINES (appreciable amount of fines)		SP	Poorly-Graded Sands, Gravelly Sands, Little or No Fines							
		FINE-GRAINED SOILS More than 50% of material is smaller than No. 200 sieve size.	SILTS AND CLAYS Liquid Limit less than 50%	SM	Silty Sands, Sand-Silt Mixtures						
SC	Clayey Sands, Sand-Clay Mixtures										
ML	Inorganic Silts and Very Fine Sands, Rock Flour, Silty or Clayey Fine Sands or Clayey Silts with Slight Plasticity										
SILTS AND CLAYS Liquid Limit greater than 50%	CL		Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays								
	OL		Organic Silts and Organic Silty Clays of Low Plasticity								
	MH		Inorganic Silts, Micaceous or Diatomaceous Fine Sand or Silty Soils								
HIGHLY ORGANIC SOILS	SILTS AND CLAYS Liquid Limit greater than 50%	CH	Inorganic Clays of High Plasticity, Fat Clays								
		OH	Organic Silts and Organic Clays of Medium to High Plasticity								
		PT	Peat, Humus, Swamp Soils with High Organic Contents								

STRATIFICATION:

DESCRIPTION	THICKNESS
Seam	up to 1/8"
Layer	1/8" to 12"

Occasional:
One or less per 6" of thickness

Numerous:
More than one per 6" of thickness

TYPICAL SAMPLER GRAPHIC SYMBOLS

Bulk/Bag Sample

Standard Penetration Split Spoon Sampler

Rock Core

No Recovery

3.25" OD, 2.42" ID D&M Sampler

3.0" OD, 2.42" ID D&M Sampler

California Sampler

Thin Wall

WATER SYMBOL

Water Level

Note: Dual Symbols are used to indicate borderline soil classifications.

FIGURE 4



Attachment 1

Site-Specific Seismic Study

March 15, 2023
Job No. 0213-110-23

Mr. Spencer Ward
Tom Stuart Construction
360 North 700 West, Suite G
North Salt Lake, Utah 84054

Mr. Ward:

Re: Summary Report
PRELIMINARY Site-Specific Seismic Study
Proposed Spanish Fork Development
Southwest 4800 South and 600 West
Spanish Fork, Utah

1. INTRODUCTION

1.1 GENERAL

This report presents the results of our preliminary site-specific seismic study performed at the site of the proposed Spanish Fork Development. GSH Geotechnical, Inc (GSH) completed a preliminary geotechnical study¹ for the site. This report is presented as a preliminary study due to the fact that a final geotechnical study is not available for any portion of the development and final development plans were not available, and therefore, site-specific seismic studies will be required for each structure in the development once these plans and final geotechnical studies are completed. This preliminary study is not to be used for the design of any structure and is only for preliminary information. Data from the preliminary geotechnical study along with a geophysical survey was used for this preliminary site-specific seismic study.

The preliminary shear-wave velocity profile for the upper 350 feet at the site (including $\bar{v}_{s30}$ for the upper 100 feet) was determined utilizing preliminary boring data from our preliminary geotechnical study and a preliminary geophysical survey consisting of Refraction Microtremor (ReMi) testing.

¹ “Report, Preliminary Geotechnical Study, Proposed Spanish Fork Development, Southwest of 4800 South and 600 West, Spanish Fork, Utah.” GSH Job No. 2093-018-21. Dated November 4, 2021.

The preliminary ground motion hazard and design ground motion response spectra at the site were developed utilizing a site-specific site response analysis (SRA). The preliminary analysis was completed in accordance with the procedures presented in ASCE 7-16, Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE 7-16) and Supplement 1 to ASCE 7-16. Design level studies will be required once the final layout and plans are available as well as once final geotechnical studies are completed.

1.2 OBJECTIVES AND SCOPE

The objectives and scope of the study were planned in discussions between Mr. Spencer Ward of Tom Stuart Construction and Mr. Alan Spilker, PE, of GSH.

In general, the objectives of this study were to:

1. Preliminarily define the subsurface conditions at the site, including a shear-wave profile to a depth of 350 feet.
2. Develop preliminary site-specific and design ground motion response spectra for the site.

In accomplishing these objectives, our scope has included the following:

1. A review of available subsurface information from the preliminary geotechnical study completed for the site.
2. A field program consisting of the completion of a Refraction Microtremor (ReMi) geophysical exploration to a depth of 350 feet including the development of $\bar{v}_{s30}$ for the upper 100 feet.
3. Performance of a preliminary site-specific site response analysis (SRA) in accordance with the ASCE 7-16 Section 21.1, Site Response Analysis.
4. Development of preliminary site-specific and design ground motion response spectra for the site in accordance with the ASCE 7-16 Section 21.3, Design Response Spectrum.

1.3 AUTHORIZATION

Authorization was provided by providing Purchase Order 69461 dated February 6, 2023.

1.4 PROFESSIONAL STATEMENTS

Supporting data upon which our recommendations are based are presented in subsequent sections of this preliminary report. Recommendations presented herein are preliminary in nature and

governed by the physical properties of the soils encountered in the geophysical testing, exploration borings, and projected groundwater conditions. If subsurface conditions other than those described in this report are encountered, GSH must be informed so that our recommendations can be reviewed and amended, if necessary.

Our professional services have been performed, our findings developed, and our recommendations prepared in accordance with generally accepted engineering principles and practices in this area at this time.

Design level studies will be required once the final layout, plans, and geotechnical studies are available.

2. PROPOSED CONSTRUCTION

The 165-acre site is proposed to be developed with commercial and residential facilities, and associated pavements. The structures are anticipated to be 1 to 4 stories above grade supported upon conventional spread and continuous wall footings. Paved parking areas and drive lanes are planned around the structure.

It is estimated that the future structures' fundamental periods will be approximately 0.4 seconds.

3. SITE CONDITIONS

3.1 SURFACE

The site is located southwest of 4800 South and 600 West in Spanish Fork, Utah. The site is currently vacant/agricultural land with 6 agricultural structures/outbuildings spread throughout the site, and 4800 South bisecting the northern portion of the site. The topography of the site is relatively flat, grading down to the northeast with a total relief of approximately 4 to 6 feet. Site vegetation consists of various weeds and brush/grass land and agricultural grass fields, with sparse mature trees.

The site is bounded to the north by the Spanish Fork Airport followed by vacant/undeveloped brushland and agricultural fields; to the east by 500 West Street followed by vacant/undeveloped brushland and the Spanish Fork Airport; to the south by agricultural grass fields; and to the west by 800 West Street followed by agricultural grass fields along with single-family residential structures.

3.2 SUBSURFACE SOIL AND GROUNDWATER

The following paragraphs provide generalized descriptions of the subsurface profiles and soil conditions encountered within the borings conducted during the preliminary geotechnical study. As previously noted, soil conditions may vary in unexplored locations.

The borings were completed to depths ranging from 21.5 to 46.5 feet. The soil conditions encountered in each of the borings, to the depths completed, were generally similar across the boring locations.

Natural soils were encountered below the ground surface in all boring locations. The natural soils consisted primarily of clay with varying silt and sand content, silt with sand content, and sand with varying clay, silt, and gravel content.

The natural clay soils were very soft to very stiff, moist to saturated, brown in color, and low to moderately over-consolidated. The natural granular silt and sand soils were medium dense, saturated, and brown in color.

Groundwater was measured as shallow as 2.4 feet below the existing ground surface during the preliminary geotechnical study for the site.

For a more descriptive interpretation of subsurface conditions, please refer to our preliminary geotechnical report completed for the site (GSH Job No. 2093-018-21).

3.3 SHEAR WAVE VELOCITY PROFILE

The preliminary site shear-wave velocity profile was completed utilizing geophysical exploration. The testing consisted of Refraction Microtremor (ReMi) testing. Testing is performed at the surface using a series of geophone sensors and a seismic source. A wavefield transformation is performed on the recorded geophone movements. The transformation is then utilized to create a shear-wave dispersion curve to model the subsurface shear-wave velocity profile.

The location of the ReMi line on the site is presented on Figure 1, Site Plan. The borings completed in conjunction with the geotechnical study are also shown on Figure 1.

The site classification for ASCE 7-16 was Site Class D in the preliminary geotechnical report. However, areas of potentially liquefiable soils are anticipated to be encountered at the site which would designate it as Site Class F. As a follow up to the preliminary geotechnical report the ReMi testing results were analyzed to a depth of 350 feet with a resulting $\bar{v}_{s30}$ value of 823 ft/s. This preliminarily characterizes the site as a Site Class D, Stiff Soil Profile as defined in Chapter 20 of ASCE 7-16.

The shear-wave velocity results are provided on attached Figure 2, Shear-Wave Velocity Profile.

3.4 GEOLOGIC SETTING

The site is located in the Utah Valley, which is in the Basin and Range Physiographic Province. The Salt Lake Valley is near (west of) the transition between the Basin and Range Physiographic Province on the west and the Middle Rocky Mountain Physiographic Province to the east. The Basin and Range Province is characterized by generally north-trending valleys and mountain

ranges that have formed by displacement along normal faults. The Wasatch fault forms the boundary between the 2 provinces and has been active for approximately 10 million years. The Middle Rocky Mountains were formed during a period of regional compression that occurred in Cretaceous time, about 75 to 70 million years ago (Hunt, 1967). The surficial geology of the area is characterized by materials deposited within the past 30,000 years by late Pleistocene Lake Bonneville (Currey and Oviatt, 1985), and young lacustrine and deltaic deposits (Holocene to upper Pleistocene) were deposited on delta margins as the lake receded to its present Great Salt Lake levels (Hylland and others, 2014). As the ancient lake(s) receded, streams began to regrade through shoreline deltas formed at the mouths of major Wasatch Range canyons and the eroded material was deposited in the basin as a series of recessional deltas, alluvial fans, and shoreline sequences. Younger alluvial-fan deposits (Q_{afy}) and lacustrine silt and clay (Q_{lmp}) are mapped at the site (Solomon and Machette, 2009).

3.5 FAULTING

There are a number of mapped faults near the site. The faults are primarily normal mechanism. Some of the faults included are the Provo section of the Wasatch fault zone (mapped 3.02 miles northeast of the site), the Nephi Section of the Wasatch fault zone (mapped 5.08 miles south-southwest of the site), and the Utah Lake Faults (mapped 6.84 miles west-northwest of the site).

4. SITE RESPONSE ANALYSIS

A preliminary soil model was developed from the boring, laboratory, and ReMi data from this study and the preliminary geotechnical study for the site.

A series of earthquake time histories were selected and scaled to match the MCE_R response spectrum at the base of the soil column. Histories were selected from events with similar magnitudes, distances and spectral shape in the period ranges of significance for the proposed structures (approximately 0.4 seconds). These ground motion time histories were input at the base of the soil column model as outcrop motions, propagated through the soil column model, and calculated as surface ground motions. The results of the preliminary SRA analysis are presented in the table in the following section.

5. DESIGN RESPONSE SPECTRUM

The preliminary response spectrum produced from the site-specific seismic analysis was compared with the minimum code spectrum values per ASCE 7-16 Section 21.3, including updates presented in Supplement 1 to ASCE 7-16. This process includes taking the 2014 mapped values from the USGS and utilizing F_a from Table 11.4-1 and 2.5 as F_v to obtain the modified accelerations, then reducing them by 20 percent to obtain the code minimum spectral accelerations.

The preliminary site-specific response spectrum is lower than the minimum code spectrum at select periods; therefore, the minimum code spectrum governs the design spectrum for the site at these periods. These values are presented in the table on the following page.

Period (sec)	Code 80% Minimum Spectral Acceleration (g)	Site-Specific Spectral Acceleration (g)	Code Modified* Site-Specific Spectral Acceleration (g)	Design Spectral Acceleration (2/3 of Code Modified Site-Specific Acceleration) (g)
0.05	0.658	0.472	0.658	0.439
0.1	0.850	0.481	0.850	0.567
0.2	1.165	0.542	1.165	0.777
0.3	1.165	0.729	1.165	0.777
0.4	1.165	0.897	1.165	0.777
0.5	1.165	1.099	1.165	0.777
0.6	1.165	1.268	1.268	0.846
0.8	1.165	1.135	1.165	0.777
1.0	1.059	1.006	1.059	0.706
1.2	0.883	1.057	1.057	0.705
1.4	0.757	0.866	0.866	0.577
1.6	0.662	0.722	0.722	0.481
1.8	0.588	0.582	0.588	0.392
2.0	0.530	0.486	0.530	0.353
3.0	0.353	0.252	0.353	0.235
4.0	0.265	0.137	0.265	0.177
5.0	0.212	0.086	0.212	0.141

*The greater of the site-specific and the code minimum spectral acceleration.

6. DESIGN ACCELERATION PARAMETERS

The preliminary site-specific response spectrum was analyzed in accordance with the procedure outlined in ASCE 7-16 Section 21.4 to produce the design acceleration parameters presented in the table below:

Site-Specific Parameter	Spectral Acceleration Value (g)
S_{DS}	0.777
S_{D1}	0.845

As previously mentioned, this preliminary study is not to be used for the design of any structure and is only for preliminary information.

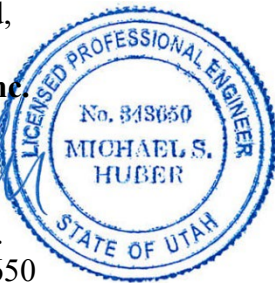
7. CLOSURE

If you have any questions or would like to discuss these items further, please feel free to contact us at (801) 685-9190.

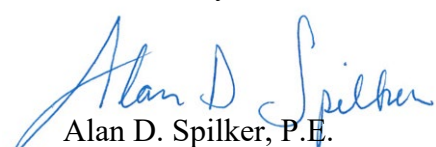
Respectfully submitted,

GSH Geotechnical, Inc.


Michael S. Huber, P.E.
State of Utah No. 343650
Vice President/Senior Geotechnical Engineer



Reviewed by:


Alan D. Spilker, P.E.
State of Utah No. 334228
President/Senior Geotechnical Engineer

MSH/ADS:jmt

Encl.

Figure 1, Site Plan
Figure 2, Shear-Wave Velocity Profile

Addressee (email)

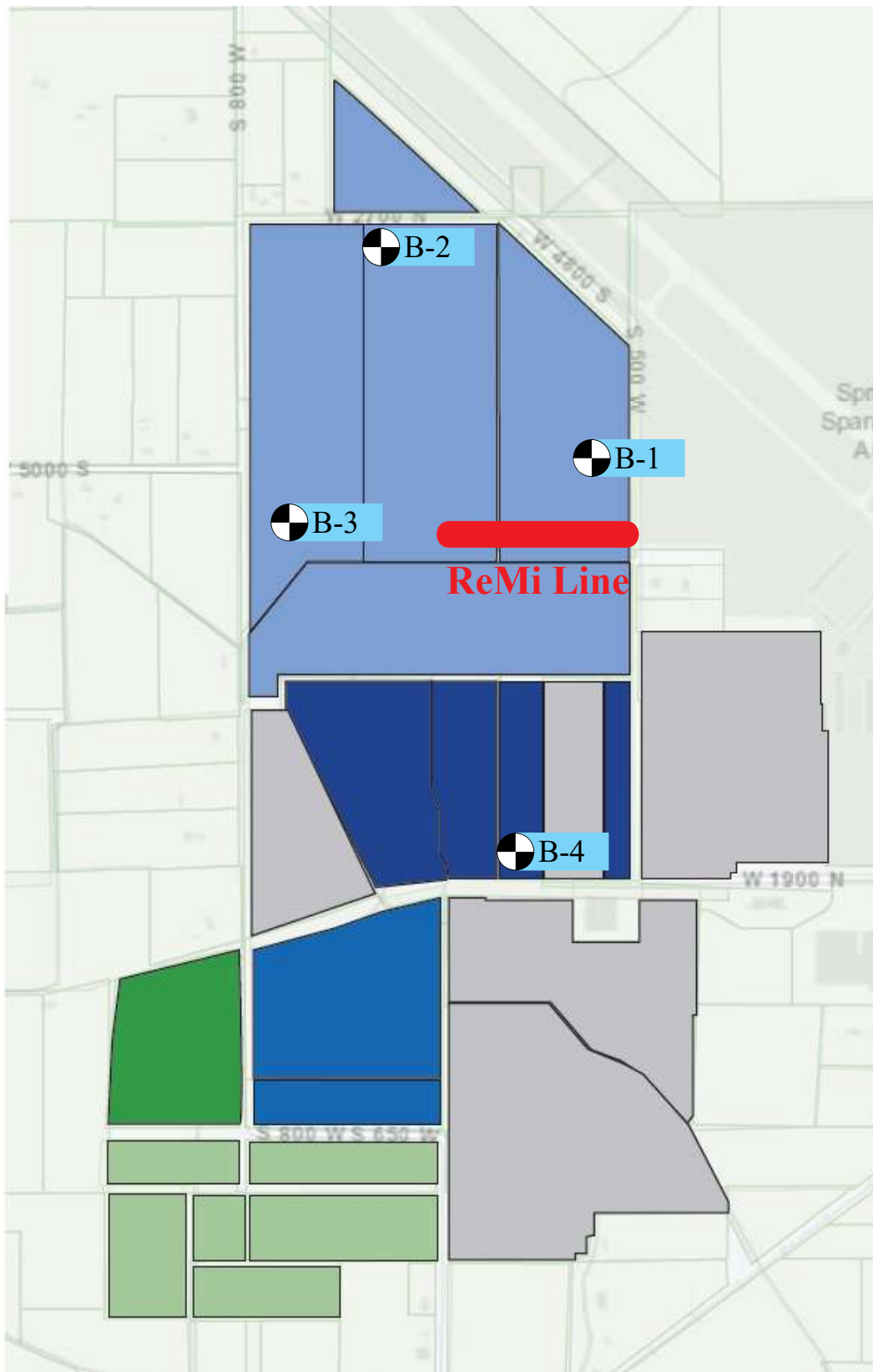
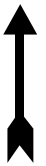
Geologic References

Currey, D.R., and Oviatt, C.G., 1985, Durations, average rates, and probable causes of Lake Bonneville expansion, still-stands, and contractions during the last deep-lake cycle, 32,000 to 10,000 years ago, in Kay, P.A., and Diaz, H.F., (eds.), Problems of and prospects for predicting Great Salt Lake levels - Processing of a NOAA Conference, March 26-28, 1985: Salt Lake City, Utah

Hunt, C.B., 1967, Physiography of the United States: San Francisco, W.H. Freeman, 480 p.

Hylland, M. D., DuRoss, C.B., McDonald, G.N., Olig, S.S., Oviatt, C.G., Mahan, S.A., Crone, A.J., and Personius, S.F., 2014, Late Quaternary paleoseismology of the West Valley fault zone, Utah: Insights from the Baileys Lake trench site, *in* DuRoss, C.B. and Hylland, M.D., Evaluating surface faulting chronologies of graben-bounding faults in Salt Lake Valley, Utah—new paleoseismic data from the Salt Lake City segment of the Wasatch fault zone and the West Valley fault zone—Paleoseismology of Utah, Volume 24: Utah Geological Survey Special Study 149, p. 41–76, 8 appendices, 1 plate.

Solomon, Barry J. and Machette, Michael N., 2009, Geologic Map of the Provo 7.5' Quadrangle, Utah County, Utah: Utah Geologic Survey Map 233, Plate 1.



APPROXIMATE SCALE IN FEET
440 0 440 880

REFERENCE:
ADAPTED FROM DRAWING ENTITLED
"SPANISH FORK LAND" BY COLLIERS INTERNATIONAL

FIGURE 1
SITE PLAN
 GSH

SHEAR-WAVE VELOCITY PROFILE

